DESIGN & OPERATIONS PLAN AND CLOSURE PLAN
NEW LISKEARD WASTE DISPOSAL SITE
NEW LISKEARD, ONTARIO

Submitted to:
The City of Temiskaming Shores
P.O. Box 2050, 325 Farr Drive
Haileybury, Ontario
P0J 1K0

Submitted by:
Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
Tel: (705) 682-2632

12 February 2020
Wood Project No.: TY910491

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 Background

Wood Environment & Infrastructure Solutions, a Division of Wood Limited Canada (Wood), was retained by The City of Temiskaming Shores (the City) to prepare a Design and Operations Plan (D&O), as well as a Closure Plan for the New Liskeard Waste Disposal Site (referred to as the Site). The Site is located approximately 3 kilometres (km) west of the former Town of New Liskeard, Ontario, West ½ of Lot 5, Concession 2, within the City of Temiskaming Shores, in the District of Temiskaming. The location of the Site is shown on Figure 1. The site plan and existing conditions at the Site, as of July 2019, are presented on Figure 2 and 3, respectively.

The Site ceased accepting waste in June 2009 and has since been inactive. Since operations have ceased, the waste stream has subsequently been diverted to the Haileybury Landfill. Based on the generation projections contained within the most recent annual monitoring report (Wood, 2019a), the Haileybury landfill is expected to reach its approved capacity within 2.3 years, as of May 2018. As part of the Environmental Assessment (EA) for the New Waste Management Capacity Project, the expansion of the New Liskeard Landfill was the selected as the preferred future waste management option for the City. The expansion would extend southwest over a total area 7.7 hectares (ha), 1.8 ha beyond the current landfill toe, providing the City with a maximum of 366,845 cubic metres (m^3) of additional capacity for waste and daily cover.

As per the EA, the landfill expansion will be spread over the existing landfill cover, organized and divided into 3 cells, for the purpose of logical sequencing. No impervious lining would separate the new cells from the existing waste pile, rather the expansion cells would simply be a vertical extension of the existing waste pile. For the preparation of each cell, and to improve the continuity of the expanded fill pile and promote infiltration of the new cell through the existing landfill, each cell base would be prepared by scarifying (loosening) the existing landfill cover, removing vegetative matter as required, in preparation for new waste material. This process would continue with interim cover as was previously practiced at the site to allow good hydraulic connection between the new waste and the existing waste pile.

It is assumed that the construction of the landfill expansion will begin from the south end at Cell 1. The expansion will progress sequentially from Cell 1 through Cell 3 (i.e., south to north). The activities associated with the landfill expansion are expected to occur over a 45-year period and are divided into four phases for the assessment of potential effects:

- Phase 1 Construction (Year 1), includes the preparation of the Cell 1 base and associated construction of perimeter access roads, and berm (including the appropriate sediment and erosion protection measures);
- Phase 2 Operations (Years 2 to 25), includes landfilling at active cells (1 through 3) and concurrent development of cells (2 and 3) and subsequent closure of cells (1 and 2), as they reach the designed final contours;
- Phase 3 Closure (Years 25 to 26), includes closure of Cell 3 and placement of final capping and cover; and,

- Phase 4 Post-Closure (Years 27 to 45), includes post-closure monitoring (including groundwater).

During the post-closure period, the only activities anticipated are annual water quality monitoring, Site performance monitoring and maintenance.

1.2 Site Approvals

The Site was formerly operated under the Certificate of Approval No. A571505, provided in Appendix A, issued on 9 May 2000, and amended on 27 April 2005, 17 April 2007, 24 October 2012 and 11 December 2013. The Site was in operation prior to the issuance of the C of A and is reported to have been in operation for over 90 years prior to the current state of inactivity, before which time the area was used as a limestone quarry (Story Environmental Inc. (Story), 2013). The Site was approved to accept domestic, commercial and non-hazardous solid industrial waste. The C of A specifies an approved landfill area of 2.02 ha within a total Site area of 32 ha, however it is reported that the historical waste fill area extended outside of the approved fill area footprint and is currently approximately 6.12 ha.

The 2007 amendment included the addition of a permitted Contaminant Attenuation Zone (CAZ) extending 400 m to the northeast of the landfill boundary, an approximate area of 30 ha, for the purpose of leachate management. The 2012 amendment approves the construction of solar panels within the CAZ. The most recent C of A amendment, dated 11 December 2013, acknowledges the ongoing EA process and potential vertical expansion of the Site.

The New Waste Management Capacity Project requires approval under the Environment Assessment Act (EAA), the Environmental Protection Act (EPA), and the Ontario Water Resources Act (OWRA). The application for approval under the EPA and OWRA are combined into an application for an Environmental Compliance Approval (ECA) for a Waste Disposal Landfill Site. Under OWRA, a Permit to Take Water may be required if a leachate collection system is required; however, the current size and design does not warrant a collection system, as the site is designed and has historically operated as a natural attenuation site since its inception, without reported problems.

The City was successful in obtaining EA approval and is in the process of completing the application for an ECA. The D&O Plan, as well as Closure Plan both constitute part of the requirements for the ECA application.

1.3 Objective of Report

The objective of the D&O Plan and Closure Plan is to present the design for the expansion of the Site and an operation and management plan for the Site in support of an ECA application. The proposed design meets the requirements of O. Reg.232/98 and includes the volume of waste already deposited above the approved capacity and additional capacity for the future waste generation from the City.

The D&O Plan provides for the long-term development and use of the Site as a non-hazardous municipal solid waste landfill. The Closure Plan provides for the progressive sequential closure of the Site.

1.4 Design Concept

The concept of the D&O Plan and Closure Plan is to allow for the long-term development and use of the Site as a non-hazardous municipal solid waste landfill, such that the impact to the surrounding environment will be minimized. The D&O Plan and Closure Plans have been developed to provide a Site design that meets the requirements of O. Reg. 232/98, subject to the following constraints and design features:

- contain landfill area to the approved landfill footprint area;
- maintain approved landfill volumes;
- create development sequence;
- maintain approved final contours for the proposed landfill area compatible with the anticipated end use;
- minimize soil volume requirements or soil excess for construction of cover soils and miscellaneous Site development works;
- control of surface water runoff from the proposed landfill area to minimize any adverse effects off-Site; and,
- minimize impacts from dust, litter, noise, odour, vector, vermin and traffic.

2.0 DESIGN CONSIDERATIONS

2.1 Site Description

A summary of the Site description is provided below, as compiled from various historical reports. Existing Site features and monitoring locations are presented on Figures 2 through 5.

2.1.1 Site Topography and Drainage

The Site is situated on the east side of a limestone ridge which forms a watershed divide separating the South Wabi Creek catchment, located west of the Site, from the Wabi Creek catchment, located east of the Site. The topography within the Site boundary is dominated by the waste mound producing a slight radial groundwater flow pattern within the waste pile area, with a predictable overall groundwater flow pattern to the northeast over the Contaminant Attenuation Zone (CAZ). The surrounding site features provide perimeter infiltration and convey runoff east around the waste mound. East of the waste deposit the topography flattens across the CAZ; this area is characterized with high infiltration rates resulting in low surface water runoff. East of the CAZ boundary the topography steepens significantly which reduces the infiltration potential and forms ephemeral watercourses which transition into intermittent channels. Two primary intermittent channels along the steep valley slopes with substrates comprised of erodible mineral soils have been identified east of the CAZ boundary. They report to the roadside ditch of HWY

65 which conveys surface water approximately 2 km downstream to Wabi Creek. The intermittent channels are likely seasonally limited to the spring freshet and during large rain events.

The current contours and topographic features of the Site are presented on Figure 3. There is no surface water on-site or in the immediate vicinity of the Site the overall drainage for the Site is directed northeast.

The adjacent solar farm project had completed an assessment on the impacts of drainage within the CAZ and determined the impervious surfaces do not impact the characteristics of the CAZ drainage (Dillon Consulting Limited (DCL), 2011). The overall change in surface water runoff peak flows as a result of the solar farm project is considered insignificant (DCL, 2011).

2.1.2 Summary of Site Geology and Hydrogeology

Annual monitoring of surface, groundwater and residential supply wells at and within the vicinity of the New Liskeard Landfill has been completed since 2017, 2000 and 2002, respectively. The installation of groundwater monitoring wells, as well as the establishment of residential supply well water sampling and surface water stations have been accomplished as part of previous site investigations (Figure 4 and 5).

The New Liskeard Landfill has historically been monitored through the sampling of up to 50 groundwater monitoring wells. Currently the groundwater conditions at the site are monitored utilizing 30 groundwater wells, in addition to the measurement of 9 groundwater elevation monitoring locations and the sampling of 7 off-Site residential supply wells. The groundwater monitoring program has been completed on a biannual basis from 2000 to 2002, four times annually from 2003 to 2007, and three times annually (spring, summer and fall) from 2008 to date. Residential sampling is completed once annually during the spring sampling event. A surface water monitoring program was initiated in 2017, consisting of 6 surface water stations, and is completed 8 times annually.

The following sections summarize the available Site geologic and hydrogeologic information, as well as the general findings of the borehole investigations completed to date. Further information is provided in Sections 3.1 through 3.4 of the amended EA and Section 2.0 of the 2020 Annual Monitoring Report, including figures that illustrate the landfill cross section and the downgradient interpreted hydrogeology.

2.1.2.1 Site Geology

Borehole logs, including those prepared by others, detailing soil and groundwater conditions for the monitoring well network are provided in Appendix B. The geological conditions at the Site, as determined by the boreholes completed at the Site, indicate a thin veneer typically between 2 and 5 m of very loose to very dense silty glacial till overlying limestone or igneous bedrock within the property boundary and extending east within the CAZ. Limestone was found to overly the igneous rock type towards the north edge of the CAZ boundary. Overburden deposits increase in thickness east of the Site near the eastern CAZ boundary and the downgradient sentry location to range between 12 m and 23 m. The thicker overburden deposits are characterized as a loose

to dense silty sand deposit; underlain by a stiff silty clay deposit; which overlies a dense silty sand deposit over limestone or igneous bedrock.

2.1.2.2 Site Hydrogeology

As previously described in the EA (Amec Foster Wheeler, 2018), the Site is situated on a topographically elevated, exposed (i.e., little to no overburden) limestone bedrock ridge. A number of documented fault zones are present in the vicinity of the Site and within the downgradient area. Geological investigations in this area indicate a thin veneer overburden within the Site boundary and extending east into the CAZ with depths typically ranging from 2 to 5 m. As this area is on a topographic high near an inferred groundwater divide there are strong downward gradients within nested wells indicating a recharging aquifer. The absence of a significant low permeability confining layer overlying the limestone bedrock in this area means that there is a low probability of leachate outbreak downgradient of the landfill site within the CAZ. Previous studies have indicated similar hydraulic properties between the bedrock and the overburden deposits and the two stratigraphic units generally form one aquifer.

Overburden thickness increase towards the east boundary of the CAZ and ranges from 12 to 23 m. The increased overburden deposits form a silty clay deposit which divides the overlying and underlying silty sand deposits. This area of the drainage basin is followed by a steep downward topographic change. Upward vertical groundwater gradients observed in the monitoring well nests indicate a discharging groundwater condition in the lower elevations of the site. The silty clay deposit is inferred to have a lower permeability than the overlying silty sand deposit and forms a hydraulic barrier to allow a shallow overburden aquifer to prevail within the silty sand deposit. Bedrock near the CAZ boundary, and further to the northeast, is reported by Jagger Hims Limited (JHL) to be characterized as assumed mafic igneous (JHL, 2008). It is anticipated the igneous mafic bedrock has a lower permeability forming a barrier to contaminant migration and produces a confined deep overburden aquifer. As a result of the low permeability igneous mafic bedrock the confined deep overburden aquifer is producing upward vertical hydraulic gradients as observed in the nested wells in this area.

Groundwater flows through the overburden and upper bedrock from the landfill to the northeast. JHL reported that highly fractured bedrock extended to 10 m below ground surface at well nest OW-1R (situated immediately northeast of the existing waste footprint), which corresponds to approximately the upper 7 m of the limestone bedrock (JHL, 2008). Other boreholes indicated more fractured bedrock in the upper 1 to 2 m of bedrock relative to deeper bedrock, including OW27-14.

Strong downward hydraulic gradients have been reported on the bedrock ridge and below the landfill, indicating that the landfill is located in a groundwater recharge area. This is to be expected since the site is located just east of a presumed groundwater divide at the top of the bedrock ridge. The vertical hydraulic gradients level out to nearly horizontal downgradient of the landfill. At the eastern boundary of the CAZ, upward vertical hydraulic gradients have been observed in some well nests. The two seasonal channels present east of the CAZ indicates that there is likely

a seasonal groundwater discharge of locally recharged groundwater resources and are not discharging potentially impacted groundwater resources.

Through the fill area and the CAZ for the Site, the hydraulic gradient of the groundwater in the shallow aquifer is approximately 0.045 m/m to 0.050 m/m (based on recent annual monitoring reports). The deep aquifer hydraulic gradient is similar, at approximately 0.038 m/m to 0.050 m/m. Downgradient of the CAZ, the hydraulic gradient steepens to a typical value of approximately 0.2 m/m.

Groundwater contaminant velocity was calculated for the above groundwater conditions. The typical gradient of groundwater movement through the CAZ is 0.05 m/m. Assuming a soil porosity of 0.3, and the overburden hydraulic conductivity calculated above (8.9×10^{-8} m/s), a contaminant velocity of 47 cm per year is calculated. Using the higher hydraulic conductivity calculated from the upper bedrock/overburden contact (1.5×10^{-7} m/s), a velocity of 79 cm per year is calculated. Groundwater that leaves the CAZ experiences higher gradients as it moves toward Highway 65. For example, the overburden velocity would increase to 1.9 m per year, and deep groundwater movement at the bedrock contact would increase to 3.2 m per year.

Static water levels were recorded by Wood at each of the wells during the spring, summer and fall 2018 groundwater monitoring events. Appendix C presents the groundwater elevations measured during the 2018 groundwater monitoring events. Figures 8A through 8F present the inferred groundwater elevation contours and groundwater flow directions for both the shallow and deep aquifers for each of the three 2018 monitoring events. In general, the recorded static groundwater levels indicate groundwater flow across the Site towards the northeast in both the shallow and deep groundwater flow systems. Groundwater elevations in the vicinity of the Site mimic the topography of the area, decreasing to the northeast within the fill area, then flattening out across the CAZ, and subsequently decreasing steeply from the northeast corner of the CAZ to Highway 65.

2.2 Land Use Designation of Site and Adjacent Lands

The Site is located within the existing facility footprint, currently on City-owned lands designated as waste management. Land use in proximity to the Site is designated as agricultural, to the north and west; renewable energy generation to the east (Canadian Solar's New Liskeard 1, 3, 4 solar project); and rural area south and southeast. The privately-owned lands immediately to the south are currently occupied by the solar facility. The Site is also bound by a Hydro One Networks Inc. transmission line rights-of-way on the west and north sides.

The existing infrastructure at the Site consists of two gravel roads, as well as an office equipment housing structure. The roads extend from south to north; one is located to the west of the former landfill face and the second first extends along the south edge of the Site, then east. The structure, located at the entrance to the Site, has an approximate footprint of 80 m^2.

2.3 Adjacent Downgradient Properties

The City has acquired 32 ha of additional land downgradient from the Site, in order to comprise a natural attenuation zone for the Site. Several residential supply wells are located downgradient of the Site, to the northeast along Highway 65. Collection, analysis and interpretation of

groundwater samples obtained from this residential supply are included as part of the annual monitoring program for the Site.

2.4 Waste Characteristics

The former New Liskeard Landfill was approved to accept disposal of non-hazardous municipal solid waste generated within the boundaries of the City. No waste has been disposed of at the Site since operation were ceased 2009. For the expansion, the type and classification of waste will be the same as pre-2009 (i.e. no changes to waste type are proposed).

2.5 Waste Generation Forecast

A 25-year waste generation projection was presented as part of the EA, for the former communities of Haileybury, Dymond, and New Liskeard, comprising the City, including the Town of Cobalt. The density of uncompacted residential waste generated by the City is assumed to be of 150 kg/m^3 (Amec Foster Wheeler, 2010). As the density of the compacted material at both the New Liskeard and Haileybury Landfills are unknown, a conservation compaction density of 500 kg/m^3, representing the density of residential solid waste following landfill compaction, was utilized in order to calculate the volume of compacted residential waste. Results of the EA indicate that the projected waste generated, over a 25-year planning period, is approximately 197,281 m^3 of compacted solid waste. In addition to the daily cover soil quantities, corresponding to approximately 20% of the landfill capacity, the total waste disposal volume is calculated at approximately 247,000 m^3 (rounded value).

The City administers a number of waste diversion programs consisting of a bi-weekly recyclable curbside collection, a depot at the existing landfill for the Ontario Tire Stewardship program, as well as for Waste Electrical and Electronic Equipment. Cardboard and single-stream recycling bins are also provided at the existing landfill. An Orange Drop event is organized by the City annually for the collection of Household Hazardous Waste. It was conservatively assumed that there will be a minimal amount of waste diverted over the planning period, but as the City continues to improve and increase its waste diversion capacity there will be a resulting increase in the life of the current landfill.

2.6 End Use

There is presently no end use plan formalized for the Site. It is anticipated that most of the Site area, will be returned to a naturalized condition, with no planned land use. Use of the Site will likely consist of conservation and passive recreation with enhanced regeneration/restoration. The final contours proposed for the landfill will allow for a revegetated, passive land use area.

The closed Site will remain on lands owned by the City, who will be responsible for all post-closure inspections, maintenance and care, as well as post-closure monitoring and reporting.

A Closure Plan for the Site is included in Section 14.0 of this report and outlines the required closure activities. This Closure Plan has been prepared in accordance with the Ontario Regulation 232/98, and includes the following:

- proposed end use;
- final contour configuration;
- procedures for closure;
- design and construction of final cover;
- landscaping;
- site facilities (if any);
- closure schedule;
- rodent control;
- surface water control; and
- post-closure care.

2.7 Design Criteria

The major components of the landfill design includes the following:

- buffer zones;
- base contours;
- leachate management;
- site capacity;
- soil volumes;
- final contours and cover construction; and,
- surface water management.

The primary landfill design criteria used for the design of the above components for the Site are presented in Table 1. These design criteria are based on the MECP "Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New and Expanding Landfill Sites" (MECP, 2010) and current landfill industry standards commonly used in the Province of Ontario.

Table 1: Landfill Design Criteria

Item	Criteria
On-Site Buffer Zone	• Minimum 30 m width along property boundaries adjacent to waste area
Maximum Elevation of Landfill Final Contours	• Approximately 280 m above sea level (masl)
Maximum Site Capacity	• Approximately 366,845 m^3 (total landfill volume)
Maximum Side slope (H:V)	• Landfill final contours 4:1 (25%)

Minimum Top slope (H:V)	• Landfill final contours 20:1 (5%)
Final Cover Depth of 0.75 m	• 0.60 m low permeability soil • 0.15 m vegetated topsoil
Leachate management	• CAZ downgradient of landfill

3.0 SITE DESIGN

3.1 Buffer Zones

The primary purpose of buffer zones is to allow the implementation of environmental controls, to provide sufficient land area to locate landfill operating and waste diversion facilities, and to buffer adjacent lands from landfilling operations. It is required by the MECP guideline (O. Reg. 232/98) that a minimum 30 m buffer should be kept between the waste disposal limit and the property boundary.

The horizontal limits of the refuse for the new expansion area, as per the design, has to provide an approximate 60 m wide buffer zone along the property boundary. This exceeds the minimum 30 m wide buffer zone, as required by Guideline D-4 “Land Use on or Near Landfills or Dumps” (MECP, 1994). A buffer zone incorporated around the landfill footprint, to the Site boundary, is shown on Figure 6.

The buffer zones, Site facilities and features that will be established during the new operation are presented on Figure 6. Thus, sufficient areas are provided for the establishment of environmental monitoring wells, Site access road, and storm water works, as required.

3.2 Base Contours

The proposed base contours for the expanded landfilling area are presented on Figure 3. The landfill base contours were based on the existing topographical contours of the former landfill. The existing waste deposit has base contours ranging from approximately 250 masl at the east end to 280 masl at the west end. These base contours were acquired from a survey completed in August 2019 by Story Environmental.

In addition, the proposed base contours, in conjunction with the proposed final contours, were designed to minimize the overall landfill footprint. A minimized landfill footprint will serve to reduce the amount of infiltration area and consequently minimize the volume of any leachate that might be generated.

3.3 Final Contours

The final contours for the proposed landfill area are presented on Figure 6, with a cross-section presented on Figure 7. The final contours were designed in accordance with MECP guideline O. Reg 232/98, compatible with intended end use, and to ensure that there was no significant reduction in Site capacity, in order to satisfy the buffer zone requirements for future landfilling.

The final contour design is noted to meet the maximum criteria of 4:1 (25 percent) for the side slopes and a minimum criteria of 20:1 (5 percent) for the top portion of the proposed landfill area.

The use of minimum slope criteria is necessary to provide adequate surface water runoff and reduce infiltration, and consequently leachate production, particularly after long term consolidation of the disposed waste has occurred. A maximum slope criteria relates to soil erosion during storm events and ensures that slopes are manageable for construction and maintenance equipment.

The maximum elevation of the proposed landfill area (i.e., to top of final cover) will be 278 masl, being an approximate maximum height of 28 m above surrounding ground elevation (minimum adjacent ground elevation of 250 masl. The proposed expansion will extend outwards, to the east, from the existing waste deposit, as such the maximum elevation will be slightly below the current base elevation.

Within sequences where several working benches will be required to attain the proposed final contours, the following operational and development guidelines should be followed. The maximum height of a working bench should be no greater than 3 m and should follow the contours of the existing waste or land and promote surface water drainage. Within each working bench the waste should be deposited in a maximum of 1 m lifts with 150 mm of cover material placed, as required.

3.4 Daily Cover

At landfills accepting municipal solid waste, daily cover fulfills a number of functions including: minimizing erosion of landfilled waste, minimizing blowing litter, reducing odours, discouraging vermin and vector activity, and improving vehicular access to the active disposal area. Cover soil will be applied to active disposal areas on a daily basis, under continued operation of the Site, as a proactive measure. For the purposes of soil volume calculations, a design ratio of the volume of waste to the volume of waste cover soil equal to 4:1 will be assumed for the Site.

The majority of the volume of waste cover soil required during the Site operations will be secured from suitable on-Site sources and/or contaminated soil that is disposed of on-Site. Prior to use as cover material, contaminated soil will be stockpiled on-Site for a period of time, for aeration purposes. This material will be stockpiled in convenient locations so that it is readily available for cover at the end of each operating day. Clean fill or other inert fill (i.e., earth, rockfill or waste of a similar nature that contains no putrescible materials and/or soluble, decomposable chemical substances, subject to acceptance protocol) brought to the landfill for disposal, will be segregated and stockpiled for use as waste cover soil or road construction material.

3.5 Interim Cover

During landfill development, areas which are not considered part of the active disposal area but scheduled to receive additional lifts of waste at some future time will be temporarily completed with interim cover soils to promote surface water runoff and to limit the exposure of waste at the Site. Interim cover will consist of a 0.3 m thick layer of low permeability soil. Interim cover will be placed on disposal areas which will remain inactive for more than six (6) months, after which landfilling will resume until final contours are reached.

Interim cover removal, prior to resumption of landfilling, will be completed to promote hydraulic connection between waste lifts and allow leachate to infiltrate readily to the base of the landfill. In areas where final contours have been obtained, final cover will be constructed.

3.6 Final Cover

A progressive, final cover will be used throughout the Site in order to minimize infiltration and leachate generation. As final contours are reached the final cover will be progressively placed. a final cover consisting of a traditional soil cover system is suitable for the Site. The traditional system is low permeability cover and is outlined in the subsequent section.

3.6.1 Traditional Soil Cover

The low permeability soil will be obtained from the excavation of the proposed landfill base or borrow pits, if available, or from suitable off-Site sources. This material will be placed directly over the uncompacted waste in continuous, uniform, loose lifts not exceeding 0.2 m in thickness. In accordance standard industry practices, the low permeability soil will be compacted to a minimum of 95 percent of the material's Standard Proctor Maximum Dry Density (SPMDD) and at or up to 4% above the optimum moisture content. The low permeability soil must have a minimum of 60 percent fines (silt and clay), by weight, passing the No. 200 sieve (0.074 mm opening), of which a minimum of 15 percent is clay (0.002 mm). A 150 mm vegetative topsoil cover will be placed over the cover material as specified in the following Section.

3.6.2 Topsoil and Vegetative Cover

Topsoil will be secured from suitable off-Site sources and placed directly over the low permeability soil or the synthetic liner protective cover material. Organic composted material from the Site may be mixed with the topsoil to obtain and organic content in the range of 5 percent to 20 percent. The mixed topsoil should be fertile, agricultural soil typical for the area of the Site. The topsoil should be free of clay clods, impurities, plants, weeds and visible roots. The pH of the topsoil should range from 5.4 to 7.

The proposed final cover vegetation will be placed by hydroseeding through the application of seed mix and mulch using a water-borne spray system. The seed mix proposed for the final cover will be required to satisfy the following considerations:

- The seed mix must develop hardy growth suitable for the climate and environmental conditions.

- The root growth must provide a strong anchor to reduce erosion and sediment transport particularly on the side slopes.
- The resultant vegetation must be easy to manage and should not require significant maintenance.

The hydroseed mix is selected from Table 1 of Ontario Provincial Standard Specifications (OPSS) Section 572. The Standard Roadside Mix is commonly used by the Ontario Ministry of Transportation (MTO) and the Ontario Ministry of Natural Resources and Forestry (MNRF) to revegetate many sloping roadside embankments. The proposed seed mix contains native Ontario plant species at the following mix ratios:

- Creeping Red Fescue, *Festuca rubra* (50% to 60%)
- Kentucky Bluegrass, *Poa pratensis* (25% to 30%)
- Perennial Ryegrass, *Lolium perrenne* (12% to 18%)
- White Clover, *Trifolium repens* (2% to 4%).

The Standard Roadside Mix was chosen for its ability to establish itself given the conditions of the proposed topsoil layer. Once established, the proposed seed mix creates a fibrous root growth that acts as a strong anchor for the soil, thus minimizing erosion and sediment transport of the topsoil rooting medium during storm events. The proposed seed mix will be applied at a rate of 150 kg/ha to 170 kg/ha. A nurse crop of annual Rye Grass should also be applied in order to provide for quick cover for erosion protection during the first year after application while the proposed seed mix becomes established. The Rye Grass nurse crop seed will also be applied at a rate of 60 kg/ha.

3.7 Contaminating Attenuation Zone (CAZ)

A CAZ has been established at the Site to provide additional contaminant attenuation buffer for the Site. The City completed the acquisition of additional land, and an amendment to the C of A was issued to incorporate the CAZ in 2007, following the 2005 application. The current CAZ extends approximately 400 m downgradient of the northeast edge of the existing waste footprint.

With respect to leachate management, it is proposed that the Site continue to operate as a natural attenuation landfill which will utilize the attributes of the Site's natural setting for the attenuation of leachate on Site. The findings of hydrogeological characterization and historic monitoring results indicate that natural attenuation is an appropriate means of continued groundwater management at the Site following expansion. Although, the CAZ is sufficient for expansion to the east, it is recommended that the existing CAZ be expanded to the north by approximately 50 m to 100 m to account for potential changes in the groundwater flow system due to groundwater mounding within the landfill deposits. Subsequently, the City may be required to obtain approximately 2 to 4 ha of additional land to ensure a minimum 400 m attenuation distance to the northeast, since the expansion will increase the current footprint area and reduce the available

downgradient recharge area. Figure 2 presents the configuration of the expanded CAZ required to fulfill the preliminary design criteria.

The effectiveness of the leachate management under continued operation of the Site will be evaluated through the long-term monitoring program for the Site. Contingency plans will be developed as part of the annual reporting process, should the long-term water quality monitoring program indicate that continued operation of the landfill is resulting in significant impact to the groundwater quality at the Site.

3.8 Stormwater Management System

A system of existing drainage ditches at the perimeter of the Site will be utilized to divert "clean" surface water from the Site prior to being discharge to the environment. These perimeter ditches will convey surface water runoff, via overland flow, for discharge to the existing ditch at the North end of the Site, as illustrated on Figure 3.

Stormwater drainage from the Site will be managed through the construction of a containment berm at the toe of the landfill slope, as an infiltration basin. This berm will allow for any potentially waste impacted and sediment laden stormwater runoff to be temporarily detained and separated from "clean" stormwater. All water that has contacted landfill waste will be allowed to infiltrate and attenuate with the groundwater on site. The berm will be constructed along the toe of the slope (i.e., north and east).

The temporary stormwater pond was sized to accept a 24 hour 1 in 50 year design storm, based on Intensity Duration Frequency (IDF) data for nearby Earlton Ontario, obtained from the federal government web site. A 50 year and a 10 year return period were considered for design. The 50 year return period was selected since it was considered to be in line with the pre-closure and capping life of the landfill. As a worst-case scenario, it was assumed that 80% of the rainfall would report to the stormwater pond during a frozen ground condition. The data is summarized below:

Design Rainfall

The 10-year and 50-year 24 hour design rainfall depth were taken from Environment Canada intensity-duration-frequency precipitation data obtained from nearby EARLTON A, Station 6072225. 50 years was chosen as the largest even as it is similar to the proposed site life. The rainfall values used are:

- 10-year 24 hour: 68.99 mm
- 50-year 24 hour: 90.2 mm

Runoff Volume

It was assumed that the worst case would be a rainfall event on frozen ground, with a 80% runoff rate. Therefore, over the 90,650 m^2 catchment area of the landfill closed cap and working area, the total runoff volume that would need to be contained in the pond at the toe of the landfill under each of these scenarios would be:

- 10-year 24 hour: 5,003 m^3 pond capacity
- 50-year 24 hour: 6,541 m^3 pond capacity

Note that in operating conditions sediment would collect in the pond. An allowance of 0.75 m of sediment was used in pond design. The pond design is illustrated in Figure 4.

In operation, the pond bottom elevation should be monitored to ensure that the pond base has 0.75 m or less of sediment in order to maintain capacity to contain the 1 in 50 design storm. At more than 0.75 m sediment, pond cleanout should be performed. The volume calculations relative to pond water elevation are summarized below:

Elevation (m)	Pond Volume (cubic metres), No Sediment	Pond Volume (cubic metres), 0.75 m Sediment	Comments
245.00	0	0	Pond Base
245.50	500	0	
245.75	780	0	
246.00	1,095	315	
246.50	1,805	1,025	
247.00	2,630	1,850	
247.50	3,585	2,805	
248.00	4,665	3,885	
248.50	5,885	5,105	
249.00	7,250	6,470	Perimeter road base
249.25	7,970	7,190	
249.50	8,710	7,930	Top of road 250.00

Note that from the above, 99% of the 1 in 50 return period storm would be contained by the pond itself with 0.75 m of sediment. The remaining 1% of volume would be impounded by the perimeter road, which represents less than 25 mm water rise above the top of the pond to be contained by the road, which is considered minor and acceptable. The 1 in 10 year storm is fully contained with the full sediment load.

Temporary swales are to be constructed around the working area of the landfill to divert up gradient runoff around and away from the active landfill area divert water away from the fill area. The runoff will be conveyed from both the top and downslopes of the working face, through temporary swales, and will discharge into the infiltration basin located at the toe of the landfill slope. The proposed ditch profile is illustrated on Figure 9. Sediment and erosion control measures, such as silt fences and temporary berms, will assist in preventing the migration of suspended sediment from the Site.

