Supporting Document 2

Conceptual Design Report

Eastern Ontario Waste Handling Facility Landfill Expansion Environmental Assessment
GFL Environmental Inc.

Moose Creek, Ontario

May 8, 2018

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1 Introduction

1.1 Background

GFL Environmental Inc. (GFL), formerly Lafleche Environmental Inc., is undertaking an environmental assessment (EA) to provide additional landfill disposal capacity for non-hazardous solid waste at the Eastern Ontario Waste Handling Facility (EOWHF). The EOWHF is located on parts of Lots 16, 17 and 18, Concession 10 in the Township of North Stormont, United Counties of Stormont, Dundas and Glengarry, Ontario. The location is provided on Figure 1 “Site Location” in Appendix A.

GFL has received approval of the EA Terms of Reference (ToR) for the proposed expansion of the EOWHF. As documented in the approved ToR, two landfill expansion options for the existing EOWHF have been identified as follows:

- Developing the areas of Stage 3B and Stage 4 as originally planned in the 1998 EA (Alternative Method 1); and
- Developing Stage 3B as contemplated in the original approval (1998 EA) and the development of a modified configuration of Stage 4 (Alternative Method 2).

Both alternative methods are conceptually designed for use in the assessment and evaluation of the two alternative landfill expansion options during the EA. The conceptual designs for both alternative methods are presented in this report.

1.2 Objectives

The Conceptual Design Report (CDR) presents conceptual design and operations information for the two landfill expansion alternative methods defined in the ToR. This report provides information on the main aspects of the landfill design and operations proposed for the two alternative methods, including:

- Figures showing the two landfill alternative methods, including landfill base and top of waste contours;
- Landfill development sequence and operations for both alternative methods;
- Leachate management, including leachate generation and leachate treatment for both alternative methods;
- Gas management;
- Surface water management for both alternative methods, including drainage pathways; and
- Typical details of the key features associated with the landfill.

The conceptual designs for the two alternative methods have differences relating primarily to the geometry of the footprint of the expansion area, with the same design concepts to be applied to the base liner, leachate collection and cover systems for both alternative methods.

The CDR provides conceptual level detail of the alternative designs for each environmental discipline to conduct an assessment of the potential environmental effects.
The landfill design and operations concepts presented in the CDR for the two alternative methods will be further developed during the technical design stage for the preferred alternative in support of the application to the Ministry of the Environment and Climate Change (MOECC) and the Environmental Compliance Approval (ECA) of the site expansion. The concepts presented in the CDR for both alternative methods are a minimum requirement and different methods may be applicable to achieve the same or better design criteria.

The conceptual designs for both alternative methods were prepared with consideration of the requirements of Ontario Regulation 232/98 (O. Reg. 232/98) and are consistent with the guidelines of the MOECC publication entitled Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites, Ontario Ministry of the Environment (last revised June 2010).

O. Reg. 232/98 requires that the Ontario Landfill Standards be applied to new landfills and expansions with a total disposal capacity in excess of 40,000 m³. O. Reg. 232/98 and the associated design guidance document were not applicable to the original landfill approval and design for the EOWHF site, as the original approval pre-dates the introduction of O. Reg. 232/98. Some of the elements of the original design and of the proposed design are not identical to the generic designs addressed in O. Reg. 232/98 and the MOECC’s guidance document since the original design was based on the regulatory requirements for a site-specific design in place at the time that the original EA approval and ECA for the site were granted.

O. Reg. 232/98 allows for a site-specific design in addition to the generic design elements. The proposed conceptual design meets or exceeds the performance requirements of the generic design elements, while also incorporating site-specific design elements that integrate aspects of the site that enhance environmental performance.

The conceptual design is intended to provide an equivalent or superior level of environmental performance relative to the generic designs in O. Reg. 232/98, and in particular with regard to technical items that have the potential to result in off-site impacts to the natural and built environment. The details of the design to be presented for the technical approval of the preferred alternative for the ECA approval under the Ontario Environmental Protection Act will be developed to meet or exceed the applicable sections of O. Reg. 232/98. The conceptual design of the preferred alternative, identified through the EA approval process, may be optimized as part of the ECA design and approval process.

2 Conceptual Design Basis – Alternative Method 1

2.1 Overview

Alternative Method 1 consists in developing the areas of Stage 3B in line with the existing Stage 3A, and Stage 4 in parallel with Stages 3A and 3B (Figure 2). This alternative method would provide approximately 4.2 million m³ of landfill capacity. This option extends west and northward, closer to the wastewater treatment plant, onto land currently used for storing finished compost. The design of these stages will be consistent with the currently-approved design, which includes base excavation, final contours, liner and leachate collection system, landfill gas collection and daily operations. The existing buffer area within the southern, eastern and western boundaries of the facility would remain.
2.2 Cell Geometry

The cells geometry for Alternative Method 1, including the top of waste and final cover, is shown on Figures 3 and 4 in Appendix A. Stages 3B and 4 include a total of 10 cells.

The proposed design consists of a natural containment landfill that relies on existing *in situ* low permeability silty clay deposits to form an effective hydraulic containment layer with performance criteria equivalent to or exceeding a generic composite liner system, as was included in the design for Stages 1, 2 and 3A. This is overlain by a leachate collection system (LCS), which consists of a leachate collection blanket of coarse stones overlain by a protective layer consisting of finer granular materials that also act as a filter, consistent with the design criteria set out in O. Reg. 232/98, Schedule 1.

The conceptual cell base grade elevations have been based on the interpreted contours for the bottom of the desiccated clay zone, while also maintaining sufficient slope to facilitate leachate drainage and reduce the head of leachate on the base of the cells. The cell base grade in each stage consists of an east-west oriented central ridge at an elevation approximately corresponding to the elevation of the interface between the upper peat unit and the underlying clayey layer, and then sloping off from the ridge towards both the south and north to an elevation which is slightly below the desiccated clay/grey silty clay transition.

Alternative Method 1 (Stages 3B and 4) would provide a total landfill footprint of approximately 40.3 hectares with an ultimate site capacity (airspace) of approximately 4.2 million m³.

Stages 3B and 4 will each be surrounded by a perimeter containment berm with a minimum top platform width of 20 m designed to ensure the stability of the cell excavation slope during filling and for the final side slope. The berm will have exterior slopes ratios of 4H:1V (horizontal:vertical) and interior cell slope ratios of 4H:1V for Stage 3B and a 6 m wide bench with a slope ratio of 10H:1V breaking up the slope in order to limit the excavation in the unweathered *in situ* clay.

The containment berms will be built from on-site excavated compacted clay and keyed into the underlying non-desiccated silty clay or will be built from earth fill material with the geosynthetic clay liner (GCL) extending for the full height of the berm, down through the desiccated clay and keyed into the underlying grey silty clay.

The maximum elevation of the final cover for the two stages will be 80 m above mean sea level (AMSL), which accounts for the consolidation settlement of the silty clay deposit that will occur due to the applied load of the waste mound. As such, the maximum height will be 15 m. The base will be excavated in a saw-tooth pattern with high density polyethylene (HDPE) perforated leachate collection piping (LCP). The desiccated clay subgrade will be shaped by excavation at a 2% cross fall toward the LCP, while the clay subgrade will have a minimum of 0.5% longitudinal grade, from the high point along the east-west centreline towards the north and south end edges of the aforementioned Stage, to build the perimeter leachate header piping (LHP) trench.

The LCP will connect to LHP located in a header trench along the north and south sides of the base of Stages 3B and 4.

In Stage 3B, two leachate sumps with submersible pumps will be installed. There will be eight pumps installed for Stage 4, one for each cell.
Temporary interior containment berms will be installed between the operating cells to prevent both the escape of leachate from the active cell and the inflow of clean surface runoff from adjacent areas into the active cell area (where it would require handling as leachate). These berms will be located along the east-west central subgrade crest of the Stage, as well as along the north-south subgrade crests at the limits of each cell as the Stage is developed. The berms will be built with compacted clay soil or by leaving native clay soils in place as the subgrade is excavated and removed sequentially as the cells are constructed and put into operation, thereby recovering the air space.

2.3 Buffer Area

The existing buffer area along the southern, eastern and western property boundaries will remain the same for the expansion. As such, the 120-m wide buffer area will be maintained along the south of the existing Stage 1, while a 50-m wide buffer area will remain along the east and west sides between the limit of waste and the property boundary. The minimum separation distance between the fill areas in Stage 4 and the north property boundary will be 285 m.

The buffer area will accommodate operational and environmental features such as access roads, stormwater management ponds and ditches and groundwater monitoring wells.

2.4 Site Development and Capacity

The proposed site development for Alternative Method 1 is described in the sub-sections below. It includes the landfilling sequence, as well as operational considerations during landfill construction.

