

# HOLBROOK LANDFILL 2022 WATER MONITORING REPORT

**COUNTY OF OXFORD** 

PROJECT NO.: 111-53037-06 DATE: MARCH 02, 2023

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March 02, 2023

Mr. Frank Gross, C.Tech Manager of Transportation & Waste County of Oxford 21 Reeve Street, Woodstock, Ontario N4S 7Y3

Dear Sir:

Subject: Holbrook Landfill, County of Oxford

**2022 Water Monitoring Report** 

We are pleased to provide one (1) digital copy of the 2022 Water Monitoring Report for the closed Holbrook Landfill.

The report contains a discussion of the results of the monitoring completed in 2022, including an assessment of compliance, and provides conclusions and recommendations. Technical data are appended.

The "Monitoring and Screening Checklist" with signed declaration, as per the Ministry of the Environment, Conservation and Parks (MECP) Technical Guidance Document – Monitoring and Reporting for Waste Disposal Sites is provided in Appendix G.

Yours truly,

WSP Canada Inc.

alles Sunt

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Project Engineer
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WSP ref.: 111-53037-06

# EXECUTIVE SUMMARY

The closed Holbrook Landfill (site) is located on Part of Lots 20 and 21, Concession III near the village of Holbrook in the Township of Norwich. The site is located north of Quaker Street (Norwich Road 3), and is bounded by agricultural land to the east and west, and Long Point Region Conservation Authority (LPRCA) wetlands to the north and south. It is understood that the landfill site originally started accepting waste around 1970, and was assumed by the County of Oxford in 1982. The landfill operated until July 1986, at which time it was capped and seeded as part of the staged development and closure of the site. The closed site is currently operated under Ministry of the Environment, Conservation and Parks (MECP) Amended Environmental Compliance Approval (ECA) No. A070702, dated March 6, 2018. The 2022 annual monitoring program was completed at the site in accordance with ECA requirements.

Groundwater movement in the shallow flow system across most of the site is inferred to be southwesterly towards the on-site creek, while shallow groundwater movement in the western portion of the site (west of the creek) is inferred to flow east towards the creek. However, the shallow flow system groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. Thus, groundwater flow in the shallow flow system across the majority of the site is inferred to converge on the on-site stream, with a minor component of localized shallow groundwater flow from the fill area toward the east and southeast.

Groundwater movement in the deeper flow system is inferred to be in a generally south to southeasterly direction beneath the site. The horizontal hydraulic gradient across the site is low, with a grade change of less than 1 m from the north to southeast limits of the site.

There may have been some historical landfill impacts in a number of the shallow groundwater flow system wells adjacent to the northeast and particularly to the east and southeast of the landfill; however, most of these have abated such that there was no clear indication of leachate influence in the shallow observation wells at the downgradient property boundaries to the east/southeast at the site during 2022. The shallow groundwater quality complies with Guideline B-7 (as established by the MECP as a mechanism to assess the acceptable level of leachate impacts on the groundwater system), with the exception of hardness, chloride, alkalinity, sodium and dissolved organic carbon (DOC) at observation well 26R, and hardness and nitrate at well 44. Concentrations of hardness are interpreted to be naturally elevated in the shallow flow system. The nitrate exceedance at well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate; the concentration is likely the result of agricultural activities that surround this well location. It is inferred that road salting and/or off-site sources are a contributing factor in the exceedances at observation well 26R. Based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Groundwater appears to flow north from the property boundary at 26R toward monitoring well 46. Meanwhile, key parameter concentrations within monitoring wells 45 and 46 were well below the concentrations at 26R.

There was no clear indication of leachate influence in the deeper groundwater flow system at the property boundaries in 2022. The deep groundwater quality complies with Guideline B-7, with the exception of hardness and iron at wells 27, 37R and 38. Concentrations of hardness and iron are interpreted to be naturally elevated in the deep flow system.

None of the groundwater trigger criteria at the site were exceeded during 2022, with the exception of the chloride concentration at observation well 26R. Based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound.

Surface water quality in the wetland at the northeast site boundary, and the northern and southeast on-site retention ponds was not measurably affected by the landfill in 2022. Surface water quality at intermediate station C04 along the on-site stream and retention pond P02 in the central part of the site were inferred to be slightly influenced by the landfill. Surface water quality in the on-site stream leaving the site (station C01) has been affected by landfill influences from the upstream portions of the on-site stream, shallow groundwater discharge, and possibly road salting activities. However, the landfill influences in the surface water quality leaving the site are very weak, based on the monitoring results, with chloride values below the Canadian Environmental Quality Guideline (CEQG) water quality guideline for the protection of aquatic life. Surface water quality leaving the site at station C01 complies with the current trigger level boundary criteria.

No methane was detected during the 2022 monitoring event at any of the landfill gas monitoring probes, located adjacent to the east, northeast, and north of the landfill mound.

Based on the findings of the 2022 monitoring program, it is recommended that the monitoring program outlined within this report be continued at the site in 2023.

## SIGNATURES

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- A CERTIFICATES OF APPROVAL
- **B** BOREHOLE LOGS
- C GROUNDWATER ELEVATION DATA
- D GROUNDWATER CHEMISTRY
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- F LABORATORY CERTIFICATES OF ANALYSIS
- **G** MONITORING AND SCREENING CHECKLIST

# 1 INTRODUCTION

### 1.1 BACKGROUND

The closed Holbrook Landfill (site) is located on Part of Lots 20 and 21, Concession III near the village of Holbrook in the Township of Norwich. The site is located north of Quaker Street (Norwich Road 3), and is bounded by agricultural land to the east and west, and Long Point Region Conservation Authority (LPRCA) wetlands to the north and south. The general site location is shown on Figure 1.

It is understood that the landfill site was originally owned by Ingersoll Sanitation Ltd. and started accepting waste around 1970. The site was subsequently owned and operated by Superior Sanitation Services Inc. before the County of Oxford assumed the site in January 1982. The landfill operated until July 1986, at which time it was capped and seeded as part of the staged development and closure of the site. During County ownership from January 1982 until July 1986, the site received only domestic, commercial, and non-hazardous industrial solid waste.

The site operated under Provisional Certificate of Approval (CofA) No. A070702 issued on March 31, 1983 which permitted landfilling at the site until June 30, 1984. It is understood that the County subsequently obtained an extension of the CofA from June 1984, until the site was closed in 1986. A copy of the site CofA (Waste) is provided in Appendix A.

The County purchased the property to the east of the landfill for use as a buffer zone on August 15, 1990.

Following closure of the site, the County monitored the groundwater and surface water quality at the site, while the Ministry of the Environment, Conservation and Parks (MECP) monitored off-site domestic wells in the area. The monitoring data since closure was reviewed by Charlesworth & Associates in 1996 and a revised monitoring program was recommended. The MECP approved the revised monitoring program for the site, which has been undertaken by the County on an annual basis. The groundwater and surface water monitoring locations are shown on the Site Plan, Figure 2.

On September 8, 2016, the site CofA (Waste) was updated by the MECP to Amended Environmental Compliance Approval (ECA) No. A070702. The new approval incorporated the County owned buffer lands to the east of the landfill into a Contaminant Attenuation Zone (CAZ). As part of the new ECA, a closure plan was submitted to the MECP, which included a trigger mechanism and contingency plan as well as a new monitoring program. The closure plan was accepted by the MECP in Notice No. 1 of the ECA, dated March 6, 2018.

WSP Canada Inc. (WSP) was retained by the County to complete the 2022 annual monitoring program at the site.

### 1.2 SUPPLEMENTAL INVESTIGATIONS

### 1.2.1 WELL NETWORK UPGRADE PROGRAM 2013-2015

In 2012, GENIVAR (now called WSP) completed a site survey, well network inspection and hydrogeological assessment work program at the site (GENIVAR, 2013). The work program followed the recommendations

provided in the 2010 Water Monitoring Report as well as the MECP review of the 2009 Water Monitoring Report, as outlined in their letter dated April 4, 2011.

Additional borehole logs, historic groundwater elevation data and geological cross-sections from this program have been incorporated into this report.

Based on the results of the well inspection and hydrogeological assessment program, it was recommended that the monitoring network at the Site be upgraded. This work program would include the drilling and installation of new wells, decommissioning and replacement of existing wells and completion of a Site survey, among other things. The well network upgrades were completed in a phased approach.

Phase I of the work program was completed in the summer of 2013 and included the decommissioning of well 17, drilling and installation of background wells 39 and 40, and the drilling and installation of leachate well 41. The locations of the installed wells are shown on the Site Plan, Figure 2. Wells 39, 40 and 41 were surveyed and incorporated into the annual monitoring program in 2014.

Phase II of the well network upgrade program was completed in the fall of 2014. This work program included the decommissioning of 15 wells, drilling and installation of 9 replacement wells, and installation of a single staff gauge. The locations of the installed wells and staff gauge are shown on the Site Plan, Figure 2. The replacement wells and new staff gauge were surveyed and incorporated into the 2015 annual monitoring program.

The remaining phase (Phase III) of the well network upgrade program was completed in the summer of 2015. This work program included the decommissioning of 16 wells, drilling and installation of 12 replacement wells, and the drilling and installation of 3 new monitoring wells. The locations of the installed wells are shown on the Site Plan, Figure 2. A full Site survey was completed following this final phase of the work program, in order to calculate groundwater elevations (in metres above sea level) at all the new and replacement monitoring wells. The wells were incorporated into a revised annual monitoring program in 2016, as outlined in Section 2.0.

#### 1.2.2 SUPPLMENTAL DRILLING AND SAMPLING PROGRAM 2019

In 2019, a supplemental drilling program was completed at the site to investigate exceedances noted at observation well 26R. Monitoring wells 45 and 46 were installed north of well 26R on August 15 and 16, 2019. The locations of the new wells are shown on the Site Plan (Figure 2) and the borehole logs are provided in Appendix B. A survey of the reference elevations for the new wells was completed by the County of Oxford. These wells were added to the annual monitoring program for supplemental groundwater elevation and quality information.

## 1.3 PHYSICAL SETTING

#### TOPOGRAPHY AND DRAINAGE

The elevation of the original ground surface at the site generally decreased in a southwesterly direction from the northeast portion of the site where the refuse was placed, towards a small creek in the southwest portion, then increased towards the western property boundary. Following the closure of the landfill site, the drainage configuration at the site was modified by the capped landfill, which is reportedly the highest elevation on the property, and by the subsequent landscaping which has created a pond in the southwest portion of the site.

The swampy area to the north of the property is part of the headwaters of Otter Creek which flows in a generally northeasterly direction.

The small creek situated within the site property originates to the northwest of the site and flows in a somewhat southerly direction to the southwestern part of the site before draining into a swampy area south of the road. This area is the headwaters of Branch Creek, which flows in a southeasterly direction away from the area.

#### **GEOLOGIC SETTING**

The description of the site geology provided herein is based on a review of published maps and reports, including findings from other investigations carried out in the general area, and historic intrusive investigations completed at the Holbrook landfill.

Cross-sections depicting the general stratigraphy across the site are provided on Figure 3 (Cross-section A-A'), Figure 4 (Cross-section B-B') and Figure 5 (Cross-section C-C'). The locations of the cross-sections are shown on Figure 2.

The study area is situated within the Mount Elgin Ridges physiographic region of Southern Ontario (Chapman and Putnam, 1984). The ridges generally consist of moraines of brown clay or silty clay till with low areas covered with alluvial silt, sand and gravel.

The Holbrook landfill site is situated within an undrumlinized till plain. Three approximately northeast to southwest trending till moraines occur in the area. The Ingersoll Moraine is found to the west of the village of Holbrook and the St. Thomas Moraine occurs northeast and southwest of the landfill site. Additionally, the Norwich moraine occurs south of Newark and extends in a northeasterly direction to the north of Norwich. Several northwest to southeast trending drumlins occur immediately north of the village of Holbrook and represent the southeasterly extent of a large drumlin field which lies to the northwest.

The surficial deposits in the area are generally related to ice moving in a northwesterly direction out of the Erie basin. The soil generally consists of a clay loam of the Huron series with a silt loam of the Honeywood series occurring in the vicinity of the northern boundary of the site (Soil Survey of Oxford County, 1961).

Glaciofluvial outwash deposits occur in the northern part of the property (Barnett, 1976 and Cowan, 1975). These deposits consist primarily of sand, gravelly sand, and sandy gravel.

In the southern part of the property the surficial deposits are principally the Port Stanley Till, which is a silty to silty clay till and represents a glacial advance during the Port Bruce Stadial. The Port Stanley Till occurs at the surface of the Ingersoll, St. Thomas, and Norwich Moraines.

A bog deposit occurs adjacent to and south of the southern boundary of the property.

A large area of glaciolacustrine, shallow water, fine to medium and silty fine sand occurs to the northeast and east of the site. Glaciofluvial outwash sand and ice-contact stratified drift consisting primarily of sand were deposited to the northwest.

As noted above, the surficial overburden at the Site consists of a glaciofluvial outwash deposit (Upper Sand and Gravel Unit) in the northern area, and the Port Stanley Till (Upper Clayey Silt Unit) in the south. Beneath these uppermost soils is a clayey silt unit, which may or may not contain gravel (Lower Clayey Silt Unit) and is variable in thickness. This in turn is underlain by a laterally extensive sand and gravel formation (Lower Sand and Gravel Unit). The Lower Sand and Gravel Unit is reportedly underlain by a relatively thick gravelly silt till formation.

The overburden deposits at the site range from approximately 29 m to 46 m in thickness. In general, the surficial deposits increase in thickness from east to west.

The bedrock underlying the site consists of Middle Devonian limestone and dolostone of the Detroit River Group. None of the intrusive investigations at the site encountered bedrock.

#### HYDROGEOLOGIC SETTING

The local geologic units at the site are grouped into four (4) hydrostratigraphic units as summarized below, and as shown in the cross-section Figures 3, 4, and 5. Results of historic in-situ hydraulic conductivity testing completed at the site (James F. MacLaren Ltd., 1979 and MacLaren Engineers, 1982) are also provided.

		CALCULATED HYDRAULIC CONDUCTIV RESULTS (cm/s)										
FLOW SYSTEM	HYDROSTRATIGRAPHY	Range	Mean									
			2.9x10 <sup>-1</sup> - 2.6x10 <sup>-3</sup>									
Shallow Flow	Upper Sand and Gravel Unit	5.6x10 <sup>-1</sup> - 9.0x10 <sup>-6</sup>	coarse fine sediments sediments									
System	Upper Clayey Silt Unit	8.1x10 <sup>-5</sup> - 9.4x10 <sup>-5</sup>	8.8x10 <sup>-5</sup>									
	Lower Clayey Silt Unit (confining / semi-confining layer)	3.5x10 <sup>-6</sup> - 9.5x10 <sup>-6</sup>	6.5x10 <sup>-6</sup>									
			3.6x10 <sup>-1</sup> - 6.1x10 <sup>-5</sup>									
Deep Flow System	Lower Sand and Gravel Unit	3.6x10 <sup>-1</sup> - 7.2x10 <sup>-5</sup>	coarse fine sediments sediments									

Although each hydrostratigraphic unit is identified as part of a groundwater flow system, each flow system has a hydraulic influence on the others. Shallow groundwater flow directions are expected to follow the surface drainage patterns.

The Upper Sand and Gravel Unit and Upper Clayey Silt Unit are considered to represent the shallow groundwater flow system. The Lower Sand and Gravel Unit represents the deeper groundwater flow system at the site.

The Lower Clayey Silt Unit likely forms a confining or semi-confining layer restricting groundwater movement. The unit may be intermittently present as the lateral extent and thickness of the unit is unknown. The Lower Clayey Silt Unit has the capacity to transmit water laterally; however, groundwater movement through this unit is inferred to be slower and predominantly downward, as weak downward vertical hydraulic gradients between the shallow and deep flow systems in the vicinity of the landfill have been reported.

The Upper Sand and Gravel Unit and the Lower Sand and Gravel Unit have the greatest capacity to transmit groundwater. The Upper Clayey Silt Unit and the Lower Clayey Silt Unit consist of finer grained material and groundwater movement through the soils is expected to be slow, based on the hydraulic conductivity results shown above.

# 2 ANNUAL MONITORING PROGRAM

### 2.1 OBJECTIVES AND SCOPE

The principal objectives of the annual monitoring program at the Holbrook landfill site are as follows.

- To provide documentation of the monitoring program results and findings.
- To assess the current and potential impacts of the landfill site on overburden groundwater quality.
- To assess the current and potential impacts of the landfill site on surface water quality.
- To provide recommendations on future monitoring and remedial actions, if required.

The monitoring program includes a data collection component, and an analysis and interpretation component. This report documents the data collected as part of the 2022 annual monitoring program activities, and our interpretation of the results. Available historic data are also incorporated into the report.

### 2.2 ANNUAL MONITORING PROGRAM

The 2022 annual program at the site included groundwater and surface water monitoring. The groundwater monitoring program included on-site observation wells and a private domestic well. In 2022, groundwater level measurements, groundwater sampling of on-site wells and private domestic wells, and surface water sampling were completed by WSP following general monitoring protocols and procedures, provided in Table 2-1.

### 2.2.1 GROUNDWATER - ON-SITE OBSERVATION WELLS

The groundwater monitoring program completed in 2022 included the following items.

- Annual groundwater level measurements at thirty (30) observation well locations in May;
- Annual staff gauge measurement at one (1) staff gauge located in Branch Creek;
- Annual groundwater sample collection from eighteen (18) observation wells (seventeen (17) on-site wells and one (1) private domestic well) in May 2022; and
- Additional groundwater level measurements and groundwater sample collection in May 2022 at two wells installed in 2019 (45 and 46).

#### Table 2-1 Monitoring Protocols and Procedures

# GROUNDWATER LEVEL MEASUREMENT

# GROUNDWATER/LEACHATE SAMPLING

#### **SURFACE WATER SAMPLING**

- Monitor integrity is visually inspected (casing, lock, caps, etc.).
- Well cap is carefully removed to avoid introducing foreign material into monitor.
- A water level is measured using a clean electronic water level meter with a stainless steel probe and graduated cable.
- The water level measurement is referenced to a known geodetic elevation on the monitor and checked twice for confirmation.
- The water level is recorded in the dedicated project field book and checked against previous reading.
- If the water level is significantly greater than historic value, the level in the well is checked again.
- The water level depth probe and cable are rinsed with de-ionized water between wells.
- Water levels in each monitor are measured and recorded prior to purging.

- Each monitoring well is purged prior to sampling in order to remove stagnant water in the monitor and surrounding sand pack.
- Purging and sampling is carried out using the dedicated inertial lift pump and high density polyethylene tubing in place within the monitors
- Well volumes are determined in the field based on the water level measurement. At least 3 well volumes are removed for moderate yield wells, or 1 to 2 well volumes for low yield wells (wells that dry out and are slow to recover). The volume of water purged is measured in a graduated container.
- Field parameters (pH, conductivity and temperature) are measured using calibrated instruments during purging to ensure that representative formation water is sampled. Purging is considered completed once the pH, conductivity, and temperature have stabilized.
- The groundwater sample is collected from the well as soon as there is a sufficient volume of liquid within the well, usually on the same day or on the following day, at the latest.
- Samples collected for metals analysis are field filtered using a high capacity in-line 0.45 micron disposable filter. The sample is collected directly from the filter discharge into the sample bottle.
- Water samples are collected directly into the laboratory provided bottles with the appropriate preservatives added. Sample bottles are marked, labelled, and sealed in the field.
- Samples are stored in coolers packed with ice, and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures.
- Field notes including date, weather, the sampling data, time, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book.

- Attempts are made to schedule surface water monitoring events to correspond to periods of anticipated flow whenever possible (i.e. 24 hrs after a significant precipitation event).
- Surface water samples at each location are collected prior to flow measurement.
- Monitoring is completed from downstream to upstream locations to avoid sediment disturbance which may influence sample integrity.
- Surface water samples are collected directly into the laboratory provided bottles that do not have preservatives. For bottles with preservatives added, standard grab sampling methods are used and then the water decanted into laboratory provided bottles with the appropriate preservatives. The sample container is pointed upstream and care is taken to avoid particulate and organic matter in the water.
- Sample bottles are marked, labelled and sealed in the field.
- Samples are stored in ice packed coolers, and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures.
- Field parameters (pH, conductivity, temperature and dissolved oxygen) are measured from a separate beaker of water using calibrated instruments.
- When the flows are adequate, stream flow discharge is estimated based on the crosssectional area of the stream, and the water velocity.
- A cross-sectional profile of the stream is determined by measuring the cross sectional width and depth of the wetted stream at various points. The velocity is estimated by measuring travel time between two profiles across the stream.
- Field notes including date, weather, time, sampling data, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book.

The 2022 groundwater monitoring network at the site is outlined in the following table.

MONITORING	DESIGNATION											
NETWORK	Annual Water Levels	Annual Groundwater Sampling										
Shallow Flow System	4R, 5R, 10R, 11R, 13R, 14R, 15A, 16AR, 18R, 19R, 24AR, 26R, 28R, 32R, 33R, 40, 41, 43, 44, 45, 46	11R, 16AR, 19R, 26R, 28R, 32R, 40, 41, 43, 44, 45, 46										
Deep Flow System	16R, 21R, 24R, 25R, 27, 31, 35, 37R, 38, 39, 42	21R, 24R, 25R, 27, 37R, 38, 39, 42, D2										

Notes:

Groundwater samples were submitted to SGS Canada Inc. in Lakefield, Ontario for analysis of the following parameters.

GENERAL PA	RAMETERS		
рН	Conductivity	Hardness	
MAJOR AND	MINOR IONS		
Alkalinity	Chloride	Potassium	Sulphate
Calcium	Magnesium	Sodium	
NUTRIENTS A	AND ORGANICS		
Ammonia	Nitrite	DOC	
Nitrate	TKN		
DISSOLVE	D METALS		
Boron	Iron		
Chromium	Manganese		

Select wells (26R, 27, 32R, 37R, 38, 39, 40, 41, 42, 43, 44, 45, and 46) were also analyzed for the volatile organic compounds of vinyl chloride, benzene, and 1,4 dichlorobenzene in May 2022, as per the approved environmental monitoring program.

The groundwater sampling locations are shown on the Site Plan, Figure 2. Copies of available borehole logs for the observation wells are provided in Appendix B. Monitoring well details are provided in Table C-1, Appendix C. It is assumed that the observation well designations and borehole logs are consistent between those used in previous reports (Charlesworth & Associates, 2008 and MacLaren Engineers, 1982).

#### 2.2.2 GROUNDWATER - PRIVATE DOMESTIC WELL

Since 1997, the County has sampled a private domestic well that is now referred to as the Pearce domestic well (D2), formerly the Roswell domestic well. Of the more than thirty (30) private domestic wells in the vicinity of the

A number of shallow flow system observation wells may be screened across the upper flow system and the shallow confining layer.

site, domestic well D2 was deemed the most likely to exhibit potential influences from landfill leachate, given the inferred flow regimes at the site. The location of domestic well D2 is shown on Figure 2.

The private domestic well groundwater monitoring program completed in 2022 included annual groundwater sampling at well D2 in May. Groundwater samples were submitted to SGS Canada Inc. in Lakefield, Ontario for analysis of the parameters previously noted for the groundwater monitoring program.

#### 2.2.3 SURFACE WATER

Surface water monitoring was completed at the stations listed in the following table. The locations of the surface water monitoring stations are shown on Figure 2.

SURFACE WATER STATION	RELATIVE POSITION	SAMPLING FREQUENCY		
C01	The on-site stream, south (downstream) of the landfill where the stream leaves the site property boundary via a culvert beneath Quaker Street. Station C01 is downstream of surface water stations C04 and C06.	Semi-annually (spring and fall)		
C06	Collected from a swampy area, northwest (upstream) of the landfill where the on-site stream enters the site property.	(		
C04	The on-site stream, intermediate station southwest (downstream) of the landfill. Station C04 is downstream of stations C06 and P02.			
P02	The on-site pond situated adjacent west (downstream) of the landfill. The pond is inferred to be the receiving body for shallow groundwater moving from beneath the landfill. Drainage from P02 enters the on-site stream between sampling points C04 and C06.	Annually (spring)		
P03	The on-site retention pond situated close to the landfill in the northern portion of the site.	, m., man, (ep., ., g)		
P01	The on-site retention pond situated in the southeast portion of the site.			
NE1	The swampy area situated in the northeast portion of the site, at the toe of the landfill.			

The semi-annual sample collection was completed on April 6 and October 18, 2022, and the annual sample collection was completed on April 6, 2022. The surface water monitoring protocols and procedures are presented in Table 2-1.

The surface water samples were submitted to SGS Canada Inc. in Lakefield, Ontario for analysis of the parameters listed below.

GENERAL PA	ARAMETERS	GENERAL PARAMETERS											
рН	Conductivity	Hardness											
MAJOR AND	MINOR IONS												
Alkalinity	Chloride	Potassium	Sulphate										
Calcium	Magnesium	Sodium											
NUTRIENTS A	AND ORGANICS												
Ammonia	Nitrite	Un-ionized	Ammonia										
Nitrate													
DISSOLVE	D METALS												
Boron	Iron												

Manganese

#### 2.2.4 LANDFILL GAS

Chromium

During 2022, landfill gas measurements were completed on an annual basis at standpipes SP3R, SP4R, and SP5. The locations of these standpipes are shown on Figure 2. The monitoring included the measurement of methane, carbon dioxide, oxygen, and balance gas concentrations, as well as water levels to determine whether or not the screened interval was partially flooded. Measurements and readings were completed on April 6, 2022.

# 3 GROUNDWATER LEVELS AND FLOW CONDITIONS

Groundwater levels are measured annually in the observation wells at the site prior to the sampling event. The groundwater level elevation data from May 2022 and the available historic water level elevation data for the site are provided in Table C-2 and graphically in Figures C-1 through C-15, Appendix C. A well survey to establish elevation and location was completed in 2012, and groundwater elevations have been calculated from the current and historic water levels measured at the site. New observation wells installed in 2013 were surveyed for location and elevation in 2014, while new and replacement wells installed in 2014/2015 were surveyed for location and elevation in 2015. The two wells installed in August 2019 were surveyed for location and elevation in 2019.

It is noted that the majority of wells in the monitoring well network were installed in 2013-2015, and were only incorporated into the groundwater monitoring program in 2014-2016. As such, there is a somewhat limited data available for historic comparisons. In 2022, groundwater elevations measured in the observation wells were typically within their respective historic ranges. Monitoring wells 26R and 46 had groundwater elevations in May 2022 which were below their respective historic ranges, however, well 46 was installed in 2019 and has only limited data available for historic comparison.

Groundwater level elevations measured in the observation wells mostly increased from May 2021 to May 2022, following the historic low elevations noted in many wells in 2021. Also, as noted historically, flowing conditions were observed in May 2022 at observation wells 26R and 27, meaning that the groundwater pressure was above both the ground surface and the top of the pipe. An extension was added to the top of the pipe in order to obtain a measurable groundwater elevation at these wells. The May 2022 groundwater elevations at observation wells 45 and 46 were also at or above ground surface, but were below the top of pipe.

### 3.1 GROUNDWATER FLOW

Observation wells at the site have been grouped into the shallow groundwater flow system, deep groundwater flow system, or confining/semi-confining system.

The groundwater table is located in the Upper Sand and Gravel Unit and the Upper Clayey Silt Unit which represents the shallow flow system. The groundwater table elevations measured in May 2022 and the interpreted shallow water table contours are presented on Figure 6. In general, groundwater movement in the shallow flow system across most of the site is inferred to be southwesterly towards the on-site creek, while shallow groundwater movement in the western portion of the site (west of the creek) is inferred to flow east towards the creek. However, the shallow flow system groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. In addition, recently installed monitors 45 and 46 indicate there is localized groundwater flow from the south of the site moving north towards the waste.

Hence, over the majority of the site, groundwater flow in the shallow flow system is inferred to converge on the creek, contributing to the flow of the creek. Also, given that the thickness of the Upper Sand and Gravel Unit in the northern part of the site thins toward the creek in the southwest, shallow groundwater below the landfill likely contributes to the creek. Further, the retention pond located in the central portion of the site likely acts as a discharge zone for the shallow groundwater. As such, any leachate influences observed in the shallow flow system across the majority of the site would likely impact the surface water quality. There may be a minor component of localized shallow groundwater flow from the fill area east, north and southeast toward the buffer property.

Based on historic borehole logs, the base of waste was at an elevation of approximately 279 mASL to 280 mASL; though there was an area of deeper waste, approximately 275 mASL, in the west central portion of the fill area (BH22) that was associated with a swampy depression. Previous observation wells in the waste disposal area are no longer present. In order to determine if groundwater (leachate) mounding is present at the site, leachate well 41 was incorporated into the 2014 annual monitoring program. Based on the May 2022 liquid level within well 41 (283.25 mASL), localized perched leachate mounding is likely present at the site. This mounding is attributed to areas of low hydraulic conductivity within the refuse, and has the potential to influence shallow groundwater quality adjacent to the disposal area or result in surface seeps.

Though some shallow flow system observation wells located adjacent to the north and northeast of the landfill are situated hydraulically upgradient of the landfill, it is possible that they have been historically influenced by localized landfill effects and as such, are not considered to be suitable background observation wells. Shallow flow system well 40 is more representative of upgradient conditions, and was incorporated into the 2014 annual monitoring program as a background observation well.

Groundwater elevations measured in the deeper flow system in May 2022 are presented in Figure 7. Groundwater flow in the deep flow system is inferred to be in a generally south to southeasterly direction under a very low horizontal hydraulic gradient. As shown on Figure 7, the difference in head across most of the site is less than 1 m,

although there is a greater head of at least 1.9 m between the background wells in the northwest corner of the site and the downgradient wells.

Observation well 39 was installed in 2013 to serve as a background observation well for the deep flow system. However, the groundwater elevation measured in the well did not appear to correspond with the other deep flow system groundwater elevations on site. Well 39 was drilled to a similar depth as nearby deep flow system wells, but a significant layer of clayey silt was not encountered when drilling the borehole for observation well 39. Based on recommendations from the 2014 annual water monitoring report, a deeper observation well (42) was installed in the summer of 2015, which penetrated a confining to semi-confining layer of approximately 6.5 m of clayey silt. Observation well 42 was incorporated into the 2016 monitoring program as a deep flow system background observation well. Similar to observation well 39, the groundwater elevation measured in observation well 42 does not appear to correspond with the other deep flow system groundwater elevations on site, but rather corresponds to the shallow groundwater elevation at this location. It is inferred that the confining/semi-confining unit in the northwestern corner of the site may be discontinuous, as there is little to no difference in groundwater elevation between the shallow and deep flow systems.

As part of a further evaluation into the source of trigger exceedances at monitoring well 26R, shallow observation wells 45 and 46 were installed in August 2019, north of monitoring well 26R. Since first measuring groundwater levels from within boundary monitoring well 26R in 2016, artesian conditions have consistently been observed. Artesian conditions have also been observed at monitoring wells 45 and 46, since their installation. Based on groundwater elevations measured in 2020 through 2022, groundwater appears to flow north from the property boundary at 26R toward monitoring well 46, closer to the landfill mound. It should be noted that limited data is available for wells 45 and 46, as they were installed in August 2019. Continued monitoring will be required to confirm this conclusion.

Groundwater levels in the shallow flow system are generally higher than those in the deeper flow system at corresponding downgradient locations. As such, vertical hydraulic gradients are downward through the less permeable confining/semi-confining unit. The vertical linear velocity of groundwater downward through the confining/semi-confining layer was estimated to be in the order of 0.01 to 1.5 m/yr (MacLaren Engineers, 1982). By comparison, the horizontal linear groundwater velocity in the deeper flow system is estimated to be in the range of 12.7 to 45.7 m/yr (MacLaren Engineers, 1982). As such, the volume of flow through the deeper flow system is considerably greater than the vertical leakage of shallow groundwater downward through the confining/semi-confining unit.

For the purposes of assessing the groundwater quality, the downgradient observation wells were divided into groups based on their location in the inferred flow regimes, which is consistent with the previous reports at the site. This approach facilitates the assessment of groundwater quality within the two flow systems with respect to the inferred groundwater flow regimes and potential leachate impact.

# 4 GROUNDWATER QUALITY

The available groundwater chemical data for the site from 1979 to 2022 are provided in Appendix D. The groundwater chemical results for the shallow flow system and the deeper flow system are provided in Tables D-1 and D-2, respectively. The private domestic groundwater chemical results are provided in Table D-3. The tables also provide the applicable Ontario Drinking Water Quality Standards (2003, revised June 2006) (ODWQSs). Time versus concentration graphs for chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are presented on Figures D-1 to D-35, Appendix D. The 2022 laboratory certificates of analysis are included in Appendix F.

The quality assurance/quality control (QA/QC) program for the monitoring program at the site included a field and a laboratory component. Standard field protocols were used to ensure consistency.

Laboratory reports were reviewed as part of the laboratory QA/QC program. Blind duplicate samples were collected from wells 26R and D2 in May 2022. Duplicate samples were similar to the original samples results with the calculated Relative Percent Difference (RPD) generally within the 20% guideline for acceptability or less than two times the laboratory reported method detection limit (MDL), with the exception of total hardness, calcium, magnesium and manganese concentrations for the samples collected from well D2. Acceptable data quality control including laboratory blanks, spiked blanks, laboratory duplicates, and laboratory percent recoveries of analysis indicated that the detected constituent concentrations were accurate and reflected actual groundwater conditions at the time of sample collection and are acceptable for inclusion into the database.

### 4.1 LEACHATE CHEMISTRY

Leachate is produced from the infiltration of precipitation through the waste. Processes within the waste degrade the quality of the percolating water to create leachate. The chemical composition of leachate can vary within the waste cells depending on various factors such as refuse composition, age, hydraulic conductivity, residence time, and the leachate flow regime.

There is currently one leachate well (41) in the observation well network, located in the south portion of the landfill, for characterizing the leachate quality. This leachate well has been sampled since 2014. It is noted that older refuse is located in the north portion of the landfill and younger refuse is located in the south potion of landfill (James F. MacLaren Ltd., 1979). As such, it is likely that the leachate strength in the north portion of the landfill is weaker than the leachate strength in the south portion of the landfill.

The 2022 leachate chemistry results are provided in Table 4-1. The groundwater chemistry ranges from the background shallow flow system and deeper flow system observations wells, along with the range of representative concentrations for municipal landfills in Ontario, are also summarized.

The 2022 leachate quality at the Site was generally below or within the lower portion of the range of representative concentrations for municipal landfills in Ontario (Freeze and Cherry, 1979 and the Ministry of the Environment, 1993). The leachate strength at the site is considered to be very weak, with chloride and sodium concentrations below their respective ODWQSs. Nonetheless, concentrations of most parameters in the leachate well were elevated relative to the background shallow and deep flow system groundwater. In particular, concentrations of chloride, alkalinity, potassium, boron, iron, ammonia, TKN, benzene, 1,4-dichlorobenze, and historic concentrations of vinyl chloride are notably elevated in the landfill leachate relative to the background groundwater quality, and serve as diagnostic leachate indicator parameters for the site.

The historic laboratory leachate quality data at leachate well 41 is provided in Table D-1, Appendix D. Time versus concentration graphs for the leachate indicator parameters of chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are shown on Figures D-1 through D-7, Appendix D. Several leachate indicator parameter concentrations have decreased overall since 2016. Parameter concentrations at leachate well 41 in 2022 were within their respective historic range.

Table 4-1 2022 Background Groundwater Chemistry Relative to Landfill Leachate Chemistry

	ONTARIO		PARA	METER CONCENTRATION	ONS							
PARAMETER	DRINKING WATER	Leachate	2022 Bac	kground Range	Typical Landfill Leachate	,,						
	QUALITY STANDARDS	(well 41)	Shallow Flow System (well 40)	Deep Flow System (well 39 and 42)	(source)							
рН	6.5 - 8.5 OG	7.30	7.95	8.08 - 8.21	6 - 7	(2)						
Conductivity	-	2010	699	381 - 710								
Hardness	80 – 100 OG	663	431	221 - 379	400 - 2,000	(2)						
Chloride	250 AO	72	29	<1 - 44	20 - 2,500	(2)						
Sulphate	500 AO	7	51	2 - 55	<1 - 300	(2)						
Alkalinity	30 – 500 OG	1040	338	221 - 300	300 - 2,000	(2)						
Calcium	-	190	131	45.8 105	100 - 1,000	(2)						
Magnesium	-	45.7	25.3	26.0 - 28.3	100 - 1,500	(1)						
Potassium	-	61.4	0.995	1.16 - 1.62	200 - 1,000	(1)						
Sodium	200 AO	59.4	13.4	21.8 - 23.7	200 - 1,200	(1)						
Ammonia	-	89.9	0.2	<0.1 - 0.4	5 - 1,000	(2)						
TKN	-	98.9	<0.5	<0.5 - <0.5	1 - 100	(2)						
Nitrate	10.0 MAC	<0.06	0.08	<0.06 - 0.26								
Nitrite	1.0 MAC	<0.03	<0.03	<0.03 - 0.04	0.1 - 0.50	(2)						
DOC	5 AO	28.4	5.8	1.1 - 1.2								
Boron	5.0 IMAC	1.75	0.024	0.034 - 0.052	0.5 - 10	(2)						
Chromium	0.05 MAC	0.00247	0.00045	<0.00008 - 0.00016	<0.01 - 0.5	(2)						
Iron	0.3 AO	59.4	2.94	0.180 - 0.398	1 - 1,000	(1)						
Manganese	0.05 AO	0.392	0.238	0.0107 - 0.141	0.01 - 100	(1)						
Vinyl Chloride	1 MAC	0.4	<0.2	<0.20								
Benzene	1 MAC	15.5	<0.5	<0.50								
1,4 Dichlorobenzene	5 MAC 1 AO	15.9	<0.5	<0.50								

Notes:

All concentrations in mg/L except pH (unitless), conductivity ( $\mu$ S/cm), and VOCs vinyl chloride, benzene and 1,4-dichlorobenzene ( $\mu$ g/L)

Shading indicates concentration exceeds Ontario Drinking Water Quality Standard.

## 4.2 GROUNDWATER CHEMISTRY

Background concentrations for groundwater were established in the 1980s, based on chemical results from upgradient domestic wells. However, the domestic wells used were screened in various aquifer units, and the background concentrations were not representative of either the shallow or deeper groundwater flow system.

During the time when the site was operating, shallow groundwater beneath the fill area was considered to be impacted based on the results from observation well 34, drilled through the refuse and screened in the underlying

<sup>(1)</sup> Typical leachate characteristics data from Freeze & Cherry (1979).

<sup>(2)</sup> Typical leachate characteristics data from the Ministry of the Environment (1993).

shallow aquifer. Observation well 34 was reportedly destroyed in 1984. Also, some of the wells adjacent to the northeast and east of the fill area showed evidence of leachate influences, likely from periodic leachate seeps. The reports at the time concluded that any contamination in the shallow flow system had not migrated off-site as the flow system likely discharged to the on-site stream. It is understood that the periodic leachate seeps would have been addressed through the site closure works and are no longer an issue.

Within the deeper flow system, leachate impacts in the groundwater were not observed during the site operation. Observation well 36, screened in the deeper aquifer below the waste, did not show any evidence of leachate influence. The well reportedly became non-functional after 1985; and was destroyed during historic landfilling activities.

Nineteen (19) overburden groundwater observation wells, one (1) leachate observation well, and one (1) private domestic well were sampled for general inorganic parameters as part of the 2022 monitoring program. Twelve (12) of the overburden groundwater observations wells and the one (1) leachate observation well were also sampled for select volatile organic compounds (VOCs). Based on the inferred shallow groundwater flow pattern and measured groundwater elevations, some observation wells located along the north and northeastern landfill boundary may have been situated hydraulically upgradient of the landfill. Given their proximity however, it is possible that they were influenced in the past by localized landfill effects and thus, they are not considered to be representative of background conditions in the shallow flow system. Similarly, there were no observation wells situated hydraulically upgradient of the landfill in the deeper groundwater flow system prior to 2013. Observation wells 39 and 40 were installed in mid-2013 to address these deficiencies and have since been included in the annual monitoring program. Observation well 42 was installed in 2015 and has been included in the annual monitoring program since 2016. These wells are considered to be representative of background conditions, as they are situated hydraulically upgradient of the inferred landfill mound.

#### 4.2.1 GROUNDWATER QUALITY COMPARISON

A summary of the 2022 chemical results for the observation wells at the site, along with their respective historical ranges, is provided in Table 4-2. For assessment purposes, the observation wells were divided into the following groups based on their location in the inferred groundwater flow regime, as shown below.

FLOW SYSTEM OBS	SERVATION WELLS AND POSITIONS RELATIVE TO FILL AREA
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	Background northwest	40
	Adjacent northeast	32R
	Adjacent east	11R
Shallow Flow System	East	44
Shallow I low System	Adjacent west	19R
	Adjacent southeast	28R
	South	26R, 45, & 46
	Southeast	43
	Background northwest	39 & 42
	Adjacent northeast	24R
	Adjacent east	25R
Deep Flow System	East	38
	Adjacent west	21R
	South	27
	Southeast	37R & D2

**Table 4-2: Historic Groundwater Quality Comparison** 

Observation Well		рН		Conductivity		Hardness		Chloride		Sulphate		Alkalinity		Calcium		Magnesium		Potassium		Sodium		Ammoi	nia
Position Relative to the Landfill	Well	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	e 2022 Results
Refuse				•		•								•									
Landfill Mound	41	6.46 - 7.79	7.30	1840 - 3670	2010	501 - 685	663	66.9 - <b>267</b>	72	<1.5 - 22.0	7	301 <b>- 1590</b>	1040	121 - 199	190	38.6 - 61.3	45.7	50.2 - 132	61.4	54.1 - 151	59.4	72.8 - 195	89.9
Shallow Flow Systen	n																						
Background Northwest	40	7.24 - 8.15	7.95	658 - 782	699	359 - 450	431	16.5 - 22.2	29	34.5 - 45.0	51	328 - 349	338	106 - 142	131	20.1 - 24.0	25.3	0.89 - 1.15	0.995	10.5 - 12.0	13.4	0.16 - 0.22	2 0.2
Adjacent Northeast	32/32R	7.65 - 8.25	8.08	220 - 598	582	148 - 351	335	1.0 - 14.0	15	25.0 - 39.0	33	167 - 284	291	40.9 - 95.4	87.0	11.8 - 27.6	28.8	0.783 - 2.0	0.816	4.0 - 22.5	9.88	<0.02 - 0.06	<0.1
Adjacent East	11/11R	6.88 - 8.20	7.76	290 - 1650	1540	120 - 825	806	3.9 - 120	140	2.60 - 29.9	5	105 - <b>827</b>	767	36.4 - 202	197	6.5 - 78.1	76.2	0.75 - 6.33	4.80	3.9 - 60.5	71.2	0.72 - 5.74	2.6
East	44	7.58 - 8.22	7.99	667 - 840	735	362 - 395	434	12.3 - 16.0	20	37.7 - 61.0	50	262 - 302	280	87.4 - 98.7	112	30.5 - 35.9	37.4	1.26 - 1.39	1.28	6.21 - 7.22	7.60	<0.010 - 0.07	<0.1
Adjacent West	19R	7.43 - 8.27	8.15	385 - 504	428	190 - 245	267	1.55 - 4.19	2	25.5 - 30.0	35	213 - 232	214	39.9 - 61.0	64.4	18.4 - 22.6	25.8	1.29 - 1.65	1.37	13.8 - 27.3	16.3	<0.010 - 0.16	<0.1
West	16AR	7.75 - 8.15	8.13	571 - 635	659	276 - 319	365	23.3 - 27.0	29	54.5 - 86.0	95	268 - 277	283	59.8 - 72.9	84.1	30.7 - 33.3	37.8	1.30 - 2.38	1.43	22.1 - 24.4	26.3	<0.02 - 0.045	5 <0.1
Adjacent Southeast	28/28R	7.30 - 8.29	8.24	380 - 662	525	184 - 382	281	1.6 - 6.4	7	25.9 - 67.0	75	150 - <b>789</b>	281	39.0 - 82.9	62.8	21.0 - 40.4	30.2	0.66 - 2.94	1.69	6.6 - 28.4	37.1	0.06 - 0.16	<0.1
South	26/26R	7.21 - 8.13	7.88	595 - 2210	1590	339 - 657	609	15.8 - <b>319</b>	240	14.8 - 21.0	24	223 - <b>739</b>	586	85.8 - 172	150	25.6 - 65.3	56.9	1.10 - 3.20	2.52	8.11 - <b>208</b>	186	0.042 - 0.11	<0.1
	45	7.90 - 8.24	8.23	328 - 334	324	143 - 184	222	<1 - 1.14	3	19.4 - 25.0	32	153 - 157	162	33.3 - 50.1	60.8	14.3 - 14.6	17.1	1.05 - 1.62	0.963	24.6 - 28.2	28.0	<0.1 - 0.131	1 0.1
	46	7.88 - 8.20	8.24	391 - 430	431	247 - 262	276	2 - 2.97	1	14.8 - 33.0	37	198 - 222	230	63.4 - 71.4	74.0	20.3 - 21.4	22.3	1.02 - 1.10	1.04	2.36 - 4.35	2.18	<0.1 - 0.052	2 <0.1
Southeast	43	7.53 - 8.25	8.18	321 - 421	418	110 - 130	144	1.35 - 16.0	24	10.6 - 59.0	34	172 - 202	187	22.5 - 26.0	31.9	12.5 - 16.5	15.5	1.12 - 1.78	1.27	22.0 - 49.4	63.5	0.06 - 0.14	<0.1
Deep Flow System		<u> </u>		•																			
Background Northwest	39	7.52 - 8.18	8.08	666 - 773	710	294 - 374	379	33.9 - 39.8	44	41.9 - 50.0	55	275 - 315	300	76.3 - 107	105	23.5 - 27.8	28.3	1.55 - 1.83	1.62	20.0 - 23.1	23.7	0.04 - 0.11	<0.1
	42	7.42 - 8.22	8.21	347 - 422	381	161 - 281	221	0.51 - 2.12	<1	1.45 - 5.69	2	211 - 269	221	28.2 - 42.3	45.8	20.6 - 29.0	26.0	1.06 - 1.45	1.16	18.0 - 21.3	21.8	0.29 - 0.42	0.4
Adjacent Northeast	24/24R	7.27 - 8.36	8.18	288 - 920	406	130 - 404	246	0.5 - 65.5	2	13.4 - 41.2	17	141 - 348	218	28.3 - 118	59.8	14.9 - 26.4	23.6	0.48 - 2.59	1.06	10.9 - 32.4	12.4	0.013 - 0.42	0.4
Adjacent East	25/25R	6.93 - 8.32	8.04	270 - 1518	415	133 - 500	232	3.1 - 213	15	4.20 - 53.4	7	138 - 500	213	32.4 - 120	60.1	11.0 - 70.5	20.0	0.95 - 15.0	1.41	6.13 - <b>296</b>	19.3	0.060 - 0.20	0.1
East	38	7.30 - 8.32	7.98	290 - 630	542	173 - 330	310	3.0 - 27.0	31	21.1 - 25.6	27	158 - 280	252	47.5 - 86.8	83.1	13.0 - 27.0	24.8	0.44 - 2.00	1.20	9.92 - 24.5	18.4	0.07 - 0.13	<0.1
Adjacent West	21/21R	7.10 - 8.26	8.06	409 - 609	593	210 - 440	353	5.0 - 36.0	40	15.0 - 33.2	8	181 - 270	279	50.2 - 95.5	91.2	15.7 - 26.4	30.5	0.40 - 2.31	1.57	8.1 - 27.5	15.4	0.09 - 0.20	0.1
South	27	7.00 - 8.14	8.05	400 - 905	688	298 - 384	395	10.0 - 62.7	41	29.5 - 42.1	36	236 - 340	305	75.0 - 104	110	22.0 - 30.3	29.1	1.23 - 5.32	1.50	12.1 - 33.6	18.7	<0.02 - 0.10	<0.1
Southeast	37/37R	7.10 - 8.32	8.05	394 - 655	624	252 - 493	375	10.0 - 35.0	38	35.8 - 44.5	41	217 - 290	277	62.9 - 92.3	101	22.9 - 34.6	29.6	<0.02 - 1.75	1.39	7.09 - 13.8	14.8	0.05 - 0.15	<0.1
	D2 *	7.30 - 8.38	8.22	398 - 888	697	<0.50* - 430	1.0*	1.0 - 47.0	49	30.0 - 43.0	40	210 - 370	294	0.089* - 122	0.28*	:0.05 * - 31.6	0.083*	0.08* - 3.11	0.116*	11.0 - 168*	207*	<0.010 - 0.12	<0.1

 $<sup>\</sup>textit{Notes:} \quad \text{Concentrations are in } \textit{mg/L} \text{ with the exception of VOCs which are in } \textit{\mug/L}, \textit{pH} \text{ which is in SU, and conductivity which is in } \textit{\muS/cm.}$ 

Bold and shading indicates exceedance of ODWQS.

<sup>•</sup> Blank indicates there is no historic data for thie specified parameter.

Shaded parameters across title row have been identified as diagnostic indicator parameters.

<sup>• \*</sup> Groundwater sample from domestic well D2 is inferred to be softened prior to collection; the results should be viewed with caution.

**Table 4-2: Historic Groundwater Quality Comparison** 

Observation Well		TKN		Nitrate		Nitrite		DOC		Boron	1	Chr	romium			Iron	Ma	inganese		Vinyl Chlo	ride	Benzen	е	1,4 Dichlorobenzene	
Position Relative to the Landfill	Well	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Ra	ange	2022 esults	Historic Ra	ange 2022 Results	Historic F	Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results	Historic Range	2022 Results
Refuse																									
Landfill Mound	41	84.3 - 212	98.9	<0.06 - <0.50	<0.06	<0.03 - <0.50	<0.03	27.4 - 146	28.4	1.63 - 4.85	1.75	<0.0050 - 0.	0.011	00247	43.6 - 6	3.7 59.4	0.179 -	0.486	0.392	<0.50 <b>- 1.2</b>	0.4	<8.00 - 25	15.5	<4.00 - 71	15.9
Shallow Flow System	m																								
Background Northwest	40	0.16 - 1.48	<0.5	<0.05 - 0.13	80.0	<0.010 - <0.25	<0.03	6.6 - 8.06	5.8	0.019 - 0.036	0.024	<0.00050 - 0.	0.005 0.0	00045	2.79 - 9	.96 2.94	0.211 -	0.931	0.238	<0.17 - <0.68	<0.2	<0.20 - <0.80	<0.5	<0.20 - <0.50	<0.5
Adjacent Northeast	32/32R	<0.10 - 0.85	<0.5	<0.05 - 0.11	0.41	<0.010 - <0.05	<0.03	1.2 - 2.70	1.6	0.028 - 0.043	0.057	<0.00050 - <	:0.003 0.0	00009	<0.01 - 2	<b>.56</b> 0.082	0.020 -	0.380	0.0871	<0.17 - <0.50	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	<0.5
Adjacent East	11/11R	2.38 - 6.95	4.0	<0.10 - 0.12	<0.06	<0.03 - <0.25	<0.03	10.5 - 20.5	19.0	0.203 - 0.264	0.243	<0.00050 - 0.	0.008 0.00	00051	<0.02 - 8	.96 3.99	0.048 -	0.432	0.0598	2.2 - 2.6		<0.20 - 0.22		<0.10	
East	44	<0.10 - 0.46	<0.5	15.4 - 27.4	19.1	<0.010 - <0.25	<0.03	0.8 - 3.12	1.0	0.022 - 0.04	0.022	0.00078 - <	:0.003 0.0	00078	<0.01 - 0	.034 0.007	0.00124 -	0.003	0.00081	<0.17 - <0.50	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	<0.5
Adjacent West	19R	0.19 - 1.80	<0.5	<0.05 - 0.23	0.24	<0.010 - <0.050	<0.03	0.9 - 3.6	1.1	0.039 - 0.061	0.052	<0.00050 - <	:0.003 0.0	00019	<0.007 - <b>0</b>	<b>.313</b> <0.007	0.00081 -	0.084	0.00010	<0.17		<0.20		<0.10	
West	16AR	<0.10 - 1.13	<0.5	<0.05 - 0.087	0.14	<0.010 - <0.05	<0.03	1.3 - 2.62	1.3	0.032 - 0.045		<0.00050 - <				.178 0.047	0.0176 -		0.0217						
																				0.47		0.00		0.40	
Adjacent Southeast	28/28R	0.15 - 0.43	<0.5	<0.020 - 0.09	0.18	<0.010 - <0.05	<0.03	1.1 - 2.9	2.2	0.073 - 0.090	0.089	<0.00050 - <			<0.01 - 1	.66 0.119	0.0177 -	0.627	0.0194	<0.17		<0.20		<0.10	
South	26/26R	0.60 - 1.05	<0.5	<0.06 - <0.5	<0.06	<0.03 - <0.5	<0.03	10.6 - 13.0	8.2	1.41 - 1.85	1.27	<0.003 - 0.		00057	0.19 - 2				0.0394	<0.17 - <0.68	<0.2	<0.20 - <0.80	<0.5	<0.10 - <0.50	
	45 46	<0.5 - 0.22 <0.5 - 0.56	<0.5 0.6	<0.020 - 0.11 <0.020 - <0.06	0.17 0.14	<0.03 - 0.048 <0.010 - <0.03	<0.03	1.8 - 4.3 2.6 - 3.1	1.2 2.1	0.118 - 0.133 0.013 - 0.015		<0.00050 - 0.			0.049 - 0 0.562 - 0	.050 <b>0.336</b> .667 <b>0.386</b>	0.0193 -		0.0375	<0.2 - <0.50 <0.4 - <0.50	<0.2 <0.2	<0.50 <0.50 - <1	<0.5 <0.5	<0.50 <0.50 - <1	<0.5 <0.5
O a seth a a a set	43																								
Southeast	43	0.20 - 0.60	<0.5	<0.05 - 0.200	0.11	<0.05 - 0.022	<0.03	1.6 - 2.51	1.7	0.13 - 0.166	0.145	<0.00050 - <	(0.003 0.0	00015	(0.010 - 0	.145 <0.007	0.009 -	0.0123	0.00340	<0.17 - <0.68	<0.2	<0.20 - <0.80	<0.5	<0.10 - <0.50	<0.5
Deep Flow System		-		ī				<u>,                                      </u>		ī		-					_			ī		1		<u> </u>	
Background Northwest	39	<0.10 - 0.36	<0.5	0.14 - 0.670		<0.05 - 0.054	0.04	1.2 - 3.65	1.2	0.025 - 0.034		<0.00050 - 0.			0.183 - 0		0.131 -		0.141	<0.17 - <0.50	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	
	42	0.29 - 1.09	<0.5	<0.020 - 0.031	<0.06	<0.010 - <0.05	<0.03	0.9 - 2.44	1.1	0.051 - 0.063	0.052	<0.00050 - <	(0.003 <0.	.00008	0.038 -	0.180	0.010 -	0.106	0.0107	<0.17 - <0.50	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	<0.5
Adjacent Northeast	24/24R	0.25 - 0.75	<0.5	<0.05 - 2.48	<0.06	<0.010 - <0.05	0.03	2.9 - 4.36	3.2	0.045 - 0.053	0.044	<0.00050 - <	:0.003 0.0	00025	<0.01 - 6	.10 0.512	<0.00050 -	0.100	0.0158	<0.17		<0.20		<0.10	
Adjacent East	25/25R	0.12 - 0.35	<0.5	<0.020 - 0.22	<0.06	<0.010 - <0.05	<0.03	1.8 - <b>5.42</b>	2.2	0.047 - 0.069	0.061	<0.00050 - <	:0.003 0.0	00024	<0.01 - 1	.90 0.875	0.006 -	0.825	0.0246	<0.17		<0.20		<0.10	
East	38	<0.10 - 0.22	<0.5	<0.020 - <0.06	<0.06	<0.010 - <0.05	<0.03	1.2 - 2.37	1.8	0.043 - 0.068	0.050	<0.00050 - <	:0.003 0.0	00010	<0.01 - 3	.05 0.634	<0.020 -	0.093	0.0503	<0.17 - <0.2	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	<0.5
Adjacent West	21/21R	0.18 - 0.45	<0.5	<0.020 - <0.06	<0.06	<0.010 - <0.05	<0.03	1.1 - 2.36	1.6	0.046 - 0.066	0.052	<0.00050 - <	:0.003 0.0	00016	<0.01 - 1	.08 1.28	<0.020 -	0.250	0.0416	<0.17		<0.20		<0.10	
South	27	<0.10 - 0.63	<0.5	<0.020 - <0.25	<0.06	<0.010 - <0.25	<0.03	1.0 - 2.99	1.4	0.083 - 0.266	0.084	<0.00050 - 0.	0.005 0.0	00010	<0.04 - 1	.09 1.00	0.050 -	0.065	0.0639	<0.17 - <0.50	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	<0.5
Southeast	37/37R	<0.10 - 0.37	<0.5	<0.020 - <0.25	<0.06	<0.010 - <0.25	<0.03	0.8 - 2.26	1.1	0.048 - 0.056	0.047	<0.00050 - 0.	0.004 <0.	.00008	0.02 - 3	.27 0.816	0.030 -	0.211	0.0455	<0.17 - <0.50	<0.2	<0.20 - <0.50	<0.5	<0.10 - <0.50	<0.5
	D2 *	<0.05 - 0.50	<0.5	<0.020 - <0.25	<0.06	<0.010 - <0.25	<0.03	1.2 - 3.54	1.1	0.051 - 0.060	0.053	<0.00050 - 0.	0.004 0.0	00012	<0.01 - 1	.89 0.025	<0.00050 -	0.054	0.00035	<0.17		<0.20		<0.10	

 $\textit{Notes:} \quad \bullet \quad \text{Concentrations are in } mg/L \text{ with the exception of VOCs which are in } \mu g/L, pH \text{ which is in SU, and conductivity which is in } \mu S/cm.$ 

Bold and shading indicates exceedance of ODWQS.

Blank indicates there is no historic data for thie specified parameter.

<sup>•</sup> Shaded parameters across title row have been identified as diagnostic indicator parameters.

<sup>• \*</sup> Groundwater sample from domestic well D2 is inferred to be softened prior to collection; the results should be viewed with caution.

#### SHALLOW GROUNDWATER FLOW SYSTEM

As observed in Table 4-2, the 2022 parameter concentrations in the shallow groundwater observation wells were typically within or below their respective historic concentration ranges for the wells. The following parameters were above the historic range for the specified well and former well, if applicable:

- Well 11R chloride and sodium;
- Well 16AR conductivity, hardness, chloride, sulphate, alkalinity, calcium, magnesium, sodium and nitrate;
- Well 19R hardness, sulphate, calcium, magnesium and nitrate;
- Well 26R sulphate;
- Well 28R chloride, sulphate, sodium and nitrate;
- Well 32R chloride, alkalinity, magnesium, nitrate and boron;
- Well 40 chloride, sulphate, magnesium and sodium;
- Well 43 hardness, chloride, calcium and sodium; and
- Well 44 hardness, chloride, calcium, magnesium and sodium.

It is noted that the parameters nitrate and boron were first added to the sampling program in 2016/2017; therefore, the comparison to historic data is generally limited for these parameters until a larger historic database is available. In addition, the majority of wells in the monitoring well network were installed in 2013-2015, and were only incorporated into the groundwater monitoring program in 2014-2016. As such, there is limited data available for historic comparisons. Monitoring wells 45 and 46 were installed in 2019 and therefore these wells will not be included in the above summary until sufficient data is obtained for comparison. The elevated concentrations in replacement wells with respect to the historic range of results at the former wells may be the result of the slight variations in screen depth and location for the replacement monitoring wells.

Time versus concentration graphs for the leachate indicator parameters of chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are shown on Figures D-8 through D-35, Appendix D.

Shallow flow system well 40 is representative of upgradient conditions, and was incorporated into the 2014 annual monitoring program as a background observation well. Concentrations of leachate indicator parameters have generally fluctuated with no increasing or decreasing trends, with the exception of a significant iron concentration spike that occurred in May 2017. The iron concentrations since 2017 have returned to the expected historic concentration range. The May 2022 chloride concentration was also slightly elevated in well 40 compared to the limited historical data.

Over the long-term, concentrations of general parameters and major and minor ions at observation wells 32 and 32R typically increased between the 1980s and mid to late 1990s. Since then however, concentrations have typically fluctuated with no overall pattern. As shown on the concentration versus time graphs for this well, leachate indicator parameter concentrations have fluctuated with no overall increasing trends, although it is noted that the chloride, boron and alkalinity concentrations in 2022 were above their respective historic ranges for well 32/32R.

The sampling results for observation wells 11 and 11R, located adjacent to the east, show that concentrations of select general parameters and major and minor ions increased from the late 1970s to late 1980s, decreased until mid-1990s, and typically fluctuated with no overall trend since that time. One exception is alkalinity concentrations, which fluctuated with an overall increase from the late 1990s/early 2000s to 2015. Metals concentrations at well 11 have fluctuated over the long term with no overall trend. In 2016, observation well 11 was decommissioned and

replaced by observation well 11R. When compared to recent results at former well 11, most parameters at replacement well 11R had appreciably elevated concentrations in 2016-2022. These concentrations indicate a residual landfill influence, directly adjacent to the east of the landfill mound. The higher concentrations at replacement well 11R do not necessarily indicate a change in groundwater conditions at the site, however, continued monitoring at observation well 11R is recommended. Chloride concentrations in the replacement well 11R appear to be trending upward and should continue to be monitored.

Concentrations of leachate indicator parameters at observation wells 16AR, 19R, 43, and 44 have generally fluctuated with no discernable increasing or decreasing trends. Chloride concentrations at well 16AR increased in 2021 and 2022 and should continue to be monitored for any trends.

At observation wells 28 and 28R, general parameter, major and minor ion, and metal concentrations have fluctuated over the long term with no overall increasing or decreasing trend. It is noted that there was a discernable increase in the potassium concentrations from 2012 to 2015, although this concentration has decreased from 2016 into 2022 at replacement well 28R.