4.0 LANDFILL VOLUMES

4.1 General

The overall waste and daily cover soil represent a landfill volume of approximately 366,845 m^3. The calculated volumes associated with the landfill area are summarized in Table 2 and include a volume breakdown for the total Site, final cover, and waste cover. The final cover volume calculation considered a 0.6 m thick low permeability soil layer underlying a 0.15 m thick vegetated topsoil layer. The required volume of waste cover is computed based on a 4:1 ratio of waste to waste cover soil.

Table 2 Summary of Proposed Landfill Volume Requirements

Disposal Area	Footprint Area (ha)	Total Site Volume(1) (m^3)	Final Cover Volume(2) (m^3)	Landfill Volume(3) (m^3)	Waste Volume(4) (m^3)	Daily Cover Volume (m^3)
Total	7.70	400,520	33,675	366,845	317,525	49,320

Notes:

(1) Volume requirements for interim cover have not been included in the landfill volume summary, as interim cover the interim cover will generally be removed prior to landfilling. As such, interim cover will not consume a portion of the total Site volume.
(2) Final cover includes 0.6 m of low permeability soil and 0.15 m of vegetated top soil.
(3) Landfill volume includes waste and daily cover.
(4) Waste and daily cover volumes are based on a 4:1 design ratio of the landfill volume.

It should be noted, that the volume requirements for interim cover have not been included in the landfill volume summary (Table 2), as interim cover removal prior to landfilling will generally be completed. As such, interim cover will not consume a portion of the total Site volume.

4.2 Total Site Volume

The total Site volume is calculated based on the current landfill base contours, as well as the final contours for the expansion. The base contours consist of the existing surface, surveyed in August 2019. By comparing the surveyed August 2019 contours to the proposed final contours, the total site volume is determined to be 400,520 m^3.

4.3 Landfill Volume

The landfill volume, comprised of the waste and daily soil cover, was determined by subtracting the volume of final cover soils from the total Site volume. The total volume for 0.75 m thick final cover is approximately 33,675 m^3, as such, the total landfill volume is estimated to be 366,845 m^3.

4.4 Waste Volume

Typically, the volume of waste is determined by subtracting the volume of final cover soil and weekly cover soil from the total remaining Site volume. Assuming a waste to daily cover soil ratio of 4:1, the total waste volume of the Site is estimated to be 317,525 m^3.

4.5 Soil Requirements

The soil volume requirements for construction and operation of the proposed landfill area are presented in Table 3.

The cover soils required for construction of the landfill area include: daily cover, interim cover, and final cover. The total volume of cover soils required is estimated to be 86,445 m^3. This amount consists of 49,320 m^3 of daily cover, 3,450 m^3 of potential interim cover and 33,675 m^3 of final cover. A breakdown of this amount by soil type is provided in Table 3.

Additional soils are required for establishment of miscellaneous Site operations, temporary surface water diversion berms, and other Site improvements not previously identified. Since these soil requirements are in small quantity and are not practical to estimate, they are not included in Table 3.

Table 3 Summary of Proposed Soil Volume Requirements

Soil Usage	Soil Volume Requirements(1) (m^3)			
	Low Permeability Soil (m^3)	Topsoil (m^3)	Clean or Inert Fill (m^3)	Total (m^3)
Daily Cover	-	-	49,320	49,320
Interim Cover	3,450	-	-	3,450
Final Cover	26,940	6,735		33,675
Total	30,390	6,735	49,320	86,445

Note:

(1) Quantities presented in table are for placed and compacted volumes, ± 50%.
(2) Waste cover may consist of clean or inert fill, or alternatively waste cover materials as approved by the MECP.

5.0 SITE LIFE

The site life is projected to be 25 years, dependent on potential future waste diversion efforts. The projected landfill volume was calculated based on the future waste management requirements for a 25-year planning period as part of the EA process, outlined in the New Waste Management Capacity, Amended EA completed by Amec Forster Wheeler (2018).

Scales to determine accurate waste generation rates and waste diversion would assist in confirming the estimated Site life numbers. In the interim, the annual topographic surveys should be conducted in order to provide an approximation of the waste volume consumption. The development of the new gatehouse, scales and a public disposal area off the actual working face of the landfill (i.e., a bin system) would give City personnel more control over the Site, as well as promote and increase waste diversion, whereby increasing site life and reduce the overall liability from a Health and Safety perspective.

6.0 SITE DEVELOPMENT PLAN

6.1 General

The proposed sequential development for the operation of the Site is proposed to occur over four phases. Operation in each phase will consist of landfilling and new base preparation. In each phase, new base will be constructed so that it will be ready for landfilling in the next stage.

The landfill expansion will spread over three waste disposal cells. Phase I will consist of the construction of Cell 1 base and associated site infrastructure. A progressive filling/closure plan will be utilized throughout development of the Site in order to minimize leachate generation. Interim cover will be placed on disposal areas which remain inactive for more than six (6) months, after which landfilling will resume until final contours are reached. Interim cover will be removed from the waste prior to the resumption of landfilling, in order to promote hydraulic connection between waste lifts.

Landfilling will begin from the south end at Cell 1 and progress sequentially through Cell 3 (i.e., south to north). The concurrent development of Cells 2 through 3 will occur during Phase II, including the subsequent closure of Cells 1 through 2 as they reach the designated final contours.

6.2 Sequential Development

The following briefly summarizes the main components of each landfill development sequence presented on Figure 14:

<u>Sequence 1</u>

- Clear, grub and prepare base of Cell 1, scarify (loosen) base as required if clay is encountered
- Construction of associated perimeter access roads, swales, and berm (including the appropriate sediment and erosion protection measures).

Sequence 2

- Waste disposal to take place in the south extent of the expansion area at Cell 1;
- Clear, grub and prepare base of Cells 2 scarify (loosen) base as required if clay is encountered;
- Waste disposal to take place in the south extent and progress sequentially northward until final contours are reached;
- Maintain Site perimeter/maintenance road, drainage ditch, and berm, and extend to disposal areas; and,
- Place interim cover on areas that have reached interim contours.

Sequence 3

- Waste disposal to take place at Cell 2;
- Clear, grub and prepare base of Cells 3, scarify (loosen) base as required if clay is encountered;
- Decommission leachate monitoring wells (OW-1R-I, OW-1R-II, and OW-1R-III);
- Install twined leachate monitoring wells (2), replacing the former wells, at the base of Cell 2;
- Waste disposal to progress sequentially northward until final contours are reached;
- Maintain Site perimeter /maintenance road, drainage ditch, and berm, and extend to disposal areas; and,
- Place interim cover on areas that have reached interim contours.

Sequence 4

- Waste disposal to take place at Cell 3;
- Waste disposal to take place in the south extent and progress sequentially northward until final contours are reached;
- Maintain Site perimeter/maintenance road, drainage ditch, and berm and extend to disposal areas;
- Place final cover on areas that have reached final contours; and,
- Site closure and implementation of monitoring program.

7.0 LEACHATE MANAGEMENT PLAN

7.1 General

The leachate management plan for the Site utilizes a natural attenuation through a downgradient CAZ, as indicated earlier. The performance of the landfill and the CAZ will be evaluated by way of a trigger Level Monitoring Program located downgradient of the Site.

7.2 Contaminant Attenuation Zone

The landfill will continue to be operated as a natural attenuation landfill for the purposes of leachate management. Leachate generated within the landfill will be infiltrated and attenuated by the on-Site soils beneath and adjacent to the waste mound. Attenuation of the leachate will be accomplished primarily through filtration, dilution, dispersion and adsorption processes.

The findings of the hydrogeological characterization and historical annual monitoring reports for the Site indicate that the Site is suitable to continue to operate as a natural attenuation landfill with the CAZ. Although, the CAZ is sufficient for expansion to the east, it is recommended that the existing CAZ be expanded to the north by approximately 50 m to 100 m. Subsequently, the City will be required to obtain approximately 2 to 4 hectares of additional land to ensure a minimum attenuation distance to the northeast.

The effectiveness of the leachate attenuation mechanisms during Site operation will be evaluated, by means of the long-term water quality monitoring program discussed in Section 13.1. Should the results of the long-term monitoring program indicate that the landfill is causing unacceptable impact to the groundwater at the Site, or that impacts from the landfill are extending to the extent of the current CAZ, then contingency plans are available to mitigate the impact as discussed in Sections 7.5, 8.3, and 9.6, for leachate, landfill gas and surface water respectively.

7.3 Evaluation of Site Performance

The performance of the Site, with respect to the impact on groundwater quality within the aquifer under the Site, has been assessed on an annual basis since 2000 (2013 by Wood), as provided in the annual monitoring reports. This work has involved comparison of measured groundwater quality results from monitoring wells to the Ontario Drinking Water Standards (ODWS). In addition, recent (i.e., 2018) annual monitoring reports and the hydrogeological characterization, examined the potential impact of landfill operations on local groundwater quality using the MECP's Reasonable Use Concept (RUC).

Groundwater impacts of the proposed expansion are assessed at the property boundary in consideration of the RUC. The RUC guideline is intended to quantify the magnitude of the acceptable impact at the downgradient property boundary, of a given site, in recognition of the projected "reasonable use" of groundwater on adjacent properties. However, for existing landfill sites, the ODWS are also used as water quality interference guideline, based on the “background” groundwater quality, and the groundwater quality observed on the downgradient side of the landfill (potentially affected by site operations). In previous reports the RUC has been applied to a

number of “critical contaminants” that are deemed appropriate to evaluate the downgradient groundwater quality, as a trigger level for further assessment of the overall performance of the Site. In the case of the New Liskeard Waste Disposal Site expansion, the critical contaminant for calculation of an RUC at the downgradient property boundary is chloride, due to it’s transport in groundwater via advective transport, with minimal “attenuation” due to other physical-chemical processes in the subsurface (e.g., adsorption, degradation, etc.). Chloride is an ubiquitous parameter for RUC calculations at landfill sites across Ontario because of this “conservative” behavior with respect to transport in groundwater.

The MECP's RUC promulgates the protocol for calculating the maximum allowable level of a particular parameter, such as chloride in groundwater, at the downgradient Site boundary. For chloride, a non-health (aesthetic) related parameter under the ODWS, addition of the established background concentration to 50 percent of the difference between the ODWS and the background concentration is the maximum allowable concentration at the downgradient Site boundary.

7.4 Trigger Level Monitoring Program

A Trigger Level Monitoring Program was recommended as part the EA process. The program specifies trigger locations, trigger parameters, trigger concentrations, and re-sampling procedures, as appropriate. The program has been developed in such a manner so that sustained concentrations in excess of the RUC criteria, respectively, are not reached at the downgradient property boundaries, where applicable, prior to implementation of the appropriate contingency measure(s) outlined below.

The Trigger Level Monitoring Program is a three-tiered program that includes routine monitoring, compliance monitoring and confirmation monitoring. Trigger levels are proposed to be 80 percent of the RUC, when the background parameter concentration does not exceed the respective guideline. In the event the background concentration exceeds the guideline, the maximum parameter concentration for the respective background location will be set as the Tier I trigger concentration. The proposed trigger levels will provide sufficient time to undertake the following actions, should there be an exceedance of any trigger level in the future:

- Confirm the trigger level exceedance through re-sampling in duplicate from the location exhibiting the exceedance;
- Evaluate the degree, nature and potential source(s) of the identified trigger level impact(s);
- Evaluate the need to increase monitoring frequency and/or expand the trigger parameter list, and implement if required;
- Evaluate the need to establish additional trigger locations along the downgradient boundaries of the CAZ, and implement if required;
- Evaluate the need for expansion of the established CAZ and/or implementation of the active leachate-impacted groundwater management strategy that forms part of the Contingency Plan discussed in Section 7.5 and 9.6 of this D&O plan; and,
- Design, build and commission the active leachate-impacted groundwater water management strategy, if determined to be required.

The following sections detail the Trigger Level Monitoring Program, which is reflective of existing and background conditions at the Site. Under the proposed program, the groundwater trigger parameters and levels are based on the ODWS, and 80 percent of the RUC values, or maximum background concentration, calculated using the groundwater quality data from the shallow and deep aquifers, in OW-10-II and OW-10-I, respectively. Surface water trigger parameter are discussed in Section 9. Using 80 percent of the allowable limits to establish the trigger values will provide the necessary factor of safety, while accommodating for variability in the sample data (i.e., anomalous sample data due to improper sampling techniques, improper laboratory analysis, etc.).

7.4.1 Trigger Level Assessment

As described in the following sections, a three-tier trigger mechanism is utilized to assess the groundwater quality at the Site.

TIER I – ROUTINE MONITORING

As previously indicated, groundwater monitoring will continue to be conducted three times annually; in the spring (May/June), summer (July/August) and fall (September/October), for a comprehensive list of analytical parameters. The monitoring program is part of the Tier I trigger program and is considered an Alert Level of monitoring. At Tier I monitoring, ODWS and RUC (calculated using the background concentrations) allowable limits are utilized as the initial trigger values for groundwater.

Other than the New Liskeard Waste Disposal Site, there are currently no other primary sources of groundwater impact identified that may be causing a measurable impact on the local on-Site groundwater. Background well nest (OW-10) parameter concentrations are typically low and consistent. Thus, the Tier I trigger parameters are those parameters indicative of leachate from the Site, which generally meet the ODWS and are not at elevated concentrations. The background water quality comprises low chloride and most metals parameters, moderate concentrations of alkalinity, dissolved organic carbon (DOC) and sulphate, and high concentrations of hardness, organic nitrogen and total dissolved solids (TDS). These values are considered representative of regional background quality in the aquifer sampled by the well screen. The ODWS exceedances at this location are hardness, organic nitrogen and TDS. As a result, these parameters have therefore not been used in the proposed Trigger Level Monitoring Program.

TIER II – CONFIRMATION MONITORING

The Tier II – Confirmation Monitoring program is to be implemented if the concentrations of more than three trigger parameters exceed the Tier I monitoring trigger concentrations a single trigger location during a single monitoring event. As part of Confirmation Monitoring, water quality samples are to be collected in duplicate from the trigger location exhibiting the Tier I exceedance during the next regularly scheduled monitoring event. If the duplicate samples indicate that Tier I trigger concentrations are not consecutively exceeded, then Tier I monitoring is to resume; however, if the Tier I exceedance is confirmed, evaluation will be made with respect to the degree, nature and potential source(s) of the trigger level impact.

Initially, trigger parameter concentrations are to be compared to the ODWS, to be utilized as an indicator of timing and urgency of response. The comparison will also include trend analysis over time, with an emphasis on seasonality, if any. An evaluation of the need to increase monitoring frequency and/or expand the trigger parameter list will also be undertaken at this time. If the Tier II – Confirmation Monitoring program indicates that the Site is out of compliance, as compared to the ODWS, then implementation of contingency (i.e., remedial) measures may be required in consultation with the MECP, that will form part of the Contingency Plan discussed in Section 7.5.

TIER III – COMPLIANCE MONITORING

The Tier III – Compliance Monitoring program is designed to assess the effectiveness of remedial measures. Details of the Compliance Monitoring program, including compliance performance trigger parameters, concentrations, locations and monitoring frequency, would be determined in conjunction with remedial measure development and implementation. Once compliance is confirmed at the Tier III level and remedial measures have controlled and reduced the impact, the Tier III program would be discontinued and Tier I monitoring would resume.

7.4.2 Determination of Non-Compliance

Tier I trigger levels for groundwater will be set at the 80 percent of the RUC, when the background parameter concentration does not exceed the ODWS guideline. In the event the background concentration exceeds the ODWS guideline, the maximum parameter concentration for the respective background location will be set as the Tier I trigger concentration. As additional water quality data are collected as part of the annual monitoring program, the determination of compliance will be based on the available trigger level water quality database, which will be updated with running geometric mean calculations used, based on the most recent ten successive sampling events at the trigger locations. Although, the running geometric mean is intended to account for any variation in water quality within a typical range of fluctuation, it is noted that data that is interpreted to not be representative of actual water quality (i.e., anomalous values interpreted to be the result of sampling or laboratory biases) will be excluded from the geometric mean, if appropriate.

7.4.3 Groundwater/Leachate Characteristics

The “source strength” of the leachate at the active and closed landfill sites is demonstrated by OW-1R-I and OW-1R-III, respectively. Groundwater quality at source monitoring locations has been characterized by elevated concentrations of various parameters. The following parameters are typically elevated at similar sites, and have been quantified at elevated concentrations in the two on-Site leachate monitoring wells:

- Alkalinity;
- Barium;
- Boron;
- Chloride;
- Dissolved organic carbon (DOC);
- Hardness;
- Manganese;
- Organic Nitrogen;
- Sodium; and,
- Total dissolved solids (TDS).

Based on the available historical Site water quality data, hardness, and organic nitrogen were detected at the upgradient (background) wells, OW-10-I, OW-10-II and OW-10-III, as well as TDS in OW-10-II at concentrations that exceeded the ODWS. Manganese concentrations recorded for OW-10-II range from <0.002 to 0.719, periodically in exceedance of ODWS.

While hardness may typically be considered a good trigger parameter, the naturally occurring concentrations in the background samples are elevated relative to the ODWS and therefore are not considered useful as trigger groundwater/leachate parameters, as they would not be diagnostic of the leachate at the Site. Organic nitrogen is not considered to be a good indicator parameter for landfill-derived impacts, as elevated organic nitrogen levels are often typical of groundwater throughout northern Ontario.

7.4.4 Trigger Locations

Given the groundwater flow directions, a number of downgradient monitoring wells are considered to be trigger locations, including well nests OW-16, OW-24, OW-25, OW-30 and OW-31 downgradient of the Site. Trigger monitoring wells are shown on Figure 4.

7.4.5 Trigger Parameters

Groundwater trigger parameters were established based on a review of the above water quality characteristics at the Site, as well as typical landfill leachate characteristics. The trigger parameters selected are considered to be diagnostic of the source groundwater quality at the Site and are not likely to be naturally elevated at background locations. The selected groundwater trigger parameters for both the shallow and deep aquifers, along with their corresponding RUC values (i.e., Fall 2018), are outlined in Table 4 and 5, respectively. It is recommended that the trigger parameters be re-evaluated annually following analysis of temporal trends in the data.

7.4.6 Establishment of Groundwater Trigger Concentration

The groundwater trigger parameter concentrations that would initiate Tier II – Confirmation Monitoring should necessarily be less than the ODWS values in order to allow time to resolve any issues before the ODWS limits are exceeded at the downgradient trigger boundary. The trigger parameter concentrations have therefore been established at 80% of the RUC allowable limits, or the maximum parameter concentration for the respective background location. On this basis, the RUC allowable limits were calculated in accordance with the given formula outlined below:

$$Cm = Cb + X(Cr - Cb)$$

where:

- Cm is the maximum allowable concentration for the contaminant (i.e., the RUC allowable limit);
- Cb is the background concentration of the contaminant in the groundwater of the receptor aquifer (i.e., the geometric mean of the background level);
- Cr is the health related drinking water objective for the contaminant or the aesthetic drinking water objective for the contaminant; and,

- X is,
  a) 0.25, if Cr is a health related drinking water parameter; or
  b) 0.50, if Cr is a non-health related drinking water parameter.

The geometric mean of all trigger level concentrations for the downgradient trigger monitoring well will be re-calculated every year to reflect the additional data that will be obtained during each sampling event. As such, the groundwater trigger level monitoring program is considered dynamic and will be subject to review and possible revision each year. The 2018 annual monitoring report notes that OW-10-III will be incorporated into the Guideline B-7 assessment after a sufficient database has been compiled for this recently installed monitoring well. The shallow and deep groundwater trigger concentrations are presented below in Table 4 and 5, respectively.

Table 4: Tier I Shallow Aquifer Groundwater Trigger Parameters and Concentrations (Fall 2018)

Trigger Wells	Trigger Parameter	ODWS Cr (mg/L)	(RUP) Maximum Concentration Cm=Cb+x(Cr-Cb) (mg/L)	Max. Background Concentration Cmb (mg/L)	80% of RUP (mg/L)	Trigger Concentration Tc=Max (0.8*Cm, Cmb) (mg/L)
OW-16 OW-24 OW-25 OW-30 OW-31	Barium	1	0.265	0.029	0.212	0.212
	Boron	5	1.27	0.141	1.02	1.02
	Alkalinity	30 - 500	148 - 383	313	118 - 306	313
	Chloride	250	126	5.70	101	101
	Manganese	0.05	0.027	0.719	0.021	0.791
	Sodium	200	101	4.30	81.0	81.0
	Zinc	5	2.50	0.04	2.00	2.00

Note:
(1) Health related parameters are *italicized*.
(2) Remaining parameters are non-health related.

Table 5: Tier I Deep Aquifer Groundwater Trigger Parameters and Concentrations (Fall 2018)

Trigger Wells	Trigger Parameter	ODWS Cr (mg/L)	(RUP) Maximum Concentration Cm=Cb+x(Cr-Cb) (mg/L)	Max. Background Concentration Cmb (mg/L)	80% of RUP (mg/L)	Trigger Concentration Tc=Max (0.8*Cm, Cmb) (mg/L)
OW-16 OW-24 OW-25 OW-30 OW-31	Barium	1	0.272	0.038	0.218	0.218
	Boron	5	1.34	0.232	1.07	1.07
	Alkalinity	30 -500	148 - 383	338	118 - 306	338
	Chloride	250	127	6.43	101	101
	Manganese	0.05	0.04	0.04	0.03	0.04
	Sodium	200	102	5.85	81.5	81.5
	Zinc	5	2.50	0.041	2.00	2.00

Note:

(1) Health related parameters are *italicized*.
(2) Remaining parameters are non-health related.

7.5 Contingency Measures

Based on the compliance and predictive trigger level monitoring program, the need for implementation of a contingency measure(s) will be determined. Prior to implementation of any contingency measures, a groundwater or leachate treatability assessment will be conducted, as appropriate. This assessment will serve to provide detailed characterization of the groundwater or leachate, assessment of remedial alternatives, identification of pre-treatment and disposal requirements, if required, and recommendations for appropriate contingency measures.

It is expected that assessment of remedial alternatives may include evaluation of the following measures which are applicable for the landfill:

- *Expansion of the Contaminant Attenuation Zone* - The purchase of additional property located immediately adjacent to the Site and/or current CAZ in the area of concern, or the formalization of a groundwater easement, would allow the landfill to continue to operate

within compliance. This measure would be consistent with the supply of bottled water to any potentially affected residents in the vicinity of the area of concern. The suitability of this approach would be verified through completion of an impact assessment on the effects of current and predicted plume migration.

- *Installation of an Active Extraction System* - A series of groundwater extraction wells could be installed along the downgradient Site property boundary in the area of concern. The groundwater extraction system would provide hydraulic containment through pumping to prevent the potential migration of leachate impacted groundwater beyond the Site boundary. The depth, location, and total number of wells required to provide adequate hydraulic containment would be determined as part of the assessment of remedial alternatives. The collected groundwater/leachate could be hauled for disposal at an off-Site treatment facility. Alternatively, the collected groundwater/leachate could be pumped via forcemain to an on-Site treatment facility or wetlands treatment system. Pretreated groundwater/leachate would be pumped to a stormwater management pond for subsequent infiltration and/or controlled discharge.
- *Cut-off walls to enclose the plume and a treatment alternative.* An example of such a system potentially applicable for this Site, would be a passive funnel and gate system. A passive treatment system could consist of a sheet pile or slurry trench used to construct a cut-off wall ("funnel") and direct the leachate-impacted groundwater from the landfill to a central location for passive treatment by a reactive media ("gate"). The leachate impacted groundwater would pass through the reactive media for pre-treatment and subsequently discharged to the native overburden soils for further attenuation. The cut-off wall would be installed to intersect the area of concern and would be required to be extended to a depth sufficient to mitigate the underflow of the leachate-impacted groundwater. The reactive media could consist of such material as granular activated carbon, limestone or iron fillings. Selection of the appropriate material would be determined based on the results of the leachate characterization.

Upon implementation of a recommended contingency measure(s), a compliance monitoring program will be undertaken to verify the effectiveness of the contingency measure(s).

8.0 LANDFILL GAS MANAGEMENT PLAN

8.1 General

Landfill gas is generated by methanogenic bacteria 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. The length of time that a landfill may generate landfill gas can be in excess of 50 years.

Landfill gas is composed of a variety of chemical compounds, which reflect the type of wastes that are 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 that the methane gas creates an explosive hazard under certain conditions

(between 5-15 percent by volume in air); that landfill gas will reduce or replace the percentage of the natural atmosphere in enclosed structures, thus creating an oxygen deficient environment; and the potential for health effects depending on the trace gas compounds and levels.

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.

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 permeability soil stratigraphic units that are present around the landfill site. The landfill gas generation rate will govern the amount of landfill gas migration. A perched water table or frost layer will create a boundary layer which will reduce gas migration.

8.2 Trigger Locations

Landfill gas monitoring is not currently required at the Site, although Wood observed evidence of methane gas in well OW-18 during the 2014 monitoring efforts. It was subsequently decided that a landfill gas monitoring program would be initiated in 2015, in order to measure and track potential landfill gas production within the former waste deposits. Landfill gas measurements are now completed three times annually in OW-18. The former monitoring well is screened within the existing refuse and as such is representative of source conditions. The elevated concentrations of methane gas recorded are an indication of the generation of landfill gas occurring within the former landfill.

The current use of a single gas monitoring prob is insufficient in assessing the potential migration of landfill gas within the subsurface. As concentration of methane at this location are elevated, it is recommended that additional gas monitoring wells be installed at various locations throughout the Site, namely along the property boundary, as to comply with the conditions outlined in O.Reg. 232/98. The addition of gas monitoring wells to the network would provide additional data regarding the potential occurrence of subsurface gas migration at the property boundary. As such, no trigger locations are currently available at the Site.

8.3 Trigger Levels

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 proposed trigger levels should reflect an average of several monitoring events. As such, when a methane level exceeds a trigger level, the monitoring frequency should be increased to weekly, from the regular three times annually (spring, summer and fall) monitoring schedule, in order to confirm the recorded level. Should the level continue to increase, the monitoring frequency should be evaluated promptly to ensure that a potentially hazardous situation is not occurring prior to remediation of the problem.

8.4 Contingency Measures

The contingency measures outlined are presented in the event of a trigger value exceedance. Prior to implementation of contingency measures, a detailed assessment of the gas migration will be conducted. The assessment would then recommend the appropriate contingency measure, if any.

The detailed assessment would consist of a review of all landfill gas monitoring data collected to date, a review of the landfilling sequence in the area of concern, and the soil stratigraphy for this area. Based on the information review, additional gas probes or temporary gas measuring locations may be required to augment the existing data. The results of the detailed assessment will be used in order to provide a recommendation for future monitoring and/or the need for the installation of remedial measures.

Contingency measures could consist of the addition of a passive gas vent in the area of concern, or the installation of a gas migration barrier system at the Site perimeter or around a structure (i.e., building), if required.

Passive gas vents can be constructed in one of several manners. A common method is the use of a stone trench, which allows the gas to vent from either a waste disposal area or from the buffer zone. The stone trench will allow the landfill gas to be released at a known location. The cost for installation of a passive gravel venting system is relatively low.

Well vents can also be used to control landfill gas migration. Well vents are constructed of a stone and perforated pipe column, installed vertically into the waste and protruding from the landfill surface. The stone media and perforated pipe allows the landfill gas to migrate to the surface at a controlled point. A wind-operated rotary-turbine is typically installed at the top of the vent to allow for additional landfill gas extraction and dissipation.

The installation of a landfill gas migration barrier system is a standard approach used to protect buildings with subgrade spaces from landfill gas migration. A gas migration barrier system may include either a passive or active collection system or a pressurized air system. For each case, the size of the system and the local conditions will govern the type of apparatus to be installed.

9.0 SURFACE WATER MANGEMENT PLAN

9.1 General

There are no surface water bodies on-Site, however an unnamed tributary, with headwaters near the northeast corner of the CAZ, flows away from the Site to the northeast, discharging to the Wabi River approximately 1.5 km downstream.

An annual surface water monitoring program was initiated in 2017, but is not a current requirement of the C of A. Surface water monitoring is now completed at six stations (SW-1 through SW-6), situated at upstream, mid-Site and downstream locations on various watercourses in the vicinity of the Site. Sampling is undertaken eight times per year; each sampling event is a minimum of 30 days apart, with mandatory sampling events conducted during spring freshet and summer low flow periods.

The most recent surface water quality results (2018) indicate similar water quality at stations SW-1, SW-5 and SW-6, which generally quantify lower concentrations of indicator parameters than stations SW-2, SW-3 and SW-4. Concentrations of indictor parameters at SW-4 are significantly higher than those at the remaining monitoring stations and appear to be consistently elevated based on the data available to date. The 2018 data indicate stable results at all locations, with no potentially anomalous concentrations noted. The consistently elevated concentrations of indicator parameters at SW-4 are not interpreted to be landfill-related, as dissimilar trends are apparent from the upstream surface water station SW-2. Therefore, the water quality conditions at SW-4 are interpreted to be the result of a source downstream of SW-2, confirming a lack of landfill-derived impact to surface water downstream of the CAZ boundary.

9.2 Maintenance and Monitoring of Surface Water Management Works

The perimeter ditching network will be maintained by removal of collected sediment on an "as-required" basis, to ensure that the ditching continue to infiltrate and operate as designed. All sediment removed during the operating life of the landfill will be returned to the active disposal area. Subsequent to landfill closure, all sediment removed will be returned to the landfill and spread as cover soil. Sediment transport from the landfill area will decrease, as the vegetative cover over closed areas of the landfill is established.

Additional measures will also be employed to minimize sediment transport at the source and prevent runoff that has contacted landfilled waste. Such runoff may contain particulate and/or soluble pollutants. If required, the following measures may be utilized to reduce sediment transport:

- temporary soil berms will be utilized throughout the active landfill disposal area to stop runoff from leaving waste areas and to direct up gradient runoff around the active area. All water that has contacted landfill waste will be treated as leachate and allowed to infiltrate and attenuate; and,
- straw bale check dams and/or silt fences will be utilized in drainage swales and on slopes to enhance sedimentation and erosion control, during and immediately after construction phases, in locations where necessary.

The SWM works will require minimal maintenance after construction and once vegetation has been established. However, the following maintenance items are recommended:

- Inspect integrity of the side slopes and vegetation viability of the swales and infiltration basins, as well as for erosion, on a semi-annual basis during the first two years of operation and as a minimum annually thereafter. Repair as required.
- Inspect sediment depth in the swales and infiltration basins on a semi-annual basis during the first two years of operation and as a minimum annually thereafter. Sediment should be removed and returned to the tablelands adjacent to the Site on sufficient frequency to ensure that the accumulated average depth is no greater than approximately 0.15 m and 0.25 m, in the case of the swales and infiltration basins, respectively.
- Inspect integrity of culverts on a semi-annual basis during the first two years of operation and as a minimum annually thereafter. Remove sediment and/or repair as required.

Annual inspections are preferably conducted during the spring and should be conducted by employees of the City.

9.3 Evaluation of Site Performance

The performance of the Site, with respect to the impact on surface water quality, in the vicinity of the Site, has been assessed on an annual basis since 2017, as provided in the annual monitoring reports. Monitoring is to be conducted eight times per year, each sampling event with a minimum of 30 days apart. Samples collected during the spring freshet and summer low flow events are analyzed for additional parameters. This work has involved comparison of measured surface water to the Ontario Provincial Water Quality Objectives (PWQO), Aquatic Protection Value (APV) and Canadian Water Quality Guidelines (CWQG).