2.4.1 Phasing

Stages 3B and 4 will be separated into two and eight cells as shown on Figure 3 in Appendix A. Cells 1 and 2 in Stage 3B will be the first to be constructed and operated, followed by the construction and operation of cells 1 and 2 in Stage 4.

Based on the conceptual design for Alternative Method 1, the corresponding capacity is estimated as shown in Table 1.

<table>
<thead>
<tr>
<th>Cell</th>
<th>Area (m²)</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 3B (CELLS 1-2)</td>
<td>55,216</td>
<td>630,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 1-2)</td>
<td>93,038</td>
<td>920,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 3-4)</td>
<td>81,222</td>
<td>865,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 5-6)</td>
<td>81,222</td>
<td>865,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 7-8)</td>
<td>93,038</td>
<td>920,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>403,736</td>
<td>4,200,000</td>
</tr>
</tbody>
</table>

In Stage 3B, landfilling in the cells will start on the east side of each cell and proceed westward. In Stage 4, landfilling will start on the west side and proceed eastward. The waste will be placed so that the temporary interior waste slopes will be configured to maintain adequate overall stability of the waste mound above the clay deposit.
2.4.2 Site Development Schedule

The approximate duration for landfilling in each Stage is expected to be as follows:

- Landfilling in Stage 3B will commence first in the extension of the approved Stage 3A and will be completed within a year, at which point the maximum elevation in all phases will be attained;
- Landfilling in Stage 4 will commence after the completion of Stage 3B.

Depending on the volume of waste received at the landfill on an annual basis, landfill expansion will provide disposal capacity for approximately five to ten years. The minimum timeframe is based on the landfill receiving the maximum annual approved volume of 755,000 tonnes, as well as compaction/airspace utilization rates of approximately 1.0 tonne/m³, consistent with those that have been achieved in recent years. The actual life of each stage may last longer depending on actual volumes received and the degree of compaction achieved.

2.4.3 Construction Activities

Prior to commencing Stages 3B and 4 landfilling operations, a portion of Stage 3B, and eventually Stage 4, will be excavated and prepared to accept waste. The following activities will take place prior to the start of landfilling operations:

- Construction of temporary ditches to reroute stormwater around the excavation during construction;
- Construction of necessary drainage features in accordance with the stormwater management plan and tie in temporary ditching;
- Excavation to the base grades over the fill area required for initial landfilling operations; and
- Construction of the LCS features within the area excavated to base contours and building of temporary separation berms at the edge of the LCS in order to separate landfilling from surface water in the ongoing excavation areas.

The transition from one cell to the next will involve the following sequence:

- Construction of the next cell ready to receive waste;
- Removal of the portion(s) of the temporary interior berms required to allow completion of the leachate collection and header pipe trenches and installation of the piping and granular drainage blanket. Each run of leachate collection pipe (LCP) and the leachate header pipe (LHP) will be connected (south to north and west to east, respectively) across the cells. Although not essential for operations, this approach allows for the option of accessing the full length of piping from the cleanouts for each section of LCP and LHP to perform flushing and maintenance; and
- Removal of the remainder of the interior berms (if desired to recover airspace).

The final cover will be constructed once two cells have reached their full height and after the LFG collection system is installed. The landfilling sequence will allow for the placement of the final cover as soon as possible in order to limit the uncovered areas to limit infiltration of precipitation, which in turn will reduce leachate generation.
2.5  Leachate Generation and Management

The design concept for the expansion involves effective leachate management to minimize the build-up of leachate on the base of the landfill and to effectively remove and treat the leachate to enable the effluent to be discharged to off-site surface water receptors. Estimates of the volume of leachate and the rate at which it is generated at the site were developed in order to determine the design parameter for the collection and treatment infrastructure.

2.5.1  Leachate Generation

To predict the amount of leachate that will be generated by Stages 1, 2, 3A, 3B and 4, predictive modelling and empirical data were used. The modelling of precipitation infiltration rates was performed using the US EPA’s Hydrologic Evaluation of Landfill Performance (HELP) model. Outputs from the model were then compared to actual infiltration ratios obtained from similar landfills in Ontario and Quebec. The comparison of empirical data with the modelling results indicated that the HELP model tends to underestimate leachate generation for active cells. The general observation is that the model is more accurate for closed areas of the landfill, either with permeable or impermeable cover.

Based on this analysis, the ratio of annual precipitation resulting in leachate for active cells is estimated to be approximately 65% since runoff is also collected in the leachate collection system (in this case, the evaporation being the only water not included in the leachate volume). For closed cells with an impermeable cover system incorporating a geomembrane, it is estimated that a maximum of 5% of the total precipitation ends up in the leachate collection system.

The leachate generated by Stage 1 was calculated using the HELP model (detailed calculations are provided in Appendix B). The maximum amount of leachate generated in 2012 for Stage 1 was approximately 128,000 m³/year. However, Phases 3, 4, 7 and 8 of Stage 1 received waste in the earlier part of 2012 and were carefully closed out concurrent with the initialization of Stage 2. The entire Stage 1 is now capped with a permeable final cover. According to the HELP model, Stage 1 produces an estimated 10.3 m³/day/hectare for a total of 98,185 m³/year.

The modelling used to evaluate the maximum amount of leachate that could be generated in one year for Alternative Method 1 was based on the following assumptions:

- A final permeable cover over Stage 1 (an area of approximately 26 hectares);
- A final low permeability cover (geomembrane and protective soil) over Stages 2 and 3A/3B and part of Stage 4 (an area of approximately 68 hectares);
- The ultimate maximum leachate flow will be generated at the mid-point of development of Stage 4, leaving four cells open (17 hectares approximately) and part of Stage 4, Stage 3 and Stage 2 with an impermeable final cover incorporating a geomembrane, and Stage 1 with a permeable compacted soil final cover;
- Leachate generation based on the average yearly rainfall from the St. Albert and Cornwall weather stations from 1987 to 2016. Precipitations and evaporation of the two aerobic ponds ahead of the Leachate Treatment Plant were also taken into account in the calculations.

For sensitivity checking, and to account for climate change, leachate generation was also calculated for 80th percentile rainfall and for the average annual rainfall, plus the addition of one standard deviation. The results are presented in Table 2.
The amount of leachate that could be generated in one year at closure for Alternative Method 1 is presented in Table 3.

Table 3 : Leachate Generation for Stages 1, 2, 3A, 3B and 4, Alternative Method 1 – at closure

<table>
<thead>
<tr>
<th>Amount (mm/year)</th>
<th>Volume (m³/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual rainfall</td>
<td>1,056</td>
</tr>
<tr>
<td>80th percentile</td>
<td>1,175</td>
</tr>
<tr>
<td>Average annual +1 standard deviation</td>
<td>1,183</td>
</tr>
</tbody>
</table>

2.5.2 Leachate Treatment Plant Capacity

The existing leachate treatment plant has the capacity to treat 833 m³/d for a total annual volume of 304,000 m³. The approved amended ECA No. 3962-AQP JDP allows for a total of 200,000 m³/year for leachate treatment.

The effluent requirements before discharge are shown in Table 4 of this report, as per Table 1, Section 6: “Effluent Limits” in ECA No. 5759-8FGS44.

Table 4 : Effluent Limits

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Units</th>
<th>Effluent Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBOD₅</td>
<td>mg/L</td>
<td>10.0</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>10.0</td>
</tr>
<tr>
<td>TP</td>
<td>mg/L</td>
<td>0.3</td>
</tr>
<tr>
<td>Total Ammonia Nitrogen</td>
<td>mg/L</td>
<td>1.0</td>
</tr>
<tr>
<td>Dissolved Oxygen (Minimum Level)</td>
<td>mg/L</td>
<td>4.0</td>
</tr>
<tr>
<td>Iron</td>
<td>mg/L</td>
<td>1.0</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/L</td>
<td>0.2</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/L</td>
<td>0.2</td>
</tr>
<tr>
<td>Phenols</td>
<td>mg/L</td>
<td>0.005</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>6.0-8.5</td>
</tr>
</tbody>
</table>

2.5.3 Leachate Management and Treatment

Leachate will continue to be managed on-site as per current practices and infrastructure. The current leachate management infrastructure includes:

- A leachate collection system;
- Leachate holding ponds;
- A leachate treatment facility and associated holding/aeration ponds, etc., as approved under Amended ECA No. 3962-AQPJDP, dated August 29, 2017;
- Seasonal variation in leachate generation rates will be managed by using temporary storage in the landfill cell and/or stored in existing leachate holding ponds.

2.6 Landfill Gas Management

Management of gas generated by the decomposition of the landfilled waste in the expansion area will involve active gas collection and combustion by flaring or as fuel in reciprocating engines generating electrical power by expanding the existing collection system and adding flaring capacity to the existing landfill gas management infrastructure at the EOWHF.