Concentrations of several leachate indicator parameters (chloride, alkalinity, potassium, and iron) displayed increasing concentration trends with time from 1997 to 2012 at observation well 26. The condition of the well was determined to be deteriorating and was decommissioned and replaced with observation well 26R in 2015 to monitor downgradient groundwater conditions in the shallow flow system. This well was incorporated into the monitoring program and sampled in 2016. Parameter concentrations in replacement well 26R appear to be slightly decreasing with time, although they remain elevated compared to historical levels. Chloride concentrations display the most significant concentration increase over time between 2004 and 2016, although they have since been noted to be decreasing. In order to further investigate the groundwater conditions in the vicinity of observation well 26R, a supplemental drilling program was completed and two additional wells (45 and 46) were installed in August 2019. Groundwater samples have been collected from monitoring wells 45 and 46 annually since 2019 and submitted to the laboratory for analysis of the annual groundwater parameter package. It is noted that VOCs have not been detected in the samples collected from monitoring wells 45 and 46 since installation. The parameter concentrations at monitoring wells 45 and 46 are significantly below the concentrations at 26R. In particular, chloride concentrations, which exceeded the trigger levels at well 26R, were well below the trigger levels at wells 45 and 46 in 2019 through 2022.

Based on the groundwater elevation and chemistry results at recently installed wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Groundwater appears to flow north from the property boundary at 26R toward monitoring wells 45 and 46. Meanwhile, key parameter concentrations within monitoring wells 45 and 46 were well below the concentrations at 26R. Continued additional monitoring of wells 45 and 46 is recommended to confirm this conclusion.

It is suspected that road salting is a contributing factor in the increasing concentrations at well 26R, as both chloride and sodium concentrations were significantly greater at well 26R than within leachate well 41 in 2022, as well as in recent historical results. VOCs have not been detected in the samples collected at well 26R.

Groundwater quality at the adjacent and downgradient observation wells were generally similar to those observed in background well 40. The exceptions, which were discernably higher than historic background levels (greater than 50% higher), were concentrations of: conductivity, hardness, chloride, alkalinity, magnesium, potassium, sodium, ammonia, TKN, DOC, and boron at observation well 11R; sulphate and sodium at observation well 16AR; conductivity, chloride, alkalinity, magnesium, potassium, sodium, and boron at observation well 26R; sodium and boron at observation wells 28R, 43 and 45; and nitrate at observation wells 19R, 32R and 44.

In general, the highest parameter concentrations in the shallow groundwater flow system at the site were typically observed in observation well 11R and included elevated concentrations of a number of general parameters and major ions. This was followed by concentrations at 26R. Conversely, parameter concentrations at shallow groundwater wells 16AR, 19R, 28R, 32R, 43, 44, 45, and 46 were typically similar to those observed in the background well.

In summary, there may have been some historical landfill impacts in a number of the shallow groundwater flow system wells adjacent to the northeast, and particularly adjacent to the east of the landfill; however, these impacts have generally abated such that there was no clear indication of leachate influence in the shallow observation wells further downgradient to the east/southeast at the site during 2022. The area adjacent to the east of the landfill, near 11R, should continue to be inspected to confirm that there are no leachate seeps. Potentially increasing parameter concentrations observed at observation well 11R may be landfill related, although some parameter concentrations appear to be decreasing in recent years. Off-site influenced groundwater appears to be contributing to the elevated concentrations at 26R, as supported by additional monitoring completed at wells 45 and 46. Continued additional monitoring should be undertaken at wells 45 and 46 to confirm this inference. Similar to well 11R, some leachate indicator parameter concentrations at well 26R appear to be decreasing in recent years.

#### DEEP GROUNDWATER FLOW SYSTEM

As observed in Table 4-2, the 2022 parameter concentrations in the deeper groundwater observation wells were typically within or below their respective historic concentration ranges for the wells, with some exceptions. The following parameters were above the historic range for the specified well and former well, if applicable:

- Well 21R chloride, alkalinity, magnesium and iron;
- Well 27 hardness and calcium;
- Well 37R chloride, calcium and sodium;
- Well 38 chloride and sulphate;
- Well 39 hardness, chloride, sulphate, magnesium, sodium and iron; and
- Well 42 calcium and sodium.

The elevated concentrations in replacement wells with respect to the historic range of results at the former wells may be the result of the slight variations in screen depth and location for the replacement monitoring wells.

Time versus concentration graphs for the leachate indicator parameters of chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are shown on Figures D-8 through D-35, Appendix D.

Deep flow system wells 39 and 42 are representative of upgradient conditions, and were incorporated into the 2014 and 2016 annual monitoring programs, respectively, as background observation wells. Concentrations of leachate indicator parameters have generally fluctuated with no increasing or decreasing trends, although the May 2022 chloride concentration was slightly elevated in well 39 compared to the limited historical data.

It is observed in these graphs that the 2010 through 2022 iron concentrations in deep wells 21/21R, 24/24R, 25/25R, and 38 are marginally to appreciably elevated relative to the historic data in the respective wells. The reason for this trend is not clear, although it is inferred that the change in iron concentrations may be related to a change in laboratory analytical method; as a different laboratory was used after 2010.

The concentration versus time graphs for observation well 24/24R, located adjacent to the northeast, show that leachate indicator concentrations have fluctuated over the long term with no overall increasing or decreasing trends.

At observation well 25/25R, located adjacent to the east of the landfill, concentrations of most parameters fluctuated with an overall increase from 1999 to 2007, followed by an overall decrease from 2007 to 2015, and now appear to be generally stable.

To the east and southeast of the landfill, along the eastern limit of the buffer zone property (CAZ), the concentration versus time graphs for well 37/37R and well 38, show that leachate indicator parameter concentrations have fluctuated over the long term with no overall increasing or decreasing trends. The exceptions are the chloride concentrations, which have increased marginally in both wells since the early 2000s, but are still considered low and are far below the ODWQS.

To the west of the landfill area, at observation well 21/21R, most parameters have generally fluctuated over the long term with no overall trend with the exception of iron and chloride concentrations which appear to be increasing over time. Chloride concentrations in the old well 21 fluctuated with an overall increase from 1999 to 2007, followed by an overall decrease from 2008 to 2014. Chloride concentrations in the replacement well 21R appear to be increasing since sampling began in 2015, with a historical maximum reported in 2022. However, the concentrations are still considered low and remain far below the ODWQS.

At observation well 27, located south of the landfill, most parameter concentrations fluctuated with no overall increasing trends prior to 1995. When monitoring of well 27 resumed again in 2012, most constituent concentrations appeared to slightly increase compared to prior to 1995, but concentration trends have remained stable.

Groundwater quality at the adjacent and downgradient observation wells were generally similar to those observed in background wells 39 and 42.

In general, the highest parameter concentrations in the deep groundwater flow system at the site were observed in background well 39 and observation well 27 (located along the southern property boundary). The 2022 parameter concentrations at well 27 do not show clear evidence of an adverse leachate influence, given the chloride concentration of just 41 mg/L and the absence of VOC detections. There is no conclusive evidence of a leachate influence on the deep groundwater quality at well 27 at this time.

Parameter concentrations at well 21/21R situated west of the landfill, and well 37/37R at the southeast corner of the buffer zone property (CAZ) were also marginally elevated relative to the other deeper flow system wells; but typically similar to, or below the parameter concentrations at well 39 in the northwest corner. As discussed previously, recent chloride concentrations in the replacement well 21R may be increasing, but still remain relatively low. Concentrations of other leachate indicators are generally fluctuating within historical ranges. Marginally increasing chloride concentrations were also observed at observation well 37/37R, but remain relatively low and well below the ODWQS for chloride. The increasing chloride concentrations may be indicative of the natural fluctuations in the deeper flow system or influences from road salting activities. As such, there is no conclusive evidence of a leachate influence on the deep groundwater quality at wells 21/21R and 37/37R at this time.

In summary, there was no clear evidence of a leachate influence in the deeper groundwater flow system along the northeast portion of the property boundary (well 24R), adjacent east to the landfill mound (well 25R), west of the landfill (well 21R) and south of the landfill (27). Continued monitoring is recommended to expand the chemical databases. Deeper groundwater quality at the east and southeast limits of the buffer zone property (wells 38 and 37R respectively) do not demonstrate a leachate influence.

#### 4.2.2 DOMESTIC WELLS

As observed in Table 4-2, the 2022 parameter concentrations in domestic well D2 (Pearce) were within or below their respective historic concentration ranges, with the exception of chloride and sodium. Domestic well D2 is believed to obtain its water from the deep flow system.

It is noted that domestic well D2 (Pearce) came under new ownership before the 2015 sampling event, with notable renovations happening at the home. Previous groundwater chemical results (2012-2013, 2016-2021) have strongly suggested that the water was treated (ie. softened) prior to sample collection. This was also the case in the 2022 sample.

The concentration versus time graphs for well D2 show that parameter concentrations have fluctuated over the long term with no overall increasing or decreasing trends at this location.

Parameter concentrations at domestic groundwater well D2 (Pearce) were generally similar to those observed at the other deep flow system wells. Anthropogenic sources, such as road salting, septic beds, home renovations, and/or the well distribution system may be responsible for some of the historically elevated concentrations at domestic well D2. Groundwater quality in the well does not show evidence of leachate influence, based on a comparison with background shallow groundwater quality.

#### 4.2.3 TRILINEAR DIAGRAM

The natural variability in the overburden groundwater quality at the Site is illustrated on the trilinear diagram (Figure 8) using the May 2022 analytical results. The anion chemical results are presented on the triangular graph in the lower right, while the cation chemical results are presented on the triangular graph in the lower left. The anion and cation results are combined on the diamond shaped graph in the centre. Water with similar chemical signatures will plot together on the tri-linear plot.

Leachate chemistry from the Site is plotted in red on the trilinear plot, for reference purposes. Leachate chemistry from well 41 is bicarbonate enriched and sulphate deficient, with a slightly dominant calcium cation.

The shallow and deep flow system groundwater quality at the Site generally plots together on the trilinear diagram. As shown on Figure 8, groundwater is typically enriched with bicarbonate (anion), with a dominant calcium cation. An exception is the groundwater quality at domestic well D2, which is enriched with bicarbonate (anion) and sodium (cation), as a result of the water being treated (ie. softened) prior to sample collection.

The shallow and deep groundwater samples from the site plot consistently together near the left corner of the combined graph, with the exception of well 26R which was influenced by elevated chloride and sodium concentrations, and domestic well D2 which was influenced by elevated sodium concentrations. However, the water quality at these wells do not exhibit typical leachate quality influences. As mentioned in Section 4.2.1, observation well 26R is suspected to be influenced by road salting, as both chloride and sodium concentrations were greater at well 26R than within leachate well 41. As mentioned in Section 4.2.2, the groundwater quality at domestic well D2 suggests that the water was treated (ie. softened) prior to sample collection. Shallow groundwater in well 43 also plotted slightly separate from the other monitors due to the influence of slightly elevated sodium concentrations.

The leachate chemistry from the Site plots slightly lower than most groundwater quality, near the left corner of the combined graph. Typical municipal leachate would plot toward the lower left-central area of the combined graph. The location of the well 41 chemistry on the combined graph suggests a weak leachate strength.

In summary, the trilinear plot does not provide any indication of a discernible leachate impact to the shallow or deep groundwater flow systems.

#### 4.2.4 ONTARIO DRINKING WATER QUALITY STANDARDS

The following parameters were detected at concentrations exceeding the Ontario Drinking Water Quality Standards (ODWQS) (MECP, June 2003) in samples collected from the shallow flow system and deeper flow system observation wells during 2022.

- Hardness at all wells sampled in 2022, except Domestic Well D2;
- Alkalinity at shallow flow system wells 11R and 26R;
- Nitrate at shallow flow system well 44;
- DOC at shallow flow system wells 11R, 26R and 40;
- Iron at shallow flow system wells 11R, 26R, 40, 45 and 46, and at deep flow system wells 21R, 24R, 25R, 27, 37R, 38 and 39;
- Manganese at shallow flow system wells 11R, 32R and 40, and at deep flow system wells 27, 38 and 39; and
- Sodium at Domestic Well D2.

Most parameters that exceeded the ODWQS within the shallow groundwater flow system and deep groundwater flow system have objectives or guidelines related to the aesthetic quality or operational treatment of the water and are not health related. The exception to this is nitrate, which has a maximum acceptable concentration limit. The nitrate exceedance observed at shallow flow system well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate, and only in very low concentrations in the shallow groundwater adjacent to the east side of the landfill mound. It is much more likely that this concentration is the result of agricultural activities that surround this well location. A supplemental sample was collected at observation well OW33R in May 2019, in order to better assess the landfill's potential contribution of nitrate on the east side of the site. The nitrate concentration at well OW33R was 0.496 mg/L which is well below the ODWQS of 10.0 mg/L for nitrate, and significantly less than the concentrations observed at well 44 in recent years (15.4 – 27.4 mg/L from 2017-2022). Given that well 33R is directly adjacent to the landfill and the nitrate concentration was low, the elevated nitrate concentration at well 44 is unlikely to be landfill related.

Concentrations of hardness, iron, and manganese observed in the shallow and deep groundwater flow systems, and DOC in the shallow flow system, appear to naturally approach or exceed the ODWQS, since exceedances for these parameters have been observed at background wells. Alkalinity exceedances observed at shallow groundwater well 11/11R may indicate residual landfill influences. The sodium exceedance at Domestic Well D2 is likely the result of softening treatment prior to sample collection.

#### 4.2.5 GUIDELINE B-7 COMPLIANCE ASSESSMENT

Guideline B-7 was established by the MECP as a mechanism to assess the acceptable level of leachate impacts on the groundwater system. Guideline B-7 is applied to groundwater quality at the property boundary, and is intended to protect both existing and potential reasonable uses of the groundwater on adjacent properties. The Guideline

states that, for non-health related parameters, the impact from the landfill should not raise the concentration by more than half the difference between the background concentration and the Ontario Drinking Water Quality Standard or Objective (ODWQS).

#### SHALLOW FLOW SYSTEM

Groundwater movement in the shallow flow system across most of the site is inferred to converge on the on-site stream; though the groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. Hence, there may be a minor component of localized shallow groundwater flow from the fill area east and southeast toward the buffer property.

MECP Guideline B-7 criteria were calculated to assess the significance of the landfill effects on the shallow groundwater flow system along the eastern property boundary. Guideline B-7 is normally applied at the property boundary, and is intended to protect both existing and potential reasonable uses of that groundwater on adjacent properties.

Guideline B-7 criteria were calculated for parameters that have ODWQS. The chemistry results measured in 2022 from shallow background monitoring well 40 were used as the reference concentration for the groundwater flow system.

Table 4-3 provides a comparison of the calculated Guideline B-7 criteria and downgradient wells on Site.

Table 4-3 2022 Guideline B-7 Compliance – Shallow Flow System

PARAMETER	REFERENCE QUALITY	ODWQS	GUIDELINE B-7	MONITORING WELL					
	QUALITI		D-1	26R	32R	43	44	45*	46*
Hardness	431	80-100	431 †	609	335	144	434	222	276
Chloride	29	250	140	240	15	24	20	3	1
Sulphate	51	500	276	24	33	34	50	32	37
Alkalinity	338	30-500	419	586	291	187	280	162	230
Sodium	13.4	200	107	186	9.88	63.5	7.60	28.0	2.18
Nitrate	0.08	10.0	2.56	<0.06	0.41	0.11	19.1	0.17	0.14
Nitrite	<0.03	1.0	0.26	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
DOC	5.8	5	5.8 †	8.2	1.6	1.7	1.0	1.2	2.1
Boron	0.024	5.0	1.27	1.27	0.057	0.145	0.022	0.133	0.020
Chromium	0.00045	0.05	0.013	0.00057	0.00009	0.00015	0.00078	0.00039	0.00020
Iron	2.94	0.3	2.94 †	1.96	0.082	<0.007	0.007	0.336	0.386
Manganese	0.238	0.05	0.238 †	0.0394	0.0871	0.0034	0.00081	0.0375	0.0156
Vinyl Chloride (µg/L)	<0.2	1	0.33	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzene (µg/L)	<0.50	1	0.44	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4 Dichlorobenzene (µg/L)	<0.50	5 MAC	1.44	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
		1 AO	0.63						

Notes:

- All concentrations are mg/L unless otherwise noted.
- ODWQS Ontario Drinking Water Quality Standards (June 2003)
- Shading indicates concentrations exceed Guideline B-7 criteria.
- Reference quality based on 2022 groundwater quality measured from background observation well 40.
- † When the reference concentration is greater than the ODWQS, the reference value is used as the Guideline B-7 Criterion.
- \* Wells included for comparison purposes only, as GB-7 is actually assessed at the property boundary.

In summary, concentrations at the landfill property boundary complied with the Guideline B-7 (GB-7) criteria, with the exception of hardness, chloride, alkalinity, sodium and DOC at observation well 26R, and hardness and nitrate at well 44.

The hardness exceedance at observation well 26R is consistent with historic results. The hardness exceedance at well 44 was above the historical range, however the concentration is similar to the concentration reported in the background well 40. These exceedances do not appear to be related to the landfill. Concentrations of hardness observed in the shallow flow system appear to naturally exceed the ODWQS, as exceedances for these parameters are observed at the background well.

As discussed previously, the nitrate exceedance observed at well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate, and only in very low concentrations in the shallow groundwater adjacent to the east side of the landfill mound. Furthermore, other leachate indicator parameters such as chloride, alkalinity, and VOCs are not elevated at well 44. A supplemental sample was collected at observation well OW33R in 2019, in order to better assess the landfill's contribution of nitrate on the east side of the site. The nitrate concentration was found to be low at well 33R (well below ODWQS and GB-7 Criteria), indicating the elevated nitrate concentration at well 44 is unlikely to be landfill related. The nitrate concentration is likely the result of agricultural activities that surround this well location.

It is suspected that road salting is a contributing factor in the exceedances at observation well 26R, as both chloride and sodium concentrations were greater at well 26R than within leachate well 41 in 2022, as well as in recent historical results. As discussed earlier, in order to further investigate the groundwater conditions in the vicinity of observation well 26R, a supplemental drilling program was completed and two additional wells (45 and 46) were installed in August 2019. Groundwater samples were collected from monitoring wells annually since 2019 and submitted to the laboratory for analysis of the annual groundwater parameter package. It is noted that VOCs were not detected in the samples collected from monitoring wells 45 and 46 in 2019 through 2022. The parameter concentrations at monitoring wells 45 and 46 were significantly lower than the concentrations at 26R, and no concentrations exceeded the GB-7 Criteria in 2019 through 2022. Based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Based on historical data, groundwater appears to flow north from the property boundary at 26R toward monitoring wells 45 and 46. Continued additional monitoring of wells 45 and 46 is recommended to confirm this conclusion.

As limited historic databases are available for several of the parameters at observation wells 26R and 44, continued monitoring is recommended to confirm these Guideline B-7 exceedances.

#### DEEP GROUNDWATER FLOW SYSTEM

Groundwater flow in the deep flow system is inferred to be in a generally south to southeasterly direction under a low horizontal hydraulic gradient. MECP Guideline B-7 criteria were calculated to assess the significance of the landfill effects on the deep groundwater flow system. Guideline B-7 is applied at the property boundary, and is intended to protect both existing and potential reasonable uses of the groundwater on adjacent properties.

Guideline B-7 criteria were calculated for parameters that have ODWQS. The median chemistry results measured in 2022 from deep background monitoring wells 39 and 42 were used as the reference concentration for the deep flow system.

Table 4-4 provides a comparison of the calculated Guideline B-7 criteria and deep flow system downgradient wells on Site. Guideline B-7 is applied at the property boundary and is applicable to observation wells 27, 37R, and 38.

Table 4-4 2022 Guideline B-7 Compliance - Deep Flow System

PARAMETER	REFERENCE ODWQ		GUIDELINE B-7	MONITORING WELL			
	QUALITI		<b>D</b> -1	27	37R	38	
Hardness	300	80-100	300 †	395	375	310	
Chloride	22.3	250	136	41	38	31	
Sulphate	28.5	500	500 <b>264</b>		41	27	
Alkalinity	261	30-500	380	305	277	252	
Sodium	22.8	200	111	18.7	14.8	18.4	
Nitrate	0.15	10.0	2.61	<0.06	<0.06	<0.06	
Nitrite	0.03	1.0	0.27	<0.03	<0.03	<0.03	
DOC	1.2	5	3.1	1.4	1.1	1.8	
Boron	0.043	5.0	1.28	0.084	0.047	0.050	
Chromium	0.0001	0.05	0.013	0.0001	<0.00008	0.0001	
Iron	0.289	0.3	0.29	1.00	0.816	0.634	
Manganese	0.076	0.05	0.076 †	0.0639	0.0455	0.050	
Vinyl Chloride (μg/L)	<0.20	1	0.33	<0.2	<0.2	<0.2	
Benzene (µg/L)	<0.50	1	0.44	<0.5	<0.5	<0.5	
1,4 Dichlorobenzene (µg/L)	<0.50	5 MAC	1.44	<0.50	<0.50	<0.50	
1,4 Didiliolopelizerie (µg/L)	<b>40.30</b>	1 AO	0.63	<b>~</b> 0.50			

- Notes: All concentrations are mg/L unless otherwise noted.
  - ODWQS Ontario Drinking Water Quality Standards (June 2003)
  - · Shading indicates concentrations exceed Guideline B-7 criteria.
  - Reference quality based on 2022 groundwater quality measured from background observation wells 39 and 42.
  - † When the reference concentration is greater than the ODWQS, the reference value is used as the Guideline B-7 Criterion.

In summary, concentrations at the property boundary complied with the Guideline B-7 criteria, with the exception of hardness and iron at wells 27, 37R and 38. As stated in Section 4.2.4., concentrations of hardness and iron appear to be naturally elevated in the deep flow system. The hardness concentrations at observation wells 37R and 38 are actually below the 2022 background result at well 39 and the concentration at well 27 was only slightly above the concentration at well 39. As such, the site is considered to be in compliance at the downgradient property boundaries.

#### 4.2.6 TRIGGER MECHANISM COMPLIANCE ASSESSMENT

On September 8, 2016, the site CofA (Waste) was updated by the MECP to Amended Environmental Compliance Approval (ECA) No. A070702. The new approval incorporated the County owned buffer lands to the east of the landfill into a Contaminant Attenuation Zone (CAZ). As part of the new ECA, a closure plan was submitted to the MECP on June 28, 2017, which included a trigger mechanism and contingency plan as well as a new monitoring program.

On October 24, 2017, the County received comments from the MECP regarding their review of the closure plan. One of the comments made by the MECP noted that some of the trigger parameters had been selected based on very few sets of analytical sets of data. The reviewer felt that the list of trigger parameters should be reviewed/revised after a few years to ensure that the parameters selected are meaningful.

A response to the MECP comments was provided by WSP on December 8, 2017, on behalf of the County. In the response, it was noted that trigger parameters for the groundwater trigger mechanism plan were selected based on the available data, as the historic monitoring program contained very few practical leachate indicator parameters. It was agreed that the trigger parameters will be reassessed after a few years to ensure that the selected parameters are meaningful.

The closure plan and response were accepted by the MECP in Notice No. 1 of the ECA, dated March 6, 2018; however, the trigger mechanism plan was not implemented in 2022 as the chemical database was still limited. It is proposed to finalize the trigger criteria once a minimum of eight data sets have been collected for each parameter. Table 4-5 outlines the current groundwater trigger concentrations and boundary criteria, with 2022 results for the selected boundary wells.

MONITORING WELL

Table 4-5 2022 Groundwater Trigger Mechanism Compliance Assessment

#### **Shallow Flow System Deep Flow System TRIGGER PARAMETER LEVEL** 37R 38 43 44 26R 27 Chloride 240 24 20 41 38 31 134 Boron 1.3 1.27 0.145 0.022 0.084 0.047 0.050 <0.2 Vinyl Chloride (µg/L) 0.4 < 0.2 < 0.2 < 0.2 <0.2 < 0.2 Benzene (µg/L) 0.4 < 0.5 < 0.5 <0.5 < 0.5 <0.5 <0.5 <0.5 <0.5 <0.5 < 0.5 <0.5 <0.5 1,4 Dichlorobenzene (µg/L) 1.3

Notes:

The property boundary groundwater trigger criteria at the site were not exceeded during 2021, with the exception of the chloride concentration at observation well 26R. It is suspected that road salting and/or off-site sources are contributing factors in the chloride concentrations at observation well 26R, as chloride and sodium concentrations were greater at well 26R than within the leachate well 41 in 2022, as well as in recent historical results. It is also noted that VOCs have not been detected in the samples collected at well 26R. As discussed previously, based on the groundwater elevation and chemistry results at recently installed wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Additional monitoring results will be required to confirm this conclusion.

Continued monitoring is required to expand the chemical database at the boundary wells.

# 5 SURFACE WATER QUALITY

The general surface water chemical results from the surface water stations are provided in Table E-1, Appendix E. The laboratory certificates of analysis are provided in Appendix F. Concentration versus time graphs for conductivity, hardness, alkalinity, calcium, chloride, magnesium, iron, and manganese are presented on Figures E-1 through E-21. Surface water samples are collected semi-annually from stations C01 and C06, and annually in April from stations C04, P01, P02, P03, and NE1. The surface water station locations are shown on Figure 2.

The QA/QC program for the monitoring program at the site included a field and a laboratory component. Standard field protocols were used to ensure consistency.

All concentrations are mg/L unless otherwise noted.

 $<sup>\</sup>bullet \ {\tt Shading \ indicates \ concentrations \ exceed \ proposed \ trigger \ boundary \ criteria.}$ 

Laboratory reports were reviewed as part of the laboratory QA/QC program. Blind duplicate samples were collected from surface water station C01 in April and October 2022. In general, duplicate samples were similar to the original samples results with the calculated Relative Percent Difference (RPD) within the 20% guideline for acceptability or less than two times the laboratory reported method detection limit (MDL), with the exception of chromium in April (>2MDL). Acceptable data quality control including laboratory blanks, spiked blanks, laboratory duplicates, and laboratory percent recoveries of analysis indicated that the detected constituent concentrations were accurate and reflected actual surface water conditions at the time of sample collection and are acceptable for inclusion into the database.

### 5.1 SURFACE WATER QUALITY COMPARISON

#### I) WETLANDS ON NORTHEAST BOUNDARY (NE1)

Surface water station NE1 is situated in the wetland area north of the site, associated with the Otter Creek drainage system. Station NE1 is in the area of ponded water situated at the toe of the landfill, which receives runoff from the north and east side slopes of the landfill.

The 2022 chemistry results at surface water station NE1 were generally within their respective historic ranges, with the exception of ammonia and un-ionized ammonia. It is noted that there are no drainage channels within the low relief (swampy) area northeast of the landfill. Surface water run-off into the swampy area travels overland as sheet flow, usually forming ponds and eventually infiltrating into the soil. As such, stagnant water conditions usually exist at the time of sampling at station NE1. During stagnant conditions, chemical precipitates, evaporation and biological activity serve to change the water quality. Thus, the concentration results at NE1 are likely indicative of the swampy, stagnant conditions in the area, and are not representative of the natural water quality in flowing conditions.

As illustrated in Figures E-10 to E-12, alkalinity, hardness, conductivity, calcium and magnesium concentrations at NE1 appear to be fluctuating and increasing since 2013. The remaining parameter concentrations at NE1 have fluctuated over time with no overall long-term increasing or decreasing trends.

Of the parameters tested, only the parameters pH, alkalinity, un-ionized ammonia, boron, chromium, and iron have PWQOs. The 2022 surface water chemistry at station NE1 complied with the PWQOs for the parameters tested, with the exception of un-ionized ammonia and iron which were above the PWQO. The un-ionized ammonia concentration in 2022 was the highest since analysis of this parameter began in 2018. The 2022 iron concentration was within the historical range for this sampling location.

Based on the monitoring results, surface water quality in the northeast portion of the site was not measurably affected by the landfill site in 2022.

#### III) ON-SITE STREAM (C01, C04, AND C06) AND ADJACENT RETENTION POND (P02)

Surface water station C06 is located in a swampy area near the northwest corner of the site, inferred to be the headwaters of the on-site stream, and represents the upstream surface water quality conditions in the on-site stream. Station C04 is located downstream of C06 in the on-site stream, within the landfill property, while station C01 is located furthest downstream at the southern property boundary. The on-site stream exits the southern portion of the site via a culvert beneath Quaker Street.

Surface water station P02 is located on the retention pond situated in the central portion of the site, adjacent and west of the landfill. The pond receives surface water run-off from the western portion of the fill area, and also

shallow groundwater moving from beneath the landfill. Drainage from the retention pond (P02) enters the on-site stream between surface water stations C06 and C04.

The 2022 chemistry results from the stations along the on-site stream were within their respective historic ranges with the exception of: potassium and sodium for station CO1; turbidity (field), sodium, ammonia and un-ionized ammonia for station C04; and sodium and boron for station C06. Within the retention pond at station P02, several parameters in 2022 were above their respective historic ranges including hardness, chloride, sulphate, alkalinity, calcium, potassium, sodium and ammonia.

However, it is noted that the parameters turbidity (field), sulphate, potassium, sodium, ammonia, un-ionized ammonia, nitrate, nitrite, boron and chromium were first added to the sampling program in 2017/2018; and thus, only limited historic data is available for comparison.

The 2022 chemistry results from the on-site stream and pond P02 are shown on Table 5-1 in sequence of the flow direction, downstream from station C06.

Table 5-1 2022 Surface Water Chemistry – On-Site Stream and Pond P02

	C06	P02	C04	C01
рН	8.13	8.10	8.27	8.02 - 8.26
Conductivity	592	864	803	678 - 737
Hardness	298	402	382	296 - 341
Chloride	52	71	62	54 - 61
Sulphate	15	26	25	22 - 22
Alkalinity	253	373	338	274 - 284
Calcium	91.5	110	107	70.8 - 95.3
Magnesium	16.9	31.0	28.2	25.2 - 28.9
Potassium	1.27	12.3	9.79	8.48 - 10.6
Sodium	27.8	45.5	38.1	33.6 - 40.7
Ammonia	<0.1	9.7	6.2	0.5 - 0.8
Un-ionized Ammonia	<0.001	0.058	0.242	0.004 - 0.010
Nitrate	0.22	0.32	0.78	0.57 - 2.13
Nitrite	<0.03	<0.03	<0.03	<0.03 - <0.03
Boron	0.040	0.443	0.389	0.332 - 0.359
Chromium	0.00032	0.00023	0.00040	<0.00008 - <0.00008
Iron	0.05	0.56	0.29	0.12 - 0.55
Manganese	0.0342	0.0833	0.0776	0.0590 - 0.276

Notes:

All concentrations in mg/L except pH (unitless) and conductivity ( $\mu$ S/cm).

As observed in Table 5-1, parameter concentrations typically increased between stations C06 and C04. The increase is likely related to the quality of surface water discharge from pond P02. Surface water quality concentrations generally remained similar between stations C04 and C01. The chemical results for station C01 were collected semi-annually, while the results from C04 were collected only annually (April). Based on a comparison of the April results alone, all parameter concentrations (with the exception of nitrate) decreased between intermediate station C04 and downstream station C01; however, parameter concentrations at downstream station C01 were still mostly higher than those observed at upstream station C06. A comparison between upstream station C06 and downstream station C01 was not possible for October 2022, as C06 was dry during the sampling event.

As illustrated in Figures E-1 to E-9 for stations C01 to C06 and Figures E-16 to E-18 for pond P02, parameter concentrations have typically fluctuated over the long-term with no overall increasing or decreasing trends; though there are some exceptions. Chloride concentrations at stations C01, C04 and C06 increased between about 1998 and 2002, and have generally fluctuated with no overall trend since that time. Alkalinity and conductivity concentrations at C04 increased overall from the mid-1990s until approximately 2013 and now appear to have stabilized. Alkalinity, hardness, conductivity, and chloride concentrations at retention pond station P02 have fluctuated with an overall increasing trend from the mid-1990s to 2015, but decreased in 2016/2017 and now appear to be fluctuating around this level.

The increasing parameter concentrations observed in retention pond P02 from the mid-1990s to 2015 are likely attributable to landfill influences since the pond is inferred to receive shallow groundwater flow from beneath the landfill. Likewise, the increased chloride concentrations at surface water stations C01 and C04 are likely related, at least in part, to discharge of shallow groundwater from beneath the landfill. Station C06 is located along the western property boundary. It is unlikely that any shallow groundwater from beneath the landfill is reaching the stream at this point. Thus, the increasing chloride levels at C06 may be related to off-site influences, such as road salting along County Road 13. However, monitoring should be continued for confirmation.

Previous reports have suggested that the increasing chloride concentrations observed at downstream station C01 coincided with the increase of chloride concentrations observed at shallow groundwater observation well 26, which is under artesian conditions. Packer systems were installed in shallow observation well 26 and deep observation well 27 (also artesian) in the summer of 2009 to prevent the wells from flowing to the receiving surface water course. An appreciable decrease in chloride concentrations at downstream station C01 was not observed in the sampling results after the packers were installed. As a result of the artesian conditions observed at well 26/26R, shallow groundwater with elevated chloride concentrations (similar to those at 26/26R) may be discharging into the low lying forested area west of well 26/26R and possibly directly into Branch Creek, contributing to the chloride levels.

A comparison of the chloride concentrations at C01, C04, and pond P02 (Figures E-2, E-5 and E-17, Appendix E) indicates that they are likely related. Since 1998, chloride levels at C01 have ranged from 29.0 mg/L to 79.8 mg/L with an average of 52.2 mg/L, while levels at C04 have ranged from 33.0 mg/L to 63.3 mg/L with an average of 51.2 mg/L. The chloride concentrations at pond P02 have ranged from 10.0 mg/L to 71.0 mg/L with an average of 50.0 mg/L. It is also understood that the area in the vicinity of surface water station C01 (i.e., a culvert) occasionally floods above the road level during the spring freshet and/or periods of high rainfall. As such, flooding and road salting influences may also contribute to the elevated chloride concentrations observed at station C01.

The 2022 concentrations at on-site stream stations C01, C04, and C06 and retention pond station P02 generally complied with the PWQOs, with the following exceptions:

- Unionized ammonia concentrations at stations C04 and P02;
- Boron concentrations at stations C01 (April and October), C04 and P02; and

Iron concentrations at stations C01 (October) and P02.

In summary, weak landfill influences are likely observed in the surface water quality in retention pond P02, and in the on-site stream at intermediate station C04. The retention pond and on-site stream are inferred to receive shallow groundwater flow from beneath the landfill. At station C01, landfill influences from the upstream portions of the on-site stream, shallow groundwater discharge, and road salting practices have all likely contributed to the chloride levels at the station.

#### IV) NORTHERN ON-SITE RETENTION POND (P03)

Surface water station P03 is located on the retention pond situated in the northern portion of the site, near the fill area. The pond likely receives surface water run-off from portions of the north and northwest areas of the landfill area.

The 2022 chemistry results at retention pond P03 were within than their respective historic ranges with the exceptions of hardness, sulphate and calcium which were above their respective historic ranges. As illustrated in Figures E-19 to E-21, parameter concentrations have fluctuated over the long-term with spikes of elevated concentrations, but with no overall increasing or decreasing trends. Concentrations of alkalinity, hardness, conductivity and calcium have been steadily increasing since experiencing a large decrease in concentration in 2012 for these parameters. The 2020 surface water concentrations at station P03 complied with the PWQO, with the exception of boron.

Based on the monitoring results, surface water quality in retention pond P03, in the northern portion of the site, was not measurably affected by the landfill site in 2022.

#### V) SOUTHEAST ON-SITE RETENTION POND (P01)

Surface water station P01 is located on the retention pond situated in the southeast portion of the site. The pond likely receives surface water run-off from portions of the south and southeast areas of the landfill area.

The 2022 chemistry results at retention pond P01 were within their respective historic ranges, with the exception of turbidity (field), which was above its limited historic range. As illustrated in Figures E-13 to E-15, concentrations of most parameters have fluctuated over the long-term with no overall increasing trend. The 2022 surface water concentrations at station P01 complied with the PWQO.

Based on the monitoring results, surface water quality in retention pond P01, in the southeast portion of the site, was not measurably affected by the landfill site in 2022.

#### 5.2 TRIGGER MECHANISM COMPLIANCE ASSESSMENT

On September 8, 2016, the site CofA (Waste) was updated by the MECP to Amended Environmental Compliance Approval (ECA) No. A070702. The approval incorporated the County owned buffer lands to the east of the landfill into a Contaminant Attenuation Zone (CAZ). As part of the ECA, a closure plan was submitted to the MECP on June 28, 2017, which included a trigger mechanism and contingency plan as well as a new monitoring program.

On October 24, 2017, the County received comments from the MECP regarding their review of the closure plan. One of the comments made by the MECP noted that the surface water monitoring data for the trigger parameters and

the database is quite small. The reviewer felt that once a larger database of results is established, especially for unionized ammonia and boron, then the initial set of triggers should be re-assessed.

A response to the MECP comments was provided by WSP on December 8, 2017, on behalf of the County. In the response, it was agreed that once a larger database of results is established, the proposed triggers may need to be reassessed. It is proposed to finalize the trigger criteria once a minimum of eight data sets have been collected for each parameter.

The closure plan and response were accepted by the MECP in Notice No. 1 of the ECA, dated March 6, 2018. Table 5-2 outlines the current surface water trigger concentrations and boundary criteria, with 2022 results for the downstream surface water trigger location (C01).

Table 5-2 2022 Surface Water Trigger Mechanism Compliance Assessment

#### **SURFACE WATER STATION C01**

PARAMETER	TRIGGER LEVEL	Date (2022)		
		April 6	October 18	
Chloride	120	54	61	
Boron	1.5	0.332	0.359	
Un-ionized Ammonia	0.02	0.004	0.010	

Notes: • All concentrations are mg/L unless otherwise noted.

None of the surface water trigger criteria at the site were exceeded during 2022. Continued monitoring is required to expand the chemical database, particularly for boron and un-ionized ammonia.

#### 5.3 SUMMARY

Based on the monitoring results, the on-site stream surface water quality demonstrates a weak landfill influence through the central portion of the site (station C04). It should be noted that the landfill influence is marginal, with the 2022 chloride concentration at 62 mg/L.

At the downstream station C01, where the on-site stream leaves the property, surface water quality has demonstrated marginally elevated chloride levels for a number of years. The chloride levels may be attributed to landfill influences from the upstream portions of the on-site stream, from shallow groundwater discharge, and from road salting practices. The April and October 2022 boron concentrations and October 2022 iron concentrations at downstream station C01 exceeded the PWQO.

Therefore, based on the monitoring results, surface water quality in the on-site stream leaving the site has been affected by landfill influences from the upstream portions of the on-site stream and in the shallow groundwater, and possibly from road salting activities. It is noted however, that the landfill influences in the surface water quality leaving the site are minor at most, with chloride concentrations ranging from 54 to 61 mg/L in 2022. The Canadian Environmental Quality Guideline (CEQG) for chloride for the protection of aquatic life is 120 mg/L. Surface water quality leaving the site at station C01 complies with the current trigger level boundary criteria.

<sup>•</sup> Shading indicates concentrations exceed proposed trigger criteria.

# 6 LANDFILL GAS MONITORING RESULTS

Landfill gas concentrations were measured at standpipes SP3R, SP4R, and SP5 on May 16, 2022, as per the approved monitoring program. These standpipes are located adjacent to the east, northeast, and north of the landfill mound, respectively.

The following table summarizes the landfill gas monitoring results and water levels within the standpipes in 2022. The combustible gas concentrations were measured as a percent of the lower explosive limit (LEL) for methane, and are presented in the following table. The LEL for methane represents 5% gas by volume in air.

SAMPLING LOCATION	% LEL Methane	% CO <sub>2</sub>	% O <sub>2</sub>	% Balance Gas	Groundwater Elevation (masl)
SP3R	0.0	0.0	20.9	79.1	280.48
SP4R	0.0	0.0	20.9	79.1	279.34
SP5	0.0	0.0	20.9	79.1	279.58

Methane was not detected at any of the locations, suggesting that landfill gas is not migrating from the site. At SP3R and SP4R, the water level was above the screened portion of the well (flooded), while the water level at SP5 was within the screened interval of the well (partially flooded).

## 7 2023 MONITORING PROGRAM

The annual monitoring program, as detailed in the ECA, should be continued at the Holbrook Landfill site in 2023. The packers placed in shallow and deep groundwater wells 26R and 27 should be maintained to prevent discharge from the flowing wells from reaching the surface water drainage system.

Table 7-1 provides the recommended 2023 environmental monitoring program for the Site.

Table 7-1 2023 Environmental Monitoring Program

ACTIVITY	LOCATION	SAMPLING FREQUENCY	ANALYSIS / MEASUREMENT
Groundwater and Leachate Level Monitoring	Shallow Flow System: 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16AR, 18R, 19R, 24AR, 26R, 28R, 32R, 33R, 40, 43, 44, 45, 46, SG1  Deep Flow System: 16R, 21R, 24R, 25R, 27, 31, 35, 37R, 38, 39, 42  Leachate Well: 41	Annual (May)	Water Level Measurement

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ACTIVITY	LOCATION	SAMPLING FREQUENCY	ANALYSIS / MEASUREMENT	
Groundwater and Leachate Sampling	Shallow Flow System: 11R, 16AR, 19R, 26R, 28R, 32R, 40, 43, 44, 45, 46  Deep Flow System: 21R, 24R, 25R, 27, 37R, 38, 39, 42  Private Wells: D2 (Pearce)  Leachate Well: 41	Annual (May)	Field Parameters: pH, conductivity, temperature  General Parameters: pH, conductivity, hardness  Major and Minor Ions: alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate  Nutrients and Organics: ammonia, nitrate, nitrite, TKN, DOC  Dissolved Metals: boron, chromium, iron, manganese	
	Shallow Flow System: 32R, 26R, 40, 43, 44, 45, 46  Deep Flow System: 27, 37R, 38, 39, 42  Leachate Well: 41	Annual (May)	Volatile Organic Compounds: vinyl chloride, benzene, 1,4 dichlorobenzene	
Landfill Gas Monitoring	Standpipes: SP3R, SP4R, SP5	Annual	Methane, carbon dioxide, oxygen, balance gas, as well as water level	
	Surface Water Station: C01, C06	Semi-annual (spring and fall)	Field Parameters: pH, conductivity, temperature, turbidity  General Parameters: pH, conductivity, hardness  Major and Minor Ions: alkalinity, calcium,	
Surface Water Sampling	Surface Water Station: C04, P01, P02, P03, NE1	Annual (spring)	chloride, magnesium, potassium, sodium, sulphate  Nutrients and Organics: ammonia, unionized ammonia, nitrate, nitrite  Total Metals: boron, chromium, iron, manganese	

# 8 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the 2022 monitoring program presented in this report, the following conclusions are provided.

— Groundwater movement in the shallow flow system across most of the site is inferred to be southwesterly towards the on-site creek, while shallow groundwater movement in the western portion of the site (west of the creek) is inferred to flow east towards the creek. However, the shallow flow system groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. Thus, groundwater flow in the shallow flow system across the majority of the site is inferred to converge on the on-site stream, with a minor component of localized shallow groundwater flow from the fill area toward the east and southeast.

- The retention pond located in the central portion of the site (pond P02) likely receives shallow groundwater inflow from beneath the landfill.
- Groundwater movement in the deeper flow system is inferred to be in a generally south to southeasterly
  direction beneath the site. The horizontal hydraulic gradient across the site is low, with a grade change of less
  than 1 m from the north to southeast limits of the site.
- The leachate strength at the site is relatively weak, with chloride and sodium concentrations below their respective Ontario Drinking Water Quality Standards (ODWQSs).
- There may have been some historical landfill impacts in a number of the shallow groundwater flow system wells adjacent to the northeast and particularly to the east and southeast of the landfill; however, most of these have abated such that there was no clear indication of leachate influence in the shallow observation wells at the downgradient property boundaries to the east/southeast at the site during 2022. The shallow groundwater quality complies with Guideline B-7, with the exception of hardness, chloride, alkalinity, sodium and DOC at observation well 26R, and hardness and nitrate at well 44. Concentrations of hardness are interpreted to be naturally elevated in the shallow flow system. The nitrate exceedance at well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate, and only in very low concentrations in the shallow groundwater adjacent to the east side of the landfill mound. Furthermore, other leachate indicator parameters such as chloride, alkalinity, and VOCs are not elevated at well 44. The nitrate concentration is likely the result of agricultural activities that surround this well location.
- It is suspected that road salting and/or off-site sources are a contributing factor in the exceedances at observation well 26R, as both chloride and sodium concentrations were greater at well 26R than within leachate well 41 in 2022, as well as in recent historical results. Based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Groundwater appears to flow north from the property boundary at 26R toward monitoring well 46. Meanwhile, key parameter concentrations within monitoring wells 45 and 46 were well below the concentrations at 26R. Continued additional monitoring of wells 45 and 46 is recommended to confirm this conclusion.
- There was no clear indication of leachate influence in the deeper groundwater flow system at the property boundaries in 2022. The deep groundwater quality complies with Guideline B-7, with the exception of hardness and iron at wells 27, 37R and 38. Concentrations of hardness and iron are interpreted to be naturally elevated in the deep flow system. The hardness concentrations at observation wells 37R and 38 are actually below the 2022 background result at well 39 and the concentration at well 27 was only slightly above the concentration at well 39. Thus, the site is considered to be in compliance at the downgradient property boundaries.
- None of the groundwater trigger criteria at the site were exceeded during 2022, with the exception of the chloride concentration at observation well 26R. It is suspected that road salting and/or off-site sources are contributing factors in the chloride concentrations at observation well 26R, as both chloride and sodium concentrations were greater at well 26R than within the leachate well 41 in 2022, as well as in recent historical results. It is also noted that VOCs have not been detected in the samples collected at well 26R. As discussed previously, based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound.
- Surface water quality in the wetland at the northeast site boundary, and the northern and southeast on-site retention ponds was not measurably affected by the landfill in 2022. Surface water quality at intermediate station C04 along the on-site stream and retention pond P02 in the central part of the site were inferred to be slightly influenced by the landfill.
- Surface water quality in the on-site stream leaving the site (station C01) has been affected by landfill influences from the upstream portions of the on-site stream, shallow groundwater discharge, and possibly road salting

activities. However, the landfill influences in the surface water quality leaving the site are very weak, based on the monitoring results, with chloride values below the CEQG water quality guideline for the protection of aquatic life. Surface water quality leaving the site at station C01 complies with the current trigger level boundary criteria.

No methane was detected during the 2022 monitoring event at any of the landfill gas monitoring probes, located adjacent to the east, northeast, and north of the landfill mound.

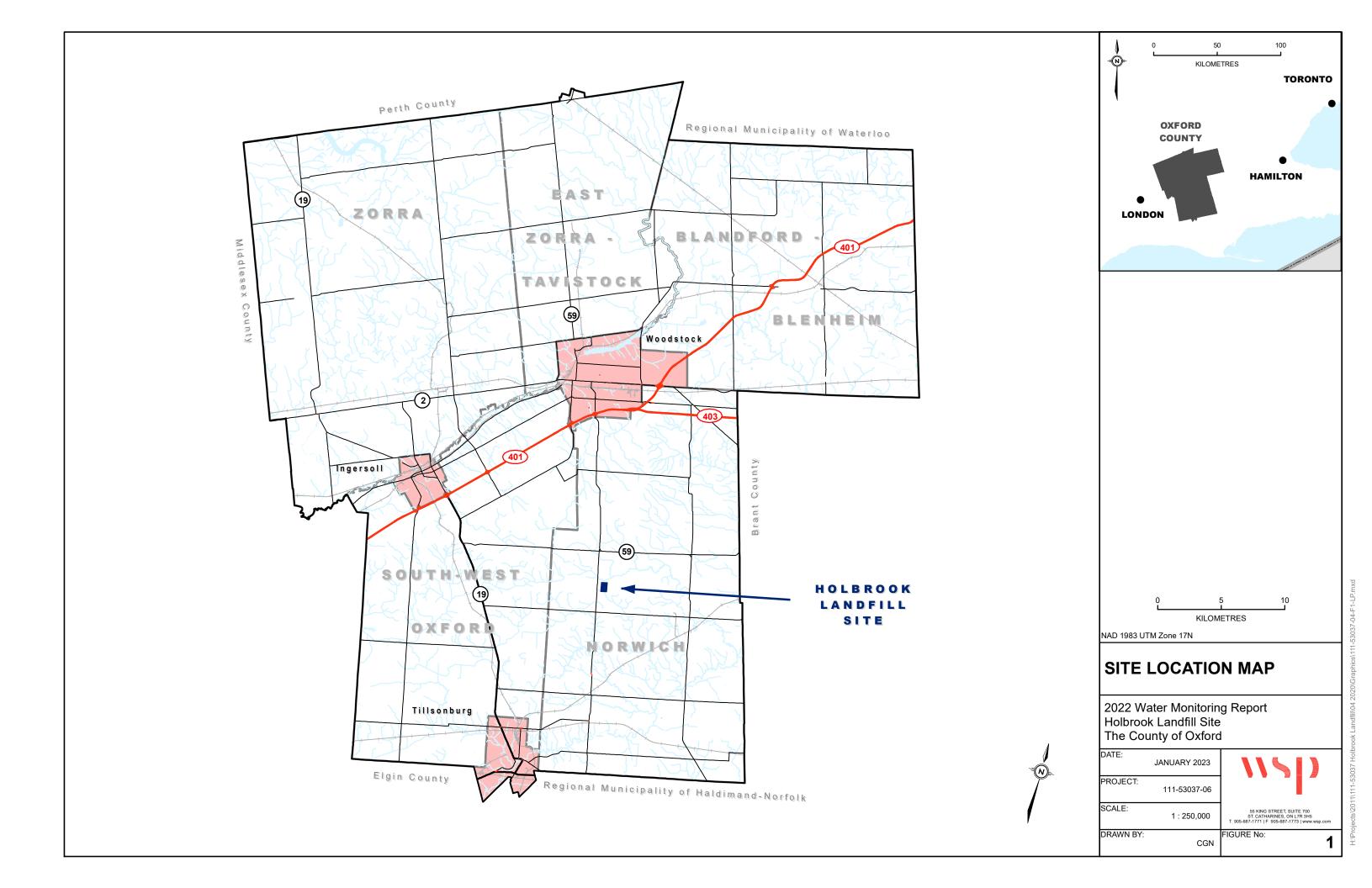
Based on the findings of the 2022 monitoring program, the following recommendations are provided for consideration.

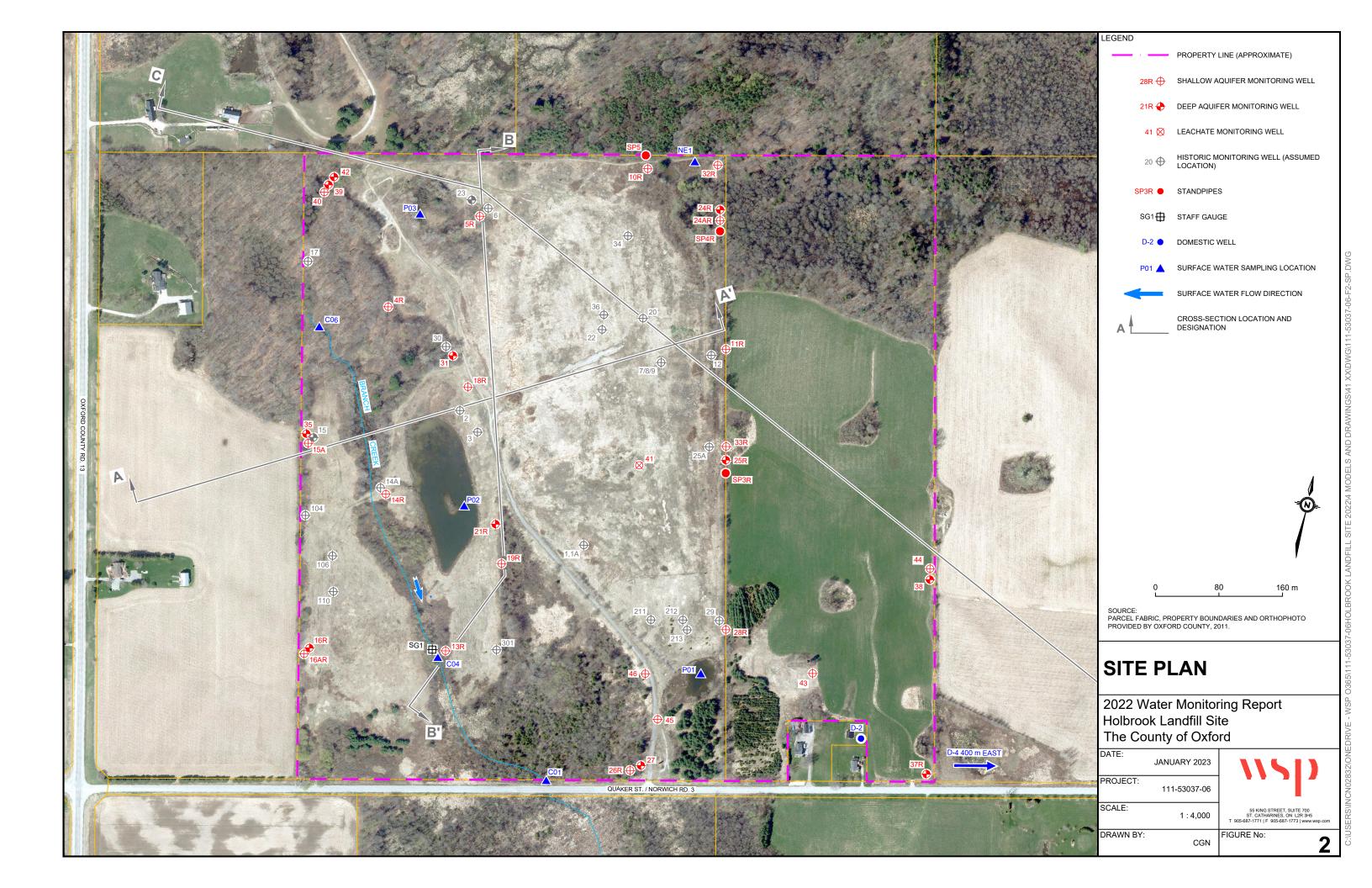
- Monitoring should be continued at the site in 2023 with the recommended program presented in Section 7.0.
- The landfill slopes should continue to be inspected to confirm that there are no leachate seeps in the area.
- Supplemental groundwater samples should continue to be collected in 2023 at observation wells 45 and 46 to further evaluate the source of the trigger exceedances at observation well 26R.
- Once monitoring for the expanded parameter database has been completed for a few years, the groundwater and surface water trigger mechanism plans should be re-assessed. A minimum of eight data sets should be collected for each parameter, before re-assessing.