9.4 Trigger Level Monitoring Program

The Trigger Level Monitoring Program is a three-tiered program that includes routine monitoring, compliance monitoring and confirmation monitoring. Trigger levels are proposed to be 80 percent of the PWQO, where a PWQO allowable limit has not been determined for a parameter (i.e., chloride), 80% of the APV will be proposed, in order to provide sufficient time to undertake the following actions, should there be an exceedance of any trigger level in the future.

9.4.1 Determination of Non-Compliance

Tier I trigger levels for surface water will be set at 80 percent of the PWQO or APV. The Tier II – Confirmation Monitoring Program is to be implemented if the concentrations of more than two trigger parameters exceed the Tier I monitoring trigger concentrations, at the trigger location during a single monitoring event. As additional water quality data are collected, as part of the annual monitoring program, the determination of compliance will be based on the available trigger level water quality database, which will be updated with running geometric mean calculations used, based on the most recent ten successive sampling events at the trigger location.

9.4.2 Surface Water Characteristics

Based on the available database regarding the background Site surface water quality, iron was detected in concentrations exceeding the PWQO in samples collected from upstream (background) surface water location SW-1.

Since the naturally occurring concentrations of iron is already elevated relative to the PWQO, it would not be diagnostic of landfill leachate in Site surface water and is not considered useful trigger parameter. Trigger parameters are discussed in section 9.4.4.

9.4.3 Trigger Location

Surface water station SW2, located downstream of the confluence of the headwaters (2 tributaries) to Wabi Creek, was determined as a suitable trigger location for the Site. As a result, sustained concentrations at this location would trigger Tier II Confirmation Monitoring. Trigger concentrations are established at values less than the PWQO or APV allowable limits in order to allow time to resolve any issues before the limits are exceeded, where applicable, prior to implementation of the appropriate contingency measure(s) outlined in Section 9.6.

9.4.4 Trigger Parameters

Surface water trigger parameters were established based on a review of the above water quality characteristics at the Site, as well as Site leachate characteristics, as described in Section 7.4.3. The selected surface water trigger parameters, along with their corresponding PWQO or APV values, are outlined in Table 6.

9.4.5 Establishment of Surface Water Trigger Concentrations

The trigger parameter concentrations that would trigger Tier II Confirmation Monitoring should be less than the PWQO or APV allowable limits, in order to allow time to resolve any issues before the limits are exceeded. Therefore, the trigger parameter concentration has been established at 80 percent of the PWQO or APV allowable limit.

The geometric mean of all trigger level concentrations for the downstream location will be re-calculated every year to reflect the additional data that will be obtained during each sampling event. As such, the surface water Trigger Level Monitoring Program is considered dynamic and will be subject to review and possible revision each year. The trigger concentrations and associated SW-2 concentrations are presented below in Table 6.

Table 6: Tier I Surface Water Trigger Concentrations (2018)

Trigger Parameter	PWQO (mg/L)	APV (mg/L)	Trigger Concentration (80% of PWQO or APV) (mg/L)
Chloride	-	180	144
Barium	2.3	-	1.84
Boron	0.20	-	0.16
Chromium	0.0089	-	0.0071
Zinc	0.03	-	0.024

Note:

(1) In the event a PWQO limit has not been determined, the APV limit was applied.

9.5 Contingency Measures

Should surface water quality results be found to be out of compliance, as described above, installation of an interim cap to all completed portions of the landfill area will be required in order to reduce infiltration, and in turn, leachate generation at the Site. If further measures are required, surface water remediation strategies can be discussed with the MECP, as necessary.

Upon implementation of a recommended contingency measure(s), a compliance monitoring program will be undertaken to verify the effectiveness of the contingency measure(s).

10.0 SITE FACILITIES

Currently the Site facilities consist of an entrance gate, office equipment housing and access roads, however, facilities will be improved and/or constructed during the construction phase of the Site.

10.1 Fencing

Site access will continue to be controlled via the main entrance gate off Rockley Road, as shown on Figure 6. The main entrance gate will be locked outside of normal operating hours to prohibit vehicle entrance and uncontrolled disposal when the Site is closed.

The property boundary will require adequate fencing in order to secure the perimeter of the Site. The east perimeter property boundary of the Site is currently fenced with chain link and barb wire, as part of the solar farm's facility fence.

Landfill staff would monitor the perimeter Site boundaries with respect to unauthorized entry, uncontrolled disposal, and perimeter fencing condition. If it is discovered that a portion of the fencing surrounding the property is damaged, it will be repaired or replaced as soon as practical.

10.2 Gatehouse/Scale

A gatehouse and/or scale will be located proximal to the main entrance of the Site. The gatehouse provides working space for landfill staff and storage of landfill records. A scale provides accurate measurements for the recording of incoming waste volumes. Portable washroom facilities will be provided for landfill staff, adjacent to the gatehouse.

All vehicular access to the Site is controlled at the gatehouse. Vehicles entering the Site are routed to the gatehouse via the Site access road, where they are recorded and directed by landfill staff to the appropriate disposal area. The existing gatehouse will be maintained at its present location for continued long-term operation of the Site.

10.3 Signage

Signage will be posted at the main entrance gate to the landfill providing the name of the landfill, the owner of the landfill, the address and telephone number of the City, hours of operation of the Site, and tipping fees for the Site.

Miscellaneous traffic control signs (e.g., Stop) and instructional signs (e.g., All Refuse, Tires Only, Waste Oil Only, etc.) will also be posted at the main entrance gate and throughout the Site. Additional signage will be required along Rockley Road to address traffic concerns and enhance public safety (i.e., entrance signage, top of knoll east of site entrance).

The signage will generally be adequate for continued long-term operation of the Site. The need for additional signage will be reviewed from time to time by landfill staff for adequacy and implemented, as required.

10.4 Site Access Road

The existing Site road network is shown on Figure 2. Access to the Site is via the main entrance gate off Rockley Road. The access road to the gate is constructed with a gravel surface.

The existing Site access road was constructed with granular material to an approximate 6 m width. The existing Site access road will continue to be utilized to provide access to the landfill Site, as shown on Figure 6. The entrance road, as well as areas of public access (i.e., waste/recycling bin location, etc.) will be upgraded with a paved surface to mitigate track out of sediment, dust and improve snow removal management. The on-Site portions of this road will continue to be maintained with a granular surface.

In order to facilitate development and landfilling of the expansion area, the existing Site access road will be extended in order to allow access to the active landfilling area. The Site access road

will be progressively constructed, which will extend from south extent of Cell 1 northwards. The Site access road location has been selected to follow the progressive development of the Site and general Site review access. Haul roads will be constructed, as required, to provide access to the working area(s) of the landfill. Haul roads will also facilitate the hauling of waste and daily cover soil to the active landfill disposal face.

As the Site access road is extended, it should be constructed with granular material to an approximate 6 m width. The Site access road will be graded to an approximate 2% high-to-low grading to promote surface water run-off. This road should be constructed on top of final contours whenever possible.

The completed Site access road will allow for access to the completed sideslopes for long-term maintenance and monitoring of the Site.

10.5 Special Disposal Areas

A Special Disposal Area will be established and maintained at the Site under continued long-term operation of the landfill. This area, as outlined in the following subsections, will allow for the on-Site collection of recyclable items and recoverable materials (i.e., waste oil and antifreeze) without the public entering the active disposal area. The need for additional Special Disposal Areas will be reviewed from time to time by landfill staff for adequacy and implemented as required.

10.6 Site Equipment

The Site is owned and operated by the City, therefore it is the City's responsibility to maintain adequate Site equipment and carry out the daily landfill works as specified by the contract documents, and in accordance with applicable legislation, ECA, and the approved DO&C Plan.

The equipment typically utilized by operating contractors consists of a landfill compactor used for spreading and compacting of waste, and a loader is used for the placement of daily cover. In addition, the operator should have access to other equipment such as water truck, dozers, dump trucks, and a wood chipper. This equipment may be utilized as required at the Site, on a full or part time basis, for clearing and grubbing, construction of secondary haul roads, soil hauling activities, and shipping of clean wood waste.

The above-noted equipment, and equivalent replacements, will generally be adequate for continued long-term operation of the Site.

10.7 Screening and Landscaping

The Site is situated on a topographically elevated area and the final waste elevation contours will most likely be visible above the vegetation at some distance from the site. The surrounding vegetation would obstruct the view of waste from nearby public access locations, with the exception of the landfill entrance, off Rockley Road, which would be visible.

Requirements for further landscaping of the landfill area will be assessed as part of the Closure Plan, as discussed in Section 14.1.9. The additional landscaping, if required, would be undertaken during completion of Site's final closure works.

11.0 WASTE DIVERSION FACILITIES

11.1 Current Waste Diversion Activities

The City administers the management of recyclable waste through its Solid Waste Management Policy (By-law No. 2015-021). A number of services are currently provided by the City in terms of both residential and industrial, commercial, and institutional (ICI) collection. An automated curbside collection system has been introduced for garbage and "single stream" recycling. Rollout bins are supplied to households and ICI establishments within the City, consisting of a 65-gallon garbage bin and a 95-gallon recycling bin. Collection is conducted on a bi-weekly basis, and alternates between garbage and recycling. An Orange Drop Event is held annually for the collection of Household Hazardous Waste; a drop-off depot is provided at the existing Haileybury landfill for the Ontario Tire Stewardship program and Waste Electrical and Electronic Equipment; as well as a two-week amnesty (no tipping fees) program.

In 2015, the City developed requirements for contractors to supply a waste diversion plan for construction and demolition material. This is monitored through the City's building/demolition application process. The City also budgets sufficient funds annually to provide continued promotion and education associated with the curbside recycling, Waste Electrical and Electronic Equipment, and Household Hazardous Waste programs.

Compostable material, such as food waste, and leaf and yard waste are accepted at the Haileybury Landfill at no fee to the residents. However, according to the City's Solid Waste Management Plan (Earth Tech, 2008), the City does not operate a composting program.

11.2 Proposed Waste Diversion Activities

11.2.1 Segregation

All vehicular access to the Site will be controlled at the gatehouse. The gatehouse attendant will inspect all loads entering the Site to determine the action to be followed. If the load conforms to the type of waste approved for landfilling at the Site, the attendant will complete a work order, invoice and direct the driver to the appropriate off-loading area. Should the waste load not conform to the excepted waste standards, then the operator will complete a rejection slip and may verify the rejection with the MECP.

The waste vehicle will then be directed off Site. Where applicable, the landfill operator will segregate recyclable materials from the waste using a rubber-tired backhoe or by manual means. Recyclable materials, which may include scrap metal, glass, and plastic will be temporarily stored in discrete stockpiles or roll off bins located in the recyclable materials storage area for temporary storage. As the roll-off bins reach capacity, the recyclable material will be shipped off Site to recyclers or to end users.

11.2.2 Storage

On-Site storage of recyclable materials will be facilitated using up to five open top bins. The placement of the bins will be angled to allow for ease of access by hauling vehicles and process-related equipment. As the roll-off bins reach capacity, the recyclable material will be shipped off Site to recyclers or to end users.

11.3 Record Keeping

Records relating to the waste diversion facility will be maintained and retained on Site for a minimum of 3 years. The records will be made available for review upon request by the MECP, and the City. Record content will include, but is not limited to the following:

- the type, amount, and source of materials accepted at the facility;
- the processing that the materials received, any significant problems that occurred during the processing, and any actions that were taken in response to such problems; and,
- the types and amount of materials transferred from the Site, and to whom they were transferred.

11.4 Emergency Response

Due to the relatively inert nature of the stockpiled recyclable metals and miscellaneous recyclable materials, explosions and spills are not anticipated, or to be potential hazards. In the event that an emergency should occur, such as a fire, prevention devices or equipment (e.g., fire extinguishers) will be available to personnel and proper procedures and methods of use detailed. In the event of a large fire, the local Fire Department will be summoned by the Site personnel immediately. Site personnel will advise the Sanitation Supervisor who will advise the Fire Chief of the location and nature of the fire and follow their directions on how to proceed. If it is safe to do so, Site personnel may use fire fighting equipment and heavy equipment available on Site to control or extinguish the fire, and remove or isolate flammable materials which may contribute to the fire.

Various fire extinguishing devices are located in key positions within the landfill, such as the gatehouse, the equipment storage building and all City vehicles

11.5 Waste Management Plan

The diversion rate obtained from the 2014-2015 Municipal Datacall, an on-line tool to provide data from the City to Waste Diversion Ontario, was 28%. Information regarding the most recent diversion rate (i.e., 2017) for the City was unavailable. Given that the policies, funding structure, and application framework for the Waste Free Ontario Act are not fully developed, the interim waste diversion goals set out by the MOECC are 30% by 2020, 50% by 2030, and a 60% diversion rate by 2040, where feasible (Amec Foster Wheeler, 2017).

Significant changes to the waste diversion plan have been made since the compilation of the Solid Waste Management Master Plan (Earth Tech, 2008). A number of suggestions have been implemented including the utilization of standardized waste containers, the inclusion of a variety of recyclable materials (i.e., No. 2 plastics, paper fibres, etc.), a household hazardous waste drop off event, and introducing limitations to the ICI sector. Although, the current diversion rate is unknown, to further increase its diversion, the City will need to evaluate additional options for the continued improvement of their waste diversion programs.

Results from the 2014-2015 Municipal Datacall indicate that the City participated in a total of two of the six diversion streams (i.e., deposit return program and recyclables). As compared to municipalities of a similar population size, increased diversion rates were recorded for municipalities which participated in a minimum of four diversion streams, including organics and on-property diversion. Whilst providing services or resources to its residents, related to on-property and organic waste diversion, may require additional action, making such services and/or resources available will likely enable the City in achieving higher diversion rates. Such recommendations include:

- The promotion of waste minimization through public education.
- The design and implementation of a leaf and yard waste composting program.
- The design and implementation of a residential organic waste composting program.

Waste minimization at the source is the first objective in reducing waste disposed in landfills. Minimizing the production of waste is the most effective means of reducing waste disposal. Through public engagement, outreach and education, the City can encourage its residents to avoid generating waste by using backyard composters, grasscycling, buying green, etc. This option would require additional costs to enhance the City's promotional and educational program. In terms of diversion rate, waste minimization has been shown to result in an increase of up to 3 percent in the annual diversion rate.

Leaf and yard waste, as well as organic waste are not currently being collected by the City, however can be disposed of at a landfill site. A drop-off depot can be provided for the diversion of leaf and yard waste, alternatively an annual spring/fall event can be held to provide the collection of leaf and yard waste. In terms of organic waste (i.e. food waste), many municipalities have implemented a curbside collection program as a separate waste stream. This would involve the provision of source specific containers to residents, as well as a re-evaluation of the collection system, schedule and fleet vehicles. Composting of these waste streams is typically accomplished through the windrow technology, which has the least expensive operating costs, as opposed to in-vessel technologies.

An evaluation of the waste generated within the leaf and yard, as well as organics stream would provide a better indication as to whether this would be a feasible option for the City. Limited volumes within these streams may be more costly if it does not offset the amount of domestic refuse collected and disposed. The addition of a composting program would also require an amendment to the ECA. Nevertheless, the diversion of these waste streams from the landfill would provide additional percentage points towards the City's annual diversion rate.

12.0 SITE OPERATIONS

The City recognizes the need to maintain positive relations with landowners adjacent to and near the Site. Efforts to mitigate the impacts of nuisance factors such as dust, litter, noise, and odour will be carried out and completed in accordance with the protocols discussed in the following sections.

12.1 Supervision

The Site is owned and operated by the City, therefore it is the City's responsibility to maintain adequate Site equipment and carry out the daily landfill works in accordance with applicable legislation, the ECA, and the approved D&O Plan.

The anticipated staffing requirement for the operations consists of two dedicated landfill employees (gatehouse attendant/landfill operator). The employee is present at the Site at all times during operating hours. The gatehouse attendant is responsible for maintaining Site security, controlling Site access, accepting and recording waste loads, collecting tipping fees, and directing incoming waste loads to the appropriate disposal area. In general, the responsibilities of the landfill operator are to ensure deposition of waste in the designated disposal area, place and compact waste, place weekly cover soil, and ensure deposition of recyclable items and recoverable materials in the Special Disposal Area. The landfill operator is also responsible for maintaining environmental controls including dust, litter, noise, and odour control measures.

The City will ensure that all landfill employees are adequately trained with respect to the legal and technical requirements for operation of the landfill, in accordance with applicable legislation, the ECA, and the D&O Plan.

12.2 Hours of Operation

The Site will operate from 8:30 a.m. to 4:30 p.m. Tuesday to Saturday. The Site will be closed on Mondays, Sundays and Statutory Holidays.

These hours of operation will be maintained for continued long-term operation of the Site. Equipment may operate at the Site up to 1 hour before and no later than 2 hours after the hours of operation to complete the required maintenance and cover soil placement activities.

Landfill operating hours are reviewed from time to time by the City for adequacy and staffing requirements. If these hours are found to be problematic, then they will be reviewed for adequacy and the appropriate approvals obtained from the MECP should revisions to the hours of operation be required.

12.3 Site Access and Security

Access to the Site will continue to be controlled via the main entrance gate off Rockley Road, as shown on Figure 6. The main entrance gate is locked outside of normal operating hours to prohibit vehicle entrance and uncontrolled disposal when the Site is closed.
The perimeter boundaries of the Site will be fenced as discussed in Section 10.1. Also discussed in Section 10.1, a dedicated employee is present at the Site at all times during operating hours. This employee maintains Site security and ensures that all persons entering the Site are authorized to do so. Landfill staff will continue to monitor the perimeter Site boundaries with respect to unauthorized entry and uncontrolled disposal.

12.4 Inspection and Record Keeping

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. These inspections will be conducted on a monthly basis. The landfill operator will maintain a check list of housekeeping items that need to be implemented on a regular basis. Records of observations made during the Site inspections and all regular housekeeping activities carried out will also be maintained. A sample monthly inspection report is provided in Appendix D.

In addition to the above, the gatehouse attendant will ensure that all material entering the Site (i.e. waste and clean/inert fill) is recorded as to the number of daily loads and 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 the contaminating lifespan of the Site, and made available for review upon request of the MECP.

12.5 Base Preparation

Trees, vegetation, and topsoil, where present, will be removed from the proposed landfill expansion areas prior to and during base preparation works. The landfill base will be constructed in stages, as discussed in Section 6.0.

Ideally, upon completing landfilling in one development sequence, the base within the next sequence should be completed. However, due to the time requirements for preparation of the base and the limited construction season in this region, some base areas may have to be prepared during the summer months for landfilling to commence during the winter, spring, and early summer of the following year. The actual time for base preparation will be evaluated on a yearly basis and will be constructed during suitable weather conditions. To minimize the double handling of soils, base preparation for each landfill sequence will be staged, as much as possible, to allow for the use of excavated soils as cover material.

12.6 Waste and Cover Soil Placement

Waste will be placed utilizing the area method in which the waste will be filled and compacted on previously filled areas or the prepared base, where applicable, and covered with daily cover soil at the end of each week. The size of the active disposal area will be limited to no greater than 100 m^2 at any one time. Waste will be placed in lifts of approximately 1 m, along with the placement of daily cover soil.

Daily Cover Soil

At the end of each day, a minimum of 0.15 m of daily cover soil will be placed on all exposed waste. Daily cover soils will help minimize litter migrating from active areas and also control odour. A course-grained soil will be utilized as daily cover, whenever possible, to promote hydraulic connection between waste lifts and allow leachate to infiltrate readily to the base of the landfill. Where fine-grained soils are utilized as daily cover, small grooves will be cut in the working face to ensure a hydraulic connection of the underlying waste and landfill base.

Interim Cover

Certain areas of the landfill will remain inactive over a period of time after which waste placement will resume until final contours are reached. Areas of the landfill which will remain inactive for more than six (6) months will be completed with interim cover material. Interim cover will consist of a 0.3 m layer of cover soil placed over the waste and graded to promote surface water runoff. Interim cover removal, prior to resumption of landfilling, will be practiced to promote hydraulic connection between waste lifts and allow leachate to readily infiltrate to the base of the landfill.

Interim cover may be seeded, if necessary, to help minimize dust generation and erosion of soils at the Site.

Final Cover

A progressive final cover placement program will be carried out in areas of the landfill that have reached final contours. The progressive placement of final cover will reduce leachate generation by promoting surface water runoff, thereby reducing infiltration into the landfill. Final cover will consist of a minimum 0.6 m layer of low permeability clay soil overlain by 0.15 m of vegetated topsoil.

12.7 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, 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 under extreme conditions.

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:

i) soil handling operations will be minimized during times of high winds;

ii) vegetation will be established on inactive areas, if required, to minimize wind erosion; and,

iii) if dry conditions warrant, a dust suppressant (e.g., water) will be applied to the on-Site roadways and soil borrow areas, and if required to the active disposal area.

12.8 Litter Control

Given the nature of landfilling operations, litter control can be problematic under many conditions. However, several measures can be taken to help minimize the amount of windblown debris leaving the active disposal area of the Site. Control measures can be divided into two groups, which include preventative measures to limit the generation of litter and regular maintenance measures to collect litter which does not leave the Site. Litter inspections will be carried out around the perimeter of the Site on a monthly basis.

Preventative Litter Control Measures

Preventative litter control measures are taken to minimize the blowing of debris from the active area of the landfill. The following 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 be tarped, if required, to prevent litter from 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;
- the active face of the landfill will be kept to a minimum, especially on windy days. This may be accomplished by placing weekly cover soils over a portion 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 windblown 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.

Regular Site Maintenance Measures

Under normal operating condition and with the implementation of the above control measures, it is still expected that some litter will be blown from the active landfill area. Regular Site perimeter maintenance controls this litter and prevents it from leaving the boundaries of the Site. The landfill operator will carry out monthly inspections around the perimeter of the Site. Any windblown litter observed during the inspections will be collected and returned to the active landfill area.

12.9 Noise Control

Potential noise impacts from the Site will generally result from operation of the landfill construction equipment discussed in Section 10.6. 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, as discussed in Section 12.2.

All landfill construction equipment associated with the development, operation, or closure of the Site will comply with the noise level limits outlined in the "Noise Guidelines for Landfill Sites" (MECP, 1998). In addition, a landfill equipment maintenance program will be implemented at the Site by the operating contractor, with particular attention being given to maintaining and where feasible, improving the noise muffling systems on landfill construction equipment. Landfill construction equipment will be inspected by the operating contractor at least annually.

12.10 Odour Control

In general, landfills have the potential to emit two types of odours, refuse odour and landfill gas odour. Refuse odour is generated by recently disposed waste and is controllable by the application of daily cover soil. Landfill gas odour is generated during the anaerobic decomposition of organic waste material.

Should landfill gas odours become a problem at the Site, an investigation will be required. The investigation will address such items as gas generation rates, odour problem areas around the Site, and potential methods to reduce odours such as gas collection systems.

12.11 Traffic Control and Impact

It is anticipated that there will be a significant increase in the volume of vehicular traffic currently experienced in the vicinity of to the Site, under the long-term operation of the landfill. School bus transportation schedules and routes will be considered as part of a mitigation plan that addresses waste haulage schedules to minimize any potential traffic conflicts.

Access to the Site will continue to be via the main entrance off Rockley Road, as shown on Figure 6. All vehicular entrance to the Site is controlled at the gatehouse.

Rockley Road, as well as the Site access road to the entrance gate, has a granular surface and therefore provides good access to the Site. If weather conditions warrant, then the landfill operator or City will arrange for the Site access road to be cleaned in the vicinity of the Site entrance, on an as-required basis.

Traffic control signs (e.g., Stop) and instructional signs (e.g., Waste Oil and Antifreeze Only, etc.) will be maintained in the vicinity of the Site entrance and gatehouse, and throughout the Site. The need for additional traffic control signs will be reviewed from time to time by the City for adequacy and implemented, as required.

12.12 Vector and Vermin Control

The terms vector and vermin refer to objectionable insects, rodents, and birds that sometime establish a habitat at a landfill. Common landfill vector and vermin include flies, rats, and gulls.

The impact of these species is of concern from a health perspective and from an aesthetic perspective. Landfill operations are required to control vector and vermin on the landfill site property.

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

- Flies are a common occurrence at any type of waste disposal operation. The flies breed and maggots develop in the waste, in particular the food wastes. The application of weekly 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 weekly 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 this would be required to be addressed and measures 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.

Monthly inspections for evidence of vector and vermin will be conducted in conjunction with the monthly litter inspections.

12.13 Burning and Scavenging Of Waste

Burning of waste is prohibited at the Site. No burning of waste will be conducted during continued long-term operation of the Site.

Scavenging of deposited and stockpiled waste is prohibited at the Site. No scavenging will be allowed during continued long-term operation of the Site. Segregation of recyclable items and recoverable materials from the incoming waste streams will be conducted at on-Site facilities as discussed in Section 11.2. These materials will be moved off-Site for subsequent recycling/recovery on an as-required basis.

12.14 Winter and Wet Weather Operation

Winter operations require advanced planning for site preparation, snow removal, and the stockpiling and storage of cover material.

Many operational problems occur as a direct result of failure to prepare an adequate disposal area in advance of winter. An area sufficient to hold more than the expected volume of waste should be prepared in advance. In addition, stockpiles of cover material, areas for stockpiling

snow, and snow fencing to minimize and control drifting, should be provided and placed before winter sets in.

During the winter months the active landfill area will be located in such a manner so as to be free draining, sheltered from the prevailing winds and if possible, located with a southern exposure. Up to twice the estimated required area for disposal through the winter months, will be prepared to minimize problems due to heavy snow and equipment failure. During winter conditions, flatter grades may be required at the daily working face to facilitate equipment travel.

Sufficient quantities of daily cover soil will be stockpiled in convenient locations on Site, to satisfy daily cover soil requirements through the winter conditions. These stockpiles will be protected from water and subsequently freezing, through the use of tarpaulins and/or straw, if required.

Snow ploughing and an area to store snow will be considered in advance of winter conditions. A snow disposal area will be created adjacent to the active landfill area to allow the removal of snow from the tipping face. This area will be located such that during snow melt events, the runoff will not flow into the active landfill area.

Should snow require removal and stockpiling after ploughing then a suitable area for snow storage, which will not interfere with daily landfill operation will be determined. All runoff from snow, which has contacted waste will be managed as leachate and controlled to promote infiltration, within the limits of waste, to the base of the landfill.

Snow fencing will be placed on an as required basis, to control the drifting and accumulation of snow at the Site.

Waste disposal, particularly during winter months, are extremely hard on disposal equipment. As such, the Site equipment will be cleaned and maintained, as appropriate, to ensure adequate operation.

During wet weather operations surface water will be directed away from the active landfill area by means of temporary soil berms constructed upgradient of the active area, as required. Under extremely wet weather conditions, disposal operations may be moved to drier working areas to facilitate vehicle travel at the working face.

On-Site equipment required to be used for continued landfill operations during rainfall events, will be equipped with closed cabs.

Site roadways will be maintained in a passable condition during wet weather conditions. Haul roads to the active landfill area will be located so as to ensure continuous access to the active face during wet weather conditions. Should washouts of the Site roadways occur due to rainfall events, then the roadways will be re-constructed as soon as possible thereafter, in a manner consistent with the design presented in the D&O Plan.

13.0 SITE MONITORING PROGRAM

13.1 Water Quality Monitoring

A comprehensive water quality monitoring program is currently conducted at the New Liskeard Waste Disposal Site three times annually, in spring (May/June), summer (July/August) and fall (September/October) for groundwater and eight time per year for surface water. The groundwater monitoring program consists of hydraulic (water level) monitoring, groundwater sample collection and analysis for a full analytical parameter list. The surface water monitoring program, initiated in 2017, is not a current requirement of the C of A, but consists of sample collection and analysis for a full analytical parameter list during spring freshet and summer low flow conditions, and the analysis of a partial analytical parameter list during all other events. The reporting period for the monitoring program is January 1 to December 31 of each calendar year.

The water quality monitoring program will continue to be implemented under long-term operation of the Site. The program will serve to monitor the performance of leachate attenuation mechanisms and to determine the impact, if any, of landfilling activities on groundwater and surface water at and in the vicinity of the Site.

In consideration of the historic groundwater and surface water analytical results to date, as presented in the 2018 Annual Monitoring Report (Wood, 2019b), it is proposed that the long-term monitoring program continue to utilize the existing monitoring network already established for the Site. As the current source monitoring wells (OW-1R-I and OW-1R-III) are located within the proposed fill area of Cell 3, it is recommended the program be supplemented with the proposed repositioning of the wells, to be installed at the base of Cell 2, following the cell closure and subsequent construction of Cell 3. The current groundwater and surface water monitoring locations are presented on Figures 4 and 5, respectively. It is proposed to continue the current monitoring schedule for both groundwater and surface water collection.

The water quality monitoring network proposed for the long-term monitoring program is provided in Appendix E. In addition, hydraulic (water level) monitoring will be conducted at all groundwater monitoring wells currently established for the Site, regardless of whether they are sampled for water quality purposes.

In consideration of the historical groundwater and surface water analytical results to date, it is proposed that the groundwater and surface water samples continue to be analyzed for a similar list of parameters utilized for the current monitoring program. The parameter list for the long-term monitoring program is summarized in Appendix F.

It is noted that the proposed water quality monitoring program will be subject to further ongoing rationalization as part of the implementation of the groundwater, surface water and landfill gas trigger criteria and contingency plans and future Annual Monitoring Reports for the Site. Any proposed future changes to the water quality monitoring program will be justified in the Annual Monitoring Reports and submitted to the MECP for approval prior to implementation at the Site.

Post closure monitoring requirements will be developed as part of the Closure Plan discussed in Section 14.3.

13.2 Landfill Gas Monitoring

As discussed in Section 8.1, a landfill gas monitoring program is not currently a requirement of the C of A for the Site. Wood observed evidence of methane gas in well OW-18 during the 2014 monitoring efforts. It was subsequently decided that a landfill gas monitoring program would be initiated in 2015, in order to measure and track potential landfill gas production within the waste deposits. Landfill gas measurements are now completed three times annually in OW-18.

It is recommended that the current gas monitoring network be expanded to monitor potential landfill gas migration at the property boundary in order to comply with O.Reg 232/98. A minimum of one gas monitoring well should be installed in the northeast section of the CAZ in order to implement the Trigger Level Monitoring Program. In addition, should a building(s) be established at the Site in close proximity to the landfill, it is suggested that a gas monitoring well be installed in the vicinity as to monitor the potential subsurface migration of landfill gas towards the building(s).

The landfill gas monitoring program would have the following objectives:

- To determine if landfill gas is migrating off Site in the area(s) of greatest concern;
- To commence the collection of landfill gas monitoring data, to that future assessments of landfill gas migration can be made if required; and,
- To ensure the protection of the building(s) located on-Site.

The monitoring of landfill gas would be conducted in conjunction with the groundwater monitoring program three times annually, in the spring, summer and fall. Gas monitoring well(s) would be monitoring percent methane, carbon dioxide, oxygen and balance.

13.3 Annual Monitoring Reporting

As in the past, an annual monitoring report will be prepared for the Site. The report will continue to present a summary and detailed evaluation of all data collected for the long-term Site monitoring program including an assessment of the suitability of the program.