2.6.1 Landfill Gas Collection and Destruction System

2.6.1.1 System Description and Capacity

The landfill gas (LFG) collection system is the portion of the system which collects and conveys the LFG to the LFG Plant. The LFG collection system includes vertical extraction wells (72 in Stage 1, 72 in Stage 2 and eventually 40 in Stage 3A connected by buried sub-lateral, lateral and header piping. Vertical extraction wells will also be installed in Stages 3B and 4 with collection piping that will be conveyed to the LFG Plant. The collection piping will slope towards strategic drainage locations where condensate will be drained into the waste or pumped to the leachate collection system.

The existing LFG collection system collects and conveys the landfill gas to four Jenbacher internal combustion reciprocating (IC) engines capable of generating up to 4.2 MW of power with a total system capacity of 2,485 m³-LFG/h. As a backup, the LFG can also be combusted in an enclosed flare with a maximum capacity of 5,400 m³-LFG/hour.

The LFG Plant is located south of Stage 1 and west of the public (small vehicles) drop-off area, as shown on Figure 2 in Appendix A. The approvals allow for a LFG plant that will ultimately consist of eight engines, an air compressor, three LFG blowers, three chiller skids and one enclosed flare.

The LFG collection system is connected to a central mechanical system that provides the vacuum necessary to extract the LFG from the wellfield and transfer it under low pressure to the Jenbacher engines for combustion. Under normal operating conditions, LFG collected at the site is directed to the IC engines, which run at maximum capacity for optimal energy generation. Any excess LFG is sent to the flare for destruction. The flare will operate only when some or all of the engines are off-line for maintenance, or during periods where there is surplus gas when the engines are running at full load. Therefore, during stoppage of all four IC engines, the maximum destruction capacity available is 5,400 m³/h.

2.6.1.2 LFG Collection Efficiency

Vertical collection wells installed in the landfill are connected to a network of collection pipes that direct LFG to the IC engines and the flare. Negative pressure is maintained in the collection system by a blower unit.
A collection efficiency of 75% is assumed, which is the typical efficiency of collection systems at municipal solid waste landfills (MSWL)\(^1\).

### 2.6.2 Waste Quantities and Composition

The landfill began receiving waste in 2001. Historic disposal rates (in tonnes per year) are indicated in Table 5. These raw annual quantities include all types of waste, as well as daily and final cover soil.

According to GFL's estimates, the annual landflling rate from 2017 and beyond will be 755,000 tonnes. During the last year of activity, the landflling rate will be reduced to 600,000 tonnes in order to comply with the maximum capacity allowed. It is also expected that landflling operations will take place in Stages 3B and 4 until 2025 inclusively.

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Landfilled Tonnage (Waste and Cover Soil)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Tonnes per year</strong></td>
</tr>
<tr>
<td>2001</td>
<td>55,010</td>
</tr>
<tr>
<td>2002</td>
<td>114,079</td>
</tr>
<tr>
<td>2003</td>
<td>141,577</td>
</tr>
<tr>
<td>2004</td>
<td>239,428</td>
</tr>
<tr>
<td>2005</td>
<td>197,695</td>
</tr>
<tr>
<td>2006</td>
<td>235,525</td>
</tr>
<tr>
<td>2007</td>
<td>292,243</td>
</tr>
<tr>
<td>2008</td>
<td>151,151</td>
</tr>
<tr>
<td>2009</td>
<td>268,085</td>
</tr>
<tr>
<td>2010</td>
<td>257,144</td>
</tr>
<tr>
<td>2011</td>
<td>281,460</td>
</tr>
<tr>
<td>2012</td>
<td>398,383</td>
</tr>
<tr>
<td>2013</td>
<td>398,026</td>
</tr>
<tr>
<td>2014</td>
<td>526,653</td>
</tr>
<tr>
<td>2015</td>
<td>619,626</td>
</tr>
<tr>
<td>2016</td>
<td>734,874</td>
</tr>
<tr>
<td>2017 to 2024 (estimated)</td>
<td>600,000-755,000</td>
</tr>
<tr>
<td>2025 (estimated)</td>
<td>600,000</td>
</tr>
</tbody>
</table>

In addition, a detailed breakdown of the different materials landfilled is available for the years 2008 to 2015. Landfilled materials include daily and final cover soil, as well as the following types of waste:

- Municipal solid waste (MSW);
- Construction and demolition waste (C&D);
- Institutional, commercial and industrial Waste (ICI); and
- Specified risk material (SRM).

Table 6 indicates the average waste composition as determined from historical data.

<table>
<thead>
<tr>
<th>Table 6: Average Waste Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>C&amp;D</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fraction (excluding soil)</td>
</tr>
<tr>
<td>According to 2008-2015 data</td>
</tr>
<tr>
<td>Fraction</td>
</tr>
<tr>
<td>According to 2015 data</td>
</tr>
<tr>
<td>Fraction (excluding Soil)</td>
</tr>
</tbody>
</table>

These data were used to determine a typical waste composition for the landfilling years prior to 2008, based on the assumption that waste distribution documented for 2008-2015 is representative of that for previous years, i.e., 2001 to 2007. It was also assumed that from 2016 onwards, typical waste composition would remain the same as that which was characterized in 2015.

Table 7 shows the annual landfilled tonnage, historical and projected, broken down by waste category according to these assumptions.

<table>
<thead>
<tr>
<th>Table 7: Annual Landfilled Tonnage by Waste Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>------</td>
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<td>2009</td>
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<td>2010</td>
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### 2.6.3 LFG Generation Projections

The Landfill Gas Emissions (LandGEM) tool\(^2\) was used to model LFG generation for the expanded landfill and estimate LFG generation rates at the EOWHF.

LandGEM calculates annual LFG production rates using annual landfilling rates and data on the biodegradation of the waste organic fraction, as represented by the following parameters:

- Year-by-year landfilled waste tonnage;
- Methane generation potential (L0) expressed as m\(^3\) of methane per tonne of waste (m\(^3\) CH\(_4\)/t);
- Methane generation rate (k) expressed as a kinetic rate (year\(^{-1}\)); and
- Methane concentration in LFG.

#### 2.6.3.1 Annual Landfilling Rate by Waste Category

In terms of methane generation potential and kinetics, ICI waste is typically similar to MSW despite differences in composition. SRM, although a very specific material, is also similar to MSW due to a high organic content. C&D waste, however, differs greatly from MSW due to its lower organic content, higher inert content, and general composition.

For the purposes of this assessment, it was assumed that MSW, ICI and SRM waste are the same in terms of methane generation, and that C&D waste is significantly different. In addition, cover soils were assumed not to contribute to methane generation.

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\(^2\) [https://www3.epa.gov/ttnatc1/dir1/landgem-v302-guide.pdf](https://www3.epa.gov/ttnatc1/dir1/landgem-v302-guide.pdf)
LFG generation rates were therefore calculated separately for MSW, ICI and SRM waste and for C&D waste. The contributions of both groups of waste were then combined, resulting in total LFG generation by all landfilled waste.

2.6.4 Results and Interpretation

The projected LFG generation and collection rates, assuming 75% collection efficiency, as well as the projected contributions of the IC engines and the flare to the destruction of the collected LFG, are detailed in Appendix C.

The information provided in Appendix C includes historical data regarding LFG reclamation and destruction between 2012 and 2016, which is useful in verifying assumptions made in the context of this assessment. Year 2012 can be discarded since it represents the system’s first year of operation. Year 2014 can also be discarded because the annual flow was lower than in 2013 and 2015 and does not appear to reflect optimal operations. Based on 2013 and 2015 data, the reclamation/destruction rates are in the 73%-77% range of the theoretical LFG generation rate as modelled by LandGEM. The assumption of a 75% collection efficiency is therefore adequate and may be used for LFG collection projections.

LFG generation rates will increase gradually until a maximum is reached in year 2026 (72,864,362 m$^3$/year, or 8,318 m$^3$/h). No further landfilling will occur in Stage 4 from 2026 onwards, which will result in a gradual decrease in LFG generation.

As mentioned above, the annual collection rates were calculated based on a 75% collection efficiency. As the annual rate of LFG generation increases, so does the annual rate of LFG collection. Maximum LFG collection will occur in 2026 in the amount of 54,648,271 m$^3$ (or 6,238 m$^3$/h).

Between the years 2023 and 2027 inclusively, the current capacity of the flare will not suffice to process (burn) all of the collected LFG in the event of a shutdown of all four installed IC engines. Therefore, in addition to the flare, at least two of the four IC engines would need to be kept running at all times in order to process all of the LFG collected at the site. Therefore, a second enclosed flare will be installed to manage additional gas volumes and/or as a contingency should the four existing IC engines be down.

2.7 Stormwater Management

The EOWHF landfill site is located in the Fraser Drain sub-watershed, which drains into Moose Creek, located approximately 0.55 km west of the site. The EOWHF site’s sole outfall is located in the northwestern portion of the site and consists of a pipe 1,200 mm in diameter installed at an elevation of 63.05 m (JFSA, 2016). It discharges in the Fraser Drain.