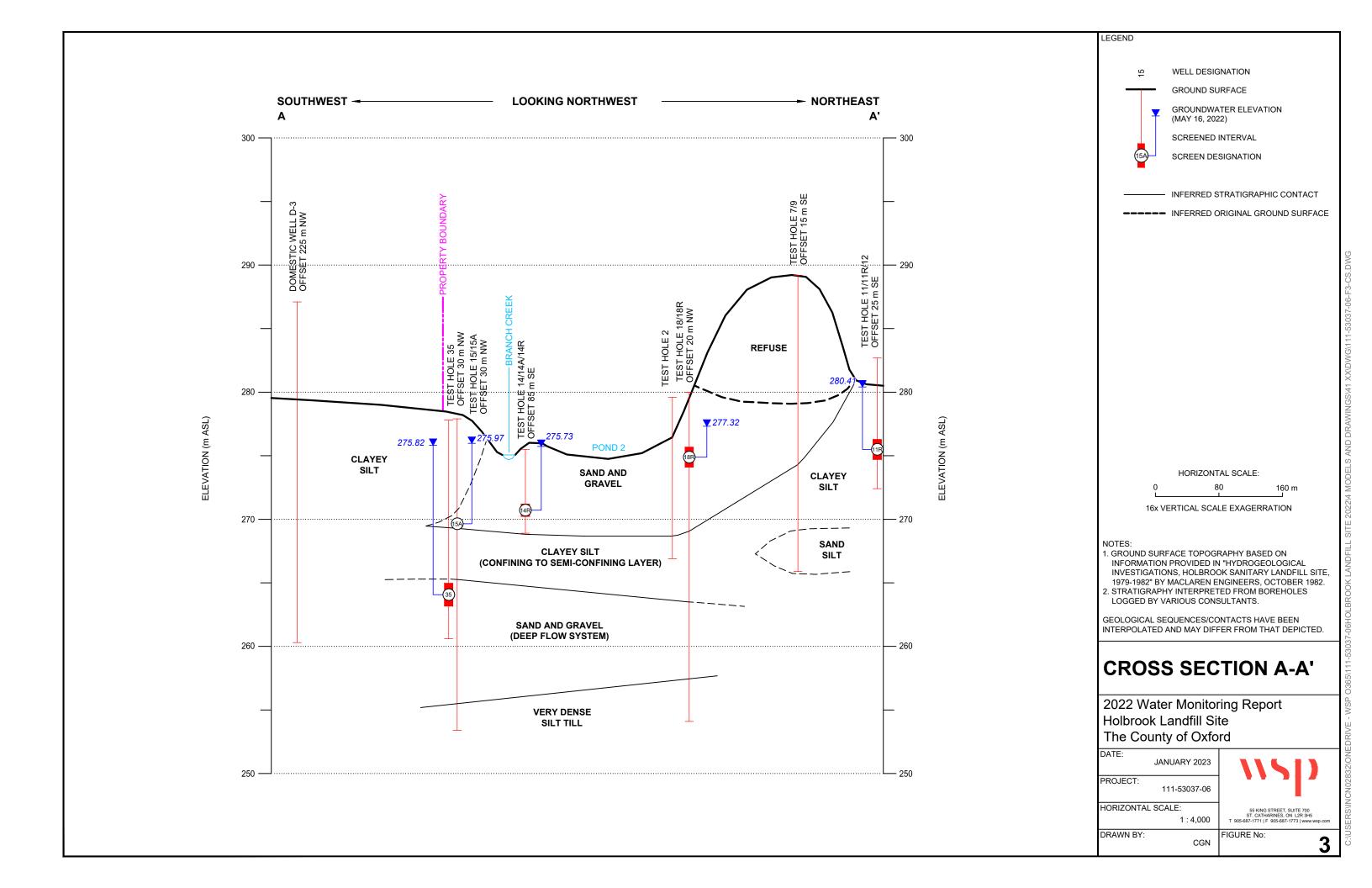
## 9 REFERENCES

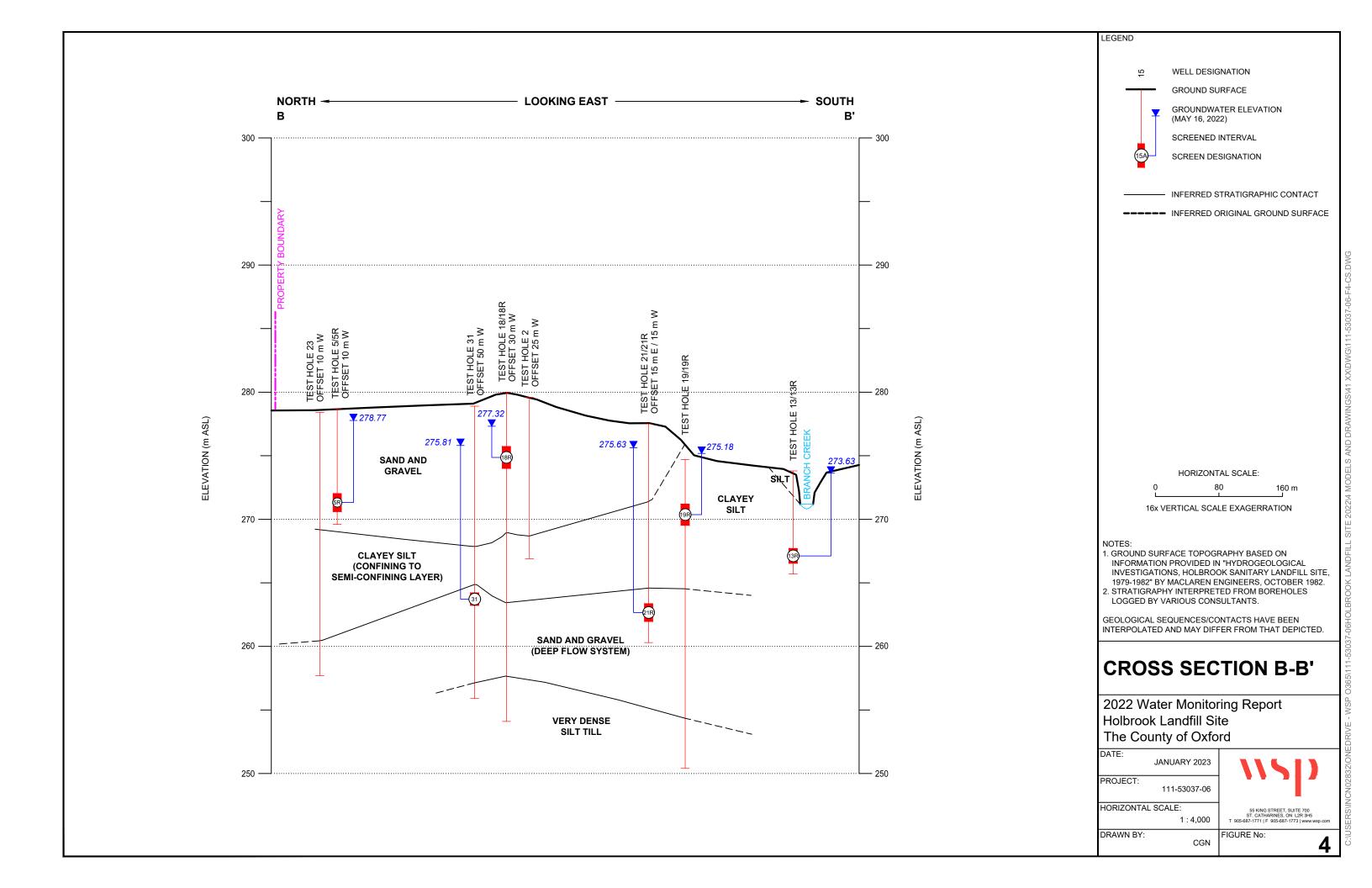
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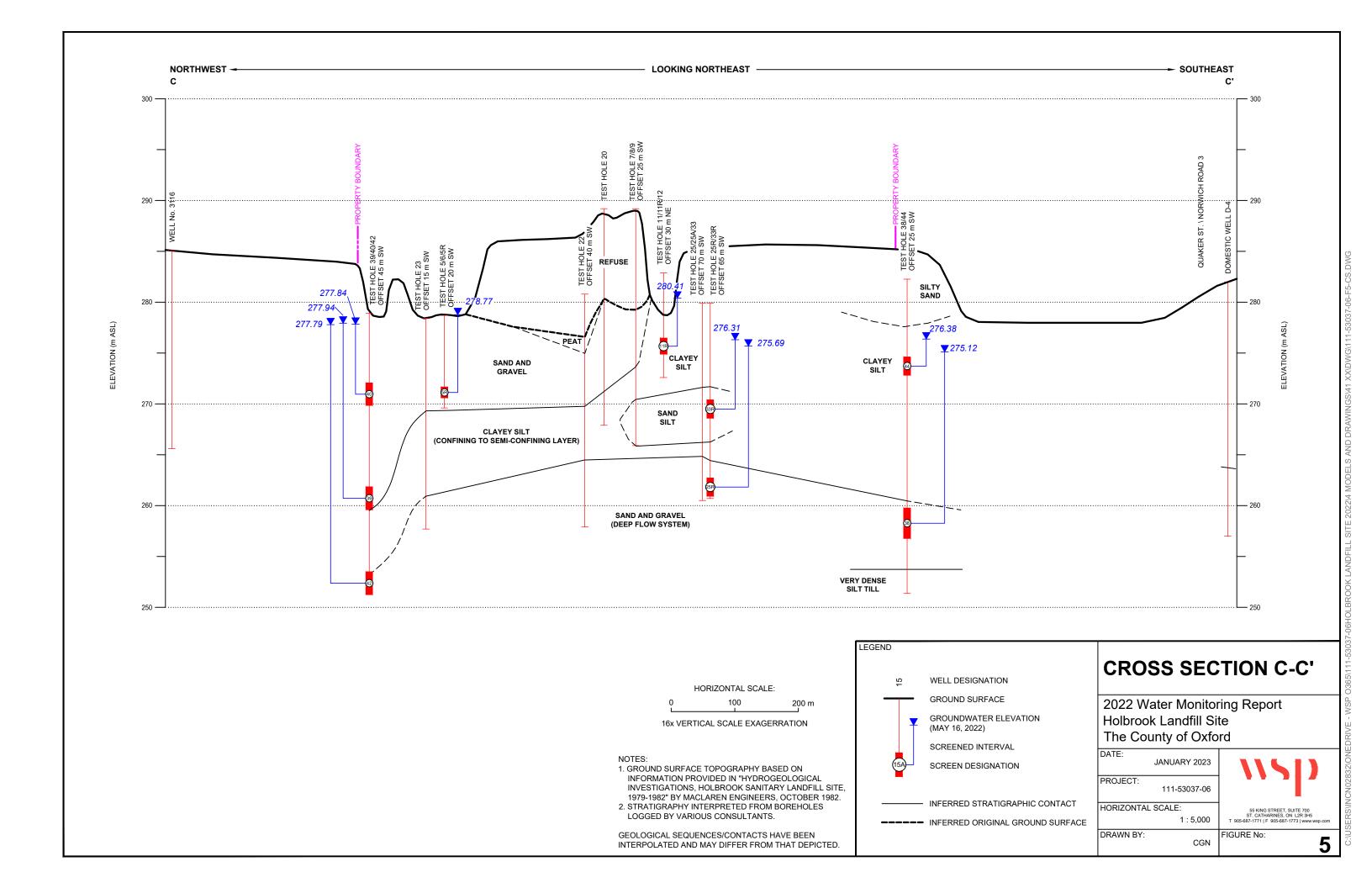
# **FIGURES**

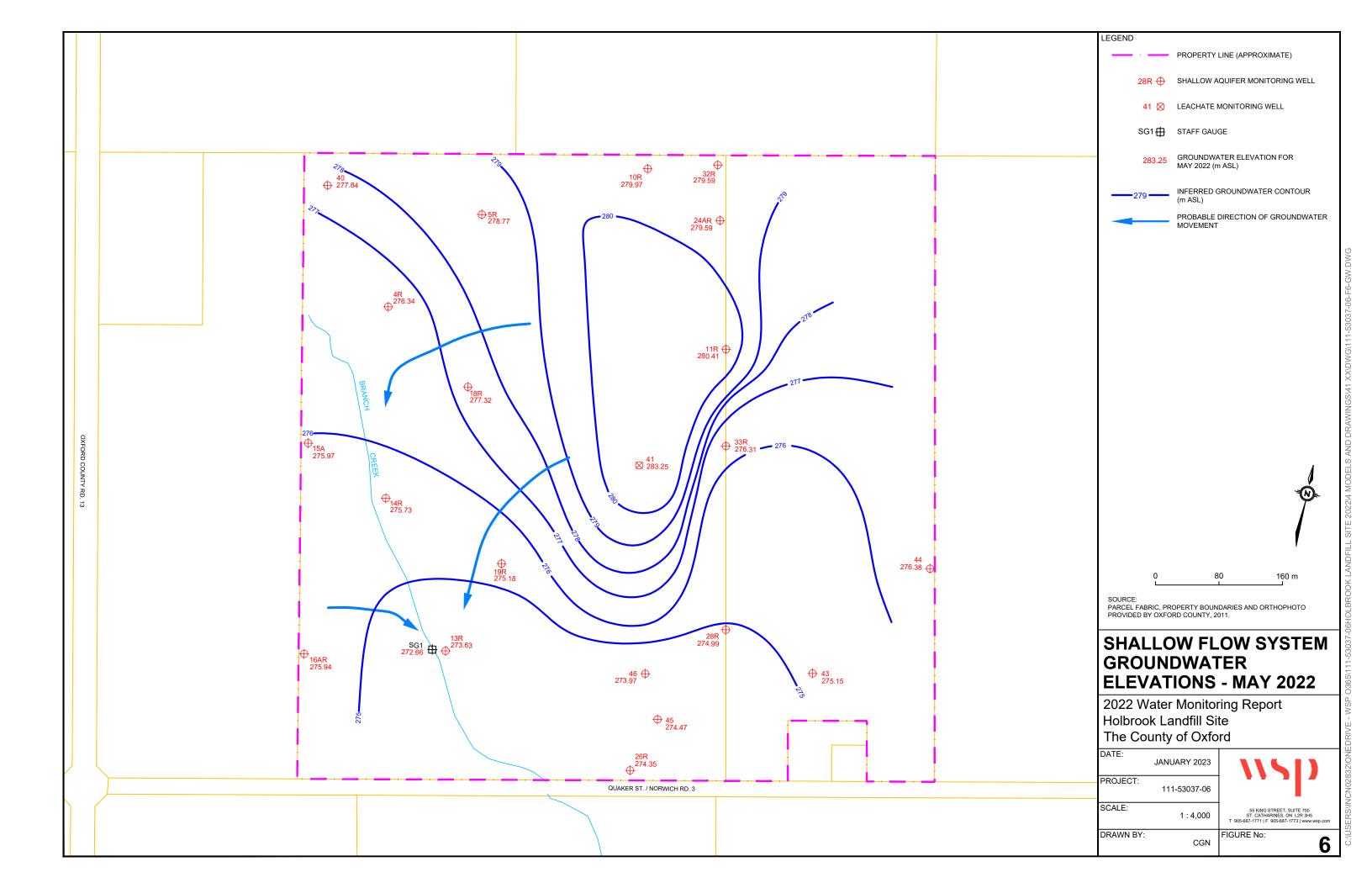


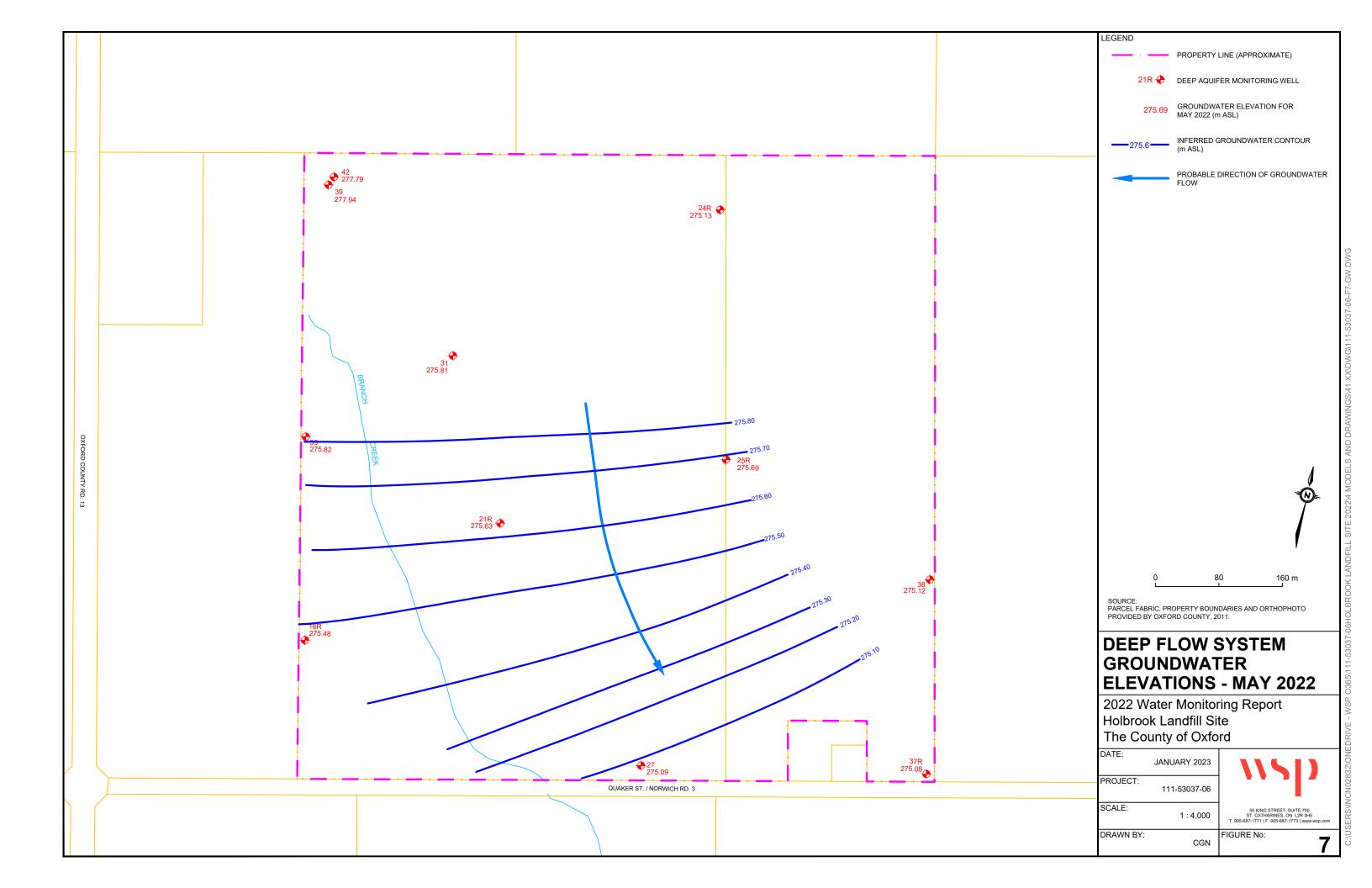


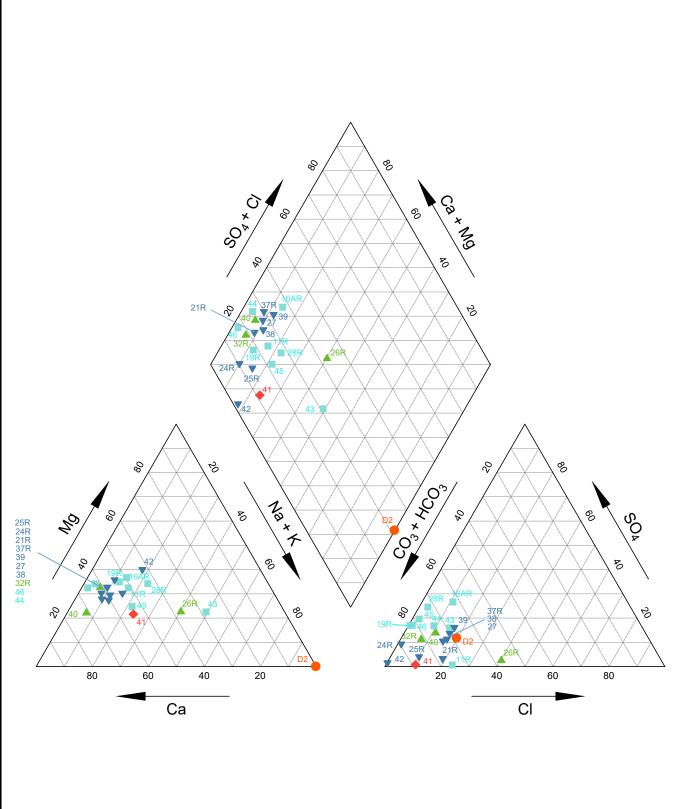














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## **APPENDIX**

# CERTIFICATES OF APPROVAL



Ministry

Southwestern

of the

Region

Environment

985 Adelaide Street South London, Ontario. N6E 1V3 (519) 681-3600

February 4, 1983

Mr. D. Pratt County Engineer County of Oxford Box 397 Woodstock, Ontario

Dear Sir:

RE:

Holbrook Landfill

Certificate A-07-07-02 Our File M & P 19-03

On January 31, 1983 Mr. J. Stinson, Environmental Officer, inspected the Holbrook landfill site. The site is inspected to determine the operating condition at that time.

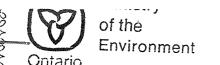
The site was well operated with a small dumping face and an ample supply of cover material. A larger fence was constructed around the landfill area to contain the

The site is well run and maintained. If additional information is required please contact this office.

Yours truly,

JFS:jc 4/1/3F J. F. Janse, P. Eng. District Officer

Municipal and Private Abatement



## PROVISIONAL CERTIFICATE OF APPROVAL WASTE DISPOSAL SITE

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

County of Oxford, P.O. Box 397, 415 Hunter Street, Woodstock, Ontario. N4S 7Y3

for the use and operation of a 10.12 hectare (25 acre) landfilling site within a total site area of 40.5 hectares (100 acres),

all in accordance with the following plans and specifications:

Located:

S.W. 1/4 Lot 20, and S.E. 1/4 Lot 21, Concession 3, Township of Norwich, County of Oxford.

which includes the use of the site only for the disposal of the following categories of waste (NOTE: Use of the site for additional categories of wastes requires a new application and amendments to the Provisional Certificate of

Domestic, commercial and non-hazardous solid industrial

wastes.

and subject to the following conditions:

- 1. The use, operation and closure of the site shall be in accordance with the following documents:
  - (1) Report prepared by MacLaren Engineers entitled "County of Oxford, Contingency Plan for Solid Waste Disposal", dated March 1982.
  - (2) The terms of the Agreement between the Corporation of the County of Oxford and the Corporation of the Township of Norwich concerning the use, operation and closure of the site dated December 8, 1982.
  - (3) Report prepared by MacLaren Engineers entitled "Hydrogeological Investigations Summary Report October 1982".

Dated this 31stday of March , 1983.

Director, Section 38
Environmental Protection Act



## PROVISIONAL CERTIFICATE OF APPROVAL WASTE DISPOSAL SITE

The following conditions are additional to the conditions shown on Provisional Certificate of Approval Number

A 070702 dated

March 31, 1983

- (4) Application form signed by D.L. Pratt of the County of Oxford entitled "Application for a Certificate of Approval for a Waste Disposal Site (Landfill)" dated March 15, 1982.
- 2. Background water quality levels for the site are to be determined to the satisfaction of the Director of the Southwestern Region of the Ministry of the Environment.
- 3. Upon cessation of waste disposal operations at the site, the site is to be properly closed utilizing at least 2 feet of suitable final cover material, in a manner which establishes properly graded final slopes and to the satisfaction of the Director of the Southwestern Region of the Ministry of the Environment.
- 4. No waste is to be deposited at the site after June 30, 1984.
- 5. By June 30, 1983 suitable plans accompdating a minimum 5% slope in all of cell 1 and detailing the staged development and closure of the site are to be submitted to the Director of the Environmental Approvals and Project Engineering Branch and, following its approval, shall be implemented.
- 6. Where there is a conflict between a provision of documents (1),(3), or (4) listed in condition 1 and a provision of document (2) listed in condition 1, the provision in document (2) shall apply.
- 7. By June 30, 1983 a suitable surface water control plan is to be submitted to the Director of the Environmental Approvals and Project Engineering Branch and, following its approval, shall be implemented.

(Page .....2 of .2 ...... Pages)



#### MINISTRY OF THE ENVIRONMENT

### NOTICE

TO:

County of Oxford, P.O. Box 397, 415 Hunter Street, Woodstock, Ontrio. N4S 7Y3

You are hereby notified that Provisional Certificate of Approval No. A 070702 has been issued to you subject to the conditions outlined therein.

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

- 1. The reason for the imposition of condition no. 1 is to ensure that the use, operation and closure of the site is in accordance with the plans and documentation submitted for approval and approved by the Director of the Environmental Approvals and Project Engineering Branch and is carried out in an orderly and systematic manner and the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R. of Ontario 1980) pursuant to that Act. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.
- 2. The reason for the imposition of condition no. 2 is that defining proper background water quality levels is an integral part of a monitoring program to establish that pollutant attenuation is taking place on site as intended and the use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.
- 3. The reason for the imposition of condition no. 3 is to ensure that the site is operated and closed in an aesthetically acceptable manner and to control insects, rodents and infiltration and to ensure that the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R. of Ontario 1980) pursuant to that Act. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.
- 4. The reason for the imposition of condition no. 4 is that the applicant has estimated, based on an anticipated rate of landfilling, that the site should reach its design capacity by June 30, 1984.

- 5. The reason for the imposition of condition no. 5 is that although a minimum 5% final slope is to be achieved in cell 1 and cell 2 of the site to control infiltration, the design plans and specifications contained in document (1) listed in condition 1 do not provide for a minimum 5% final slope in a portion of cell 1. Suitable plans and specifications are therefore necessary to ensure that the minimum 5% final slope is achieved in all portions of cell 1 and cell 2. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.
- 6. The reason for the imposition of condition no.6 is to clarify the manner in which the site is to be orderly and systematically used, operated and closed in the event that there is conflict between the provisions of document (2) and the provisions of documents (1),(3) or (4). The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.
- 7. The reason for the imposition of condition no. 7 is that a suitable surface water control plan is an integral part of an operating and development report for a landfilling site which is needed to ensure that the use, operation and closure of the site is carried out in a proper manner and the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R. of Ontario 1980) pursuant to that Act. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

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.

This Notice should be served upon:

The Secretary
Environmental Appeal Board
1 St. Clair Avenue West AND
5th Floor
Toronto, Ontario M4V 1K7

The Director Section 38, E.P.A. Ministry of the Environment 135 St. Clair Ave. W., Toronto, Ontario M4V 1P5

Dated at Toronto this 31st day of March, 1983.

Director

Section 38, E.P.A.

Ministry of the Environment



#### Environmental Appeal Board

1 St. Clair Avenue Wes Toronto, Ontario M4V 1K7

## FORM OF NOTICE OF APPEAL EXPLANATORY NOTES

Appeals to the Environmental Appeal Board should be made in the attached form, which is intended to provide the Board and the respondent with specific details regarding the nature of the appeal.

The form has been structured to allow sufficient space for a typical appeal, and two copies of the form are attached in case the appellant wishes to insert the information on the form provided. A third copy is attached for retention by the appellant.

The form is not intended to be restricting or confining and if, in a particular case, it is found that insufficient space is available on the forms provided, the particulars may be attached on additional plain white sheets.

In some cases, appellants may prefer not to use the forms provided by the Board. The Board will accept Notices of Appeal submitted on the appellant's stationery, provided that the required format and particulars as indicated on the Board's form are present.



#### PROVISIONAL CERT WASTE DI

HOLBROOK COFA

Under the Environmental Protection A limitations thereof, this Provisional Certificate of Approval is issued to:

County of Oxford, P.O. Box 397, 415 Hunter Street, Woodstock, Untario. N45 773 THIS IS A TRUE COPY OF YOU ORIGINAL CRANTED WAS MAKED

for the use and operation of a 10.12 hectare (25 acre) landfilling site within a total site area of 10.5 hectares (100 acres)

all in accordance with the following plans and specifications:

Located:

S.M. 1/4 Lot 20 and S.E. 1/4 Lot 21, Concession 3, Township of Norwich,

County of Oxford.

which includes the use of the site only for the disposal of the following categories of waste (NOTE: Use of the site for additional categories of wastes requires a new application and amendments to the Provisional Certificate of Approval)

domestic, commercial and non-hazardous solid industrial wastes.

and subject to the following conditions:

- The use, operation and closure of the site shall be in accordance with the following documents:
  - (1) Report propaged by MacLaren Engineers entitle: "Support Focusent for Proposed 1984 Extension to the Holbrook Sanitary Landfill Site" dated April 1984.
  - (2) Report prepared by MacLaren Ungineers entitled "Additional Hydrogeological Investigations at the Molbrook Sanitary Landfill Site" dated October 1983.

Dated this 28th day of June , 1984 .

Director, Section 38 Environmental Protection Act



## PROVISIONAL CERTIFICATE OF APPROVAL WASTE DISPOSAL SITE

The following conditions are additional to the conditions shown on Provisional Certificate of Approval Number

A 070702

dated

June 28, 1984

- (3) The terms of the Agreement between the Corporation of the County of Oxford and the Corporation of the Township of Norwich concerning the use, operation and closure of the site dated May 29, 1984.
- (4) Application form signed by D.L. Pratt of the County of Oxford entitled "Application for a Certificate of Approval for a Waste Disposal Site (Landfill)" dated April 10, 1984.
- By August 31, 1984 a list of erosion control measures suitable to the Director of the Southwestern Region of the Ministry of the Environment (herein after referred to as "The Director") shall be submitted to him.
- The erosion control measures submitted pursuant to condition no. 2 above shall be implemented in accordance with the approval of The Director.
- 4. The Site Plan, Figure no. 1 contained in the report entitled "Support Document for Proposed 1984 Extension to the Holbrook Sanitary Landfill Site" dated April, 1984 shall be modified in a manner approved by The Director to provide a minimum slope greater than 5%.
- Where waste is to be placed on top of existing final cover, the existing final cover material must be removed prior thereto.
- No waste is to be deposited at the site after June 30, 1986.
- 7. The surface water sampling program as outlined in Section 2 of the Agreement between the County of Oxford and the Township of Norwich dated May 29, 1984 shall be modified to include analysis for total phosphorus and ammonia in addition to the parameters listed in the Agreement.

(Page ........ of ........ Pages)



#### MINISTRY OF THE ENVIRONMENT

#### NOTICE

County of Oxford, P.O. Box 397, 415 Hunter Street,

Woodstock, Ontario. N4S 7Y3

Jun 28/5.4.

You are hereby notified that Provisional Certificate of Approval No. A 070702 has been issued to you subject to the conditions cutlined therein.

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

- 1. The reason for the imposition of condition no. 1 is to ensure that the use, operation and closure of the site is in accordance with the plans and documentation submitted for approval and approved by the Director of the Environmental Approvals and Project Engineering Branch and is carried out in an orderly and systematic manner and the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R.O. 1980) pursuant to that Act. The use, operation and closure of this site without such a condition may create a nuisance or may result in a bazard to the health or safety of any person.
- The reason for the imposition of condition nos. 2 and 3 is to ensure that erosion is minimized on the side slopes of the landfilled area and the operation of the site without such condition may create a nuisance.
- The reason for the imposition of condition no. 4 is to reduce the amount of infiltration that would result in leachate production.
- 4. The reason for the imposition of condition no. 5 is to promote the downward migration of leachate and to minimize leachate breakouts.
- 5. The reason for the imposition of condition no. 6 is that the applicant has agreed to not to extend the use of the site after June 30, 1985.
- 6. The reason for the imposition of condition no. 7 is that the added parameters mentioned therein are significant as indicators of the possible effect of landfills on aquatic life.

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.

This Notice should be served upon:

The Secretary Environmental Appeal Board 1 St. Clair Avenue West 5th Floor Toronto, Ontario MAV 1K7

AND

The Director Section 38, E.P.A. Ministry of the Environment 135 St. Clair Ave. W., Toronto, Ontario M4V 1P5

Dated at Toronto this 28th day of June, 1984.

Director, Section 38, E.P.A.,

Ministry of the Environment.



Ministry of the Environment and Climate Change Ministère de l'Environnement et de l'Action en matière de changement climatique

#### AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL

**NUMBER A070702** 

Issue Date: September 8, 2016

County of Oxford 21 Reeve St Post Office Box No. 1614 Woodstock, Ontario N4S 7Y3

Site Location: Holbrook Landfill - closed

Part of Lot 20 & 21, Concession 3 Norwich Township, County of Oxford

You have applied under section 20.2 of Part II.1 of the <u>Environmental Protection Act</u>, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

10.12 hectare landfilling site within a total site area of 40.5 hectares.

For the purpose of this environmental compliance approval, the following definitions apply:

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

"Director" means any Ministry employee appointed in writing by the Minister pursuant to section 5 of the EPA as a Director for the purposes of Part II.1 of the EPA;

"District Manager" means the District Manager of the local district office of the Ministry in which the Site is geographically located;

"EPA" means Environmental Protection Act, R.S.O. 1990, c. E. 19, as amended;

"Ministry" means the Ontario Ministry of the Environment and Climate Change;

"Owner" means any person that is responsible for the establishment or operation of the Site being approved by this Approval, and includes The County of Oxford and its successors and assigns;

"Regional Director" means the Regional Director of the local Regional Office of the Ministry in

which the Site is located; and

"Regulation 232" means Ontario Regulation 232/98 (New Landfill Standards) made under the EPA, as amended from time to time;

"Regulation 347" means Ontario Regulation 347, R.R.O. 1990, made under the EPA, as amended;

"Regulation 903" means Regulation 903, R.R.O. 1990, made under the OWRA, as amended;

"Site" means the entire waste disposal site, including the buffer land at Parts of Lot 20 & 21, Concession 3, Township of Norwich, County of Oxford.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

#### TERMS AND CONDITIONS

#### 1. **GENERAL**

#### Compliance

- The *Owner* and *Operator* shall ensure compliance with all the conditions of this *Approval* and shall ensure that any person authorized to carry out work on or operate any aspect of the *Site* is notified of this *Approval* and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.
- Any person authorized to carry out work on or operate any aspect of the *Site* shall comply with the conditions of this *Approval*.

#### In Accordance

3 Except as otherwise provided by this *Approval*, the *Site* shall be designed, developed, built, operated and maintained in accordance with the documentation listed in the attached Schedule "A".

#### Interpretation

- Where there is a conflict between a provision of any document listed in Schedule "A" in this *Approval*, and the conditions of this *Approval*, the conditions in this *Approval* shall take precedence.
- Where there is a conflict between the application and a provision in any document listed in Schedule "A", the application shall take precedence, unless it is clear that

- the purpose of the document was to amend the application and that the *Ministry* approved the amendment.
- Where there is a conflict between any two documents listed in Schedule "A", the document bearing the most recent date shall take precedence.
- The conditions of this *Approval* are severable. If any condition of this *Approval*, or the application of any condition of this *Approval* to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this *Approval* shall not be affected thereby.

#### Other Legal Obligations

- 8 The issuance of, and compliance with, this *Approval* does not:
  - (a) relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement; or
  - (b) limit in any way the authority of the *Ministry* to require certain steps be taken or to require the *Owner* and *Operator* to furnish any further information related to compliance with this *Approval*.

#### Adverse Effect

- The *Owner* shall take steps to minimize and ameliorate any adverse effect on the natural environment or impairment of water quality resulting from the *Site*, including such accelerated or additional monitoring as may be necessary to determine the nature and extent of the effect or impairment.
- Despite an *Owner* or any other person fulfilling any obligations imposed by this *Approval* the person remains responsible for any contravention of any other condition of this *Approval* or any applicable statute, regulation, or other legal requirement resulting from any act or omission that caused the adverse effect to the natural environment or impairment of water quality.

#### **Change of Ownership**

- The *Owner* shall notify the *Director*, in writing, and forward a copy of the notification to the *District Manager*, within 30 days of the occurrence of any changes in the following information:
  - (a) the ownership of the *Site*;
  - (b) the *Operator* of the *Site*;
  - (c) the address of the Owner or Operator; and
  - (d) the partners, where the *Owner or Operator* is or at any time becomes a partnership and a copy of the most recent declaration filed under the *Business Names Act*, R. S. O. 1990, c. B.17, shall be included in the notification.

- No portion of this *Site* shall be transferred or encumbered after closing of the *Site* unless the *Director* is notified in advance and sufficient financial assurance is deposited with the *Ministry* to ensure that these conditions will be carried out.
- In the event of any change in ownership of the *Site*, other than change to a successor municipality, the *Owner* shall notify the successor of and provide the successor with a copy of this *Approval*, and the *Owner* shall provide a copy of the notification to the *District Manager* and the *Director*.

#### Certificate of Requirement/Registration on Title

#### Registration on Title Requirement

- Prior to dealing with the property in any way, the *Owner* shall provide a copy of this *Approval* and any amendments, to any person who will acquire an interest in the property as a result of the dealing.
- 15 (a) Within sixty (60) calendar days from the date of issuance of this *Approval*, the *Owner* shall submit to the *Director* a completed Certificate of Requirement which shall include:
  - (i) a plan of survey prepared, signed and sealed by an Ontario Land Surveyor, which shows the area of the *Site* where waste has been or is to be deposited at the *Site*;
  - (ii) proof of ownership of the *Site*;
  - (iii) a letter signed by a member of the Law Society of Upper Canada or other qualified legal practitioner acceptable to the *Director*, verifying the legal description provided in the Certificate of Requirement;
  - (iv) the legal abstract of the property; and
  - (v) any supporting documents including a registerable description of the Site.
- (b) Within fifteen (15) calendar days of receiving a Certificate of Requirement authorized by the *Director*, the *Owner* shall:
  - (i) register the Certificate of Requirement in the appropriate Land Registry Office on the title to the property; and
  - (ii) submit to the *Director* and *District Manager*, written verification that the Certificate of Requirement has been registered on title.

#### Registration on Title Requirement - Contaminant Attenuation Zone (CAZ)

16. The Owner shall, within sixty (60) calendar days from the date of issuance of this Approval, submit to the *Director* documents confirming that a contaminant attenuation zone (CAZ) has been established, in either fee simple or by way of a groundwater easement.

- Within thirty (30) calendar days from the date of establishing a contaminant attenuation zone (CAZ) (overburden and/or bedrock aquifers) in either fee simple or by way of a groundwater easement, the *Owner* shall submit to the *Director* a completed Certificate of Requirement which shall include:
- (a) If rights are obtained in fee simple, the *Owner* shall provide:
  - (i) documentation evidencing ownership of the CAZ obtained in compliance with *O.Reg. 232/98*, as amended;
  - (ii) a completed Certificate of Requirement and supporting documents containing a registerable description of the CAZ; and
  - (iii) a letter signed by a member of the Law Society of Upper Canada; or other qualified legal practitioner acceptable to the *Director*, verifying the legal description of the CAZ.
- (b) within fifteen (15) calendar days of receiving a Certificate of Requirement signed or authorized by the *Director*, the Owner shall:
  - (i) register the Certificate of Requirement in the appropriate Land Registry Office on the title to the property; and
  - (ii) submit to the *Director* and the *District Manager*, written verification that the Certificate of Requirement has been registered on title.
- (c) If rights are obtained by way of a groundwater easement, the Applicant shall:
  - (i) provide a copy of the easement;
  - (ii) provide a plan of survey signed and sealed by an Ontario Land Surveyor for the CAZ;
  - (ii) submit proof of registration on title of the groundwater easement to the *Director:*
- (d) The *Owner* shall not amend or remove or consent to the removal of the easement or CAZ from title without the prior written consent of the *Director*.

#### 2. CLOSURE PLAN

- 1. By no later than July 15, 2017, the Owner shall submit to the Director for approval, with copies to the District Manager, a detailed Site closure plan pertaining to the termination of landfilling operations at this Site, post-closure inspection, maintenance and monitoring, and end use. The plan shall include but not be limited to the following information:
- (a) a plan showing *Site* appearance after closure;
- (b) a description of the proposed end use of the Site;

- (c) a descriptions of the procedures for closure of the *Site*, including:
  - (i) advance notification of the public of the Landfill closure;
  - (ii) posting of a sign at the *Site* entrance indicating that the *Landfill* is closed and identifying any alternative waste disposal arrangements;
  - (iii) completion, inspection and maintenance of the final cover and landscaping;
  - (iv) Site security;
  - (v) removal of unnecessary *Landfill* related structures, buildings and facilities;
  - (vi) final construction of any control, treatment, disposal and monitoring facilities for leachate, groundwater, surface water and landfill gas; and
  - (vii)a schedule indicating the time period for implementing sub-conditions (i) to (vi) above.
- (d) descriptions of the procedures for post-closure care of the *Landfill*, including:
  - (i) operation, inspection and maintenance of the control, treatment, disposal and monitoring facilities for leachate, groundwater, surface water and landfill gas;
  - (ii) record keeping and reporting; and
  - (iii) complaint contact and response procedures;
- (e) an assessment of the adequacy of and need to implement the contingency plans for leachate and methane gas; and
- (f) an updated estimate of the contaminating life span of the *Site*, based on the results of the monitoring programs to date.
- 2 The Site shall be closed in accordance with the closure plan as approved by the Director.
- 3 The Site is hereby acknowledged to be closed for receipt of waste for disposal since 1986, and no waste management activities shall be carried out at the Site without approval of the Director.

#### 3.0 LANDFILL MONITORING

#### **Compliance**

- The *Site* shall be operated in such a way as to ensure compliance with the following:
  - (a) Reasonable Use Guideline B-7 for the protection of the groundwater at the *Site*; and
  - (b) Provincial Water Quality Objectives included in the July 1994 publication entitled *Water Management Policies, Guidelines, Provincial Water Quality Objectives*, as amended from time to time or limits set by the *Regional Director*, for the protection of the surface water at and off the *Site*.
  - (c) The *Owner* shall submit to the *Director*, Environmental Approvals Branch, Ministry of the Environment and Climate Change an application for approval to amend the *ECA* to address any non-compliance Guideline B-7, including if

warranted an application to incorporate a contaminant attenuation zone into the approval, and including a proposed updated *EMP*. The application shall outline the options that were considered for bringing the *Site* into compliance with Guideline B-7 and the rationale for the preferred option, and include all necessary supporting documentation.

The *Owner* shall monitor surface water and ground water in accordance with documents in Schedule "A"

#### **Annual Report**

- A written report on the development, operation and monitoring of the *Site*, shall be completed annually (the "Annual Report"). The Annual Report shall be submitted to the *District Manager*, by March 31st of the year following the period being reported upon.
- 4 The Annual Report shall include but not be limited to the following information:
  - (a) the results and an interpretive analysis of the results of all leachate, groundwater, surface water and landfill gas monitoring, including an assessment of the need to amend the monitoring programs;
  - (b) site plans showing the final contours of the *Site* and vegetative cover;
  - (c) a discussion of any operational problems encountered at the *Site* and corrective action taken;
  - (d) a report on the status of all monitoring wells and a statement as to compliance with *Regulation 903;*
  - (e) any other information with respect to the *Site* which the *District Manager* may require from time to time; and
  - (f) a summary and analysis of all hydraulic and geochemical monitoring results.

#### **Groundwater Wells and Monitors**

- 5 The *Owner* shall ensure that all groundwater monitoring wells which form part of the monitoring program are properly capped, locked and protected from damage.
- Any groundwater monitoring well included in the on-going monitoring program that are damaged shall be assessed, repaired, replaced or decommissioned by the *Owner*, as required.
  - (a) The *Owner* shall repair or replace any monitoring well which is destroyed or in any way made to be inoperable for sampling such that no more than one regular sampling event is missed.
  - (b) All monitoring wells which are no longer required as part of the groundwater monitoring program, and have been approved by the *District*

*Manager* for abandonment, shall be decommissioned by the *Owner*, as required, in accordance with *Reg. 903*, that will prevent contamination through the abandoned well. A report on the decommissioning of the well shall be included in the Annual Report for the period during which the well was decommissioned.

#### **Changes to the Monitoring Plan**

- The *Owner* may request to make changes to the monitoring program(s) to the *District Manager* in accordance with the recommendations of the annual report. The *Owner* shall make clear reference to the proposed changes in separate letter that shall accompany the annual report.
- Within fourteen (14) days of receiving the written correspondence from the *District Manager* confirming that the *District Manager* is in agreement with the proposed changes to the environmental monitoring program, the *Owner* shall forward a letter identifying the proposed changes and a copy of the correspondences from the *District Manager* and all other correspondences and responses related to the changes to the monitoring program, to the *Director* requesting the *Approval* be amended to approve the proposed changes to the environmental monitoring plan prior to implementation.
- In the event any other changes to the environmental monitoring program are proposed outside of the recommendation of the annual report, the *Owner* shall follow current ministry procedures for seeking approval for amending the *Approval*.

#### **Trigger Mechanism and Contingency Plan**

- By no later than July 15, 2017, the *Owner* shall submit to the *Director*, for approval, and copies to the *District Manager*, details of a trigger mechanisms plan for surface water and groundwater quality monitoring for the purpose of initiating investigative activities into the cause of increased contaminant concentrations
- 11. By no later than July 15, 2017, the *Owner* shall submit to the *Director* for approval, and copies to the *District Manager*, details of a contingency plan to be implemented in the event that the surface water or groundwater quality exceeds any trigger mechanism.
- In the event of a confirmed exceedance of a site-specific trigger level relating to leachate mounding or groundwater or surface water impacts due to leachate, the *Owner* shall immediately notify the *District Manager*, and an investigation into the cause and the need for implementation of remedial or contingency actions shall be carried out by the *Owner* in accordance with the approved trigger

- mechanisms and associated contingency plans.
- If monitoring results, investigative activities and/or trigger mechanisms indicate the need to implement contingency measures, the *Owner* shall ensure that the following steps are taken:
  - (a) The *Owner* shall notify the *District Manager*, in writing of the need to implement contingency measures, no later than 30 days after confirmation of the exceedances;
  - (b) Detailed plans, specifications and descriptions for the design, operation and maintenance of the contingency measures shall be prepared and submitted by the *Owner* to the *District Manager* for approval; and
  - (c) The contingency measures shall be implemented by the *Owner* upon approval by the *District Manager* .
- 14 The *Owner* shall ensure that any proposed changes to the site-specific trigger levels for leachate impacts to the surface water or groundwater, are approved in advance by the *Director* via an amendment to this *Approval*.

#### SCHEDULE "A"

- 1. Report prepared by Maclaren Engineers entitled "Support Document for Proposed 1984 extension to the Holbrook Sanitary landfill Site" dated April 1984.
- 2. Report prepared by MacLaren Engineers entitled "Additional Hydrogeological Investigation at the Holbrook Sanitary Landfill Site" dated October 1983.
- 3. The terms of the Agreement between the Corporation of the County of Oxford and the Corporation of the Township of Norwich concerning the use, operation and closure of the site dated May 29, 1984.
- 4. Application form signed by D.L. Pratt of the County of Oxford entitled "Application for a Certificate of Approval for a Waste Disposal Site (Landfill) "dated April 10, 1984.
- 5. Holbrook Landfill County of Oxford 2012 Water Monitoring Report" prepared by Genivar Inc. dated May 2013

*The reasons for the imposition of these terms and conditions are as follows:* 

#### **GENERAL**

- The reason for Conditions 1(1), (2), (4), (5), (6), (7), (8), (9) and (10) is to clarify the legal rights and responsibilities of the *Owner* under this *Approval*.
- The reasons for Condition 1(3) is to ensure that the *Site* is designed, operated, monitored and maintained in accordance with the application and supporting documentation submitted by the *Owner*, and not in a manner which the *Director* has not been asked to consider.
- The reasons for Condition 1(11) are to ensure that the *Site* is operated under the corporate name which appears on the application form submitted for this approval and to ensure that the *Director* is informed of any changes.
- The reasons for Condition 1(12) are to restrict potential transfer or encumbrance of the *Site* without the approval of the *Director* and to ensure that any transfer of encumbrance can be made only on the basis that it will not endanger compliance with this *Approval*.
- The reason for Condition 1(13) is to ensure that the successor is aware of its legal responsibilities.
- The reason for Condition 1(14) and (15) are that the Part II. *1 Director* is an individual with authority pursuant to Section 197 of the Environmental Protection Act to require registration on title and provide any person with an interest in property before dealing with the property in any way to give a copy of the Approval to any person who will acquire an interest in the property as a result of the dealing.

#### **CLOSURE PLAN**

The reasons for Condition 2 are to ensure that final closure of the *Site* is completed in an aesthetically pleasing manner, in accordance with Ministry standards, and to ensure the long-term protection of the health and safety of the public and the environment.

#### **LANDFILL MONITORING**

- Condition 3(1) is included to provide the groundwater and surface water limits to prevent water pollution at the *Site*.
- Conditions 3(2) is included to require the Owner to demonstrate that the *Site* is performing as designed and the impacts on the natural environment are acceptable. Regular monitoring allows for the analysis of trends over time and ensures that there is an

early warning of potential problems so that any necessary remedial/contingency action can be taken.

- The reasons for Condition (3) and 3(4) are to ensure that regular review of site development, operations and monitoring data is documented and any possible improvements to site design, operations or monitoring programs are identified. An annual report is an important tool used in reviewing site activities and for determining the effectiveness of site design.
- Conditions 3(5), 3(6) and 3(7) are included to ensure the integrity of the groundwater monitoring network so that accurate monitoring results are achieved and the natural environment is protected.
- Reasons for conditions 3(8), 3(9) and 3(10) are included to streamline the approval of the changes to the monitoring plan.
- Reason for conditions 3(11) to 3 (14) inclusive are added to ensure the *Owner* has a plan with an organized set of procedures for identifying and responding to potential issues relating to groundwater and surface water contamination at the *Site's* compliance point.

### Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). A070702 issued on March 31, 1983

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 and Climate Change 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

\* 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) 326-5370 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 8th day of September, 2016

Dale Gable, P.Eng.

Director

appointed for the purposes of Part II.1 of the *Environmental Protection Act* 

HV/

c: District Manager, MOECC London - District Field Alert, County of Oxford

### COUNTY OF OXFORD RECEIVED

MAR 1 3 2018



Ministry of the Environment and Climate Change Ministère de l'Environnement et de l'Action en matière de changement climatique

### AMENDMENT TO ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER A070702

Notice No. 1

Issue Date: March 6, 2018

County of Oxford 21 Reeve St Post Office Box, No. 1614 Woodstock, Ontario N4S 7Y3

Site Location: Holbrook Landfill - closed Lot 20 & 21, Concession 3

Norwich Township, County of Oxford

You are hereby notified that I have amended Approval No. A070702 issued on September 8, 2016 for the post closure inspection, monitoring and maintenance of 10.2 hectare closed Holbrook Landfill site within a total site area of 62.31 hectares, as follows:

Definition of "Site" is revised as follows:

"Site" means the entire waste disposal site, including the buffer land and Contaminant Attenuation Zone located at Parts 1 and 2 of Lot 20 & 21, Concession 3, Township of Norwich, County of Oxford.

Conditions 2(1), 3(2), 3(10) and 3(11) are hereby revoked and replaced with the following:

#### 2. **CLOSURE PLAN**

2. (1) Closure plan dated June 2017 and amended by letter report dated December 8, 2017 prepared by WSP and submitted to Bob Slivar, Senior Environmental Officer, London District Office, Ministry of the Environment and Climate Change, is hereby approved subject to the conditions of this Approval.

#### 3.0 LANDFILL MONITORING

3. The Owner shall monitor surface water and ground water in accordance with Schedules (2)

#### Trigger Mechanism and Contingency Plan

- 3. (10) Trigger mechanisms shall be in accordance with Items 6 and 7 in Schedule "A".
- 3. (11) Contingency plan in the event of a confirmed exceedance of a site-specific trigger level relating to leachate mounding or groundwater or surface water impacts due to leachate shall be in accordance with Items 6 and 7 in Schedule "A".

#### Conditions 2(2) and 2(3) are added to the *Approval*:

- 2. (2) No person shall use, operate, establish, alter, enlarge or extend a waste disposal site except under and in accordance with an environmental compliance approval. As such the *Owner/Operator* shall obtain approval from the *Director* through an amendment to this *Approval* prior to any changes to the approved closure plan/facilities within the closed *Site*.
- 2. (3) Notwithstanding condition 2(1), the *Owner* shall submit to the *Director* for approval for any change to the current "natural open space with restricted public access". Supporting documentation to the application shall contain the following as a minimum:
  - (a) Detailed plan showing all the groundwater monitoring wells;
  - (b) A detailed site plan showing where any structures or pathways are located;
  - (c) Potential dangers related to methane gas is a concern to the *Ministry*.

    Decomposition of waste and producing methane can continue many years pass the closure of a landfill depending on factors within the landfill that expedite or slow down decomposition of An assessment of methane gas in the landfill as this will help the *Ministry* determine if the site is safe for public use; and
  - (d) Consultation with the interested parties (specially residents within 500 m) about the change in landuse and the proposal.

### The following items are added to the Schedule "A":

#### SCHEDULE "A"

- 6. Report titled "Holbrook Landfill, Closure Plan" dated June 2017 prepared by WSP Canada Inc.
- 7. Letter report dated December 8, 2017 prepared by Albert Siertsema, P.Eng., Project Engineer, Environment and Dan Mohr, P.Eng., Assistant Vice President Environment, Ontario, submitted to Bob Slivar, Senior Environmental Officer, London District Office, Ministry of the Environment and Climate Change as a response to comments from Technical Support, Ministry of the Environment and Climate Change.

1

## Schedule "B" Surface Water Monitoring Program

ACTIVITY	LOCATION	SAMPLING	ANALYSIS /
	DOCATION	FREQUENCY	1
Surface Water Sampling	Surface Water Station:		MEASUREMENT
Surface Water Sumpling	C01, C06	fall)	Field Parameters: pH,
	001, 000	1411)	conductivity, temperature,
			turbidity General Parameters:
			pH, conductivity,
			hardness
			Major and Minor Ions:
			alkalinity, calcium,
			chloride, magnesium,
			potassium, sodium,
			sulphate
			Nutrients and Organics:
			ammonia, un-ionized
			ammonia, nitrate, nitrite
· ·			Dissolved Metals: boron,
			chromium, iron,
			manganese
	Surface Water Station:	Annual (spring)	Field Parameters: pH,
	C04, P01, P02, P03, NE1		conductivity, temperature,
•			turbidity
			General Parameters:
			pH, conductivity,
			hardness
			Major and Minor Ions:
			alkalinity, calcium,
			chloride, magnesium,
			potassium, sodium,
			sulphate
			Nutrients and Organics:
			ammonia, un-ionized
			ammonia, nitrate, nitrite
			Dissolved Metals: boron,
			chromium, iron,
			manganese

## Schedule "C" Groundwater and Landfill Gas Monitoring Programs

ACTIVITY	LOCATION	SAMPLING FREQUENCY	ANALYSIS / MEASUREMENT
Groundwater and Leachate Level Monitoring	Shallow Flow System: 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16AR, 18R, 19R, 24AR, 26R, 28R, 32R, 33R, 39, 40, 43, 44, SG1 Deep Flow System: 16R, 21R, 24R, 25R, 27, 31, 35, 37R, 38, 42	Annual (May)	Water Level Measurement
Groundwater and Leachate Sampling	Leachate Well: 41  Shallow Flow System: 11R, 16AR, 19R, 26R, 28R, 32R, 40, 43, 44  Deep Flow System: 21R, 24R, 25R, 27, 37R, 38, 39, 42  Private Wells: D2 (Pearce)  Leachate Well: 41	Annual (May)	Field Parameters: pH, conductivity, temperature General Parameters: pH, conductivity, hardness Major and Minor Ions: alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate Nutrients and Organics: ammonia, nitrate, nitrite, TKN, DOC Dissolved Metals: boron, chromium, iron, manganese
	Shallow Flow System: 32R, 26R, 40, 43, 44 Deep Flow System: 27, 37R, 38, 39, 42 Leachate Well: 41	Annual (May)	Volatile Organic Compounds: vinyl chloride, benzene, 1,4 dichlorobenzene
Landfill Gas Monitoring	Standpipes: SP3R, SP4R, SP5	Annual	Methane, carbon dioxide, oxygen, balance gas, as well as water level

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

- Preamble is amended to clarify the approved total *Site* area which includes Contaminant Attenuation Zone.
- Condition 2(1) was revised to approve the closure plan for the *Site* to ensure the final closure of the *Site* is completed in an aesthetically pleasing manner, in accordance with *Ministry* standards, and to ensure the long-term protection of the health and safety of the public and the environment.
- Condition 3(2) is included to require the *Owner* to demonstrate that the *Site* is performing as designed and the impacts on the natural environment are acceptable. Regular monitoring allows for the analysis of trends over time and ensures that there is an early warning of potential problems so that any necessary remedial/contingency action can be taken. This condition was revised to approve the revised groundwater and surface water monitoring program.
- Conditions 3(10) and 3(11) approved trigger mechanisms and contingency plans proposed for the Site. This provides a plan with an organized set of procedures for identifying and responding to potential issues relating to groundwater and surface water contamination at the Site's compliance point.
- Conditions 2(2) and 2(3) are added to ensure that the *Site* is designed, operated, monitored and maintained in accordance with the application and supporting documentation submitted by the *Owner*, and not in a manner which the *Director* has not been asked to consider.

### This Notice shall constitute part of the approval issued under Approval No. A070702 dated September 8, 2016 as amended.

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:

- a. 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;
- b. 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:

- 1. The name of the appellant;
- 2. The address of the appellant:
- 3. The environmental compliance approval number;
- 4. The date of the environmental compliance approval;
- 5. The name of the Director, and:

6. 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 and Climate Change 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

\* 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) 326-5370 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 6th day of March, 2018

Yak D. Golle

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

RM/

c: District Manager, MOECC London - District Dave Vermeeren, Waste Management Supervisor, County of Oxford

# **APPENDIX**

B BOREHOLE LOGS

		GEOLOGICAL LOG		A PRINCIPAL CALLANDAR OF CONTROL	T A		tensistent januaryoo pramataanna singali kadi	TEST HOLE No. 2			
ш	EL		PLOT	OMETER	NUMBER	TYPE	J.3m	SHEET 1 OF 1			
tt () 3 SCALE	(m) DEPTH (m)	DESCRIPTION	STRAT.	PIEZOME	SAMPLE	SAMPLE	BLOWS/0.3m	NOTES			
				I	de Clande Committee de la Committe de Comm	Commentation of arms of an article from		DATE DRILLED 1 May 1979			
	279.6	GROUND SURFACE			. 37			TYPE OF RIG <u>CME</u> 75			
	0.0				CLA	ľ	Affinition of the quicken of the stall forming	DRILLING METHOD Hollow Stem Augers			
5-		Yellowish grey loose				SS	9	DEPTH WATER FOUND ~ 2.5			
10-3		very fine sandy silt			2	SS	6	(m below ground surface)  STATIC WATER LEVEL2.9 * (m below ground surface)			
15 - 5	3.7	Grey compact layered silty fine to medium gravelly very fine to	0 0		3	SS	10	PIPE DIAMETER <u>51</u> (mm) LENGTH OF PIEZOMETER <u>0.5</u> (m) TYPE OF PIEZOMETER			
		coarse sand	. 0		Correction frances of knowledges		Actor breathfreeze Albertalism Adribus	Trow			
20-			0.0	1	4	SS	20	SAMPLE TYPE SS-SPLIT SPOON			
25-			0	BACKFILL	5	SS	13	WA-WASH			
-		Grey interlayered compact			area and a second			Elevation (m GSD) (26 JUNE 1979) *			
30-	neggemmennen det men keer keer keer keer keer keer keer ke	fine sand and medium to coarse sand near base	0		6	SS	14	Piezometer			
35-11	268.6			AND	7	SS	15				
40-12	266.9	Grey clayey silt (grey silty sand with some clay from above)		CAVE		SS	17				
-13	12.7	End of Hole		Same and the same	A STATE OF THE STA						
45 14	and at the state of the state o		And the state of t	Zini de la	racione action and y acroism to a racional des		ANTENED RESERVATION OF THE PROPERTY OF THE PRO	Oll MacLaren			
50-15	de la constitución de la constit							MacLAREN ENGINEERS INC.			
TEST HOLE RECORD G.M.P. PROJECT NO. 11602-5											

### LOG OF BOREHOLE 2 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started 2014/09/30

supervisor | location | Holbrook, ON MEQ method | Hollow stem augers, 215 mm dia. project no. | 111-53037-00 132-00 reviewer | coring | n/a **AMS** 

SAMPLE

SUBSURFACE PROFILE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and Plot X Dynamic Cone Water Content (%) Comments 30 40 Number 1.0 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) Core PID Recovery 20 **GROUND SURFACE** GR SA SI CI Yellowish grey loose very fine sandy silt 276 275 -2 274 - 3 273 272.8 3.7 Grey compact layered silty fine to medium gravelly very fine to coarse sand 272 - 5 271 - 6 270 269 0 - 8 268 - 9 267.4 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH2 (MacLaren Engineers Inc., 1979). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

CONTRACTOR			GEOLOGICAL LOG		A STOREGY PARTY CONTRACTOR OF THE PARTY CONTRACTOR OF	ER			TEST HOLE No. 4
SCALE	ğ	EL	O.C. CODID TION	PLOT	Z OMETER	NUMBER	TYPE	/0.3m	SHEET _ OF _ I
(ft)(m	DEP		DESCRIPTION	STRAT.	PIEZON	SAMPLE	SAMPLE	BLOWS/0.3m	NOTES
	CONTRACTOR AND THE PROPERTY AND THE PROP				_				DATE DRILLED 1 May 1979
		9.0	GROUND SURFACE		0.	99			TYPE OF RIG <u>CME 75</u>
		0.0		9 - 5		CLA	Y		DRILLING METHOD Hollow Stem Augers
5-1					BACKFILL	1	SS	6	
1-2	2	MONTHUMBERSHOWN	Brown fine gravelly clayey silt		BA	and in Secretarion			DEPTH WATER FOUND <u>№ 3.8</u> (m below ground surface)
10-3	3	aure de Carlos de la companya de la				2	SS	14	STATIC WATER LEVEL 2.4 * (m below ground surface)
14	B	5.0	Brown interlayered fine	<u></u>	AND	Commercial Control of the Control of			PIPE DIAMETER 51 (mm)
15		4.0	sandy silt to silty fine sand and fine to medium		CAVE	3	SS		LENGTH OF PIEZOMETER 0.5 (m)  TYPE OF PIEZOMETER
			sand overlying dense fine		1				Trow
20-6	-	2.4	gravelly very fine to very coarse sand near base		İ	4	SS	31	SAMPLE TYPE
		6.6	End of Hole						SS-SPLIT SPOON WA-WASH
25-	3					A CONTRACTOR OF THE PROPERTY O			∇ 276.6 Static Water  Elevation (m GSD)
30-5						THE REAL PROPERTY OF THE PERSON OF THE PERSO			(26 JUNE 1979) *
1 1	0								‡ Piezometer
35		MEN-COMMUNICACION COMMUNICACION COMPINICACION COMUNICACION COMPINICACION COMPINICACION COMPINICACION COMPINICACION							
		farmonicontrol							
40-12	2								
	3	Manufaction of the Control of the Co		Street St					
45 - 7.	4			Description of the second					MacLaren
50	5								MacLAREN Engineers inc.
No. of the Control of		TE	ST HOLE RECORD			G.	M. F		PROJECT NO.   1602-5

### LOG OF BOREHOLE 4 Decommissioning **WSP**



project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/24

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and X Dynamic Cone Water Content (%) Graphic Plot Comments 10 30 40 Number 20 N-Value & Plasticity Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) PID Core Recovery 20 **GROUND SURFACE** GR SA SI CI Brown fine gravelly clayey silt 279 278 - 2 277 - 3 276 Brown interlayered fine sandy silt to silty fine sand and fine to medium sand overlying dense fine gravelly very fine to 275 very coarse sand near base -6 273.2 6.1 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH4 (MacLaren Engineers Inc., 1979). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 4R**



project | Holbrook Landfill Site

client | Oxford County

location | Holbrook, ON

position |

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

MEQ

date started | 2014/09/24

supervisor | reviewer | **AMS** 

		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		(0)	Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY GROUND SURFACE	Graphic Plot	Number	Туре	SPT N-Value Core Recovery	Elevation Scale (mARD)	X Dynamic Cone	Water Content (%) & Plasticity  PL MC LL 10 20 30	PID Readings Well Details	
- 0 - -		Brown <b>TOPSOIL</b> and organics, some roots, some clayey silt, dry, loose.	77	1	SS	10	•				an on or
- - - 1	0.6	Orangey brown to brown fine <b>SAND AND GRAVEL</b> , some silt, moist to wet, compact.		2	SS	12					
- - -2		Some roots and cobbles, red brown silty sand.		3	SS	12					
- - -				4	SS	18					
-				5	SS	23					
- 4 - -	3.8	Grey brown coarse <b>SAND AND GRAVEL</b> , trace fine sand, trace silt, saturated, compact.		6	SS	16					
- -5 -				7	SS	17					
- - -6				8	SS	14					
js.gpj	6.2	END OF BOREHOLE									
brary: genivar - library.glb report: gen log v1 file: bhlogs.gpj											
orary: g											

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	gooding or project in the control of		GEOLOGICAL LOG			2		And the second and th	TEST HOLE No. 5
iu L		EL		PLOT	TER	NUMBER	TYPE	0.3m	SHEET _ I OF _ I
(++)	THE REAL PROPERTY.	(mGSD) DEPTH (m)	DESCRIPTION	STRAT.	PIEZ OMETER	SAMPLE	SAMPLE	BLOWS/0	NOTES
				economics from the state of the	7	TI DAY BOOTLESS CROOKER BOOK BEING		246.000 customer reasoname, co., (25,54-	DATE DRILLED <u>1 May 1979</u>
oodbackmacenneedfrether		278.7	GROUND SURFACE	o e constituente de la constitue	1	. 03	m		TYPE OF RIG 75
	Burno	0.0		0 0	9	CLA			DRILLING METHOD Hollow Stem Augers
5-	2	Constitute and Automotive and Automo	Brown compact medium gravelly very fine to	0.0		1	SS	10	DEPTH WATER FOUND ~ 1.0
10	3		very coarse sand with layers of medium sand	0.0		2	SS	14	(m below ground surface)  STATIC WATER LEVEL 1.0 *  (m below ground surface)
15-	5			0.0	BACKFILL	3	SS	19	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 (m) TYPE OF PIEZOMETER
20-	6	5.5	Brown compact fine sandy silt and very fine sand		AND	4	SS	20	SAMPLE TYPE
25-	7	.271.8 6.9	Brown dense fine gravelly coarse to very coarse sand	0 0	HIIII CAVE	5	SS	38	SS-SPLIT SPOON WA-WASH
30-	9	269.6 9.1	End of Hole	.0		SOUTHWEST OF THE PROPERTY OF T		magnification and major an	
1 †	10	9.1	End of Hole						‡ Piezometer
35-	linear li			PAGE AND LINE OF THE PAGE AND		Number of Common		derekon monte erkanakon japan kannan japan k	
40-	12			The second secon		CONTINUED INTERPRETATION OF THE PROPERTY OF TH			
45	13							epinetinas de constante de cons	om Maclaren
50	15								MocLAREN ENGINEERS INC.
		TE	ST HOLE RECORD			G.	M. I	?	PROJECT NO. 11602-5

### LOG OF BOREHOLE 5 Decommissioning **WSP**



project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted 2014/09/23 date started |

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and Plot X Dynamic Cone Water Content (%) Comments 30 40 Number 1.0 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) Core PD Recovery 20 **GROUND SURFACE** GR SA SI CI Brown compact medium gravelly very fine to very coarse sand with layers of 279 0 0 278 0 -2 277 0 0 - 3 276 0 0 275 0 - 5 274 0 273.7 5.5 Brown compact fine sandy silt and very fine sand - 6 273 Brown dense fine gravelly coarse to very 272 0 -8 271.1 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH5 (MacLaren Engineers Inc., 1979). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 5R**



project | Holbrook Landfill Site

client | Oxford County

location | Holbrook, ON

position |

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/24

supervisor | MEQ

reviewer | AMS

	SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		<u>s</u>		Lab Data
Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value Core	Elevation Scale (mARD)	× Dynamic Cone 10 20 30 40  Undrained Shear Strength (kPa) ○ Unconfined ▶ Pocket Penetrometer ■ Lab Vane	Water Content (%) & Plasticity  PL MC LL 10 20 30	PID Readings	Well Details	and Commen GRAIN S DISTRIBUT (MIT
	GROUND SURFACE	ਰੱ			Recovery	_ =	40 80 120 160	10 20 30	۵		(MII GR SA
	Brown fine to coarse <b>SAND</b> , some medium gravel, some organics, dry to moist, very loose to loose.		1	SS	9						
			-			-	/				
			2	SS	0		V				
1.1	Grey brown to orangey brown fine to coarse <b>SAND</b> , trace to some silt, some medium gravel, moist to wet, compact.		-								
	medium gravel, moist to wet, compact.										
			3	SS	14						
			L			-					
			4	SS	15						
			4	55	15						
			H			-					
						1					
			5	ss	12						
			6	SS	13						
4.6		, ·									
	GRÁVEL, trace to some silt, wet, compact.	. 0	7	ss	11						
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		. C									
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		° C	8	SS	16						
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		. 0	10	SS	17						
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7.6		۰				1					
	GRAVEL, some silt, saturated, compact.	, C	11	SS	16						
	compact.	0									
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			1 ' 2	SS	19						
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9.1		1.0	1		<u> </u>	J					<u> </u>
	END OF BOREHOLE										
											Sheet No

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MINISTER CALL THE CAL	official physical results and the first and	GEOLOGICAL LOG		CONTRACTOR OF THE PROPERTY OF	Z Z	odnobelovanoskazdob prosperovandoba	A CONTRACTOR OF THE PROPERTY O	TEST HOLE No. 6
SCALE	EL (mGSD)	DESCRIPTION	T. PLOT	PIEZ OMETER	LE NUMBER	LE TYPE	15/0.3m	SHEET   OF
(ft)(m)	DEPTH (m)		STRAT.	PIEZ	SAMPLE	SAMPLE	BLOWS/	NOTES
	And the first of t						And the second s	DATE DRILLED 1 May 1979
	278.7	GROUND SURFACE		To	.73			TYPE OF RIGCME 75
1	0.0		0.00	. 🕎	CLA	Y	entranscription (Control of Control of Contr	DRILLING METHOD Hollow Stem Augers
5- -2	ACCOMPANIES AND ACCOMPANIES AN	Brown compact medium gravelly very fine to very coarse sand with	6	BACKFILL			PER	DEPTH WATER FOUND _~ 1.0
10-3		layers of medium sand	0.0	ID BACK			Del Silvani del Constanti del	(m below ground surface)  STATIC WATER LEVEL 1.0 *  (m below ground surface)
-4	AND THE REAL PROPERTY OF THE P		0.0	CAVE AND			objective for Liberty case in this projection control and	PIPE DIAMETER 51 (mm)
15 - 5	274.1 4.6	End of Hole	<u>;ö∷∴</u>				NO-MODEL STATE OF THE PROPERTY	LENGTH OF PIEZOMETER 0.5 (m) TYPE OF PIEZOMETER
20-6	NAME OF THE OWNER						Deviation with the Carticle States of the Car	SAMPLE TYPE
<b> </b>   <b>7</b>			Optional of the Control of the Contr					SS-SPLIT SPOON WA-WASH
25-8			\$000 mm					□ 277.7 Static Water     Elevation (mGSD)
30-9								(26 JUNE 1979) *
-10			4-man					‡ [1620me.e.
35-11			Yari minimili cheri principali cupi cupi cupi cupi cupi cupi cupi cup					
40-12								
-13								
45 -14								MacLaren MacLaren
50-15								MOCLAREN ENGINEERS INC.
	TE	ST HOLE RECORD			G.	M. F	2	PROJECT NO. 11602-5