In addition, updated aerial photography or a topographic survey will also be completed for the Site annually. The aerial photography or topographic survey will be used to develop an updated contour plan for the Site, which in turn will be used to calculate the annual volume of landfill consumed. From this data, the remaining Site capacity will be calculated along with predictions of remaining Site life. These results will also be included in the annual monitoring and progress report along with the following information:

- a monthly summary of waste tonnages received at the Site;
- a monthly summary of recyclable/reusable material tonnages received at and removed from the Site;
- a summary of Site operations and development progress; and,
- a summary of operational problems experienced, or complaints received regarding operation of the Site, if any, and their resolution.

The annual monitoring and progress report will be submitted in final form to the MECP for review and comment. The submission date is proposed to be maintained at May 31 of each year to allow for receipt and interpretation of the final analytical reports, completion of the topographic update and associated landfill volume and Site life calculations, and summation of the Site operations and development progress for the previous calendar year. All comments provided by the reviewers will continue to be addressed during the following annual monitoring and progress reporting period and reported upon.

13.4 Contingency Measures Implementation

The effectiveness of the design works and leachate attenuation mechanisms will be evaluated by means of the long-term monitoring program discussed in Sections 13.1. Should the results of the program indicate that continued long-term operation of the landfill is resulting in significant impact to the groundwater or surface water quality at the Site, or that significant landfill gas migration is occurring which could result in a potentially hazardous situation, then applicable contingency measures will be evaluated, and if necessary, implemented.

As previously indicated, a groundwater/surface water monitoring program has been developed and approved for the Site. A predictive trigger level monitoring program has been developed as part of this report. The program specifies trigger locations, trigger parameters, trigger concentrations, and re-sampling requirements, as appropriate. Details of the compliance and predictive trigger level monitoring program and contingency measures for the management of potential groundwater contamination, landfill gas migration and surface water contamination are presented in Sections 7.4, 8.2 and 9.5, respectively.

14.0 CLOSURE PLAN

14.1 Closure Works

14.1.1 General

Following the completion of the landfilling at the Site (i.e., final contours and maximum capacity are achieved), closure works will be undertaken at the Site. The works to be completed at the Site as part of the Site closure include the following:

- Regrading of the existing waste deposits;
- Construction of the final landfill cap;
- Erosion control and ditching/swales; and,
- Removal of roadways located within the fill area limits.

Details of the closure works for the Site are presented in the following sections.

14.1.2 Final Waste Contour Plan

The proposed final waste contours are presented on Figure 6. The final contours will maximize surface water runoff, thereby reducing the amount of infiltration and consequently minimizing leachate generation.

As part of the closure works, the waste contours will be reconfigured to approximately 20H:1V (5%) slopes shown on Figure 6 to allow for better surface water drainage and reduce infiltration. The waste contours were developed to also reduce the amount of regrading and excavation of waste material required to prepare for placement of final cover and conform to the minimum slope required/recommended by MECP guidelines (O.Reg. 232/98). The final waste contours also reduce the need to build up and import additional material or excavate waste already deposited within.

14.1.3 Final Cover

The placement of an interim cover was previously completed, as the cells reached maximum capacity. This interim cover on the completed cells will be stripped off and stockpiled for use as final capping material, once the waste deposits are regraded and sloped as per Figure 6. The final cover cannot be placed until closure activities, such as regrading, are completed.

The final cover will be constructed with a 0.6 m low permeability soil (i.e., silty clay) underlying a 0.15 m layer of vegetated topsoil. The top of the final contours (i.e., top of the topsoil layer) is shown on Figure 6 and as per the details in Section 14.1.2. It is estimated that approximately 26,940 m^3 of low permeability capping soils and approximately 6,735 m^3 of topsoil (in-place volumes) will be required to complete the final cover.

The low permeability soil will be obtained from a suitable off-Site source. Selection of a suitable off-Site source will be approved during construction of the Closure works and would be the responsibility of the selected contractor to identify the source. Material recommended by the contractor would be tested to confirm conformance to the Site requirements by an engineering representative overseeing construction.
This material will be placed directly over the regraded and proof rolled top of waste in continuous uniform lifts not exceeding 0.2 m in thickness prior to compaction. The low permeability soil will be placed and compacted to a minimum 95% Standard Proctor Density within minus 1% to plus 3% of optimum moisture content. A low permeability soil having a minimum 60% fines (silt and clay) of which a minimum of 15% is clay.

Topsoil will also be obtained from a suitable off-Site source. The topsoil layer will be placed directly over the completed compacted clay liner layer to a minimum thickness of 0.15 m. The topsoil should be fertile, agricultural soil, typical for the locality and capable of sustaining vigorous plant growth. The topsoil should be free of subsoils, clay or impurities, plants, weeds and roots. The pH of the topsoil should range between 5.4 and 7.0. The organic content of the topsoil should range between 5% and 20%.

Vegetative cover will be established as soon as practical following the placement of topsoil, using seed and mulch. Seeding of newly topsoiled areas will be performed promptly in order to establish the vegetative cover and minimize erosion due to surface water runoff. The hydroseed mix is selected from Table 1 of Ontario Provincial Standard Specifications (OPSS) Section 572. The Standard Roadside Mix is commonly used by the Ontario Ministry of Transportation (MTO) and the Ontario Ministry of Natural Resources and Forestry (MNRF) to revegetate many sloping

roadside embankments. The proposed seed mix contains native Ontario plant species at the following mix ratios:

- Creeping Red Fescue, *Festuca rubra* (50% to 60%)
- Kentucky Bluegrass, *Poa pratensis* (25% to 30%)
- Perennial Ryegrass, *Lolium perrenne* (12% to 18%)
- White Clover, *Trifolium repens* (2% to 4%).

The Standard Roadside Mix was chosen for its ability to establish itself given the conditions of the proposed topsoil layer. Once established, the proposed seed mix creates a fibrous root growth that acts as a strong anchor for the soil, thus minimizing erosion and sediment transport of the topsoil rooting medium during storm events. The proposed seed mix will be applied at a rate of 250 kg/ha. A nurse crop of annual Rye Grass should also be applied in order to provide for quick cover for erosion protection during the first year after application while the proposed seed mix becomes established. The Rye Grass nurse crop seed will also be applied at a rate of 60 kg/ha. The above seed mixture has been successfully used for difficult conditions in northern Ontario and is considered hardy under dry conditions and suitable for infertile, poor sandy soil.

14.1.4 Erosion Control

During the regrading of the final waste contours and final cover works, a variety of erosion control measures may be required based on conditions encountered and the implementation of the closure works schedule. These erosion control measures may include installation of silt fencing at the toe of slopes prior to conducting work. The erosion control fence would be installed and maintained in such a manner as to prevent the migration of sediment from the landfill area until such time that vegetation is sufficiently established over the final cover to prevent erosion. Straw bale check dams will also be installed, as required, and maintained in the constructed swales until vegetation is properly established, as to prevent erosion.

14.1.5 Site Access Road

A gravel access road is located mid-Site and enters from the south boundary, a secondary road also extends south-north along the wester property boundary, as indicated on Figure 2. The gravel access roads will be maintained during operation and following completion of the closure works in order to allow for future maintenance and inspection of landfill side slopes and cap. The gravel access road will continue to be accessed through the main gate from Rockley Road.

14.1.6 Surface Water Management

Surface water drainage at the site will generally be conveyed by swales around the working area of the waste footprint, as well as an existing drainage ditches along the east extent of the property boundary, as illustrated on Figure 6. Temporary swales are to be constructed around the working face of the landfill, in order to promote surface water drainage from the top of the landfill towards the infiltration basin and containment berm. The swales will also direct surface water runoff from the surrounding area away from the landfill. This is important in order to reduce infiltration, which will in turn improve slope stability and reduce any generation of leachate within the waste area. Any depressions along the top of landfill, that have the potential to hold water, should be filled or regraded in order to promote runoff during the initial phase of the sequencing plan.

The swales will extend along the top and downslopes of the waste footprint, as illustrated on Figure 9. Swales will promote overland flow of runoff towards the infiltration basing located at the toe of the landfill. It should be ensured during construction that the swales do not discharge along the immediate edge of the waste area, but rather that flow is directed away from the landfilled area to both the north and south. Swales are to be directed to a suitable outlet or appropriately lined with rip rap / armoured down the slope.

14.1.7 Groundwater Management

The effectiveness of the leachate attenuation mechanisms during Site operation will be evaluated, by means of the long-term water quality monitoring program discussed in Section 13.1. Should the results of the long-term monitoring program indicate that the landfill is causing unacceptable impact to the groundwater at the Site, or that impacts from the landfill are extending to the extent of the current CAZ, then contingency plans are available to mitigate the impact as discussed in Section 7.5.

14.1.8 Landfill Gas Mitigation

Given the landfill gas concentrations recorded within the former waste deposit, landfill gas production and potential migration is potentially an issue of concern. As elevated landfill gas levels have been identified, incorporating passive gas vents into the closure of the former waste deposit, as well as the expansion area, will provide gas relief of accumulating methane, beneath the landfill cover.

14.1.9 Landscaping

As described in Section 2.1, the Site is located in an area of undeveloped, privately owned land. To incorporate the Site with its surroundings, the post-closure ascetic of the Site is a green space area with low sloped, naturally contoured mounds with low grass cover. During the closure works, on-Site trees will be preserved and maintained.

14.2 Post-Closure Inspection, Maintenance, and Care

14.2.1 Final Cover

The long-term maintenance of the final cover will consist of regular inspections primarily for surface erosion, differential settlement, vegetative distress and leachate seeps. These conditions, if left to deteriorate, could lead to failure of the final cover and exposure of the underlying waste. The greatest potential for failure of the final cover will occur during the period of time immediately following the closure of the Site. During this time, the vegetative cover may not be fully established, and settlement of the recently placed waste may occur.

In order to identify the above conditions at an early stage in development, visual inspections of the final cover will be made on a quarterly basis, by a qualified person, for a period of approximately two years following Site closure. With the establishment of a strong vegetative cover over the landfill Site, these inspections will be reduced to annual inspections, with the inspection frequency reviewed on an annual basis.

Surface erosion and differential settlement areas will be repaired by the expedient placement of additional surface cover material, as specified in Section 14.1.4, and topsoil to match the original grades. Prompt seeding to establish a vegetative cover will be undertaken to minimize erosion of the repaired area. Should leachate seepage be observed from landfill side slopes, the area will be excavated, and a granular ditch installed to drain the leachate into the underlying waste, then the final cover restored.

14.2.2 Surface Water Management Works

The long-term maintenance of the surface water swales, ditches, containment berm and infiltration basin will consist primarily of inspections for erosion and sediment build up. Buildup of sediment may reduce the effectiveness of the works and potentially result in re-suspension of accumulated sediment. The perimeter landfill ditches will be inspected concurrently and at the same frequency as the final cover inspections (initially quarterly for two years, then annually). Annual inspections are to be conducted in the spring, preferably immediately following freshet.

The perimeter landfill ditches will be repaired by filling and grading eroded areas or by removing sediment, debris, or any other blockages from within the ditches, as required. Particular attention will be paid to minimize disturbance of any designed erosion protection and any natural vegetative growth (i.e., reeds and cattails) that may establish within the stormwater management channels.

14.2.3 Fencing/Access and Site Security

The Site access is controlled via the main entrance gate off Rockley Road, as shown on Figure 2. The perimeter property boundary will be fenced and tie in to the solar farm's facility fence located along the east edge of the Site. The gated entrance to the property, as well as the fencing, will be maintained after closure, and will remain locked at all times to mitigate unauthorized entry. Post-closure inspection of the fencing and security gate will be undertaken concurrently and on the same frequency as the final cover inspections (initially quarterly for two years, then annually), and will be maintained to suitable conditions throughout the post-closure period.

14.2.4 Gravel Road Access

The gravel access road leading to the Site will be inspected concurrently and on the same frequency as the final cover inspections (initially quarterly for two years, then annually), and the repair of any erosion, rutting or potholes will be performed as soon as practical once identified.

Snow clearing of the gravel access road will be performed on an as-required basis. The gravel access road up to the perimeter of the waste deposits will be maintained throughout the post-closure period in sufficient condition to facilitate the long-term maintenance of landfill slopes, surface water works and the monitoring well network.

14.2.5 Monitoring Wells

The existing groundwater monitoring wells (discussed in detail in Section 13.1) will remain in place and operational following Site closure. Any monitoring wells damaged during the post-closure

period will be repaired or decommissioned, as appropriate, in an expedient manner, under the direction of a qualified hydrogeologist or engineer.

14.3 Post-Closure Monitoring and Reporting

14.3.1 Post-Closure Monitoring

Post Closure monitoring is typically considered to be undertaken for a minimum period of 25 years. It is anticipated, however, that this program would be subject to revision following the initial five years of post-closure monitoring, given the historical data already available. As a monitoring program is already in place and has been approved by the MECP, it is recommended that the current program be continued post-closure, including the implementation of the Contingency Plan (Section 7.5, 8.5, and 9.6).

It is recommended the program be supplemented with the proposed repositioning of the source monitoring wells (OW-1R-I and OW-1R-III), to be installed at the base of Cell 2, following the cell closure and the subsequent construction of Cell 3. All aspects of the current program are to be continued post-closure, including monitoring of groundwater elevations, and groundwater, surface water quality and landfill gas monitoring.

Following 25 years of post-closure monitoring, or possibly earlier, depending on Site conditions and analytical parameter concentrations, an application may be made to the MECP to discontinue water quality monitoring at the Site. It is anticipated that the landfill Site inspections will no longer be required at that time.

14.3.2 Post-Closure Reporting and Record Keeping

The monitoring program and associated reporting will be based on calendar year periods during post-closure. All monitoring data collected during the year will be included in the annual monitoring report and assessed with respect to potential impacts to the environment, namely any off-Site migration of impacted groundwater and surface water. Analytical data will be reviewed to define water quality trends. If definite stabilized or declining trends in the parameter concentrations below the water quality criteria established for the Site are demonstrated, approval will be sought from the MECP to implement a reduced monitoring program, likely consisting of fewer monitoring locations, or potentially a reduced parameter list or reduced reporting frequency. The groundwater quality of the Site will be assessed with respect to MECP criteria listed in the ODWS. Surface water quality will be assessed with respect to the PWQO.

The annual monitoring report will be submitted to the MECP for review by 31 March of each year. All comments provided by the reviewers will be addressed during the following annual monitoring and reporting period and reported on in the following report. The annual monitoring report will also provide recommendations for refinement of the program, as appropriate, based on the ongoing assessment of the post-closure water quality monitoring results.

All inspection and reporting records will be maintained at the legal address of the landfill owner for a minimum of three years and made available for review upon request of the MECP.

15.0 CLOSURE

This report has been prepared for the exclusive use of the City for specific application to this Site and was prepared in accordance with the verbal and written requests from the City and generally accepted industry practices. No other warranty, expressed or implied is made.

Respectfully Submitted,

Wood Environment and Infrastructure Solutions,
A division of Wood Canada Limited

Prepared by:

Dominique Courchesne, B.Sc.
Environmental Scientist

Reviewed by:

Brian Grant, P.Eng.
Senior Hydrogeologist

16.0 REFERENCES

Amec Foster Wheeler Environment and Infrastructure. 2010. Feasibility Study for Development of a Long-Term Landfill Disposal Strategy.

Amec Foster Wheeler Environmental and Infrastructure. 2017. Response to MOECC Comments (Response #3), Waste management Master Plan Environmental Assessment, City of Temiskaming Shores New Waste Management Capacity Requirements, Temiskaming Shores, Ontario.

Amec Foster Wheeler Environment and Infrastructure. 2018. City of Temiskaming Shores, New Waste Management Capacity Amended Environmental Assessment, Temiskaming Shores, Ontario.

Dillon Consulting Limited. 2011. New Liskeard 1, 3 and 4 – Draft Water Assessment Report.

Earth Tech Canada Inc. 2008. Solid Waste Management Master Plan.

Jagger Hims Limited, 2008. New Liskeard Landfill Site 2007 Annual Groundwater Report.

MECP. 1994. Guideline D-4 Land Use On or Near Landfills and Dumps. Ministry of the Environment, Conservation and Parks.

MECP. 1998. Noise Guidelines for Landfill Sites. Ministry of the Environment, Conservation and Parks.

MECP. 2010. Landfill Standards: A Guide to the Regulatory and Approval Requirements for New and Expanding Landfills. Ministry of the Environment, Conservation and Parks.

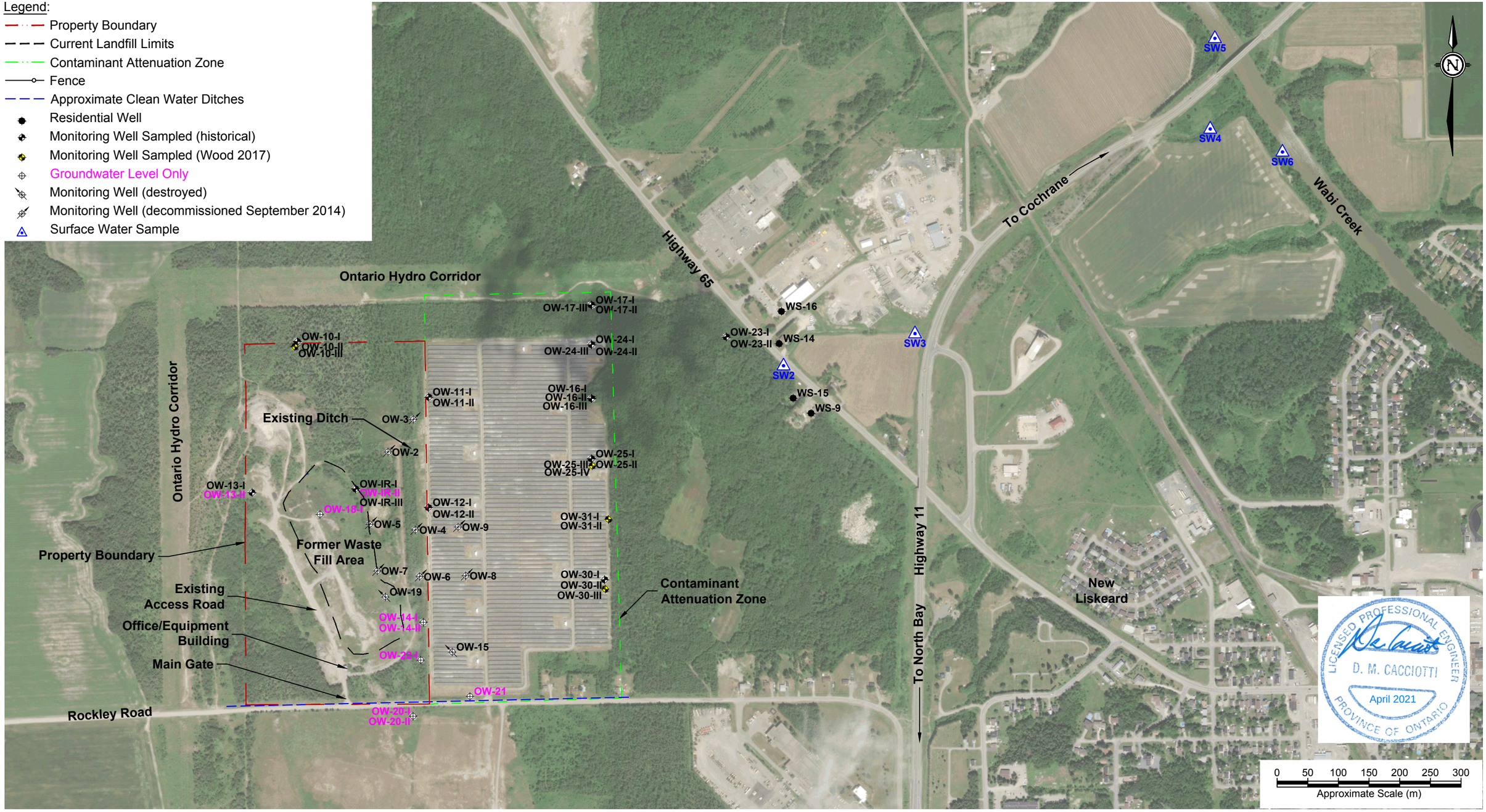
Story Environmental Inc. (Story). 2013. City of Temiskaming Shores, 2012 Annual Monitoring Report, New Liskeard Landfill Site, Temiskaming Shores, Ontario.

Sutcliffe Rody Quesnel Inc. 2004. City of Temiskaming Shores, New Liskeard Landfill, Operation and Maintenance Manual.

Wood Environment and Infrastructure Solutions. 2019a. City of Temiskaming Shores, 2018 Annual Groundwater and Surface Water Monitoring Report, Haileybury Waste Disposal Site, New Liskeard, Ontario.

Wood Environment and Infrastructure Solutions. 2019b. City of Temiskaming Shores, 2018 Annual Groundwater and Surface Water Monitoring Report, New Liskeard Waste Disposal Site, New Liskeard, Ontario.

Figures



Notes:
1. Aerial Photo taken from Google Earth.
2. Property line and landfill boundary based on S.R.Q 2007 survey.

City of Temiskaming Shores

Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
705-682-2632

DWN BY:	KKJ
CHK'D BY:	DMC
DATUM:	NAD 83 Zone 17
SCALE:	as shown

PROJECT: New Liskeard Landfill Expansion
Temiskaming, Ontario

TITLE: Site Plan

DATE	May 2020
PROJECT No.	TY91049
REV. No.	1
FIGURE No.	2

Legend:
- Property Boundary
- Existing Landfill Extents
- Fence Line
- Original Contours (MASL)
- Approximate Clean Water Ditches

Existing Ditch

Former Waste Fill Area

Office/Equipment Building

Main Gate

Existing Access Road

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 20 40 60 80 100
Approximate Scale (m)

Notes:
1. Original contours survey by Story Environmental, on the 22 August 2019.
2. Property line and landfill boundary based on S.R.Q 2007 survey.

City of Temiskaming Shores

Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
705-682-2632

DWN BY:	KKJ
CHK'D BY:	DMC
DATUM:	NAD 83 Zone 17
SCALE:	as shown
PROJECT	New Liskeard Landfill Expansion Temiskaming, Ontario
TITLE	Current Site Conditions
DATE	May 2020
PROJECT No.	TY91049
REV. No.	1
FIGURE No.	3

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)

Ontario Hydro Corridor

Ontario Hydro Corridor

Highway 65

To Cochrane

N

OW-17-III
OW-17-I
OW-17-II

WS-16

OW-10-I
OW-10-II
OW-10-III

OW-24-III
OW-24-I
OW-24-II

OW-23-I
OW-23-II

WS-14

A'

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400

A

OW-11-I
OW-11-II

OW-16-I
OW-16-II
OW-16-III

WS-15

WS-9

OW-3

OW-2

OW-25-III
OW-25-I
OW-25-II
OW-25-IV

OW-13-I
OW-13-II

OW-IR-I
OW-IR-II
OW-IR-III

OW-12-I
OW-12-II

OW-18-I

OW-31-I
OW-31-II

OW-5

OW-4

OW-9

Property Boundary

Former Waste Fill Area

OW-7

OW-6

OW-8

OW-30-I
OW-30-II
OW-30-III

Contaminant Attenuation Zone

Highway 11

New Liskeard

OW-19

Existing Access Road

OW-14-I
OW-14-II

OW-15

OW-22-I

Main Gate

OW-21

Rockley Road

OW-20-I
OW-20-II

To North Bay

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

	The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020
		CHK'D BY: DMC		PROJECT No.: TY91049
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632	wood.	DATUM: NAD 83	TITLE: Groundwater Monitoring Location Plan	REV. No.: 6
		SCALE: as shown		FIGURE No.: 4

	The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020
		CHK'D BY: DMC		PROJECT No.: TY91049
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632	wood.	DATUM: NAD 83	TITLE: Surface Water Monitoring Location Plan	REV. No.: 6
		SCALE: as shown		FIGURE No.: 5

Existing Ditch

Proposed Clean Water Diversion Ditch

Proposed Seepage Collection Ditch

Proposed Seepage Pond

Proposed Clean Water Diversion Ditch

Proposed Road Addition

Proposed North Seepage Collection Ditch

Cell 1

Cell 2

Cell 3

Cell 4

Cell 5

Gate

Proposed Culvert

Former Waste Fill Area

Proposed Culvert

Proposed Scale

Ramp

Disposal Bins

Ramp

Unload Area

Proposed Culvert

Proposed Ditch

Proposed Transfer Station

Legend:

- Property Boundary
- Existing Landfill Extents
- Final Waste Footprint
- Proposed Landfill Expansion Cell Boundaries
- Existing Fence
- Proposed Fence
- Original Contours (MASL)
- Proposed Contours (MASL)
- Clean Water Diversion Ditche
- Proposed Seepage Collection Water Ditch
- Proposed Road
- Surface Water Flow Direction

0 20 40 60 80 100
Approximate Scale (m)

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
PROVINCE OF ONTARIO

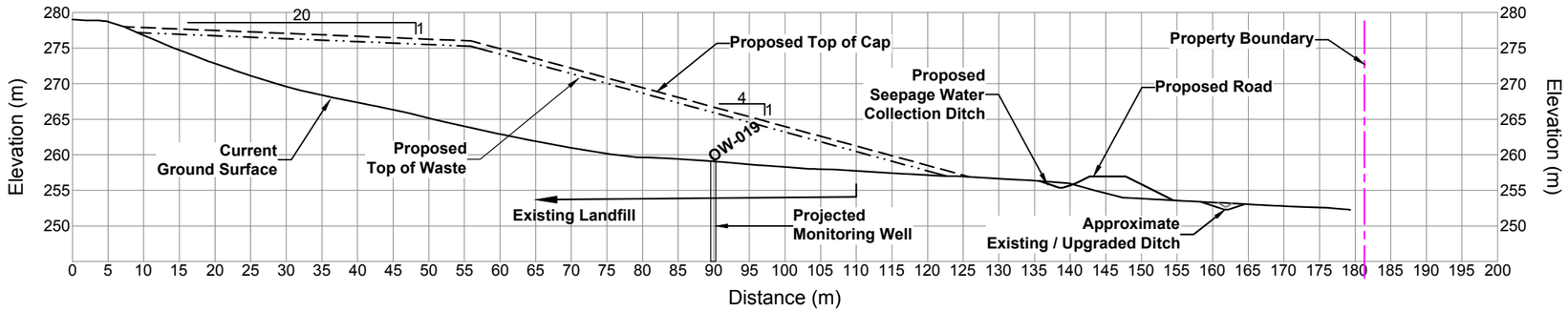
Notes:

1. Contours survey provided by Story Environmental, on the 22 August 2019.
2. Property line and landfill boundary based on S.R.Q 2007 survey.

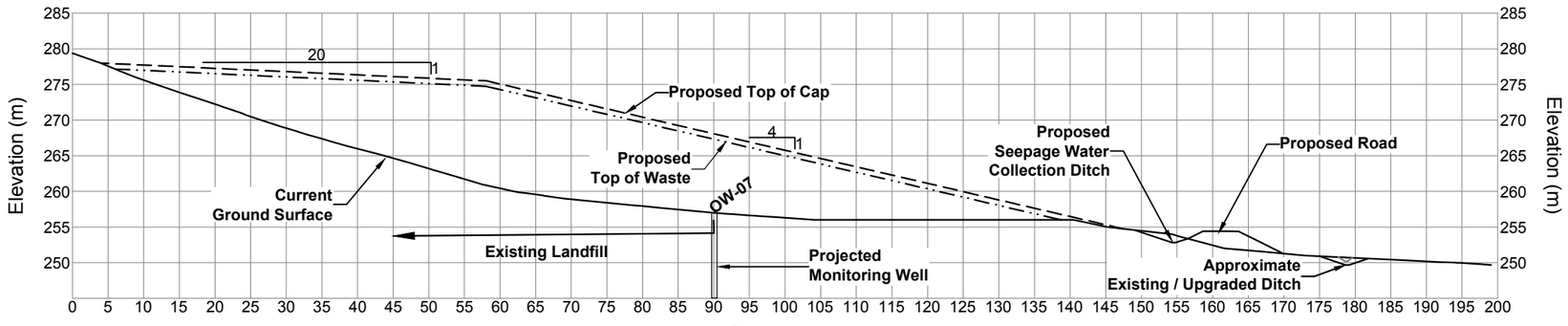
City of Temiskaming Shores

Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
705-682-2632

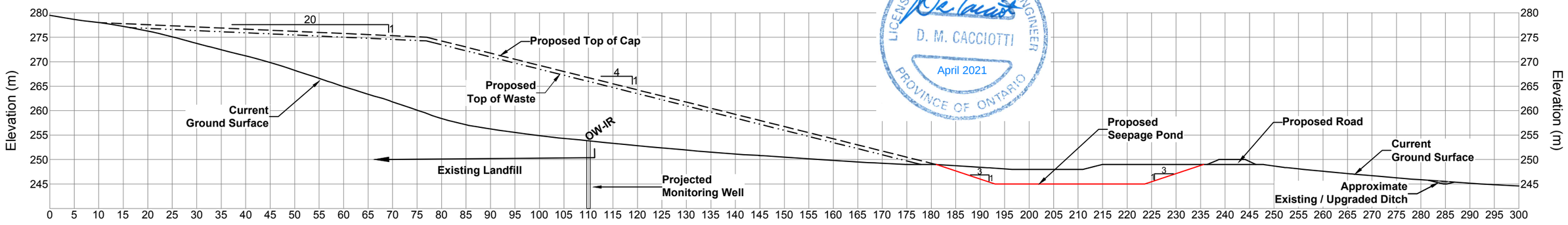
DWN BY:	KKJ
CHK'D BY:	DMC
DATUM:	NAD 83 Zone 17
SCALE:	as shown
PROJECT	New Liskeard Landfill Expansion Temiskaming, Ontario
TITLE	Proposed Top Of Cap Contours For Landfill Expansion
DATE	May 2020
PROJECT No.	TY91049
REV. No.	3
FIGURE No.	6



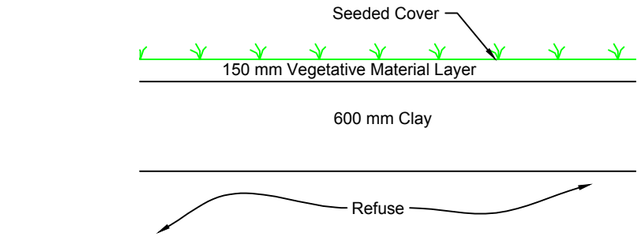
Cross Section A-A Cell 1



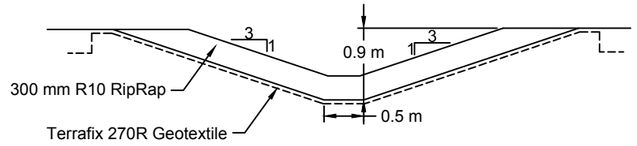
Cross Section B-B Cell 2



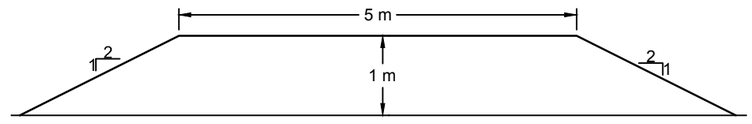
Cross Section C-C Cell 3



Detail 1 - Typical Cap Cover



Detail 2 - Typical Ditch



Detail 3 - Typical Road

Notes:

1. Current ground surface provided by Story Environmental, on the 22 August 2019.

City of Temiskaming Shores

Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
705-682-2632

DWN BY:	KKJ
CHK'D BY:	DMC
DATUM:	not applicable
SCALE:	as shown
PROJECT	New Liskeard Landfill Expansion Temiskaming, Ontario
TITLE	Proposed Landfill Expansion Cross Sections
DATE	May 2020
PROJECT No.	TY91049
REV. No.	1
FIGURE No.	7