The expansion of the landfill site will increase surface imperviousness in the area, as well as surface runoff. In order to avoid increasing flood risks and protect water quality, the proposed stormwater management (SWM) conceptual design enhances the existing non-contaminated stormwater system.

Relevant SWM criteria, as identified by MOECC in O. Reg. 232/98 and its guidance document entitled “Landfill Standards Guidelines” (1998), include:

- Water quality enhancement features (i.e., sedimentation ponds) of non-contaminated storm water will be sized to provide “Enhanced” (Level 1) protection (i.e. 80 percent long-term suspended solid removal) and meet the SWM design requirements of the Ministry of the Environment's Stormwater Management Planning and Design (MOECC Manual).
• Surface water quantity controls (i.e., peak flow reduction) of non-contaminated stormwater to be designed to temporarily store the runoff volume generated from storm events up to the higher of the 24-hour, 100-year design storm or the prevailing Regional Storm event, at or below the existing condition peak flows, such that there is no appreciable change in the potential for flooding and/or erosion in the watercourses receiving surface water discharges.

To assess the design of the SWM system, the design storms used are summarized below:

• Rainfall data: Environment Canada updated intensity-duration-frequency (IDF) curves, 2014 revision;
• Rain gauge station: Ottawa CDA (6105978);
• Quantity control design storms: 24-hour SCS Type II storm for the 1:2-years 1:10-year and 1:100-year return periods;
• Climate change: total precipitation volume is increased by 18% (recommendation based on the guidance document published by the “Ministère du Développement durable, de l’Environnement et de la Lutte contre les changements climatiques” or MDDELCC (the Quebec government authority on the environment) entitled Manuel de conception des ouvrages municipaux de gestion des eaux pluviales (manual for the design of municipal stormwater management structures), 2017).

In order to satisfy quantity and quality requirements, additional storage areas must be added to the existing SWM system. The enhanced surface management system consists of five wet ponds and a perimeter ditch. The existing system already consists of three ponds and a perimeter ditch. The proposed SWM system therefore includes two new wet ponds.

The proposed locations of these additional ponds are along the perimeter of the EOWHF landfill property and are designed as an enlargement of the existing perimeter ditch. The proposed northwest pond is located north of Stage 4 and along the west boundary of the site extending to the outfall in the northwest corner. The proposed northeast pond wraps around the northeast corner of the site and is aligned along the north and east boundaries of the landfill property.

Figure 5 in Appendix A shows the proposed SWM system for Alternative Method 1. The estimated storage volumes in the existing and new facilities are indicated in Table 8.

Table 8 : SWM Facilities - Estimated Volumes for Alternative Method 1

<table>
<thead>
<tr>
<th>Facility ID</th>
<th>Existing/proposed</th>
<th>SWM Practice Type</th>
<th>Control Type</th>
<th>Location</th>
<th>Permanent Pool (m³)</th>
<th>Extended volume (m³)</th>
<th>Total Storage Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond-1</td>
<td>Existing</td>
<td>Wet pond</td>
<td>Quality: 80% long-term suspended solids</td>
<td>East of Stage 1</td>
<td>3,800</td>
<td>7,500</td>
<td>10,300</td>
</tr>
<tr>
<td>Pond-2</td>
<td>Existing</td>
<td>Wet pond</td>
<td>Quantity: 100-year storm</td>
<td>East of Stage 2</td>
<td>1,650</td>
<td>6,350</td>
<td>8,000</td>
</tr>
<tr>
<td>Pond-7</td>
<td>Existing</td>
<td>Wet pond</td>
<td>Quality: 80% long-term suspended solids</td>
<td>West of Stage 1</td>
<td>2,100</td>
<td>5,650</td>
<td>7,750</td>
</tr>
<tr>
<td>Pond-NE</td>
<td>Proposed</td>
<td>Wet pond</td>
<td>Quantity: 100-year storm</td>
<td>Northeastern area</td>
<td>10,800</td>
<td>18,450</td>
<td>29,250</td>
</tr>
<tr>
<td>Pond-WE</td>
<td>Proposed</td>
<td>Wet pond</td>
<td>Quantity: 100-year storm</td>
<td>Northwestern area</td>
<td>14,250</td>
<td>11,000</td>
<td>25,250</td>
</tr>
<tr>
<td>Perimeter ditch</td>
<td>Existing</td>
<td>Water transport</td>
<td>Quantity: 100-year storm</td>
<td>On the outside perimeter of the landfill site</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
For stormwater quality control, the wet ponds have been designed to enhance the protection level, i.e. 80% long-term suspended solid removal. In accordance with MOECC guidelines, water quality storage requirements are based on impervious levels. In ultimate development conditions, the imperviousness of the EOWHF site is evaluated at approximatively 85%, which corresponds to a volumetric water quality criteria of 250 m³/ha.

For stormwater quantity control, the wet ponds have been designed to temporarily store the runoff volume generated by storm events up to the 24-hour, 100-year design storm and maintain discharge peak flows at or below the predevelopment conditions.

2.8 Ancillary Facilities and Infrastructure

The construction of Stages 3B and 4, Alternative Method 1, will require moving existing operational roadways, as well as the compost curing pad and storage piles. Access roadways will be built between Stages 3A/3B and 4 and on the east, west and north sides of Stage 4 to allow access to the cells and pumping stations as shown on Figure 3 in Appendix A.

2.9 Landfill Operations

Landfill operations, including operating hours, equipment, waste placement, daily and intermediate cover and nuisance control measures for Alternative Method 1, are described below. The landfill operations will remain as they are for the previous stages.

2.9.1 Operating Hours

The normal hours of operation for receiving waste at the site are:

- Monday to Friday 7:00 am to 6:00 pm;
- Saturday 7:00 am to 5:00 pm.

Normal hours of operation for the receipt and handling of SRM are 7:00 am to 3:00 pm, Monday through Friday.

The site is closed on Sundays and all statutory holidays, except for special circumstances where municipal contracts for refuse collection are carried out on holidays. If quantities of waste are sufficiently low over an extended period of time on a consistent basis, the hours of the landfill operation may be reduced.

Equipment hours of operation extend beyond the hours during which the site is open for receiving waste to allow for site preparation and soil covering activities. The hours of equipment operation are:

- Monday to Friday 6:30 am to 6:30 pm;
- Saturday 6:30 am to 5:30 pm.

Before opening, staff members prepare for the arrival of waste by starting up the weigh scale system, moving equipment to the working face, and preparing roads for traffic (i.e., snow plowing or grading). After closing the site to the public, waste compaction is completed and daily and intermediate cover is installed, as required.
2.9.2 Site Equipment

Site equipment may be modified from time to time as necessary. It is anticipated that the following equipment will continue to be used at the site:

- Landfill compactors (2) for levelling, compaction and grading of waste;
- Bulldozers (2) for levelling, compaction and grading of waste;
- Loaders (2) for loading, snow removal and processing;
- Articulating dump truck (1) for general site maintenance and hauling daily cover;
- Excavator (1) for excavating, soil movement, processing;
- Dedicated mobile grinder/mixer vehicle (1) for grinding/mixing SRM waste and transporting SRM waste between the SRM waste area and the composting facility; and
- Water truck (1) for dust control.

No additional large pieces of equipment are anticipated to be required for landfill operations. Other equipment may be used periodically to carry out other landfill-related tasks, such as landscaping and maintenance. They may include tractors, mowers, and roll-off trucks. Some of this equipment may be provided by outside contractors.

2.9.3 Site Traffic

The landfill will continue to operate within its approved limits of 755,000 tonnes annually and at an average daily rate of 2,500 tonnes per day.

There will be no change to the facility's service area, the origin-destination patterns of vehicles traveling to or from the facility, or the maximum daily trips generated. Consequently, operations are expected to remain unchanged in terms of the origin and destinations of trucks, as well as haul routes, and site traffic generation is expected to increase nominally considering that the landfill is currently accepting approximately 83% of its permitted yearly tonnage (as of 2015).

The current haul route to the EOWHF, via Highway 417, Highway 138 and Lafleche Road, will remain unchanged. Approximately 90% of the vehicles entering the weigh scale are large industrial trucks, including dump trucks, walking floor trucks, rear loaders, front loaders, and roll-offs. Automobiles and service/pick-up trucks represent the remainder of the vehicles. The larger trucks generally travel to/from Ottawa or to/from the south via Highway 138. The smaller personal vehicles and pick-up trucks likely serve the surrounding local communities.