### LOG OF BOREHOLE 6 Decommissioning **WSP**



project | Holbrook Landfill Site

date started | 2014/09/23 client | Oxford County rig type | CME 75, track-mounted

MEQ location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | project no. | 111-53037-00 132-00 coring | n/a reviewer | AMS

E)		SUBSURFACE PROFILE		SA	MPLE		Penetration Test Values (Blows / 0.3m)		S		Lab Data
Depth Scale (m)	Elev Depth	STRATIGRAPHY	Graphic Plot	Type	SPT N-Value	Elevation Scale (mARD)	× Dynamic Cone 10 20 30 40  Undrained Shear Strength (kPa)	Water Content (%) & Plasticity	Readings	Well Details	and Comments
Jepth	(m)	on Andrew	raph		Core	Eleva (m	O Unconfined + Field Vane Pocket Penetrometer Lab Vane	PL MC LL 10 20 30	PD		GRAIN SIZE DISTRIBUTION (%) (MIT)
L <sub>0</sub>	279.2	GROUND SURFACE			Recovery	"	40 80 120 160	10 20 30			GR SA SI CL
-		Brown compact to medium gravelly very fine to very coarse sand with layers of medium sand				279 - - -					
-1 - -						- 278 – - -					
- -2 -						- 277 – -					
- -3 -	275.5					- 276 - -					

#### **END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH6 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

		GEOLOGICAL LOG	<del> </del>					TEST HOLE No. 10
			TE	R	NUMBER	TYPE	Ε	SHEET I OF I
SCALE	EL (m) DEPTH	DESCRIPTION	STRAT. PLOT	PIEZOMETER	SAMPLE NU	SAMPLE TY	BLOWS/0.3m	NOTES
							- Constitution of the Cons	DATE DRILLED 3 May 1979
THE COLUMN TWO COLUMNS AND ADDRESS AND ADD	280.0	ground surface			.95			TYPE OF RIG
5-2	277.7	Brown compact fine to medium sand with fine gravel layers	0 0 0 0 0	PACKEL I	$l_1$		23	DRILLING  METHOD Hollow Stem Augers  DEPTH WATER FOUND ~ 0.8
10-3	2.3	Brown loose silty very fine sand			2	SS	9	(m below ground surface)  STATIC WATER LEVEL
15 5	275.0	End of Hole		CAVE	3	SS	6	LENGTH OF PIEZOMETER 0.5 (m)  TYPE OF PIEZOMETER  Trow
20-6 -7 25-		-	er dente delle en la service des la social de la service d		женения на применения метериальной в применения на применения на применения на применения на применения на при			SAMPLE TYPE  SS-SPLIT SPOON  WA-WASH
30-9					AND THE PROPERTY OF THE PROPER	OCCUPATION OF THE PROPERTY OF	ANGENTIAL PROPERTY OF THE PROPERTY OF THE BEAUTY OF THE PROPERTY OF THE PROPER	□ 279.2 Static Water Elevation (m GSD) (26 JUNE 1979) *
35-11					e de la companya de l	ON THE RESIDENCE AND SECURIOR STATEMENT THE STATEMENT OF	Anderson in the Second and Anderson in the Secon	
40 - 12				NAMES OF THE PROPERTY OF THE P	And the second s	petransia mandransia da desta de desta desta de	ипреви ветуплије (дебе се тема ветуплије (дебе се тема ветуплије) на превидени ветуплије (дебе се тема	
45 14	TO THE PROPERTY OF THE PROPERT		action of the second of the se	CHARLEST TO THE THREE PROPERTY OF THREE	coleiferich confidenting come in pass	spiechesp	Marian Casa Constantina (de mentre mentre de m	Maclaren Maclaren
50 15		,		The state of the s	and selections of the selection of the s	and descent such control of	one control of the co	MOCLAREN ENGINEERS INC.
esterio escaracio carano		EST HOLE RECORD			G	i.M.	P.	PROJECT NO. 11602-5

### LOG OF BOREHOLE 10 Decommissioning WSP



project | Holbrook Landfill Site

2015/07/09 client | Oxford County rig type | Acker Soil-Max, track-mounted date started |

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. MEQ supervisor | project no. | 111-53037-00 132-02 coring | n/a reviewer | **AMS** 

6	_ [		SUBSURFACE PROFILE			SA	MPLE	d)	Penetr (Blows	ation Test / 0.3m)	Values					<u>s</u>		Lab Data
Denth Scale (m)	0000	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value	Elevation Scale (mARD)	X Dy	namic Cone 0 20 ned Shea	e ) 3(	0 40	Water &	Content Plasticity	t (%) /	Readings	Well Details	and Comments
-0 #ged_	Deb.	(m) 281.6	GROUND SURFACE		Nur	T	Core Recovery	Eleva:	O U ● P	nconfined	etrometer	+ Field Vane ■ Lab Vane	PL 10	мс 20	LL 30	PID		GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
			Brown compact fine to medium sand with fine gravel layers	. (				-										
E				. (				281 –										
-1				. (				-	-									
ŀ				。 ()				-	-									
ŀ				。 () ()				280 -										
-2 -		279.3		. O				-										
ŀ		2.3	Brown loose silty very fine sand					- 279 –										
-3								-										
"		278.3						-										
		3.4	END OF DODELIOLE															

#### **END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH10 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 10R**



project | Holbrook Landfill Site

client | Oxford County

rig type | ACKER SOIL-MAX, track-mounted

Iocation | Holbrook, Oxford County method | Hollow stem augers, 215 mm dia. supervisor |

project no. | 111-53037-00 132-02

MEQ

date started | 2015/07/09

coring | n/a AMS reviewer |

	_		SUBSURFACE PROFILE			SA	MPLE		Penetration (Blows / 0.	Test	Values	$\overline{}$						S		Lab Data
	Deptn Scale (m)	Elev Depth (m)		Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dynam 10 Undrained ○ Uncor ● Pocke	c Cone 20 Shear fined t Penetr	3,0 Streng	th (kPa)  Field	l Vane Vane	P	ater Co & Pla		(%) LL <b>- </b> 3,0	PID Readings	Well Details	and Comments  GRAIN SIZE DISTRIBUTION (%) (MIT)
-0			GROUND SURFACE  Dark brown SANDY TOPSOIL, dry to				necovery	"	40	80	12	0 16	60	1	0 2	0 :	30			GR SA SI CL
-			moist, loose.	\(\bar{\gamma} \) \(\gamm		SS														
+	ĺ	0.3	Light brown fine to medium <b>SAND</b> , dry to moist, loose.		1	55	6													
$\mathbf{I}$			to moist, loose.																	
$\mathbf{F}$																				
-1					2	SS	7													
ŀ																				
ŀ																				
Ī																				
_2					3	SS	9													
-																				
-	İ	2.3	Light brown coarse <b>SAND</b> and fine to medium angular <b>GRAVEL</b> , wet, loose.	.0																
ŀ			medium angular <b>dri Avel</b> , wet, 1005e.	्०	4	SS	29													
$\mathbf{F}$	İ	2.7	Brown <b>SILTY SAND</b> , fine grained, wet to saturated, dilatent, compact.																	
-3			saturateu, unaterit, compact.																	
ŀ					5	SS	25													
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			END OF BOREHOLE																	
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and all who designed and all all and all and all and all and all and all and all and a	RESIDENCE OF THE PROPERTY OF T	GEOLOGICAL LOG			œ		SCOTT COLUMN TO THE PROPERTY OF THE PROPERTY O	TEST HOLE No. 11			
L			PLOT	E C	NUMBER	TYPE	0.3m	SHEET I OF I			
a) (tt)	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT. P	PIEZ OMETER	SAMPLE	SAMPLE 1	BLOWS/0.	NOTES			
				T				DATE DRILLED 3 May 1979			
	280.5	GROUND SURFACE	polociacimiz	1	. 28	m		TYPE OF RIGCME_75			
-	0.0				CLA	Y		DRILLING METHOD Hollow Stem Augers			
5 - 2		Brown clayey very fine			1	SS	9	DEPTH WATER FOUND _ ~ 1.2			
10 - 3		sandy silt		BACKFIL	2	SS	16	(m below ground surface)  STATIC WATER LEVEL $\frac{1.3 *}{}$ (m below ground surface)			
15	275 5			GRAVEL	3	SS	16	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 (m)			
-5	275.5	End of Hole			ydraeth cheutonerthinologaeth de yddynaeth daeth d		anna domena di internativa di intern	TYPE OF PIEZOMETER			
20-	7							SAMPLE TYPE SS-SPLIT SPOON			
25-8					Market Company		A CONTRACTOR CONTRACTO	WA-WASH			
30-9			AND COMMISSION OF THE PROPERTY		CONTRACTOR AND AND AND AND AND AND AND AND AND AND		install ventels amount is and facility con	(26 JUNE 1979) *			
	0						esson underwisse, on relanoussédies	‡ Piezometer			
35-	Description of the second		American Control of the Control of t				Manufacture and control of the contr				
40-1	2		NOTE A SECURE OF LANGUAGE CONTRACTOR OF THE PROPERTY OF THE PR	THE REPORT OF THE PROPERTY OF							
105	4			-Checkle Coperation Control of the Coperation Coperatio	NEED ENGINEERING PROPERTY OF THE SERVICE OF THE SER			om MacLaren			
50-1	5		e para para para para para para para par	ACCUSATION OF THE STATE OF THE	seasomertaling approximate of		The equipodes present statistics at the	MOCLAREN ENGINEERS INC.			
	Company	ST HOLE RECORD		ATT LANGUAGE TO THE STATE OF TH	G	.M. I	P.	PROJECT NO. 11602-5			

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# LOG OF BOREHOLE 11 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/15

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

orojec	t no.	111-53037-00 132-02				C	oring	II/a							г	eviev	wer	AIVIO
		SUBSURFACE PROFILE			SA	MPLE	_	Penetra	ation Tes	t Values	_					S		Lab Data
Depth Scale (m)			ot			SPT	Elevation Scale (mARD)	× Dy	namic Co	ne		Wat	ter Cor	ntent (% sticity	6)	Readings	= =	and
Sca	Elev	STRATIGRAPHY	Graphic Plot	Number	Туре	N-Value	ion 9 ARD			0 30	0 40 gth (kPa)		& Plas	sticity `		Зеас	Well Details	Comments
epth	Deptl (m)	STRATIGNAPHT	aph	Nun	Тy	Core	evat (m	O U	nconfined	atrometer	+ Field Vane ■ Lab Vane	PL	. мо	Ш		PID F		GRAIN SIZE DISTRIBUTION (%) (MIT)
	280.	GROUND SURFACE	ত			Recovery	Ш	4	0 8	0 12	20 160	10	. мо С	30		а.		GR SA SI CL
١		Brown clayey very fine sandy silt	Ш												I			Ι Π
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							280 –											
Ι.																		
-1							-	1										
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L							279 –											
-2							-	1										
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-3																		
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-							277 -											
-4							_											
ŀ	276.3	3		]			-											
	4.5	END OF BOREHOLE																
		Stratigraphy inferred from original borehole log for BH11 (MacLaren Engineers Inc., 1979).																
		Monitoring well decommissioned by overdrilling to full borehole depth and																
		sealing with bentonite.																
igpj.																		
decon																		
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-																		Sheet No. 1 of 1

### **LOG OF BOREHOLE 11R**



project | Holbrook Landfill Site

client | Oxford County

project no. | 111-53037-00 132-02

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

supervisor |

2015/07/24 date started |

coring | n/a reviewer |

MEQ **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mASL) Readings and Well Details Depth Scale X Dynamic Cone Water Content (%) Graphic Plot Comments 30 40 Number 1.0 20 N-Value & Plasticity Elev Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) Core PID Recovery 20 GROUND SURFACE GR SA SI CL - 0 Dark brown TOPSOIL, some fine silty sand, rootlets, moist, loose SS 5 Reddish brown fine to medium SAND, trace gravel, dry to moist, loose, compact below 1.5 m. 2 SS 9 3 SS 24 -2 SS 21 - 3 3.1 Reddish brown fine SAND, trace to some silt, trace fine gravel, wet, compact. 5 SS 22 6 SS 13 4.6 Reddish brown SANDY SILT, trace clay, SS 8 - 5 Grey-brown **CLAYEY SILT**, some fine to medium sand, APL to WTPL, stiff. 8 SS 6 - 6 9 SS 9 Grey-brown **SANDY SILT**, trace clay, trace fine to medium gravel, wet, 10 SS 15 compact. SS 9 -8 Grey CLAYEY SILT, some gravel, trace sand, DTPL, very stiff. 12 SS 22 9.0 **END OF BOREHOLE** 

		GEOLOGICAL LOG			<u>ж</u>			TEST HOLE No. 12
(+) (a) SCALE	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT. PLOT	PIEZOMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	NOTES
	280.5	GROUND SURFACE			O1 CLA			DATE DRILLED 3 May 1979  TYPE OF RIG CME 75  DRILLING METHOD Hollow Stem Augers
10-3 10-3 15-5 20-6	272.4	Brown clayey very fine sandy silt		HHHH GRAVEL BACKFILL	1 2	SS	20	DEPTH WATER FOUND ~ 1.2  (m below ground surface)  STATIC WATER LEVEL _ 2.2 *  (m below ground surface)  PIPE DIAMETER _51 _ (mm)  LENGTH OF PIEZOMETER _ 0.5 (m)  TYPE OF PIEZOMETER _ Trow  SAMPLE TYPE  SS-SPLIT SPOON WA-WASH
30-9		End of Hole			nichter; verzigelicher werden zehn ode des der mittel die des der verwenderen derscher der der der der der der			
40-12	Manual contraction of the contra			manilogiement/introductions/controlings/co				om Maclaren
50	A CONTRACTOR OF THE CONTRACTOR	ST HOLE RECORD	EL AQUINE SINO POR PRESENTA DE LA CALVANTA DE LA CA		G.	M. F	2	MocLAREN ENGINEERS INC.

### LOG OF BOREHOLE 12 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted 2015/07/16 date started |

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | **MEQ** project no. | 111-53037-00 132-02 coring | n/a reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and Plot X Dynamic Cone Water Content (%) Comments 10 30 40 Number 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) 吕 Core Recovery 20 **GROUND SURFACE** GR SA SI CI Brown clayey very fine sandy silt 280 279 -2 278 - 3 277 276 - 5 275 - 6 274 273 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH12 (MacLaren Engineers Inc., 1979). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

	massifications successive	GEOLOGICAL LOG		energy fector franchise parameters from	X	NO PERSONAL PROPERTY OF STREET, STREET		TEST HOLE No. 13				
SCALE	EL EL OFFICE PARTIES				NUMBER	TYPE	/0.3m	SHEET I OF I				
(ft)(m)	DEPTH			PIEZOMETER	SAMPLE	SAMPLE	BLOWS/0.3m	NOTES				
			-			Controller (CO) CO CO CO CO CO CO CO CO CO CO CO CO CO	Paralle CT prices a second construction	DATE DRILLED 13 June 1979				
	273.8	GROUND SURFACE	and in the latest and	0	. 88	m		TYPE OF RIGCME 75				
-	0.0	Brown mottled silt near surface			CLA	Y	en contraction of the contractio	DRILLING  METHOD Hollow Stem Auge				
5-1		overlying Brown compact silty very fine sand	7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		1	SS	24	DEPTH WATER FOUND				
10 - 3	2.1		0 8		2	SS	15	(m below ground surface) STATIC WATER LEVEL $2.2 *$ (m below ground surface)				
15 - 5	THE THE PROPERTY OF THE PROPER	Grey/brown fine gravelly very fine sandy clayey silt	\(\frac{1}{2}\)		3	SS	18	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 ( TYPE OF PIEZOMETER				
20-6	ODANIA NESARA NA PROPERTA DE LA CONTRA LA CONT	·	9 c		4	SS	16	Trow SAMPLE TYPE				
7	Management and a second and a s		10 10 10		-	C.C.		SS-SPLIT SPOON WA-WASH				
258	265.7 8.1		<u>∷;;</u>	土	5	SS	15	▽ 271.6 Static Water Elevation(m GSD) (26 JUNE 1979)*				
30 7 9	references extended to the control of the control o			and the control of the second control of the				Piezometer				
35 - 11	Page 3 dans de la composition della composition			adominimated established control security								
10 12	COVER OF VALUE OF VAL			#ChristonCheshellminamCheshellmin								
-13	and a statement and a statemen			A solventing and a second and a								
45 14				operate the second				Om MacLarer				

### LOG OF BOREHOLE 13 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/25

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and Plot X Dynamic Cone Water Content (%) Comments 30 40 Number 1.0 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) PID Core Recovery 20 **GROUND SURFACE** GR SA SI CI Brown mottled silt near surface overlying 274 brown compact silty very fine sand. 273 -2 272 Grey/brown fine gravelly very fine sandy clayey silt - 3 271 270 - 5 269 - 6 268 267 266.3 7.8 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH13 (MacLaren Engineers Inc., 1979). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 13R**



project | Holbrook Landfill Site

client | Oxford County

location | Holbrook, ON

position |

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/25

supervisor | SCL

reviewer | AMS

ē		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		<u>ω</u>		Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY GROUND SURFACE	Graphic Plot	Number	Туре	SPT N-Value Core Recovery	Elevation Scale (mARD)	X Dynamic Cone 10 20 30 40  Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160	Water Content (%) & Plasticity  PL MC LL 10 20 30	PID Readings	Well Details	and Comments  GRAIN SIZE DISTRIBUTION (%) (MIT)  GR SA SI CL
- 0 - - -		Orangey brown SILTY SAND, trace rootlets and roots, some fine to coarse sand, trace gravel, moist, loose.		. 1	SS	5						GR SA SI CL
- -1 -				2	SS	6						
- - -2	1.5	Orangey brown fine to medium <b>SAND</b> , some silt, some rounded gravel, moist to wet, compact.		3	SS	23						
-				4	SS	27						
-3 - - -		Increasing presence of coarse gravel and cobbles at 3 m.		5	SS	24						
- -4 -	3.8	Orangey brown <b>SANDY SILT</b> , becoming grey brown below 5 m, trace fine rounded gravel, dilatent, APL, very stiff.		6	SS	17						
- - -5				7	SS	17						
- - - -6				8	SS	30						
- - -	6.1	Grey SILT, some clay, trace to some fine sand, trace rounded gravel, weakly dilatent, APL to WTPL, stiff.		9	SS	12						
- -7 -				10	SS	14				:		
ohlogs.gpj	7.6	END OF BOREHOLE	1 1/1	<b>!</b>			ı				·.     ·.	
og v1 file:												
port: gen lo												
rary.glb re												
library: genivar - library.glb report: gen log v1 file: bhlogs.gpi												
library:												Shoot No. 1 of 1

	pointon and an annual control of the		GEOLOGICAL LOG			ER	Andread General Cardio		TEST HOLE No. 14		
SCALE		EL (mGSD)	DESCRIPTION	T. PLOT	PIEZ OMETER	LE NUMBER	LE TYPE	1S/0.3m	SHEET I OF I		
(ft)(m	- 1	DEPTH (m)		STRAT.	PIEZ	SAMPLE	SAMPLE	BLOWS,	NOTES		
		construction desired transfer control to the second		ASSOCIATION CONTRACTOR	T.		estropic promote constitution and a second c	Winnelder, promote programme, EU-lossifier	DATE DRILLED 13 June 1979		
		275.5	GROUND SURFACE	مين نوستون نوستون		. 23 CLA			TYPE OF RIG CME 75  DRILLING		
1 1 1-1		0.0	Grey gravelly clayey fine sandy silt overlying grey compact Silty fine sand			1	SS	16	METHOD Hollow Stem Auger		
5-1-2	2	1.8	Grey fine gravelly clayey very fine to fine sandy			CONTINUED OF THE PERSON OF THE	commontificative and continue a		DEPTH WATER FOUND <u>№ 0.8</u> (m below ground surface) STATIC WATER LEVEL <u>+0.7</u> *		
10+5	3	271.5	silt			2	SS	9	(m below ground surface)  PIPE DIAMETER 51 (mm)		
15	5	4.0	Grey dense interlayered fine, medium and coarse sand, sandy gravel and	0.6	####	3	SS	40	LENGTH OF PIEZOMETER 0.5 (TYPE OF PIEZOMETER		
20	6	268.9	gravelly sand. (Grey silty very fine sand at base).			4	SS	42	SAMPLE TYPE		
25	7   8	6.6	End of Hole						SS-SPLIT SPOON WA-WASH  276.2 Static Water		
30	9				ntarea colonal has demande entre entre entre entre entre entre entre entre entre entre entre entre entre entre	processore extraordinaria processor in the contraction of the contract		emando de proprio de la composição de la composição de la composição de la composição de la composição de la c	Elevation (m GSD) (26 JUNE 1979) *		
35-	0					SECTION OF THE PROPERTY OF THE	ACTIVATION OF THE PROPERTY OF	And the second control of the second control	*		
+	12			moves permissed the designation of the control of t	ndermichtichen ober der Generalisten		· ·	worth characteristics and a second se			
+	13			orenia del consessione de la consessione della c	anous afteriorates and the edifferential	COLUMN TO THE PROPERTY OF THE PERTY OF THE P		Component and a second a second and cond and			
45	14					PROCEEDINGS CALANTINGS CONTROLLED		anti-branch and anti-branch an	om MacLaren		
50 <sup>±1</sup>	15			Note that the state of the stat		and the second s	Name of the last o		MOCLAREN ENGINEERS INC.		
			ST HOLE RECORD			G	.M.	P.	PROJECT NO. 11602-5		

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### LOG OF BOREHOLE 14 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/17

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and Plot X Dynamic Cone Water Content (%) Comments 30 40 Number 1.0 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) PID Core Recovery 20 GR SA SI CI Grey gravelly clayey fine sandy silt overlying grey compact silty fine sand 275 Grey fine gravelly clayey very fine to fine sandy silt 274 - 2 273 - 3 272 Grey dense interlayered fine, medium and coarse sand, sandy gravel and gravelly sand. (Grey silty very fine sand 0 at base). 0 271 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH14 (MacLaren Engineers Inc., 1979). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 14R**



project | Holbrook Landfill Site

client | Oxford County

position |

location | Holbrook, ON

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/17

supervisor | MEQ

reviewer | AMS

- E		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		<u>0</u>	Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Туре	SPT N-Value Core	Elevation Scale (mARD)	X Dynamic Cone  10 20 30 40  Undrained Shear Strength (kPa)  O Unconfined + Field Vane	Water Content (%) & Plasticity	) Readings Well	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT)
	(,	GROUND SURFACE	Gra	Z		Recovery	Ele	● Pocket Penetrometer ■ Lab Vane 40 80 120 160	PL MC LL 10 20 30	E E	(MIT) GR SA SI CL
- 0 - -		Brown grey CLAYEY SILT, with orange striations, some sandy silt, trace medium gravel, trace organics, DTPL to APL, firm.		1	SS	10					an or of oc
- -1 -				2	SS	12					
- - -2	1.5	Brown grey fine <b>SILTY SAND</b> , some medium gravel, wet, loose to compact.		3	SS	35					
-	2.6	Grey CLAYEY SILT, trace fine gravel, trace sand, APL to WTPL, firm.		4	SS	13					
-3 - -				5	SS	13					
- -4 -	3.8	Grey medium to coarse <b>SAND AND GRAVEL</b> , some sandy silt, trace clay, saturated, compact to dense.		6	SS	24					
- - -5		Increasing presence of coarse gravel and cobbles at 5 m.		7	SS	24					
-				8	SS	38					
-6 - -			, () , ()	9	SS	20					
-			0								
l <b>ibrary:</b> genivar - library.glb. <b>report:</b> gen log v.f. <b>file:</b> bhlogs.gpj	6.9	END OF BOREHOLE	La				I				

alasa santa da para sa sa calab nyunnan		GEOLOGICAL LOG			œ			TEST HOLE No. 14A
SCALE	EL (mGSD)	DESCRIPTION	PLOT	PIEZOMETER	E NUMBER	E TYPE	BLOWS/0.3m	SHEET I OF I
(ft)(m	DEPTH		STRAT.	PIEZO	SAMPLE	SAMPLE	BLOWS	NOTES
					. 39	m		DATE DRILLED 13 June 1979  TYPE OF RIG CME 75
5	275.5				CLA	Y		DRILLING METHOD Hollow Stem Augers
10-1	1.8 272.1 3.4	Grey fine gravelly clayey very fine to fine sandy silt		##### GRAVEL-BACKFIL				DEPTH WATER FOUND ~ 0.8
15								PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 (m) TYPE OF PIEZOMETER Trow
20-	7		providence and construction of the following the construction of t					SAMPLE TYPE SS-SPLIT SPOON WA-WASH
25-	3						ACTIVITATION CONTRACTOR STREET, CONTRACTOR C	▽ 274.7 Static Water Elevation(m GSD) (26 JUNE 1979)*
1	0							‡ Piezometer
35-1	1		Company of the Compan				manishin mengangan pengangan pengangan pengangan pengangan pengangan pengangan pengangan pengangan pengangan p	
407	3		STREET, STREET			Selection of the select	en y dag de la manage que a de la manage de	
	5		SENSOTER DATE STATEMENT OF STAT			AND AND AND AND AND AND AND AND AND AND	Винацияния принципальной в при	MacLaren  MocLAREN ENGINEERS INC.
50-1	TE	ST HOLE RECORD	VIII.		G.	M. F	2	PROJECT NO. 11602-5

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# LOG OF BOREHOLE 14A Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/17

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-00coring | n/areviewer | AMS

<u></u>		SUBSURFACE PROFILE			SA	MPLE	0	Penetration Te (Blows / 0.3m)	est Values		<u>0</u>		Lab Data
Depth Scale (m)	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value	Elevation Scale (mARD)	× Dynamic Co 1,0		Water Content (%) & Plasticity	Readings	Well Details	and Comments
	(m) 275.9	GROUND SURFACE	Graph	Nun	Τ <sub>y</sub>	Core Recovery	Elevat (m	<ul><li>Unconfine</li><li>Pocket Pe</li></ul>		PL MC LL 10 20 30	PID F		GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
-0 - - - -1 - - - - - -	<u>274.1</u> 1.8	Grey gravelly clayey fine sandy silt overlying grey compact silty fine sand							20 100				GH SA SI CL
	273.2 2.7	END OF PORFHOLE											

#### END OF BOREHOLE

Stratigraphy inferred from original borehole log for BH14A (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

		GEOLOGICAL LOG						TEST HOLE No. 15
er.			PLOT	2	NUMBER	TYPE	E,	SHEET t OF t
(ft)(m)	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT. F	PIEZOMETER	SAMPLE N	SAMPLE	BLOWS/0.	NOTES
			on the production of Com-	-			A CONTINUE DE CONT	DATE DRILLED 13 June 1979
	277.9	GROUND SURFACE	AT US A STATE OF THE STATE OF T	1	.18	m	NAME OF THE OWNER OWNER	TYPE OF RIG CME 75
	0.0				CLA		one control of the co	DRILLING METHOD Hollow Stem Augers
5-7			ē	9	1	ss	6	
-2 10-3		Brown gravelly clayey			2	SS	32	DEPTH WATER FOUND  (m below ground surface)  STATIC WATER LEVEL
-		silt	9		3	SS	19	
15-			<u>о</u>					LENGTH OF PIEZOMETER <u>0.5</u> (m)  TYPE OF PIEZOMETER  Trow
206			٩		4	SS	24	SAMPLE TYPE
25-	271.2 6.7 270.3 7.6	Brown compact interlayered silty fine sand, fine to medium sand and very fine sandy silt		BACKFILI	5	ss	11	SS-SPLIT SPOON WA-WASH
30-9	7.6	June 1		GRAVEL	6	ss	4	▼ 276.3 Static Water Elevation (m GSD) (26 JUNE 1979) ±
-10		Brown gravelly clayey			Anni Contractorio			I Piezometer
35-11		silt		AUCTORNICATO OTRANSPORM	7	SS	92	
40-12					CLA	SS	39	
-13	265.1 12.8		9.0					
45-14				CC (C) THE PROPERTY OF THE PRO	9	SS		
- -15 50-		Brown compact to dense	00000	\$\$\$.	10	SS	35	
-16		fine to very coarse sandy fine to medium gravel (minor silt)	@ () 0 a 0 0	444444	11	SS	22	
55-17		(	0.0					
-18 60-			0.0 2.0		12	SS		
-19	A CONTRACTOR CONTRACTO		06 00 00					ne generalis (cha
65-20			00	CAVE				
70-21			0.0	٦	1.3	SS		
-22	0		i Q					
75-23	255.0 22.9		E.O.					
-24	253.4	Brown very dense gravelly silt till	000		14	SS	70-	
-25	24.5	End of Hole						
85-26								om Maclaren
-27								MocLAREN
	TE	ST HOLE RECORD			G	M.1	P	PROJECT NO. 11602-5
L				L				

# LOG OF BOREHOLE 15 Decommissioning WSP



project | Holbrook Landfill Site

date started | 2014/09/22 client | Oxford County rig type | CME 75, track-mounted

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 AMS coring | n/a reviewer |

STRATIGRAPHY		SUBSURFACE PROFILE	=			SA	MPLE		Penetra	tion Tes	t Value	s						w		Lab Data
278 - Brown gravelly clayey sit	5 e			ot			SPT	scale	× Dyn	amic Cor	ne		_	Wa	ater Co	ntent (	(%)	ding	= ≅	and
278 - Brown gravelly clayey sit	Elev	V STRATIC RADUV		ic P	ber	be	N-Value	ion 9				-			& Pla	sticity		Зеас	We Deta	l
278 - Brown gravelly clayey sit	m)	m STRATIGRAPHY		aphi	휘	Ž	Core	evati (m	O Un	confined		+ Fiel	d Vane	F	PL M	ic L	L	D F		GRAIN SIZE DISTRIBUTION
Brown gravelly clayey silt  276  277  276  277  277  277  277  27		.3 GROUND SURFACE		ğ	_		Recovery	苗	● Po	cket Pen	etrometer	r <b>■</b> Lab 20 16	Vane 60	1	0 2	0 3	<b>1</b> 80	Ь		(MIT) GR SA SI
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sand. Fine to medium sand and very fine sand. Fine to medium sand and very fine sand, fine to medium sand and very fine sand and very fine sand sand sand sand sand sand sand sand	2/8.		9					278 —												
271.6  6.7  Brown to compact interlayered silty fine sand, fine to medium sand and very fine sandy silt  270.7  7.6  Brown gravelly clayey silt  270.2  288.8  288.8  266.7  286.8  286.			8	19				270												
271.6  6.7  Brown to compact interlayered silty fine sand, fine to medium sand and very fine sandy silt  270.7  7.6  Brown gravelly clayey silt  270.2  288.8  288.8  266.7  286.8  286.			[:					-												
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine  272 -  273 -  274 -  273 -  272 -  273 -  277 -  278 Brown gravelly clayey silt  270 -  289 -  289 -  289 -  288 -  287 -  286 -  287 -  286 -  287 -  286 -  287 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -			2					277 -												
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine  272 -  273 -  274 -  273 -  272 -  273 -  277 -  278 Brown gravelly clayey silt  270 -  289 -  289 -  289 -  288 -  287 -  286 -  287 -  286 -  287 -  286 -  287 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -			þ:	П				_												
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine  272 -  273 -  274 -  273 -  272 -  273 -  277 -  278 Brown gravelly clayey silt  270 -  289 -  289 -  289 -  288 -  287 -  286 -  287 -  286 -  287 -  286 -  287 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -  287 -  288 -			2	[4]																
271 6  273 -  273 -  273 -  272 -  273 -  274 -  275 -  276    Brown to compact interfayered silty fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sand, fine to medium gravel sand, fine to medium gravel coarse sandy fine to medium gravel (minor silt)  271 -  272 -  273 -  277 -  271 -  271 -  271 -  271 -  271 -  271 -  271 -  271 -  272 -  273 -  274 -  275 -  266 -  266 -  266 -  266 -  265 -  (minor silt)				ďφ				276												
271 6  273 -  273 -  273 -  272 -  273 -  274 -  275 -  276    Brown to compact interfayered silty fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sand, fine to medium gravel sand, fine to medium gravel coarse sandy fine to medium gravel (minor silt)  271 -  272 -  273 -  277 -  271 -  271 -  271 -  271 -  271 -  271 -  271 -  271 -  272 -  273 -  274 -  275 -  266 -  266 -  266 -  266 -  265 -  (minor silt)			ľ					-												
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  288 - Sandy silt  288 - Sandy silt  288 - Sandy silt  288 - Sandy silt  287 - Sandy silt  288 - Sandy silt  289 - Sandy silt  289 - Sandy silt  289 - Sandy silt  280 - Sandy silt			9					275 —												
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  288 - Sandy silt  288 - Sandy silt  288 - Sandy silt  288 - Sandy silt  287 - Sandy silt  288 - Sandy silt  289 - Sandy silt  289 - Sandy silt  289 - Sandy silt  280 - Sandy silt			[·	M																
271.6  Brown to compact interlayered silty fine sand, fine to medium sand and very fine sand, fine to medium sand and very fine sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  270 - Sandy silt  288 - Sandy silt  288 - Sandy silt  288 - Sandy silt  288 - Sandy silt  287 - Sandy silt  288 - Sandy silt  289 - Sandy silt  289 - Sandy silt  289 - Sandy silt  280 - Sandy silt			, P	14																
271.6 6.7 Brown to compact interlayered silty fine sand, fine to medium sand and very fine sandy silt 270.7 7.6 Brown gravelly clayey silt 270.7 269.7 269.7 268.7 266.7 266.7 266.7 266.7 266.7 266.7 266.7 265.5 12.8 Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt) 265.5 265.7 266.7			K	<b>/</b>				274 –												
271.6 6.7 Brown to compact interlayered silty fine sand, fine to medium sand and very fine sandy silt 270.7 7.6 Brown gravelly clayey silt 270.7 269.7 269.7 268.7 266.7 266.7 266.7 266.7 266.7 266.7 266.7 265.5 12.8 Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt) 265.5 265.7 266.7			Į.					-												
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and, fine to medium sand and very fine sand, silt  271 –  7.6 Brown gravelly clayey silt  270 –  269 –  268 –  267 –  266 –  266 –  265 –  12.8 Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt)  271 –  265 –  266 –  265 –  266 –  265 –  266 –  267 –  267 –  268	971 4	6	<b>S</b> .					272 -												
270.7 Sandy silt  7.6 Brown gravelly clayey silt  270 -  269 -  268 -  267 -  266 -  266 -  266 -  265 -  12.8 Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt)  270 -  265 -  265 -  265 -  265 -  265 -  266 -  265 -  266 -  265 -  266 -  267 -  268 -  268 -  268 -  268 -  266 -  266 -  266 -  267 -  268 -  268 -  268 -  268 -  266 -  266 -  266 -  267 -  268 -  268 -  268 -  268 -  266 -  266 -  266 -  267 -  268 -  267 -  268 -  268 -  268 -  268 -  266 -  266 -  266 -  266 -  266 -  267 -  268 -  268 -  268 -  268 -  266 -  266 -  266 -  267 -  268 -  268 -  268 -  268 -  268 -  268 -  268 -  266 -  266 -  266 -  267 -  268 -  26	6.7	7 Brown to compact interlayered siltv	fine					-												
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265.5  12.8  Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt)  265 – 265 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 265 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 265 – 264 – 264 – 264 – 264 – 264 – 265 – 265 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 264 – 265 – 264 – 264 – 265			, P	14				_												
265.5  Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt)  265 – 264 – 265 – 264	:		6																	
Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt)			ľ.					266 –												
coarse sandy fine to medium gravel (minor silt)	10.0		v 0	Щ				-												
		coarse sandy fine to medium grave	1 [:					265 —												
0 264-		(minor siit)	).  -	٥				_												
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262.3 16.0			Þ	0				264												
263 – 263 –			Y:					-												
262.3 16.0								263 —												
16.0	262 (	3		0				_												
	16.0	0 END OF BOREHOLE	Į¢.		L									<u> </u>						
		borehole log for BH15 (MacLaren																		
Stratigraphy inferred from original borehole log for BH15 (MacLaren		Engineers Inc., 1979).																		
Stratigraphy inferred from original borehole log for BH15 (MacLaren Engineers Inc., 1979).		Monitoring well decommissioned by overdrilling to full borehole depth or	/ nd																	
Stratigraphy inferred from original borehole log for BH15 (MacLaren Engineers Inc., 1979).  Monitoring well decommissioned by overdrilling to full borehole depth and		overunning to ruii borenole deptit at	IU																	
Stratigraphy inferred from original borehole log for BH15 (MacLaren Engineers Inc., 1979).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.		sealing with bentonite.																		
Stratigraphy inferred from original borehole log for BH15 (MacLaren Engineers Inc., 1979).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.		sealing with bentonite.																		
borehole log for BH15 (MacLaren Engineers Inc., 1979).  Monitoring well decommissioned by overdrilling to full borehole depth and		sealing with bentonite.																		
Stratigraphy inferred from original borehole log for BH15 (MacLaren Engineers Inc., 1979).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.		sealing with bentonite.																		

	AND THE REAL PROPERTY OF THE P	GEOLOGICAL	LOG		T C	den opposite president in the president of the president		TEST HOLE No. 15A
(tt)	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT. PLOT	PIEZOMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	NOTES
(f1)(m) -1 5- -2 10-3 -4 15- -5 -7 25- -8	District Control	Brown gravelly classilt  Brown compact into silty fine sand, very sand and very sand sand sand silty sand sand silty silty sand silty silty sand silty silty sand silty silty sand silty silty sand silty silty sand silty silty silty sand silty si	ayey o o o o o o o o o o o o o o o o o o	GRAVEL BACKFILL	GS CLASIL	m EY	ВГ	DATE DRILLED 14 June 1979  TYPE OF RIG CME 75  DRILLING   METHOD Hollow Stem Augers  DEPTH WATER FOUND   (m below ground surface)  STATIC WATER LEVEL 1.8 *   (m below ground surface)  PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 (m) TYPE OF PIEZOMETER Trow  SAMPLE TYPE  SS-SPLIT SPOON WA-WASH
30-9 -10 35-11 40-12 -13 45-14	9.1	silt		###	G.	M. F	)	PROJECT NO. 11602-5

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							T	
		GEOLOGICAL LOG			E.			TEST HOLE No. 16
Led	EL		PLOT	ETER	NUMBER	TYPE	0.3m	SHEET I OF I
SCALE	(mGSD)	DESCRIPTION	STRAT.	EZOME	SAMPLE	SAMPLE	BLOWS/C	NOTES
(ft) (m)	(m)		Ts.	ā	SA	SAN	13	
				•			Newson Company of the	DATE DRILLED 14 June 1979
	277.8	GROUND SURFACE			.17			TYPE OF RIG CME 75
7	0.0				QLA'		STATEMENT STATEM	DRILLING METHOD Hollow Stem Augers
5-		Brown gravelly clayey				SS	32	
-2		silt	2		chokuna kanana k			(m below ground surface)
10-3			3		2	SS	15	STATIC WATER LEVEL 2.0 * (m below ground surface)
15-		(Brown fine sandy gravel			3	SS	12	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 (m)
-5		layer at ~ 4.6 m BGS)						TYPE OF PIEZOMETER
206			Ĕ		4	SS	14	SAMPLE TYPE
-7	270.8 7.0		75.50		e	ss	13	SS - SPLIT SPOON WA - WASH
25-[-8		Brown very loose to		1		22	13	▼ 275.9 Static Water Elevation (m GSD)
30 - 9	eestatus (Alexandra)	compact very fine sandy silt		BACKFIL	6	SS	3	(26 JUNE 1979) *
1-10	267.4							Piezometer
35-11	10.4			GRAVEL.	7	ss	23	All the state of t
1-12		Brown gravelly clayey silt	Ē					
13	264.7		<u>a</u>		CLA	SS	40	
45 44	13.1	Brown very loose to	1111	0.00	9	SS	3	
-15		compact silty very fine to fine sand		CAVE		A constitution of the cons		
50-	262.0			******	10	ss	21	
1-16 55-1-2-	15.8	Brown dense medium to coarse sand, fine to coarse sandy fine to medium gravel			~ ~	ss	24	
	260.6 17.2	End of Hole	1.9.5			20	24	
60-18	2997407391024000000999		Military					
-19	en en en en en en en en en en en en en e		POLICE DE LA COMPANSION					
65-20								
70			National Control of Co				Continues to the Continue to the Continues to the Continue to the Continues to the Continues to the Continue	
-22						population		MacLaren MacLaren
75-1 <sub>-23</sub>								MOCLAREN ENGINEERS INC.
make to the control of the control o	TE	ST HOLE RECORD			G.	M. P.		PROJECT NO. 11602-5

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# LOG OF BOREHOLE 16 Decommissioning WSP



project | Holbrook Landfill Site

rig type | CME 75, track-mounted date started | 2014/09/18 client | Oxford County

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | AMS

	SUBSURFACE PROFILE			SA	MPLE		Penetration Te (Blows / 0.3m)	st Values				σ		Lab Data
		olot	<u></u>		SPT	Elevation Scale (mARD)	× Dynamic Co		40	Water (	Content (%)	PID Readings	Well Details	and Comments
Elev Depth	STRATIGRAPHY	hic F	Number	Type	N-Value	ation	Undrained She	ar Strength (F	(Pa)		lasticity `	Rea	We	
(m)	ODOUND OUDEAGE	Graphic Plot	Ž	-	Core Recovery	Elev.	O Unconfined Pocket Per 40 8	etrometer = 0 120	Field Vane Lab Vane 160	PL 10	MC LL 20 30	PID		GRAIN SI DISTRIBUTIO (MIT)
278.2	GROUND SURFACE  Brown gravelly clayey silt				,	278 <b>–</b>	40 6	0 120	160	10	20 30			GR SA
	, , ,					_								
						277								
			1			276 –								
		*				2/6-								
						-								
						275 –								
	(Brown fine sandy gravel layer at ~ 4.6 m					274								
	BGS)					-								
						273 –								
						-								
						272 –								
271.2 7.0						-								
7.0	Brown very loose to compact very fine sandy silt					271 –								
	cana, and					-								
						270 –								
						-								
						269 -								
						-								
267.8						268 -								
10.4	Brown gravelly clayey silt	8				-								
						267 —								
		8				-								
		PH				266 -								
						-								
265.1 13.1	Brown very loose to compact silty very	PH				265 -								
	fine to fine sand	朏				-								
						264 -								
		拙				-								
						263 —								
262.4		出出				-								
15.8	END OF BOREHOLE	1.1.			'			'	1			<b>!</b>		
	Stratigraphy inferred from original borehole log for BH16 (MacLaren													
	Engineers Inc., 1979).													
	Monitoring well decommissioned by													
	overdrilling to full borehole depth and sealing with bentonite.													
														Sheet No.

### **LOG OF BOREHOLE 16R**



project | Holbrook Landfill Site

client | Oxford County

position |

location | Holbrook, ON

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/19

supervisor | MEQ

reviewer | AMS

- 1		SUBSURFACE PROFILE			SΔ	MPLE		Penetration Test Values			
·		SUBSUNFACE PROFILE	T to	$\vdash$		SPT	cale	Penetration Test Values (Blows / 0.3m) × Dynamic Cone	Water Content (%)	sgni   s	Lab Data and
Ī	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value	Elevation Scale (mARD)	10 20 30 40  Undrained Shear Strength (kPa)  O Unconfined + Field Vane	& Plasticity	Neadings Well Details	GRAIN S DISTRIBUTION (MIT)
	(111)	GROUND SURFACE	Gra	Ž		Core Recovery	Щ Ф	● Pocket Penetrometer ■ Lab Vane 40 80 120 160	10 20 30	Old	(MIT) GR SA
Ī		Brown <b>CLAYEY SILT</b> , some fine to medium gravel, trace sand, DTPL, stiff to very stiff.		1	SS	8					
		Abundant rootlets to 0.8 m depth.		2	SS	18	-				
				3	SS	33					
ŀ	2.3	Brown to grey <b>CLAYEY SILT</b> , some orange striations, trace fine sand, trace		4	SS	21					
		gravel, DTPL, stiff to very stiff.		5	SS	24					
				6	SS	15					
	4.9			7	SS	27					
	4.3	Grey brown fine SILTY GRAVEL AND SAND, trace to some cobbles, wet, compact.	, C	l a	SS	21					
ŀ	6.0	Grey CLAYEY SILT, trace fine silty sand, APL, stiff.	.0	9	SS	20	<u> </u>  -				
				10	SS	17					
ŀ	7.8	Cray fine CANDY OILT trace clayer silt		11		3					
	7.0	Grey fine <b>SANDY SILT</b> , trace clayey silt, trace fine gravel and coarse sand, WTPL, soft.									
				12		3					
	10.0			13		4					
	10.0	Grey <b>SANDY SILT TILL</b> , some medium gravel, some fine to coarse sand seams, APL, stiff to very stiff.		14	SS	27		7			
		Reddish brown from 11.0 m to 11.5 m depth.		15		24	_				
		·		16	SS	17					
				17	SS	37	]				
	10.7	150mm thick coarse gravelly sand seam at 12.9 m depth.		18	SS	37					
	13.7	Grey fine <b>SAND</b> , some silt, trace fine gravel, wet, compact.		19	SS	34					
				20	SS	38					
				21	SS	24					
		300mm thick coarse gravel seam at 16.5m depth.	1	22	SS	34					

game money colors		, and the second							
			GEOLOGICAL LOG			<u>~</u>		Web planting reprintment of the second	TEST HOLE No. 16A
ii IV J	2021	EL (mGSD)	DESCRIPTION	T. PLOT	OMETER	LE NUMBER	LE TYPE	/S/0.3m	SHEET I OF I
(f†)(	in a second common contract of the contract of	DEPTH (m)		STRAT.	PIEZ	SAMPLE	SAMPLE	BLOWS,	NOTES
						38		en management producer and a second producer	DATE DRILLED 14 June 1979
		277.8	GROUND SURFACE						TYPE OF RIG <u>CME 75</u>
	- -1	0.0				CLA	Y	avur kiraspinooting onating pook into dok	DRILLING METHOD Hollow Stem Augers
5-	- -2 -		Brown gravelly clayey silt			misera filmicosamis um pocações de massa de mass		with the section with the section of	DEPTH WATER FOUND (m below ground surface) STATIC WATER LEVEL1.8*
10-	-3 - -4				BACKFILL				(m below ground surface)  PIPE DIAMETER 51 (mm)
15	-5		(Brown fine sandy gravel layer at $\sim$ 4.6 m BGS)		GRAVEL BA	City broad de la City			LENGTH OF PIEZOMETER 0.5 (m) TYPE OF PIEZOMETER Trow
20-	-6	270.8			AND	annoyanikan pankaban dan dan dan dan dan dan dan dan dan d		of descriptions of the Conference of the Confere	SAMPLE TYPE SS-SPLIT SPOON
25-	-7 - -8	7.0	Brown very loose to compact very fine sandy		# CAVE	no-entropologico-politico		mphilosomhaidhadhaonflamn, mphilomrach	WA-WASH
30-	- - 9	268.7 9.1	silt End of Hole		**************************************	остерота при при при при при при при при при при		entretacionale de la company d	Elevation (m GSD) (26 JUNE 1979) *
35-	-10	energia de la constitució de l			Actoristic Actor of Bullian Actor Actor (Actor (Actor) Actor de de la company			÷ 1,620,110.01	
and the second	-11 - -12			AND DESCRIPTION OF THE PROPERTY OF THE PROPERT	cholopic statellation decimalism debasetion	modernica edice edica edice edica edice edice edice edice edice edice edice edice edice edice edica edice edica edice edice edice edice edice edice edice edice edice edice edica edice edice edice edica ed		Dramountenance agreement a	
40-	-13			NAMES OF THE PROPERTY OF THE P	and and described in the control of	ind-will construct to the construction of the	AND THE PROPERTY IN THE PROPER	And continued and designation of the continued and the continued a	
45	- -14 -			STATISMENT OF THE PROPERTY OF	Paracologica production of the control of the contr	And the grown and the contraction and the cont	CONSCIONATION CONTINUES OF THE CONTINUES	ate ballonica bilitheral Distriction commerces (s.	om MacLaren
50	-15				A COLUMN TO THE PROPERTY OF TH				MOCLAREN ENGINEERS INC.
			ST HOLE RECORD		econductives described and a second	G	. M.	R	PROJECT NO. 11602-5

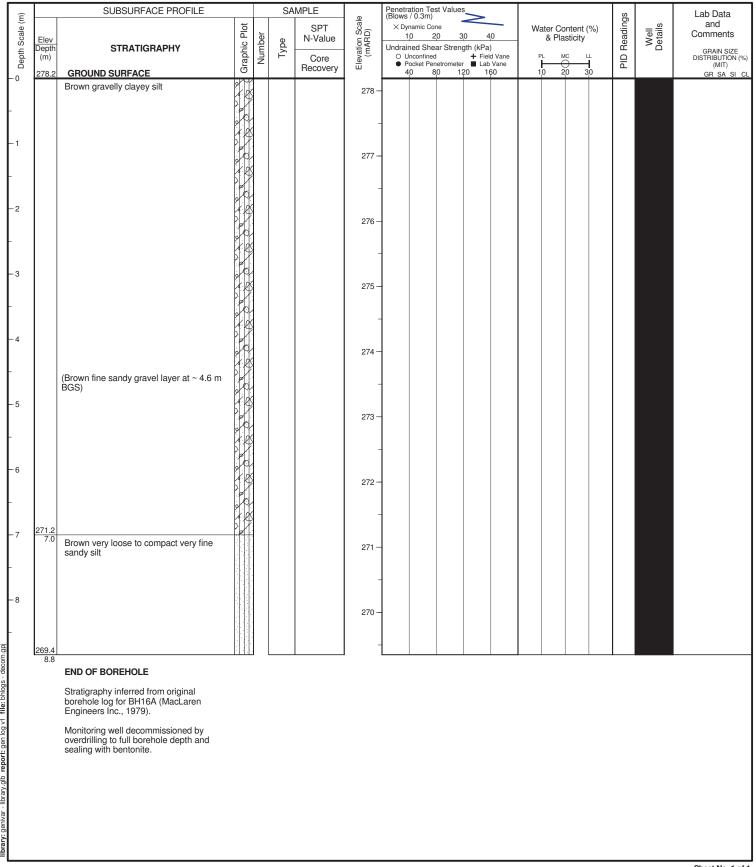
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### LOG OF BOREHOLE 16A Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/18

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-00coring | n/areviewer | AMS



### **LOG OF BOREHOLE 16AR**



project | Holbrook Landfill Site project no. | 111-53037-00 132-00

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/22

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQposition |coring | n/areviewer | AMS

Ē		SUBSURFACE PROFILE			SA	MPLE	_	Penetration Test Values (Blows / 0.3m)		S		Lab Data
Depth Scale (m)			Plot	-		SPT	Elevation Scale (mARD)	X Dynamic Cone 1,0 2,0 3,0 4,0	Water Content (%)	PID Readings	Well Details	and Comments
th Sc	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value	ation mAR	Undrained Shear Strength (kPa)	& Plasticity	Rea	W	
	(m)	GROUND SURFACE	Grap	ž	_	Core Recovery	Elev (	O Unconfined + Field Vane Pocket Penetrometer Lab Vane 40 80 120 160	PL MC LL 1,0 2,0 3,0	PID		GRAIN SIZE DISTRIBUTION (%) (MIT)
-0		Brown CLAYEY SILT, some fine to medium gravel, trace sand, DTPL, stiff to very stiff.		1	SS	55		70 00 120 100				GR SA SI CL
ŀ		Abundant rootlets to 0.8 m depth.		_								
<b>–</b> 1		Abundant rootiets to 0.6 m deptil.		1								
Ι΄												
-			11	1_								
				2	SS	22						
-2				_				/				
	2.3	Brown to grey <b>CLAYEY SILT</b> , some orange striations, trace fine sand, trace	$\mathcal{H}$									
		orange striations, trace fine sand, trace gravel, DTPL, stiff to very stiff.						/				
-3			1									
				3	SS	12						
-			11	Ľ	- 00	12						
			111									
-4			H									
-			<b>1</b> //									
			H		SS	58						
-5	4.9	Grey brown fine SILTY GRAVEL AND SAND, trace to some cobbles, wet,	. ()	4	55	58			1			
		compact.	, 0									
Ī			. 0									
-6			) 0									
	6.0	Grey CLAYEY SILT, trace fine silty sand, APL, stiff.	11									
ŀ			M	5	SS	14						
				$\top$								
-7												
-			11									
	7.8	Crow fine CANDY CILT trace elevery eith										
-8	7.0	Grey fine <b>SANDY SILT</b> , trace clayey silt, trace fine gravel and coarse sand, WTPL, soft.	掂	6	SS	18						
		WIFL, SOIL	鵾									
			肼									
9			搨									
library; genivar - library.glb report; gen log v1 file: bhlogs.gpj 			进									
ile: bh	9.4	END OF BOREHOLE										
g v1		Stratigraphy inferred from adjacent										
gen lc		borehole 16.										
report												
y.glb												
libra												
enivar												
rary: ç												
≝												Sheet No. 1 of 1

The continues are a second continues and the con		GEOLOGICAL LOG			ER			TEST HOLE No. 17
SCALE	EL		PLOT	OMETER	NUMBER	TYPE	0.3m	SHEET 1 OF 1
(f1)(m)	(mGSD) DEPTH (m)	DESCRIPTION	STRAT.	PIEZOM	SAMPLE	SAMPLE	BLOWS/0.3m	NOTES
THE STATE OF THE S			A Company of the Comp		.04	The Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles of the Charles	The state of the s	DATE DRILLED 29 June 1979  TYPE OF RIG CME 75
	278.6	GROUND SURFACE	7757		CLA	<u> </u>		
	0.0	Yellowish brown loose			LLA 1	SS	6	DRILLING METHOD Hollow Stem Augers
-2		very fine sandy silt overlying brown clayey silt						DEPTH WATER FOUND 1.2  (m below ground surface)  STATIC WATER LEVEL 1.5 *
10 - 3	274.9			BACKFILL	2	SS	7	
15 - 5	3.7	Brown interlayered compact fine to medium and medium to coarse sand overlying brown gravelly medium to		E AND		SS	10	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 0.5 (m) TYPE OF PIEZOMETER Trow
20-6	271.7	coarse sand	0000	∰AS	4	SS	5	SAMPLE TYPE
25-8	6.9	Brown fine to coarse sandy fine to medium	0.00		5	SS		SS-SPLIT SPOON WA-WASH
30-9	269.0	gravel overlying fine to coarse sand near base	00.00		6	AU	4000 Edge	□ 277.1 Static Water Elevation (m GSD) (26 JUNE 1979) *
-10	0.6	End of Hole						‡ Piezometer
35 - 11			And Confession of the State of					
40 -12 -13								
45-					and the second s		parjone and party of the party	om MacLaren
150	The figure section of the first section of the firs						ACCOUNT TO THE PARTY OF THE PAR	MocLAREN ENGINEERS INC.
Michigan de la composito della	TE	ST HOLE RECORD			G.	M. F	•	PROJECT NO. 11602-5

#### **BOREHOLE NO. BH17 DECOMMISSIONING**

PAGE 1 of 1

PROJECT NAME: HOLBROOK LANDFILL PROJECT NO.: 111-53037-00 132-00

CLIENT: COUNTY OF OXFORD DATE COMPLETED: Jul 18, 2013

BOREHOLE TYPE: HOLLOW STEM AUGER SUPERVISOR: TJB

GROUND ELEVATION: 278.6 mASL REVIEWER: RFK

		ST			S	SAMPL	E		CONE PENETRATION	WATER	
DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	"N" VALUE 10 20 30	10 20 30	REMARKS
3.0 3.7 — 4.0	YELLOWISH BROWN LOOSE VERY FINE SANDY SILT OVERLYING BROWN CLAYEY SILT  BROWN INTERLAYERED COMPACT FINE TO MEDIUM AND MEDIUM TO COARSE SAND OVERLYING BROWN GRAVELLY MEDIUM TO COARSE SAND						*		STRENGTH	W <sub>P</sub> W <sub>L</sub>	STRATIGRAPHY INFERRED FROM ORIGINAL BOREHOLE LOG FOR BH17 (MacLaren Engineers Inc., 1979)  ORIGINAL BOREHOLE CAVET AND WAS BACKFILLED TO 6 DEPTH BEFORE WELL INSTALLATION.
6.9 — 8.0	BROWN FINE TO COARSE SANDY FINE TO MEDIUM GRAVEL OVERLYING FINE TO COARSE SAND NEAR BASE										
9.6 —	END OF ORIGINAL BOREHOLE										

			The second secon						71 A 1 10 1 27 4 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
			GEOLOGICAL LOG			Z.			TEST HOLE No. 18
				PLOT	<b>E</b>	NUMBER	TYPE	38	SHEET 1 OF 1
	SCALE	EL (mGSD)	DESCRIPTION		I EZOMETER			.0/SM0	
		DEPTH		STRAT	1626	SAMPLE	SAMPLE	BLOWS	NOTES
itt.	)(m)	(m)	T.H. 18B-	S	Q.,				10 13 14 0
			0.6 m T.H. 18C		Ľ	S 1	I. 1 86	8 9	DATE DRILLED 10,11,14 Sept 81
		280.0	GROUND SURFACE "	28.00	Ť	VT.	I. I .99	8 m	TYPE OF RIG CHE 55
		0.0	BROWN COMPACT SILTY V. FINE		П	BAC	ŒIJ	L	DRILLING
	-1		SAND						METHOD HOLLOW STEM AUGERS
5-	-2	0.00	(CLAYEY FROM 0 - 1.1 m;			1	SS		DEPTH WATER FOUND ~ 1.5
4	-	DOM:	MINOR CLAY & SOME F. GRAVEL AT 1.5 m) 277	∇.		BAC	ŒIJ	eI.	(m below ground surface) STATIC WATER LEVEL 2.6 *
10-	-3	276.0		23		2	SS	9	(m below ground surface)
*	-4	4.0	GREY V. LOOSE V.FINE - FINE			۵,	SS	o	PIPE DIAMETER 51,13(mm)
15-	- -5	274.8	SAND WITH SOME SILT	ā,	Ħ.		J	Ĭ	LENGTH OF PIEZOMETER 15 3 (m) TYPE OF PIEZOMETER SLOTTED
	-	5.2	GREY COMPACT C. SAND & F.	Ø 8					& FIBERGLASS WRAPPED
20-	-6 -		GRAVEL (SOME SILT - M. SAND	0 0 0		4.	SS	48	SAMPLE TYPE
4	-7		MATRIX & M. GRAVEL)	0:0	****				SS-SPLIT SPOON WA-WASH
25-	-8	-		9	Second Wees	5	SS	25	<sub>0</sub> 277.39 Static Water
4	-			@ () @ ()	Countries				Elevation (m GSD)
30-	-9 -		COARSE SANDY F. GRAVELLY MED. SAND AT 9.1 m	90	+	6	SS	11	(23 Sept 81) Piezometer
4	-10		( SOME V.F FINE SAND MATRIX & M. GRAVEL)	9.0	1				
35-	- -11	269.2	CATALON SE ELO CATALONIO		*	7	SS	29	T.H. Static Water No. Elevation
	-		1						(m GSD)
40	-12 -		DK. GREY COMPACT CLAYEY SILT (MINOR		a a a a a a a a a a a a a a a a a a a	8	SS	20	* 18 277.39 18A Blocked
	-13		V.F. SAND & OCCAS. C. SAND, F. GRAVEL)						18B 277.59 18C 276.10
45	- -14		INTERLAYERED WITH			9	SS	13	00 F V U 20 V
	-		<pre> &lt;5 mm LAYERS OF GREY  SILTY V. FINE SAND AT 13.5</pre>						
50-	-15 -		F MED. GRAVELLY CLAYEY SILT AT 15 m			10	SS	§2	Accession
	-16	263.7	Notation de la reconstruction de la reconstruction de la construction		CAVE				MERCHANISM
55-	17	16.3	•	50	రో	11	SS		THE PARTY OF THE P
			GREY V. DENSE SAND & GRAVEI	60		Charles and Charle			
60-	-18	quanticonocio	(BOTH VARIABLE IN SIZE FROM FINE - COARSE)			12	SS	100	
	-19	tion and a second	A SULL A SULLA SUL	000	ŧ		Westware		Application in the state of the
65-	-20		GREY C. SANDY F. GRAVELLY MED. SAND AT 16.8 m	000	Ŧ	The second secon			A. Company of the Com
	}	a quantitativa de la constanta	The succession of the state of	80°	ŧ	Total Control	post Stationard at	100000000000000000000000000000000000000	and the second s
70-	-21			000	Ĭ.	13	SS	59	
	-22	-		000	E	and the same of th	EDINESS CONTRACTOR	pieskaucosche	TO THE PARTY OF TH
75-	† -23	22.3	DK. GREY V. DENSE	Syldenceromery					DATE OF THE PROPERTY OF THE PR
Series and a serie	1		V. STONY SILT TILL (MINOR V. FINE SAND)	20000000000000000000000000000000000000	The state of the s	AND DESCRIPTION OF THE PERSON			· occupant
80-	-24		territor to E with DEMINI	epassing (SCS)		14	SS	50	•
	- - - - - - -		SOCIAL STATE OF THE STATE OF TH		- Commission of the Commission	National Control of the Control of t			
85-	]  -26	254.1		-		15	SS	150	Maclaren Maclaren
Description of the last of the	1	7 23.3	END OF DOLL	and the second		American control of the control of t	ononing and a second		Off MacLaren
90-	}-27					Name and Publishers	AND STREET, ST		uclared engreers planeds
	No from Language and Pag	TF	ST HOLE RECORD			0	. PA.	9	4 SCENTISTS NC 11602-5
<u></u> _					·		. 186.	B	PROJECT NO.