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)
- (191.11) Inferred Groundwater Contour with Elevation (m)
- Inferred Groundwater Flow Direction

Ontario Hydro Corridor

Ontario Hydro Corridor

Highway 65

To Cochrane

N

196.0
206.0
216.0
226.0
236.0
246.0
256.0
266.0

OW-10-I
OW-10-II
OW-10-III

OW-11-I
OW-11-II

OW-3

OW-2

OW-13-I
OW-13-II

OW-IR-I
OW-IR-II
OW-IR-III

OW-18-I

OW-12-I
OW-12-II

OW-5

OW-4

OW-9

OW-7

OW-6

OW-8

OW-19

OW-14-I
OW-14-II

OW-15

OW-22-I

OW-21

OW-20-I
OW-20-II

OW-17-III
OW-17-I
OW-17-II

OW-24-III
OW-24-I
OW-24-II

OW-16-I
OW-16-II
OW-16-III

OW-25-III
OW-25-I
OW-25-II
OW-25-IV

OW-31-I
OW-31-II

OW-30-I
OW-30-II
OW-30-III

OW-23-I
OW-23-II

WS-16

WS-14

WS-15

WS-9

FLOW

Property Boundary

Former Waste Fill Area

Existing Access Road

Main Gate

Rockley Road

Contaminant Attenuation Zone

Highway 11

To North Bay

New Liskeard

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020	
	CHK'D BY: DMC		PROJECT No.: TY91049	
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632	DATUM: NAD 83	TITLE: Inferred Shallow Groundwater Contour Plan, May 2018	REV. No.: 6	
	SCALE: as shown		FIGURE No.: 8A	

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)
- (191.11) Inferred Groundwater Contour with Elevation (m)
- Inferred Groundwater Flow Direction

Ontario Hydro Corridor

Ontario Hydro Corridor

Highway 65

To Cochrane

N

OW-10-I
OW-10-II
OW-10-III

OW-11-I
OW-11-II

OW-3

OW-2

OW-13-I
OW-13-II

OW-IR-I
OW-IR-II
OW-IR-III

OW-12-I
OW-12-II

OW-18-I

OW-5

OW-4

OW-9

OW-7

OW-6

OW-8

OW-19

OW-14-I
OW-14-II

OW-15

OW-29-I

OW-21

OW-20-I
OW-20-II

OW-17-III
OW-17-I
OW-17-II

OW-24-III
OW-24-I
OW-24-II

OW-16-I
OW-16-II
OW-16-III

OW-25-III
OW-25-I
OW-25-II
OW-25-IV

OW-31-I
OW-31-II

OW-30-I
OW-30-II
OW-30-III

WS-16

OW-23-I
OW-23-II

WS-14

WS-15

WS-9

FLOW

Property Boundary

Former Waste Fill Area

Existing Access Road

Main Gate

Rockley Road

Contaminant Attenuation Zone

Highway 11

To North Bay

New Liskeard

226.0
216.0
206.0
196.0
236.0
246.0
256.0
266.0

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

	The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020
		CHK'D BY: DMC		PROJECT No.: TY91049
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632	wood.	DATUM: NAD 83	TITLE: Inferred Deep Groundwater Contour Plan May 2018	REV. No.: 6
		SCALE: as shown		FIGURE No.: 5B

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)
- (191.11) Inferred Groundwater Contour with Elevation (m)
- Inferred Groundwater Flow Direction

Ontario Hydro Corridor

Highway 65

To Cochrane

N

OW-17-III OW-17-I OW-17-II

WS-16

OW-23-I OW-23-II

WS-14

OW-24-III OW-24-I OW-24-II

OW-10-I OW-10-II OW-10-III

OW-16-I OW-16-II OW-16-III

WS-15

WS-9

OW-11-I OW-11-II

OW-3

OW-2

OW-25-III OW-25-I OW-25-II OW-25-IV

FLOW

OW-13-I OW-13-II

OW-IR-I OW-IR-II OW-IR-III

OW-18-I

OW-12-I OW-12-II

OW-31-I OW-31-II

OW-5

OW-4

OW-9

Property Boundary

Former Waste Fill Area

OW-7

OW-6

OW-8

OW-30-I OW-30-II OW-30-III

Contaminant Attenuation Zone

OW-19

Existing Access Road

OW-14-I OW-14-II

OW-15

OW-22-I

Main Gate

OW-21

Rockley Road

OW-20-I OW-20-II

Highway 11

To North Bay

New Liskeard

196.0 206.0 216.0 226.0 236.0 246.0 256.0 266.0

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

City of Temiskaming Shores	The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020
		CHK'D BY: DMC		PROJECT No.: TY91049
Wood Environment & Infrastructure Solutions, 131 Fielding Road, Lively, Ontario, P3Y 1L7, 705-682-2632	wood.	DATUM: NAD 83	TITLE: Inferred Shallow Groundwater Contour Plan, July 2018	REV. No.: 6
		SCALE: as shown		FIGURE No.: 8C

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)
- (191.11) Inferred Groundwater Contour with Elevation (m)
- Inferred Groundwater Flow Direction

Ontario Hydro Corridor

Ontario Hydro Corridor

Highway 65

Highway 11

To Cochrane

To North Bay

New Liskeard

Property Boundary

Existing Access Road

Main Gate

Rockley Road

Former Waste Fill Area

Contaminant Attenuation Zone

FLOW

OW-10-I
OW-10-II
OW-10-III

OW-11-I
OW-11-II

OW-3

OW-2

OW-13-I
OW-13-II

OW-IR-I
OW-IR-II
OW-IR-III

OW-18-I

OW-12-I
OW-12-II

OW-5

OW-4

OW-9

OW-7

OW-6

OW-8

OW-19

OW-14-I
OW-14-II

OW-15

OW-23-I

OW-21

OW-20-I
OW-20-II

OW-17-III
OW-17-I
OW-17-II

OW-24-III
OW-24-I
OW-24-II

OW-16-I
OW-16-II
OW-16-III

OW-25-III
OW-25-I
OW-25-II
OW-25-IV

OW-31-I
OW-31-II

OW-30-I
OW-30-II
OW-30-III

WS-16

OW-23-I
OW-23-II

WS-14

WS-15

WS-9

226.0
216.0
206.0
196.0
256.0
246.0
236.0
266.0

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020
	CHK'D BY: DMC		PROJECT No.: TY91049
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632	DATUM: NAD 83	TITLE: Inferred Deep Groundwater Contour Plan July 2018	REV. No.: 6
	SCALE: as shown		FIGURE No.: 8D

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)
- (191.11) Inferred Groundwater Contour with Elevation (m)
- Inferred Groundwater Flow Direction

Ontario Hydro Corridor

Ontario Hydro Corridor

Highway 65

To Cochrane

N

OW-10-I
OW-10-II
OW-10-III

OW-11-I
OW-11-II

OW-3

OW-2

OW-13-I
OW-13-II

OW-IR-I
OW-IR-II
OW-IR-III

OW-18-I

OW-12-I
OW-12-II

OW-5

OW-4

OW-9

OW-7

OW-6

OW-8

OW-19

OW-14-I
OW-14-II

OW-15

OW-22-I

OW-21

OW-20-I
OW-20-II

OW-17-III
OW-17-I
OW-17-II

OW-24-III
OW-24-I
OW-24-II

OW-16-I
OW-16-II
OW-16-III

OW-25-III
OW-25-I
OW-25-II
OW-25-IV

OW-31-I
OW-31-II

OW-30-I
OW-30-II
OW-30-III

OW-23-I
OW-23-II

WS-16

WS-14

WS-15

WS-9

196.0
206.0
216.0
226.0
236.0
246.0
256.0
266.0

FLOW

Property Boundary

Former Waste Fill Area

Existing Access Road

Main Gate

Rockley Road

Contaminant Attenuation Zone

Highway 11

To North Bay

New Liskeard

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

	The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020
		CHK'D BY: DMC		PROJECT No.: TY91049
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632		DATUM: NAD 83	TITLE: Inferred Shallow Groundwater Contour Plan October 2018	REV. No.: 6
		SCALE: as shown		FIGURE No.: 8E

Legend:

- Residential Well
- Monitoring Well Sampled (historical)
- Monitoring Well Sampled (Wood 2017)
- Groundwater Level Only
- Monitoring Well (destroyed)
- Monitoring Well (decommissioned September 2014)
- (191.11) Inferred Groundwater Contour with Elevation (m)
- Inferred Groundwater Flow Direction

Ontario Hydro Corridor

Highway 65

To Cochrane

N

OW-17-III OW-17-I OW-17-II

OW-24-III OW-24-I OW-24-II

OW-16-III OW-16-I OW-16-II

OW-25-III OW-25-IV OW-25-I OW-25-II

OW-31-I OW-31-II

OW-30-I OW-30-II OW-30-III

OW-23-I OW-23-II

WS-16

WS-14

WS-15

WS-9

OW-10-I OW-10-II OW-10-III

OW-11-I OW-11-II

OW-3

OW-2

OW-13-I OW-13-II

OW-IR-I OW-IR-II OW-IR-III

OW-12-I OW-12-II

OW-18-I

OW-5

OW-4

OW-9

OW-7

OW-6

OW-8

OW-19

OW-14-I OW-14-II

OW-15

OW-22-I

OW-21

OW-20-I OW-20-II

FLOW

226.0 216.0 206.0 196.0 236.0 256.0 246.0 266.0

Property Boundary

Former Waste Fill Area

Existing Access Road

Main Gate

Rockley Road

Contaminant Attenuation Zone

Highway 11

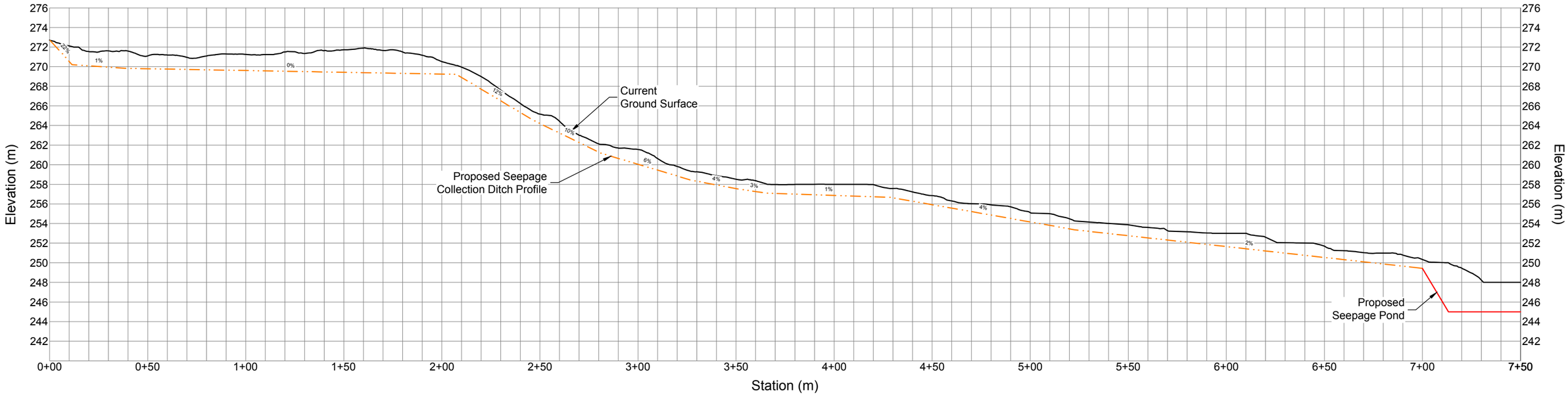
To North Bay

New Liskeard

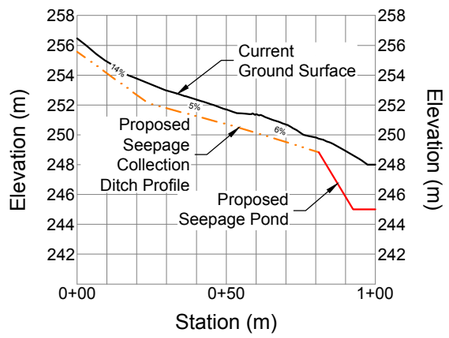
LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

0 50 100 150 200 250 300
Approximate Scale (m)

The City of Temiskaming Shores	DWN BY: CKC	PROJECT: New Liskeard Landfill Expansion, Temiskaming, Ontario	DATE: January 2020	
	CHK'D BY: DMC		PROJECT No.: TY91049	
Wood Environment & Infrastructure Solutions 131 Fielding Road Lively, Ontario P3Y 1L7 705-682-2632	DATUM: NAD 83	TITLE: Inferred Deep Groundwater Contour Plan October 2018	REV. No.: 6	
	SCALE: as shown		FIGURE No.: 8F	



Proposed East Seepage Collection Ditch Profile D-D



Proposed North Seepage Collection Ditch Profile E-E

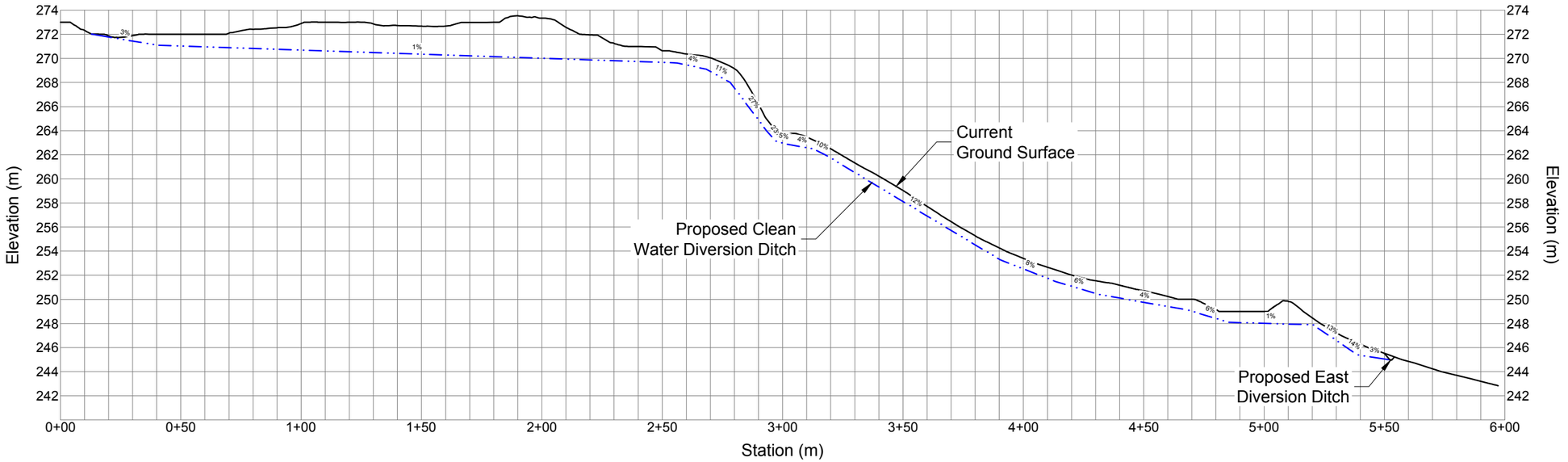
LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

Notes:
1. Current ground surface provided by Story Environmental, on the 22 August 2019.

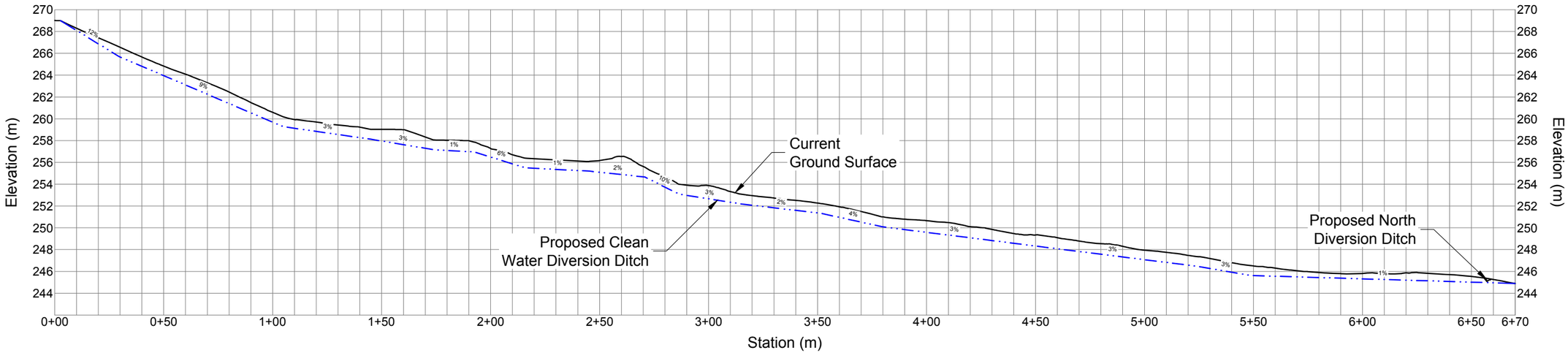
City of Temiskaming Shores

Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
705-682-2632

DWN BY:	KKJ
CHK'D BY:	DMC
DATUM:	not applicable
SCALE:	as shown
PROJECT	New Liskeard Landfill Expansion Temiskaming, Ontario
TITLE	Ditch Profile and Details
DATE	May 2020
PROJECT No.	TY91049
REV. No.	1
FIGURE No.	9



Proposed North Clean Water Diversion Ditch



Proposed East Clean Water Diversion Ditch

LICENSED PROFESSIONAL ENGINEER
D. M. CACCIOTTI
April 2021
PROVINCE OF ONTARIO

Notes:
1. Current ground surface provided by Story Environmental, on the 22 August 2019.

City of Temiskaming Shores

Wood Environment & Infrastructure Solutions
131 Fielding Road
Lively, Ontario
P3Y 1L7
705-682-2632

DWN BY:	KKJ
CHK'D BY:	DMC
DATUM:	not applicable
SCALE:	as shown
PROJECT	New Liskeard Landfill Expansion Temiskaming, Ontario
TITLE	Clean Water Diversion Ditch Profiles
DATE	May 2020
PROJECT No.	TY91049
REV. No.	1
FIGURE No.	10

Appendix A

Certificate of Approval
No. A571505

Under the Environmental Protection Act and the regulations and subject to the limitations thereof, this Provisional Certificate of Approval is issued to:

The Corporation of the Town of New Liskeard
P.O. Box 730, 90 Whitewood Avenue
New Liskeard, Ontario
P0J 1P0

for the use and operation of a 2.02 hectare landfilling area within a 32 hectare total site area.

all in accordance with the following plans and specifications:

as listed in Schedule "A"

Located: West ½ of Lot 5, Concession 2
Corporation of the Town of New Liskeard

which includes the use of the site only for the Processing and Disposal *of the following categories of waste (Note: Use of the site or additional categories of wastes requires a new application and amendments to the Provisional Certificate of Approval)* domestic, commercial and non-hazardous solid industrial waste

and subject to the following conditions:

For the purpose of this Provisional Certificate of Approval:

(a) "Certificate" means this Provisional Certificate of Approval including its schedules, if any, issued in accordance with the Environmental Protection Act;

(b) "Director" means a Director of the Environmental Assessment and Approvals Branch of the Ministry;

(c) "Regoinal Director" means the Director, Thunder Bay Regional Office of the Northern Region of the Ministry;

(d) "District Manager" means the District Manager of the Timmins District Office of the Northern Region of the Ministry;

(d) "Ministry" means the Ontario Ministry of the Environment, unless specific reference is made to another Ministry;

(e) "Town" means the Corporation of the Town of New Liskeard;

(g) "Provincial Officer" means a person who is designated by the Ministry of Environment as a Provincial Officer for the purposes of the Environmental Protection Act, the Ontario Water Resources Act, the Pesticides Act, and their respective regulations;

(h) "Site" means the facility described in the application for this Provisional Certificate of Approval and in the supporting documentation referred to herein;

(i) "ODWO" means the Ontario Drinking Water Objectives; and

(j) "RUP" means the Ministry's Reasonable Use Policy (Policy 15-08).

GENERAL

(1) Except as otherwise provided by these conditions, the Site shall be designed, developed, used, maintained and operated, and all facilities, equipment and fixtures shall be built and installed, in accordance with the Application for a Certificate Approval for a Waste Disposal Site dated April 12, 2000 and supporting documentation, and plans and specifications listed in Schedule "A".

(2) The requirements specified in this Provisional Certificate of Approval are the requirements under the Environmental Protection Act, R.S.O. 1990. The issuance of this Provisional Certificate of Approval in no way abrogates the Town's legal obligations to take all reasonable steps to avoid violating other applicable provisions of this legislation and other legislation and regulations.

(3) The requirements of this Provisional Certificate of Approval are severable. If any requirement of this Provisional Certificate of Approval, or the application of any requirement of this Provisional Certificate of Approval to any circumstance, is held invalid, the application of such requirement to other circumstances and the remainder of this Provisional Certificate of Approval shall not be affected in any way.

(4) The Town shall ensure compliance with all the terms and conditions of this Provisional Certificate of Approval. Any non-compliance constitutes a violation of the Environmental Protection Act, R.S.O. 1990 and is grounds for enforcement.

(5) (a) The Town shall, forthwith upon request of the Director, District Manager, or Provincial Officer (as defined in the Act), furnish any information requested by such persons with respect to compliance with this Provisional Certificate of Approval, including but not limited to, any records required to be kept under this Provisional Certificate of Approval; and

(b) In the event the Town provides the Ministry with information, records, documentation or notification in accordance with this Provisional Certificate of Approval (for the purposes of this condition referred to as "Information"),

(i) the receipt of Information by the Ministry;
(ii) the acceptance by the Ministry of the Information's completeness or accuracy; or
(iii) the failure of the Ministry to prosecute the Town, or to require the Town to take any action, under this Provisional Certificate of Approval or any statute or regulation in relation to the Information

shall not be construed as an approval, excuse or justification by the Ministry of any act or omission of the Town relating to the Information, amounting to non-compliance with this Provisional Certificate of Approval or any statute or regulation.

(6) The Town shall allow Ministry personnel, or a Ministry authorized representative(s), upon presentation of credentials, to:

(a) carry out any and all inspections authorized by Section 156, 157 or 158 of the Environmental Protection Act, R.S.O. 1990, Section 15, 16 or 17 of the Ontario Water Resources Act, R.S.O. 1990, or Section 19 or 20 of the Pesticides Act, R.S.O. 1990, as amended from time to time, of any place to which this Provisional Certificate of Approval relates; and,

without restricting the generality of the foregoing, to:

(b) (i) enter upon the premises where the records required by the conditions of this Provisional Certificate of Approval are kept;
(ii) have access to and copy, at reasonable times, any records required by the conditions of this Provisional Certificate of Approval;
(iii) inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations required by the conditions of this Provisional Certificate of Approval; and
(iv) sample and monitor at reasonable times for the purposes of assuring compliance with the conditions of this Provisional Certificate of Approval.

(7) (a) Where there is a conflict between a provision of any document referred to in Schedule "A", and the conditions of this Provisional Certificate of Approval, the conditions in this Provisional Certificate of Approval shall take precedence; and

(b) Where there is a conflict between documents listed in Schedule "A", the document bearing the most recent date shall prevail.

(8) The Town shall ensure that all communications/correspondence made pursuant to this Provisional Certificate of Approval includes reference to the Provisional Certificate of Approval No. A 571505.

(9) The Town shall notify the Director in writing of any of the following changes within thirty (30) days of the change occurring:

(a) change of Town or Owner of the Site or both;
(b) change of address or address of the new Town;
(c) change of partners where the Operator or Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, 1991 shall be included in the notification to the Director;

(d) any change of name of the corporation where the Operator or Owner is or at any time becomes a corporation, and a copy of the most current "Initial Notice or Notice of Change" (form 1 or 2 of O. Reg. 182, Chapter C-39, R.R.O. 1990 as amended from time to time), filed under the Corporations Information Act shall be included in the notification to the Director; and

(e) change in directors or officers of the corporation where the Operator or Owner is or at any time becomes a corporation, and a copy of the most current "Initial Notice or Notice of Change" as referred to in 9(d), supra.

(10) In the event of any change in ownership of the Site, the Town shall notify, in writing, the succeeding owner of the existence of this Provisional Certificate of Approval, and a copy of such notice shall be forwarded to the Director.

(11) Any information relating to this Provisional Certificate of Approval and contained in Ministry files may be made available to the public in accordance with the provisions of the Freedom of Information and Protection of Privacy Act, R.S.O. 1990, C. F-31.

(12) All records and monitoring data required by the conditions of this Provisional Certificate of Approval must be kept on the Town's premises for a minimum period of two (2) years from the date of their creation.

OPERATIONAL

(13) This Certificate revokes all previously issued Certificates for this Site.

(14) The Town shall ensure that the Site is operated by trained personnel in a safe and secure manner, and that the wastes are properly handled, so as not to pose any threat to the general public, Site personnel or the environment, and that access to the Site is limited to the Town and his staff.

(15) Within ninety (90) days of the issuance of this Certificate, the Town shall mark the Site boundaries, as identified in the site plan included with the application and supporting documents, with permanent markers, that shall be erected so as to be visible throughout the year for the life of the Site.

(16) The Town shall ensure that no burning of waste shall take place at the Site.

(17) All waste received at the Site under the authority of this Certificate shall be deposited within a 2.02 hectare landfilling area shown on Sheets A and B, provided with the Application for the Certificate.

(18) The Site shall be closed when final contours shown on Sheet B and reduced by 0.9m for final cover, have been reached.

(19) Liquid industrial waste or hazardous waste as defined in Ont. Reg. 347 shall not be received or deposited at the Site.

(20) The Town shall operate a litter maintenance program, which will include the collection and proper disposal of any wind blown or vector borne litter, from off-site deposition locations and from those areas of the Site that are not being actively landfilled.

(21) (a) The Town shall:

i) Within 60 days of the date of this Certificate, submit to the Director, for the Director's signature, two copies of a completed Certificate of Prohibition containing a registrable description of the Property, in accordance with Forms 4 & 5 of O. Reg. 14/92; and

ii) Within 10 calendar days of receiving the Certificates of Prohibition signed by the Director, register the Certificate of Prohibition in the appropriate Land Registry Office on title to the Property and submit to the Director the duplicate registered copy immediately following registration; and

(b) Pursuant to Section 197 of the Environmental Protection Act, neither the Owner nor any person having an interest in the Property shall deal with the Property in any way without first giving a copy of this Certificate to each person acquiring an interest in the Property as a result of the dealing.

(22) Within 18 (eighteen) months of the issuance of this Certificate, the Town shall submit for the Director's approval a hydrogeological report. This report shall include but not limited to the following issues:

(a) groundwater regime evaluation (hydraulic gradients, direction of groundwater flow, groundwater flow velocity);
(b) the extent of the existing groundwater contaminant plume;
(c) monitoring requirements; and
(d) contaminant attenuation zone requirements.

(23) Within two years of the issuance of this Certificate, the Town shall submit for the Director's approval an Operation and Maintenance Plan. This Plan shall include but not be limited to the following issues:

(a) the Site capacity approved in accordance with the Ministry's protocol;
(b) total in situ waste volume;
(c) the remaining life of the Site;
(d) new final contours reflecting the capacity defined in (a);
(e) the final cover installation in the Fill Beyond Approved Limit (FBAL) areas and its schedule;
(f) Site operations including daily and final cover;
(g) the groundwater monitoring program; and
(h) the closure plan.

(24) The Site shall be operated, maintained and monitored in accordance with the approved Operation & Maintenance Plan required by Condition 23.

(25) Two years before the Site is expected to stop receiving waste, the Town shall submit for the Director's approval an updated Closure Plan. This Plan shall include, but not be limited to the following issues:

(a) the choice of final cover material;
(b) changes to the final contour plan that may be previously identified in the annual reports, or recommended in the Closure Plan;
(c) the sequence and schedule for final cover installation;
(d) post-closure and end-use plans which reflect an after-use of conservation and passive recreation;
(e) schedules for Site inspections;
(f) plans and schedules for post-closure groundwater and surface water monitoring programs; and
(g) plans and schedules for the routine monitoring and maintenance of the final cover.

(26) The Town shall prepare and submit an annual report to the Regional Director by June 1st of the year following the calendar year covered by the report which shall include as a minimum, the following:

(a) a summary of total annual quantities of waste received at the Site;
(b) a drawing(s) of the Site indicating all groundwater monitoring locations;
(c) tables outlining monitor locations, analytical parameters sampled, and frequency of sampling;
(d) an analysis and interpretation of groundwater monitoring data; a review of the adequacy of the monitoring program; conclusions of the monitoring data; and recommendations for any changes in monitoring program that may be necessary;
(e) an assessment of groundwater quality in relation to the RUP and ODWO;
(f) an assessment of the efficiency of the Contaminant Attenuation Zone established;
(g) an update of changes in operations, equipment, or procedures made or produced at the Site, and any operating difficulties encountered;
(h) drawings showing areas of fill, buffer areas, current Site contours, maximum final Site contours, any recommended changes of the final contours of the Site, percentage of available space utilized, and an estimate of the remaining disposal capacity and Site life;
(i) a statement as to compliance with all Conditions and with the inspection and reporting requirements of the Conditions;
(j) summary of any complaints made regarding Site operation and the Town's response and action taken; and
(k) recommendations respecting any proposed changes in the operation of the Site.

COMPLAINT PROCEDURES

(27) If at any time, the Town receives complaints regarding the operation of the Site, the Town shall respond to these complaints according to the following procedures:

(a) The Town shall record each complaint on a formal complaint form entered in a sequentially numbered log book. The information recorded shall include the nature of the complaint, the name, address and the telephone number of the complainant and the time and date of the complaint;

? COMPLAINTS

(b) The Town, upon notification of the complaint shall initiate appropriate steps to determine all possible causes of the complaint, proceed to take the necessary actions to eliminate the cause of the complaint and forward a formal reply to the complainant; and

(c) The Town shall retain on-site a report written within one (1) week of the complaint date, listing the actions taken to resolve the complaint and any recommendations for remedial measures, and managerial or operational changes to reasonably avoid the re-occurrence of similar incidents.

SCHEDULE "A"

This Schedule "A" forms part of this Provisional Certificate of Approval:

1. The updated Application for a Certificate of Approval for a Waste Disposal Site dated April 12, 2000.

2. Letters from Sutcliffe Rody Quesnel Inc. to the MOE dated February 4, 2000, March 14, 2000 and April 12, 2000.

3. Site Plan Approved Area (Sheet A) and Site Plan Final Contours (Sheet B) prepared by Sutcliffe Rody Quesnel Inc. and dated February 2000.

The reasons for the imposition of these Conditions are as follows:

(1) The reason for Condition (1) is to ensure that the Site is operated in accordance with the application and supporting documentation submitted by the Town, and not in a manner which the Director has not been asked to consider.

(2) The reason for Conditions (2), (3), (4), (5), (7), (8), (9), (10), (11) and (12) is to clarify the legal rights and responsibilities of the Town.

(3) The reason for Condition (6) is to ensure that the appropriate Ministry staff have ready access to information and the operations of the Site which are approved under this Provisional Certificate of Approval. Condition (6) is supplementary to the powers of entry afforded a Provincial Officer pursuant to the Environmental Protection Act, the Ontario Water Resources Act, and the Pesticides Act, as amended.

(4) The reason for Condition (13) is to ensure that this Certificate revokes all previously issued Certificates for this Site.

(5) The reason for Conditions (14) and (20) is to ensure that the Site is operated in an environmentally safe manner.