Future traffic volumes for the EOWHF have been projected based on actual site data over a period of two operating years and are shown in Table 9. The data in Table 9 represents one way inbound trips only. It is projected that the site will typically generate 66, 38, and 26 two-way trips during the weekday AM and PM, and Saturday midday peak hours, respectively, assuming that inbound trips are equal to outbound trips.
Table 9: Projected Future Inbound Peak Hourly Traffic Volumes for the EOWHF Landfill

<table>
<thead>
<tr>
<th>Component</th>
<th>AM</th>
<th>PM</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inbound trips</td>
<td>33</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Trip rate (trips per 1,000 tonnes)</td>
<td>0.044</td>
<td>0.025</td>
<td>0.017</td>
</tr>
</tbody>
</table>

The landfill expansion is not anticipated to generate additional measurable traffic related to construction due to the nature of the on-site soil materials and their suitability for utilization as the base liner and for cover material. Liner construction does require the import of stone from local quarries typically over a 2-month period during the summer each year. Additional soils for final cover and capping of completed cells are typically required every two years. The construction traffic related to the development and capping of the existing landfill was assessed based on weigh scale data from previous years and has been included in the projected vehicle trips presented in Table 9.

2.9.4 Waste Placement

GFL’s compactor is equipped with a GPS compaction system that allows the compactor operator to follow the top of waste proposed contours.

2.9.4.1 Initial Lift Placement

The first waste lift will be placed in a thin layer over the entire prepared base area in order to avoid damage to the LCS due to equipment travel or frost. A minimum 1.5 metre depth of waste will be placed in the first layer. The waste is initially placed near the perimeter of the fill area and pushed out over the exposed LCS.

The landfilled waste will act as a travelling surface for equipment and waste trucks. The size of typical open tipping face will be approximately 60,000 m².

2.9.4.2 Subsequent Waste Placement

Waste placement will proceed in Cells 1 through 2 of Stage 3B and in Cells 1 through 8 of Stage 4. Waste will not be placed outside of the limits of landfilling or within the buffer areas around the perimeter of the site. Waste haul vehicles access the active face via a well-maintained granular surface access road. Upon arriving at the active face, a worker screens the load and directs the vehicles back to the active face. The length of the active face is confined in an area that is as small as possible, while spacious enough for trucks to safely unload.

Landfilling is carried out using the “area” method, where waste is spread over the underlying waste lifts and compacted by repeated passes of the compacting equipment over the layered waste. Additional layers of waste are placed and compacted using a bulldozer and compactor until a total average depth of about 5 m of waste has been placed. For stability, the working face will be sloped locally at a ratio of 4H to 5H:1V and in accordance with the temporary interior waste slope geometry approved for Stage 3A.

2.9.5 Daily and Intermediate Cover

2.9.5.1 Cover Types

Soil from off-site sources will be used as daily cover.
As per Section 35 of Amended ECA No. A420018, the following alternative cover may be used, subject to the methods of application, material limitations and restrictions described therein:

- Geosynthetic materials: Enviro Cover system (plastic cover material);
- Waste materials considered to be solid non-hazardous waste: soils and dewatered and digested sewage and pulp mill stabilized sludge;
- Spray applied materials, including polymer based foams and recycled cellulose material;
- Waste materials considered to be solid non-hazardous waste, including auto fluff, shredder fluff, dredged materials, grill ash, tire shreds, processed organic shingles, wood chips, compost and foundry sand; and
- Non-hazardous waste fine material from the waste disposal site located at 197 Putman Industrial Road in Belleville, Ontario.

2.9.5.2 Placement Procedures

At the end of each working day, the entire working face will be graded smooth and compacted. Exposed waste will be covered by approximately 0.15 m of suitable cover material or appropriate approved alternative cover, as described above, on a daily basis. Areas not visited for more than six months will be covered with a minimum of 0.3 m of cover material. Daily or interim cover will be removed as much as possible prior to resuming placement of waste in an area.

2.9.6 Nuisance Control Measures

2.9.6.1 Dust

Dust is an inherent part of landfilling operations, particularly during long dry spells when rain does not wet down well-travelled roads. The main source of dust is on-site access roads, particularly if unpaved, and equipment movement around the landfill working area. To deal with dust, a number of existing dust control measures will be retained:

- The landfill access road (the road allowance between Concessions 9 and 10, Lafleche Road) from Highway 138 is paved. Gravel is the proposed surface material for the landfill roads from the scales to the working area. Waste materials, such as concrete rubble or wood chips, that have a low silt content may also be used to reduce dust levels in the landfill;
- Trucks using the site are restricted to a maximum speed of 19 km/hour to avoid generating excessive amounts of airborne dust or suspended particulate matter;
- To avoid excessive dust generation, on-site roads are routinely maintained as part of the normal site operations. During dry periods, water is applied on a regular basis on unpaved or surface treated roads. Approved dust suppressants are used, when required; and
- When possible on windy days, the working face is operated below the grade level of the surrounding lands.

The access road from Highway 138 to the site is long (1.4 km). This helps in minimizing the amount of mud tracked from the site onto public highways. Due to the length of the road, a tire washing facility may be considered for the site, if the methods mentioned above are not effective. To date, this has not been required.
2.9.6.2 Noise

Standard landfill noise control practices will be applied during landfilling in Stage 3B and 4, such as:

- Maintaining a U-shaped working face when placing waste to provide an obstacle to break the line-of-sight between the noise sources and the receptor;
- Maintaining the existing screening berms along the west and north portion of the site perimeter;
- Sequencing the development stages so that equipment and haul routes are located where the landfill mound is higher between active landfill areas and the site perimeter;
- Maintaining equipment as per manufacturer specifications to ensure that engine noise is minimized;
- Confining construction activities to the hours of operation (see Section 2.9.1) under normal conditions (unless unusual weather conditions dictate otherwise); and
- Planting trees to enhance noise screening.

The site is currently operated in accordance with the MOECC’s Noise Guidelines for Landfill Sites.

2.9.6.3 Litter

Litter is controlled through a number of methods, which will remain during the operation of Stages 3B and 4. Portable litter control fences are used around the working area. They are placed immediately downwind of the working area to maximize the capture of windblown litter. The portable litter fence units are mounted on skids so that they may be moved by landfill equipment on a daily basis to remain downwind of the working face. Their location is determined based on the prevailing wind conditions. These fencing units can be joined so that varying lengths of fence can be constructed to meet different conditions. A typical fence is approximately 3.5 m high and 9 m long.

Perimeter fences around the site in strategic locations are also used as a means of containing litter. Keeping the working face to a minimum width assists in reducing litter generation. Lightweight waste materials are covered as soon as possible with other waste or soil.

Drivers of waste trucks are required to properly cover their loads to prevent the escape of waste. There is a tarp removal area close to the working face. Although the use of tarpaulins cannot be enforced for trucks on public roads, any truck that comes to the site is refused entry if its load is not properly secured. Occurrences of such violations are recorded.

As there are no controls that will completely stop blowing litter on windy days, a regular program of litter pickup is implemented at the site. Litter is collected from the spaces between the portable and permanent fences on an as required basis at the discretion of GFL’s environmental compliance or operations manager. The litter control fences are cleaned regularly. Extra staff is assigned to litter collection following windy days and in the spring, when snowmelt reveals litter not seen during winter months.

Litter collection off-site on adjacent properties is done on an as required basis.

2.9.6.4 Vectors and Vermin

The presence of animals at the landfill is of concern because of their potential to create nuisance to surrounding residences and agricultural activities. Animals may be attracted to a landfill because it provides a suitable foraging habitat. Consequently, they could move in the landfill temporarily or
permanently. Because the working area is compacted and covered daily with soil, rodents and insects do not survive at modern landfills and do not create problems.

Birds, such as ring-billed and herring gulls, may become a nuisance by attending adjacent or nearby properties, creating noise, fouling those sites, and causing damage to earthworm populations on agricultural lands. To address the control of gull numbers, a bird control program was initiated at the onset of landfilling and will remain for the development of Stages 3B and 4. Method options include:

- A daily cover of waste;
- Minimizing the size of working face;
- Minimizing the areas of bare ground;
- Encouraging the growth of tall grass (discouraging loafing);
- Creating vegetated banks at the stormwater management ponds;
- Obtaining scare/kill permits from the Canadian Wildlife Service;
- Using scare pistols (bangers, crackers) to discourage seagulls from settling on tipping faces, overhead, and loafing areas;
- Hiring falconry services, using trained hawks and/or falcons; and
- Daily observation and recording of seagull kill numbers.

In addition to the vector controls detailed above, specific pest control efforts related to the SRM operations include the following:

- Disposing of SRM in the landfill immediately after delivery; and
- When buried in the landfill, covering SRM immediately with a sufficient amount of cover material.

2.9.6.5 Odour Control

The potential sources of odour during the active phase of Stages 3B and 4 will be waste at the working face and landfill gas (LFG).

Waste that is brought to the site with a strong odour will be placed at the toe of the working face and covered immediately with other garbage or soil cover. The application of cover soils at the end of the working day will also control odour. If required, odour suppressing agents will be used to eliminate odour problems. Odours from waste may originate from cracks or fissures in the soil cover after landfilling has taken place. Regular inspections identify any cracks that can be repaired by filling with soil.