### LOG OF BOREHOLE 18 Decommissioning WSP



project | Holbrook Landfill Site

rig type | CME 75, track-mounted client | Oxford County date started | 2014/09/16

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Elevation Scale (mARD) Readings and Plot X Dynamic Cone Water Content (%) Comments 30 40 Number 1.0 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) ○ Unconfined + Field Vane

Pocket Penetrometer
40 80 120 160 Core PD Recovery 20 **GROUND SURFACE** GR SA SI CI Brown compact silty very fine sand (Clayey from 0 - 1.1 m, minor clay and some fine gravel at 1.5 m) 279 278 - 2 277 - 3 276 Grey very loose very fine - fine sand with some silt 275 - 5 274.6 Grey compact coarse sand and fine (some silt to medium sand matrix and medium gravel) **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH18 (MacLaren Engineers Inc., 1981). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 18R**



project | Holbrook Landfill Site

client | Oxford County

position |

location | Holbrook, ON

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/16

supervisor | MEQ

reviewer | AMS

posi	lion					oring   1	<i>"</i> a		. Teviewe	21	AIVIO	
Ê		SUBSURFACE PROFILE			SA	MPLE	<u>_0</u>	Penetration Test Values (Blows / 0.3m)		gs		Lab Data
Depth Scale (m)	Elev Depth (m)		Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mARD)	X Dynamic Cone 10 20 30 40  Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane	Water Content (%) & Plasticity  PL MC LL 10 20 30	PID Readings	Well Details	and Comments  GRAIN SIZE DISTRIBUTION (%) (MIT)
-0	-	Brown SILTY SAND, some organics	11.1			riecovery	<del> </del>	40 80 120 160	10 20 30			GR SA SI CI
-		Brown <b>SILTY SAND</b> , some organics, some fine sand, some fine to medium subrounded gravel, moist, loose.		. 1	SS	11						
			H									
-1 -				2	SS	16						
- - -2	1.5	Grey brown fine <b>SILTY SAND</b> , some fine to medium gravel, trace clay, moist, loose.		3	SS	8	_					
-				4	SS	25						
-3 -	3.3	Grey brown medium SAND AND	.00	5	SS	14	-					
-		Grey brown medium SAND AND GRAVEL, occassional subangular medium gravel, some silt, wet, compact.	0				-					
-4			. 0	6	SS	27	-					
-			. (				-					
- - -5		Clayey silt seam at 4.7 m depth.	000	7	SS	42						
-			00				1					
-			· ()	8	SS	25						
-6	L		) ()				1					
	6.1	END OF BOREHOLE										
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ary: ge												
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EL (mc50) DEPTH  (ft)(m) (n)				GEOLOGICAL LOG						TEST HOLE No. 19
274.7 GROUND SURFACE 91 m  274.7 GROUND SURFACE 91 m  3 CLAY  1 SS 24  BROWN COMPACT SL. CLAYEY SILT (SOME F. GRAVEL)  2 SS 13  4 SS 16  5 269.2  20 6 5.5 GREY COMPACT INTERLAYERED AND FINE FINE SAND CLAYEY SILT CONTAINS THIE FINE SAND  10 264.6  25 SS 29  26 CLAYEY SILT CONTAINS THIE FINE SAND  10 264.6  10 264.6  10 264.6  11 SS 24  SS 25 SS 29  10 SS 39  10 264.6  11 SS 25 SS 29  11 CREY DENSE INTERLAYERED SAND AND GRAVEL  13 SS 79 + Static Water TH. Elevation NO. (as GSD)  10 264.6  11 SS 28  11 CREY DENSE INTERLAYERED SAND AND GRAVEL  13 SS 76 +  STATIC WATER LEVEL  15 SS 29  10 SS 39  11 SS 43  12 SS 16  15 SS 29  10 SS 43  11 SS 43  12 SS 16  13 SS 76 +  14 SS 16 SAMPLE TYPE SAMPLE TYPE SAMPLE TYPE SAMPLE TYPE SAMPLE TYPE SAMPLE TYPE SS SS 19  275.55 Static Water TH. Elevation NO. (as GSD)  10 SS 43  11 SS 43  12 SS 28  10 SS 43  11 SS 43  12 SS 28  10 SS 43  11 SS 76 +  12 SS 28  13 SS 76 +  14 SS 137  15 SS 79  16 SS 20  25 SA 10 SS 25  25 SA 10 SS 25  26 SS 20 SS 25  27 SS 79 SS 28  10 SS 43  11 SS 76 SS 20  25 SA 10 SS 39  10 SS 43  11 SS 43  12 SS 25  13 SS 76 SS 20  25 SA 10 SS 25  25 SA 25 SA 25  26 SS 20 SS 25  27 SS 39  10 SS 43  11 SS 43  12 SS 25  13 SS 76 SS 20  25 SA 25  25 SA 25 SA 25  25 SA 25 SA 25  26 SA 25 SA 25  27 SS 79 SS 28  28 SA 28 SA 28  28 SA 28 SA 28  29 SS 28 SA 28  20 SA 28 SA 28  20 SA 28 SA 28  20 SA 28 SA 28  20 SA 28 SA 28  20 SA 28 SA 28  21 SA 28 SA 28  22 SA 29  23 SA 16 SA 28 SA	аботальноская пределенного	ᄪ	EL		PLOT	6E 64 64	NUMBER	TYPE	. 3m	SHEET OF
0.94 m	destroy		DEPTH	DESCRIPTION	STRAT.	PIEZOM	SAMPLE	SAMPLE	BLOWS/C	NOTES
274.7 GROUND SURFACE STATE CLAYEY SILT (SOME F. GRAVEL)  BROWN COMPACT SL. CLAYEY 1 SS 24  BROWN COMPACT SL. CLAYEY 1 SS 24  BRANTILL IN METHOD BOLLOW STEM ARRESTS  10 -3 SILT (SOME F. GRAVEL)  2 SS 13 SC 14  GREY COMPACT INTERLATERED LAND STATE WATER FOUNDA S.5. (In below ground surface) STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE CHAYEY SILT E SILTY V. FIRE SAND CLAYEY SILT E SILTY V. FIRE SAND CLAYEY SILT (MINOR SAND)  3 SS 14  4 SS 16  5 GREY CENEY COMPACT INTERLATERED LAND STATE WATER STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER LEVEL. OF THE STATE WATER STATE WATER STATE WATER LEVEL. OF THE STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER LEVEL. OF THE STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER STATE WATER LEVEL. OF THE STATE WATER STATE				0.94 m T.H.195	\					DATE DRILLED 14 - 16 Sept 81  TYPE OF RIG CME 55
S	-	<u> </u>	The second second	GROUND SURFACE 91 M		4	777			
BROWE COMPACT SIL CLAVEY   SANTE		-1	0.0		PRODUCTION OF THE PROPERTY OF		CI	T		METHOD BOLLOW STEM
2   SS   13   (a below ground surface)   CRAVEL   CRAVEL   Fire DIAMETER 51.13   (m)   Fire Short   CRAVEL   Fire Short   Fire Shor	5	8 1								DEPTH WATER FOUND \$2.5
15 - 5 269.2	10-	-3					2	SS	13	STATIC WATER LEVEL +0.85 * (m below ground surface)
269.2  20	15-	4								PIPE DIAMETER 51.13(mm) LENGTH OF PIEZOMETER1.5,1.6 m
CREY COMPACT INTERLATERED   CLAYEY SILT & SILTY V. FINE   CLAYEY SILT & SILTY V. FINE   CLAYEY SILT & CONTAINS STEIN   CLAYEY SILT (CONTAINS STEIN   CLAYEY SILT (CHAYEY SILT (MINOR SAND)   CLAYEY SILT (MINOR SAND)   CLAYEY SILT (MINOR SAND)   CLAYEY SILT (MINOR SAND)   CLAYEY SILT (MINOR SAND)   Piezometer   Clayer Silty V. Fine Sand Clayer   Clayer Silty V. Fine Sand (Some Clayer Silty V. Fine Sand (Some Clayer Silty V. Fine Sand (Some Clayer Silty V. Fine Sand (Some Clayer Silty V. Silty V. Fine Sand (Some Clayer Silty V. Silty V. Fine Sand (Some Clayer Silty V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand (Some Clayer V. Silty V. Fine Sand AT 23 m)   Some Clayer V. Silty V. Fine										TYPE OF PIEZOMETER SINTTED
25 - 8	20-				222	And and an analysis of the second	4	SS	16	
266. 2 LAYERS OF SILTY V.FINE SAND (23 Sept 81)  8.5 GREY DENSE V.F. GRAVELLY (23 Sept 81)  10.1 264.6  10.1 35-11  11	25-			(CLAYEY SILT CONTAINS THIN	•••	N.	5	SS	29	WA-WASH
10   264.6   10.1	20	-		GREY DENSE V.F. GRAVELLY					30	Elevation (m GSD) (23 Sept 81)
GREY DENSE INTERLAYERED SAND AND GRAVEL THE ELevation NO. (m GSD)  **19	30	  -10		CLAYEY SILT (MINOR SAND)	0		-	SS T	39	Piezometer
AND GRAVEL  13 AND GRAVEL  AND GRAVEL  13 AND GRAVEL  145 -14  (GENERALLY F. GRAVELLY MED. & COARSE SAND, F MED. GRAVEL)  9 SS 28  10 SS 43  11 SS 43  11 SS 43  12 SS 25  13 SS 76 +  14 SS 137  15 SS 181  16 SS 48  19 275.55  19 275.65+ 10 275.65+ 10	35-	-	10.1	GREY DENSK	760 960 90	\$000000	7	SS	79	
13	40-	-12				Ī	8	SS	48	estaboling group in union on the construction and t
15	45					en dissilieramente en en				19A 275.65+
50   -16   55   -17   257.0   10   SS   43   43   43   43   43   43   44   45   45	70	-14 -		MED. & COARSE SAND,						
55-17 257.0	50-	-				0.000 percentation of the contraction of the contra	9	SS	28	
17.7 GREY COMPACT TO DENSE V. SILTY V. FINE SAND (SOME CLAYEY SILT INTERBEDS)  11 SS 43  12 SS 25  12 SS 25  13 SS 76 +  14 SS 137  15 SS 181  160  170  180  190  100  100  110  110  111  110  111  110  111  110	55-	-	257 (		0.00		10	ss	43	
19	60-	-18	-		\$Q	2000000	ш	SS	43	
70-21 20.7 DK. GREY V. DENSE V. STONY SILT TILL 13 SS 76 +  75-23 (LAYER OF GREY V. SILTY V. FINE SAND AT 23 m) 14 SS 1.37  80-24 250.0 15 SS 1.81		1	SECTION AND ADDRESS OF THE PROPERTY OF THE PRO	(SOME CLAYEY SILT		E	12	SS	25	
70-1 DK. GREY V. DENSE V. STONY SILT TILL  75-23 (LAYER OF GREY V. SILTY V. FINE SAND AT 23 m)  13 SS 76 +  14 SS 1.37  15 SS 1.81  25 24 J END OF HOLE	65		254.0	-		Car				
75 -23	70-	+	OTTO SERVICE S				13	SS	76	+
250.0   15 SS 181   25 24.3 END OF HOLE	75-	1		-			14	SS	137	
-25 24 7 END OF HOLE	80-	24	g - 1				15	SS	181	
85-1-26 OIII Maclar	G. G. T. G. G. G. G. G. G. G. G. G. G. G. G. G.	1	24.3							
	85							1		O[[] [Maclaren
	90						and the second			wal, aren enst-eers P, anners 8 stentists mit

### LOG OF BOREHOLE 19 Decommissioning WSP



project | Holbrook Landfill Site

SUBSURFACE PROFILE

date started | client | Oxford County rig type | CME 75, track-mounted 2014/09/26

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. reviewer | project no. | 111-53037-00 132-00 AMS coring | n/a

SAMPLE

supervisor | MEQ

Penetration Test Values (Blows / 0.3m) Readings Lab Data Elevation Scale (mARD) and Plot X Dynamic Cone Water Content (%) Comments 10 30 40 Number 20 N-Value & Plasticity Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) ○ Unconfined + Field Vane

Pocket Penetrometer
40 80 120 160 PID Core Recovery 20 **GROUND SURFACE** GR SA SI CI Brown compact sl. clayey silt (some fine gravel) 274 273 - 2 272 - 3 271 270 - 5 269.8 **END OF BOREHOLE** Stratigraphy inferred from original borehole log for BH19 (MacLaren Engineers Inc., 1981). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

### **LOG OF BOREHOLE 19R**



project | Holbrook Landfill Site

client | Oxford County

location | Holbrook, ON

position |

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/26

supervisor | SCL

reviewer | AMS

posii	lion	•			C	oring   r	1/a		reviewe	er	AIVIS	
ê		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		S		Lab Data
Depth Scale (m)	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value	Elevation Scale (mARD)	X Dynamic Cone     1,0	Water Content (%) & Plasticity	PID Readings	Well Details	and Comments
Dept	(m)		Grap	₹	_	Core Recovery	Eleva	O Unconfined	PL MC LL 10 20 30	PID		GRAIN SIZE DISTRIBUTION (%) (MIT)
-0 -		GROUND SURFACE  Dark brown SILTY SAND TO SANDY SILT, trace to some organics and rootlets, trace clay, moist, loose.	)	1	SS	6		40 80 120 160	10 20 30			GR SA SI CL
- - -1 -	0.8	Orangey brown to grey brown <b>CLAYEY SILT</b> , trace to some fine gravel, trace cobble, APL, stiff.		2	SS	9						
-2		Becoming grey below 2 m depth.		3	SS							
- - - -3				4	SS	13	-					
- - -				5	SS	15	-					
- 4 -				6	SS	14	-					
- - -5	5.2			7	SS	17						
		END OF BOREHOLE										
library: genivar - library.glb report: gen log vf file: bhlogs.gpj												
brary.glb <b>report:</b> gen l												
<b>library:</b> genivar - lit												

		GEOLOGICAL LOG				A CONTRACTOR OF THE CONTRACTOR		TEST HOLE No. 21
SCALE	£ L	· :	PL07	TER.	NUMBER	TYPE		SHEET <u>1</u> OF <u>1</u>
(ft)(m)	(mGSD) DEPTH	DESCRIPTION	STRAT.	PIEZOMETER,	SAMPLE	SAMPLE	BLOWS/0.3m	NOTES
5-2	277.5	GROUND SURFACE  BROWN SL. CLAYEY SILT (GRAVELLY FROM 2 - 6 m) OVERLYING GREY COMPACT INTERLAYERED CLAYEY SILT (OCCAS. GRAVEL) & SILTY			CL	KFI		DATE DRILLED 13 - 16 Oct./81  TYPE OF RIG CME 55  DRILLING METHOD Hollow Stem Augers, Casing  DEPTH WATER FOUND 2.4 (m below ground surface) STATIC WATER LEVEL 1.3
15- -5 206		V. FINE SAND OF VARIABLE THICKNESS	0 0 0	Transcrucco estamologica estamo		SS	22	(m below ground surface)  PIPE DIAMETER 51 (mm)  LENGTH OF PIEZOMETER 1.2 (m)  TYPE OF PIEZOMETER SLOTTED  AND FIBREGLASS WRAPPED  SAMPLE TYPE  SS-SPLIT SPOON WA-WASH
30-9		(SILTY V.FINE TO FINE	000		2	SS		Static Water 276.22 Elevation (m GSD) (26 Oct./81) Piezometer
35-11	265.0	SAND WITH SOME MED. SAND AT 10.7 & 12.2 m)	000	CAVE	3	SS	7	
-13 45 -14	12.5 264.1 13.4	GREY DENSE V. GRAVELLY CLAYEY SILT GREY DENSE GRANULAR MED COARSE SAND OVERLYING F	0,0,0		5	SS	44	
50-15		MED. SANDY GRAVEL WHICH CONTAINS SOME SILT & V.F. SAND		<b>Managar</b>	шений денний систем в тимором поставлений в принага поставлений п			
55-17	260.3 17.2	END OF HOLE			6	SS	66	
65-20	Avera to reproduce the second				одилија да обораз од предостава од од од од од од од од од од од од од			Om MacLaren
70 <sup>]-21</sup>			MocLaren Engineers Planners & Scientists Inc					
	TE	ST HOLE RECORD			G.	M.I	•	PROJECT NO. 11602-5

# LOG OF BOREHOLE 21 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/20

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)				w		Lab Data
Depth Scale (m)			tol	İ, I		SPT	Elevation Scale (mARD)	X Dynamic Cone	_	Water Cor	ntent (%)	PID Readings	= = =	and Comments
Sca	Elev Depth	STRATIGRAPHY	li P	Number	Туре	N-Value	tion (	10 20 30 Undrained Shear Strength (kPa	40 a)	. & Plas	ticity	Read	Well Details	
Depti	(m)	S. MATIGINA III	Graphic Plot	Ŋ	ŕ	Core	Eleva (n	O Unconfined + Fig ● Pocket Penetrometer ■ La	eld Vane ib Vane	PL MC	: ц. <b>——</b>			GRAIN SIZE DISTRIBUTION (%) (MIT)
-0	277.8	GROUND SURFACE	U	Ш		Recovery	ш	40 80 120 1	160	10 20	30	-		GR SA SI CL
		Brown clayey silt (gravelly from 2 - 6 m) overlying grey compact interlayered clayey silt (occassional gravel) & silty very fine sand of variable thickness		1			-							
		clayey silt (occassional gravel) & silty	W				277 -							
<del>-</del> 1		voly into saila si vallasio illioliticos	И	1			-							
ŀ			M				276 –							
-2			W	1										
ŀ			11											
-3			1/1				275 –							
-			M	1			=							
-4			[4]				274 –							
'			14	1			-							
			K				273 -							
-5			И	1			_							
<b> </b>			$\mathcal{M}$				272 -							
-6			W.	1										
-			11	1			_							
-7			121	1			271 –							
-			11	1			-							
-8			/	1			270 –							
Ľ			11	1			-	-						
			$ \mathcal{I} $				269 -							
-9			W	1			_							
ŀ			$ \mathcal{U} $	1			268							
- 10				1										
ŀ		(Silty very fine to fine sand with some		1										
-11		(Silty very fine to fine sand with some medium sand at 10.7 & 12.2 m)	И	1			267 -							
-			M				=							
- 12			121	1			266 -							
	265.3		11	]			-	-						
[	12.5	Grey dense very gravelly clayey silt	M	1			265 -							
- 13	264.4			1			_							
1	13.4	Grey dense granular medium to coarse sand overlying fine to medium sandy					264							
- 14		gravel which contains some silt & very												
i <u>d</u>		fine sand												
— 15							263 -							
- sbo	262.3 15.5						-							
e: ph	15.5	END OF BOREHOLE												
≥ E		Stratigraphy inferred from original												
en log		borehole log for BH21 (MacLaren Engineers Inc., 1981).												
ort: g														
b rep		Monitoring well decommissioned by overdrilling to full borehole depth and												
rary.g		sealing with bentonite.												
library: genivar - library.gib report: gen log v1 file: bhlogs - decom.gpl														
geniva														
rary:														
≝∟														Ch+N · ·
														Sheet No. 1 of 1

### **LOG OF BOREHOLE 21R**



project | Holbrook Landfill Site

client | Oxford County

location | Holbrook, ON

position |

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-00 132-00

date started | 2014/09/29

supervisor | SCL

reviewer | AMS

Ē			SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)			S		Lab Data
Depth Scale (m)	, [	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Туре	SPT N-Value	Elevation Scale (mARD)	× Dynamic Cone 1,0 2,0 3,0 4,0 Undrained Shear Strength (kPa)		Water Content (%) & Plasticity	Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%)
		(m)	GROUND SURFACE	Grap	ž		Core Recovery	Elev	O Unconfined + Field Pocket Penetrometer ■ Lab 40 80 120 16	Vane	PL MC LL 10 20 30	PID		DISTRIBUTION (%) (MIT) GR SA SI CL
-0 -	Ī		Dark orangey brown <b>SILTY SAND</b> , trace rootlets, trace gravel, moist, loose to compact.		1	SS	8							an on or
-1			·		2	SS	33							
-2		1.5	Orangey brown <b>SANDY SILT</b> , some thin interlayered red brown fine to medium sand, trace clay, APL becoming WTPL,		3	SS	10							
-3			firm to stiff.		4	SS	7							
-	F	3.4	Orangey brown fine to coarse SILTY SAND AND GRAVEL, saturated,	.0	5	SS	14							
-4			compact to dense.	, o	6	SS	16							
-5				00	7	SS	31							
- -6				· ()	8	SS	18							
- -7				0,00	9	SS	27							SS10 - no sample
F'			Becoming siltier below 7.5 m depth.	. (	10	SS								due to cobble/boulder
-8				, 0	11	SS	12							
- -9		8.2	Grey <b>CLAYEY SILT</b> , some fine rounded and subangular gravel, some fine sand, WTPL, stiff to very stiff.		12	SS	25							
-					13	SS	17							
- 10 -					14	SS	24							
-11		10.7	Grey <b>SANDY SILT</b> with interlayered compact grey fine to coarse sand, trace clay, saturated, compact.		15	SS	22							
- 12			,		16	SS	26							
- - 13		12.2	Grey <b>SANDY GRAVEL</b> , fine to medium gravel, saturated, dense to very loose.	. (	17	SS	47			7				
ŀ				, O	18	SS	43			/				
):sbolld :-				, o	19	SS	31							
₩ - 15				.0	20	SS	58			>				
Ilbrary: genivar - library.glb report: gen log v1 file: bhlogs.gpj		15.5		,0	21	SS	32							
library.glb		16.0	END OF BOREHOLE											
genivar -														
library:														Shoot No. 1 of 1

		GEOLOGICAL LOG			atel I John Store				TEST HOLE No. 23
				5	<b>a</b>	NUMBER	TYPE	3	SHEET 1 OF 1
(ft)(m)	EL (mGSD) DEPTH (m)	· ·	STRAT	e andres	PIEZOMETER	SAMPLE NU	SAMPLE TY	BLOWS/0.3	NOTES
				0					DATE DRILLED 22,23 Oct /81
	278.4	GROUND SURFACE			1	12	m		TYPE OF RIG CME 55
Ĺ	0.0		0.0		Ē	CL	ΆĀ		DRILLING METHODHOLLOW STEM AUGERS
5-2		GREY COARSE SAND AND GRAVEL	000	90000 o					DEPTH WATER FOUND (m below ground surface)
10 - 3			0.0	2007		1	SS	28	STATIC WATER LEVEL +0.2 (m below ground surface)
15-5		(SOME SILT AND FINE SAND)	\$ 000 000 000 000 000 000 000 000 000 0					okoczak food supraciana do propinski	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 2.1 (m) TYPE OF PIEZOMETER SLOTTED AND NYLON SCREEN WRAPPED
20-6						2	SS	39	SAMPLE TYPE
-7 25-			000						SS-SPLIT SPOON WA-WASH
30-9	269.0		0000			3	SS	20	278.66 ∇ Static Water Elevation (m GSD) (26 Oct √81)
35-	9.4	GREY COMPACT CLAYEY SILT				4	SS	26	Piezometer
						3	W L.	20	
40-12		GREY V. DENSE GRAVELLY				5	SS	187	+
45-14		CLAYEY SILT			E	6	SS	166	
50-15					CAVE	7	SS	204	Control of the Contro
16			The same of the sa		Photosocopological	ACCUPATION OF THE PROPERTY OF		8.5000 September 1995	Children
35 -17	260.7		CONTRACTOR OF THE PROPERTY OF		WINTERPRESENTATION	8	SS	63	The state of the s
-18 60- -19	17.7	GREY COARSE SANDY GRAVEL	8808		200000000000000000000000000000000000000	9	SS	190	
65-20	257.7		08080						O))) MacLaren
70 <sup>2</sup> 1	20.7	END OF HOLE	244						MacLaren Engineers Planners & Scientists Ing
	TE	ST HOLE RECORD	M.I		PROJECT NO. 11602-5				

# LOG OF BOREHOLE 23 Decommissioning WSP



project | Holbrook Landfill Site

date started | 2015/07/09 client | Oxford County rig type | Acker Soil-Max, track-mounted

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ coring | n/a project no. | 111-53037-00 132-02 AMS reviewer |

Schedule   Schedule	Ē		SUBSURFACE PROFILE			SA	MPLE	_	Penetration (Blows / 0.3	Test	Values						S		Lab Data
- 40 50 120 160 10 20 30 10 cm at a 1.0.  - 40 50 120 160 10 20 30 10 cm at a 1.0.  - 41	le (r			lot			SPT	scale	× Dynamic	Cone			Wate	er Co	ntent (	%)	ding	= =	and
- 40 50 120 160 10 20 30 10 cm at a 1.0.  - 40 50 120 160 10 20 30 10 cm at a 1.0.  - 41	Sca	Elev	CTRATICRADUV	S.	per	be	N-Value	ion 9					8	& Plas	sticity	,	Зеас	We Jeta	
- 40 ag 120 190 30 30	ptth	Depth (m)	STRATIGRAPHY	ihdr	l m	Typ	Core	evati (m,	O Uncont	ined		+ Field Vane	PL	М	Ç L		D F		GRAIN SIZE DISTRIBUTION (%)
Clay coanse and and gravel (some alt and fine sand)  278  3		1	GROUND SURFACE	ğ			Recovery	ă		Penel	trometer 12	Lab Vane 160	10	2	0 3	<b>1</b> 0	F		(MIT) GR SA SI CL
and fine sand)  - 2	-0		Grey coarse sand and gravel (some silt	٥															
277 -3	ŀ		and fine sand)					_											
277 -3	-1			0				278 —											
-2   277   276   -2   276   -2   -2   -2   -2   -2   -2   -2   -	ŀ							-											
276 -6 -6 -7 -7 -8 -8 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9	-2			D				277 —											
-4 -5 -5 -6 -7 -7 -7 -8 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9	-			, O				-											
- 4 - 5 - 6 - 7 - 7 - 8 - 9 - 2015 - 10 - 10 - 11 - 12 - 12 - 13 - 13 - 14 - 15 - 16 - 17 - 17 - 18 - 17 - 18 - 17 - 18 - 17 - 18 - 17 - 18 - 18 - 18 - 18 - 18 - 18 - 18 - 18	-3			. 0				276 —											
277	L			0				_											
273 - 273 - 273 - 273 - 273 - 275 -	L			Ιν				275											
274 - 273 - 273 - 273 - 273 - 273 - 274 - 275 -	1			1				_											
- 6 - 7 - 7 - 8 - 8 - 9 - 265 10 - 11 - 12 - 12 - 13 - 13 - 14 - 15 - 16 - 17 - 17 - 18 - 17 - 17 - 18 - 17 - 17 - 18 - 17 - 18 - 17 - 18 - 17 - 18 - 17 - 18 - 18 - 18 - 18 - 18 - 18 - 18 - 18				0				274											
- 6	<b>-</b> 5			. 0				2/4-											
277 - 277 -	ŀ			0				_											
272	-6			P				273 —											
20	ŀ			D				-											
- 8   271   270	-7			0				272 —											
288 5 3-8 Grey compacy clayey slit 299 -11 287.4 -12 -13 Grey very dense gravelly clayey slit 28713 -14 -15 -16 -17 -18 -17 -18 -19 -19 -20 -20 -20 -20 -20 -20 -20 -20 -20 -20	-			. 0				-											
- 9 298.5	-8			0				271 —											
200.5   9.	-			Ιν				-											
289.5   9.4   Grey compacy clayey slit   269   268   267   4   11.5   Grey very dense gravelly clayey slit   267   266   265	<b>-</b> 9			)				270 -											
10   269   Company daylysist   269   268   268   268   267   267   266	ľ	269.5		0				_											
11 267.4 -12 11.5 Grey very dense gravelly clayey slit 26713 26614 26515 26416 26317 261218 17.7 Grey coarse sandy gravel 26119 261.2 -19 26220 255.5 20.4  END OF BOREHOLE  Stratigraphy Inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981).  Monotring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.	L <sub>10</sub>	3.4	Grey compacy clayey silt	W				269											
287.4 11.5 Grey very dense gravelly clayey silt 266 – 13 266 – 14 265 – 15 264 – 16 263 – 17 Grey coarse sandy gravel 261 – 262 – 262 – 263 – 264 – 265 – 269 – 260 – 26	Γ''			W				_											
287.4 11.5 Grey very dense gravelly clayey silt 266 – 13 266 – 14 265 – 15 264 – 16 263 – 17 Grey coarse sandy gravel 261 – 262 – 262 – 263 – 264 – 265 – 269 – 260 – 26	Ĭ			W				000											
11.5 Grey very dense gravelly clayey slit  266 -  16	F-11	267.4		И				268 -											
- 13 - 14 - 14 - 15 - 16 - 17 - 18 - 17 - 18 - 17 - 18 - 17 - 17 - 18 - 19 - 261 - 262 - 263 - 2	ŀ	11.5	Grev very dense gravelly clavey silt					_											
265 –  16	- 12		arely tery derive gravery staye, em	1/				267 —											
265 –  16	ŀ							-											
264 –  16	- 13			1//				266 —											
264 –  16	-			//				-											
264 – 16 16 17.7 Grey coarse sandy gravel 261 – 19 283.5 20.4 END OF BOREHOLE Stratigraphy inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981). Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.	- 14			//				265 —											
263 - 263 -	1			1/				_											
263 - 263 -	_15			1/				264											
261 2  18  17.7 Grey coarse sandy gravel  261 2  260 2  258.5  20.4  END OF BOREHOLE  Stratigraphy inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.	'			//				_											
261 2  18  17.7 Grey coarse sandy gravel  261 2  260 2  258.5  20.4  END OF BOREHOLE  Stratigraphy inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.	Ī.,			1/				262											
261.2 17.7 Grey coarse sandy gravel 261  261  260  258.5  20.4  END OF BOREHOLE  Stratigraphy inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.	16			1/				263											
261.2 17.7 Grey coarse sandy gravel 261  261  260  258.5  20.4  END OF BOREHOLE  Stratigraphy inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.	ŀ			11															
				//				262 —											
	m.gpj	261.2		//				-											
	18	17.7	Grey coarse sandy gravel	V				261 —											
	- sg			D				-											
	- 19			0 0				260 —											
	₽							-											
	5 - 20			0				259 —											
	gen	258.5		0															
	port:	۷.4	END OF BOREHOLE																
	р 2																		
	ary.gl		borehole log for BH23 (MacLaren																
	-libr		Engineers Inc., 1981).																
	nivar		Monitoring well decommissioned by																
	y: ge		overdrilling to full borehole depth and																
	brar		scaling with belitting.																
Sheet No. 1 ht 1																			Sheet No. 1 of 1

		GEOLOGICAL LOG	e e e e e e e e e e e e e e e e e e e		8			TEST HOLE No. 24
SCALE	EL		15074	ZOMETER	NUMBER	TYPE	0.3m	SHEET 1 OF 1
(ft)(m)	(mGSD) DEPTH (m)	DESCRIPTION	STRAT	PIEZON	SAMPLE	SAMPLE	9Lows/	NOTES
								DATE DRILLED 11 Feb./82
	279.2	GROUND SURFACE		I	0.5	6 m		TYPE OF RIG CME 75
52	0.0	Brown compact fine to coarse sand with trace gravel	Section and the section of the secti		7 2		20	DRILLING  METHOD Hollow Stem Augers  DEPTH WATER FOUND ~1  (m below ground surface)  STATIC WATER LEVEL 4.0
10-3	275.3	,						(m below ground surface)
15-	3.9				3	SS	9	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 1 (m) TYPE OF PIEZOMETER Slotted ABS pipe and Nitex nylon screen
20		Brown clayey silt; some fine to coarse sand layers several	SECTION SECTIO		4	SS	7	WTAPPED SAMPLE TYPE
-7 25- -8		centimeters thick; trace gravel		DALEGE STATEMENT OF STATEMENT O	5	SS	18	SS - SPLIT SPOON WA-WASH
30-9		≈ 8.0 - 8.5 m = fine silty sand with trace gravel		STEELS OF THE ST	6	SS	9	275.97Static Water Elevation (m GSD) (18 February 1982)
-10 35 - 11				er Constant (Commission (Constant)	7	SS	15	₹ Piezometer
40 -12				dacebose year of employer configurations and the configuration of the co	8	SS	32	
-13	266.0	all participation on the control of		CONTRACTOR OF				
45 14	264.6	Brown loose fine sand ?		CONTRACTOR CONTRACTOR	9	SS	6	
50 -16	263.0	Brown interlayered fine sand and clay	0.		10	ss	103	
55 17	16.2	Brown silt with fine sand layers (trace	Control Contro	CONTRACTOR AND PROPERTY (COLUMN TO SECULIARIES)	11	ss	49	
-18 60 -19	260.0	of gravel appears near contact with gravel layer)	THE RESIDENCE OF THE PARTY OF T		12	SS	70	
65-20	19.2	Dense sandy gravel (sand generally	000	88860000000000000000000000000000000000	13	SS	52	
70		medium to coarse grained)	000		14	ss	37	Om Maclaren
122			95		STEELES STEELE			Maclaren
7523	256.3	END OF HOLE	19.8 19.8					Moclaren Engineers, planners & Scientists
COMPANY	TF	ST HOLF RECORD	e) ADDRESS STATEMENT	Ter-	में ।	2		11602-5

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# LOG OF BOREHOLE 24 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/13

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

$\widehat{}$		SUBSURFACE PROFILE			SA	MPLE		Penetration (Blows / 0.3n	est Value	es						<b>(</b> 0		Lab Data
Depth Scale (m)			ŏ			SPT	Elevation Scale (mARD)	× Dynamic	Oone		_	Wat	er Co	ntent (	%)	PID Readings	_ <u>s</u>	and
Scal	Elev Depth	CTD 4 TIOD 4 DUV	Graphic Plot	Number	e De	N-Value	on S ARD	1 <sub>,</sub> 0 Undrained S			0		& Pla	sticity	,	leac	Well Details	Comments
t tde	(m)	STRATIGRAPHY	aphi	l m	Туре	Core	evati (m,	O Unconfir	ed	+ Field	d Vane	PL	М	Э Ц		D		GRAIN SIZE DISTRIBUTION (%) (MIT)
	279.7	GROUND SURFACE	ğ	-		Recovery	ă	Pocket F		er <b>■</b> Lab 120 16		10	2	) 3	0	┛		(MIT) GR SA SI CL
-0		Brown compact fine to coarse sand with					-											
ľ		trace gravei					279 —											
<del>-</del> 1							_											
ŀ							278 —											
-2							_											
ŀ							277 —											
-3							_											
ŀ	275.8						276 —											
-4	3.9	Brown clayey silt; some fine to coarse sand layers several centimeters thick;	И															
-		sand layers several centimeters thick; trace gravel	11	1			275 —											
-5		liace graver																
ŀ			W	1			274 —											
-6			W	$\mid \cdot \mid$			2/4											
ŀ			И	1			070											
-7				1			273 —											
-			1/1															
-8		O.O. O.E. was fine alltwood with trace	M	1			272 —											
1		~8.0 - 8.5 m = fine silty sand with trace gravel	H	$  \cdot  $			-											
<b>-</b> 9			ИI	1			271 —											
Ľ			11)	1			-											
- 10			1/1	1			270 —											
[ 10			W	1			-											
			W	$\mid \cdot \mid$			269 —											
-11			И	1			-											
Ī				1			268 —											
- 12			1/1	1			_											
ŀ			M	1			267 —											
- 13	266.5 13.2		Ш				_											
ŀ	13.2	Brown loose fine sand					266											
- 14							_											
ŀ	265.1 14.6		17				265 —											
- 15	14.0	Brown interlayered fine sand and clay	1/	1			203											
-			1/				264 —											
- 16	263.5 16.2			1			264 —											
ŀ	16.2	Brown silt with fine sand layers (trace of	Ш	]			-											
- 17		gravel appears near contact with gravel layer)					263 —											
idb-		•		.			_											
E - 18							262											
S - O							-											
50   19	260.5						261 —											
ijĹ	19.2	Dense sandy gravel (sand generally	l'U				-											
5 – 20		medium to coarse grained)	. C				260 -											
gen k	259.3		0	] [			-											
i.	20.4	END OF BOREHOLE																
o re																		
ary.gll		Stratigraphy inferred from original borehole log for BH24 (MacLaren																
- libra		Engineers Inc., 1982).																
nivar		Monitoring well decommissioned by																
ry: ge		overdrilling to full borehole depth and sealing with bentonite.																
Ilbrary: genivar - ilbrary: gb report: gen log vf file: bhlogs - decom.gpi		g somormo.																
_																		Sheet No. 1 of 1

### **LOG OF BOREHOLE 24R**



project | Holbrook Landfill Site

rig type | ACKER SOIL-MAX, track-mounted client | Oxford County date started | 2015/07/14

Iocation | Holbrook, Oxford County method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02

coring | n/a AMS reviewer |

Ê		SUBSURFACE PROFILE			SA	MPLE	. 0	enetration Test Values ows / 0.3m) Sp Lab Da	
Depth Scale (m)	Elev Depti (m)		Graphic Plot	Number	Туре	SPT N-Value Core Recovery	Elevation Scale (mASL)	× Dynamic Cone 10 20 30 40  Idrained Shear Strength (kPa) ○ Unconfined	ents N SIZE JTION (%) IT)
-0		GROUND SURFACE  Brown fine to medium SILTY SAND, some fine gravel, trace organics, moist, compact.		1	SS	12	_	40 00 120 100 10 20 30   GR S.	SA SI CL
-1		Black clayey organic peat layer at 1.2 m depth.		2	SS	10			
-2	1.4	Grey fine to medium <b>SAND</b> , some silt, trace fine gravel, wet, compact.		3	SS	11			
-				4	SS	9			
-3 -				5	SS	15			
-4				6	SS	14			
- -5	4.9	Grey CLAYEY SILT, trace fine sand, APL to WTPL, stiff.	7	7	SS	24			
-6				8	SS	11			
				9	SS	11			
<b>-</b> 7				10	SS	12			
-8		Fine gravel seams at 7.6 m depth.		11	SS	11			
- -9				12	SS	18			
file: bhlogs.gpj	9.1	Grey SILTY SAND, trace clay, wet, compact.		13	SS	16			
eport: gen log vi	9.9	Grey CLAYEY SILT, trace medium sand, trace fine gravel, APL to WTPL, very stiff.		14	SS	16			
library: genivar - library.glb report: gen log v1 file: bhlogs.gpj				15	SS	18			
library: geni		(continued next page)		16	SS	26		Sheet N	la 1 a 6 0

#### **LOG OF BOREHOLE 24R**



project | Holbrook Landfill Site

client | Oxford County

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

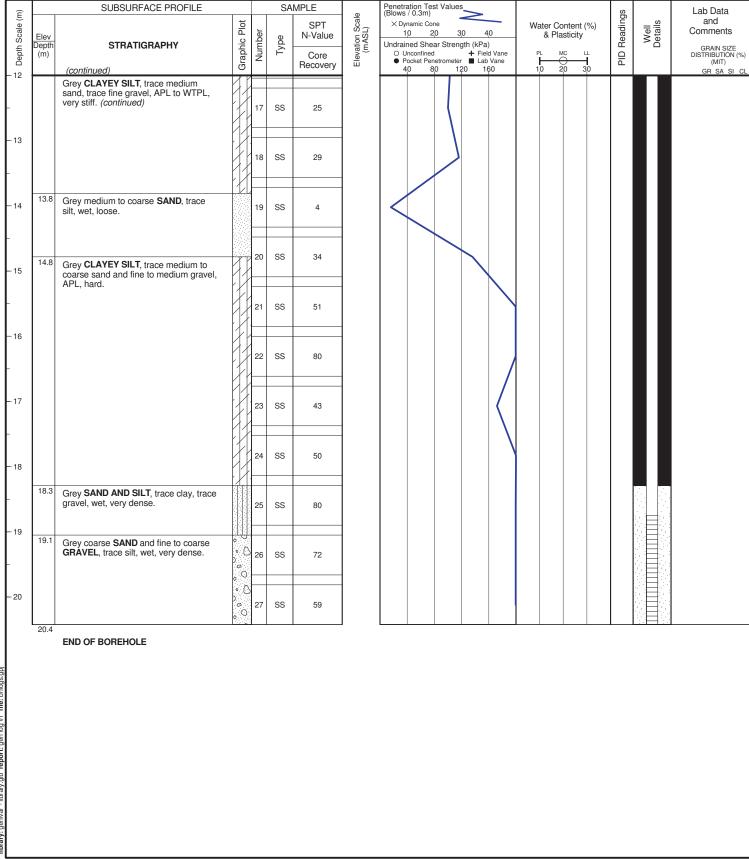
date started |

2015/07/14

method | Hollow stem augers, 215 mm dia.

supervisor | MEQ

project no. 111-53037-00 132-02 coring | n/a reviewer | **AMS** 



				powerson orbidal M				
	- Secretary of the control of the co	GEOLOGICAL LOG			2			TEST HOLE No. 24A
SCALE	EL ( <u>mGSD</u> ) DEPTH	DESCRIPTION	STRAT. PLOT	PIEZOMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	NOTES
ft)(m)	(m)		STR	9	SAN	SAN	8	
	279.2	ground surface	ACTIVITY OF THE PROPERTY OF TH		- C	3 m		TYPE OF RIG CME 75
10-3 10-3 10-3 15-5 20-6 7 25-8 30-9 -10 35-11 40-12		Fine coarse brown sand with some gravel  Brown clayey silt with trace of gravel END OF HOLE		#####				DEPTH WATER FOUND 1 (m below ground surface) STATIC WATER LEVEL 0.5 (m below ground surface)  PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 1 (m) TYPE OF PIEZOMETER Slotted AE pipe and Nitex nylon screen Wrapped SAMPLE TYPE  SS-SPLIT SPOON WA-WASH  278.73Static Water Elevation (m GSD) (18 February 1982)  Piezometer  MacLaren Engineers, PLANNERS a scientists
9 10	TE	ST HOLE RECORD			Е.Н.	R.	L	PROJECT NO. 11602-5

# LOG OF BOREHOLE 24A Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/13

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-02coring | n/areviewer | AMS

Ji Ojec	t IIO.	111-53037-00 132-02				C	oring	II/a							evie	wer	AIVIO
Ē		SUBSURFACE PROFILE			SA	MPLE		Penetra (Blows	ation Te	st Values	_				S		Lab Data
Depth Scale (m)			jo			SPT	Elevation Scale (mARD)	× Dy	namic Co	ne		Wate	r Conten Plasticit	t (%)	Readings	= =	and
Sca	Elev	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value	ion 9			0 30 ar Strength		8	Plasticit	<i>(</i> )	Jeac	Well Details	Comments
epth	Depth (m)	STRATIGNAPHT	aph	Nun	Ţ	Core	levat (m	O U	Inconfined	ar Otrengti I	+ Field Vane ■ Lab Vane	PL	МС	LL	PID F		GRAIN SIZE DISTRIBUTION (%) (MIT)
	279.7	GROUND SURFACE	ğ			Recovery	Ш	4	0 8	0 120	160	10	20	30	<u> </u>		GR SA SI CL
ľ		Fine coarse brown sand with some gravel					-	1									
ı		graver					_										
ŀ																	
-							-										
L							279 –	1									
							-	-									
-1							-										
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ŀ							-	1									
							278 -										
							-	-									
-2							-										
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ŀ							-	1									
ŀ							277 -	1									
-3							-	-									
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ŀ																	
ŀ							-										
-	275.0						276 -	1									
-4	275.8 3.9	Brown clayey silt with trace of gravel	И.				-	1									
'			11/				-	-									
	275.4 4.3		IXI	l l													
		END OF BOREHOLE															
		Stratigraphy inferred from original borehole log for BH24A (MacLaren															
		borehole log for BH24A (MacLaren Engineers Inc., 1982).															
		Monitoring well decommissioned by overdrilling to full borehole depth and															
		sealing with bentonite.															
igp.																	
decon																	
- sgc																	
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libra																	I
																	Sheet No. 1 of 1

#### **LOG OF BOREHOLE 24AR**



project | Holbrook Landfill Site

client | Oxford County

rig type | ACKER SOIL-MAX, track-mounted

.

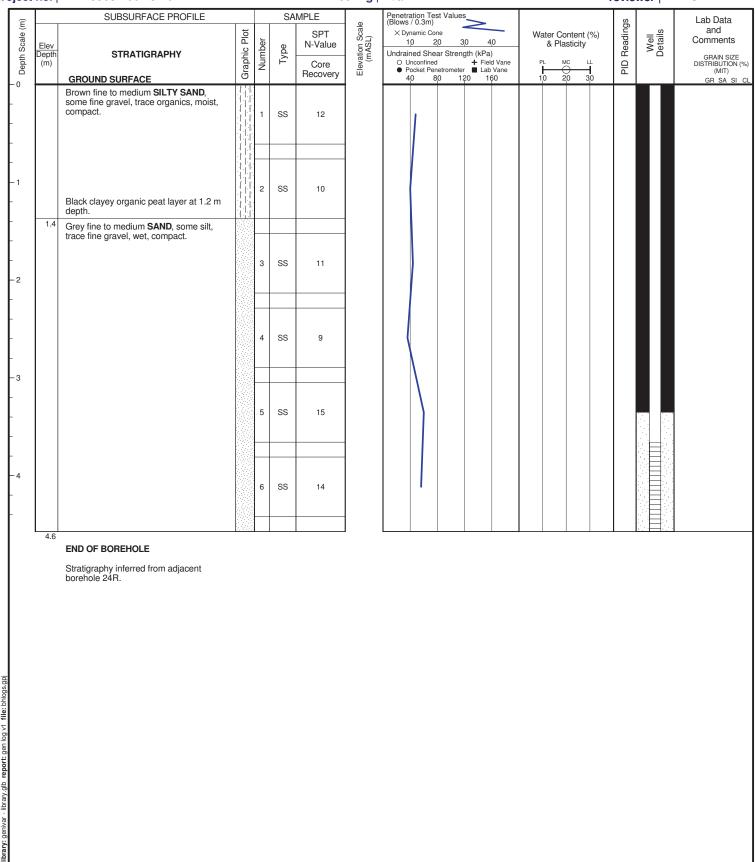
date started | 2015/07/13

location | Holbrook, Oxford County

method | Hollow stem augers, 215 mm dia.

supervisor | SM

project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS



		SEOLOGICAL LOG			E L			TEST HOLE No. 25
SCALE	EL	0.5.5.5.0.7.5.0.1	PLOT	ZOMETER	NUMBER	Ď.	/0.3m	SMEET 1 OF 1
(ft) (m)	(mGSD) DEPTH (m)	DESCRIPTION	STRAT.	PIEZO	SAMPLE	SAMPLE	BLOWS,	NOTES
								DATE DRILLED 12 Feb./82
	279.9	GROUND SURFACE		· Francisco	0.6	l m		TYPE OF RIG CME 75
<u></u>	0.0	Brown compact medium to coarse sand						DRILLING METHOD Hollow Stem Auge
5 2	1.7		CONTRACTOR CONTRACTOR  CONTRACTOR CONTRACTOR  CONTRACTOR CONTRACTOR  CONTRACTOR CONTRACTOR  CONTRACTOR CONTRACTOR  CONTRACTOR		1	SS	15	DEPTH WATER FOUND Surface
10-3			PARTY CONTROL OF THE PARTY CON		2	SS	14	(m below ground surface) STATIC WATER LEVEL 3.8 (m below ground surface)
15-	AND CONTROL BEACHER STREET, CONTROL CO	Brown clayey silt	Amenine de la facilità de la constitución de la con	03520413-02040-004013-0050-005	3	SS	23	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 1 TYPE OF PIEZOMETER Slotte
-5 <sub>20</sub> -6	Service and a se	and gravel	THE CONTRACTOR OF THE CONTRACT		4	SS	18	pipe and fibreglass wrappe
-7	SON HALL STATEMENT OF THE STATEMENT OF THE SON HALL STATEMENT OF THE S		Annual Control of the	(AA)	5	SS	23	SS-SPLIT SPOON WA-WASH
25 - 8	271.4		7 0	STRUCTURE OF THE CONTRACT OF T	6	SS	13	♥ 276.07Static Water Elevation (m GSD) (18 February 198
30 - 3	ELOCECULO ESCAPA POR PROPERTIMENTO DE CONTROL DE CONTRO	Brown sandy silt with some thin layers	9	poctational constant parties				# Piezometer
35	and the separate of the second tension of th	of fine sand and a trace of gravel	9		7	SS	7	
12	267.4		0		8	SS	18	
-13 45 -14		Brown silty clay with some gravel	The second secon		9	SS	25	
-15	265.3 14.6	Brown gravelly silt	A CONTRACTOR OF THE CONTRACTOR		10	SS	97	
16	264.0 15.9	with a trace of clay	60: 0:0:				-	
55 -17		Brown sand and gravel	000		11	SS	48	
60- -19	260.5	-	0 - 0 - 0 -		30	~~		
65-20	19.4	END OF HOLE		_	12	SS	-	
70 21	THE STATE OF THE S							om Maclare
+22 75 -23	nace of the second seco							MocLAREN ENGINEERS, PLAI
	<u> </u>	T HOLE RECORD	4		.н.	b D		BROLECT NO. 11602-5

# LOG OF BOREHOLE 25 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/17

method | Hollow stem augers, 215 mm dia. location | Holbrook, ON supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

SUBSURFACE PROFILE  SAMPLE    Som of the property of the prope	Lab Data and Comments  GRAIN SIZE DISTRIBUTION (%) (MIT)  GR SA SI CL
280.4 GROUND SURFACE  Brown compact medium to coarse sand  280 –  279 –	DISTRIBUTION (%) (MIT)
280.4 GROUND SURFACE  Brown compact medium to coarse sand  280 -  1 278.7  -2 1.7 Brown clayey silt with trace of sand and gravel	DISTRIBUTION (%) (MIT)
280.4 GROUND SURFACE  Brown compact medium to coarse sand  280 –  279 –	GR SA SI CL
Brown compact medium to coarse sand  280 –  1 –  278.7  —2 278.7  —2 1.7 Brown clayey silt with trace of sand and gravel	
-1 - 278.7 - 279	
- 278.7 279 - 279	
278.7 1.7 Brown clayey silt with trace of sand and gravel	
2 Blown Gayey silt with trace of sand and gravel	
-3     -3     -4	
_	
271.9	
Brown sandy silt with some thin layers of fine sand and a trace of gravel	
267.9 268 –	
Brown silty clay with some gravel	
-14   -1265 8   266 -   -1265 8   -1	
14.6 Brown gravelly silt with a trace of clay	
265 – 264.5	
264.5	
19.2	
END OF BOREHOLE  Stratigraphy inferred from original borehole log for BH25 (MacLaren Engineers Inc., 1982).  Monitoring well decommissioned by overdrilling to full borehole depth and sealing with hentonite	
Stratigraphy inferred from original	
borehole log for BH25 (MacLaren Engineers Inc., 1982).	
Monitoring well decommissioned by	
overfilling to full borthole depth and	
sealing with bentonite.	Sheet No. 1 of 1

### **LOG OF BOREHOLE 25R**



project | Holbrook Landfill Site

rig type | ACKER SOIL-MAX, track-mounted client | Oxford County date started | 2015/07/22

location | Holbrook, Oxford County method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02

coring | n/a reviewer | AMS

<u> </u>	<del>-                                    </del>	711 00007 00 102 02		_			oring			CVICWCI	<del>'</del>
(Ē	<u> </u>	SUBSURFACE PROFILE	_	-	SA	MPLE	<u>_0</u>	Penetration Test Values (Blows / 0.3m)		sg	Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Туре	SPT N-Value Core	Elevation Scale (mASL)	X Dynamic Cone   10 20 30 40	Water Content (%) & Plasticity	PID Readings	and Comments  GRAIN SIZE DISTRIBUTION (%) (MIT)
_0 _0		GROUND SURFACE				Recovery	ı	Pocket Penetrometer ■ Lab Vane 40 80 120 160	10 20 30	□ □	(MIT) GR SA SI CL
-0		Dark brown <b>TOPSOIL</b> , some fine sand, rootlets, moist, loose.	1/ ×	1	SS	8					
-1	0.6	Reddish brown <b>CLAYEY SILT</b> , some fine to medium sand, trace clay, trace rootlets, moist, compact.		2	SS	12	-				
-2				3	SS	24					
-	2.3	Grey-brown <b>CLAYEY SILT</b> , trace fine to coarse sand, trace gravel, DTPL to APL, stiff to very stiff.		4	SS	18					
-3				5	SS	13					
-4				6	SS	17					
-5				7	SS	14	-				
-6				8	SS	12					
-				9	SS	16					
-7 -				10	SS	30					
-8				11	SS	40					
- -9				12	SS	50					
v1 file: bhlogs.g	9.3	Grey-brown fine <b>SILTY SAND</b> , trace clay, trace fine gravel, wet to saturated, compact.		13	SS	15					
library: genivar - library glb report: gen log v1 file: bhlogs gpj				14	SS	3					
nivar - library.glb 				15	SS	18					
library: ger		(continued next page)		16	SS	9					Sheet No. 1 of 2

### **LOG OF BOREHOLE 25R**



date started | 2015/07/22

project | Holbrook Landfill Site

client | Oxford County

rig type | ACKER SOIL-MAX, track-mounted

Iocation | Holbrook, Oxford County

method | Hollow stem augers, 215 mm dia.

supervisor | MEQ

project no. | 111-53037-00 132-02 coring | n/a

reviewer | AMS

		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		<b>"</b>		Lab Data
Depth Scale (m)	Elev Depth (m)		Graphic Plot	Number	Туре	SPT N-Value Core	Elevation Scale (mASL)	X Dynamic Cone	Water Content (%) & Plasticity	PID Readings	Well Details	and Comments  GRAIN SIZE DISTRIBUTION (%) (MIT)
	()	(continued)	Gra	Z		Recovery	E E	● Pocket Penetrometer ■ Lab Vane 40 80 120 160	PL MC LL 10 20 30			(MIT) GR SA SI CL
- 12 -		Grey-brown fine <b>SILTY SAND</b> , trace clay, trace fine gravel, wet to saturated, compact.		17	SS	12						dh 3A 31 CL
<b>–</b> 13	13.0	Rapidly dilatent below 12.2 m. (continued)  Light grey CLAYEY SILT AND  GRAVEL, some fine to coarse sand,  DTPL, stiff.		18	SS	47						
- 14	14.2	CAND AND ODDAY		19	SS	74						
- - 15	14.2	Grey-brown <b>SAND AND GRAVEL</b> , some silt, trace clay, saturated, compact.	.000	20	SS	33						
-	15.2	Grey-brown <b>CLAYEY SILT</b> , some gravel, some fine to coarse sand, APL, stiff to very stiff.		21	SS	81						
- 16 -				22	SS	88						
- 17				23	SS	63						
- - 18	18.0	O CAND AND ODDAYEL : I'I		24	SS	53						
-	10.0	Grey <b>SAND AND GRAVEL</b> , trace silt, wet, hard.	,000	25	SS	83						
- 19 -				26	SS	85						
	19.8	END OF BOREHOLE	0				]					
file: bhlogs.gpj												
library: genivar - library.glb report: gen log v1 file: bhlogs.gpj												
r - library.glb re												
<b>library:</b> geniva												Sheet No. 2 of 2

		GEOLOGICAL LOG			E E			TEST HOLE No. 25A
SCALE	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT. PLOT	PIEZOMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	NOTES
	279.9	GROUND SURFACE	ANTICOLOGICAL DELICATION OF THE STATE OF THE		0.9	3 m		TYPE OF RIG CME 75
	278.2	Brown compact medium to coarse sand			A CONTRACTOR CONTRACTO	Business et alle statement en	The contract of the contract o	DRILLING METHOD Hollow Stem Augers
3	1.7 275.3	Brown compact clayey silt slightly calcareous with trace of sand and gravel		***************************************	and delications the same of the same of the same of the same of the same of the same of the same of the same of	sol evel cut hautistische chanken begründen gegen gegen gegen gegen geben der der der der der der der der der der	ridateriores compressional management de transporte de la compressional del compressional de la compressional del compressiona	DEPTH WATER FOUND Surface  (m below ground surface)  STATIC WATER LEVEL
5-5	4.6	END OF HOLE	A A COMMITTEE OF THE CO	And the state of t	and the second contract of the second contrac	en demokram il genedeser kar i help en verkeren ung paramentamen kan	And the contract of the second	LENGTH OF PIEZOMETER 1 (m) TYPE OF PIEZOMETER Slotted P pipe and fibreglass wrapped  SAMPLE TYPE
5-8					TRATEGORIAN VAN DECORPTION DE CONTRACTOR DE	stransmenters of the state of the stransfer of the state	and the state of t	SS-SPLIT SPOON WA-WASH  279.85Static Water Elevation (m GSD)
o 9 10				en de marie de la companie de la com	A STANDARD GARDEN OF CHARACTER	Caracteristics (Caracteristics) and when we have a property control of the caracteristics of the caracteristic	AT THE THE PROPERTY OF THE PRO	(19 February 1982)  # Piezometer
5-11 0-12				enifesiephelestineeneeneeneentomaterratorratorratorratorratorie	WCOTER STEELS OF THE PROPERTY AND STEELS OF THE STEEL OF THE STEELS OF T		date-websorgal/Protective-forming from the state of the s	
-13 5 -14			RETRACTION OF THE PROPERTY OF	мерьформинення менерамент ситемательного делистра		dbommelenistrandrobuserses enservadorus	EDISTRIBUTE DESCRIPTION OF STATE SERVICE SERVI	om Maclaren
15			No. transference transference (Opposite Control State Option Control Sta	февропелинализмиров		Nation Figure Mend Anders State County	aproxpances acres (separation)	Mcclaren Engineers, planners & Scientists

### LOG OF BOREHOLE 25A Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/16

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-02coring | n/areviewer | AMS

<u></u>		SUBSURFACE PROFILE		S	AMPLE		Penetration Test Values (Blows / 0.3m) Lab Data
Depth Scale (m)	Elev Depth	STRATIGRAPHY	Graphic Plot	Number Type	SPT N-Value	Elevation Scale (mARD)	× Dynamic Cone 10 20 30 40 Water Content (%)
O Depth	(m) 280.4	GROUND SURFACE	Graph	Nun Ty	Core Recovery	Elevai (m	Undrained Shear Strength (kPa)  ○ Unconfined + Field Vane  ◆ Pocket Penetrometer ■ Lab Vane  40 80 120 160 10 20 30 GRAIN SIZE DISTRIBUTION (% (MIT))  GR SA SI (6)
- U - - -		Brown compact medium to coarse sand				280 <del>-</del> -	
1  	278.7 1.7	Brown compact clavey silt slightly	77			- 279 - -	
-2 - -		Brown compact clayey silt slightly calcareous with trace of sand and gravel				- 278 - -	
-3 - -	276.9 3.5					- 277 -	

#### **END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH25A (MacLaren Engineers Inc., 1982).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

			GEOLOGICAL LOG			Œ			TEST HOLE No. 26
(f1)	3 SCALE	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT, PLOT	PIEZ OMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	NOTES
		271.8	GROUND SURFACE		T	Gau	ge		DATE DRILLED Jan. 14,16, 1983  TYPE OF RIG CME 75
5-	- -1 -	0.0	Red brown to brown inter- layered clayey and silty fine sand with minor gravel		BACKFILL	2	\$ \$ \$	8 58	DRILLING METHOD Hollow Stem Augers  DEPTH WATER FOUND 3.7
10-	-3 -4	2.1 268.1 3.7	Red brown to grey clayey silt, minor gravel	0.0.0.	MILITER THE	3 4 5	\$ \$ \$ \$ \$	15	(m below ground surface)
15-	-5 -6		coarse sand; coarse gravel; minor silt, changing gradually to predominantly coarse gravel	000000000000000000000000000000000000000	:AVE	6 7 8	ន ន ន ន	21	LENGTH OF PIEZOMETER 1.8 (m)  TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped  SAMPLE TYPE
25-	- <b>7</b> - 8	265.2 6.6	END OF HOLE	1380.					SS-SPLIT SPOON WA-WASH  Static Water Elevation (m GSD)
30-	-9 -10								# Piezometer
35- 40-	-11 - -12	,	•						
45-	-13 - -14 -		÷						Om MacLaren
50	-15	TE	ST HOLE RECORD			D.	JR		MocLAREN ENGINEERS INC. PROJECT NO. 11602-2

.