(6) The reason for Condition (15) is to allow a viable on-site inspection to realize the limits of the Site during any season.

(7) The reason for Condition (16) is to reduce potential damage and environmental effects due to fire.

(8) The reason for Conditions (17), (18), (19) and (24) is to ensure that this Site is operated in accordance with the application and submitted documentation listed in Schedule A.

(9) The reason for Condition (21) requiring registration of the Provisional Certificate of Approval is that Section 46 of the Environmental Protection Act, R.S.O. 1990, prohibits any use being made of the lands after they cease to be used for waste disposal purposes within a period of twenty-five years from the year in which such land ceased to be used for waste disposal, unless the approval of the Minister for the proposed use has been given. The purpose of this prohibition is to protect future users of the Site and the environment from any hazards which might occur as a result of waste being disposed of on the Site. This prohibition and potential hazard should be drawn to the attention of future owners and users of the Site by the Provisional Certificate of Approval being registered on title.

(10) Condition (22) is to ensure that the Town shall conduct and submit for the Director's approval a hydrogeological report.

(11) The reason for Condition (23) is to ensure that the Town shall develop and submit for the Director's approval an Operation and Maintenance Plan.

(12) The reason for Condition (25) is to ensure that two years before the Site is closed, the Town shall submit for the Director's approval an updated Closure Plan.

(13) The reason for Condition (26) is to ensure that the Town shall prepare and submit an annual report to the Regional Director by June 1st of the year following the calendar year covered by the report.

(14) The reason for Condition (27) is to ensure that the complaints are responded to in a systematic manner to protect the health and safety of the public and the environment.

You may by written notice served upon me and the Environmental Appeal Board within 15 days after receipt of this Notice, require a hearing by the Board. Section 142 of the Environmental Protection Act, R.S.O. 1990 c. E-19, as amended, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the waste disposal site is located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary,*
Environmental Appeal Board,
2300 Yonge St., 12th Floor,
P.O. Box 2382
Toronto, Ontario.
M4P 1E4

AND

The Director,
Section 39, Environmental Protection Act,
Ministry of the Environment,
250 Davisville Avenue, 3rd Floor,
Toronto, Ontario.
M4S 1H2

*Further information on the Environmental Appeal Board's requirements for an appeal can be obtained directly from the Board by: Tel: (416) 314-4600, Fax: (416) 314-4506 or e-mail: www.ert.gov.on.ca.

DATED AT TORONTO this 9th *day of* May, 2000.

A. Dominski, P. Eng.,
Director,
Section 39,
Environmental Protection Act

EZ/nb
c.: District Manager, Timmins District Office

Location: N.L. LANDFILL
C of A #: A571505 Issue Date: Apr 17/07
Revokes/Repeals: NOTICE #2

Ontario

Ministry of the Environment | Ministère de l'Environnement

AMENDMENT TO PROVISIONAL CERTIFICATE OF APPROVAL
WASTE DISPOSAL SITE
NUMBER A571505
Notice No. 2
Issue Date: April 17, 2007

APR 26 2007

To: Dave Treen.
April 30, 2007.
CWO

The Corporation of the City of Temiskaming Shores
PO Box 2050
Haileybury, Ontario
P0J 1K0

Site Location: New Liskeard Landfill
West 1/2 of Lot 5, Concession 2, Dymond Twp
Temiskaming Shores City, District of Temiskaming

You are hereby notified that I have amended Provisional Certificate of Approval No. A571505 issued on May 9, 2000 and amended April 27, 2005 for a waste disposal site (landfill), as follows:

I. This Certificate is hereby amended to recognize the addition of a contaminant attenuation zone.

II. The following Item is hereby added to Schedule "A":

4. Application for a Provisional Certificate of Approval for a Waste Disposal Site dated November 14, 2005 and signed by Dave Treen, Manager of Environmental Services, City of Temiskaming Shores, including the attached drawing entitled "New Liskeard Landfill Site Figure 1" showing the attenuation zone.

The reason for this amendment to the Certificate of Approval is as follows:

1. To recognize the addition of the contaminant attenuation zone as required by Provincial Officer's Order No. 7026-6GQLJY.

This Notice shall constitute part of the approval issued under Provisional Certificate of Approval No. A571505 dated May 9, 2000, as amended.

In accordance with Section 139 of the Environmental Protection Act, R.S.O. 1990, Chapter E-19, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to eachportion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the waste disposal site is located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
2300 Yonge St., Suite 1700
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 39, *Environmental Protection Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted waste disposal site is approved under Section 39 of the Environmental Protection Act.

DATED AT TORONTO this 17th day of April, 2007

Tesfaye Gebrezghi, P.Eng.
Director
Section 39, *Environmental Protection Act*

AN/
c: District Manager, MOE North Bay
H. James Hawken, Sutcliffe Rody Quesnel Inc.

Ontario

Ministry of the Environment
Ministère de l'Environnement

AMENDMENT TO ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER A571505
Notice No. 3
Issue Date: October 24, 2012

The Corporation of the City of Temiskaming Shores
325 Farr Dr
Temiskaming Shores, Ontario
P0J 1K0

Site Location: New Liskeard Landfill
Lot West 1/2 of Lot 5, Concession 2
Temiskaming Shores City, District of Timiskaming

You are hereby notified that I have amended Approval No. A571505 issued on May 9, 2000 and amended on April 27, 2005 and April 17, 2007 for a waste disposal site (landfill) , as follows:

This Notice of amendment authorizes installation of solar panels on the contaminant attenuation zone for the Site, and requires updated information for the Site.

The following definitions are added:

"Approval" means this Environmental Compliance Approval and any Schedules to it, including the application and supporting documentation listed in Schedule "A".

"CAZ" means the contaminant attenuation zone for the Site;

The following conditions are added to the Approval:

Closure Plan

(28) Within ninety (90) days of the date of issue of this Approval, the Owner shall submit a closure plan for the Site to the Director and copied to the District Manger, including:
   i. an as-constructed drawing of the Site, showing waste final contours, final slopes and final cap details;
   ii. total volume of waste placed at the Site;
   iii. information on post-closure Site layout and use.

Certificate of Requirement - Contaminant Attenuation Zone

cc: Dave Treen (Nov 2/12) for follow-up

(29) The Owner shall:

(a) Within sixty (60) days of the date of the issuance of this Approval, submit to the Director for review, two copies of a completed Certificate of Requirement with a registerable description of the contaminant attenuation zone; and

(b) Within 10 calendar days of receiving the Certificate of Requirement authorized by the Director, register the Certificate of Requirement in the appropriate Land Registry Office on title to the CAZ and submit to the Director the duplicate registered copy immediately following registration.

Solar Panels in CAZ

(30) The Owner shall ensure that:

i. the proposed solar panel installations within the CAZ do not interfere or affect ongoing Site groundwater and surfacewater monitoring programs, or the functioning of the CAZ;

ii. access is maintained to all existing Site CAZ monitoring wells;

iii. the proposed solar panels do not prevent or impede any future monitoring well installations that may be required within the CAZ.

The following items are added to Schedule "A"

5. Application for a Certificate of Approval, Waste Disposal Site, dated November 1, 2011 and signed by Christopher Oslund, City Manager, City of Temiskaming Shores,

6. Letter dated March 15, 2012, from Jeff Roy, Program Manager, Canadian Solar Solutions Inc., to Lynda Mulcahy, P.Eng, MOE, RE: New Liskeard Landfill Contaminant Attenuation Zone, with attached letter report dated March 7, 2012, by Anthony Story, Story Environmental Inc.

7. e-mail from David Treen, City of Temiskaming Shores, to Mark Feenstra, Canadian Solar Solutions Inc., dated October 2, 2012, 10:02am, copied to Lynda Mulcahy, MOE, RE: New Liskeard LF waste amendment

The reasons for this amendment to the Approval are as follows:

Condition 28 is included to ensure the Director has information on the post-closure Site condition.

Condition 29 is included to ensure that any persons with an interest in the lands used for contaminant attenuation are aware of this use.

Condition 30 is included to ensure that the proposed installations do not impact ongoing environmental protection programs at the Site

This Notice shall constitute part of the approval issued under Approval No. A571505 dated May 9, 2000

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;
6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 24th day of October, 2012

Tesfaye Gebrezghi, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

LM/

c: District Manager, MOE North Bay
Jeff Roy, Canadian Solar

Ontario

Ministry of the Environment
Ministère de l'Environnement

AMENDMENT TO ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER A571505
Notice No. 4
Issue Date: December 11, 2013

The Corporation of the City of Temiskaming Shores
Post Office Box, No. 2050
Haileybury, Ontario
P0J 1K0

Site Location: New Liskeard Landfill
Lot West 1/2 of Lot 5, Concession 2
Temiskaming Shores City, District of Timiskaming

You are hereby notified that I have amended Approval No. A571505 issued on May 09, 2000 and amended as subsequently for the use and operation of a Waste Disposal Site (Landfill) of a 2.02 hectare landfilling area within a total area of 32 hectare , as follows:

Pursuant to the request in a letter dated November 19, 2013, for withdrawal of the submitted closure plan as required by Condition 28 in Notice No.3 dated October 24, 2012, Condition 28 is hereby revoked and replaced by this new condition as follows:

You are hereby notified that this Approval is issued to you subject to the Condition 28 that is hereby revoked and replaced as follows:

28. (1) The *Owner/operator* shall install a minimum of 300 mm thick Interim Cover soil over the waste, pending approval for the proposed vertical expansion of the *Site* . The Interim Cover soil shall be a low permeability cover soil that shall be placed and vegetated as required .

(2) In the event the *Owner* does not receive *EAA* and *EPA* approval for the proposed vertical expansion of the *Site* or the *Owner* withdrawals from the vertical expansion option/process, then within ninety (90) of that decision the *Owner* shall submit a closure plan for the *Site* to the *Director* and copied to the *District Manger* , including:

i. an as-constructed drawing of the *Site* , showing waste final contours, final slopes and final cap details;
ii. total volume of waste placed at the *Site* ;
iii. information on post-closure *Site* layout and use.

SCHEDULE "A":

The following documentation is hereby added to Schedule "A" and forms part of the ECA No. A571505:

8. Letter dated November 19, 2013, from G. Douglas Walsh, CET, Director of Public Works, The City of Temiskaming Shores, to Dickson Odame-Osafo, MOE Waste Unit, Senior Engineer. Re: Application for Approval of WDS Closure Plan-ECA A571505, Notice No. 3 for the New Liskeard Landfill Site.

The reason for this amendment to the Approval is as follows:

1. The reason for this amendment to the Condition 28 is to provide for the potential vertical expansion of the Site as proposed, and ensure that the inactive Landfill is controlled and maintained in such a manner to address potential nuisances, achieve public interest and avoid hazards to health and safety of any person.

This Notice shall constitute part of the approval issued under Approval No. A571505 dated May 09, 2000

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;
6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 314-3717 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 11th day of December, 2013

THIS NOTICE WAS MAILED
ON Dec. 12, 2013
DC
(Signed)

Dale D. Gable

Dale Gable, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

AC/
c: Area Manager, MOE North Bay
c: District Manager, MOE Sudbury
David B. Treen CET, The Corporation of the City of Temiskaming Shores ✓

Appendix B

Borehole Logs

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW 1

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 22-23, 1980

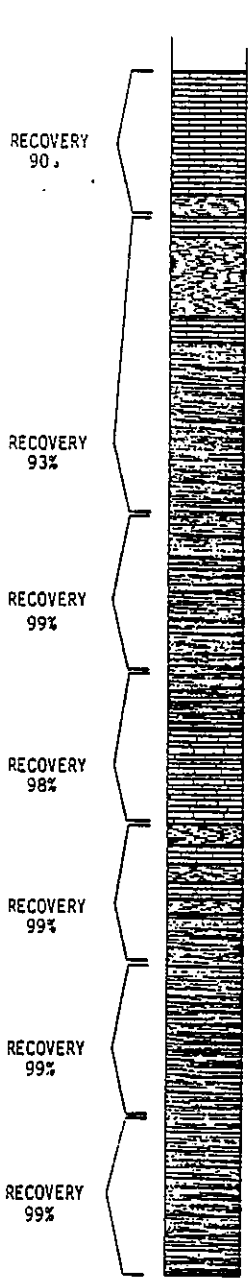
DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A B C
		TILL, glacial silty sand and gravel medium brown				
5	10					
	20	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
		see next page for detailed bedrock core log				
10	30					
	40					
15	50					
	60					
20		End Hole				
	70					

Water levels taken August 28/80

GS - GRAB SAMPLE ||||| SS - SPLIT SPOON ▨ ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

BEDROCK CORE LOG, OWI-C



6.8 Greenish grey LIMESTONE, occasional small calcite filled vugs, thin shale laminae, moderately weathered in top 0.7 metres

8.0
8.3 Grey calcareous SHALE, fossiliferous
8.6 Grey LIMESTONE, irregular bedding, fossiliferous

Greenish-grey calcareous SHALE, fissile

9.3
9.7 Grey LIMESTONE, fossiliferous

Greenish-grey calcareous SILTSTONE, fissile, occassional strata of argillaceous limestone or grey siltstone

13.6 Grey argillaceous SILTSTONE, sometimes nodular, indefinite contact with overlying unit

14.4 Greenish-grey argillaceous SHALE and LIMESTONE

15.4 Dark grey argillaceous SILTSTONE

19.0

Water levels taken August 28/80

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW2

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24/26, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A B C
		TILL, glacial silty sand and gravel medium brown				
	10	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
5	20					
	30	End Hole				
10	40					
15	50					
	60					
20	70					

Water levels taken August 28/80

GS - GRAB SAMPLE |||| SS - SPLIT SPOON ▨ ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW4

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24-25, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A B C
		TILL, glacial silty sand and gravel medium brown				
	10	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
5	20					
	30	End Hole				
10	40					
15	50					
	60					
20	70					

Water levels taken August 28/80

GS - GRAB SAMPLE SS - SPLIT SPOON ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

morrison beatty limited
consulting engineers and hydrogeologists
290 mc west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW5

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24-25, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A B C
	10	TILL, glacial silty sand and gravel medium brown				
5	20	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
10	30					
	40	End Hole				
15	50					
	60					
20						
	70					

Water levels taken August 28/80

GS - GRAB SAMPLE SS - SPLIT SPOON ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW6

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24/26, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
0	0					A, B
5	10	TILL, glacial silty sand and gravel medium brown				
5	20	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
10	30	End Hole				
15	50					
20	60					
	70					

Water levels taken August 28/80

GS - GRAB SAMPLE SS - SPLIT SPOON ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

WL-100280

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW 7

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24-26, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A B C
0		TILL, glacial silty sand and gravel medium brown				
5	10					
	20	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
10	30					
	40	End Hole				
15	50					
	60					
20						
	70					

Water levels taken August 28/80

GS - GRAB SAMPLE SS - SPLIT SPOON ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9376)

OW 8

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A, B
		TILL, glacial silty sand and gravel medium brown				
	10	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
5		End Hole				
	20					
	30					
10						
	40					
15						
	50					
	60					
20						
	70					

Water levels taken August 28/80

GS - GRAB SAMPLE SS - SPLIT SPOON ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

WL-100980

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

OW9

New Liskeard Landfill — FILE NO. 147-802

Hydrogeologic Impact Study, Phase II

GEOLOGIST/ENGINEER WDB / BWB — DATE COMPLETED June 24, 1980

DEPTH metres	DEPTH feet	DESCRIPTION	SAMPLE no.	SAMPLE type	SAMPLE "N"	WELL DETAIL
						A B
		TILL, glacial silty sand and gravel medium brown				
	10	LIMESTONE BEDROCK grey, with interbeds of calcareous shale				
5		End Hole				
	20					
	30					
10						
	40					
15						
	50					
	60					
20						
	70					

Water levels taken August 28/80

GS - GRAB SAMPLE SS - SPLIT SPOON ST - SHELBY TUBE "N" BLOWS PER FOOT WATER LEVEL ▽

WL-100880

BOREHOLE NO. OW-1R

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.00
CLIENT: SUTCLIFFE RODY QUESNEL INC.
DATE: SEPTEMBER 24-25, 2000
BOREHOLE TYPE: HQ / HW CORING
GEOLOGIST: BDT
GROUND ELEVATION: 253.07 mASL (I), 253.21 mASL (II), 253.16 mASL (III)
REVIEWER:

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH	WATER CONTENT % 10 20 30 / W_P W_L	REMARKS
0			I II III								
	FILL/DISTURBED SOIL: MEDIUM BROWN FINE SANDY SILT, TRACE CLAY, TRACE GRAVEL, DAMP			SS1	47		17				WATER LEVEL DEPTH (mbgl) I – 0.82 II – 0.78 III – 0.75
1.2				SS2	78		100				
	SAND TILL: MEDIUM GREY SILTY FINE SAND TILL, SOME GRAVEL, OCCASIONAL COBBLES, DAMP			RC	78		46				MONITOR NEST COMPLETED IN SEPARATE ADJACENT BOREHOLES
2											
3.3											INTER-FRACTURE SPACING (m):
	LIMESTONE: GREY TO GREENISH GREY, CLASTIC. CLASTS ARE SUBROUNDED TO ROUNDED. MASSIVE TO THICK BEDDED. SEVERAL SHALEY PARTINGS, 3 CM THICK. SOFT TO MEDIUM SOFT. SLIGHT TO FRESH WEATHERING. HIGHLY BROKEN WHITE CALCITE NODULES UP TO 3 CM ACROSS, ROUNDED TO ELONGATED. SHARP CONTACT WITH NEXT UNIT.			RC			78	0			0.08
4				RC			100	63			0.20
				RC			100	78			0.31
6				RC			99	83			0.31
				RC			97	83			0.37
8											
7.9											
8.5	SILTSTONE-SHALE: GREY, WITH THIN LIMESTONE INTERBEDS, APHANITIC, LAMINATED, SOFT, VERY BROKEN.			RC			93	40			0.18
				RC			100	96			0.45
9.6	LIMESTONE: GREENISH GREY, MASSIVE, CLASTIC. CLASTS ARE SUBROUNDED TO ROUNDED. MEDIUM SOFT TO SOFT. SLIGHT TO FRESH WEATHERING, BROKEN. WHITE CALCITE NODULES UP TO 1 CM ACROSS. ROUNDED TO ELONGATED.										
10				RC			100	100			0.28
10.7											
	SILTSTONE-SHALE: MEDIUM GREY, MICRO LAMINATED TO LAMINATED. SOFT, SLIGHT TO FRESH WEATHERING. BROKEN TO VERY BROKEN.			RC			100	94			
12											FRACTURE AT 12.68 m
	LIMESTONE: GREENISH GREY, CLASTIC. CLASTS UP TO 1 CM ACROSS, ROUNDED TO ELONGATED. THICK BEDDED TO MASSIVE, MEDIUM SOFT. SLIGHT TO FRESH WEATHERING. BLOCKY TO MASSIVE FRACTURING. BLACK SILTSTONE PARTING.			RC			100	100			
14											FRACTURE AT 13.71 m
14.2				RC			95	94			
	LIMESTONE: GREY, MASSIVE WITH THIN BEDS OF SHALE AND CLASTIC LIMESTONE. MEDIUM SOFT TO SOFT, MASSIVE TO BLOCKY FRACTURING. FRESH WEATHERING, OCCASIONAL CALCITE NODULE, OCCASIONAL SHALEY PARTINGS.										
16				RC			100	86			0.74
18				RC			99	100			
											FRACTURE AT 18.80 m
20	20.3 BOREHOLE TERMINATED AT 20.3 m										

Revision 1/ May 2000

BOREHOLE NO. OW-10

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.00
CLIENT: SUTCLIFFE RODY QUESNEL INC.
DATE: SEPTEMBER 21, 2000
BOREHOLE TYPE: HQ / HW CORING
GEOLOGIST: BDT
GROUND ELEVATION: 250.76 mASL
REVIEWER:

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE ROD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0									10 20 30	10 20 30	
	SILT: GREY BROWN SILT, TRACE SAND TO FINE SANDY, TRACE TO SOME CLAY, TRACE GRAVEL, DAMP			SS1	9		45				WATER LEVEL DEPTH (mbgl) I – 0.94 II – 0.49
				SS2	>50		43				
1.2				SS3			0				INTER-FRACTURE SPACING (m):
	SILT TILL: GREY BROWN, TRACE FINE SAND, TRACE CLAY, DAMP			RC			97	100			
2											
2.4											
	BEDROCK: LIMESTONE WITH SHALE AND SILTSTONE INTERBEDS. SEE BOREHOLE OW-1R FOR DETAIL.			RC			75	93			0.36
4				RC			100	94			0.58
				RC			85	49			0.23
5.8											
6	BOREHOLE TERMINATED AT 5.8 m										MONITOR NEST COMPLETED IN SEPARATE ADJACENT BOREHOLES
8											
10											
12											
14											
16											
18											
20											

BOREHOLE NO. OW-11

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.00
CLIENT: SUTCLIFFE RODY QUESNEL INC.
DATE: SEPTEMBER 20, 2000
BOREHOLE TYPE: HQ / HW CORING
GEOLOGIST: BDT
GROUND ELEVATION: 242.12 mASL
REVIEWER:

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0			I II						10 20 30	10 20 30	
	SILT TILL: LIGHT BROWN SILT TILL, TRACE SAND TO FINE SANDY, TRACE TO SOME CLAY BOULDER 0.9 m–1.3 m, MOIST			SS1	5		50			II I	WATER LEVEL DEPTH (mbgl) I – 0.89 II – 0.32
				SS2	43		72				
1.3				RC			97	48			INTER–FRACTURE SPACING (m): 0.14
2	BEDROCK: LIMESTONE WITH SHALE AND SILTSTONE INTERBEDS. SEE BOREHOLE OW–1R FOR DETAIL.			RC			100	79			0.16
4				RC			100	87			0.34
				RC			100	85			0.24
5.8											
6	BOREHOLE TERMINATED AT 5.8 m										MONITOR NEST COMPLETED IN SEPARATE ADJACENT BOREHOLES
8											
10											
12											
14											
16											
18											
20											

BOREHOLE NO. OW-12

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.00
CLIENT: SUTCLIFFE RODY QUESNEL INC.
DATE: SEPTEMBER 19, 2000
BOREHOLE TYPE: HQ / HW CORING
GEOLOGIST: BDT
GROUND ELEVATION: 248.00 mASL (I), 248.15 mASL (II)
REVIEWER:

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0			I / II						10 20 30	10 20 30	
	SILT: LIGHT BROWN GRADING TO DARK GREY SILT, TRACE TO SOME FINE SAND, TRACE TO SOME CLAY, WET, MOIST			SS1	4		33			▽	WATER LEVEL DEPTH I – 0.28 II – 0.20
				SS2	6		43				INTER-FRACTURE SPACING (m):
				SS3	22		45				
2				SS4	>50		33				
2.0	BEDROCK: LIMESTONE WITH SHALE AND SILTSTONE INTERBEDS. SEE BOREHOLE OW-1R FOR DETAIL.			RC			99	32			0.10
4				RC			100	100			0.20
				RC			100	55			0.12
5.5											
6	BOREHOLE TERMINATED AT 5.5 m										MONITOR NEST COMPLETED IN SEPARATE ADJACENT BOREHOLES
8											
10											
12											
14											
16											
18											
20											

Revision 1/ May 2000

BOREHOLE NO. OW-13

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.00
CLIENT: SUTCLIFFE RODY QUESNEL INC.
DATE: SEPTEMBER 22-23, 2000
BOREHOLE TYPE: HQ / HW CORING
GEOLOGIST: BDT
GROUND ELEVATION: 272.83 mASL (I), 272.77 mASL (II)
REVIEWER:

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0			I II						10 20 30	10 20 30	WATER LEVEL DEPTH (MBGL)
	FILL: BROWN FINE SAND TO SANDY SILT, WITH GRAVEL			SS1	13		33				i – 4.15
				SS2	>50		13				ii – 1.63
0.9				RC			98	47			INTER-FRACTURE SPACING (m):
	BEDROCK: GREENISH GREY NODULAR LIMESTONE. MASSIVE BEDDED NODULES UP TO 10 CM , SEPARATED BY SHALEY STRINGERS. VERY FINE GRAINED CRYSTALLINE. MEDIUM HARD, BROKEN TO BLOCKY. WHITE CARBONATE CLASTS OR FRAGMENTS THAT ARE ROUNDED TO ELONGATED, SOME SHELL FOSSILS. SLIGHT WEATHERING FROM 0.9 M TO 6.7 M. FRESH WEATHERING FROM 7.6 M TO 10.8 M.										0.10
2				RC			100	57		II ▽	0.13 FRACTURES BROWN STAINED
				RC			100	85			0.22 SOME FRACTURES BROWN STAINED
4										I ▽	
				RC			100	100			0.27 NO STAINED FRACTURES
6											
				RC			100	98			0.25 BROWN STAINED FRACTURE AT 6.8 m
8				RC			100	67			0.19 NO STAINED FRACTURES
10				RC			91	93			0.16 NO STAINED FRACTURES
10.8											
	BOREHOLE TERMINATED AT 10.8 m (I) AND 4.4 m (II)										MONITOR NEST COMPLETED IN SEPARATE ADJACENT BOREHOLES
12											
14											
16											
18											
20											

BOREHOLE NO. OW-14

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.00
CLIENT: SUTCLIFFE RODY QUESNEL INC.
DATE: SEPTEMBER 26-27, 2000
BOREHOLE TYPE: HQ / HW CORING
GEOLOGIST: BDT
GROUND ELEVATION: 257.93 mASL
REVIEWER:

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (Wp – Wl)	REMARKS
0			I II						10 20 30	10 20 30	
	FILL: GREY SILTY FINE SAND FILL WITH BOULDERS			SS1	10		39				WATER LEVEL DEPTH (mbgl) I – 1.91 II – 1.16 INTER-FRACTURE SPACING (m):
2				SS2	6		0				
				SS3	20		0				
											DRILLER REPORTS LOSS OF CIRCULATION
				RC			0				
4				RC			0				2.9–4.0 mbgl
4.3											
	SANDY SILT TILL: GREY FINE SANDY SILT TILL, SOME GRAVEL TO FINE TO COARSE GRAVELY, OCCASIONAL COBBLE			SS4	>50		30				
5.0				RC			97	50			0.10
	BEDROCK: LIMESTONE WITH SHALE AND SILTSTONE INTERBEDS. SEE BOREHOLE OW-1R FOR DETAIL.										
6				RC			100	8			0.05
8											
				RC			85	85			FRACTURE ZONE 8.1–8.5 mbgl
9.5											
10	BOREHOLE TERMINATED AT 9.5 m (I) AND 5.5 m (II)										MONITOR NEST COMPLETED IN SEPARATE ADJACENT BOREHOLES
12											
14											
16											
18											
20											

Revision 1/ May 2000

BOREHOLE NO. OW-15

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.02
CLIENT: TOWN OF NEW LISKEARD / SUTCLIFFE RODY QUESNEL INC.
DATE: OCTOBER 16, 2002
BOREHOLE TYPE: 108 mm I.D. HOLLOW STEM AUGER
SUPERVISOR: WDN
GROUND ELEVATION: 253.7 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % W_P W_L	REMARKS
0			I II						10 20 30	10 20 30	
0.15	TOPSOIL			1SS	5	16.5	67				MONITORS ARE INSTALLED WITHIN SEPARATE BOREHOLES.
	CLAYEY SILT: MOTTLED YELLOWISH-ORANGE BEIGE AND LIGHT GREY CLAYEY SILT, APL-WTPL, FIRM TO HARD, OCCASIONAL MEDIUM TO FINE GRAVEL.			2SS	24	14.3	42		50 FOR 76 mm		
2				3SS		14.6	36				
2.3	CLAYEY SILT TO SILTY CLAY: LIGHT GREY CALCAREOUS CLAYEY SILT TO SILTY CLAY, MOIST TO DRY, MDTPL, HARD, OCCASIONAL LIMESTONE BOULDERS, WEATHERED.			4SS		–	75		100 FOR 102 mm		
				5SS		–	25		75 FOR 102 mm		
4				6SS		–	100		100 FOR 102 mm		
				7SS		–	69		125 FOR 178 mm		
6				8SS		–	100		100 FOR 102 mm		
				9SS		–	100		100 FOR 76 mm		
8				10SS		–	100		50 FOR 76 mm		
9.4	BOREHOLE TERMINATED AT 9.4 m IN HARD CLAYEY SILT TO SILTY CLAY.										
10											
12											
14											
16											
18											
20											

BOREHOLE NO. OW-16

PROJECT NAME: NEW LISKEARD LANDFILL SITE

PROJECT NO.: 001148.02

CLIENT: TOWN OF NEW LISKEARD / SUTCLIFFE RODY QUESNEL INC.