The LFG collection system will be installed as soon as two cells are filled with waste and will be connected to the LFG plant. The gradual placement of the final low permeability cover will also help control the odours generated by the LFG.

2.9.6.6 Contingency Measures

A number of contingency measures are in place at the existing EOWHF in the event that monitoring demonstrates unacceptable levels of contaminants in groundwater or surface water, treated leachate effluent fails to meet discharge limits, and if potentially harmful methane concentrations accumulate within on-site structures. These contingency measures will continue to be maintained as part of the development and operations of Stages 3B and 4.
3 Conceptual Design Basis – Alternative Method 2

3.1 Overview

Alternative Method 2 consists in developing the areas of Stage 3B in line with the existing Stages 3A and 4 parallel to Stages 3A and 3B with the development of an L-shape configuration into the northeast corner of the property (Figure 2 in Appendix A). This alternative method would provide a landfill capacity of approximately 4.2 million m³. This alternative method would allow the continued use of land near the wastewater treatment plant for convenient, accessible storage of finished compost and bulking material. The design of these stages will be consistent with the currently-approved design, including base excavation, final contours, liner and leachate collection system, landfill gas collection and daily operations. The existing buffer area from the southern, eastern and western boundaries of the facility would remain, while portions of the northern buffer area would be used for stormwater management. The proposed layout for Alternative Method 2 is shown on Figure 6 in Appendix A.

3.2 Cell Geometry

The cells’ geometry for Alternative Method 2, including the top of waste and final cover, is shown on Figures 6 and 7 in Appendix A. Stages 3B and 4 include the construction of 12 cells.

The proposed design consists of a natural containment landfill that relies on the existing in situ low permeability silty clay deposit to form an effective hydraulic containment layer with performance criteria equivalent to or exceeding a generic composite liner system, as was included in the design for Stages 1, 2 and 3A. This is overlain by a leachate collection system (LCS), which consists of a leachate collection blanket of coarse stones overlain by a protective layer consisting of finer granular material acting as a filter, consistent with the design criteria set out in O. Reg. 232/98, Schedule 1.

The conceptual cell base grade elevations have been based on the interpreted contours for the bottom of the desiccated clay zone, while also maintaining sufficient slope to facilitate leachate drainage and reduce the head of leachate on the base of the cells. The cell base grade in each stage consists of an east-west oriented central ridge at an elevation slightly below the peat/desiccated clay interface and the underlying clayey layer, compared to Alternative Method 1, which is closer to the interface to allow for a larger width, and then sloping off from the ridge towards both the south and north to an elevation slightly below the desiccated clay/grey silty clay transition.

Alternative Method 2 (Stages 3B and 4) would provide a total landfill footprint of approximately 38.4 hectares with an ultimate site capacity (airspace) of approximately 4.2 million m³.

Stages 3B and 4 will each be surrounded by a perimeter containment berm with a minimum top platform width of 20 m designed to ensure the stability of the cell excavation slope during filling and of the final side slope. The berm will have exterior slope ratios of 4H:1V and interior cell slope ratios of 4H:1V for Stage 3B and a 6 m wide bench with a slope ratio of 10H:1V breaking up the slope in order to limit the excavation in the unweathered in situ clay.

The containment berms will be built from on-site excavated compacted clay and keyed into the underlying non-desiccated silty clay or will be built from earth fill material with the geosynthetic clay liner (GCL) extending for the full height of the berm, down through the desiccated clay and keyed into the underlying grey silty clay.

The maximum elevation of the final cover for the two stages will be 80 m AMSL, which accounts for the consolidation settlement of the silty clay deposit that will occur due to the load placed on the waste.
mound. As such, the maximum height will be 15 m. The base will be excavated in a saw-tooth pattern and high density polyethylene (HDPE) perforated leachate collection piping (LCP) will be installed. The desiccated clay subgrade will be shaped by excavation at a 2% cross fall toward the LCP, while the clay subgrade will have a minimum 0.5% longitudinal grade, from the high point along the east-west centre line towards the north and south end edges of the aforementioned Stage, to build the perimeter leachate header piping (LHP) trench.

The LCP will connect to LHP located in a header trench along the north and south sides of the base of Stages 3B and 4.

In Stage 3B, two leachate sumps with submersible pumps will be installed. There will be 10 pumps installed for Stage 4, one for each cell.

Temporary interior containment berms will be installed between the operating cells to prevent both the escape of leachate from the active cell and the inflow of clean surface runoff from adjacent areas into the active cell area (where it would require handling as leachate). These berms will be located along the east-west central subgrade crest of the Stage, as well as along the north-south subgrade crests at the limits of each cell as the Stage is developed. The berms will be built with compacted clay soil or by leaving native clay soils in place as the subgrade is excavated and removed sequentially as the cells are constructed and put into operation, thereby recovering the air space.

3.3 Buffer Area

The existing buffer area along the southern, eastern and western property boundaries will remain the same for the expansion. As such, the 120-m wide buffer area will be maintained along the south of the existing Stage 1, while a 50-m wide buffer area will remain along the east and west sides between the limit of waste and the property boundary. The minimum separation distance between the fill areas in Stage 4 and the north property boundary will be 240 m.

The buffer area will accommodate operational and environmental features, such as access roads and stormwater management ponds and ditches, as well as groundwater monitoring wells.

3.4 Site Development and Capacity

The proposed site development for Alternative Method 2 is described below. The landfilling sequence is included, as well as operational considerations during landfill construction.

3.4.1 Phasing

Stage 3B and 4 will be separated into two and 10 cells, as shown on Figure 6 in Appendix A. Cells 1 and 2 in Stage 3B will be the first to be constructed and operated, followed by the construction and operation of cells 1 and 2 in Stage 4.

Based on the conceptual design for Alternative Method 2, the corresponding capacity is estimated as shown in Table 10.
Table 10: Capacity, Footprint and Lifespan, Alternative Method 2

<table>
<thead>
<tr>
<th>Cell</th>
<th>Area (m²)</th>
<th>Volumes (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 3B (CELLS 1-2)</td>
<td>55,216</td>
<td>630,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 1-2)</td>
<td>68,746</td>
<td>715,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 3-4)</td>
<td>60,018</td>
<td>675,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 5-6)</td>
<td>60,018</td>
<td>680,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 7-8)</td>
<td>68,746</td>
<td>745,000</td>
</tr>
<tr>
<td>Stage 4 (CELLS 9-10)</td>
<td>72,020</td>
<td>755,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>384,764</td>
<td>4,200,000</td>
</tr>
</tbody>
</table>

In Stage 3B, landfilling in the cells will start on the east side of each cell and proceed westward. In Stage 4, landfilling will start on the west side and proceed eastward. The waste will be placed so that the temporary interior waste slopes will be configured so that the overall stability of the waste mound above the clay deposit will be ensured.

3.4.2 Site Development Schedule

The approximate duration of landfilling in each Stage is expected to be as follows:

- Landfilling in Stage 3B will commence first in the extension of the approved Stage 3A and will be completed within a year, at which point the maximum elevation in all phases will be attained; and
- Landfilling in Stage 4 will commence after the completion of Stage 3B.

Depending on the volume of waste received at the landfill on an annual basis, the landfill expansion will provide disposal capacity for approximately five to 10 years. The minimum timeframe is based on the landfill receiving the maximum annual approved volume of 755,000 tonnes, as well as compaction/airspace utilization rates of around 1.0 tonne/m³, consistent with those that have been achieved in recent years. The actual life of each stage may last longer depending on actual volumes received and the degree of compaction achieved.

3.4.3 Construction Activities

As for Alternative Method 1, prior to commencing Stages 3B and 4, Alternative Method 2 landfilling operations, a portion of Stage 3B and eventually Stage 4 will be excavated and prepared to accept waste. The following activities will take place prior to the start of landfilling operations:

- Construction of temporary ditches to reroute stormwater around the excavation during construction;
- Construction of necessary drainage features in accordance with the stormwater management plan and tie in temporary ditching;
- Excavation to the base grades over the fill area required for initial landfilling operations; and
- Construction of the LCS features within the area excavated to base contours and the building of temporary separation berms at the edge of the LCS in order to separate landfilling from surface water in the ongoing excavation areas.
The transition from one cell to the next will involve the following sequence:

- Construction of the next cell ready to receive waste;
- Removal of the portion(s) of the temporary interior berms required to allow the completion of the leachate collection and header pipe trenches and installation of the piping and granular drainage blanket. Each run of leachate collection pipe (LCP) and leachate header pipe (LHP) will be connected (south to north and west to east, respectively) across the cells. Although not essential to operations, this approach allows for the option of accessing the full length of piping from the cleanouts for each section of LCP and LHP to perform flushing and maintenance; and
- Removal of the remainder of the interior berms (if desired to recover airspace).