# LOG OF BOREHOLE 26 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/08/06

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

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Γ	<u></u>		SUBSURFACE PROFILE			SA	MPLE	_	Penetration Test (Blows / 0.3m)	Values			S		Lab Data
-	Depth Scale (m)			ot			SPT	Elevation Scale (mARD)	X Dynamic Cone	e	Water Co	ntent (%)	PID Readings	= <u>≈</u>	and
1	Scal	Elev Depth	OTD ATIOD ADULY	Graphic Plot	Number	90	N-Value	on S ARD	1,0 2,0		& Pla	sticity	leac	Well Details	Comments
-	pth	Depth (m)	STRATIGRAPHY	aphi	L L	Type	Core	evati (m,	Undrained Shea O Unconfined	+ Field Vane trometer ■ Lab Vane	PL N	Č Ľ	DF		GRAIN SIZE DISTRIBUTION (%) (MIT)
-		272.1	GROUND SURFACE	g	-		Recovery	ă	<ul> <li>Pocket Pene</li> <li>40 80</li> </ul>	trometer ■ Lab Vane 120 160	1,0 2	0 30	Ы		(MIT) GR SA SI CL
ı	- 0	272.1						272 -							GIT OA OI OE
╌			Red brown to brown interlayered clayey and silty fine sand with minor gravel												
L								-	1						
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L	-1							-							
-								271 -							
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ı								-							
╌	-2	270.0						270 -							
L		270.0 2.1	Red brown to grey clayey silt, minor	И	1			270-							
-			gravel	111				-							
ı								-							
╁				W)	1										
ŀ				И											
L	-3			W	1			-							
Г	-3			114				269 -							
ŀ				M				-							
╌				И	1										
L				$\mathbb{N}$				-							
- 1		268.4 3.7	Fine modition everyals mines according					-							
ı			Fine-medium gravel; minor coarse sand; coarse gravel; minor silt, changing	. 0				-							
╌	-4		gradually to predominantly coarse gravel	00				268 -							
-															
L				。 (\				-							
		267.6 4.5		0	] [			-							
-		4.5	END OF BOREHOLE												
- 1			Stratigraphy informed from original												
- 1			Stratigraphy inferred from original borehole log for BH26 (MacLaren												
- 1			Engineers Inc., 1983).												
- 1			Monitoring well decommissioned by												
- 1			overdrilling to full borehole depth and sealing with bentonite.												
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### **LOG OF BOREHOLE 26R**



project | Holbrook Landfill Site

client | Oxford County

project no. | 111-53037-00 132-02

rig type | ACKER SOIL-MAX, track-mounted

location | Holbrook, Oxford County method | Hollow stem augers, 215 mm dia.

date started | supervisor |

2015/08/07

MEQ

**AMS** 

coring | n/a reviewer |

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Readings Scale and Well Details Plot X Dynamic Cone Water Content (%) Depth Scale Elevation Sca (mASL) Comments 20 30 40 Number 1.0 N-Value & Plasticity Elev Graphic Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) Core PID Recovery 20 GROUND SURFACE GR SA SI CL - 0 Brown CLAYEY SILT, some fine to coarse sand and subrounded gravel, trace roots, APL, firm. SS 8 0.8 Reddish brown CLAYEY SILT, some fine to coarse sand, some fine to coarse subrounded gravel, APL, stiff to very stiff. 2 SS 14 SS 36 - 2 2.3 Grey CLAYEY SILT, trace fine to coarse sand, trace to some fine to coarse gravel, APL, stiff to very stiff. SS 16 -3 SS 13 5 SS 6 51 SS 44 - 5 Grey-brown coarse **SAND** and fine to coarse **GRAVEL**, some silt, saturated, 0 SS 10 -6 **END OF BOREHOLE** 

			GEOLOGICAL LOG		The Carlot Manuscriptor Carlot Carlot		Trade Conference and trade Conference Confer		TEST HOLE No. 27
	щ	F.		PLOT	TER	NUMBER	TYPE	0.3m	SHEET I OF L
	SCALE	EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT. P	PIEZ OMETER	SAMPLE P	SAMPLE 1	10	NOTES
		271.7	GROUND SURFACE	And the control of th	T	AUGE			DATE DRILLED Jan. 21,24, 1983  TYPE OF RIG CME 75
5-	-	0.0 269.6 2.1	Red brown to brown inter- layered clayey silt and silty fine sand with minor gravel  Red brown to grey clayey silt, minor gravel	. 008	SEAL				DRILLING  METHOD Casing & Tricone  DEPTH WATER FOUND 3.7,11.0  (m below ground surface)  STATIC WATER LEVEL
15-	-4 -5 -6	268.0 3.7 265.0	Fine-medium gravel; minor coarse sand, coarse gravel and silt; changing gradually to predominantly coarse gravel	920	<b>1</b>				(m below ground surface)  PIPE DIAMETER 51 (mm)  LENGTH OF PIEZOMETER 2.4 (m)  TYPE OF PIEZOMETER Slotted  and Nitex Screen Wrapped  SAMPLE TYPE
25	-7	6.7		<i>φ</i> ωυ.	BACKEII	1 2	ss ss	42 55	SS-SPLIT SPOON WA-WASH
30-	-8 -9		Dense grey clayey silt; minor fine-coarse sand, fine-coarse gravel,	0		3 <sup>-</sup> 4		52 37	Static Water Elevation (m GSD)
35-	-10	260.7	predominantly gravel layer at 8.5-9 m	0	SE AL	5 6	ss ss		‡ Piezometer .
	-11 - -12	11.0	Light brown silty fine-		V55++++	7.	ss	5	
40-	-13	,	coarse sand changing gradually to grey fine to coarse gravel with minor	0.000	H111984	9	ss ss		
45	-14	256.7	sand	0000 0000 0000 0000	CAVE	10 11	ss ss	18 2	MacLaren MacLaren
50	-15	15.0	END OF HOLE	<i>5.</i> 0					MocLAREN ENGINEERS INC.
		TE	ST HOLE RECORD	v		DJ	IR		PROJECT NO. 11602-2

		GEOLOGICAL LOG			ER		inder reflections removed in the state of th	TEST HOLE No. 28
SCALE	EL (mGSD)	DESCRIPTION	. PLOT	OMETER	E NUMBER	E TYPE	,/0.3m	SHEET I OF I
	DEPTH (m)		STRAT.	PIEZ	SAMPLE	SAMPLE	BLOWS/	NOTES
						d S		DATE DRILLED Jan. 17, 1983
	277.4	GROUND SURFACE			·80m			TYPE OF RIG CME 75
- <b>1</b>	0.0	Brown fine sand, minor silt and coarse gravel	00	BACKFILL		ss	8 19 31	DRILLING  METHOD Hollow Stem Augers
5-2	275.3		9 .	). ()	4	ss	43	DEPTH WATER FOUND $\sim 2.7$ (m below ground surface)
10-3	2.1			Ť	5	ss	2 <u>0</u>	STATIC WATER LEVEL 2.49 (m below ground surface)
4		Brown to dark brown compact-dense clayey silt,		ורר	6	SS	23	PIPE DIAMETER 51 (mm)
15-5		minor fine-coarse gravel		ВАСК		ss ss		TYPE OF PIEZOMETER 1.5 (m)  TYPE OF PIEZOMETER Slotted  and Nitex Screen Wrapped
20-6				SE AL		ss		SAMPLE TYPE
7	270.0			RAVEL	10	ss	80	SS-SPLIT SPOON WA-WASH
25-8	7.5	Light brown loose silty		9 <del>  </del>	11			♥274.94Static Water Elevation(m GSD)
30-9	067.0	fine sand		\$ \$ \$		SS		·(05 April 1983)
-10	9.6	END OF HOLE		CAVE	10			‡ Piezometer
35		*						
12	•							
-13	,					3		
45-14						2		MacLaren MacLaren
15						9		MocLAREN ENGINEERS INC.
	TE	ST HOLE RECORD	1		D.	JR.		PROJECT NO. 11602-2

# LOG OF BOREHOLE 28 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/20

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a AMS reviewer |

		SUBSURFACE PROFILE			SA	MPLE		Peneti	ration Te ( 0.3m)	st Value	s_						w		Lab Data
Depth Scale (m)			ot			SPT	Elevation Scale (mARD)	X D	namic Co		_	_	l wa	ater Co	ntent	(%)	PID Readings	_ <u>s</u>	and
Scal	Elev		<u>-</u>	Number	g	N-Value	on S ARD					10	''`	& Pla	sticity	( , 0)	ead	Well Details	Comments
E E	Depth (m)	STRATIGRAPHY	phi	ш	Type	Core	vatic (m/	Undra	ined She	ar Stren	gth (kPa + Fiel	) ld Vane	P	L M	IC I	LL	O R		GRAIN SIZE DISTRIBUTION (%) (MIT)
	' '	CROUND CUREACE	Graphic Plot	z		Recovery	Ele	• i	Jnconfined Pocket Per 40 8	netromete 0 1:	r ■ Lab 20 1	Vane 60	١ ,			<b>- </b> 30	ᇤ		(MIT)
-0	277.7	GROUND SURFACE  Brown fine sand, minor silt and coarse				-		<u> </u>	+0 0	1.	20 1	00	<u>'</u>	0 2		50			GR SA SI CL
		gravel					-	1											
-																			
							277 —												
<b>-</b> 1																			
							_												
-																			
							276 —												
Ι.																			
-2	275.6 2.1		171				_												
	2.1	Brown to dark brown compact to	K)	1															
ŀ		dense clayey silt, minor fine to coarse gravel		1															
		odaloo glavo.	121	1			275 —	1											
-3			W	1															
Γ			$\mathbb{R}$				_												
			$ \mathcal{V} $	1															
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- 1			141																
ı			И	1			273 —												
- 1			Y   1	1			2.0												
-5			[1]																
- 1			И	1			-												
- 1			121				272 —												
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			$\mathcal{M}$	ł			271 –												
-7			W	1															
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	070.0		ľΚΙ																
ŀ	270.2 7.5	Light brown loose silty fine sand	1//	1			070												
- 1		Light brown loose silty line sand					270 —	1											
-8																			
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dg.n																			
- 9 - 9	268.6																		
o-sg	9.1		1																
phlo		END OF BOREHOLE																	
ë		Stratigraphy inferred from original																	
2		borehole log for BH28 (MacLaren Engineers Inc., 1983).																	
ol ne		Engineers Inc., 1983).																	
i: ge		Monitoring well decommissioned by																	
ode		overdrilling to full borehole depth and sealing with bentonite.																	
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																			Sheet No. 1 of 1

### **LOG OF BOREHOLE 28R**



project | Holbrook Landfill Site

client | Oxford County

Iocation | Holbrook, Oxford County

project no. | 111-53037-00 132-02 coring | n/a

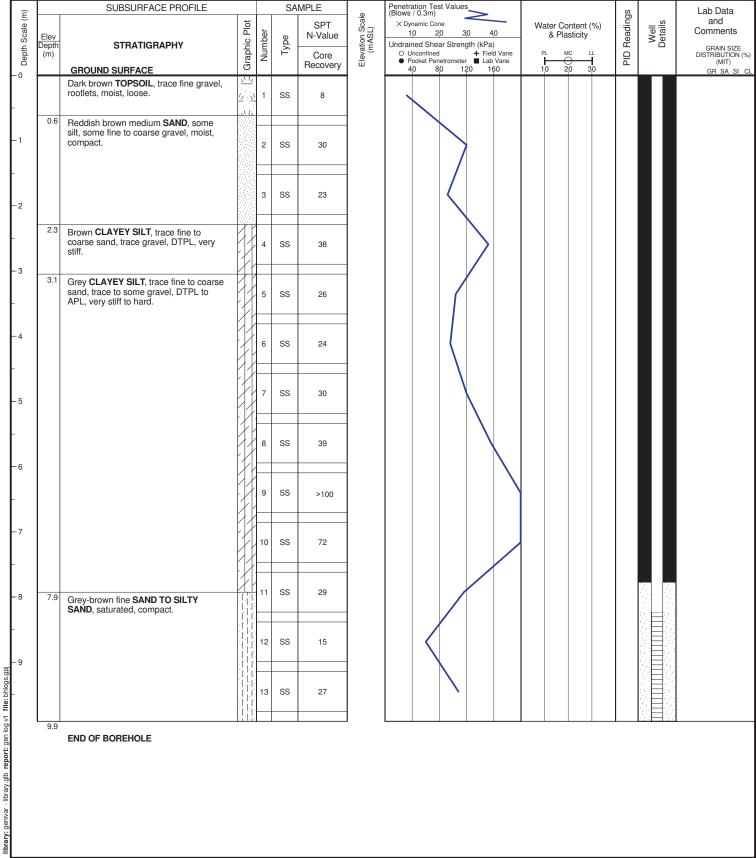
rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

date started | 2015/07/21

supervisor | MEQ

reviewer | AMS



		GEOLOGICAL LOG		The second secon	a a			TEST HOLE No. 30
((+ t))(s)	EL (mGSD) — DEPTH (m)	DESCRIPTION	STRAT, PLOT	PIEZ OMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	SHEET I OF I
	278.9	GROUND SURFACE		1-4	4 m			DATE DRILLED Jan. 18,19, 1983  TYPE OF RIG CME 75
52	276.8	Light brown fine-coarse sand, minor fine-coarse gravel, minor silt	0.0		2 3	SS SS SS		DRILLING  METHOD Hollow Stem Augers  DEPTH WATER FOUND 2.4
10-3	2.1	Grey clayey silt, minor fine-coarse sand, fine-coarse gravel		T BACKFI	4 5 6	\$\$ \$\$ \$\$	29	(m below ground surface) STATIC WATER LEVEL 1.41 (m below ground surface)
15-5	274.5 4.4	-	· · ·	BACKFILL	7	ss ss		PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 3.0 (m) TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped
20		Grey fine-coarse sand, fine gravel; minor silt, minor medium-coarse gravel	0	GRA\	'EL		ė	SAMPLE TYPE  SS-SPLIT SPOON  WA-WASH
30-9			0		9	ss.	38	□ 277.51Static Water Elevation (m GSD) (05 April 1983)  Piezometer
35-11	267.8 11.1	END OF HOLE	0	##				*
40-17 -13 45-14	,		description of the second seco					MacLaren
15	TE	ST HOLE RECORD			D.	IR		MocLAREN ENGINEERS INC.
	B &				<i>D</i> (	1		PROJECT NO. 11602-2

v

# LOG OF BOREHOLE 30 Decommissioning WSP



project | Holbrook Landfill Site

rig type | CME 75, track-mounted client | Oxford County date started | 2014/09/25

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-00 coring | n/a reviewer | AMS

<i></i> 0,00		111-53037-00 132-00					oring					revie	WC1   1	AIVIS
lε		SUBSURFACE PROFILE			SA	MPLE	<u>•</u>	Penetration 7 (Blows / 0.3m	est Values			gs		Lab Data
Depth Scale (m)			Graphic Plot	<u>_</u>		SPT	Elevation Scale (mARD)			Water Co	ontent (%) sticity	Readings	Well Details	and Comments
h Sc	Elev Depth	STRATIGRAPHY	ic F	Number	Туре	N-Value	ıtion		near Strength (kPa)			Rea	We	
Sept	(m)		rapl	2	Ė.	Core	leva (r	O Unconfin Pocket F	red + Field Vane Penetrometer Lab Vane	PL N	1C LL 20 30	PID		GRAIN SIZE DISTRIBUTION (%) (MIT)
-0	279.1	GROUND SURFACE	G	_		Recovery	 279 –	40	80 120 160	10 2	0 30			GR SA SI CL
		Light brown fine-coarse sand, minor fine- coarse gravel, minor silt					2/9-							
		graver, miner em					-							
-1							278 -							
-							-							
-2	277.0						277 –							
L	2.1	Grey clayey silt, minor fine-coarse sand, fine-coarse gravel	MI				211-							
		fine-coarse gravei					-							
-3			1211				276 -							
ŀ			M				-							
-4			겜				275 –							
L	274.7 4.4		Ш				2/5-							
	4.4	Grey fine-coarse sand, fine gravel, minor silt, minor medium-coarse gravel	. 0				-							
-5		g.u	0				274 –							
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-6			}° ∆				273 -							
			°O				2/3-							
			. 0				-							
-7			0				272 -							
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-8			. 0				271 –							
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-9			0				270 -							
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-10			, O				000							
			, O				269 -							
	268.1		. 0				-							
-11	11.0		D. 63 July	L			J							
		END OF BOREHOLE												
		Stratigraphy inferred from original borehole log for BH30 (MacLaren												
		Engineers Inc., 1983).												
		Monitoring well decommissioned by												
		overdrilling to full borehole depth and												
		sealing with bentonite.												
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			GEOLOGICAL LOG	¥I		R			TEST HOLE No. 31
	L E	EL		PLOT	ETER	NUMBER	TYPE	0.3m	SHEET 1 OF 1
(f t	SCALE	(mGSD) DEPTH	DESCRIPTION	STRAT.	PIEZOME	SAMPLE	SAMPLE	BLOWS/(	NOTES
									Jan. 25,26, 1983 DATE DRILLED Feb. 03, 1983
		278.9	GROUND SURFACE		Tº	81m			TYPE OF RIG CME 75
	1	0.0	Light brown fine-coarse sand, minor fine-coarse gravel, minor silt	0					DRILLING  METHOD Solid Stem Augers  Casing and Tricone
5	-	276.8	Grey clayey silt, minor	0				į	DEPTH WATER FOUND (m below ground surface) STATIC WATER LEVEL 2.63
10	-		fine-coarse sand, fine- coarse gravel						(m below ground surface)
15-	L	274.5 4.4		0.0					PIPE DIAMETER 51 (mm)  LENGTH OF PIEZOMETER 3.0 (m)  TYPE OF PIEZOMETER Slotted
20	-6			0.00		1	SS	16	and Nitex Screen Wrapped SAMPLE TYPE
	-7		Light brown-grey silty fine-coarse sand, fine- coarse gravel gradually	0.0		2	SS	44	
25-	-8		becoming predominantly grey coarse gravel	000		3	SS	17	▽ 276.25Static Water Elevation
30	- 9			200 200 200 200 200 200 200 200 200 200	ACKFIL	4	SS	18	(05 April 1983)
35-	-10		*		8	5	ss	c	i vieremeier
35	-11 -	267.9 11.0	Grey clayey silt, minor	0080		6	ss	20	
40	t 1		fine-coarse gravel at 11.0m minor silty fine sand at		SE AL	7	SS	13	
45-	}	265.6 13.3	13.0 m	0:0		8	SS	51 68	
	-14 -15		Light brown-grey silty fine sand, minor coarse gravel, medium-coarse sand, signif-	==	CAVE	10	SS	29	
50-			icant silt at 14.5m, medium to coarse sand at 16.8 m	0	<del> </del>	11	SS SS	46 68	
55-	1			. 0	<del></del>	13	SS		
4.0	-18	17.5		0000		14	SS	63	
60-	19		Fine-coarse gravel with	00000					
65-	-20		medium sand; minor silt	000		15	ss	64	
70-	-21	25.0		00000		16	SS	76	Oll MacLaren
75-	+	256.8 22.1 255.9	Dense grey sandy till	,0.0		17	ss	176	1.
		1_23.01 <b>TE</b>	ST HOLE RECORD	1		DJ	R	<u>.                                    </u>	PROJECT NO. 11602-2

	Territoria de la composição de la compos	GEOLOGICAL LOG		CONCINENT STRUCK CONTINUES			And of the second control of the second cont	TEST HOLE No. 32
i E	EL		PLOT	OMETER	NUMBER	TYPE	0.3m	SHEET I OF I
(t) (a) SCALE	(mGSD) DEPTH (m)	DESCRIPTION	STRAT.	PIEZOM	SAMPLE	SAMPLE	BLOWS/	NOTES
10-3 10-3	279.6 0.0 3.7 274.6 5.1	GROUND SURFACE  Light brown fine-medium sand, minor fine-coarse gravel, sandy clayey silt layer at 2.5 m  Grey loose clayey silt  END OF HOLE	0		89 m 1 1 2		7 14 28	DATE DRILLED Jan. 19, 1983  TYPE OF RIG CME 75  DRILLING   METHOD Hollow Stem Augers  DEPTH WATER FOUND ~ 0.6   (m below ground surface)  STATIC WATER LEVEL _ 0.65   (m below ground surface)  PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 1.8 (m) TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped  SAMPLE TYPE  SS-SPLIT SPOON WA-WASH  Q278.96 Static Water Elevation (m GSD)   (05 April 1983)  Piezometer
15								MocLAREN ENGINEERS INC.
	TE	ST HOLE RECORD			DJ	IR		PROJECT NO. 11602-2

# LOG OF BOREHOLE 32 Decommissioning WSP



project | Holbrook Landfill Site

date started | 2015/07/10 client | Oxford County rig type | Acker Soil-Max, track-mounted

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

راد ادا —	CCI	110.	111-55037-00 152-02					oring	7 // C				CVIC	wer	AIVIO
	Ê	SUBSURFACE PROFILE				SA	MPLE	Φ	Penetration (Blows / 0.3	Test Values 8m)			JS		Lab Data
	Depth Scale (m)			ot	L		SPT	Elevation Scale (mARD)	× Dynamic	Cone	Water Co	ontent (%) sticity	PID Readings	= Sig	and Comments
	Sca	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value	ion	1,0 Undrained S	20 30 40 Shear Strength (kPa)	& Pla	sticity	Зеа	Well Details	
	epth	(m)	STRATIGNAFITI	aph	۱	ř	Core	evat (m	O Unconf	fined + Field Vane Penetrometer Lab Vane	PL N	IC LL			GRAIN SIZE DISTRIBUTION (%) (MIT)
-(		280.1	GROUND SURFACE	۵			Recovery	□	40	80 120 160	10 2	0 30	Ь		(MII) GR SA SI CL
Γ	U		Light brown fine to medium sand, minor					280 -							
ŀ			fine to coarse gravel, sandy clayey silt					_							
ŀ			layer at 2.5 m												
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		276.4 3.7		171				-							
╁		0.7	Grey loose clayey silt	H				_							
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				Wł.				276 -	1						
				NJ				-							
ŀ		075.5						_							
		275.5 4.6		14 r				l							
			END OF BOREHOLE												
			Stratigraphy inferred from original												
			Stratigraphy inferred from original borehole log for BH32 (MacLaren												
			Engineers Inc., 1983).												
			Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.												
			sealing with bentonite.												
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### **LOG OF BOREHOLE 32R**

coring | n/a



project | Holbrook Landfill Site

client | Oxford County

project no. | 111-53037-00 132-02

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

supervisor |

2015/07/10 date started

MEQ

reviewer | **AMS** 

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Readings Depth Scale (m) Elevation Scale (mASL) and Well Details Graphic Plot X Dynamic Cone Water Content (%) Comments 10 20 30 40 Number N-Value & Plasticity Elev Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) PID Core Recovery 20 GROUND SURFACE GR SA SI CL - 0 Dark brown **TOPSOIL AND ORGANICS**, some fine gravel, dry, SS 10 0.6 Brown fine to coarse **SAND**, trace silt, wet, loose, weakly dilatant. 2 SS 6 Brown fine to coarse SAND, some medium gravel, trace to some silt, wet, compact to dense. 3 SS 22 - 2 SS 44 -3 5 SS Grey SANDY SILT, trace clay, wet, compact. SS 6 10 Grey **SILT**, trace clay, some fine sand, APL, firm. SS 10 - 5 5.2 **END OF BOREHOLE** 

			GEOLOGICAL LOG	•		ER		American and an annual section of the control of th	TEST HOLE No. 33
SCALE		EL (mGSD) DEPTH (m)	DESCRIPTION	STRAT, PLOT	PIEZ OMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	NOTES
		279.9	GROUND SURFACE		То-	76 m			TYPE OF RIG CME 75
5-	1	0.0	Black-grey clayey silt, minor medium gravel		SEAL	1	SS	7	DRILLING  METHODHOLLOW Stem Augers  DEPTH WATER FOUND
10-	3	276.5 3.4			∇	-2	SS	5	
15	<b>4</b> 5	275.0	Loose brown silty fine sand			3	SS		PIPE DIAMETER 51 (mm)  LENGTH OF PIEZOMETER 1.8 (m)  TYPE OF PIEZOMETER Slotted  and Nitex Screen Wrapped
707	6	-	Brown-grey clayey silt; minor fine-coarse gravel, minor sand		CAVE	4		39	SAMPLE TYPE  SS-SPLIT SPOON WA-WASH
1 1	8	270.8			SE AL	6	SS	12	v276.54 Static Water Elevation (m GSD) (05 April 1983)
30-	10	9.1	Brown silty fine sand		CAVE	7	SS	11	Piezometer
	11	268.0 11.9 267.2	Brown clayey silt		***************************************	8		12 37	
1	13 14	12.7	END OF HOLE						MacLaren
50	15	TE	ST HOLE RECORD			D	JR		MOCLAREN ENGINEERS INC.
			OI HULL NECOND			U,	חנ		PROJECT NO. 11602-2

# LOG OF BOREHOLE 33 Decommissioning WSP



project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/16

location | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a reviewer | AMS

<u> </u>	_	2.15						I	<b>T</b> 1111		_						
Ê	·	SUBSURFACE PROFILE		-	SA	MPLE	<u>a</u>	Penetration (Blows / 0.3	rest Value m)	es					gs		Lab Data
Depth Scale (m)			Graphic Plot	_		SPT	Elevation Scale (mARD)	× Dynami	Cone		W	ater Co	ntent (	%)	PID Readings	Well Details	and Comments
Š	Elev	STRATIGRAPHY	. <u>.</u>	Number	Туре	N-Value	ion	1 <sub>,0</sub> Undrained		30 40	-	& Pla	sticity		Зеа	We Deta	
a tag	Depth (m)	STRATIGNAPHY	ap	l n	Ţ	Core	evat (m	O Uncon	ined	+ Field Vane er ■ Lab Vane		PL M	Ç L	Ļ	ID F		GRAIN SIZE DISTRIBUTION (%) (MIT)
	280.2	GROUND SURFACE	ÿ	_		Recovery	ă	Pocker 40	Penetromete 80	er ■ Lab Vane 120 160	.	10 2	0 3	<b>1</b> 0	Ы		(MIT) GR SA SI CL
-0		Black-grey clayey silt, minor medium	И				280 -										
ŀ		gravel	- 111	7													
-1							-	1									
- 1 '				1			279 -										
-				1													
-2																	
				1			278 –	-									
ı				1			_										
-3				1													
L	276.8 3.4		-[4]	1			277 –										
	0.4	Loose brown silty fine sand					-										
-4							276 -										
-							270-										
-5	275.3						-										
I-3	4.9	Brown-grey clayey silt; minor fine to	- []	1			275 -										
ŀ		coarse gravel, minor sand		1													
-6			- []	1			-	1									
				1			274 -	-									
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L			- M				273 –										
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-				1			212-										
	071.1						-	1									
-9	271.1 9.1	Brown silty fine sand	-KI	1			271 –										
ŀ		Diown sitty line sand															
-10							-	1									
"							270 -	-									
-																	
-11																	
							269 -										
ſ	268.3						-										
- 12	268.3 11.9 268.1	Brown clayey silt	تقلر	1			l										
	12.1		_														
		END OF BOREHOLE															
		Stratigraphy inferred from original															
		Stratigraphy inferred from original borehole log for BH33 (MacLaren Engineers Inc., 1983).															
		-															
		Monitoring well decommissioned by overdrilling to full borehole depth and															
igp.r		sealing with bentonite.															
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library: genivar - library.glb report: gen log v1 file: bhlogs - decom.gpj																	
bran																	
_∟																	Sheet No. 1 of 1
																	Shoot No. 1 of 1

## **LOG OF BOREHOLE 33R**



project | Holbrook Landfill Site

client | Oxford County

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

supervisor |

date started | 2015/07/23 MEQ

project no. | 111-53037-00 132-02 coring | n/a

AMS reviewer |

L	SUBSURFACE PROFILE			SA	MPLE		Penetration Test Value (Blows / 0.3m)	s					<u>0</u>		Lab Data
Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Туре	SPT N-Value	Elevation Scale (mASL)	× Dynamic Cone 10 20 Undrained Shear Strer	30 40 ngth (kPa)	200	Wate 8	r Content Plasticity	(%) '	PID Readings	Well Details	and Commen
(m)	GROUND SURFACE	Grap	Ž		Core Recovery	Eley	<ul><li>Unconfined</li><li>Pocket Penetromete</li><li>40 80 1</li></ul>	r ■ Lab Var 20 160	ne	10	20	<b>1</b> 30	] H		GRAIN S DISTRIBUT (MIT GR SA
	Dark brown <b>TOPSOIL</b> , some fine sand, rootlets, moist, loose.	1/ - 5	. 1 !	SS	8	1									
0.6	Reddish brown <b>CLAYEY SILT</b> , some fine to medium sand, trace clay, trace rootlets, moist, compact.		2	SS	12										
	rootiots, most, compact.		3	SS	24										
2.3	Grey-brown CLAYEY SILT, trace fine to		4	SS	18	-									
	Grey-brown <b>CLAYEY SILT</b> , trace fine to coarse sand, trace gravel, DTPL to APL, stiff to very stiff.		E			-									
			5	SS	13										
			6	SS	17										
			7	SS	14										
			8	SS	12	-									
			9	SS	16										
			10	SS	30										
			11	SS	40										
			12	e ss	50										
9.3			13	s ss	15										
	clay, trace fine gravel, wet to saturated, compact.		14	SS	3										
			1 15	s ss	18										
11.7	END OF BOREHOLE														

		Annual Control of Cont	GEOLOGICAL LOG		**************************************	α	REPROCESSION IN THE PARTY AND	Double and the second s	TEST HOLE No. 35	
o.	SCALE	EL (mGSD) DEPTH	DESCRIPTION	STRAT, PLOT	EZOMETER	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	SHEET I OF I	
·	(ft) (m)	(m) 277.8	GROUND SURFACE	ls s	Id To	75 84 m		91	DATE DRILLED Jan.26,27, 1983 TYPE OF RIG CME 75	
	10-3 10-3 10-6 -7 25-8	270.7 7.1	Grey clayey silt, minor gravel interlayered with silty fine sand at 0.3 m		BACKFILL A	1 2 3 4 5 6 7 8		47 30 28 9 27 17	DRILLING  METHOD Hollow Stem Augers,  Casing and Tricone  DEPTH WATER FOUND  (m below ground surface)  STATIC WATER LEVEL 1.21  (m below ground surface)  PIPE DIAMETER 51 (mm)  LENGTH OF PIEZOMETER 1.8 (m)  TYPE OF PIEZOMETER Slotted  and Nitex Screen Wrapped  SAMPLE TYPE  SS-SPLIT SPOON  WA-WASH  AU-AUGER  V276.60 Stotic Water  Elevation (mGSD)  (05 April 1983)	
	35 - 11 -12	264.7 13.1	with fine-coarse gravel interlayered with thin horizons of fine-coarse sand	0.000	A L	9 10		73 58 34 54	Piezometer	
	-15 50- -16	260.6	Grey fine-coarse gravel with sand and minor silt	5888890000000	CAVE AND	14 15 16	SS SS SS	33		
,	-18 60 -19 65-20	17.2	END OF HOLE							·
k.	75- -23		5 <del>5</del> k.						MacLaren  MocLAREN ENGINEERS INC.	. •
je		TE	ST HOLE RECORD			DJ	R		PROJECT NO. 11602-2	

NOTAL-PROCESSES AND AND AND AND AND AND AND AND AND AND	and composition of the	GEOLOGICAL LOG		Personal distribution	2			TEST HOLE No. 37
SCALE	EL		PLOT	EZOMETER	NUMBER	TYPE	0WS/0.3m	SHEET 1 OF 1
(ft)(m)	(mGSD) DEPTH (m)	DESCRIPTION	STRAT.	PIEZOP	SAMPLE	SAMPLE	BLOWS/	NOTES
								DATE DRILLED_Feb. 11,14,15
	274.76	GROUND SURFACE			1.7	2 m		TYPE OF RIG _CME 75
5-	0.0					SS	18	DRILLING METHOD Solid Stem Auger, Casing, Tricone
10-3						SS	18	DEPTH WATER FOUND 4.6 (m below ground surface) STATIC WATER LEVEL (m below ground surface)
15-5						SS	30	PIPE DIAMETER 51 (mm) LENGTH OF PIEZOMETER 3.0 (m) TYPE OF PIEZOMETER Slotted
20-6		Grey brown clayey silt, minor fine to coarse gravel, layer of silty				ss	32	and Nitex screen wrapped  SAMPLE TYPE
25-7		fine sand at 4.6 m, trace minor fine to coarse sand from 10.6 - 12 m.		_ \		ss	38	SS-SPLIT SPOON WA-WASH AU-AUGER
-8						ss	47	Static Water Elevation (m GSD) 275.39 m
30-9				_				Piezometer
35-11				BACKFIL		SS	55	
40-12		,				SS	31	
45 -14				SE AL		SS	39	·
50-15	259.98 14.8	Fine gravel, some fine to	0,000			ss	26	
-16 55 -17	257.84 16.9	coarse sand and medium to coarse gravel, minor silt	0.00	8-1		SS	134	
-18		Brown grey clayey silt, minor fine to medium sand, fine to coarse gravel	D	E AND BACKFI		SS	64	
65 -20	255.55 19.2		0.0	CAV		SS	21	
70-21		Fine to medium gravel, some coarse gravel, minor	000	‡	And the second s	SS	11	,
-22		fine to coarse sand, minor silt	0.0.0			ss	7	
75 - 23 -24	250.99		0.00				1	
80-		Brown silty fine to coarse sand, minor fine to coarse gravel		CAVE		SS	73	
85-26	<i>Y</i> 1	very dense hard clay till. minor fine to medium grave	1			SS	600	O[[] MacLaren
90 27	248.79 26.0	sand, silt END OF HOLE						MocLAREN ENGINEERS INC.
	TE	ST HOLE RECORD			D	TR		PROJECT NO. 11602-2

## LOG OF BOREHOLE 37 Decommissioning WSP



Lab Data

<u>0</u>

project | Holbrook Landfill Site

SUBSURFACE PROFILE

date started | 2015/08/04 client | Oxford County rig type | Acker Soil-Max, track-mounted

Penetration Test Values (Blows / 0.3m)

Iocation | Holbrook, ON method | Hollow stem augers, 215 mm dia. supervisor | MEQ project no. | 111-53037-00 132-02 coring | n/a **AMS** reviewer |

SAMPLE

Г			Ι×			CDT	sale	(Blows / 0 × Dynan			≥	147. 1	~ ^	ntot '	0/\	ngs	S	Lab Da and
	Elev		Graphic Plot	ber	ě	SPT N-Value	Elevation Scale (mARD)	1,0	2	0 3,0		wat	er Co & Pla	ntent ( sticity	%)	PID Readings	Well Details	Comme
	Depth (m)	STRATIGRAPHY	aphi	Number	Type	Core	levati (m/	Undrained	d Shea onfined	ar Strengt	h (kPa) + Field Vane ■ Lab Vane	PL	М	C L	Ļ	ID R	ے م	GRAIN DISTRIBU (MI
2	275.0	GROUND SURFACE	ট			Recovery	□	40	80	0 120	) 160	10	2	0 3	0	_		GR S.
		Grey brown clayey silt, minor fine to coarse gravel, layer of silty fine sand at 4.6 m, trace minor fine to coarse sand	H				-											
		4.6 m, trace minor fine to coarse sand from 10.6 - 12 m	M				274 —											
l				1			273 —											
							-											
							272 – -											
				1			271											
			M				270 –											
l				1			269 <del>-</del>											
							- 268 –											
			M				-											
							267 – -											
							266 —											
							265 -											
							- 264											
							-											
l							263 -											
l							262 —											
l			H				261											
2	260.2						260 <del>-</del>											
	14.0	Fine gravel, some fine to coarse sand and medium to coarse gravel, minor silt	. 0				_											
			00				259 -											
2	258.1 16.9	Brown grey clavey silt, minor fine to	) C				258 —											
l		Brown grey clayey silt, minor fine to medium sand, fine to coarse gravel					257 –											
							-											
2	255.8	Fine to medium gravel, some coarse					256 -											
l		gravel, minor fine to coarse sand, minor silt	° (				255 —											
l			, O				- 254											
l			0				-											
l			.0				253											
[2	252.3 22.7	END OF BOREHOLE	D:	]		l	I -											
		Stratigraphy inferred from original																
		borehole log for BH37 (MacLaren Engineers Inc., 1983).																
		Monitoring well decommissioned by overdrilling to full borehole depth and																

## **LOG OF BOREHOLE 37R**



project | Holbrook Landfill Site

client | Oxford County rig type | ACKER SOIL-MAX, track-mounted date started | 2015/08/05

location | Holbrook, Oxford Countymethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-02coring | n/areviewer | AMS

Ē		SUBSURFACE PROFILE			SA	MPLE		Penetration Tes (Blows / 0.3m)	st Values		S		Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Туре	SPT N-Value Core	Elevation Scale (mASL)	× Dynamic Col 1,0 2 Undrained She	ne 10 30 40 ar Strength (kPa)	Water Content (%) & Plasticity	PID Readings	Well Details	and Comments  GRAIN SIZE DISTRIBUTION (%)
_0 _0		GROUND SURFACE		_		Recovery	Ĭ	Pocket Per 40 8	netrometer Lab Vane 0 120 160	10 20 30	□		(MIT) GR SA SI CL
		Dark brown <b>SANDY TOPSOIL</b> , rootlets, dry, compact.	\(\bar{\lambda} \) \(\lambd	1	SS	14						П	
	0.5	Brown coarse SILTY SAND TO SANDLY SILT, some fine to medium gravel, trace clay, trace organics, moist,						\					
-1		compact.		2	SS	18							
-2	1.5	Reddish brown <b>CLAYEY SILT</b> , some sand, trace fine gravel, APL, very stiff.		3	SS	18							
-	2.7	Gray CLAVEV SILT some fine to		4	SS	20							
-3 -		Grey CLAYEY SILT, some fine to coarse sand to silty sand layers up to 10 cm, trace fine gravel, APL, very stiff to hard.		5	SS	21							
-4 -				6	SS	27							
-5				7	SS	31							
- -6				8	SS	25							
-				9	SS	40							
-7 -				10	SS	78							
-8	7.6	Grey <b>CLAYEY SILT</b> , trace fine sand and gravel, DTPL to APL, hard.		11	SS	44							
- -9				12	SS	49							
1 file: bhlogs.gr				13	SS	52							
report: gen log v				14	SS	52							
library; genivar - libray, glb report; gen log v1 file: bhlogs.gpj				15	SS	66							
library: ger.				16	SS	51							

## **LOG OF BOREHOLE 37R**



project | Holbrook Landfill Site

Iocation | Holbrook, Oxford County

client | Oxford County

project no. | 111-53037-00 132-02

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

ato otal toa |

date started | 2015/08/05

mm dia. **supervisor** | MEQ

coring | n/a reviewer | AMS

		SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)		,,		Lab Data
Depth Scale (m)	Elev Depth (m)		Graphic Plot	Number	Туре	SPT N-Value Core	Elevation Scale (mASL)	X Dynamic Cone  10 20 30 40  Undrained Shear Strength (kPa)  O Unconfined + Field Vane	Water Content (%) & Plasticity	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT)
_ 12		(continued)	ğ	_		Recovery	ı	<ul><li>Pocket Penetrometer ■ Lab Vane</li><li>40 80 120 160</li></ul>	10 20 30	₫		(MIT) GR SA SI CL
_		Grey CLAYEY SILT, trace fine sand and gravel, DTPL to APL, hard. (continued)		17	SS	41						
- 13 -	13.0	Grey-brown <b>SANDY SILT</b> , trace clay, WTPL, very stiff to hard.		18	SS	28						
- 14				19	SS	36						
- - 15				20	SS	35						
-	15.2	Grey coarse <b>SAND</b> and fine to medium <b>GRAVEL</b> , trace silt, wet, dense to very dense.	.0	21	SS	45						
- 16 -			.0	22	SS	69		\				
- 17	16.8	Grey <b>CLAYEY SILT</b> , some fine to coarse gravel, WTPL, hard.		23	SS	77						
- 18				24	SS	73						
-	18.9			25	SS	93						
- 19 -	10.9	Grey coarse <b>GRAVELLY SAND</b> , trace silt, wet, compact.	0	26	SS	20	-			:		
-20			0	27	SS	13						
įdō	20.7	END OF BOREHOLE	0				J					
Ilbrary: genivar - ilbrary.glb report: gen log v1 file: bhlogs.gpj												
- library.glb report												
<b>library:</b> genivar												

	The second secon	GEOLOGICAL LOG		**************************************	R		NA MONTH AND ADDRESS OF THE PARTY AND ADDRESS	TEST HOLE No. 38
SCALE	EL (mGSD)	DESCRIPTION	. PLOT	PIEZOMETER	SAMPLE NUMBER	E TYPE	8LOWS/0.3m	SHEET 1 OF 1
(ft)(m)	DEPTH		STRAT.	PIEZO	SAMPL	SAMPLE	BLOWS	NOTES
				Ţ	. 33	m		DATE DRILLED <u>Feb. 15,16,17</u> 1983 TYPE OF RIG <u>CME</u> 75
	282.27 0.0	GROUND SURFACE	0.00					DRILLING METHOD Solid Stem Augers,
5 - 2		Red brown silty fine to medium sand, fine to coarse gravel	0.		THE RESERVE OF THE PERSON NAMED IN COLUMN 1	SS	25	DEPTH WATER FOUND
10-3	278.92 3.4		0.000			ss	21	(m below ground surface) STATIC WATER LEVEL (m below ground surface)
15-5	277.57 4.7	Light brown uniform fine sand		BACKFIL		ss	26	PIPE DIAMETER <u>51 (mm)</u> LENGTH OF PIEZOMETER <u>3.0 (m)</u> TYPE OF PIEZOMETER <u>Slotted</u>
206		÷				ss	19	and Nitex screen wrapped SAMPLE TYPE
25-7		· .		- ∇		ss	1	SS-SPLIT SPDON WA-WASH AU-AUGER
30-9	OCHRONIC STREET					ss	37	Static Water Elevation (m GSD) 275.45 m
35-		Red brown to grey clayey silt, minor fine to coarse gravel, minor layer of silty fine to coarse sand				ss	63	Piezometer
-11 - 4012	Series and annual series of the series of th	at 7.6 m formation becoming more dense at 10.7 m				ss	106	
-13				SE AL		ss	113	
45 -14 - -15	267.77 14.5	·				ss	23	
-16	the selection division to the second		D			ss	92	
55-17 -18		Brown-grey brown clayey silt, minor fine to coarse	0	VE		33	34	•
-19		gravel interlayered with brown silty fine sand and sandy silt	6 	CAV	~	ss	26	
65-20	and the second		 			ss	57	
70- <sup>-21</sup> -22	260.2 21.9	Grey clayey silt, fine to coarse sand, fine to 7 coarse gravel	0 0			ss	104	
7523			0.0.0	********		ss	34	·
-24 80- -25		Grey fine to coarse gravel medium to coarse sand	00	****************		ss	17	
85-26			0.	İ		ss	17	
-27 90- -28			0.0			ss	5,1	
95-29	253. <i>77</i> 28.5	Grey very dense sandy	0,0,	CAVE		SS	250	
30	251.33	clayey silt till				SS	220	Maclaren
31 105-32	30.9	END OF HOLE						MocLAREN ENGINEERS INC.
	TE	ST HOLE RECORD			DJR	t		PROJECT NO. 11602-2

.

#### **BOREHOLE NO. BH39**

PAGE 1 of 1

PROJECT NAME: HOLBROOK LANDFILL PROJECT NO.: 111-53037-00 132-00

CLIENT: COUNTY OF OXFORD DATE COMPLETED: Jul 18, 2013

BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER SUPERVISOR: TJB

GROUND ELEVATION: TO BE DETERMINED REVIEWER: KJF

15.0  16.0  16.0  16.1  16.0  16.2  SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  17.5  SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  19.0  19.8  SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE. BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.			T										
10   10   10   10   10   10   10   10			STF			SAMPL			PEN	CONE NETRATION			
10   10   10   10   10   10   10   10		STRATIGRAPHIC DESCRIPTION	RATIGRAI	TYF	N VAL	% WA		RQD		20 30			REMARKS
93	0.0		ARc	m	E	Ē	/ERY	(%)	ST	SHEAR RENGTH	⊢ W <sub>P</sub>	W	
LOCKE   SAME			7/1/	SS1	4		7		•				
SAND AND CHAVEL   TO SATURATED SAND, TRACE SLT.   SSID 22   SAND AND CHAVEL   TO SATURATED SAND, TRACE TO SOME SLT, VIET TO SATURATED SAND, TRACE TO SOME SLT, VIET TO SATURATED COMPACT.   SSID 22   SSID 22   SSID 23   SSID 24   SSID 24   SSID 25   SSID 24   SSID 25   SSID 2	1.0	LOOSE.	]	202	7		37						1 cm THICK ORGANIC LAVER AT
GRAVEL BELOW 3.0 III, TRACE SLT, SATURATED, COMPACT.  3.6		GREY-BROWN MEDIUM TO FINE GRAINED SAND,		332	′		3,						
1.0.	2.0	GRAVEL BELOW 3.0 m, TRACE SILT, SATURATED,		SS3	16		33			*			
4.0 4.0 4.1 4.0 4.1 4.1 4.1 4.1 4.1 4.1 4.1 4.1 4.1 4.1	3.0			SS4	22		37			•			
10				SS5	32		60			•			
SAID	4.0			SS6	17		10						
### SAND CREATER SAND CREATER SAND, WET, COMPACT    SAND SAND CREATER SAND, WET, COMPACT   SST   24   27													
SAND   SAND   GREY-BROWN FINE GRAINED SAND, TRACE SILT, WET TO SATURATED, VERY LOGSE TO LOOSE.   SSS   10   47	5.0			SS7	38		2						
SAND_   GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET TO SATURATED, VERY LOOSE TO LOOSE.   SS0   10	6.0			SS8	28		3						
SAND AND GRAVEL   GREY BROWN FINE TO MEDIUM GRAVEL AND FINE GRANNED SAND, TRACE TO SOME SILT, WET TO SATURATED, COMPACT.   SS14 21   47		GREY-BROWN FINE GRAINED SAND, TRACE SILT,		SS9	10		47		/				
SAND AND GRAVE: GREY-BROWN FINE TO MEDIUM GRAVEL AND FINE GRANED SAND, TRACE TO SOME SILT, WET TO SATURATED, COMPACT.   SS12 24 20	7.0	WET TO SATURATED, VERY LOOSE TO LOOSE.		SS10	2		0						
SAND AND GRAVEL:   GREY-BROWN FINE TO MEDIUM GRAVEL AND FINE GREY-BROWN SILT OF SOME SILT, WET TO SATURATED, COMPACT.   SS18 21 47	8.0			SS11	10		50		N				POOR RECOVERY IN SPOON
GRAINED SAND. TRACE TO SOME SILT, WET TO SATURATED, COMPACT.    100   93   SILTY SAND.   GREY-BROWN SILTY FINE SAND, WET, CCMPACT   SS14   21   60   67     120   122   SAND.   GREY-BROWN COARSE GRAINED SAND, SOME   SS16   49   70   70     130   162   SAND.   GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, SATURATED, COMPACT.   SS18   22   53   33     153   SS20   22   43   45   3   45     154   SAND.   GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, SATURATED, COMPACT.   SS20   50   20     155   SAND AND GRAVEL.   GREY SILTY CLAY.   GREY SILTY CLAY.   TRACE GRAVEL, APL TO WITH, GREY SILTY CLAY.   GREY SILTY CLAY.   TRACE GRAVEL, APL TO WITH, GREY SILTY CLAY.   GREY SILTY CLAY.   TRACE GRAVEL, APL TO WITH, GREY SILTY CLAY.   TRACE GRAVEL, AP	8.4		8.0										
110   SILTY SAND:   SSILTY FINE SAND, WET, COMPACT   SSILT   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT   SAND:   SSILT	9.0	GRAINED SAND, TRACE TO SOME SILT, WET TO	0000										
110 TO DENSE.  TO DENSE.  TO DENSE.  TO DENSE.  TO DENSE.  TO DENSE.  TO DENSE.  SS16 49 70  SS16 49 70  SS16 49 70  SS17 24 27  SS18 23 33  SS19 45 3 3  SS19 45 3 3  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 23 43  SS20 24 42 40  SS20 25 SAND. TRACE SILT, WET, DENSE.  SS20 25 SS20 20  SS20 27 43 40  SS20 27 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 50 20  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 43 40  SS20 28 42 42 40  SS20 SS20 88 42  SS20 88 40  SS20 88 40  SS20 88 40  SS20 88 40	10.0 9.9 —			0014	,,		60						
12.0 12.2 SAND: GREY-BROWN COARSE GRAINED SAND, SOME FINE TO MEDIUM GRAVEL, TRACE SILT, SATURATED, COMPACT.  15.0 16.0 16.0 16.2 SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  15.0 SS20 23 43 SS21 22 53 44 SS22 43 40 TRACE SILT, WET, DENSE. SS22 43 40 TRACE SILT, WET, DENSE. SS23 50 20 17.5 SAND AND GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT. SS26 74 42 SS27 88 49 70 49 49 49 49 49 49 49 49 49 49 49 49 49	11.0			3314	21		60			Ĭ			
12.0  12.2  SAND: GREY-BROWN COARSE GRAINED SAND, SOME FINE TO MEDIUM GRAVEL, TRACE SILT, SATURATED, COMPACT.  15.0  16.0  16.0  16.2  SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  17.5  SAND: GREY-BROWN MEDIUM TO COARSE GRAINED TRACE SILT, WET, DENSE.  17.5  SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL. TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  SS26  74  43  84  42  40  42  42  40  5826  74  43  88  88  88  88  88  88  88  88  8	11.0			SS15	20		67						
SAND   SAND   SAND   SS17   24   27				SS16	49		70			49			
16.0 16.0 16.0 16.2 SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  SS20 23 43 45 53 5820 23 443 45 5821 22 53 5822 43 40 42 42 40 5824 42 40 5825 81 27 COMPACT.  SS21 81 20.4 SS22 88 40 88 40 88 88 88 88 88 88 88 88 88 88 88 88 88		GREY-BROWN COARSE GRAINED SAND, SOME		SS17	24		27						
15.0  16.0  16.0  16.1  16.0  16.2  SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  17.5  SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  19.0  19.8  SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE. BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.		SATURATED, COMPACT.		SS18	23		33			•			
16.0 16.2  SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  SS21 22 53 40 40 43 41 42 40 SS22 43 40 SS23 50 20  SS23 50 20  SS24 42 40 SS24 42 40 SS25 81 27 SS26 74 43 SS26 74 43 SILTY CLAY: GREY-BROWN MEDIUM TO COARSE GRAINED SAND, AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  SS26 74 43 SILTY CLAY: GREY-BROWN MEDIUM TO COARSE GRAINED SS24 42 40 SS27 88 40 SS27 88 40 SS27 88 40	14.0			SS19	45		3			45			
16.0 16.2  SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  SS21 22 53 40 40 43 41 42 40 SS22 43 40 SS23 50 20  SS23 50 20  SS24 42 40 SS24 42 40 SS25 81 27 SS26 74 43 SS26 74 43 SILTY CLAY: GREY-BROWN MEDIUM TO COARSE GRAINED SAND, AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  SS26 74 43 SILTY CLAY: GREY-BROWN MEDIUM TO COARSE GRAINED SS24 42 40 SS27 88 40 SS27 88 40 SS27 88 40	15.0			SS20	23		43			•			
16.0  16.2    SAND:   GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.   SS22 43 40 40     17.5   SAND AND GRAVEL:   GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.   SS25 81 27     19.0   19.8   SILTY CLAY:   GREY-SILTY CLAY:   TRACE GRAVEL, APL TO WTPL, VERY DENSE.   BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.   SS27 88 40 40     20.0   SAND:   SS26 74 43 43 40     20.0   SS26 74 43 43 40     20.1   SS26 74 43 43 40     20.1   SS26 74 43 43 40     20.2   SS27 88 40 40     20.3   SS27 88 40 40     20.4   SS27 88 40 40     20.4   SS27 88 88 40 40     20.5   SS27 88 88 40 40     20.6   SS27 88 88 40 40     20.7   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88 40 40     20.8   SS27 88 88     20.8   SS27 88 8				SS21	22		53						
GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE.  SS23 50 20  17.5 SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  SS26 74 43  SS27 88 40  SS27 88 40  SS27 88 40  SS27 88 40	16.0	CANID								43			
17.5 SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  19.0 19.8 20.4 SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE. BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.	17.0	GREY-BROWN MEDIUM TO FINE GRAINED SAND,		SS22	43		40						
SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  19.0  19.8  20.0  19.8  SILTY CLAY: GREY SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE.  BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.				SS23	50		20						
SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT.  SS25 81  27  43  88  88  40  88  88  27  20.4  SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE. BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.		GREY-BROWN MEDIUM TO COARSE GRAINED	V & &	SS24	42		40			42			
20.0 19.8 SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE.  BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.		TRACE FINE SAND, WET TO SATURATED,	9 0	SS25	81		27			81			
20.0  19.8  20.4  20.4  20.4  20.4  20.4  SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE.  BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.	19.0	GOIVIF ACT.	1	SS26	74		43			74_			
20.4 GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE.  BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY.	20.0 19.8	SILTY CLAY:		1	'*								
SILTY CLAY.	20.4 —	GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL,		SS27	88		40			00			
	21.0												
	22.0 GENIVAR												

#### **BOREHOLE NO. BH40**

PAGE 1 of 1

PROJECT NAME: HOLBROOK LANDFILL PROJECT NO.: 111-53037-00 132-00

CLIENT: COUNTY OF OXFORD DATE COMPLETED: Jul 22, 2013

BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER SUPERVISOR: TJB

GROUND ELEVATION: TO BE DETERMINED REVIEWER: KJF

		ST			8	SAMPLI	E		CONE PENETRATION	WATER	
DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	"N" VALUE  10 20 30  SHEAR STRENGTH	CONTENT %  10 20 30	REMARKS
0.3 —	TOPSOIL: DARK BROWN TOPSOIL, SOME ORGANICS, WET, LOOSE.	7/1/					,		OTTENATI	AAb AAF	STRATIGRAPHY BASED ON ADJACENT DEEP BOREHOLE
1.0	SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE TO SOME SILT, SOME MEDIUM TO COARSE GRAVEL BELOW 3.0 m, TRACE SILT, SATURATED, COMPACT.	,									1 cm THICK ORGANIC LAYEF 1.0 m DEPTH
2.0											
3.0											
4.0											
4.6 —	CLAYEY SILT: GREY-BROWN CLAYEY SILT, TRACE GRAVEL, WTPL, STIFF.										
6.1 —	SAND: GREY-BROWN FINE GRAINED SAND, TRACE SILT, WET TO SATURATED, VERY LOOSE TO LOOSE.										
7.0											POOR RECOVERY IN SPOO!
3.0											
9.0	SAND AND GRAVEL: GREY-BROWN FINE TO MEDIUM GRAVEL AND FINE GRAINED SAND, TRACE TO SOME SILT, WET TO SATURATED, COMPACT.										
	BOREHOLE TERMINATED AT 9.1 m DEPTH IN SAND AND GRAVEL.										

#### **BOREHOLE NO. BH41**

PAGE 1 of 1

PROJECT NAME: HOLBROOK LANDFILL PROJECT NO.: 111-53037-00 132-00

CLIENT: COUNTY OF OXFORD DATE COMPLETED: Jul 22, 2013

BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER SUPERVISOR: TJB

GROUND ELEVATION: TO BE DETERMINED REVIEWER: RFK

		ST			S	SAMPLI	Ξ		CONE PENETRATION		TER	
DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	"N" VALUE 10 20 30  SHEAR STRENGTH	CONT	ENT %	REMARKS
0.0	TOPSOIL AND CLAY CAP	7/ 1/										
0.5 —		17 - 3-17										
	<u>WASTE</u>	וו •וו										
1.0		וו (•וו (•וו										
		וו •וו										
	WASTE BECOMING WET	( • × • ×										
	Wiele Begoming Wei	* • × • × • × • × •										
2.0		(•ו× וו (•ו×										
		( • × • × • × • × • × • × • × • × • × •										
		× · × ·										
3.0		( • × • ×										
	WASTE BECOMING SATURATED	***** **** **** **** **** ****										
		וו וו										
		( · × · × · × · × · × · × · × · × · × ·										
4.0		(•ו× וו										
		וו× (•ו×										
		( • × • × • × • × • × • × • × • × • × •										
5.0		( · × · × · × · × · × · × · × · × · × ·										
		וו וו										
		( • × • ×										
		( • × • × • × • × • × • × • × • × • × •										
6.0		( • × • × • × • × • × • × • × • × • × •										
		וו •וו										
		( • × • ×										
7.0		$\times \cdot \times \cdot$										
		( • × • × • × • × • × • × • × • × • × •										
		וו וו										
		וו וו										
8.0		( • × • ×										
		וו וו										
		( • × • × • × • × • × • × • × • × • × •										
		וו •ו×										
9.0	RODEHOLE TERMINIATED AT 0.1 DESTIL	( • × • × • × • × • × • × • × • × • × •										
	BOREHOLE TERMINATED AT 9.1 m DEPTH WASTE.	IIN										
0.0												



project | Holbrook Landfill Site

client | Oxford County rig type | ACKER SOIL-MAX, track-mounted date started | 2015/07/07

location | Holbrook, Oxford County method | Hollow stem augers, 215 mm dia. supervisor | MEQ

orojec	n j	0.	111-53037-00 132-02					oring	11/a							re	eviev	ver	AMS
۶	T		SUBSURFACE PROFILE			SA	MPLE	m	Penetr (Blows	ation Tes / 0.3m)	st Values	•					2		Lab Data
Depth Scale (m)				Jot	اً ا		SPT	Elevation Scale (mASL)	× Dy	namic Co	ne		Wat	ter Co	ntent (%	)	Readings	ails	and Comments
l Sc	E De	epth	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value	tion				0 40 gth (kPa)		& Plas	sticity		Rea	Well Details	l I
Dept	(	(m)		raph	Nur	ŕ	Core	Eleva (r	01	Inconfined		+ Field Vane ■ Lab Vane	PL		\ I		PID		GRAIN SIZE DISTRIBUTION (%) (MIT)
-0	$\vdash$	_	GROUND SURFACE	<u>7/1/</u>			Recovery			0 8		20 160	10	) 20	30	4			GR SA SI CL
	-	0.3	Dark brown <b>TOPSOIL</b> , some organics, wet, loose.																
ı		0.0	Grey-brown medium to fine grained SAND, trace to some silt, some medium																
-1			to coarse gravel below 3.0 m, trace silt,																
			saturated, compact.																
ı																			
-2																			
Ī																			
-3																			
-4																			
L																			
	F	4.6	Grey-brown <b>CLAYEY SILT</b> , trace gravel,	h.															
-5			WTPL, stiff.	11															
				}															
				W															
-6	$\vdash$	6.1		И															
ŀ		6.1	Grey-brown fine grained <b>SAND</b> , trace silt, wet to saturated, very loose to loose.																
			•																
-7																			
-																			
-8																			
-	H	8.4	Grey-brown fine to medium <b>GRAVEL</b>	٥															
			and fine grained <b>SAND</b> , trace to some silt, wet to saturated, compact.	. 0															
-9			siit, wet to saturated, compact.	,0															
-				° 0															
1				0															
-10		9.9	Grey-brown <b>SILTY FINE SAND</b> , wet, compact to dense.																
ŀ			compact to defise.	掛															
1				陆															
-11				陆															
ŀ																			
1,0				陆															
		12.2	Cray brown access are to dealing																
shlogs	Ι΄	12.2	Grey-brown coarse grained <b>SAND</b> , some fine to medium gravel, trace silt,																
iii i			saturated, compact.																
2 2 2																			
ol neg																			
14.																			
<b>e.</b> 14																			
rary.g																			
<u>a</u>																			
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			(continued next page)																Sheet No. 1 of 2

coring | n/a



project | Holbrook Landfill Site

client | Oxford County

project no. | 111-53037-00 132-02

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

date started |

2015/07/07

supervisor | MEQ

reviewer | AMS

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Readings Scale and Well Details Plot Elevation Sca (mASL) X Dynamic Cone Water Content (%) Comments 30 40 Number 1.0 20 N-Value & Plasticity Elev Graphic Undrained Shear Strength (kPa) Depth (m) **STRATIGRAPHY** Depth ( GRAIN SIZE DISTRIBUTION (%) (MIT) ○ Unconfined + Field Vane

Pocket Penetrometer Lab Vane

40 80 120 160 Core PID Recovery 20 (continued) GR SA SI CL 16 16.2 Grey-brown medium to fine grained SAND, trace silt, wet, dense. 17.5 Grey-brown medium to coarse grained SAND and medium GRAVEL, trace clayey silt, trace fine sand, wet to saturated, compact. 0 SS 32 19.1 Grey CLAYEY SILT, trace gravel, APL, 2 SS 27 very stiff. - 20 3 SS 25 20.4 Grey CLAYEY SILT, trace fine to coarse sand, increasing sand content with depth, SS >100 DTPL to APL, hard. - 21 5 SS >100 - 22 6 SS >100 - 23 SS >100 8 SS 96 - 24 9 SS >100 - 25 10 SS >100 26 25.9 Grey medium to coarse grained SAND, 11 SS 45 trace silt, wet, dense to very dense. 12 SS 80 -27 27.1 **END OF BOREHOLE** Stratigraphy to 18.3 m depth inferred from adjacent BH39.



project | Holbrook Landfill Site

client | Oxford County

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

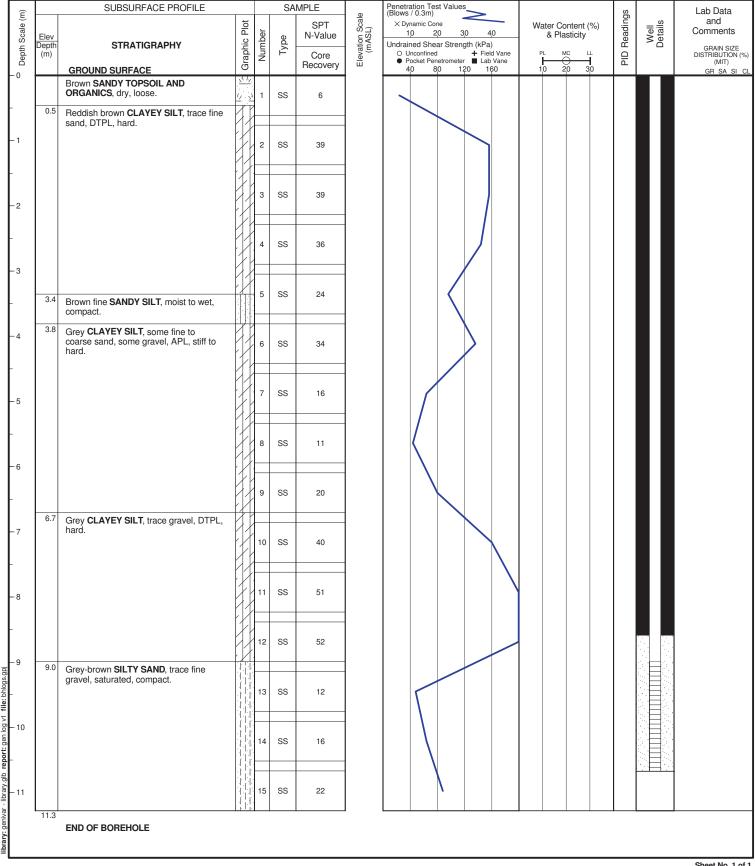
2015/07/21 date started |

supervisor |

**MEQ AMS** 

project no. | 111-53037-00 132-02 coring | n/a

reviewer |





project | Holbrook Landfill Site

client | Oxford County

project no. | 111-53037-00 132-02

Iocation | Holbrook, Oxford County

rig type | ACKER SOIL-MAX, track-mounted

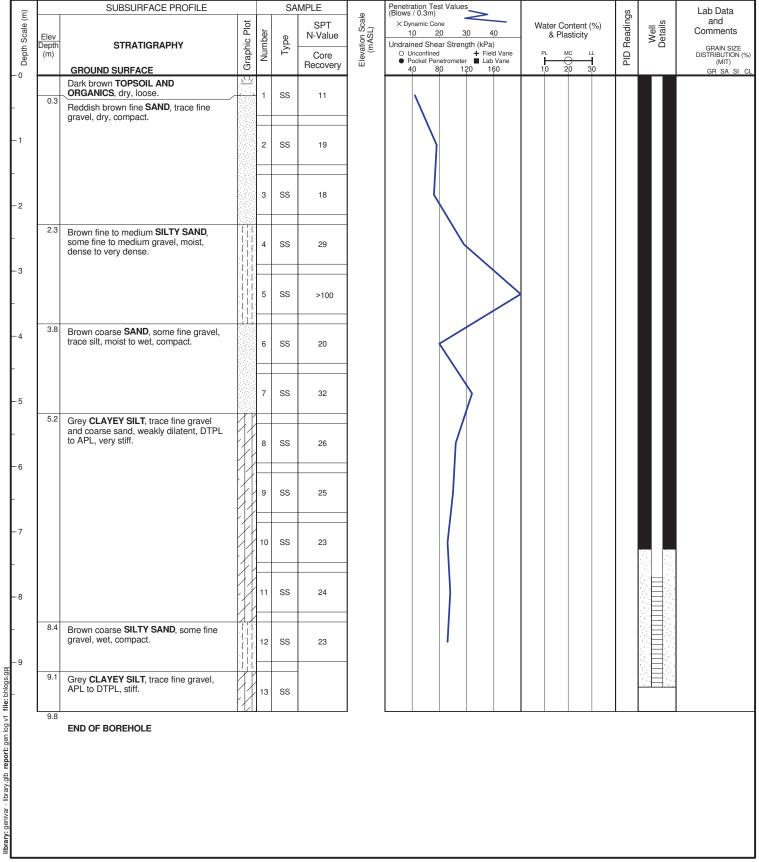
date started |

2015/08/04

method | Hollow stem augers, 215 mm dia.

supervisor | MEQ

coring | n/a reviewer | **AMS** 



project | Holbrook Landfill Site

client | County of Oxford location | Holbrook, Ontario rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

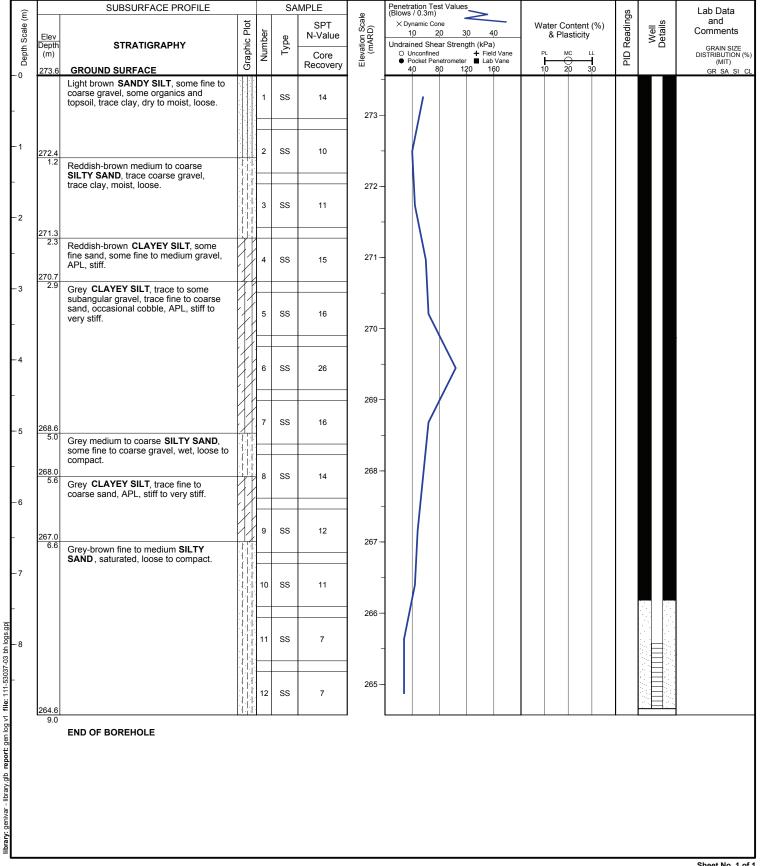
coring | n/a

project no. | 111-53037-03

date started | 2019/08/15

supervisor | MEQ

reviewer | AMS



115

project | Holbrook Landfill Site

client | County of Oxford

location | Holbrook, Ontario

rig type | CME 75, track-mounted

method | Hollow stem augers, 215 mm dia.

coring | n/a

project no. | 111-53037-03

date started | 2019/08/15

supervisor | MEQ reviewer | AMS

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Lab Data Ξ Readings Elevation Scale (mARD) and Well Details Depth Scale X Dynamic Cone Water Content (%) Graphic Plot Comments 10 30 40 20 Number N-Value & Plasticity Elev Type Undrained Shear Strength (kPa) Depth (m) **STRATIGRAPHY** GRAIN SIZE DISTRIBUTION (%) 品 Core Recovery (MIT) 20 120 **GROUND SURFACE** 40 8.0 160 GR SA SI CI - 0 Light brown coarse SAND and fine to coarse GRAVEL, some organics and SS 15 topsoil, occasional cobble, dry, loose. 273.3 Brown to reddish-brown medium to coarse **GRAVELLY SAND**, trace silt, occasional cobble, moist, loose to 273 0 2 SS 14 compact. 0 3 SS 272 -2 271.8 2.1 Reddish-brown medium SILTY SAND, trace clay, wet, loose to compact. SS 6 271 - 3 270.7 Reddish-brown CLAYEY SILT, some 5 SS 13 fine sand, some fine to medium \subrounded gravel, APL, firm. 270.2 Reddish-brown coarse SAND, some 270 fine to coarse subrounded gravel, wet, loose. 6 SS 13 Grey CLAYEY SILT, trace to some subangular gravel, trace fine to coarse sand, APL, stiff to very stiff. SS 14 269 - 5 SS 20 268 - 6 9 SS 17 267 - 7 10 SS 21 -53037-03 bh logs.gpj SS 266 11 18 - 8 265.7 8.2 Grey medium to coarse SILTY SAND, some fine to coarse gravel, trace clay, wet to saturate, loose to compact. 12 SS 14 265 - 9 Grey SILTY CLAY, APL, very stiff. 13 SS 16 264.1 **END OF BOREHOLE** 

# LOG OF BOREHOLE 104 Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/17

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-00coring | n/areviewer | AMS

SUBSURFACE PROFILE SAMPLE Penetration Test Values (Blows / 0.3m) Readings Lab Data Elevation Scale (mARD) and Graphic Plot X Dynamic Cone Water Content (%) Comments 10 20 30 Number N-Value & Plasticity Undrained Shear Strength (kPa) Depth (m) STRATIGRAPHY GRAIN SIZE DISTRIBUTION (%) (MIT) B Core 20 GROUND SURFACE GR SA SI CI 279 278 - 2 277 -3 276 **END OF BOREHOLE** No original borehole log information available.