DATE: OCTOBER 19, 2002

BOREHOLE TYPE: 108 mm I.D. HOLLOW STEM AUGER

SUPERVISOR: WDN

GROUND ELEVATION: 238.0 mASL

REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS I II III	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH	WATER CONTENT % 10 20 30 / W_P W_L	REMARKS
0											
0.15	TOPSOIL										MONITORS ARE INSTALLED WITHIN SEPARATE BOREHOLES.
	SILTY FINE TO MEDIUM SAND TO FINE SANDY SILT: LIGHT BROWN TO MOTTLED, SILTY FINE TO MEDIUM SAND TO FINE SANDY SILT, TRACE COBBLES, MOIST, DENSE TO VERY DENSE.			1SS	30	5.3	25				
2				2SS		5.9	61		100 FOR 127 mm		
2.3				3SS		7.6	50		50 FOR 128 mm		– SPOON SAMPLER BOUNCING
	SILT TILL: BROWNISH–GREY BECOMING DARK GREY BELOW 3.0 m, SILT TILL, TRACE TO SOME SAND, TRACE TO SOME CLAY, OCCASIONAL FINE TO MEDIUM GRAVEL AND COBBLES THROUGHOUT, APL TO DTPL, VERY STIFF TO HARD.			4SS	39	8.4	92				
4				5SS	44	9.6	100		44		
				6SS	29	9.7	100				
6				7SS	36	8.6	58				
8				8SS	141	8.4	67		141		
				9SS	37	8.8	100				
10				10SS	36	8.9	96				
12				11SS	86	8.2	71		86		
14				12SS	60	8.4	100		60		
				13SS	105	10.3	67		105		
16				14SS		8.9	100		130 FOR 230 mm		
18				15SS	177	8.2	72		177		
19.5	SILTY MEDIUM TO FINE SAND TO MEDIUM TO FINE SANDY SILT: GREY SILTY MEDIUM TO FINE SAND TO MEDIUM TO FINE SANDY SILT, SATURATED, OCCASIONAL MEDIUM TO FINE GRAVEL, DENSE TO VERY DENSE.										
20											

BOREHOLE NO. OW-16

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.02
CLIENT: TOWN OF NEW LISKEARD / SUTCLIFFE RODY QUESNEL INC.
DATE: OCTOBER 19, 2002
BOREHOLE TYPE: 108 mm I.D. HOLLOW STEM AUGER
SUPERVISOR: WDN
GROUND ELEVATION: 238.0 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT %	REMARKS
20	SILTY MEDIUM TO FINE SAND TO MEDIUM TO FINE SANDY SILT CONTINUED			16SS	43	10.7	100		43	Wp — Wl	
22				17SS		12.2	100		125 FOR 127 mm		
	– BOULDER AT 22.9 – 23.1 m			18SS					300 FOR 5 mm		
23.3				19RC			80	100			
24	IGNEOUS BEDROCK: BLACK WITH GREY TO WHITE SPECKLING, PHANERITIC, GRANODIORITE TO GABBRO, HARD, SLIGHTLY WEATHERED.			20SS			0	100	125 FOR 25 mm		
				21RC			100	92			
24.8											
26	BOREHOLE TERMINATED AT 24.8 m IN MAFIC IGNEOUS BEDROCK.										
28											
30											
32											
34											
36											
38											
40											

BOREHOLE NO. OW-17

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.02
CLIENT: TOWN OF NEW LISKEARD / SUTCLIFFE RODY QUESNEL INC.
DATE: OCTOBER 20, 2002
BOREHOLE TYPE: 108 mm I.D. HOLLOW STEM AUGER
SUPERVISOR: WDN
GROUND ELEVATION: 229.3 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0			I II III						10 20 30	10 20 30	
0.15	TOPSOIL										MONITORS ARE INSTALLED WITHIN SEPARATE BOREHOLES.
1.5	SILTY CLAY TO CLAYEY SILT: MOTTLED GREY BROWN SILTY CLAY TO CLAYEY SILT, TRACE FINE SAND, APL TO WTPL. STIFF.			1SS	12	34.0	100				
2				2SS	11	21.3	75				
3.0	FINE SAND, TRACE TO SOME SILT: BROWN FINE SAND, TRACE SILT, INTERBEDDED CLAYEY SILT, WET, DENSE.			3SS	39	15.4	88				
4				4SS	29	7.8	75				
	SANDY SILT TO SILT TILL: BROWN BECOMES GREY BELOW 3.4 m SANDY SILT TILL, TRACE TO SOME CLAY, TRACE MEDIUM TO FINE GRAVEL, OCCASIONAL COBBLES, APL TO DTPL, VERY STIFF TO HARD.			5SS	47	6.5	71		47		
6	– CLAYEY			6SS	21	8.4	79				
8				7SS		5.6	100		114 FOR 152 mm		
8.8											
10	SILTY FINE SAND: GREY SILTY FINE SAND, TRACE COARSE SAND, TRACE MEDIUM TO FINE GRAVEL FRAGMENTS, SATURATED, VERY DENSE.			8SS	81	13.7	100		81		
				9SS	132	14.2	100		132		
12	11.9			10SS		–	2		200 FOR 0 mm		1 ROCK CHIP WAS RECOVERED FROM THE SPOON SAMPLER.
	BOREHOLE TERMINATED ON ASSUMED MAFIC IGNEOUS BEDROCK.										
14											
16											
18											
20											

BOREHOLE NO. OW-18

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.02
CLIENT: TOWN OF NEW LISKEARD / SUTCLIFFE RODY QUESNEL INC.
DATE: OCTOBER 21, 2002
BOREHOLE TYPE: 108 mm I.D. HOLLOW STEM AUGER
SUPERVISOR: WDN
GROUND ELEVATION: 278.8 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0									10 20 30	10 20 30	
0.6	COVER SOIL FILL: BLACK TO MEDIUM BROWN SILT, SOME SAND, TRACE GRAVEL. STIFF.			1SS	10	13.8	42				
1.5	CLAYEY SILT FILL: BLACK TO BROWN TO GREY CLAYEY SILT, SOME SAND, WET, VERY STIFF.			2SS	28	20.7	0				
2	REFUSE: HOUSEHOLD REFUSE CONSISTING OF PLASTIC BAGS, PAPER, WOOD DEBRIS, PIECES OF METAL AND GLASS AT DEPTH, MOIST TO DRY, STRONG ODOUR.			3SS	54	–	20.8		54		
4											
6											
8											
10											
12											
14				4SS		–	100		50 FOR 150 mm		
				5SS		–	100		50 FOR 100 mm		
15.2											
16	SANDY CLAYEY SILT: LIGHT BROWN, DARK STAINED TO 15.4 m SANDY CLAYEY SILT, WET, ODOUROUS, HARD.			6SS	34	8.1	50				
16.1	BOREHOLE TERMINATED AT 16.1 m DUE TO REFUSAL ON ASSUMED LIMESTONE BEDROCK.										
18											
20											

Jacobs Hine Laurson

BOREHOLE NO. OW-19

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.02
CLIENT: TOWN OF NEW LISKEARD / SUTCLIFFE RODY QUESNEL INC.
DATE: OCTOBER 22, 2002
BOREHOLE TYPE: 108 mm I.D. HOLLOW STEM AUGER
SUPERVISOR: WDN
GROUND ELEVATION: 258.7 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % W_P W_L	REMARKS
0			I II						10 20 30	10 20 30	
2	MEDIUM TO FINE SAND FILL: BROWN, ORANGY-BROWN AND BLACK MEDIUM TO FINE SAND, TRACE SILT, OCCASIONAL PIECES OF SLAG, MOIST TO DRY, LOOSE.			1SS	8	3.7	50				MONITORS ARE INSTALLED WITHIN SEPARATE BOREHOLES.
				2SS	10	5.2	42				
	– TRACE FINE GRAVEL, SOME SILT, GLASS, SLIGHTLY ODOURUOS.			3SS	17	10.8	42				
2.7				4SS	99	12.2	79		99		
	FINE SANDY SILT: LIGHT BROWN FINE SANDY SILT, MOIST, VERY DENSE, SOME ROCK FRAGMENTS.										– COBBLE AT 3.0 m
3.6				5SS		–	0		126 FOR 101 mm		
4	CLAYEY SILT TO SILT, SOME CLAY: MOTTLED GREENISH-GREY THEN MEDIUM BROWN CLAYEY SILT, GRADING TO SILT SOME CLAY WITH DEPTH, TRACE SAND, FINE GRAVEL, APL, FIRM TO STIFF.			6SS	7	23.3	83				
				7SS	18	24.0	71				
5.5											
6	SANDY SILT TILL: BROWN SANDY SILT, TRACE TO SOME CLAY TILL, OCCASIONAL MEDIUM TO FINE GRAVEL, APL, VERY STIFF.			8SS	22	12.6	83				
6.1											
	BOREHOLE TERMINATED AT 6.1 m IN SANDY SILT TILL.										
8											
10											
12											
14											
16											
18											
20											

BOREHOLE NO. OW-20

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.04
CLIENT: CITY OF TEMISKAMING SHORES
DATE: NOVEMBER 11. 2004
BOREHOLE TYPE: HOLLOW STEM AUGERS 203 mm (8") O.D.
SUPERVISOR: DJW
GROUND ELEVATION: 258.52 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0			I II						10 20 30	10 20 30	
0.2	TOPSOIL, CLAYEY SILT;										STATIC WATER LEVELS AT I = 0.82 mBGL II = 0.91 mBGL ON DECEMBER 7, 2004
	CLAYEY SILT: LIGHT BROWN TO LIGHT GREY BROWN WITH MOTTLED BROWN CLAYEY SILT, NONE TO TRACE FINE GRAVEL, NONE TO TRACE SAND, DTPL TO APL, FIRM TO STIFF.			SS1	8		79				
2				SS2	15		100				
	– GREYISH BROWN AT 3.0 m.			SS3	7		100				
				SS4	10		50				
3.7	SAND: MEDIUM BROWN FINE TO MEDIUM SAND, TRACE TO SOME SILT, TRACE FINE GRAVEL, MOIST, VERY DENSE.			SS5	50+		37		50/50 mm		
4											
4.5				SS6	37		83				
	SILT TILL: GREY SILT TILL, SOME FINE SAND, TRACE TO SOME CLAY, TRACE TO SOME FINE TO MEDIUM GRAVEL, MOIST, COMPACT TO VERY DENSE.			SS7	48		42		48		
6				SS8	25		100				
	– WET AT 7.6 m.			SS9	27		100				
8											
9.1	BOREHOLE TERMINATED AT 9.1 m AT AUGER REFUSAL (PROBABLE BEDROCK).			SS10	80+		0		80/25 mm		
10											
12											
14											
16											
18											
20											

Revision 2/ Aug 2003

RECORD OF MONITORING WELL No. OW-21 Co-Ord. 17T 0597146 E, 5262516 N

Project Number: **TY131010.6000**
Project Client: **City of Temiskaming Shores**
Project Name: **Monitoring Well Installation Project - New Liskeard Landfill Site**
Project Location: **New Liskeard, Ontario**
Drilling Location: **East of Solar Farm Gate**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **9 Sep 14** Date Completed: **9 Sep 14**
Logged by: **JS**
Compiled by: **MAT**
Reviewed by: **TIM**
Revision No.: **0, 21/11/14**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING			COMMENTS
Lithology Plot	DESCRIPTION Local Ground Surface Elevation:	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	PenetrationTesting ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80	INSTRUMENTATION INSTALLATION	1 riser pipe in bentonite 1 riser pipe in sand 1 slotted pipe in sand
	light brown CLAYEY SILT trace gravel mottled, soft										STICK-UP HEIGHT: 0.95 m
	brown 0.4 SILT trace sand, gravel and clay loose to very dense	AU				1 2 3 4					
	END OF BOREHOLE 4.2 DUE TO REFUSAL ON PROBABLE BEDROCK OR BOULDERS										

AMEC Environment & Infrastructure
A division of AMEC Americas Limited
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amec.com

Scale: 1 : 30

BOREHOLE NO. OW-22

PROJECT NAME: NEW LISKEARD LANDFILL SITE

PROJECT NO.: 001148.04

CLIENT: CITY OF TEMISKAMING SHORES

DATE: NOVEMBER 11. 2004

BOREHOLE TYPE: HOLLOW STEM AUGERS 203 mm (8") O.D.

SUPERVISOR: DJW

GROUND ELEVATION: 257.99 mASL

REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	'N' VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH	WATER CONTENT % 10 20 30 (Wp, WL)	REMARKS
0	CLAYEY SILT FILL: LIGHT GREY BROWN GRADING TO LIGHT BROWN CLAYEY SILT TO CLAY AND SILT FILL, APL, SOFT TO FIRM.			SS1	5		13				STATIC WATER LEVEL AT 1.99 m BGL ON DECEMBER 7, 2004
				SS2	5		33				
2				SS3	4		21				
2.1	CLAYEY SILT AND BUREID TOPSOIL:										
2.3	CLAYEY SILT AND BURIED TOPSOIL, APL.			SS4	18		21				
	SANDY SILT TILL: LIGHT BROWN SANDY SILT TILL, TRACE TO SOME CLAY, TRACE FINE GRAVEL, DTPL TO APL, VERY STIFF TO HARD.			SS5	50+		4		50/127 mm		
				SS6	37		38				
4	– CLAYEY SILT ZONE AT 3.0 m										
4.3	BOREHOLE TERMINATED AT 4.3 m AT AUGER REFUSAL (PROBABLE BEDROCK).			SS7	66+		4		66/102 mm		
6											
8											
10											
12											
14											
16											
18											
20											

Revision 2/ Aug 2003

BOREHOLE NO. OW-23

PROJECT NAME: NEW LISKEARD LANDFILL SITE
PROJECT NO.: 001148.04
CLIENT: CITY OF TEMISKAMING SHORES
DATE: NOVEMBER 12-13. 2004
BOREHOLE TYPE: HOLLOW STEM AUGERS 203 mm (8") O.D.
SUPERVISOR: DJW
GROUND ELEVATION: 202.33 mASL
REVIEWER: BDT

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS I	MONITOR DETAILS II	SAMPLE TYPE	SAMPLE 'N' VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % / W_P W_L	REMARKS
0										10 20 30	10 20 30	
0.6	TOPSOIL: DARK BROWN TOPSOIL WITH CLAYEY SILT AND ORGANIC SILT, BRANCHES, APL, STIFF.				SS1	10		29				STATIC WATER LEVEL AT I = 6.29 m BGL II = DRY ON DECEMBER 7, 2004
1.4	CLAYEY SILT: MEDIUM BROWN CLAYEY SILT, TRACE FINE SAND, DTPL, STIFF.				SS2	14		79				
2	SANDY SILT TILL: LIGHT TO MEDIUM BROWN SANDY TO SOME SILT TILL, TRACE CLAY TO CLAYEY, TRACE FINE GRAVEL, DTPL, VERY STIFF TO HARD.				SS3	19		25				
	– COBBLES AT 3.1 m				SS4	36		100				
4					SS5	58		38		58		
	– GREY TO DARK GREY BELOW 4.6 m.				SS6	52		50		52		
6	– COBBLES BELOW 6.1 m.				SS7	50+		4		50/25 mm		
8					SS8	79		46		56/102 mm		
9.1					SS9	63		100		63		
10	CLAYEY SILT TILL: GREY CLAYEY SILT TILL, SOME FINE SAND, TRACE FINE GRAVEL, DTPL, HARD.				SS10	53		58		53		
12					SS11	83+		38		83/292 mm		
12.2	SANDY SILT TO CLAYEY SILT TILL: MEDIUM GREY TO DARK GREY SANDY SILT TO CLAYEY SILT TILL, TRACE FINE TO MEDIUM GRAVEL, TRACE CLAY, DTPL TO APL, VERY STIFF TO HARD.				SS12	56		92		56		
14												
	– WET BELOW 15.2 m.				SS13	37		96				
16												
					SS14	28		79				
18					SS15	–		–				
18.1	BOREHOLE TERMINATED AT 18.1 m AT AUGER REFUSAL (PROBABLE BEDROCK).											
20												

Revelon 2/ Aug 2003

RECORD OF MONITORING WELL No. OW-24-I Co-Ord. 17T 0597379 E, 5263237 N

Project Number: **TY131010.6000**
Project Client: **City of Temiskaming Shores**
Project Name: **Monitoring Well Installation Project - New Liskeard Landfill Site**
Project Location: **New Liskeard, Ontario**

Drilling Location: **NE Corner of Solar Farm**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **3 Sep 14** Date Completed: **3 Sep 14**

Logged by: **JS**
Compiled by: **MAT**
Reviewed by: **TIM**
Revision No.: **0, 21/11/14**

Local Ground Surface Elevation:

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)
	brown SILTY SAND some organics, roots moist, compact					0	
	light brown / grey 0.8 SILTY CLAY some sand, trace cobbles very stiff to stiff					1	
						2	
						3	
						4	
						5	
						6	

FIELD TESTING

Penetration Testing: ○ SPT ● DCPT
MTO Vane*: △ Intact ▲ Remould
Nilcon Vane*: ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa): 20 40 60 80

★ Rinse pH Values: 2 4 6 8 10 12
Soil Vapour Reading: △ parts per million (ppm): 100 200 300 400
▲ Lower Explosive Limit
✳ Passing 75 um (%)
○ Moisture Content (%): 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

1 riser pipe in bentonite
1 riser pipe in grout
1 riser pipe in sand
1 slotted pipe in sand

STICK-UP HEIGHT: 0.93 m

AMEC Environment & Infrastructure
A division of AMEC Americas Limited
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amec.com

Continued on Next Page

Scale: 1 : 30

RECORD OF MONITORING WELL No. OW-24-I Co-Ord. 17T 0597379 E, 5263237 N

Project Number: **TY131010.6000** Drilling Location: **NE Corner of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	light brown / grey SILTY CLAY some sand, trace cobbles very stiff to stiff										
	grey / brown 7.3 SANDY SILT some gravel, some to trace clay moist very dense	AU				7 8 9 10 11 12					

Continued on Next Page

RECORD OF MONITORING WELL No. OW-24-I Co-Ord. 17T 0597379 E, 5263237 N

Project Number: **TY131010.6000** Drilling Location: **NE Corner of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	grey / brown SANDY SILT some gravel, some to trace clay moist very dense					13					
	grey 13.1 SAND trace silt and gravel moist to wet, fine to medium, very dense					14					
						15					
						16					
						17					
						18					
	END OF BOREHOLE 18.3 (no refusal)										

RECORD OF MONITORING WELL No. OW-24-II Co-Ord. 17T 0597379 E, 5263237 N

Project Number: **TY131010.6000**
Project Client: **City of Temiskaming Shores**
Project Name: **Monitoring Well Installation Project - New Liskeard Landfill Site**
Project Location: **New Liskeard, Ontario**

Drilling Location: **NE Corner of Solar Farm**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **4 Sep 14** Date Completed: **4 Sep 14**

Logged by: **JS**
Compiled by: **MAT**
Reviewed by: **TIM**
Revision No.: **0, 21/11/14**

Local Ground Surface Elevation:

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)
	brown SILTY SAND some organics, roots moist, compact						
	light brown / grey 0.8 SILTY CLAY some sand, trace cobbles very stiff to stiff	AU				1 2 3 4 5 6	

FIELD TESTING

Penetration Testing: ○ SPT ● DCPT
MTO Vane*: △ Intact ▲ Remould
Nilcon Vane*: ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa): 20 40 60 80

★ Rinse pH Values: 2 4 6 8 10 12
Soil Vapour Reading: △ parts per million (ppm): 100 200 300 400
▲ Lower Explosive Limit
✳ Passing 75 um (%)
○ Moisture Content (%): 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

1 riser pipe in bentonite
1 riser pipe in sand
1 slotted pipe in sand

STICK-UP HEIGHT: 0.93 m

AMEC Environment & Infrastructure
A division of AMEC Americas Limited
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amec.com

Scale: 1 : 30

Continued on Next Page

RECORD OF MONITORING WELL No. OW-24-II Co-Ord. 17T 0597379 E, 5263237 N

Project Number: **TY131010.6000** Drilling Location: **NE Corner of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in sand 1 slotted pipe in sand
	light brown / grey SILTY CLAY some sand, trace cobbles very stiff to stiff					7					
	grey / brown 7.3 SANDY SILT some gravel, some to trace clay moist very dense					8					
						9					
	END OF BOREHOLE 9.1 (no refusal)										

BOREHOLE NO. OW 24-I

PROJECT NAME: 2007 MONITORING WELL NEST INSTALLATION
PROJECT NO.: 4-001148.08
CLIENT: CITY OF TEMISKAMING SHORES
DATE COMPLETED: Oct 24, 2007
BOREHOLE TYPE: 110 mm HOLLOW STEM AUGER
SUPERVISOR: SLW
GROUND ELEVATION: 235.9 mASL
REVIEWER: AGH

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0											UTM CO-ORDINATES UTM Zone: 17 NAD: 27 Easting: 597359 Northing: 5263019
0.1	TOPSOIL: DARK BROWN SILTY SAND, ROOTS AND ORGANIC MATERIAL, MOIST.			SS1	27	23	53				OW24-I STICKUP = 0.76 m OW24-II STICKUP = 0.81 m OW24-III STICKUP = 0.81 m
0.8	SANDY SILT: DARK GREY FINE SANDY SILT, MOIST, COMPACT.			SS2	18	23	94				
	SILTY CLAY/CLAYEY SILT: LIGHT BROWN/GREY MOTTLED SILTY CLAY/CLAYEY SILT, APL TO WPL, VERY STIFF TO STIFF.			SS3	16	36	100				
				SS4	12	38	100				
				SS5	10	38	100				
				SS6	8	48	100				
				SS7	11	36	100				
5.3	SILTY CLAY/CLAYEY SILT: MOTTLED GREY/LIGHT BROWN SILTY CLAY/CLAYEY SILT, SOME FINE TO MEDIUM SAND, TRACE COBBLES, MOIST, HARD/VERY DENSE.			SS8	64	24	42		64		OW24-III MONITOR INSTALLED AT 4.9 m
7.3	TILL: GRAY/BROWN TILL - SANDY SILT/SILTY SAND, SOME TO TRACE CLAY, SOME FINE TO MEDIUM GRAVEL, MOIST, VERY DENSE.			SS9	50	8	53				OW24-II MONITOR INSTALLED AT 8.4 m
				SS10			0				
				SS11	140	8	72		140		
				SS12	130	9	100		130		
13.1	SAND: GRAY FINE TO MEDIUM SAND, TRACE SILT, TRACE FINE TO COARSE GRAVEL, MOIST TO WET, VERY DENSE.			SS13	46	8	100		46		
				SS14	186	10	100		186		
				SS15	169	9	100		169		FLOWING SANDS
				SS16	89	16	89		89		
18.7	BOREHOLE TEMINATED AT 18.7 m DUE TO AUGER REFUSAL ON ASSUMED BEDROCK.										OW24-I MONITOR INSTALLED AT 18.7 m
20.0											

JHL GEOLOGIC B/W (METRIC) WITH UTM 4-00114808 TEMISKAMING SHORES.GPJ JAGGER HIMS BASIC.GDT 5/15/08

BOREHOLE NO. OW 25-I

PROJECT NAME: 2007 MONITORING WELL NEST INSTALLATION
PROJECT NO.: 4-001148.08
CLIENT: CITY OF TEMISKAMING SHORES
DATE COMPLETED: Oct 25, 2007
BOREHOLE TYPE: 110 mm HOLLOW STEM AUGER
SUPERVISOR: SLW
GROUND ELEVATION: 239.5 mASL
REVIEWER: AGH

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT %	REMARKS
0.0									10 20 30	10 20 30	UTM CO-ORDINATES UTM Zone: 17 NAD: 27 Easting: 597357 Northing: 5262765
0.0	TOPSOIL: DARK BROWN SILTY SAND, ROOTS AND ORGANIC MATERIAL, MOIST.			SS1	14	8	47				MOE WELL TAG # A059653
1.0	SILTY SAND/SANDY SILT: LIGHT/DARK BROWN MOTTLED SILTY SAND/SANDY SILT, SOME FINE TO MEDIUM GRAVEL, SOME TO TRACE SILT, TRACE COBBLES, MOIST, COMPACT TO DENSE, TO VERY DENSE TO COMPACT.			SS2	61	8	75			61	OW25-I STICKUP = 0.81 m OW25-II STICKUP = 0.82 m OW25-III STICKUP = 0.82 m
2.0				SS3	67	9	61			67	
2.3				SS4	38	6	81				
3.0	TILL: GREY SILT TILL, SOME TO TRACE FINE SAND, SOME TO TRACE CLAY, OCCASIONAL FINE TO MEDIUM GRAVEL, OCCASIONAL COBBLES, MOIST, HARD.			SS5	190	6	78			190	
4.0				SS6	192	7	72			192	OW25-III MONITOR INSTALLED AT 4.0 m
5.0				SS7	85	9	100			85	
6.0				SS8	90	8	89			90	
7.0											
8.0				SS9	52	8	100			52	
9.0				SS10	67	9	67			67	OW25-II MONITOR INSTALLED AT 9.1 m
10.0											
10.1	CLAYEY SILT/SILTY CLAY: DARK GREY CLAYEY SILT/SILTYCLAY, TRACE FINE SAND, TRACE FINE TO MEDIUM GRAVEL, OCCASIONAL COBBLE, MOIST, HARD TO VERY HARD.			SS11	53	9	100			53	
11.0											
12.0				SS12	56	11	100			56	
13.0											
14.0				SS13	58	10	100			58	
15.0				SS14			100				
16.0											
17.0				SS15	111	11	72			111	
18.0				SS16	100	10	94				
19.0											
20.0				SS17	50	12	72				

Wp Wl

JHL GEOLOGIC B/W (METRIC) WITH UTM 4-001148-08 TEMISKAMING SHORES.GPJ JAGGER HIMS BASIC.GDT 5/15/08

BOREHOLE NO. OW 25-I

PROJECT NAME: 2007 MONITORING WELL NEST INSTALLATION
PROJECT NO.: 4-001148.08
CLIENT: CITY OF TEMISKAMING SHORES
DATE COMPLETED: Oct 25, 2007
BOREHOLE TYPE: 110 mm HOLLOW STEM AUGER
SUPERVISOR: SLW
GROUND ELEVATION: 239.5 mASL
REVIEWER: AGH

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH	WATER CONTENT % 10 20 30 / Wp Wl	UTM CO-ORDINATES UTM Zone: 17 NAD: 27 Easting: 597357 Northing: 5262765 / REMARKS
20.0	SILT: DARK GREY SILT, SOME FINE SAND, SOME CLAY, SOME TO TRACE FINE GRAVEL, OCCASIONAL COBBLE, MOIST, HARD.			SS18	92	11	100		92		
23.0				SS19	99	14	100		99		OW25-I MONITOR INSTALLED AT 22.8 m
23.3	BOREHOLE TERMINATED AT 23.3 m DUE TO AUGER REFUSAL ON ASSUMED BEDROCK.										

JHL GEOLOGIC B/W (METRIC) WITH UTM 4-00114808 TEMISKAMING SHORES.GPJ JAGGER HIMS BASIC.GDT 5/15/08

Jagger Hims Limited

RECORD OF MONITORING WELL No. OW-30-I Co-Ord. 17T 0597401 E, 5262836 N

Project Number: **TY131010.6000**
Project Client: **City of Temiskaming Shores**
Project Name: **Monitoring Well Installation Project - New Liskeard Landfill Site**
Project Location: **New Liskeard, Ontario**

Drilling Location: **East Side of Solar Farm**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **6 Sep 14** Date Completed: **7 Sep 14**

Logged by: **JS**
Compiled by: **MAT**
Reviewed by: **TIM**
Revision No.: **0, 20/11/14**

Local Ground Surface Elevation:

dark grey
SILTY SAND
some gravel and cobbles, trace clay
damp to wet, dense to very dense

AU

STICK-UP HEIGHT: 0.90 m

COMMENTS
1 riser pipe in bentonite
1 riser pipe in grout
1 riser pipe in sand
1 slotted pipe in sand

AMEC Environment & Infrastructure
A division of AMEC Americas Limited
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amec.com

Continued on Next Page

Scale: 1 : 30

RECORD OF MONITORING WELL No. OW-30-I Co-Ord. 17T 0597401 E, 5262836 N

Project Number: **TY131010.6000** Drilling Location: **East Side of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	dark grey SILTY SAND some gravel and cobbles, trace clay damp to wet, dense to very dense					7					
						8					
						9					
		SS	1	100	15			○			
						10					
		SS	2	100	21	11		○			
						12					
		SS	3	100	30			○			

Continued on Next Page

RECORD OF MONITORING WELL No. OW-30-I Co-Ord. 17T 0597401 E, 5262836 N

Project Number: **TY131010.6000** Drilling Location: **East Side of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	dark grey SILTY SAND some gravel and cobbles, trace clay damp to wet, dense to very dense					13					
		SS	4	38	100+	14			○		
						15					
		SS	5	100	65			○			
						16					
		SS	6	100	64	17		○			
						18					
		SS	7	100	78			○			
						19					

Continued on Next Page

RECORD OF MONITORING WELL No. OW-30-I Co-Ord. 17T 0597401 E, 5262836 N

Project Number: **TY131010.6000** Drilling Location: **East Side of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	dark grey SILTY SAND some gravel and cobbles, trace clay damp to wet, dense to very dense										
		SS	8	100	50+	20		○			
	END OF BOREHOLE 20.3 DUE TO REFUSAL ON PROBABLE BEDROCK OR BOULDERS										

RECORD OF MONITORING WELL No. OW-30-II Co-Ord. 17T 0597401 E, 5262836 N

Project Number: **TY131010.6000**
Project Client: **City of Temiskaming Shores**
Project Name: **Monitoring Well Installation Project - New Liskeard Landfill Site**
Project Location: **New Liskeard, Ontario**

Drilling Location: **East Side of Solar Farm**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **5 Sep 14** Date Completed: **8 Sep 14**

Logged by: **JS**
Compiled by: **MAT**
Reviewed by: **TIM**
Revision No.: **0, 20/11/14**

Local Ground Surface Elevation:

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)
	light brown to dark grey SILTY SAND some gravel damp, dense	AU	1				
		SS	2	72	21	1	
		SS	3	75	18	2	
		SS	4	89	53	3	
		SS	5	79	38		
		SS	6	100	38	4	
		SS	7	100	26	5	
						6	

FIELD TESTING: Penetration Testing (○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80); ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS
1 riser pipe in bentonite
1 riser pipe in grout
1 riser pipe in sand
1 slotted pipe in sand

STICK-UP HEIGHT: 0.93 m

AMEC Environment & Infrastructure
A division of AMEC Americas Limited
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amec.com

Continued on Next Page

Scale: 1 : 30

RECORD OF MONITORING WELL No. OW-30-II Co-Ord. 17T 0597401 E, 5262836 N

Project Number: **TY131010.6000** Drilling Location: **East Side of Solar Farm** Logged by: **JS**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING			INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80			1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	light brown to dark grey SILTY SAND some gravel damp, dense	SS	8	100	19	0		◐				
						7						
		SS	9	87	50+			○				
	END OF BOREHOLE 7.8 (no refusal)											

RECORD OF MONITORING WELL No. OW-10-III Co-Ord. 0596682 E, 5263278 N

Project Number:	TY910491.8000	Drilling Location:	North Side of Landfill	Logged by:	ARM
Project Client:	City of Temiskaming Shores	Drilling Method:	200 mm Hollow Stem Augers	Compiled by:	MAT
Project Name:	2017 Supplemental Hydrogeological Program	Drilling Machine:	Track Mounted Drill	Reviewed by:	BRG
Project Location:	New Liskeard Landfill, City of Temiskaming Shores, Ontario	Date Started:	07 Jun 17	Date Completed: 09 Jun 17	Revision No.: 1, 23/02/18

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING			COMMENTS
Lithology Plot	DESCRIPTION Local Ground Surface Elevation:	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80	INSTRUMENTATION INSTALLATION	1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	START OF CORING					0					
	BEDROCK 2.1					1					
	TCR = 78% SCR = 75% RQD = 50%	RC	1	80		2					
	TCR = 81% SCR = 83% RQD = 33% 4.0	RC	2	80		3					
	TCR = 86% SCR = 50% RQD = 26% 4.7	RC	3	86		4					
	TCR = 98% SCR = 100% RQD = 100% 5.9	RC	4	99		5					
	TCR = 98% SCR = 100% RQD = 100% 7.4	RC	5	98		6					
	TCR = 98% SCR = 100% RQD = 100% 9.0	RC	6	99		7					
	10.5					8					
						9					
						10					
						11					

Amec Foster Wheeler
Environment & Infrastructure
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amecfw.com

Continued on Next Page

▽ No freestanding groundwater measured in open borehole on completion.

Scale: 1 : 60

RECORD OF MONITORING WELL No. OW-10-III Co-Ord. 0596682 E, 5263278 N

Project Number: **TY910491.8000** Drilling Location: **North Side of Landfill** Logged by: **ARM**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	BEDROCK TCR = 92% SCR = 66% RQD = 72% TCR = 92% SCR = 66% RQD = 72%	RC	7	92							
	11.8 TCR = 100% SCR = 95% RQD = 97%	RC	8	100		12 13					
	TCR = 100% SCR = 100% RQD = 92% 13.4	RC	9	100		14					
	TCR = 100% SCR = 93% RQD = 88% 15.0	RC	10	100		15 16					
	TCR = 100% SCR = 100% RQD = 100% 16.5	RC	11	100		17 18					
	END OF CORING 18.1										

RECORD OF MONITORING WELL No. OW-25-IV Co-Ord. 0597369 E, 5262983 N

Project Number: **TY910491.8000**	Drilling Location: **Eastern Fence Line**	Logged by:	**ARM**
Project Client: **City of Temiskaming Shores**	Drilling Method: **200 mm Hollow Stem Augers**	Compiled by:	**MAT**
Project Name: **2017 Supplemental Hydrogeological Program**	Drilling Machine: **Track Mounted Drill**	Reviewed by:	**BRG**
Project Location: **New Liskeard Landfill, City of Temiskaming Shores, Ontario**	Date Started: **12 Jun 17** Date Completed: **13 Jun 17**	Revision No.:	**1, 23/02/18**

LITHOLOGY PROFILE

Lithology Plot

DESCRIPTION

Local Ground Surface Elevation:

brown
SILT & SAND
some gravel
moist

SOIL SAMPLING

Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
SS	1	30	14
SS	2	75	16
SS	3	80	52

DEPTH (m) / **ELEVATION (m)**

1 2 3 4 5 6 7 8 9 10 11

FIELD TESTING

Penetration Testing
○ SPT ● DCPT
MTO Vane* △ Intact ▲ Remould
Nilcon Vane* ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa) 20 40 60 80

★ Rinse pH Values 2 4 6 8 10 12
Soil Vapour Reading
△ parts per million (ppm) 100 200 300 400
▲ Lower Explosive Limit
✳ Passing 75 um (%)
○ Moisture Content (%)
20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

1 riser pipe in bentonite
1 riser pipe in grout
1 riser pipe in sand
1 slotted pipe in sand

amec foster wheeler
Amec Foster Wheeler
Environment & Infrastructure
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amecfw.com

Continued on Next Page

▽ No freestanding groundwater measured in open borehole on completion.