The final cover will be constructed once two cells have reached their full height and after the LFG collection system is installed. The landfilling sequence will allow for the placement of the final cover as soon as possible in order to restrict the uncovered areas to limit the infiltration of precipitations, which in turn will reduce leachate generation.

3.5 Leachate Generation and Management

The design concept for the expansion involves effective leachate management to minimize the build-up of leachate on the base of the landfill and to effectively remove and treat the leachate to enable the effluent to be discharged to off-site surface water receptors. Estimates of the leachate volume and the rate at which it is generated at the site were produced in order to determine the design parameter for the collection and treatment infrastructure.

3.5.1 Leachate Generation

The model used to evaluate the maximum amount of leachate that could be generated in one year for Alternative Method 2 was based on the following assumptions:

- Final permeable cover over Stage 1 (26 hectares approximately);
- Final low-permeability cover (geomembrane and protective soil) over Stages 2 and 3A/3B and part of Stage 4 (an area of approximately 68 hectares);
- The ultimate maximum leachate flow will be generated at mid-development of Stage 4, leaving four cells open (14 hectares approximately) and part of Stage 4, Stages 3 and 2 with an impermeable final cover incorporating a geomembrane and Stage 1 with a permeable compacted soil final cover.

Leachate generation is based on the average yearly rainfall from the St. Albert and Cornwall weather stations from 1987 to 2016. Precipitations and evaporation in the two aerobic ponds ahead of the Leachate Treatment Plant is also taken into account in the calculations.

For sensitivity checking, and to account for climate change, the leachate generation was also calculated for 80th percentile rainfall and for the average annual rainfall, plus the addition of one standard deviation. The results are indicated in Table 11.
Table 11: Leachate Generation for Stages 1, 2, 3A, 3B and 4, Alternative Method 2

<table>
<thead>
<tr>
<th>Amount (mm/year)</th>
<th>Volume (m³/y)</th>
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<tr>
<td>Average annual rainfall</td>
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<tr>
<td>80th percentile</td>
<td>1,175</td>
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<tr>
<td>Average annual + 1 standard deviation</td>
<td>1,183</td>
</tr>
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The amount of leachate that could be generated in one year at closure for Alternative Method 2 is presented in Table 12.

Table 12: Leachate Generation for Stages 1, 2, 3A, 3B and 4, Alternative Method 2 – at closure

<table>
<thead>
<tr>
<th>Amount (mm/year)</th>
<th>Volume (m³/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual rainfall</td>
<td>1,056</td>
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<td>80th percentile</td>
<td>1,175</td>
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<tr>
<td>Average annual + 1 standard deviation</td>
<td>1,183</td>
</tr>
</tbody>
</table>

3.5.2 Leachate Treatment Plant Capacity

The existing annual leachate treatment capacity of 304,000 m³ is sufficient to treat the leachate generated by Alternative Method 2 (refer to Section 2.5.2 “Leachate Management and Treatment”).

3.6 Gas Management

The Conceptual Design for the gas management system is similar for Alternative Method 1 and Alternative Method 2. LFG flows to be collected and managed depend on waste quantity and composition. Parameters are identical for both Alternative Methods 1 and 2. Since emissions are related to the volume of landfilled waste, which will be the same for both alternative methods, the total gas emissions are also the same for both alternative methods.

The gas management system for Alternative Method 2 is described in Section 2.6.

3.7 Stormwater Management

The proposed general components of the surface water management systems are the same for Alternative Methods 1 and 2. They consist of two new wet ponds, three existing wet ponds and an existing perimeter ditch.

Since the drainage area, global ground cover and associated infiltration rate are similar for Alternative Methods 1 and 2, the total storage requirement volume is also similar. However, due to the different geometry of Stage 4 in the two alternative methods, the proposed geometry of the northeast and northwest ponds is slightly different in Alternative Method 2. The proposed northwest pond is longer and thinner than the northwest pond in Alternative Method 1, and it is located closer to the west boundary of the site from the northwest corner of Stage 4 to the site outfall in the northwest corner of the site. As for the geometry of the proposed northeast pond, it is very similar to that of the northeast pond in Alternative Method 1.

Figure 8 in Appendix A shows the proposed SWM system in Alternative Method 2. The estimated storage volumes in the existing and new facilities are indicated in Table 13.
### Table 13: SWM Facilities - Estimated Volumes for Alternative Method 2

<table>
<thead>
<tr>
<th>Facility ID</th>
<th>Existing/proposed</th>
<th>SWM Practice Type</th>
<th>Control Type</th>
<th>Location</th>
<th>Permanent Pool (m³)</th>
<th>Extended volume (m³)</th>
<th>Total Storage Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond-1</td>
<td>Existing Wet pond</td>
<td></td>
<td>Quality: 80% long-term suspended solids</td>
<td>East of Stage 1</td>
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<td>7,500</td>
<td>10,300</td>
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<tr>
<td>Pond-2</td>
<td>Existing Wet pond</td>
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<td>Quantity: 100-year storm</td>
<td>East of Stage 2</td>
<td>1,650</td>
<td>6,350</td>
<td>8,000</td>
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<td>Pond-7</td>
<td>Existing Wet pond</td>
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<td></td>
<td>West of Stage 1</td>
<td>2,100</td>
<td>5,650</td>
<td>7,750</td>
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<tr>
<td>Pond-NE</td>
<td>Proposed Wet pond</td>
<td></td>
<td></td>
<td>Northeastern area</td>
<td>10,800</td>
<td>18,150</td>
<td>28,950</td>
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<tr>
<td>Pond-WE</td>
<td>Proposed Wet pond</td>
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<td></td>
<td>Northwestern area</td>
<td>14,250</td>
<td>10,800</td>
<td>25,050</td>
</tr>
<tr>
<td>Perimeter ditch</td>
<td>Existing Water transport</td>
<td>Quantity: 100-year storm</td>
<td>On the outside perimeter of the landfill site</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
</tr>
</tbody>
</table>

### 3.8 Ancillary Facilities and Infrastructure

The construction of Stages 3B and 4 in Alternative Method 2 will require moving existing operational roadways and ditches. New roadways will be built between Stages 3A/3B and 4 and on the east, west and north sides of Stage 4 to allow access to the cells and pumping stations.

### 3.9 Landfill Operations

Landfill operations in Alternative Method 2, including operating hours, equipment, waste placement, traffic management, daily and intermediate cover and nuisance control measures, are described in Section 2.9. Landfill operations in the previous stages will remain unchanged.

### 4 Climate Change Considerations

Ongoing global climate change related to increased emissions and concentrations of greenhouse gases (GHG) in the atmosphere are addressed in the conceptual design of the EOWHF site expansion in terms of adaptation to climate change and mitigation of GHG emissions that affect the climate. This has been addressed primarily through the assessment of the impacts of increasingly intense storm events, the potential impacts of leachate generation associated with higher temperatures and increasingly intense rainfall events and snowmelt, LFG generation rates and the design of the expanded landfill gas management system to optimize collection efficiency in order to mitigate atmospheric emissions.

The observed changes in global and local climates raise questions regarding the traditional design approach and the long-term validity of the minimum design requirements set out in O. Reg. 232/98. The storm data used in the past to determine design storms for the purpose of designing stormwater management infrastructures may not be appropriate for long-term projections if climate change continues to impact activities. Given the long-term post-closure care requirements applicable to these infrastructures, an increased safety factor to address these issues will be evaluated in the context of the completion of the stormwater management infrastructures.

The effects of climate change on the design approach and conceptual design based on climate change are addressed in the sections below.
4.1 Effects of Climate Change on Conceptual Design

Increasingly severe storms and intense rainfall events, as well as reduced snow cover over the long term, are the most relevant impacts of climate change on the design of the expansion project. The potential impacts mostly pertain to the design of the stormwater management infrastructures, i.e. larger detention and sedimentation ponds are needed, as well as additional erosion protection, as more intense storm events generate higher flow velocities in ditches and swales and at discharge points.

4.1.1 Stormwater Management Design

The extreme weather events caused by climate change are of particular relevance in the design of water management infrastructures. Surface water design elements for the expansion project need to address the diversion or control of runoff coming to and from the site, as well as erosion control, sedimentation and flooding. The O. Reg. 232/98 design requirements for stormwater management include:

- external diversion channels, ditches and conveyance structures to be sized to accommodate the peak flow generated from the higher of the 100-year design storm or the prevailing Regional Storm Event (e.g., hurricane Hazel, Timmins or other historically observed maximum event);
- internal drainage ditches, storm sewers and conveyance structures to be sized to accommodate the peak flow generated from a 25-year design storm;
- a continuous overland flow route and/or ditch drainage system sized to convey the peak flow generated from the higher of the 100-year design storm or the prevailing regional storm event;
- water quality enhancement features (i.e., sedimentation ponds) of non-contaminated storm water to be designed to temporarily treat/store the runoff volume generated from a 4-hour, 25 mm storm event; and
- surface water quantity controls (i.e., peak flow reduction) of non-contaminated storm water to be designed to temporarily store the runoff volume generated from storm events up to the higher of the 24-hour, 100-year design storm or the prevailing regional storm event, at or below the existing condition peak flows, such that there is no appreciable change in the potential for flooding and/or erosion in the watercourses receiving surface water discharges.