# LOG OF BOREHOLE 301 Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | CME 75, track-mounted date started | 2014/09/26

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-00coring | n/areviewer | AMS

project		111-55057-00 152-00				•	oring	π,α					100	iewer	AIVIS
		SUBSURFACE PROFILE			SA	MPLE		Penetration (Blows / 0.3r	Test Value	s			,,	,	Lab Data
) O Depth Scale (m)			ot			SPT	Elevation Scale (mARD)	× Dynamic		<u> </u>	Water C	ontent (%	) PID Beadings	<u>_ s</u>	
Scale	Elev		Ę	Number	Φ	N-Value	RD (S	1,0	20	30 40	& Pl	ontent (%) asticity	)   Pe	Well Details	Comments
<b>1</b> €	Elev Depth (m)	STRATIGRAPHY	) jų	ᄪ	Type		/atic	Undrained S	hear Stren	igth (kPa)			, a	[ ]	GRAIN SIZE
Dep	(111)		Graphic Plot	ž	'	Core Recovery	Ele	Pocket	Penetromete	+ Field Vane er ■ Lab Vane 20 160	PL 10	MC LL 20 30		:	GRAIN SIZE DISTRIBUTION (%) (MIT)
-0	278.1	GROUND SURFACE				,	-	40	80 1	20 160	10	20 30	_		GR SA SI CL
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L							277 -	1							
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		END OF BOREHOLE													
		No original harabala log information													
		No original borehole log information available.													
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₫															
															Shoot No. 1 of 1

# LOG OF BOREHOLE SP3 Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/22

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-02coring | n/areviewer | AMS

(E)	SUBSURFACE PROFILE			SA	MPLE		Penetration Test Values (Blows / 0.3m)								S		Lab Data
Scale	Elev	STRATIGRAPHY	aphic Plot Number	Type	SPT N-Value	Elevation Scale (mARD)	× Dynamic Cone 10 20 30 40  Undrained Shear Strength (kPa)						er Conten & Plasticit		Readings	Well Details	and Comments
Depth	Depth (m) 280.4	GROUND SURFACE	Graphic		Core Recovery	Elevat (m	O Un	confined cket Pene	etrometer	+ Field ■ Lab	d Vane Vane	PL  - 10	мс 20	3.0	PID F		GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
-0	200.4	CHOOND SON ACE									-						GR SA SI CL
						280 –											
						_											
						_											
-1						-											
-	279.2					_											
1	1.2	END OF BOREHOLF															

END OF BOREHOLE

No original borehole log information

## **LOG OF BOREHOLE SP3R**



project | Holbrook Landfill Site

client | Oxford County

project no. | 111-53037-00 132-02

 ${\color{red}\textbf{location}} \;|\;\; \textbf{Holbrook, Oxford County}$ 

rig type | ACKER SOIL-MAX, track-mounted

method | Hollow stem augers, 215 mm dia.

....

date started | 2015/07/24

Lab Data

and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

supervisor |

MEQ

coring | n/a

reviewer | AMS

٦		SUBSURFACE PROFILE			SA	MPLE	<b>4</b> 2	Penetration Test Values (Blows / 0.3m)
Depth Scale (m)	Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value	Elevation Scale (mASL)	(Blows / 0.3m)  X Dynamic Cone 10 20 30 40  Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane
O Depth	(m)	GROUND SURFACE	Graph	Nun	Ту	Core Recovery	Elevat (m	O Unconfined → Field Vane  Pocket Penetrometer ■ Lab Vane  40 80 120 160 10 20 30
-		Dark brown <b>TOPSOIL</b> , some fine sand, rootlets, moist, loose.	7 7 7		SS	8		
	0.6	Reddish brown CLAYEY SILT, some	M					
- -1 -		fine to medium sand, trace clay, trace rootlets, moist, compact.		2	SS	12		
- - -2				3	SS	24		
-	2.3	Grey-brown <b>CLAYEY SILT</b> , trace fine to coarse sand, trace gravel, DTPL to APL, stiff to very stiff.		4	SS	18		
-3	3.1	END OF PODEHOLE		1				

#### END OF BOREHOLE

Stratigraphy inferred from adjacent borehole 25R.

genivar - norary.gib report: gen log vi ine: brilogs.gpj

# LOG OF BOREHOLE SP4 Decommissioning WSP

project | Holbrook Landfill Site

client | Oxford County rig type | Acker Soil-Max, track-mounted date started | 2015/07/10

location | Holbrook, ONmethod | Hollow stem augers, 215 mm dia.supervisor | MEQproject no. | 111-53037-00 132-02coring | n/areviewer | AMS

ıı oje	Ct i	10.	111-33037-00 132-02					ornig	II/a							- 11	evie	wei   /	TIVIO
Ē	<u> </u>	SUBSURFACE PROFILE				SA	MPLE	Φ	Penetration Test Values (Blows / 0.3m)										Lab Data
Denth Scale (m)		Elev Depth	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value	n Scal RD)	× Dynamic Cone     1,0    2,0    3,0    4,0  Undrained Shear Strength (kPa)     ○ Unconfined				Water Content (%) & Plasticity  PL MC LL 10 20 30			%)	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT)
- C		(m)		Graph	Nur	Ĺ	Core Recovery												
-0	1	279.6	GROUND SURFACE	$\stackrel{\smile}{-}$		-			40	8	0 120	160	1	0 2	0 30	,			GR SA SI CL
-								-											
ţ								279 –											
-								-											
-1								-											
ļ								-											
-								278 –											
ŀ	2	277.7						-											
1		1.9	END OF BOREHOLE					•				'							
			No original borehole log information available.																

### **LOG OF BOREHOLE SP4R**



project | Holbrook Landfill Site

client | Oxford County

rig type | ACKER SOIL-MAX, track-mounted

Iocation | Holbrook, Oxford County

method | Hollow stem augers, 215 mm dia.

date started | 2015/07/13

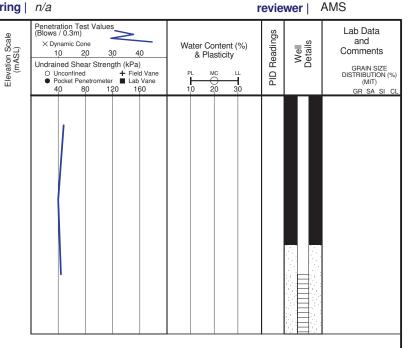
coring | n/a

supervisor | SM

**AMS** 

project no. | 111-53037-00 132-02

<del>-</del>		SUBSURFACE PROFILE			SA	MPLE
Depth Scale (m)	Elev Depth	STRATIGRAPHY	ic Plot	Number	Type	SPT N-Value
	(m)	GROUND SURFACE	Graphic	Nun	Ту	Core Recovery
-0		Brown fine to medium SILTY SAND, some fine gravel, trace organics, moist, compact.  Black clayey organic peat layer at 1.2 m depth.		1	SS	12
		чериі.				
1				2	SS	10
	1.4	Grey fine to medium <b>SAND</b> , some silt,				
-2		trace fine gravel, wet, compact.		3	SS	11
	24					



#### **END OF BOREHOLE**

Stratigraphy inferred from adjacent borehole 24R.

## **APPENDIX**

C

GROUNDWATER ELEVATION DATA

Table C-1: Monitoring Well Details Holbrook Landfill Site

Observation	Installation	Ground Surface	Measuring Point Elevation <sup>(1)</sup>	Stickup (m)	Riser Inside	Screen Length	Screen	ed Interval	Well Depth	Flow System <sup>(2)</sup>	Well Condition Status
Well	Date	Elevation (m ASL) (1)	(m ASL)	Ottokup (iii)	Diameter (mm)	(m)	(m bgs)	(m ASL)	(mbTOP)	Flow System	Well Condition Clatas
2	01-May-79	276.47	277.57	1.10	51	0.50	8.64 - 9.14	270.96 - 270.46	10.51	SFS	Decommissioned in 2014
4	01-May-79	279.32	280.34	1.02	51	0.50	5.60 - 6.10	273.40 - 272.90	7.09	SFS	Decommissioned in 2014
4R	24-Sep-14	278.91	280.12	1.21	51	1.67	4.55 - 6.22	274.36 - 272.69	7.43	SFS	✓
5	01-May-79	279.15	280.12	0.97	51	0.50	7.60 - 8.10	271.10 - 270.60	9.13	SFS	Decommissioned in 2014
5R	24-Sep-14	279.26	280.46	1.20	51	1.68	7.06 - 8.74	272.20 - 270.52	9.94	SFS	✓
6	01-May-79	279.15	279.78	0.63	51	0.50	3.16 - 3.66	275.54 - 275.04	4.39	SFS	Decommissioned in 2014
10	03-May-79	281.63	282.48	0.85	51	0.50	2.85 - 3.35	277.15 - 276.65	4.30	SFS	Decommissioned in 2015
10R	09-Jul-15	281.52	282.55	1.04	51	1.67	2.90 - 4.57	278.62 - 276.95	5.61	SFS	✓
11	03-May-79	280.79	281.99	1.20	51	0.50	4.00 - 4.50	276.50 - 276.00	5.78	SFS	Decommissioned in 2015
11R	24-Jul-15	283.02	284.11	1.09	51	1.67	6.71 - 8.38	276.31 - 274.64	9.47	SFS/SCL	✓
12	03-May-79	280.69	281.85	1.16	51	0.50	7.27 - 7.77	273.23 - 272.73	8.78	SFS/SCL	Decommissioned in 2015
13	13-Jun-79	274.08	274.89	0.81	51	0.50	7.27 - 7.77	266.53 - 266.03	8.65	SFS/SCL	Decommissioned in 2014
13R	25-Sep-14	274.16	275.26	1.10	51	1.67	5.92 - 7.59	268.24 - 266.57	8.69	SFS/SCL	✓
14	13-Jun-79	275.85	277.40	1.55	51	0.50	4.50 - 5.00	271.00 - 270.50	6.23	SFS	Decommissioned in 2014
14R	17-Sep-14	275.69	276.65	0.97	51	1.68	3.96 - 5.64	271.73 - 270.05	6.61	SFS	✓
14A	13-Jun-79	275.94	277.47	1.53	51	0.50	2.24 - 2.74	273.26 - 272.76	4.13	SFS	Decommissioned in 2014
15	13-Jun-79	278.29	279.30	1.01	51	0.50	15.50 - 16.00	262.40 - 261.90	17.18	DFS	Decommissioned in 2014
15A	14-Jun-79	278.31	279.28	0.97	51	0.50	8.00 - 8.50	270.10 - 269.60	9.13	SFS/SCL	✓
16	14-Jun-79	278.19	279.24	1.05	51	0.50	15.35 - 15.85	262.45 - 261.95	17.02	DFS	Decommissioned in 2014
16R	19-Sep-14	277.98	279.23	1.26	51	1.67	14.05 - 15.72	263.93 - 262.26	16.98	DFS	✓
16A	14-Jun-79	278.19	279.50	1.31	51	0.50	8.34 - 8.84	269.46 - 268.96	10.22	SFS/SCL	Decommissioned in 2014
16AR	22-Sep-14	278.14	279.29	1.15	51	1.67	7.75 - 9.42	270.39 - 268.72	10.57	SFS/SCL	✓
17	29-Jun-79	278.84	279.43	0.59	51	0.50	5.60 - 6.10	273.00 - 272.50	7.14	SFS/SCL	Decommissioned in 2013
18	14-Sep-81	279.78	281.31	1.53	51	1.50	4.14 - 5.64	275.86 - 274.36	6.63	SFS/SCL	Decommissioned in 2014
18R	16-Sep-14	279.57	280.76	1.19	51	1.68	4.04 - 5.72	275.53 - 273.85	6.91	SFS	✓
19	14-Sep-81	274.95	276.05	1.10	51	1.50	3.68 - 5.18	271.02 - 269.52	6.15	SFS/SCL	Decommissioned in 2014
19R	26-Sep-14	274.89	276.11	1.21	51	1.65	3.58 - 5.23	271.31 - 269.66	6.44	SFS/SCL	✓
21	16-Oct-81	277.78	278.86	1.08	51	1.20	14.34 - 15.54	263.16 - 261.96	16.59	DFS	Decommissioned in 2015
21R	29-Sep-14	277.75	278.90	1.15	51	1.70	14.15 - 15.85	263.60 - 261.90	17.00	DFS	✓
23	23-Oct-81	278.94	280.15	1.21	51	2.10	18.32 - 20.42	260.08 - 257.98	21.54	DFS	Decommissioned in 2015
24	11-Feb-82	279.73	280.35	0.62	51	1.00	19.42 - 20.42	259.78 - 258.78	20.98	DFS	Decommissioned in 2015
24R	15-Jul-15	280.25	281.00	0.74	51	1.67	18.75 - 20.42	261.50 - 259.83	21.16	DFS	✓
24A	11-Feb-82	279.72	280.84	1.12	51	1.00	3.27 - 4.27	275.93 - 274.93	5.35	SCL	Decommissioned in 2015
24AR	13-Jul-15	279.95	281.11	1.15	51	0.91	3.66 - 4.57	276.29 - 275.38	5.72	SFS	✓
25	12-Feb-82	280.42	280.84	0.42	51	1.00	18.20 - 19.20	261.70 - 260.70	19.81	DFS	Decommissioned in 2015
25R	23-Jul-15	280.72	281.83	1.10	51	1.68	17.98 - 19.66	262.74 - 261.06	20.76	DFS	✓
25A	12-Feb-82	280.41	281.30	0.89	51	1.00	2.50 - 3.50	277.40 - 276.40	4.48	SFS/SCL	Decommissioned in 2015
26	16-Jan-83	272.07	272.21	0.14	51	1.80	2.70 - 4.50	269.10 - 267.30	4.50	SFS	Decommissioned in 2015
26R	07-Aug-15	272.03	272.91	0.88	51	0.61	5.49 - 6.10	266.54 - 265.93	6.98	SFS	Artesian
27	24-Jan-83	272.20	272.35	0.15	51	2.40	10.86 - 13.26	260.84 - 258.44	13.26	DFS	Artesian



<sup>· (1)</sup> Elevations based on 2012 well network survey, with the exception of wells

<sup>4</sup>R, 5R, 10R, 11R, 13R, 14R, 15A, 16R, 16AR, 18R, 19R, 21R, 24R, 24AR, 25R, 26R, 27, 28R, 32R, 31, 33R, 35,

<sup>37</sup>R, 38, 39, 40, 41, 42, 43, 44, SP3R, SP4R, and SP5 which were surveyed in 2015.

 $<sup>\</sup>cdot$  (2) Flow system estimated based on borehole log interpretation.

<sup>·</sup> SFS - Shallow Flow System

<sup>·</sup> SFS/SCL - Shallow Flow System / Shallow Confining Layer

<sup>(</sup>possibly screened between two units)

<sup>·</sup> DFS - Deep Flow System

<sup>✓</sup> Surface seal in good condition and well is capped.

Table C-1: Monitoring Well Details Holbrook Landfill Site

Observation	Installation	Ground Surface	Measuring Point Elevation <sup>(1)</sup>	Stickup (m)	Riser Inside	Screen Length	Screene	ed Interval	Well Depth	Flow System (2)	Well Condition Status
Well	Date	Elevation (m ASL) (1)	(m ASL)		Diameter (mm)	(m)	(m bgs)	(m ASL)	(mbTOP)	, ,,,,,	
28	17-Jan-83	277.65	278.52	0.87	51	1.50	7.64 - 9.14	269.76 - 268.26	9.94	SFS/SCL	Decommissioned in 2015
28R	21-Jul-15	277.72	278.78	1.06	51	1.68	8.23 - 9.91	269.49 - 267.81	10.97	SFS/SCL	✓
30	19-Jan-83	279.10	280.63	1.53	51	3.00	8.00 - 11.00	270.90 - 267.90	12.44	SFS/SCL	Decommissioned in 2014
31	03-Feb-83	279.14	280.06	0.92	51	3.00	14.68 - 17.68	264.22 - 261.22	18.49	DFS	✓
32	19-Jan-83	280.08	280.26	0.18	51	1.80	2.77 - 4.57	276.83 - 275.03	5.46	SFS	Decommissioned in 2015
32R	10-Jul-15	280.12	281.09	0.96	51	1.67	3.28 - 4.95	276.84 - 275.17	5.91	SFS	✓
33	19-Jan-83	280.23	280.78	0.55	51	1.80	10.30 - 12.10	269.60 - 267.80	12.86	SFS/SCL	Decommissioned in 2015
33R	23-Jul-15	280.67	281.85	1.18	51	1.67	10.01 - 11.68	270.66 - 268.99	12.86	SFS/SCL	✓
35	27-Jan-83	278.11	279.03	0.81	51	1.80	12.83 - 14.63	264.97 - 263.17	15.47	DFS	✓
37	15-Jan-83	274.97	276.41	1.44	51	3.00	19.71 - 22.71	255.05 - 252.05	24.43	DFS	Decommissioned in 2015
37R	06-Aug-15	275.15	276.24	1.09	51	1.68	19.05 - 20.73	256.10 - 254.42	21.82	DFS	✓
38	17-Feb-83	282.52	283.66	1.14	51	3.00	22.50 - 25.50	259.77 - 256.77	26.83	DFS	✓
39	18-Jul-13	278.03	278.94	0.91	51	3.05	16.00 - 19.05	262.12 - 259.07	19.84	DFS	✓
40	22-Jul-13	277.95	279.14	1.19	51	3.05	5.33 - 8.38	272.65 - 269.60	9.25	SFS	✓
41	22-Jul-13	286.53	287.63	1.09	51	6.10	2.59 - 8.69	284.14 - 278.04	9.68	LEACHATE	✓
42	08-Jul-15	278.02	279.05	1.03	51	1.68	25.37 - 27.05	252.65 - 250.97	28.08	DFS	✓
43	21-Jul-15	280.62	281.66	1.04	51	1.68	8.99 - 10.67	271.63 269.95	11.71	SFS/SCL	✓
44	04-Aug-15	282.26	283.36	1.10	51	1.67	7.70 - 9.37	274.56 - 272.89	10.47	SFS/SCL	✓
45	16-Aug-19	273.56	274.56	1.00	51	0.91	7.99 - 8.90	265.57 264.66	9.90	SFS/SCL	✓
46	15-Aug-19	273.92	274.88	0.96	51	1.67	7.29 - 8.96	266.63 - 264.96	9.92	SFS/SCL	✓
SP3		280.38	280.73	0.35	32					SFS	Decommissioned in 2015
SP3R	24-Jul-15	280.75	281.81	1.06	51	1.68	1.37 - 3.05	279.38 - 277.70	4.11	SFS	✓
SP4		279.57	279.82	0.25	32					SFS	Decommissioned in 2015
SP4R	13-Jul-15	279.93	280.86	0.93	51	0.61	1.83 - 2.44	278.10 - 277.49	3.37	SFS	✓
SP5		281.64	282.30	0.66	32				2.83	SFS	✓
104		279.80	281.91	2.11	51					SFS	Decommissioned in 2014
301		278.12	279.31	1.19	51					SFS	Decommissioned in 2014

 $<sup>\</sup>cdot$  (1) Elevations based on 2012 well network survey, with the exception of wells

<sup>4</sup>R, 5R, 10R, 11R, 13R, 14R, 15A, 16R, 16AR, 18R, 19R, 21R, 24R, 24AR, 25R, 26R, 27, 28R, 32R, 31, 33R, 35, 37R, 38, 39, 40, 41, 42, 43, 44, SP3R, SP4R, and SP5 which were surveyed in 2015.

<sup>· (2)</sup> Flow system estimated based on borehole log interpretation.

<sup>·</sup> SFS - Shallow Flow System

<sup>·</sup> SFS/SCL - Shallow Flow System / Shallow Confining Layer

<sup>(</sup>possibly screened between two units)

<sup>·</sup> DFS - Deep Flow System

 $<sup>\</sup>cdot\,\checkmark\,\,$  Surface seal in good condition and well is capped.

Table C-2: Groundwater Level Elevations Holbrook Landfill Site

Well Number	Measuring Point Elevation	Ground Elevation	May-79	Jun-79	Oct-79	Mar-80	May-80	Sep-80	Feb-81	Oct-81	Oct-81	Jan-82	Jan-82	Jan-82	Feb-82	Feb-82	Apr-82
2	277.57	276.47	277.00	276.70	276.60	276.90	277.00	276.60	276.70			277.10		276.89		276.80	277.24
4	280.34	279.32	277.10	276.60	276.50	276.80	277.00	276.50	276.60		276.94	276.90		276.73		276.64	277.03
4R	280.12	278.91															
5	280.12	279.15	278.10	277.70	277.30	278.00	278.10	277.50	277.60		278.02	278.02		277.90		277.78	278.37
5R	280.46	279.26															
6	279.78	279.15	278.10	277.70	277.30	278.00	278.10	277.60	277.60		278.02	278.01		277.88		277.75	278.39
10	282.48	281.63	279.60	279.20	278.90	279.40	279.30	278.80	279.00		279.33	279.28		279.16		279.07	279.51
10R	282.55	281.52															
11	281.99	280.79	279.70	279.10	279.80	279.70	279.60	279.60	279.60		279.55	279.50		279.01		279.56	279.00
11R	284.11	283.02															
12	281.85	280.69	278.60	278.30	278.00	278.40	278.70	278.30	278.20		278.45	278.43		278.36		278.30	278.81
13	274.89	274.08		271.60	272.90	272.90	273.00	272.50	272.70		273.20	273.37		273.24		273.15	273.39
13R	275.26	274.16															
14	277.40	275.85		276.20	276.10	276.30	276.50	276.10	frozen		276.54	frozen		frozen		frozen	276.70
14R	276.65	275.69															
14A	277.47	275.94															
15	279.30	278.29		276.30	276.10	276.40	276.60	276.10	276.20	276.48	276.64	276.57	276.48	276.44	276.37	276.38	276.75
15A	279.28	278.31		276.30	276.20	276.40	276.60	276.10	276.20		276.60	276.54		276.40		276.31	276.64
16	279.24	278.19		275.90	275.70	276.00	276.20	275.70	275.80	276.08	276.25	276.19	276.11	276.05	275.95	275.95	276.31
16R	279.23	277.98															
16A	279.50	278.19		276.00	276.00	276.10	276.40	275.90	276.10		276.43	276.34		276.23		276.13	276.50
16AR	279.29	278.14															
17	279.43	278.84		277.10		277.20	277.40	276.80	277.00		277.40	277.33		277.17		277.07	277.52
18	281.31	279.78									277.56	277.42		277.21		277.13	277.60
18R	280.76	279.57															
19	276.05	274.95										frozen		frozen		frozen	
19R	276.11	274.89															
21	278.86	277.78									276.22	276.17	276.08	276.03	275.95	275.95	276.34
21R	278.90	277.75															
23	280.15	278.94									278.66	276.13	276.01	276.04	275.93	275.94	276.48
24	280.35	279.73													275.97	275.97	276.35
24R	280.35	279.73															
24A	280.84	279.72														278.73	278.92
24AR	281.11	279.95															
25	280.84	280.42													276.22	276.07	276.26
25R	281.83	280.72															
25A	281.30	280.41														279.85	279.49
26	272.21	272.07															



<sup>·</sup> Blank indicates data not available.

<sup>· 2001</sup> through 2011 water level evelvations calculated using 2012 survey data.

<sup>· (1)</sup> Data based on field measurements during 2012 well network survey.

## Table C-2: Groundwater Level Elevations Holbrook Landfill Site

Well Number	Measuring Point Elevation	Ground Elevation	May-79	Jun-79	Oct-79	Mar-80	May-80	Sep-80	Feb-81	Oct-81	Oct-81	Jan-82	Jan-82	Jan-82	Feb-82	Feb-82	Apr-82
26R	272.91	272.03															
27	272.35	272.20															
28	278.52	277.65															
28R	278.78	277.72															
30	280.63	279.10															
31	280.06	279.14															
32	280.26	280.08															
32R	281.09	280.12															
33	280.78	280.23															
33R	281.85	280.67															
35	279.03	278.11															
37	276.41	274.97															
37R	276.24	275.15															
38	283.66	282.52															
39	278.94	278.03															
40	279.14	277.95															
41	287.63	286.53															
42	279.05	278.02															
43	281.66	280.62															
44	283.36	282.26															
45	274.56	273.56															
46	274.88	273.92															
SP3	280.73	280.38															
SP3R	281.81	280.75															
SP4	279.82	279.57															
SP4R	280.86	279.93															
SP5	282.30	281.64															
104	281.91 <sup>(1)</sup>	279.80															
301	279.31	278.12															
SG1	273.41	272.49															



<sup>·</sup> Blank indicates data not available.

 $<sup>\</sup>cdot$  2001 through 2011 water level evelvations calculated using 2012 survey data.

 $<sup>\</sup>cdot$  (1) Data based on field measurements during 2012 well network survey.

Table C-2: Groundwater Level Elevations Holbrook Landfill Site

Well Number	Measuring Point Elevation	Ground Elevation	Jun-82	Aug-82	Mar-83	Apr-83	Jun-83	Aug-83	Dec-83	Jun-01	Jun-02	Jun-03	Jun-04	Jun-05	Jun-06	May-07	Jun-08
2	277.57	276.47	277.14	276.62	277.17	277.09	277.07	277.13	276.57	275.60	273.52	275.61	275.68	275.64	275.70	275.63	275.67
4	280.34	279.32	276.90	276.44	276.93	276.89	276.92	277.27	276.65	276.05	276.18	276.11	276.74	276.19	276.19	276.07	276.05
4R	280.12	278.91															
5	280.12	279.15	278.07	277.48	278.21	278.20		278.46		278.90	278.94	278.96	278.92	278.90	278.86	278.77	278.90
5R	280.46	279.26															
6	279.78	279.15	278.09	277.41	278.23	278.23	278.29	278.44	277.83	277.82	277.82	278.08	278.81	278.32	278.28	278.02	278.19
10	282.48	281.63	279.28	278.78	279.33	279.31	279.27	279.56	279.51	279.68	280.26	279.83	280.15	279.77	279.72	279.65	279.71
10R	282.55	281.52															
11	281.99	280.79		277.98	279.79	279.88		277.54	279.83	280.23	280.51	280.32	280.20	280.11	280.48	279.70	280.30
11R	284.11	283.02															
12	281.85	280.69	278.64	277.53		278.57		278.45		278.63	278.75	278.57	279.17	278.91	278.83	278.75	278.84
13	274.89	274.08	273.37	272.80		273.44											
13R	275.26	274.16															
14	277.40	275.85	276.47	276.02		276.50		276.61		275.42	275.45	275.41	275.67	275.42	275.40	275.36	275.32
14R	276.65	275.69															
14A	277.47	275.94				275.18		275.19		275.47	275.47	275.56	275.35	275.23	275.69	275.96	275.32
15	279.30	278.29	276.60	276.17		276.59		276.73		275.48	275.53	275.46	275.79	275.52	275.51	275.45	275.44
15A	279.28	278.31	276.54	276.07	276.59	276.55	276.57	276.68	276.06	275.74	275.77	275.73	276.02	275.75	275.77	275.68	275.69
16	279.24	278.19	276.21	275.70	276.24	276.20	276.17	276.27	275.81	275.26	275.30	275.21	275.56	275.25	275.27	275.21	275.18
16R	279.23	277.98															
16A	279.50	278.19	276.37	275.81		276.48		276.48		275.66	275.68	275.60	275.71	275.65	275.70	275.58	275.50
16AR	279.29	278.14															
17	279.43	278.84	277.32	276.81		277.37		277.58								276.54	276.56
18	281.31	279.78	277.44	276.93		277.43		277.42		276.06	276.06	276.12	276.33	276.13	276.17	276.09	276.13
18R	280.76	279.57															
19	276.05	274.95		275.21		flowing		flowing		274.92	274.94	274.90	275.13	274.88	274.99	274.85	275.05
19R	276.11	274.89															
21	278.86	277.78	276.22	275.69	276.09	276.20	276.19	276.30	275.90	275.43	275.47	275.37	275.75	275.44	275.44	275.35	275.34
21R	278.90	277.75															
23	280.15	278.94	276.24	275.71	276.24	276.20	276.20		275.87	275.47	275.52	275.38	275.77	275.46	275.43	275.39	275.33
24	280.35	279.73	276.24	275.73	276.26	276.23	276.24	276.33	275.90	275.53	276.96	275.45	275.83	275.53	275.50	275.44	275.42
24R	280.35	279.73															
24A	280.84	279.72	278.90	278.52	278.98	278.93	278.81	279.13	279.17	279.30	279.56	279.33	279.61	279.26	278.88	279.14	279.24
24AR	281.11	279.95															
25	280.84	280.42	276.23	275.71	276.22	279.19	276.12	276.28	275.85	275.41	275.49	275.38	275.76	275.46	275.45	275.38	275.35
25R	281.83	280.72															
25A	281.30	280.41	279.60	279.54		279.66	279.53	279.70	279.76	280.03	280.08	280.13	280.14	280.10	280.14	280.07	280.16
26	272.21	272.07				flowing	275.40	276.33	274.84	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing



<sup>·</sup> Blank indicates data not available.

<sup>· 2001</sup> through 2011 water level evelvations calculated using 2012 survey data.

<sup>· (1)</sup> Data based on field measurements during 2012 well network survey.

Table C-2: Groundwater Level Elevations Holbrook Landfill Site

Well Number	Measuring Point Elevation	Ground Elevation	Jun-82	Aug-82	Mar-83	Apr-83	Jun-83	Aug-83	Dec-83	Jun-01	Jun-02	Jun-03	Jun-04	Jun-05	Jun-06	May-07	Jun-08
26R	272.91	272.03		7.09 02				71.29 00	200 00								
27	272.35	272.20				flowing	275.03	276.16	274.46	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing
28	278.52	277.65			275.09	274.94	275.52	274.89	274.38	274.61	274.72	274.43	275.12	274.67	274.64	274.53	274.53
28R	278.78	277.72			273.09	214.54	273.32	214.09	214.30	274.01	214.12	214.43	273.12	214.01	274.04	274.33	274.33
						077.54	277.20	277.44	075 00	275.04	275.00	075.00	270.07	270.04	270.04	275.00	270.02
30	280.63	279.10				277.51	277.26	277.41	275.33	275.94	275.96	275.96	276.07	276.01	276.01	275.98	276.02
31	280.06	279.14				276.25	276.24	276.34	275.95	275.45	275.48	275.38	275.76	275.46	275.48	275.42	275.41
32	280.26	280.08				278.96	278.89	279.13	279.15	279.09	279.56	279.59	279.78	279.56	279.53	279.46	279.49
32R	281.09	280.12															
33	280.78	280.23			276.56	276.54	276.59	276.55	276.45	276.03	276.03	275.96	276.40	276.04	276.51	275.97	275.95
33R	281.85	280.67															
35	279.03	278.11				276.00	276.63	276.72	276.07	275.45	275.49	275.43	275.76	275.48	275.49	275.42	275.41
37	276.41	274.97				275.39	275.32	275.37	275.23	274.96	274.98	274.75	275.31	274.90	274.88	274.78	274.75
37R	276.24	275.15															
38	283.66	282.52				275.46	275.44	275.47	275.33	270.49	270.51	274.86	275.38	274.96	274.97	274.90	274.85
39	278.94	278.03															
40	279.14	277.95															
41	287.63	286.53															
42	279.05	278.02															
43	281.66	280.62															
44	283.36	282.26															
45	274.56	273.56															
46	274.88	273.92															
SP3	280.73	280.38								280.61	280.63	280.53	280.58	280.50	280.50	280.40	280.58
SP3R	281.81	280.75															
SP4	279.82	279.57								278.26	279.34	278.29	279.34	278.41	279.65	279.08	279.15
SP4R	280.86	279.93															
SP5	282.30	281.64								dry	278.51	279.98	280.24	279.85	279.85	279.95	279.77
104	281.91 <sup>(1)</sup>	279.80			280.06	280.06	279.42	279.40									
301	279.31	278.12				277.35	276.64	275.73									
SG1	273.41	272.49															

<sup>·</sup> Blank indicates data not available.

 $<sup>\</sup>cdot$  2001 through 2011 water level evelvations calculated using 2012 survey data.

 $<sup>\</sup>cdot$  (1) Data based on field measurements during 2012 well network survey.

Table C-2: Groundwater Level Elevations Holbrook Landfill Site

Well Number	Measuring Point Elevation	Ground Elevation	Jun-09	May-10	Jun-11	May-12	May-13	May-14	May-15	May-16	May-17	May-18	May-19	May-20	May-21	May-22
2	277.57	276.47	275.73	275.71	275.74	275.69	275.76	275.81	(2)							
4	280.34	279.32	276.36	276.24	276.48	276.03	276.39	276.39	(2)							
4R	280.12	278.91							276.16	276.43	277.14	276.84	277.06	276.66	276.26	276.34
5	280.12	279.15	278.99	278.98	278.97	278.89	278.98	278.07	(2)							
5R	280.46	279.26							278.11	278.55	278.93	279.01	279.07	278.88	278.20	278.77
6	279.78	279.15	279.78	278.17	278.67	277.92	278.70	278.73	(2)							
10	282.48	281.63	279.88	279.76	279.99	279.48	280.03	279.58	279.63	(2)						
10R	282.55	281.52								279.86	280.37	280.26	280.33	280.07	279.71	279.97
11	281.99	280.79	280.17	280.49	280.08	279.58	280.02	280.15	279.59	(2)						
11R	284.11	283.02								280.34	280.69	280.60	280.61	280.41	280.12	280.41
12	281.85	280.69	279.04	278.66	279.21	278.71	279.01	279.03	278.61	(2)						
13	274.89	274.08		273.11	272.86	272.67	272.89	272.82	(2)							
13R	275.26	274.16							273.42	273.59	274.06	273.96	274.14	273.89	273.65	273.63
14	277.40	275.85	275.45	275.39	275.49	275.36	275.43	275.51	(2)							
14R	276.65	275.69							275.47	275.68	276.05	275.94	275.97	275.81	275.63	275.73
14A	277.47	275.94	275.61	275.72	273.50	275.17	275.01	275.31	(2)							
15	279.30	278.29	274.60	275.53	275.67	275.47	275.62	275.69	(2)							
15A	279.28	278.31	275.85	275.78	275.90	275.68	275.82	275.89	275.69	275.91	276.33	276.20	276.24	276.06	275.85	275.97
16	279.24	278.19	275.35	275.26	275.41	275.17	275.37	275.46	(2)							
16R	279.23	277.98							275.22	275.43	275.82	275.70	275.77	275.56	275.33	275.48
16A	279.50	278.19	275.71	275.70	275.78	275.53	275.76	275.90	(2)							
16AR	279.29	278.14							275.64	275.89	276.26	276.15	276.23	276.03	275.80	275.94
17	279.43	278.84	276.90	276.73	277.01	<277.07	<277.63	(2)								
18	281.31	279.78	276.29	276.24	276.37	276.14	276.42	276.51	(2)							
18R	280.76	279.57							276.07	276.43	277.31	276.92	278.13	277.64	277.44	277.32
19	276.05	274.95	274.96	274.95	275.38	274.95	275.31	275.26	(2)							
19R	276.11	274.89							274.82	274.86	275.23	275.13	275.29	275.04	274.82	275.18
21	278.86	277.78	275.53	275.44	275.58	275.28	275.53	275.62	275.28	(2)						
21R	278.90	277.75							275.33	275.55	275.94	275.81	275.92	275.69	275.43	275.63
23	280.15	278.94	275.55	275.45	275.64	275.33	275.57	275.63	275.33	(2)						
24	280.35	279.73	275.62	275.53	275.68	275.37	275.62	275.71	275.37	(2)						
24R	280.35	279.73								275.05	275.44	275.31	275.41	275.19	274.93	275.13
24A	280.84	279.72	279.58	279.57	279.62	279.06	279.60	279.68	279.10	(2)						
24AR	281.11	279.95								279.35	279.81	279.79	279.77	279.64	279.39	279.59
25	280.84	280.42	275.64	275.45	275.60	275.31	275.54	275.37	(2)	(2)			-			
25R	281.83	280.72							. ,	275.63	276.02	275.90	275.97	275.85	275.53	275.69
25A	281.30	280.41	280.16	280.20	280.18	280.09	280.17	280.03	280.07	(2)						
26	272.21	272.07	flowing	flowing	flowing	flowing	275.09	275.22	275.06	(2)						



<sup>·</sup> Blank indicates data not available.

<sup>· 2001</sup> through 2011 water level evelvations calculated using 2012 survey data.

<sup>· (1)</sup> Data based on field measurements during 2012 well network survey.

<sup>· (2)</sup> Well decommissioned.

Table C-2: Groundwater Level Elevations Holbrook Landfill Site

Well Number	Measuring Point Elevation	Ground Elevation														
	Lievation	Lievation	Jun-09	May-10	Jun-11	May-12	May-13	May-14	May-15	May-16	May-17	May-18	May-19	May-20	May-21	May-22
26R	272.91	272.03								275.18	276.01	275.51	275.19	274.82	274.66	274.35
27	272.35	272.20	flowing	flowing	flowing	flowing	274.99	275.13	275.14	275.03	275.45	275.17	275.45	274.71	274.08	275.09
28	278.52	277.65	274.88	274.67	275.08	274.51	274.91	274.99	274.36	(2)						
28R	278.78	277.72								275.55	275.30	275.21	275.30	275.05	274.95	274.99
30	280.63	279.10	276.09	276.18	276.13	276.04	276.15	276.18	(2)							
31	280.06	279.14	275.60	275.53	275.67	275.41	275.66	275.73	275.58	275.82	276.17	276.06	276.16	275.96	275.74	275.81
32	280.26	280.08	279.65	279.56	279.70	279.28	279.71	279.77	279.43	(2)						
32R	281.09	280.12								279.52	279.81	279.78	279.78	279.67	279.44	279.59
33	280.78	280.23	275.98	276.00	276.26	275.93	276.18	276.22	275.88	(2)						
33R	281.85	280.67								276.22	276.55	276.48	276.57	276.28	276.20	276.31
35	279.03	278.11	275.57	275.50	275.63	275.44	275.59	275.66	275.55	275.76	276.16	276.03	276.09	275.90	275.70	275.82
37	276.41	274.97	275.01	274.97	275.01	274.55	274.95	275.07	275.22	(2)						
37R	276.24	275.15								274.99	275.40	275.19	275.38	275.15	275.04	275.08
38	283.66	282.52	275.12	274.99	275.10	274.65	275.05	275.50	274.82	275.04	275.46	275.26	275.43	275.23	275.16	275.12
39	278.94	278.03						278.02	277.43	277.67	278.47	278.18	278.44	277.94	277.51	277.94
40	279.14	277.95						277.65	277.36	277.65	278.44	278.11	278.36	278.16	277.44	277.84
41	287.63	286.53						283.29	282.58	283.33	283.68	283.73	283.65	283.45	283.38	283.25
42	279.05	278.02								277.64	278.20	278.00	278.17	277.78	277.45	277.79
43	281.66	280.62								275.09	275.47	275.38	275.52	275.31	275.26	275.15
44	283.36	282.26								276.68	276.90	276.92	277.21	276.42	276.37	276.38
45	274.56	273.56												274.66	274.29	274.47
46	274.88	273.92												274.52	274.18	273.97
SP3	280.73	280.38	280.73	280.71	280.12	280.09	280.08	280.13	280.12	(2)						
SP3R	281.81	280.75								280.25	280.50	280.48	280.49	280.46	280.44	280.48
SP4	279.82	279.57	279.42	279.42	279.46	279.03	279.46	279.51	279.04	(2)						
SP4R	280.86	279.93								279.10	279.56	279.54	279.56	279.42	279.16	279.34
SP5	282.30	281.64	280.55	279.68	279.51	279.54	280.13	279.59	279.64	279.97	279.55	279.52	279.58	279.60	279.48	279.58
104	281.91 <sup>(1)</sup>	279.80							(2)							
301	279.31	278.12				275.83			(2)							
SG1	273.41	272.49							272.67	272.61	272.67	272.63	272.64	272.61	272.62	272.66



<sup>·</sup> Blank indicates data not available.

 $<sup>\</sup>cdot$  2001 through 2011 water level evelvations calculated using 2012 survey data.

 $<sup>\</sup>cdot$  (1) Data based on field measurements during 2012 well network survey.

<sup>· (2)</sup> Well decommissioned.

Figure C-1
Groundwater Hydrograph - Adjacent Northeast
Holbrook Landfill Site - Shallow Aquifer

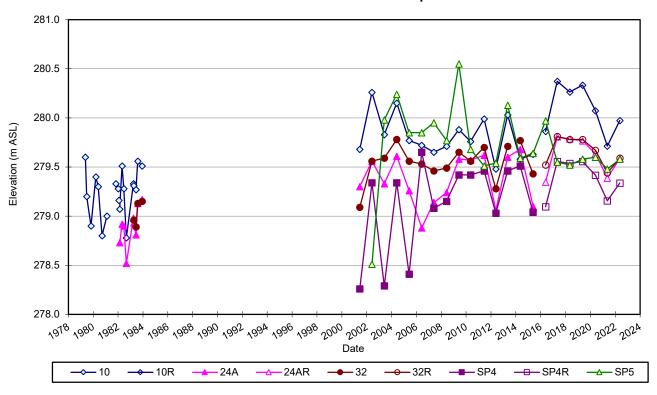


Figure C-2
Groundwater Hydrograph - Adjacent East
Holbrook Landfill Site - Shallow Aquifer

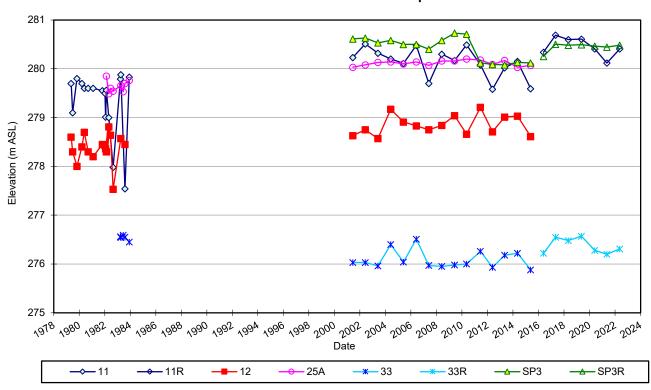




Figure C-3
Groundwater Hydrograph - Adjacent Southeast
Holbrook Landfill Site - Shallow Aquifer

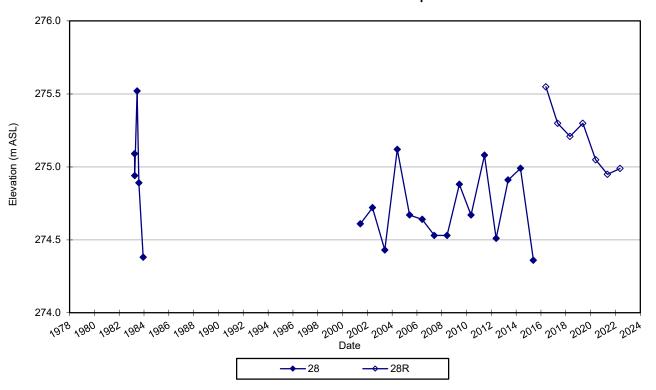


Figure C-4
Groundwater Hydrograph - Downgradient South & Cross-Gradient Southeast
Holbrook Landfill Site - Shallow Aquifer

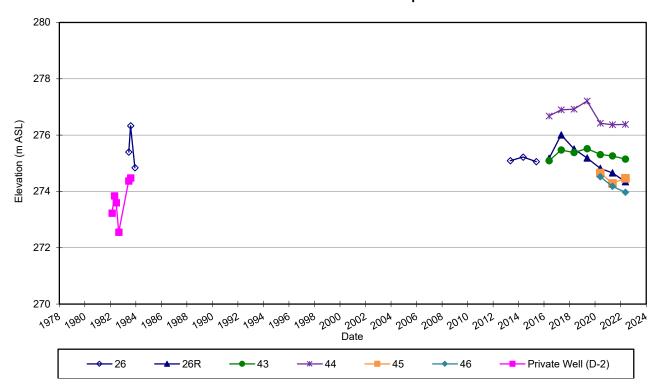




Figure C-5
Groundwater Hydrograph - Adjacent Northwest
Holbrook Landfill Site - Shallow Aquifer

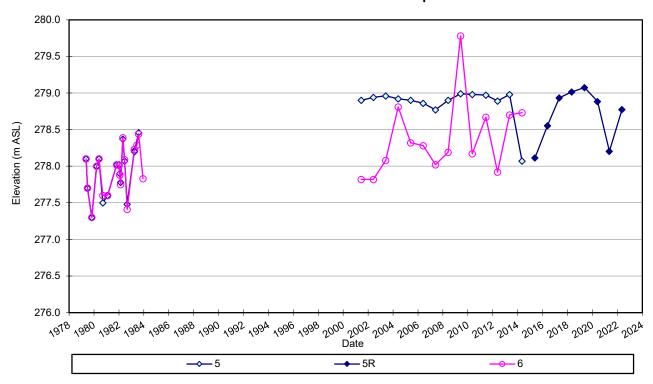


Figure C-6
Groundwater Hydrograph - Downgradient West
Holbrook Landfill Site - Shallow Aquifer

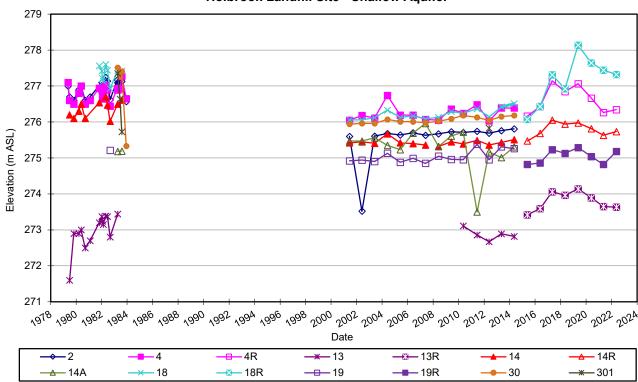




Figure C-7
Groundwater Hydrograph - Cross-Gradient/Upgradient West
Holbrook Landfill Site - Shallow Aquifer

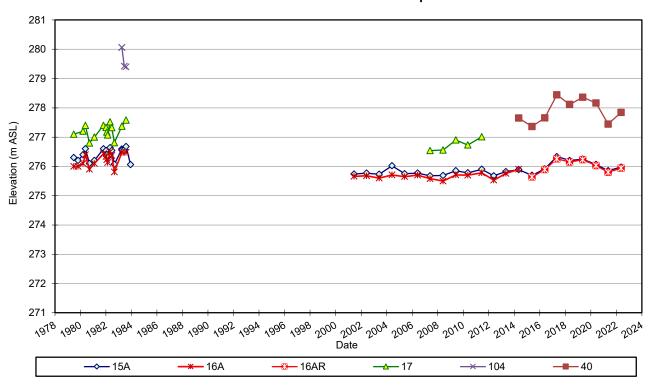


Figure C-8 Groundwater Hydrograph - Landfill Mound Holbrook Landfill Site - Refuse

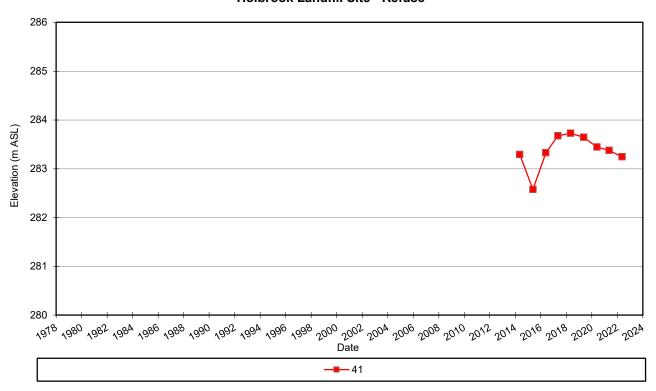




Figure C-9
Groundwater Hydrograph - Adjacent Northeast
Holbrook Landfill Site - Deep Aquifer

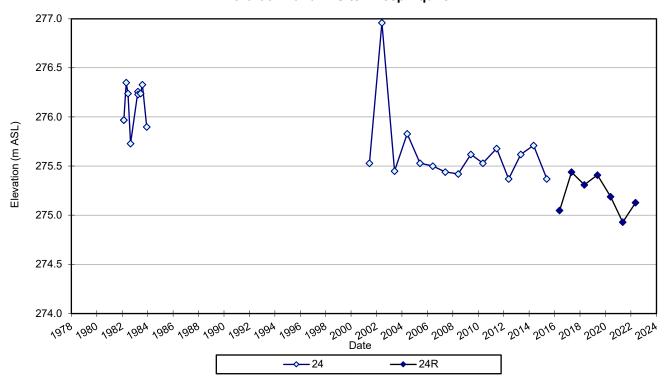


Figure C-10
Groundwater Hydrograph - Adjacent East
Holbrook Landfill Site - Deep Aquifer

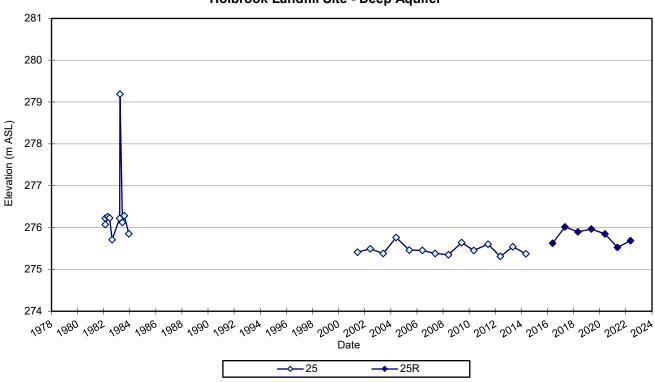




Figure C-11
Groundwater Hydrograph - Adjacent West
Holbrook Landfill Site - Deep Aquifer

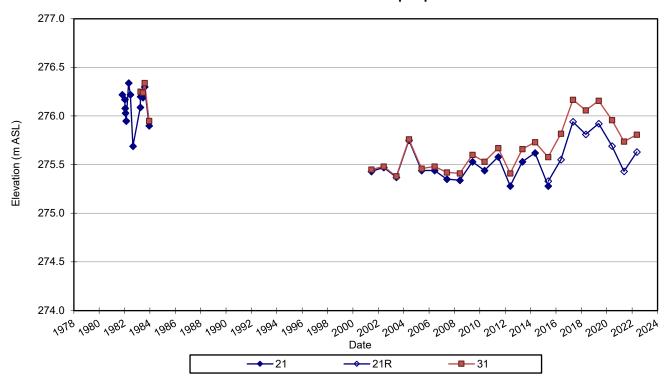


Figure C-12
Groundwater Hydrograph - Downgradient South
Holbrook Landfill Site - Deep Aquifer

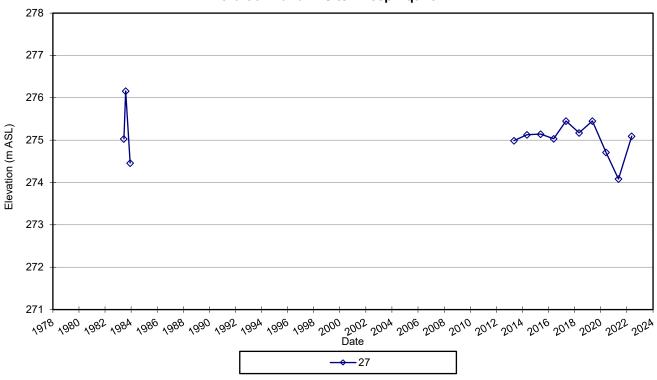


Figure C-13
Groundwater Hydrograph - Downgradient Southeast
Holbrook Landfill Site - Deep Aquifer

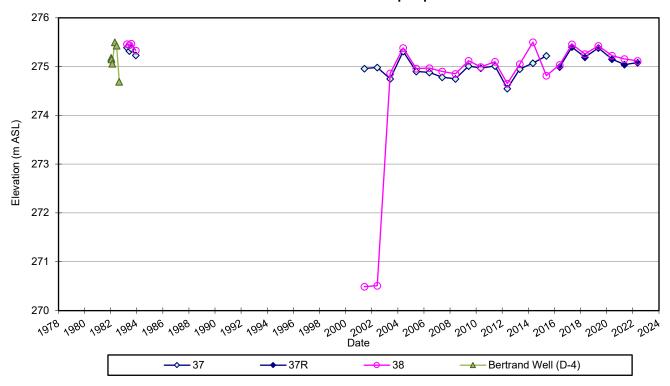


Figure C-14
Groundwater Hydrograph - Adjacent Northwest
Holbrook Landfill Site - Deep Aquifer

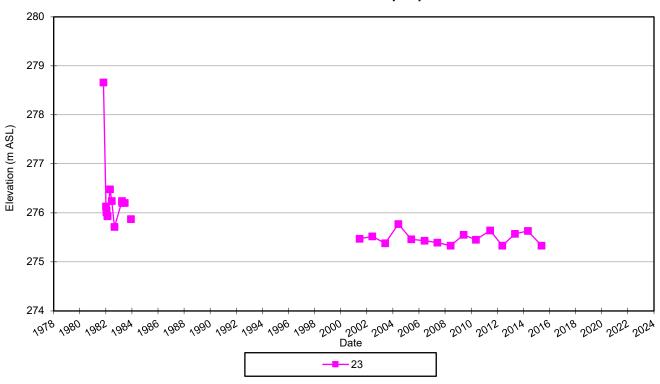
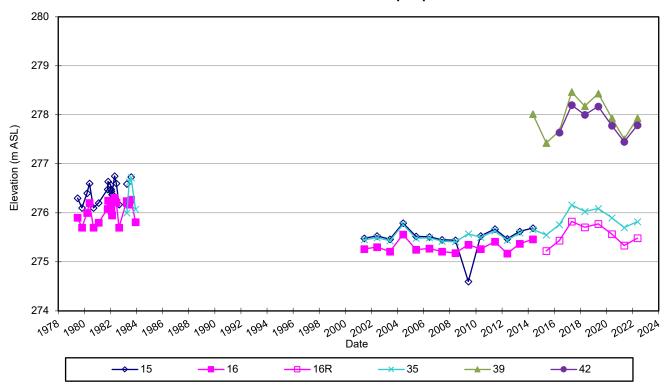


Figure C-15
Groundwater Hydrograph - Cross-Gradient West
Holbrook Landfill Site - Deep Aquifer





# **APPENDIX**

# GROUNDWATER CHEMISTRY

Notation	Description		
	all units in mg/L unless otherwise noted	EC	Electrical Conductivity
mg/L	milligrams per Litre	TKN	Total Kjeldahl Nitrogen
μg/L	micrograms per Litre	DOC	Dissolved Organic Carbon
SU	Scientific Units	Т	Temperature
μS/cm	microSiemens per centimetre		
°C	degrees Celsius		
ODWQS	Ontario Drinking Water Quality Standards (Ju	ne 2003)	
MAC	Maximum Acceptable Concentration		
IMAC	Interim Maximum Acceptable Concentration		
AO	Aesthetic objective		
OG	Operational Guideline		
nc	no OWDWS criteria		
em	equipment malfunction - field parameter data	not available	
DRY	sampling location dry at the time of sampling		
- or blank	parameter not analysed during sampling ever	nt	
< value	parameter not detected above associated lab	oratory repor	ted detection limit
*	estimated / anomalous value - result interpret	ed with caution	on or considered questionable