Scale: 1 : 60

RECORD OF MONITORING WELL No. OW-25-IV Co-Ord. 0597369 E, 5262983 N

Project Number: **TY910491.8000** Drilling Location: **Eastern Fence Line** Logged by: **ARM**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	brown SILT & SAND some gravel moist					12 13 14 15 16 17 18 19 20 21 22 23					

Continued on Next Page

RECORD OF MONITORING WELL No. OW-25-IV Co-Ord. 0597369 E, 5262983 N

Project Number: **TY910491.8000** Drilling Location: **Eastern Fence Line** Logged by: **ARM**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	brown SILT & SAND some gravel moist					24 25 26 27					
	START OF CORING 27.4 BEDROCK TCR = 85% SCR = 87% RQD = 64%	RC	4	85		28					
	TCR = 100% 28.8 SCR = 70% RQD = 63%	RC	5	100		29 30					
	END OF CORING 30.3										

amec foster wheeler

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present. Also, borehole information should be read in conjunction with the environmental report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 60

RECORD OF MONITORING WELL No. OW-30-III Co-Ord. 0597401 E, 5262825 N

Project Number: **TY910491.8000**
Project Client: **City of Temiskaming Shores**
Project Name: **2017 Supplemental Hydrogeological Program**
Project Location: **New Liskeard Landfill, City of Temiskaming Shores, Ontario**

Drilling Location: **Eastern Fence Line**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **15 May 17** Date Completed: **17 May 17**

Logged by: **ARM**
Compiled by: **MAT**
Reviewed by: **BRG**
Revision No.: **1, 23/02/18**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION Local Ground Surface Elevation:	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	brown SILTY SAND trace clay and gravel moist to wet	SS	1	67	3	0		○			
		SS	2	51	22	1		○			
	brown 1.2 SAND some silt, trace gravel moist to wet	SS	3	59	54	2		○			
						3					
						4					
						5					
						6					
						7					
						8					
						9					
						10					
						11					

Amec Foster Wheeler
Environment & Infrastructure
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amecfw.com

Continued on Next Page

▽ No freestanding groundwater measured in open borehole on completion.

Scale: 1 : 60

RECORD OF MONITORING WELL No. OW-30-III Co-Ord. 0597401 E, 5262825 N

Project Number: **TY910491.8000** Drilling Location: **Eastern Fence Line** Logged by: **ARM**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	brown SAND some silt, trace gravel moist to wet					12 13 14 15 16 17 18 19					
	START CORING 20.0 brown SAND & CLAY some gravel, trace silt compressed, moist	RC				20 21 22					
	brown 22.3 SANDSTONE oxidation, wet	RC		100		23					

Continued on Next Page

RECORD OF MONITORING WELL No. OW-30-III Co-Ord. 0597401 E, 5262825 N

Project Number: **TY910491.8000** Drilling Location: **Eastern Fence Line** Logged by: **ARM**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING		INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit; ✳ Passing 75 um (%); ○ Moisture Content (%) 20 40 60 80		1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	brown SANDSTONE oxidation, wet										
	TCR = 100% SCR = 83% RQD = 0% 23.9	RC		32		24					
	TCR = 32% SCR = 76% RQD = 7%					25					
	TCR = 84% SCR = 48% RQD = 24% 25.4	RC		84		26					
	TCR = 100% SCR = 85% RQD = 70% 26.6	RC		100		27					
	TCR = 92% SCR = 95% RQD = 96% 27.3	RC		92		28					
	TCR = 100% SCR = 97% RQD = 95% 28.8	RC		100		29					
						30					
	END OF CORING 30.4										

RECORD OF MONITORING WELL No. OW-31-I

Project Number: **TY910491.8000**
Project Client: **City of Temiskaming Shores**
Project Name: **2017 Supplemental Hydrogeological Program**
Project Location: **New Liskeard Landfill, City of Temiskaming Shores, Ontario**

Drilling Location: **Eastern Fence Line**
Drilling Method: **200 mm Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **18 May 17** Date Completed: **18 May 17**

Logged by: **ARM**
Compiled by: **MAT**
Reviewed by: **BRG**
Revision No.: **1, 23/02/18**

Local Ground Surface Elevation:

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)
	150 mm ORGANICS over						
	grey SILT 0.4 trace clay moist						
	brown SAND & GRAVEL trace silt and clay increasing silt and clay content with depth wet	AU				1 2 3 4 5 6 7	
	END OF BOREHOLE 7.6 (no refusal)						

FIELD TESTING

Penetration Testing: ○ SPT ● DCPT
MTO Vane*: △ Intact ▲ Remould
Nilcon Vane*: ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa): 20 40 60 80

★ Rinse pH Values: 2 4 6 8 10 12
Soil Vapour Reading: △ parts per million (ppm): 100 200 300 400
▲ Lower Explosive Limit
✳ Passing 75 um (%)
○ Moisture Content (%): 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

1 riser pipe in bentonite
1 riser pipe in grout
1 riser pipe in sand
1 slotted pipe in sand

Amec Foster Wheeler
Environment & Infrastructure
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amecfw.com

▽ No freestanding groundwater measured in open borehole on completion.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present. Also, borehole information should be read in conjunction with the environmental report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 60

RECORD OF MONITORING WELL No. OW-31-II Co-Ord. 0597398 E, 5262893 N

Project Number: **TY910491.8000**	Drilling Location: **Eastern Fence Line**	Logged by:	**ARM**
Project Client: **City of Temiskaming Shores**	Drilling Method: **200 mm Hollow Stem Augers**	Compiled by:	**MAT**
Project Name: **2017 Supplemental Hydrogeological Program**	Drilling Machine: **Track Mounted Drill**	Reviewed by:	**BRG**
Project Location: **New Liskeard Landfill, City of Temiskaming Shores, Ontario**	Date Started: **18 May 17** Date Completed: **18 May 17**	Revision No.:	**1, 23/02/18**

Local Ground Surface Elevation:

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)
	150 mm ORGANICS over						
	grey SILT trace clay moist	SS	1	100	24		
	0.4						
	brown SAND & GRAVEL trace silt and clay increasing silt and clay content with depth wet	SS	2	5	67	1	
		SS	3	33	40	2	
		SS	4	100	48	3	
		SS	5	16	41	4	
		SS	6	100	44	5	
		SS	7	100	40	6	
		SS	8	59	40	7	
		SS	9	100	27	8	
		SS	10	100	38	9	
						10	
	10.7					11	

FIELD TESTING

Penetration Testing: ○ SPT ● DCPT

MTO Vane*: △ Intact ▲ Remould

Nilcon Vane*: ◇ Intact ◆ Remould

* Undrained Shear Strength (kPa): 20 40 60 80

★ Rinse pH Values: 2 4 6 8 10 12

Soil Vapour Reading: △ parts per million (ppm): 100 200 300 400

▲ Lower Explosive Limit

✳ Passing 75 um (%)

○ Moisture Content (%): 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

1 riser pipe in bentonite
1 riser pipe in grout
1 riser pipe in sand
1 slotted pipe in sand

Amec Foster Wheeler
Environment & Infrastructure
131 Fielding Road
Lively, Ontario
Canada P3Y 1L7
Tel +1(705) 682-2632
Fax +1(705) 682-2260
www.amecfw.com

Continued on Next Page

▽ No freestanding groundwater measured in open borehole on completion.

Scale: 1 : 60

RECORD OF MONITORING WELL No. OW-31-II Co-Ord. 0597398 E, 5262893 N

Project Number: **TY910491.8000** Drilling Location: **Eastern Fence Line** Logged by: **ARM**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING			COMMENTS
Lithology Plot	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit ✳ Passing 75 um (%) ○ Moisture Content (%) 20 40 60 80	INSTRUMENTATION INSTALLATION	1 riser pipe in bentonite 1 riser pipe in grout 1 riser pipe in sand 1 slotted pipe in sand
	brown SILTY SAND some gravel moist		SS	11	75	30	12					
			SS	12	59	40	13					
			SS	13	72	51	14					
	brown SAND & GRAVEL moist	15.3	SS	14	42	78	15					
	END OF BOREHOLE DUE TO REFUSAL ON POSSIBLE COBBLE / BOULDERS OR BEDROCK	15.9										

amec foster wheeler

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present. Also, borehole information should be read in conjunction with the environmental report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 60

Appendix C

Summary of Groundwater Elevations

Summary of Groundwater Elevations

Monitor No.	UTM Coordinates		Current Measuring Point Elevation (masl)[1]	Elevation of Water (masl)[1]																										
	Easting	Northing		Jun-10	Sep-10	Nov-10	Jun-11	Sep-11	Nov-11	Jun-12	Sep-12	Nov-12	May-13	Jul-13	Sep-13	Jun-14	Jul-14	Sep-14	May-15	Jul-15	Sep-15	May-16	Jul-16	Sep-16	May-17	Jul-17	Sep-17	May-18	Jul-18	Oct-18
OW-1R-I	596848	5262959	254.17	251.84	251.87	252.02	251.87	251.10	252.04	251.63	251.46	252.22	251.99	251.36	251.62	251.84	251.22	251.72	251.60	250.82	250.95	251.90	251.20	250.61	251.84	251.53	251.59	251.98	251.38	251.53
OW-1R-II	596848	5262959	254.06	251.50	251.72	251.89	251.80	251.01	251.93	251.50	251.22	252.08	251.76	251.16	251.39	251.61	251.02	251.62	251.41	250.87	251.01	251.55	250.97	250.72	251.59	251.49	251.56	251.89	251.22	251.50
OW-1R-III	596848	5262959	254.19	252.16	252.56	252.64	252.51	251.87	252.66	252.29	252.09	252.79	252.91	252.20	252.42	252.97	252.16	252.74	252.76	252.15	252.47	252.85	252.99	251.96	252.75	252.36	252.41	252.77	252.25	252.38
OW-2B	596919	5263040	247.26	246.17	246.38	245.41	246.37	245.69	246.37	246.13	246.21	246.40	246.79	246.26	246.52	ND	246.31	Decommissioned												
OW-2C	596919	5263040	247.14	245.03	245.05	245.31	245.27	244.57	245.40	245.14	245.20	245.41	245.18	245.04	245.18	ND	245.11	Decommissioned												
OW-3A	596974	5263111	244.55	242.57	243.38	243.40	243.32			242.62	242.78	243.31	243.29	242.89	243.22	243.28	242.41	Decommissioned												
OW-3B	596974	5263111	244.50	242.94	243.68	243.69	243.59	242.07	243.57	242.91	243.09	243.57	243.57	243.11	243.42	243.55	242.67	Decommissioned												
OW-4A	596978	5262870	251.20	250.10	250.18	250.18	250.12	250.13		249.96	250.05	250.11	250.07	249.62	250.14	250.14	249.23	Decommissioned												
OW-4C	596978	5262870	251.31	249.64	249.78	249.79	249.43	249.15	249.58	249.37	249.34	249.45	248.96	248.61	248.89	249.52	249.85	Decommissioned												
OW-5A	596879	5262883	253.48	253.18	253.27	253.32	253.30	253.19	253.32	253.14	253.12	253.34	250.31	250.15	250.23	250.32	250.09	Decommissioned												
OW-6A	596973	5262769	254.32	253.01	253.17	253.20	253.12	252.96		252.96	253.05	253.19	253.16	253.02	253.10	253.15	252.93	Decommissioned												
OW-6B	596973	5262769	254.35	252.53	252.64	252.71	252.56	252.43	252.68	252.51	252.61	252.76	252.29	252.23	252.30	252.34	252.28	Decommissioned												
OW-7A	596895	5262781	255.83	255.35	255.32	255.48	255.42	255.29	255.51	255.35	255.20	255.59	ND	ND	252.19	252.45	252.22	Decommissioned												
OW-7B	596895	5262781	256.01										ND	ND	252.25	252.51	252.26	Decommissioned												
OW-7C	596895	5262781	255.90									251.33	ND	ND	248.15	248.30	248.13	Decommissioned												
OW-8A	597088	5262770	249.47										248.30	247.35	Damaged	248.15	248.03	Decommissioned												
OW-8B	597088	5262770	249.54	Destroyed																										
OW-9A	597071	5262876	247.25	245.55	246.29	246.30	246.26	244.85	246.25	245.83	245.55	246.27	246.11	245.15	245.72	245.45	245.45	Decommissioned												
OW-9B	597071	5262876	247.33	245.31	245.83	245.81	245.78	244.62	245.77	245.47	246.03	245.81	245.79	244.89	245.48	245.14	245.36	Decommissioned												
OW-10-I	596724	5263229	251.67	248.84	249.84	249.81	249.41	248.57	249.77	249.05	249.42	249.82	249.79	249.01	249.76	249.76	248.82	249.78	249.68	248.85	249.28	249.79	247.85	248.52	249.64	249.15	249.43	249.57	248.63	249.61
OW-10-II	596724	5263229	251.69	248.99	250.52	250.42	249.90	248.61	250.37	249.31	249.80	250.44	250.43	249.18	250.21	250.31	248.99	250.14	250.16	248.92	249.71	250.27	248.86	248.50	250.25	249.56	249.91	250.22	248.63	249.97
OW-10-III	596724	5263229	ND																								ND	ND	ND	ND
OW-11-I	597001	5263159	242.93	240.97	240.81	239.82	241.03	240.53	240.21	240.81	240.79	241.00	241.02	241.08	241.07	241.18	240.33	241.03	241.13	240.47	239.91	240.93	240.54	238.90	240.61	240.86	240.88	240.90	240.29	240.71
OW-11-II	597001	5263159	242.82	241.07	241.65	241.62	241.43	240.17	241.62	240.94	241.05	241.67	241.23	241.02	240.14	241.37	240.82	241.27	241.34	240.80	240.73	241.34	240.26	240.34	241.31	240.76	240.94	241.30	240.44	240.85
OW-12-I	597007	5262919	248.92	247.31	247.69	247.66	247.57	246.81	247.55	247.30	247.39	247.62	247.09	246.54	246.86	246.73	246.69	246.86	247.10	246.74	246.97	247.07	246.40	246.48	247.03	246.83	246.92	247.03	246.79	247.05
OW-12-II	597007	5262919	248.95	247.26	247.65	247.61	247.51	246.85	247.53	247.20	247.50	247.59	247.04	246.55	246.89	246.86	246.69	246.91	247.22	246.79	247.11	247.17	246.46	246.55	247.15	246.85	246.98	247.11	246.91	247.02
OW-13-I	596602	5262921	273.70	264.23	264.55	265.48	264.31	263.86	265.62	264.28	264.04	266.16	266.43	264.13	264.29	264.94	264.02	264.71	264.77	264.12	264.27	265.64	264.13	263.78	265.02	264.26	264.24	265.31	263.94	264.03
OW-13-II	596602	5262921	273.85	268.61	268.58	268.67		268.56	268.68	268.61	268.55	268.67	268.67	268.82	268.56	268.66	268.59	268.64	268.67	268.60	268.47	268.66	268.57	268.52	268.62	268.59	268.61	268.72	268.53	268.47
OW-14-I	596977	5262674	258.81	254.34	254.41	254.45	254.37	254.17	254.44	254.28	254.34	254.55	254.11	253.57	253.80	253.95	253.76	254.03	254.02	253.74	253.41	254.05	253.77	253.78	254.05	253.95	253.99	254.06	253.76	253.00
OW-14-II	596977	5262674	258.72	254.86	255.07	255.15	254.90	254.83	254.95	254.84	254.86	255.08	255.16	254.90	254.90	255.09	254.88	254.99	254.97	254.84	254.50	255.12	254.86	254.83	255.03	254.88	254.88	255.04	254.86	254.89
OW-15-I	597059	5262605	254.32	251.58	251.52	251.82	251.37	251.18	251.35	251.30	251.15	251.64	Destroyed																	
OW-15-II	597059	5262605	254.40	252.82	253.37	253.42	253.32		253.33	252.81	253.08	253.34	Destroyed																	
OW-16-I	597372	5263132	238.59	234.46	233.58	233.50	234.34	233.65	234.11	234.38	233.34	234.15	234.98	234.78	234.42	235.16	234.66	234.94	235.22	234.91	234.29	235.29	234.69	234.14	234.91	234.81	236.06	234.94	234.57	234.07
OW-16-II	597372	5263132	238.73	236.32	234.28	231.62	235.50	232.60	232.11	235.40	232.48	231.68	235.30	232.53	232.41	235.67	232.74	233.95	235.56	232.22	231.77	236.25	234.14	234.69	236.08	233.75	234.44	235.49	232.38	233.30
OW-16-III	597372	5263132	238.78	236.54	235.84	237.51	237.06	235.12	237.48	236.75	235.17	237.51	237.26	236.30	237.14	236.74	236.27	236.81	237.07	236.37	236.82	237.35	235.64	235.98	237.38	236.59	236.93	237.23	235.58	237.29
OW-17-I	597359	5263362	230.08	229.06	228.12	228.36	228.95	228.26	228.74	228.97	228.08	228.76	229.46	229.25	228.97	229.60	229.23	229.34	229.54	229.35	228.93	229.67	229.21	228.68	229.39	229.24	229.14	229.44	229.00	228.58
OW-17-II	597359	5263362	229.88	227.85	226.46	226.08	227.85	226.57	226.68	227.81	226.21	226.62	228.51	227.46	226.83	228.51	226.16	227.31	228.64	227.54	226.38	228.67	226.29	226.48	228.21	227.59	226.96	228.42	227.09	226.50
OW-17-III	597359	5263362	230.04	227.33		227.23	227.94		227.68	227.54	226.20	228.54	228.98	226.64	<226.26	228.54	227.32	227.11	228.64	226.54	<226.26	228.86	227.76	<226.26	228.71	226.89	<226.26	228.64	<226.26	<226.26
OW-18-I	596771	5262904	280.52										<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.48	<273.49	<273.50	<273.51
OW-20-I	596970	5262468	259.31	257.30	257.47	257.94	257.59	257.03	257.97	257.42	257.29	258.17	258.06	257.42	257.71	257.67	257.24	257.86	257.67	257.35	257.09	257.76	257.28	256.82	257.81	257.61	257.82	257.80	257.09	257.61
OW-20-II	596970	5262468	259.19	257.19	257.45	257.94	257.62	256.71	257.94	257.34	257.02	258.16	258.30	257.71	258.02	258.01	257.45	258.06	257.98	257.52	257.55	258.08	257.44	256.95	258.12	257.75	257.92	258.14	257.28	257.77
OW-21-I	597141	526527	ND	251.75	252.37	252.50	252.28	250.76	252.38	251.78	251.85	252.40	252.44	251.92	252.30	252.54	Destroyed	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OW-22-I	596974	5262607	258.63	255.66	256.04	256.14	255.96	255.23	256.10	255.69	255.60	256.19	256.26	255.68	255.79	256.13	255.59	256.01	256.02	255.63	255.25	256.14	255.61	255.15	256.12	255.85	255.90	256.17	255.48	255.67
OW-23-I	597678	5263239	202.71	196.94	196.16	196.55	197.34	196.68	196.84	197.22	196.05	196.58	197.29	197.01	196.70	197.80	197.21	197.35	197.55	197.10	196.68	197.77	197.24	196.54	196.82	196.60	191.74	196.71	196.21	195.84
OW-23-II	597678	5263239	203.02	197.21	193.17	191.44	196.86	191.49	191.54	197.29	192.25	191.24	196.07	193.50	192.52	197.51	194.78	193.80	197.93	192.35	192.56	197.92	195.14	192.62	196.69	193.40	196.70	196.48	192.06	192.01
OW-24-I	597372	5263251	ND	229.83	228.75	229.07	229.82	228.86	229.43	229.73	228.64	229.45	230.27	230.02	229.67	Destroyed		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OW-24-II	597372	5263251	236.99	232.82	229.36	234.57	233.49	230.36	235.13	233.32	229.39	235.62	235.82	233.35	234.16	Destroyed		235.00	234.64	233.63	234.87	235.39	232.97	232.18	235.18	234.20	234.79	235.27	233.27	235.22
OW-24-III	597372	5263251	236.66	232.84	231.08	234.59	231.01	231.08	235.13	233.32	231.09	235.63	235.81	233.34	234.20	234.89	233.77	234.93	234.41	233.68	234.63	234.84	232.72	231.97	234.72	234.16	234.55	235.28	233.30	235.23
OW-25-I	597370	5263000	240.33	234.41	233.30	233.50	234.39	233.46	234.12	234.27	233.25	234.34	235.00	234.68	234.40	235.12	234.56	234.90	235.17	234.72	234.19	235.23	234.49	233.98	234.82	234.64	234.54	234.91	234.35	233.90
OW-25-II	597370	5263000	240.38	236.87	236.03	233.36	236.49	235.75	234.98	236.49	235.76	234.89	236.01	234.44	235.76	235.98	235.13	235.68	235.46	233.18	235.53	236.41	236.08	235.05	236.04	235.27	236.11	235.02	234.73	235.37
OW-25-III	597370	5263000	240.36	238.62	239.00	239.22	238.91	236.82	239.08	238.61	238.14	239.10	238.88	237.53	238.55	238.18	237.54	238.07	238.27	237.70	238.60	238.82	237.30	235.71	238.78	237.94	238.23	238.48	236.31	238.78
OW-25-IV	597370	5263000	239.89																								234.05	234.43	234.20	233.62
OW-30-I	597401	5262836	241.43															228.48	236.95	229.26	231.29	237.54	232.53	230.69	234.73	232.33	232.13	234.90	230.55	231.36
OW-30-II	597401	5262836	241.56															234.55	237.25	238.29	238.09	238.53	238.11	237.96	238.88	238.53	238.72	238.13	237.77	238.36
OW-30-III	597401	5262836	241.35																								234.43	234.77	234.25	233.84
OW-31-I	597398	5262893	240.19																								238.70	233.85	232.49	232.67
OW-31-II	597398	5262893	240.20																								236.89	234.49	235.58	236.57

Notes:
(1) masl - metres above sea level.
(2) ND - no current elevation data available.

Appendix D

Monthly Inspection Report

MONTHLY INSPECTION REPORT
New Liskeard Waste Disposal Site

DATE: _____ INSPECTION PERFORMED BY: _____
TIME: _____ _____
_____

WEATHER: _____
_____

TEMP: _____°C WIND DIRECTION:_____ WIND SPEED:_____km/hr

A. GENERAL

		YES	NO	N/A	COMMENTS
1	Site Open				
2	Gatehouse Attendant on Site				
3	Landfill Operator on Site				
4	Waste dumping being monitored				
5	Adequate signage				
6	Overall Site appearance satisfactory				
7	Adequate visual screening of activities				
8	Adequate control of noise				
9	Effort being made to control litter				
10	Litter control fences in proper position				
11	Litter control fences well maintained				
12	Blowing litter visible outside the active disposal area				
13	Blowing litter picked up beyond the disposal area				
14	Adequate placement of daily cover				
15	Adequate stockpiles of daily cover				
16	Adequate compaction of waste				
17	Evidence of vector or vermin				
18	Perimeter fencing in good condition				
19	Gates locked when Site is closed				
20	Site entrance road properly cleaned and maintained				
21	Ground water monitoring wells in good condition				
22	Additional comments				

MONTHLY INSPECTION REPORT
New Liskeard Waste Disposal Site

B. SURFACE WATER CONTROL

		YES	NO	N/A	COMMENTS
1	Surface water diverted from exposed waste				
2	Contaminated surface water handled as leachate				
3	Containment berm in good condition				
4	Infiltration basin free from sediment accumulation				
5	Swales free from sediment accumulation				
6	Silt curtains adequately maintained				
7	Sufficient silt curtains in place				
8	Ditch inlets free from blockages				
9	Culverts free from blockages				
10	Vegetated swales in good condition				
11	Additional comments				

C. LANDFILL GAS

		YES	NO	N/A	COMMENTS
1	Identifiable landfill gas odours				
2	Additional comments				

D. SITE RESTORATION

		YES	NO	N/A	COMMENTS
1	Adequate interim cover on inactive disposal areas				
2	Final cover placed on completed areas				
3	Topsoil placed on completed areas				
4	Evidence of stressed vegetation				
5	Evidence of erosion				
6	Evidence of leachate seeps				
7	Evidence of differential settlement				
8	Additional comments				

Appendix E

Proposed Water Quality Monitoring Network
Long-Term Monitoring Program

Groundwater Monitoring Well Locations and Construction Details

Groundwater Monitoring Location ID	Coordinates (Zone 16, NAD 83)		Condition	Total Depth (mbgs)	Screened Interval (mbgs)	Unit Screened	On-Site Position
	Easting	Northing					
OW-1R-I	596848	5262959	Good	20.3	17.3 – 20.3	Limestone Bedrock	Source
OW-1R-III			Good	4.2	1.2 – 4.2	Silty Sand / Limestone Bedrock	Source
OW-10-I	596724	5263229	Good	5.5	4.0 – 5.5	Limestone Bedrock	Crossgradient
OW-10-II			Good	2.4	0.9 – 2.4	Silt	Crossgradient
OW-10-III			Good	18.1	12.1 - 18.1	Bedrock	Crossgradient
OW-11-I	597001	5263159	Good	5.5	4.0 – 5.5	Limestone Bedrock	Downgradient
OW-11-II			Heaved	2.3	0.8 – 2.3	Silt / Bedrock	Downgradient
OW-12-I	597007	5262919	Good	5.5	4.0 – 5.5	Limestone Bedrock	Downgradient
OW-12-II			Good	2.2	0.7 – 2.2	Silt / Bedrock	Downgradient
OW-13-I	596602	5262921	Good	10.8	7.8 – 10.8	Bedrock	Upgradient
OW-16-I	597372	5263132	Good	23.1	20.1 – 23.1	Silty Sand	CAZ Boundary
OW-16-II			Good	7.5	4.5 – 7.5	Silt	CAZ Boundary
OW-16-III			Good	4.0	1.0 – 4.0	Silty Sand / Silt	CAZ Boundary
OW-17-I	597359	5263362	Good	11.9	8.9 – 11.9	Silty Sand	Downgradient of CAZ
OW-17-II			Good	7.5	4.5 – 7.5	Sandy Silt	Downgradient of CAZ
OW-17-III			Good	3.2	0.2 – 3.2	Silty Clay / Sand	Downgradient of CAZ
OW-23-I	597678	5263239	Good	18.1	15.1 – 18.1	Sandy Silt	Downgradient Sentinel
OW-23-II			Good	13.0	10.0 – 13.0	Clayey Silt / Sandy Silt	Downgradient Sentinel
OW-24-I	597372	5263251	Good	18.7	17.2 – 18.7	Sand	CAZ Boundary
OW-24-II			Good	8.4	6.9 – 8.4	Silty Clay / Sandy Silt	CAZ Boundary
OW-24-III			Good	4.9	3.4 – 4.9	Silty Clay / Clayey Silt	CAZ Boundary
OW-25-I	597370	5263000	Good	22.8	21.3 – 22.8	Silt	CAZ Boundary
OW-25-II			Good	9.1	7.6 – 9.1	Silt	CAZ Boundary
OW-25-III			Good	4.0	2.5 – 4.0	Silt	CAZ Boundary
OW-25-IV			Good	30.3	27.3 - 30.3	Bedrock	CAZ Boundary
OW-30-I	597401	5262836	Good	20.3	17.3 – 20.3	Silty Sand	CAZ Boundary
OW-30-II			Good	7.8	4.8 – 7.8	Silty Sand	CAZ Boundary
OW-30-III			Good	30.4	27.4 - 30.4	Sandstone	CAZ Boundary
OW-31-I	597398	5262893	Good	7.6	4.6 - 7.6	Sand and Gravel	CAZ Boundary
OW-31-II			Good	15.9	12.9 - 15.9	Silty Sand / Sand and Gravel	CAZ Boundary

Notes:
1) mbgs - metres below ground surface.

Residential Well Supply Well Locations

Residential Monitoring Location ID	Coordinates Zone 16 NAD 83	
	Easting	Northing
WS-7	597484	5263623
WS-8	597497	5263589
WS-9	597857	5263155
WS-13	597321	5263658
WS-14	597770	5263282
WS-15	597818	5263188
WS-16	597744	5263356

Surface Water Monitoring Stations Summary

Surface Water Monitoring Station ID	Coordinates Zone 16 NAD 83		Watercourse	Position
	Easting	Northing		
SW-1	595598	5262440	South Wabi Creek	Upstream
SW-2	597779	5263227	Unnamed Tributary to the Wabi River	Downstream
SW-3	598065	5263297	Unnamed Tributary to the Wabi River	Downstream
SW-4	598707	5263742	Unnamed Tributary to the Wabi River	Downstream
SW-5	598717	5263939	Wabi River	Downstream
SW-6	598864	5263692	Wabi River	Downstream

Appendix F

Proposed Water Quality Analyte List
Long-Term Monitoring Program

Groundwater Analytical Parameters

General Chemistry		Metals	
Alkalinity	Total Kjeldahl Nitrogen	Aluminum	Molybdenum
Ammonia as N		Arsenic	Nickel
Chloride		Barium	Potassium
Dissolved Organic Carbon		Beryllium	Selenium
Electrical Conductivity		Bismuth	Silicon
Fluoride		Boron	Silver
Nitrate as N		Cadmium	Sodium
Nitrite as N		Calcium	Strontium
Organic Nitrogen		Chromium	Sulfur
pH		Cobalt	Thallium
Phosphate as P		Copper	Tin
Phosphorus		Iron	Titanium
Sulphate		Lead	Uranium
Total Hardness		Manganese	Vanadium
Total Dissolved Solids		Magnesium	Zinc

Surface Water Analytical Parameters - Column 4 of Schedule 5

General Chemistry		Metals	
Alkalinity (as CaCO3)	pH	Iron	
Ammonia as N	Phenols		
BOD (5)	Sulphate		
Chemical Oxygen Demand	Total Dissolved Solids		
Chloride	Total Kjeldahl Nitrogen		
Electrical Conductivity	Total Phosphorus		
Nitrate as N	Total Suspended Solids		
Nitrite as N			

Surface Water Analytical Parameters - Column 3 of Schedule 5

General Chemistry		Metals	
Alkalinity (as CaCO3)	pH	Arsenic	Dissolved Mercury
Ammonia as N	Phenols	Barium	
BOD (5)	Sulphate	Boron	
Chemical Oxygen Demand	Total Dissolved Solids	Cadmium	
Chloride	Total Kjeldahl Nitrogen	Chromium	
Electrical Conductivity	Total Phosphorus	Copper	
Nitrate as N	Total Suspended Solids	Iron	
Nitrite as N		Lead	