The design of surface water infrastructures is based on the use of local rainfall intensity-duration-frequency (IDF) curves developed using historical rainfall time series data. Annual extreme rainfall is fitted to a theoretical probability distribution from which rainfall intensities, corresponding to specific durations, are obtained. Applying this procedure involved assuming that historic meteorological conditions can be used to predict future conditions. Under changing climatic conditions, the validity of this assumption is diminished.

The detailed design will also address MOECC design criteria for approval for an ECA under the Ontario Water Resources Act, in addition to the landfill-specific requirements in O. Reg. 232/98. These will include:

- The use of local airport IDF curves as modified for Climate Change for the rainfall event analysis;
- The post-development peak discharge from a development site controlled to the equivalent 2-year predevelopment level for storms up to the 100-year return period;
- For stormwater quality control, the use of a factor of 250 m³/ha, in accordance with MOECC guideline for 80 % Enhanced Removal; and
4.1.2 Landfill Gas Management System Design

The LFG management system at the EOWHF will cover the expansion area. Using a similar collection approach (via vertical extraction wells connected by piping laterals to a header pipe system), the well network will be vacuumed using blowers and gas will be removed from the landfilled waste as filling and the placement of interim and final covers progresses. The gas will be utilized for power generation or flared if the rate of gas extraction exceeds the engine’s capacity.

4.1.3 Leachate Collection System Design

The design of the leachate collection system is not affected by the meteorological changes associated with climate change, as the potential impacts on infiltration rates and the resulting rate of leachate generation is expected to be negligible once Stages 3B and 4 will be complete. The incorporation of a geomembrane in the final cover system will further reduce infiltration compared to the generic clay cover required to meet the minimum requirements set out in O. Reg. 232/98. It is during the active phases that the leachate collection system will be affected by meteorological changes. The design of the leachate collection system and the treatment plant will address the requirements associated with these changes.

4.2 Effect of the Design on Climate Change

Mitigating the impacts of climate change in the form of LFG gas emissions will also be addressed by expanding the landfill gas collection system at the site, adding flaring and utilization capacity for the additional gas, and incorporating a geomembrane into the final cover system. This will significantly reduce emissions to atmosphere from the landfilled waste in the expansion area.

LFG systems reduce GHG emissions. Organics disposal bans also reduce short-term emissions and likely increase the overall collection efficiency of landfill gas systems as most gas are generated more slowly and over a longer period of time (it is easier to match a flat generation curve with the infrastructure for collection).

Finally, incorporating a flexible geomembrane in the cover design significantly reduces migration through the cover system and increases the efficiency of the gas collection system.

4.3 Effects of the Waste Free Ontario Act

The Province of Ontario passed legislation (Waste Free Ontario Act) to implement an enhanced waste materials stewardship regime for the management of waste resources in 2016. Regulations have yet to be implemented under the Act, making any quantitative assessment of the effects of this legislation difficult, other than to further the increased diversion of materials from landfill disposal sites.

The MOECC has indicated that it will likely impose an organic ban that will involve diverting all or most source-separated organic waste from landfill disposal sites in the province. Such a ban, when implemented, will significantly reduce the readily degradable fraction of waste received at the landfill site. This reduction in the proportion of carbonaceous materials at the site will serve to reduce the volume of landfill gas generated per tonne of waste received. While significant landfill gas generation is still anticipated due to the presence of other carbonaceous waste - primarily in the form of cellulose in paper,
fiber and wood waste - the total emissions for the quantity of waste received in the expanded landfill would be significantly less than would be generated in the absence of an organics ban and diversion of more readily biodegradable materials from the EOWHF.

LFG generation rates will likely be reduced, and the relationship of gas generation rates over time will not likely vary as greatly as it would in the absence of an organics ban. The readily putrescible waste that is targeted by organics bans tends to start degrading anaerobically prior to landfilling, and much of the landfill gas generated by these materials is never collected by landfill gas collection systems as it will have been generated and emitted into the atmosphere well before landfilling is completed in a cell and gas collection is effectively implemented. Effective gas collection does not occur until a low permeability interim cover or the final cover is in place over the waste because the extraction well system cannot be vacuumed significantly until ingress of atmospheric oxygen is minimized. Without a low permeability cover, oxygen is drawn into the system and creates a significant risk of subsurface combustion of the landfilled waste.

The result is that a significant reduction of landfill gas would not be expected compared to the situation without an organic ban. Atmospheric emissions of methane and carbon dioxide generated by the most readily biodegradable wastes affected by an organics ban would be significantly reduced because the remaining carbonaceous material would degrade more slowly over time, with most of the biodegradation and associated gas generation occurring after the interim and final cover system is in place.

Apart from the reduction in the generation of GHG in the form of carbon dioxide and methane in LFG, the introduction of an organics ban would be expected to reduce odour impacts. The ban would cover the most readily biodegradable materials in the current waste stream received at the EOWHF, which is the portion of the waste stream that tends to generate the strongest odours. It may, however, take several years before an organics ban is fully implemented at landfills in Ontario. The effect will generally be a positive one in terms of reduced GHG generation and mitigation of odours, and the conceptual design readily accommodates the implementation of an organics ban as well as the absence of such regulation.

5 Summary

The CDR presents conceptual designs and operations information for the development of two alternative methods. The conceptual designs for the two alternative methods have differences relating primarily to the geometry of the footprint of the expansion area, with the same design concepts to be applied to the base liner, leachate collection and cover systems. The conceptual designs allow the two alternative methods to be compared with regard to various technical components.

The concepts presented in the CDR for both alternative methods are a minimum requirement and different methods may be applicable to achieve the same or better objectives/purposes for the design.

6 Next Steps

The landfill design and operations concepts presented in the CDR for the two alternative methods will be further developed during the technical design stage for the preferred alternative in support of the application to the MOECC for an Environmental Compliance Approval of the site expansion. Conceptual design revisions required to incorporate mitigation measures to address potential effects identified through the assessment of environmental effects will be considered as part of the EA. Finally, the conceptual design of the preferred alternative identified in the EA may be optimized as part of the detailed design process completed for the ECA application, as required.
References


Appendix A
FIGURE 6: PLAN VIEW - ALTERNATIVE 2

LEGEND

- PROPERTY BOUNDARY
- BUFFER AERIAL LIMIT
- DITCHES
- FRASER DRAIN
- PUMPING STATION
- FINAL COVER CONTOURS

EASTERN ONTARIO WASTE HANDLING FACILITY LANDFILL EXPANSION ENVIRONMENTAL ASSESSMENT CONCEPTUAL DESIGN REPORT

STAGE 2 (EXISTING)
PHASE 3 (CLOSED)

STAGE 3A (APPROVED)
PHASE 4 (CLOSED)

STAGE 3B (FUTURE)
PHASE 5 (CLOSED)

CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
CELL 6
CELL 7
CELL 8
CELL 9
CELL 10

6.0m WIDE ACCESS ROAD

D. LESSARD
D. GRENIER

31695TH-C-CR06

TETRATRCH

0:1,000

0 20 100 200 METERS

100
200
0

METERS
FIGURE 7:
ALTERNATIVE 2

SECTION A

SECTION C

EASTERN ONTARIO
WASTE HANDLING FACILITY
LANDFILL EXPANSION
ENVIRONMENTAL ASSESSMENT
CONCEPTUAL DESIGN REPORT

PROJECT NUMBER: 31695TTH
DATE: JULY 2017
SHEET NUMBER: C-CR07

D. LESSARD
D. GRENIER
LEGEND

- PROPERTY Boundary
- FRASER DRAIN
- DITCHES
- EXISTING STORMWATER PERIMETER DITCH
- STORMWATER WET POND

FIGURE 8: ALTERNATIVE 2

EASTERN ONTARIO
WASTE HANDLING FACILITY
LANDFILL EXPANSION
ENVIRONMENTAL ASSESSMENT
CONCEPTUAL DESIGN REPORT

FIGURE 8:
SURFACE WATER MANAGEMENT
ALTERNATIVE METHOD 2

D. LESSARD
D. GRENIER

1:6 000

31695TTH-C-CR08
Table B-1 Help modelling results for Stage 1 – Permeable cover

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<tr>
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Appendix C
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<th>Year</th>
<th>Landfill Gas Generation 50% CH&lt;sub&gt;4&lt;/sub&gt; (m³/hr)</th>
<th>Landfill Gas Collection (A + B)</th>
<th>Valorization in IC Engines (A)</th>
<th>Destruction in Flare (B)</th>
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**Notes:**
- Actual data provided by LEI
- Attainment of IC engines maximum capacity