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Field	d Parameter	's	Ge	neral Param	eters			N	lajor and Mino	rlons				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	pH	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	<b>°</b> C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 AO	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
11	16-May-79				7.9	290		5.0		105									
	27-Jun-79				7.9	310	168	3.9		150									7.8
	30-Oct-79				7.6	670	348	9.5			79.5	36.2							
	20-Mar-80				7.7	630	335	13.5			77.5	34.4							
	27-May-80				8.2	432	225	10.0			52.5	22.8							
	18-Sep-80				7.5	630	334	11.5			76.0	35.0							
	6-Feb-81				7.7	690	367	17.5			83.0	38.8							
	28-Jan-82				7.7	600	396	12.0		260									2.3
	29-Apr-82				7.5	620	396	14.0											1.7
	2-Sep-82				7.8	640	340	13.5			80.5	33.6							2.9
	30-Mar-83				7.3	610	390	19.0											2.1
	13-Jun-83				7.3	390	456	26.0											1.7
	14-Sep-83				7.3	700	424	24.0											1.4
	7-Dec-83				7.7	730	570	25.0											2.1
	1-May-84				7.2	920	504	33.0											1.5
	6-Nov-84				6.9	1040	615	27.0		308	139	65.0							1.1
	30-Apr-85				7.31	875	445	27.5		284	105	44.4							3.0
	21-Oct-85				7.58	1020	519	27.0		156	125	50.0							2.5
	30-Apr-86				7.23	434	270	14.5		208	67.5	24.6							4.6
	14-Oct-86				7.31	805	420	18.0		324	102.0	40.0							2.8
	20-Apr-87				7.33	845	452	20.5			110	43.0							3.2
	6-Oct-87				7.43	750	373	17.8		349	92.9	34.2							3.7
	10-May-88				7.29	1040	591	24.8		355	148	53.7							3.1
	12-Oct-88				7.20	1040	671	29.0		556	163	64.0							9.0
	23-Jan-89				7.07	1296	669	35.3		473	162	63.6							
	30-Oct-89				7.21	1320	712	29.0		546	176	66.0							2.4
	7-May-90				7.21	1011	556	21.6		442	139	50.0							۷.٦
	29-Oct-90				7.46	1030	542	19.5		503	140	46.6							4.6
																			4.0
	6-May-91				7.44	949	488	20.6		462	122	44.4							



Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	als		Vola	atile Organic C	ompounds
Well		Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 <i>IMAC</i>	0.05 MAC	0.3 <i>AO</i>	0.05 AO	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
11	16-May-79							
	27-Jun-79			0.04				
	30-Oct-79			0.62				
	20-Mar-80			0.89				
	27-May-80			0.15				
	18-Sep-80			0.03				
	6-Feb-81			0.01				
	28-Jan-82			0.02				
	29-Apr-82							
	2-Sep-82							
	30-Mar-83							
	13-Jun-83							
	14-Sep-83							
	7-Dec-83							
	1-May-84							
	6-Nov-84			0.18				
	30-Apr-85			0.80				
	21-Oct-85			0.80				
	30-Apr-86			0.64				
	14-Oct-86			0.66				
	20-Apr-87			0.01				
	6-Oct-87			0.20				
	10-May-88			0.94				
	12-Oct-88			0.06				
	23-Jan-89			0.41				
	30-Oct-89			0.96				
	7-May-90			0.65				
	29-Oct-90			0.09				
	6-May-91			0.19				

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Fie	ld Parameters		Ge	neral Param	eters			N	ajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	pН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 AO	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
11	26-May-92				7.36	843	454	17.3		376	118	38.5							4.1
cont'd	6-Oct-92				7.55	745	398	15.0		332	104	33.7							5.0
	3-May-93				7.26	897	438	12.0		465	107	41.1							3.3
	26-Oct-93				7.26	991	502	14.4		487	128	44.0							4.2
	25-Apr-94				7.70	877	474	11.6		432	123	39.8							3.6
	25-Oct-94				7.38	782	416	11.0		359	112	32.7							3.7
	16-May-95				7.37	820	440	9.9		355	114	37.5							3.8
	15-Jun-97				7.60	714	415	7.6		386	112	32.9	2.40	7.8					
	15-Jun-98				7.36	760	487	8.0		210	137	35.1	3.14	7.87					
	15-Jun-99				7.27	885	527	13.0		308	154	34.7	3.27	9.35					
	15-Jun-00				7.86	930	537	8.0		440	153	37.7	1.38	14.9					
	15-Jun-01				7.32	993	547	10.0		565	160	35.7	0.75	17.5					
	15-Jun-02				7.12	844	427	10.0		438	124	28.4	2.06	7.16					
	15-Jun-03				7.34	868	509	15.0		450	147	34.5	1.40	11.2					
	15-Jun-04				7.65	927	448	9.0		491	125	33.1	1.28	19.8					
	15-Jun-05				8.05	796	575	9.9		517	160	40.2	2.5	9.5					
	15-Jun-06				7.24	854	510	9.0		450	148	33.8	2.0	7.3					
	29-May-07				6.88	933	390	6.0		530	118	22.9	3.0	6.3					
	5-Jun-08				7.45	973	120	8.0		450	36.4	6.5	2.0	3.9					
	4-Jun-09				7.38	889	305	5.4		477	91.5	18.7	2.7	4.44					
	13-May-10	7.10	620	8.0	7.62	970	664	5.06		600	198	41.2	2.53	6.77					
	15-Jun-11	7.33	776	11.8	7.81	922	579	5.14		565	175	34.5	2.31	5.88					
	23-May-12	6.97	788	11.1	7.73	957	557	5.82		549	163	36.4	2.28	5.86					
	9-May-13	2.34	1163	9.5	7.99	1060	634	16.7		502	186	41.1	2.22	7.06					
	9-May-14	7.31	1079	8.2	7.92	1000	478	13.3		501	130	37.2	1.99	7.68					
	27-May-15	6.98	573	14.3	7.60	997	448	9.53	29.9	522	121	35.5	2.00	8.02					

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	ıls		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 IMAC	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
11	26-May-92	0.0 1111740	0.00 M/AO	0.41	0.00 AC	T MAG	·	o mao i ao
cont'd	6-Oct-92			0.14				
oone a	3-May-93			0.85				
	26-Oct-93			0.08				
	25-Apr-94			1.03				
	25-Oct-94			0.29				
	16-May-95			0.64				
	15-Jun-97			0.15	0.110			
	15-Jun-98			1.17	0.170			
	15-Jun-99			0.08	0.180			
	15-Jun-00			1.29	0.410			
	15-Jun-01			<0.02	0.180			
	15-Jun-02			0.26	0.180			
	15-Jun-03			0.19	0.210			
	15-Jun-04			0.03	0.060			
	15-Jun-05			<0.05	0.058			
	15-Jun-06			0.06	0.161			
	29-May-07			0.27	0.203			
	5-Jun-08			1.74	0.048			
	4-Jun-09			0.273	0.094			
	13-May-10			0.216	0.178			
	15-Jun-11			0.291	0.148			
	23-May-12			0.550	0.227			
	9-May-13			0.636	0.313			
	9-May-14			1.30	0.432			
	27-May-15			0.169	0.078			
	a, 10			3.100	2.370			

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Field	d Parameters		Ge	neral Param	eters			N	lajor and Mino	rlons				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	pН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units ODWQS	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	°C 15 <i>AO</i>	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 <i>AO</i>
11R	25-May-16	7.00	1062	11.9	8.10	1440	664	76.4	7.34	735	163	62.5	4.92	45.1	nc	IIC	10.0 MAC	1.0 MAC	5 AU
TIK	1-Nov-16	7.26	1415	12.2	7.78	1450	-	78.4	4.65	758	163	60.3	4.24	43.4	0.72	2.56	<0.25	<0.25	12.9
	4-May-17	7.31	1590	8.08	7.93	1650	724	85.7	4.32	776	178	67.9	5.67	53.9	5.00	6.29	<0.25	<0.25	10.5
	10-May-18	7.09	1350	10.23	7.74	1540	700	104	3.12	827	172	65.8	6.33	58.1	5.74	6.95	<0.25	<0.25	19.7
	17-May-19	7.24	1380	10.73	6.94	1430	825	102	3.4	753	202	78.1	5.62	60.5	3.96	5.08	<0.10	<0.050	20.5
	12-May-20	7.46	1300	9.61	7.19	1530	777	100	2.6	715	185	76.8	3.58	59.6	1.13	2.38	<0.10	<0.050	17.3
	12-May-21	7.21	1620	10.1	7.98	1550	761	120	4	715	194	66.8	3.09	54.7	3.3	4.6	0.12	<0.03	16.9
	17-May-22	7.21	1450	10.2	7.76	1540	806	140	5	767	197	76.2	4.80	71.2	2.6	4.0	<0.06	<0.03	19.0
16AR	10-May-18	7.87	557	9.43	7.84	605	276	23.3	54.5	277	59.8	30.7	2.38	23.3	<0.02	<0.10	<0.05	<0.05	1.3
	16-May-19	7.86	506	9.95	7.99	571	305	24.2	59.0	268	68.6	32.5	1.64	22.1	0.045	0.36	0.073	<0.010	1.81
	11-May-20	7.90	577	8.10	7.75	635	297	23.8	56.4	273	67.7	31.0	1.30	22.2	0.046	1.13	0.087	<0.010	2.62
	12-May-21	7.70	683	10.5	8.15	619	319	27	86	244	72.9	33.3	1.42	24.4	<0.1	<0.5	0.09	<0.03	1.1
	16-May-22	7.94	661	11.2	8.13	659	365	29	95	283	84.1	37.8	1.43	26.3	<0.1	<0.5	0.14	<0.03	1.3
19R	1-Nov-16	8.33	494	11.5	8.01	466		4.19	26.6	223	39.9	18.4	1.65	27.3	0.12	0.34	0.06	<0.05	1.9
	4-May-17	8.34	459	8.46	8.27	504	190	2.64	27.8	230	40.9	21.3	1.57	20.5	0.16	0.88	<0.05	<0.05	2.8
	10-May-18	8.28	447	9.65	7.43	432	191	1.96	27.7	232	41.1	21.4	1.42	17.2	<0.02	0.19	0.13	<0.05	0.9
	16-May-19	8.04	359	9.17	7.87	385	210	1.76	26.0	214	47.2	22.3	1.31	15.5	<0.010	1.8	0.105	<0.010	1.72
	11-May-20	8.15	389	7.74	7.98	424	207	1.55	25.5	213	48.7	20.6	1.29	13.8	0.034	0.19	0.223	<0.010	1.83
	11-May-21	8.05	442	9.8	8.27	432	245	2	30	205	61.0	22.6	1.44	14.4	<0.1	<0.5	0.23	<0.03	3.6
	16-May-22	8.35	430	12.0	8.15	428	267	2	35	214	64.4	25.8	1.37	16.3	<0.1	<0.5	0.24	<0.03	1.1
26	15-Jun-97				8.04	606	343	15.8		276	93.3	26.8	1.1	8.6					
	15-Jun-98				7.97	595	339	17.0		268	93.7	25.6	1.45	8.11					
	15-Jun-99				7.97	729	400	46.0		223	107	32.3	1.43	27.6					
	15-Jun-00				8.10	760	388	45.0		360	101	32.9	1.56	29.7					ı
	15-Jun-01				7.64	821	442	51.0		357	117	36.5	1.36	30.8					
	15-Jun-02				7.54	916	451	71.0		384	115	39.8	1.39	33.2					
	15-Jun-03				7.59		501	85.0		419	129	43.5	1.35	36.6					
	15-Jun-04				7.54	1110	503	30.0		261	129	44.0	1.64	63.9					
	15-Jun-05				8.13	1360	568	192		468	160	49.3	2.1	80.0					
	15-Jun-06				7.21	1540	610	237		470	155	54.3	2.0	93.5					
					<u> </u>		0.0	5.							<u> </u>				



Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	als		Vola	atile Organic C	ompounds
Well		Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 IMAC	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
11R	25-May-16			7.68	0.086			
	1-Nov-16	0.203	<0.003	6.36	0.068	2.2	<0.20	<0.10
	4-May-17	0.264	<0.003	8.70	0.072	2.6	0.22	<0.10
	10-May-18	0.272	0.008	7.81	0.063			
	17-May-19	0.258	0.00284	8.96	0.130			
	12-May-20	0.215	<0.00050	1.56	0.062			
	12-May-21	0.204	0.00042	2.67	0.059			
	17-May-22	0.243	0.00051	3.99	0.060			
16AR	10-May-18	0.045	<0.003	<0.010	0.026			
	16-May-19	0.037	<0.00050	0.178	0.0311			
	11-May-20	0.032	<0.00050	0.013	0.0176			
	12-May-21	0.040	0.00013	0.03	0.0240			
	16-May-22	0.038	0.00009	0.047	0.0217			
19R	1-Nov-16	0.061	<0.003	0.313	0.084	<0.17	<0.20	<0.10
	4-May-17	0.053	<0.003	<0.010	0.009	<0.17	<0.20	<0.10
	10-May-18	0.044	<0.003	<0.010	0.003			
	16-May-19	0.041	<0.00050	0.020	0.00272			
	11-May-20	0.039	<0.00050	0.067	0.00081			
	11-May-21	0.050	0.00017	<0.007	0.00020			
	16-May-22	0.052	0.00019	<0.007	0.00010			
26	15-Jun-97			0.38	0.060			
	15-Jun-98			0.19	0.060			
	15-Jun-99			0.48	0.030			
	15-Jun-00			0.61	0.030			
	15-Jun-01			0.58	0.040			
	15-Jun-02			0.67	0.040			
	15-Jun-03			0.77	0.050			
	15-Jun-04			0.92	0.060			
	15-Jun-05			1.40	0.078			
	15-Jun-06			1.15	0.078			

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Fiel	d Parameters		Ge	neral Param	eters			N	ajor and Mino	rlons				Nutrients	and Organic In	dicators	-
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units ODWQS	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	°C 15 <i>AO</i>	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	80-100 <i>OG</i>	250 AO	500 <i>AO</i>	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 <i>AO</i>
26	29-May-07				7.24	1600	580	235		510	143	54.0	2.0	120					
cont'd	5-Jun-08				7.69	1730	570	260		550	145	51.5	2.0	126					
	4-Jun-09				7.60	1810	599	242		555	148	55.9	2.7	149					
26R	13-May-10	7.11	1650	10.2	7.81	1680	346	300		594	85.8	31.9	1.33	80.5					
	15-Jun-11	7.35	1458	9.5	7.81	1650	639	300		581	158	59.3	3.05	171					
	23-May-12	7.95	1465	10.0	7.81	1790	648	294		600	161	59.7	2.70	174					
	1-Nov-16	7.40	1820	14.6	7.95	2030		319	17.3	705	133	65.3	3.20	208	0.06	0.88	<0.25	<0.25	11.1
	4-May-17	7.27	2050	8.79	8.08	2210	578	302	18.0	739	134	59.1	2.78	208	0.11	1.05	<0.5	<0.5	13.0
	11-May-18	6.99	1710	10.25	7.99	1840	580	286	17.1	702	136	58.4	2.75	202	0.07	0.85	<0.5	<0.5	12.1
	16-May-19	7.31	1470	11.43	7.41	1750	607	278	16.7	652	142	61.0	2.61	192	0.042	0.89	<0.10	<0.050	10.9
	11-May-20	7.15	1710	8.83	7.29	1770	601	265	14.8	658	151	54.1	2.51	182	0.048	0.86	<0.10	<0.050	10.6
	11-May-21	7.32	1823	9.2	8.08	1790	657	260	21	601	172	55.4	2.95	183	<0.1	0.6	<0.06	<0.03	9.8
	17-May-22	7.35	1552	9.0	7.88	1590	609	240	24	586	150	56.9	2.52	186	<0.1	<0.5	<0.06	<0.03	8.2
28	5-Apr-83				7.8	390	216	5.0		211	50.0	25.0							13.4
	13-Jun-83				7.5	390	252	2.0		234	54.0	27.0							6.5
	13-Sep-83				7.6	400	220	2.0											3.2
	8-Dec-83				7.5	420	270	5.0											1.8
	1-May-84				7.5	510	258	2.0											1.5
	5-Nov-84				7.3	510	258	2.0		224	54.0	30.0							0.6
	29-Apr-85				7.79	560	242	3.5		243	47.5	30.0							2.6
	21-Oct-85				8.05	510	224	3.0		233	43.5	28.0							1.5
	30-Apr-86				7.77	424	257	3.5		258	49.0	32.6							3.9
	14-Oct-86				7.68	455	211	2.5		212	40.5	26.6							1.3
	20-Apr-87				7.61	520	238	2.5		237	45.0	30.4							2.4
	6-Oct-87				7.84	458	246	1.6		230	48.4	30.4							1.6
	10-May-88				7.70	520	270	2.9		156	53.0	33.4							1.2
	12-Oct-88				7.70	380	184	3.0		150	39.0	21.0							1.2
	30-Oct-89				7.73	501	237	3.8		235	45.6	29.9							1.1
	7-May-90				7.84	546	266	6.4		244	51.1	33.6							0.8
	29-Oct-90				7.73	495	227	4.1		235	45.6	27.5							1.2



Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	ıls		Vol	atile Organic C	ompounds
Well		Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 IMAC	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 AO	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 <i>MAC 1 AO</i>
26	29-May-07			0.25	0.118			
cont'd	5-Jun-08			0.64	0.096			
	4-Jun-09			1.59	0.090			
26R	13-May-10			1.92	0.089			
	15-Jun-11			1.85	0.089			
	23-May-12			1.79	0.083			
	1-Nov-16	1.80	<0.003	2.16	0.050	<0.17	<0.20	<0.10
	4-May-17	1.85	<0.003	2.14	0.041	<0.17	<0.20	<0.10
	11-May-18	1.80	0.012	2.03	0.042	<0.68	<0.80	<0.40
	16-May-19	1.71	<0.0050	2.03	0.0409	<0.50	<0.50	<0.50
	11-May-20	1.73	<0.0050	2.06	0.0406	<0.50	<0.50	<0.50
	11-May-21	1.41	0.00053	2.19	0.045	<0.2	<0.5	<0.5
	17-May-22	1.27	0.00057	1.96	0.039	<0.2	<0.5	<0.5
28	5-Apr-83			0.35				
	13-Jun-83			0.57				
	13-Sep-83							
	8-Dec-83							
	1-May-84							
	5-Nov-84			<0.04				
	29-Apr-85			1.66				
	21-Oct-85			0.01				
	30-Apr-86			0.03				
	14-Oct-86			0.04				
	20-Apr-87			0.02				
	6-Oct-87			0.03				
	10-May-88			0.03				
	12-Oct-88			<.05				
	30-Oct-89			<0.01				
	7-May-90			<0.01				
	29-Oct-90			1.60				

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Fiel	d Parameters		Ge	neral Param	eters			N	lajor and Mino	rlons				Nutrients	and Organic In	dicators	
Well	Dute	рН	EC	Т	pН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
28	6-May-91				7.76	469	221	3.6		225	45.2	26.2							
cont'd	4-Nov-91				7.94	435	207	2.7		195	41.1	25.2							2.0
	26-May-92				7.66	457	227	2.3		215	45.0	27.8							1.7
	6-Oct-92				7.83	551	295	5.9		255	58.9	35.9							3.6
	3-May-93				7.69	553	280	3.5		789	55.0	35.4							1.0
	26-Oct-93				7.79	535	260	2.7		292	51.3	31.9							1.3
	25-Apr-94				7.81	542	282	3.5		275	57.4	33.5							2.3
	25-Oct-94				7.88	523	262	4.0		264	54.9	30.4							1.4
	16-May-95				7.94	529	274	3.1		255	56.7	32.2							1.3
	15-Jun-97					382	210	1.8		185	47.2		1.4	6.6					
	15-Jun-98					420	219	3.0		214	48.8		2.10	6.80					
	15-Jun-99					497	232	3.0		240	51.5		2.01	8.62					
	15-Jun-00					539	257	3.0		265	55.7		1.21	23.7					
	15-Jun-01					582	347	3.0		301	78.1		0.81	14.5					
	15-Jun-02					581	327	3.0		292	68.8		1.73	9.0					
	15-Jun-03					662	382	5.0		308	80.7		1.18	13.1					
	15-Jun-04					580	272	6.0		311	58.8		0.66	16.7					
	15-Jun-05					529	334	3.23		261	71.2		1.9	11.0					
	15-Jun-06					544	350	4.0		270	82.9		2.0	8.8					
	29-May-07				7.35	597	300	4.0		290	64.2	35.1	2.0	10.7					
	5-Jun-08				7.93	569	310	4.0		270	70.5	31.9	2.0	9.6					
	4-Jun-09				7.98	588	309	2.7		297	68.2	33.7	1.9	8.24					
	13-May-10	7.74	480	9.2	8.05	568	354	2.68		320	75.3	40.4	2.01	10.9					
	15-Jun-11	8.03	451	10.7	8.11	516	287	2.44		272	60.1	33.2	1.90	12.1					
	23-May-12	7.41	451	11.4	8.07	521	271	3.32		275	55.9	32.0	1.75	13.4					
	9-May-13	7.92	613	9.7	8.23	581	302	3.16		262	61.5	36.1	1.95	13.8					
	9-May-14	7.70	623	9.4	7.89	589	296	2.98		267	61.4	34.6	2.58	12.5					
	27-May-15	7.95	380	14.6	8.00	593	282	3.49	31.0	280	59.6	32.3	2.94	12.1					



Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	ıls		Vola	atile Organic C	ompounds
Well		Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 <i>IMAC</i>	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 AO	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
28	6-May-91			0.01				
cont'd	4-Nov-91			0.15				
	26-May-92			<0.01				
	6-Oct-92			0.14				
	3-May-93			0.13				
	26-Oct-93			0.21				
	25-Apr-94			0.02				
	25-Oct-94			<0.01				
	16-May-95			0.04				
	15-Jun-97			<0.02	0.050			
	15-Jun-98			0.17	0.330			
	15-Jun-99			0.09	0.110			
	15-Jun-00			0.02	0.170			
	15-Jun-01			<0.02	0.100			
	15-Jun-02			0.06	0.100			
	15-Jun-03			0.11	0.070			
	15-Jun-04			0.02	0.190			
	15-Jun-05			<0.05	<0.02			
	15-Jun-06			0.06	0.627			
	29-May-07			<0.05	0.009			
	5-Jun-08			<0.05	0.572			
	4-Jun-09			<0.050	0.012			
	13-May-10			0.042	0.133			
	15-Jun-11			0.080	0.141			
	23-May-12			0.060	0.086			
	9-May-13			0.080	0.092			
	9-May-14			0.225	0.113			
	27-May-15			0.015	0.156			

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Field	d Parameters		Gei	neral Param	eters			N	ajor and Mino	rlons				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units ODWQS	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	°C 15 <i>AO</i>	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	80-100 <i>OG</i>	250 AO	500 <i>AO</i>	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 <i>AO</i>
28R	25-May-16	7.63	408	13.5	8.17	533	219	6.10	37.8	263	44.7	26.1	2.49	25.0		110	10.0 111/10	1.0 111/40	o Ac
	1-Nov-16	8.39	535	12.0	8.05	541		4.50	30.7	272	46.2	24.5	2.00	25.6	0.11	0.25	<0.05	<0.05	2.9
	4-May-17	8.15	325	9.82	8.29	567	221	2.75	31.1	270	44.8	26.4	2.33	28.4	0.10	0.33	<0.05	<0.05	1.6
	10-May-18	7.85	313	9.76	8.01	517	222	3.06	32.6	284	45.6	26.3	2.04	28.2	0.06	0.15	0.09	<0.05	1.1
	16-May-19	7.60	221	10.45	8.04	467	234	2.48	29.9	268	48.1	27.7	1.45	25.8	0.16	51.9*	<0.020	<0.010	1.75
	12-May-20	8.19	406	9.15	7.95	516	242	2.51	25.9	270	51.0	27.8	1.72	23.9	0.10	0.43	<0.020	<0.010	1.96
	12-May-21	8.03	475	9.9	8.00	480	232	3	67	239	51.4	25.1	1.47	22.3	0.10	<0.5	<0.06	<0.03	2.0
	17-May-22	8.03	277	10.2	8.24	525	281	7	75	281	62.8	30.2	1.69	37.1	<0.1	<0.5	0.18	<0.03	2.2
32	5-Apr-83				7.7	300	176			167	48.0	16.0							1.1
32	14-Jun-83				7.7	270	148			168	41.0	14.0							1.2
	19-Aug-83				7.9	310	140			100	41.0	14.0							1.2
	13-Sep-83				7.6	320	182												0.6
	7-Dec-83				7.0	220	232												1.3
	1-May-84				7.7	380	200												0.9
	6-Nov-84				7.4	420	212			182	57.0	17.0							0.3
	30-Apr-85				7.85	427	210	1.5		204	54.5	17.8							1.3
	21-Oct-85				7.95	434	212	1.5			58.0	16.2							3.7
	30-Apr-86				7.77	314	201	1.0		195	52.5	17.0							2.5
	14-Oct-86				7.69	403	204	1.0		195	54.5	16.4							1.3
	20-Apr-87				7.65	398	207	1.5		194	54.0	17.4							2.3
	6-Oct-87				7.82	382	223	2.7		200	59.8	17.9							2.0
	10-May-88				7.74	390	217	1.1		177	59.4	16.6							1.2
	12-Oct-88				7.80	370	185	4.0		194	51.0	14.0							1.4
	30-Oct-89				7.73	432	217	6.7		205	59.8	16.4							1.3
	7-May-90				7.86	419	212	4.1		202	55.9	17.5							0.6
	29-Oct-90				7.77	465	223	8.7		221	61.3	17.0							1.3
	6-May-91				7.90	413	199	3.7		204	52.3	16.6							
	4-Nov-91				7.86	496	238	12.5		227	62.4	20.0							2.5
	26-May-92				7.76	455	236	6.7		216	61.4	20.0							2.1
	6-Oct-92				7.84	475	252	9.6		213	67.0	20.5							2.2



Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	als		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 <i>AO</i>	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
28R	25-May-16			<0.010	0.023			
	1-Nov-16	0.074	<0.003	<0.010	0.023	<0.17	<0.20	<0.10
	4-May-17	0.09	<0.003	0.167	0.021	<0.17	<0.20	<0.10
	10-May-18	0.08	<0.003	<0.010	0.018			
	16-May-19	0.084	<0.00050	0.255	0.0194			
	12-May-20	0.073	<0.00050	0.055	0.0177			
	12-May-21	0.085	0.00018	0.27	0.019			
	17-May-22	0.089	0.00019	0.119	0.0194			
32	5-Apr-83			0.23				
	14-Jun-83			0.65				
	19-Aug-83							
	13-Sep-83							
	7-Dec-83							
	1-May-84							
	6-Nov-84			<0.04				
	30-Apr-85			2.56				
	21-Oct-85			0.18				
	30-Apr-86			0.01				
	14-Oct-86			0.02				
	20-Apr-87			0.03				
	6-Oct-87			0.01				
	10-May-88			0.03				
	12-Oct-88			<.05				
	30-Oct-89			0.01				
	7-May-90			0.01				
	29-Oct-90			0.02				
	6-May-91			0.09				
	4-Nov-91			0.10				
	26-May-92			<0.01				
	6-Oct-92			0.05				

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Field	d Parameters		Ge	neral Param	eters			N	lajor and Mino	rlons				Nutrients	and Organic In	dicators	
Well		рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units ODWQS	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	⁰C 15 <i>AO</i>	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 AO
32	3-May-93				7.75	440	222	6.3		228	58.0	18.6							1.2
cont'd	26-Oct-93				7.88	509	250	11.7		252	67.0	20.1							2.7
	25-Apr-94				8.05	451	242	7.4		235	64.3	19.7							2.4
	25-Oct-94				7.89	498	246	8.8		237	65.6	19.9							4.3
	16-May-95				7.86	472	240	7.5		250	62.9	20.0							1.8
	15-Jun-97				8.17	437	235	5.3		191	59.3	21.1	0.70	7.40					
	15-Jun-98				8.06	439	275	8.0		208	75.1	21.2	1.13	7.17					
	15-Jun-99				7.57	530	311	8.0		228	83.4	24.9	0.84	8.46					
	15-Jun-00				8.07	515	267	7.0		240	70.7	22.0	0.53	19.7					
	15-Jun-01				7.80	518	312	7.0		250	83.4	25.1	0.42	22.5					
	15-Jun-02				7.60	472	244	6.0		233	63.9	20.7	0.86	6.15					
	15-Jun-03				7.84	509	288	7.0		264	75.6	24.1	0.38	9.15					
	15-Jun-04				7.89	460	225	7.0		234	56.6	19.8	0.36	15.9					
	15-Jun-05				8.25	433	256	6.8		216	66.8	21.6	0.8	8.3					
	15-Jun-06				7.72	455	290	8.0		250	79.4	22.8	<1	6.7					
	29-May-07				7.30	458	200	6.0		230	54.3	15.9	1.0	6.8					
	5-Jun-08				7.99	457	150	7.0		230	40.9	11.8	2.0	6.3					
	4-Jun-09				7.99	492	157	6.8		243	43.1	11.9	1.8	4.0					
	13-May-10	8.08	430	7.8	7.86	536	335	10.6		274	88.6	27.6	0.98	7.72					
	15-Jun-11	8.13	427	10.5	8.08	511	291	9.32		270	76.7	24.2	1.09	7.34					
	23-May-12	6.66	430	9.0	7.93	543	291	9.39		266	76.4	24.3	1.11	7.35					
	9-May-13	7.80	592	8.9	8.16	562	301	8.63		244	78.5	25.6	0.94	7.64					
	9-May-14	7.99	569	7.0	8.13	527	273	8.15		231	69.9	23.9	0.94	7.36					
	27-May-15	7.51	343	15.3	8.04	548	252	9.37	27.4	252	63.6	22.6	0.98	8.39					
32R	25-May-16	7.80	235	11.3	8.09	558	274	10.9	33.2	271	70.5	23.7	1.01	7.9					
	1-Nov-16	8.23	630	12.5	8.07	582		10.6	29.8	278	78	23.3	1.27	7.98	<0.02	0.12	<0.05	<0.05	1.6
	4-May-17	7.92	535	7.27	8.19	598	275	8.74	31.3	271	70.5	24.1	1.22	8.13	0.04	0.28	0.06	<0.05	1.6
	11-May-18	7.72	477	7.42	7.92	507	270	8.42	29.1	271	69.7	23.4	1.17	7.93	0.04	<0.10	0.11	<0.05	1.2
	16-May-19	8.10	421	10.02	7.87	508	293	9.87	37.1	284	76.4	24.9	0.808	7.80	0.06	124*	<0.020	<0.010	1.99
	12-May-20	7.94	462	7.40	7.65	542	275	8.82	25.0	235	71.7	23.4	0.783	7.97	0.064	0.85	0.024	<0.010	2.43



Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	ıls		Vola	atile Organic C	ompounds
Well		Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 <i>IMAC</i>	0.05 MAC	0.3 AO	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
32	3-May-93			0.08				
cont'd	26-Oct-93			0.01				
	25-Apr-94			0.03				
	25-Oct-94			0.21				
	16-May-95			0.13				
	15-Jun-97			0.02	0.110			
	15-Jun-98			0.07	0.380			
	15-Jun-99			0.10	0.020			
	15-Jun-00			<0.02	0.060			
	15-Jun-01			<0.02	0.120			
	15-Jun-02			0.12	0.070			
	15-Jun-03			0.10	0.050			
	15-Jun-04			0.04	0.050			
	15-Jun-05			0.09	0.033			
	15-Jun-06			0.97	0.083			
	29-May-07			0.17	0.073			
	5-Jun-08			0.06	0.040			
	4-Jun-09			<0.050	0.039			
	13-May-10			0.579	0.057			
	15-Jun-11			0.366	0.058			
	23-May-12			0.400	0.053			
	9-May-13			0.429	0.050			
	9-May-14			0.353	0.049			
	27-May-15			<0.010	0.032			
32R	25-May-16			0.267	0.04			
	1-Nov-16	0.043	<0.003	0.099	0.049	<0.17	<0.20	<0.10
	4-May-17	0.029	<0.003	0.156	0.036	<0.17	<0.20	<0.10
	11-May-18	0.032	<0.003	0.130	0.041	<0.17	<0.20	<0.10
	16-May-19	0.030	<0.00050	0.170	0.0391	<0.50	<0.50	<0.50
	12-May-20	0.028	<0.00050	0.258	0.0446	<0.50	<0.50	<0.50

Table D-1: Groundwater Chemical Results - Shallow Flow System

Well	Date -	Field Parameters			General Parameters			Major and Minor Ions						Nutrients and Organic Indicators					
		pН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm			-	-		_							
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 AO	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
32R	11-May-21	7.75	620	7.7	8.14	519	351	14	39	245	95.4	27.5	0.920	8.47	<0.1	<0.5	0.08	<0.03	2.7
cont'd	16-May-22	7.73	573	8.8	8.08	582	335	15	33	291	87.0	28.8	0.816	9.88	<0.1	<0.5	0.41	<0.03	1.6
33R	16-May-19	8.35	381	11.19	8.02	437	195	3.76	29.4	244	50.1	16.9	4.24	30.7	0.085	2.44	0.496	<0.010	3.53
40	9-May-14	7.18	786	9.5	8.05	728	381	16.5		348	113	24.0	1.15	10.7					
	27-May-15	6.99	476	10.7	7.90	734	365	17.8	37.5	341	110	22.0	0.89	12.0					
	24-May-16	7.22	556	10.2	8.07	722	384	16.7	41	349	115	23.5	0.97	11					
	1-Nov-16	7.66	711	9.9	7.88	714		22.2	40.1	328	106	20.1	0.99	10.7	0.19	0.57	<0.25	<0.25	6.6
	4-May-17	7.45	719	9.07	8.15	782	364	18.8	38.4	346	109	22.3	1.13	11.1	0.16	0.65	<0.05	<0.05	7.3
	10-May-18	7.25	642	9.86	7.86	692	359	18.2	34.5	369	108	21.6	0.96	11.2	0.20	0.60	<0.25	<0.25	6.8
	16-May-19	7.45	589	10.11	7.24	658	385	20.3	37.8	345	116	23.4	0.951	11.3	0.224	1.48	<0.020	<0.010	7.06
	11-May-20	7.94	462	7.40	7.29	707	368	19.7	40.7	333	113	21.2	0.919	10.5	0.187	0.79	0.021	<0.010	8.06
	11-May-21	7.50	758	8.7	8.15	722	450	20	45	337	142	23.2	1.02	10.4	0.3	<0.5	<0.06	<0.03	6.8
	16-May-22	7.35	718	9.8	7.95	699	431	29	51	338	131	25.3	0.995	13.4	0.2	<0.5	0.08	<0.03	5.8
41	9-May-14	6.41	2980	11.9	7.66	2590	501	166		1110	121	48.3	84.7	103					
	27-May-15	6.81	1954	15.3	7.41	2840	614	167	2	1240	145	61.1	110	123					
	25-May-16	6.75	2930	13.3	7.79	2600	587	156	1.8	1190	150	51.7	84.9	97.6					
	1-Nov-16	6.80	3430	15.7	7.58	3670		267	3.8	1590	134	61.3	132	151	195	212	<0.5	<0.5	75.7
	4-May-17	6.76	2820	14.50	7.57	2210	569	83.3	2.61	1060	158	42.3	55.8	62.5	87.0	86.5	<0.25	<0.25	35.0
	10-May-18	6.60	2100	13.93	7.49	1870	546	66.9	3.5	1010	155	38.6	50.2	55.1	75.0	84.3	<0.5	<0.5	30.4
	16-May-19	6.38	1760	10.19	6.46	1840	633	75.2	<3.0	820	178	45.6	54.2	54.1	72.8	89.5	<0.20	<0.10	27.4
	12-May-20	6.52	1950	9.23	6.48	2160	626	74.0	<1.5	301	178	44.2	58.7	58.6	99.2	92.8	<0.10	<0.050	31.9
	12-May-21	6.77	2050	10.2	7.63	2160	685	80	22	1030	199	45.9	66.5	63.3	99.1	95.8	<0.06	<0.03	146
	17-May-22	6.92	2100	10.3	7.30	2010	663	72	7	1040	190	45.7	61.4	59.4	89.9	98.9	<0.06	<0.03	28.4

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	als		Volatile Organic Compounds					
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene µg/L 5 MAC 1 AO			
	Units ODWQS	5.0 <i>IMAC</i>	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>				
32R	11-May-21	0.043	0.0001	0.747	0.0389	<0.2	<0.5	<0.5			
	·										
cont'd	16-May-22	0.057	0.00009	0.082	0.0871	<0.2	<0.5	<0.5			
33R	16-May-19	0.062	<0.00050	0.368	0.0279						
40	9-May-14			3.80	0.268						
	27-May-15			2.99	0.249						
	24-May-16			3.15	0.211						
	1-Nov-16	0.022	<0.003	2.96	0.212	<0.17	<0.20	<0.10			
	4-May-17	0.024	0.005	9.96	0.931	<0.17	<0.20	<0.10			
	10-May-18	0.020	0.004	2.79	0.219	<0.68	<0.80	<0.40			
	16-May-19	0.019	<0.00050	2.80	0.225	<0.50	<0.50	<0.50			
	11-May-20	0.019	<0.00050	2.85	0.218	<0.50	<0.50	<0.50			
	11-May-21	0.036	0.00029	3.19	0.242	<0.2	<0.5	<0.5			
	16-May-22	0.024	0.00045	2.94	0.238	<0.2	<0.5	<0.5			
41	9-May-14			54.7	0.361						
	27-May-15			49.2	0.278						
	25-May-16			63.7	0.328						
	1-Nov-16	4.85	0.006	43.6	0.179	0.90	25	71			
	4-May-17	1.70	0.004	60.5	0.436	1.2	19	21			
	10-May-18	1.71	0.011	55.7	0.484	<6.80	<8.00	<4.00			
	16-May-19	1.94	<0.0050	59.4	0.486	<0.50	17.5	14.5			
	12-May-20	1.63	<0.0050	59.3	0.448	<0.50	15.4	12.1			
	12-May-21	1.90	0.00306	60.6	0.391	0.5	18.8	17.9			
	17-May-22	1.75	0.00247	59.4	0.392	0.4	15.5	15.9			

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date	Field	d Parameters		Ger	neral Param	eters			N	lajor and Mino	r lons				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units ODWQS	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	°C 15 <i>AO</i>	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 AO
43			225			348	125	2.57	16.2	175		16.2	1.67	23.1	nc	iic	10.0 MAC	1.0 MAC	JAO
43	25-May-16	8.03		11.7	8.11						23.4								
	4-May-17	8.41	338	9.40	7.53	365	127	1.35	10.6	174	23.6	16.5	1.73	22.0	0.06	0.36	<0.05	<0.05	2.2
	11-May-18	8.38	285	9.90	7.71	331	122	2.53	12.4	184	22.5	16.1	1.78	23.9	0.14	0.20	<0.05	<0.05	2.0
	17-May-19	8.03	287	10.75	8.25	321	130	5.61	17.4	183	26.0	15.8	1.12	29.4	0.085	2.37 *	0.088	0.030	2.42
	12-May-20	8.59	356	10.36	8.13	421	117	14.6	25.2	202	23.9	13.9	1.29	49.0	0.063	0.20	0.151	0.022	2.51
	12-May-21	7.93	210	11.5	8.24	394	110	16	59	172	23.5	12.5	1.2	49.4	0.1	0.6	0.20	0.08	1.6
	17-May-22	8.20	177	13.0	8.18	418	144	24	34	187	31.9	15.5	1.27	63.5	<0.1	<0.5	0.11	<0.03	1.7
44	24-May-16	7.40	617	11.3	8.11	800	362	13.9	46.0	269	87.4	34.8	1.35	6.58					
															0.07	0.40	07.4	0.05	4.0
	5-May-17	7.81	788	9.00	8.22	840	385	12.3	45.8	262	96.0	35.3	1.37	6.21	0.07	<0.10	27.4	<0.25	1.9
	11-May-18	7.66	713	9.12	7.93	738	384	12.5	41.6	286	96.9	34.4	1.32	6.23	<0.02	<0.10	27.4	<0.25	0.8
	17-May-19	7.78	626	10.63	7.62	708	395	13.8	42.0	274	98.7	35.9	1.26	6.35	<0.010	0.46	24.1	<0.010	3.12
	12-May-20	7.83	661	9.24	7.58	762	384	13.6	37.7	302	98.4	33.6	1.27	6.29	0.016	<0.15	20.7	<0.010	2.17
	12-May-21	7.89	750	10.3	7.98	667	342	16	61	229	86.8	30.5	1.39	7.22	<0.1	<0.5	15.4	<0.03	1.2
	17-May-22	7.77	736	11.1	7.99	735	434	20	50	280	112	37.4	1.28	7.60	<0.1	<0.5	19.1	<0.03	1.0
45	28-Aug-19	8.20	310	13.89	8.24	385	146	3.23	36.1	171	34.0	14.8	2.27	32.5	0.137	18.4	<0.020	<0.010	2.48
	12-May-20	8.50	290	9.13	7.90	334	143	1.14	19.4	157	33.3	14.6	1.62	28.2	0.131	0.22	<0.020	0.048	4.30
	11-May-21	8.15	350	8.8	8.24	328	184	<1	25	153	50.1	14.3	1.05	24.6	<0.1	<0.5	0.11	<0.03	1.8
	16-May-22	8.10	338	10.9	8.23	324	222	3	32	162	41.6	17.1	0.963	28.0	0.1	<0.5	0.17	<0.03	1.2
				. 0.0	0.20					.02				20.0				10.00	
46	28-Aug-19	8.01	208	12.95	7.99	471	245	4.55	24.9	236	62.2	21.9	2.01	15.9	0.072	9.3	<0.020	<0.010	5.62
	12-May-20	8.25	330	9.43	7.88	430	247	2.97	14.8	222	63.4	21.4	1.10	4.35	0.052	0.56	<0.020	<0.010	2.59
	11-May-21	8.18	385	10.4	8.20	391	262	2	33	198	71.4	20.3	1.02	2.36	<0.1	<0.5	<0.06	<0.03	3.1
	16-May-22	8.04	451	13.0	8.24	431	276	1	37	230	106	22.3	1.04	2.18	<0.1	0.6	0.14	<0.03	2.1
															ļ				

Table D-1: Groundwater Chemical Results - Shallow Flow System

	Date		Meta	als		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 <i>IMAC</i>	0.05.44.0	0.3 <i>AO</i>	0.05.40	μg/L	μg/L	μg/L
		5.0 IIVIAC	0.05 MAC		0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
43	25-May-16			0.039	0.010			
	4-May-17	0.153	<0.003	<0.010	0.009	<0.17	<0.20	<0.10
	11-May-18	0.14	<0.003	0.027	0.010	<0.68	<0.80	<0.40
	17-May-19	0.133	<0.00050	0.034	0.00864	<0.50	<0.50	<0.50
	12-May-20	0.166	<0.00050	0.145	0.01230	<0.50	<0.50	<0.50
	12-May-21	0.162	0.00012	0.01	<0.002	<0.2	<0.5	<0.5
	17-May-22	0.145	0.00015	<0.007	0.00340	<0.2	<0.5	<0.5
44	24-May-16			<0.010	0.003			
	5-May-17	0.04	<0.003	<0.010	<0.002	<0.17	<0.20	<0.10
	11-May-18	0.03	0.003	<0.010	<0.002	<0.17	<0.20	<0.10
	17-May-19	0.023	0.00078	0.010	0.00086	<0.50	<0.50	<0.50
	12-May-20	0.022	0.00092	0.034	0.00124	<0.50	<0.50	<0.50
	12-May-21	0.032	0.00040	0.01	<0.002	<0.2	<0.5	<0.5
	17-May-22	0.022	0.00078	0.007	0.00081	<0.2	<0.5	<0.5
45	28-Aug-19	0.127	<0.00050	0.020	0.0378	<0.50	<0.50	<0.50
	12-May-20	0.133	<0.00050	0.050	0.0293	<0.50	<0.50	<0.50
	11-May-21	0.118	0.00015	0.049	0.0193	<0.2	<0.5	<0.5
	16-May-22	0.133	0.00039	0.336	0.0375	<0.2	<0.5	<0.5
46	28-Aug-19	0.016	<0.00050	0.509	0.0199	<0.50	<0.50	<0.50
	12-May-20	0.013	<0.00050	0.667	0.0181	<0.50	<0.50	<0.50
	11-May-21	0.015	0.00014	0.562	0.0177	<0.4	<1	<1
	16-May-22	0.020	0.0002	0.386	0.0156	<0.2	<0.5	<0.5

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters		Ge	neral Param	eters			N	ajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	su	μS/cm	۰C	su	μS/cm			<b>-</b>	,		<b>g</b>							
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 AO	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 MAC	5 AO
21	27-Oct-81				7.7	510		10.0											
	29-Oct-81				8.0	510		8.0											
	28-Jan-82				7.9	490	304	5.0		240									2.1
	29-Apr-82				7.1	445	340	8.0											9.3
	2-Sep-82				7.7	550	283	9.5			76.0	22.6							3.2
	30-Mar-83				7.5	450	276	8.0											1.3
	14-Jun-83				7.4	490	280	7.0											1.3
	14-Sep-83				7.3	480	278	9.0											1.1
	8-Dec-83				7.4	480	440	11.0											1.8
	30-Apr-84				7.3	570	298	9.0											0.9
	5-Nov-84				7.1	550	296	8.0		231	79.0	24.0							1.2
	29-Apr-85				7.87	575	267	10.0		246	70.0	22.4							1.6
	21-Oct-85				7.94	555	271	10.0		261	71.0	22.8							3.6
	30-Apr-86				7.72	460	284	14.0		261	77.0	22.2							2.4
	14-Oct-86				7.66	580	286	13.5		255	76.5	23.0							2.3
	20-Apr-87				7.76	540	260	12.5			67.0	22.4							2.6
	6-Oct-87				7.72	495	259	9.4		223	69.3	20.8							2.4
	10-May-88				7.70	510	265	10.5		190	71.2	21.2							1.6
	12-Oct-88				7.60	510	263	14.0		242	69.0	22.0							2.7
	30-Oct-89				7.71	555	276	14.7		260	73.2	22.5							1.5
	7-May-90				7.93	534	279	13.8		251	73.9	22.9							1.1
	29-Oct-90				7.60	532	254	13.3		243	69.0	19.8							6.0
	6-May-91				7.74	517	251	11.8		241	68.6	19.0							
	26-May-92				7.56	428	210	9.2		196	57.3	16.3							2.0
	6-Oct-92				7.51	409	214	9.4		181	59.6	15.7							2.5
	3-May-93				7.57	459	220	10.7		221	60.3	16.9							1.6
	26-Oct-93				7.41	453	227	12.7		230	63.3	16.7							2.5
	25-Apr-94				7.84	499	257	11.4		246	70.0	19.9							2.2
	25-Oct-94				7.61	491	240	11.4		231	65.3	18.6							1.9



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
21	27-Oct-81							
	29-Oct-81							
	28-Jan-82			<0.02				
	29-Apr-82							
	2-Sep-82							
	30-Mar-83							
	14-Jun-83							
	14-Sep-83							
	8-Dec-83							
	30-Apr-84							
	5-Nov-84			0.04				
	29-Apr-85			1.06				
	21-Oct-85			<0.01				
	30-Apr-86			0.07				
	14-Oct-86			<0.01				
	20-Apr-87			0.12				
	6-Oct-87			0.01				
	10-May-88			0.02				
	12-Oct-88			<.05				
	30-Oct-89			0.02				
	7-May-90			0.02				
	29-Oct-90			0.45				
	6-May-91			0.02				
	26-May-92			<0.01				
	6-Oct-92			0.02				
	3-May-93			0.02				
	26-Oct-93			0.04				
	25-Apr-94			0.01				
	25-Oct-94			0.33				



Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters	:	Ge	neral Param	eters			N	lajor and Mino	r lons				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
21	16-May-95				7.64	502	257	11.1		257	69.9	19.9							1.6
cont'd	15-Jun-97				8.10	555	316	13.5		253	85.2	25.0	1.20						
	15-Jun-98				7.58	441	250	10.0		200	69.7	18.5	2.31						
	15-Jun-99				7.84	498	294	12.0		200	84.0	20.5	1.81						
	15-Jun-00				8.20	517	275	12.0		248	75.1	21.3	0.56						
	15-Jun-01				7.70	514	300	13.0		231	82.1	23.1	0.45						
	15-Jun-02				7.64	559	294	15.0		257	78.2	24.0	1.41						
	15-Jun-03				7.78	536	298	16.0		265	80.3	23.7	1.57						
	15-Jun-04				7.84	565	271	17.0		262	71.6	22.3	0.40						
	15-Jun-05				8.19	542	308	17.4		253	83.7	24.1	1.9						
	15-Jun-06				7.53	526	320	20.0		260	92.6	22.2	2.0						
	29-May-07				7.24	544	260	17.0		260	68.6	21.9	2.0	8.1					
	5-Jun-08				7.90	594	290	29.0		270	77.8	23.6	2.0	10.2					
	4-Jun-09				7.95	566	282	18.3		248	76.6	22.1	1.9	8.12					
	14-May-10	7.72	580	10.9	7.96	579	347	28.6		270	95.5	26.4	1.59	10.0					
	15-Jun-11	7.89	468	11.1	8.06	562	312	27.0		261	86.7	23.1	1.48	10.0					
	23-May-12	7.31	485	11.0	7.85	592	304	25.9		265	84.2	22.8	1.55	10.2					
	9-May-13	7.71	650	9.5	8.14	601	324	25.4		237	88.2	25.1	1.59	10.7					
	9-May-14	7.71	650	9.5	8.11	606	303	24.7		252	81.5	24.1	1.66	10.7					
21R	25-May-16	7.52	408	11.9	8.26	536	210	20.1	33.2	237	50.2	20.6	1.92	27.5					
	1-Nov-16	8.07	637	10.2	8.14	547		22.8	24.9	240	60.0	20.5	1.60	19.1	0.15	0.38	<0.05	<0.05	1.4
	4-May-17	7.94	555	9.96	8.22	602	238	23.4	27.4	253	59.4	21.7	1.61	23.0	0.20	0.34	<0.05	<0.05	1.1
	10-May-18	7.61	504	11.10	7.83	541	236	22.1	24.1	269	59.4	21.2	1.70	25.1	0.09	0.34	<0.05	<0.05	1.4
	16-May-19	7.73	477	10.28	7.70	517	268	25.3	20.9	261	67.4	24.2	1.51	21.9	0.093	0.45	<0.020	<0.010	1.97
	11-May-20	7.85	513	9.00	7.78	556	260	26.3	15.0	262	66.5	22.8	1.59	17.4	0.105	0.18	<0.020	<0.010	2.36
	11-May-21	7.66	630	9.8	8.22	609	312	36	14	266	83.6	25.2	1.63	15.0	0.1	<0.5	<0.06	<0.03	1.7
	17-May-22	7.88	609	10.1	8.06	593	353	40	8	279	91.2	30.5	1.57	15.4	0.1	<0.5	<0.06	<0.03	1.6
	1110, 22	7.00		10.1	0.00					2.0	01.2		1.01	10. 1	Ŭ.,				1.0

Table D-2: Groundwater Chemical Results - Deep Flow System

		Meta	ıls		Vola	atile Organic C	compounds
Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
Units					μg/L	μg/L	μg/L
	5.0 IMAC	0.05 MAC		0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
16-May-95			0.03				
15-Jun-97			<0.02	0.250			
15-Jun-98			<0.02	<0.02			
15-Jun-99			0.04	0.090			
15-Jun-00			<0.02	0.030			
15-Jun-01			<0.02	<0.02			
15-Jun-02			<0.02	<0.02			
15-Jun-03			<0.02	<0.02			
15-Jun-04			<0.02	<0.02			
15-Jun-05			0.06	<0.02			
15-Jun-06			<0.05	0.009			
29-May-07			<0.05	0.003			
5-Jun-08			<0.05	0.147			
4-Jun-09			<0.050	0.004			
14-May-10			0.852	0.135			
15-Jun-11			0.601	0.110			
23-May-12			0.280	0.093			
9-May-13			0.591	0.122			
9-May-14			0.532	0.200			
25-May-16			0.645	0.024			
1-Nov-16	0.046	<0.003	0.814	0.032	<0.17	<0.20	<0.10
4-May-17	0.047	<0.003	0.752	0.035	<0.17	<0.20	<0.10
10-May-18	0.049	<0.003	0.741	0.036			
16-May-19	0.050	0.00054	0.933	0.0382			
11-May-20	0.046	<0.00050	0.905	0.0302			
11-May-21	0.066	0.00008	1.08	0.0449			
17-May-22	0.052	0.00016	1.28	0.0416			
	16-May-95 15-Jun-97 15-Jun-98 15-Jun-99 15-Jun-00 15-Jun-01 15-Jun-02 15-Jun-03 15-Jun-04 15-Jun-05 15-Jun-06 29-May-07 5-Jun-08 4-Jun-09 14-May-10 15-Jun-11 23-May-12 9-May-13 9-May-14 25-May-16 1-Nov-16 4-May-17 10-May-18 16-May-19 11-May-20 11-May-20	Units ODWQS 5.0 IMAC  16-May-95 15-Jun-97 15-Jun-98 15-Jun-00 15-Jun-01 15-Jun-02 15-Jun-03 15-Jun-04 15-Jun-05 15-Jun-08 4-Jun-09 14-May-10 15-Jun-11 23-May-12 9-May-13 9-May-14  25-May-16 1-Nov-16 0.046 4-May-17 0.047 10-May-18 0.049 11-May-20 0.066	Date         Boron         Chromium           0DWQS         5.0 IMAC         0.05 MAC           16-May-95         15-Jun-97         15-Jun-98           15-Jun-99         15-Jun-00         15-Jun-00           15-Jun-01         15-Jun-02         15-Jun-03           15-Jun-05         15-Jun-06         29-May-07           5-Jun-08         4-Jun-09         14-May-10           15-Jun-11         23-May-12         9-May-13           9-May-14         25-May-16         <0.003           1-Nov-16         0.046         <0.003           4-May-17         0.047         <0.003           16-May-19         0.050         0.00054           11-May-20         0.046         <0.00050           11-May-21         0.066         0.00008	Units         Boron         Chromium         Iron           16-May-95         5.0 IMAC         0.05 MAC         0.3 AO           15-Jun-97         <0.02         <0.02           15-Jun-98         <0.02         <0.02           15-Jun-99         0.04         <0.02           15-Jun-01         <0.02         <0.02           15-Jun-02         <0.02         <0.02           15-Jun-03         <0.02         <0.02           15-Jun-04         <0.02         <0.02           15-Jun-05         <0.06         <0.05           15-Jun-06         <0.05         <0.05           29-May-07         <0.05         <0.05           5-Jun-08         <0.05         <0.05           4-Jun-09         <0.05         <0.05           15-Jun-11         <0.605         <0.050           15-Jun-12         <0.05         <0.050           15-Jun-14         <0.05         <0.05           29-May-13         <0.05         <0.050           9-May-14         <0.03         <0.645           1-Nov-16         <0.046         <0.003         <0.741           10-May-18         <0.049         <0.003         <0.741	Date Units ODWGS         Boron So IMAC         Chromium Ons Mac         Iron Ons AC         Manganese           16-May-95         5.0 IMAC         0.05 MAC         0.3 AC         0.05 AC           15-Jun-97         < 0.02         0.250            15-Jun-98         < 0.02         < 0.02         < 0.02           15-Jun-00         < 0.02         < 0.02         < 0.02           15-Jun-01         < 0.02         < 0.02         < 0.02           15-Jun-03         < 0.02         < 0.02         < 0.02           15-Jun-04         < 0.02         < 0.02         < 0.02           15-Jun-05         < 0.06         < 0.02         < 0.02           15-Jun-06         < 0.05         0.003         < 0.02           15-Jun-07         < 0.05         0.003         < 0.02           15-Jun-08         < 0.05         0.003         < 0.02           15-Jun-09         < 0.05         0.003         < 0.02           15-Jun-10         < 0.05         0.004         < 0.05         0.004           14-May-10         < 0.05         0.004         < 0.05         0.004           15-Jun-11         < 0.05         0.05         0.004         < 0.05         0.004	Date Units ODWQS         Boron         Chromium         Iron         Manganese         Vinyl Chloride pg/L pg/L pg/L pg/L pg/L pg/L pg/L pg/L	Born

Table D-2: Groundwater Chemical Results - Deep Flow System

		Fiel	d Parameters		Ge	neral Param	eters			N	lajor and Mino	lons				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
24	19-Feb-82				8.1	430	215	15.0		180									230
	29-Apr-82				7.8	345	212	2.0											14.0
	30-Apr-82				8.1	377	182	1.6											14.3
	4-May-82				8.1	372	177	1.5			36.0	21.0							
	2-Sep-82				7.3	372	179	0.5			37.5	20.8							8.9
	30-Mar-83				7.7	340	196												8.8
	13-Jun-83				7.7	860	200												3.3
	13-Sep-83				7.7	350	188	1.0											4.1
	7-Dec-83				7.7	330	235												3.2
	1-May-84				7.7	390	188	1.0											5.4
	6-Nov-84				7.4	385	172			188	39.0	18.0							2.6
	30-Apr-85				7.27	920	404	65.5		348	118	26.4							3.8
	21-Oct-85				8.02	382	182			218	40.0	19.8							3.5
	30-Apr-86				7.75	304	167	2.0		204	37.5	17.8							5.3
	15-Oct-86				7.40	350	188			206	44.0	19.0							3.6
	20-Apr-87				7.61	383	177	1.0		206	38.5	19.6							4.2
	6-Oct-87				7.69	371	185	1.4		202	40.1	20.6							4.1
	10-May-88				7.46	348	152	4.3		141	34.6	15.9							4.3
	12-Oct-88				7.40	340	137	4.0		174	30.0	15.0							4.1
	30-Oct-89				7.47	366	143	3.5		197	31.7	15.5							3.7
	7-May-90				7.64	369	149	3.3		198	34.2	15.3							3.6
	29-Oct-90				7.45	366	143	3.0		196	32.4	15.0							4.4
	6-May-91				7.53	357	146	1.3		195	32.5	15.6							
	4-Nov-91				7.95	390	176	1.1		197	37.3	20.0							3.6
	26-May-92				7.67	394	189	0.5		214	41.0	20.9							3.2
	6-Oct-92				7.79	391	202	0.9		199	44.7	21.9							3.6
	3-May-93				7.75	379	171	1.6		216	37.8	18.6							3.6
	26-Oct-93				7.96	383	181	2.2		226	41.6	18.8							3.8
	25-Apr-94				7.65	342	147	2.4		190	34.3	14.9							4.6



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 <i>IMAC</i>	0.05 <i>MAC</i>	0.3 AO	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
24	19-Feb-82			<0.05				
	29-Apr-82			10.00				
	30-Apr-82							
	4-May-82							
	2-Sep-82							
	30-Mar-83							
	13-Jun-83							
	13-Sep-83							
	7-Dec-83							
	1-May-84							
	6-Nov-84			<0.04				
	30-Apr-85			6.10				
	21-Oct-85			0.02				
	30-Apr-86			0.03				
	15-Oct-86			0.03				
	20-Apr-87			0.05				
	6-Oct-87			0.05				
	10-May-88			0.04				
	12-Oct-88			<.05				
	30-Oct-89			0.06				
	7-May-90			0.05				
	29-Oct-90			0.17				
	6-May-91			0.31				
	4-Nov-91			0.01				
	26-May-92			<0.01				
	6-Oct-92			0.07				
	3-May-93			0.03				
	26-Oct-93			0.45				
	25-Apr-94			0.26				

Table D-2: Groundwater Chemical Results - Deep Flow System

Date   PH	Nitrate Nitrite  10.0 MAC 1.0 MAC	3.2 3.9
ODWQS   6.5 - 8.5 OG   nc   15 AO   6.5 - 8.5 OG   nc   80-100 OG   250 AO   500 AO   30 - 500 OG   nc   nc   nc   nc   nc   nc   nc   n	10.0 MAC 1.0 MAC	3.2
24       25-Oct-94       7.98       401       186       1.2       219       40.3       20.6         cont'd       16-May-95       7.97       390       192       1.2       214       42.9       20.6         15-Jun-97       8.09       369       187       2.1       202       42.4       19.8       1.20       13.4         15-Jun-98       8.00       333       175       2.0       178       40.4       18.0       2.13       12.7         15-Jun-99       8.16       382       203       1.0       199       46.9       20.8       0.99       11.3         15-Jun-00       8.24       382       184       1.0       205       40.9       19.9       0.58       16.3         15-Jun-01       7.96       373       221       1.0       201       51.2       22.5       0.48       15.0	10.0 MAC 1.0 MAC	3.2
cont'd       16-May-95       7.97       390       192       1.2       214       42.9       20.6         15-Jun-97       8.09       369       187       2.1       202       42.4       19.8       1.20       13.4         15-Jun-98       8.00       333       175       2.0       178       40.4       18.0       2.13       12.7         15-Jun-99       8.16       382       203       1.0       199       46.9       20.8       0.99       11.3         15-Jun-00       8.24       382       184       1.0       205       40.9       19.9       0.58       16.3         15-Jun-01       7.96       373       221       1.0       201       51.2       22.5       0.48       15.0		
15-Jun-97		3.9
15-Jun-98		
15-Jun-99 8.16 382 203 1.0 199 46.9 20.8 0.99 11.3 8.24 382 184 1.0 205 40.9 19.9 0.58 16.3 15-Jun-01 7.96 373 221 1.0 201 51.2 22.5 0.48 15.0		
15-Jun-00 8.24 382 184 1.0 205 40.9 19.9 0.58 16.3 15-Jun-01 7.96 373 221 1.0 201 51.2 22.5 0.48 15.0		Ì
15-Jun-01 7.96 373 221 1.0 201 51.2 22.5 0.48 15.0		
15-Jun-02 7.77 382 193 1.0 209 41.6 21.7 0.84 11.9		
15-Jun-03 7.89 383 203 1.0 213 44.9 22.0 0.78 12.8		
15-Jun-04 7.97 401 178 2.0 212 38.6 19.8 0.62 13.9		
15-Jun-05 8.36 384 207 1.7 211 45.7 22.5 1.1 13.0		
15-Jun-06 7.79 288 130 3.0 170 28.3 15.2 2.0 15.4		
29-May-07 7.60 375 230 2.0 200 57.8 20.5 2.0 11.2		
5-Jun-08 8.07 391 190 <2 200 44.8 20.0 2.0 12.6		
4-Jun-09 8.08 385 199 <2.0 207 46.2 20.3 1.8 11.0		
13-May-10 7.94 290 8.9 8.05 368 216 1.29 208 48.9 22.9 1.05 11.4		
15-Jun-11 8.03 315 10.6 8.16 364 195 1.39 204 43.9 20.7 1.00 10.9		
23-May-12 7.42 323 9.7 7.97 387 192 2.15 207 43.1 20.5 0.96 10.9		
23-May-12 7.42 323 9.7 8.05 390 194 2.1 207 43.5 20.7 1.0 10.9		
9-May-13 7.90 417 9.1 8.31 424 201 1.68 205 44.7 21.6 1.07 11.1		
9-May-14 7.73 422 9.2 8.23 396 192 1.78 197 42.1 21.0 1.03 10.9		
27-May-15 7.29 260 11.3 8.14 404 193 1.84 13.4 203 44.3 19.9 0.92 11.1		
24R 25-May-16 7.77 401 12.3 7.68 500 184 10.8 41.2 220 35.3 23.2 2.59 32.4		
1-Nov-16 8.50 418 10.2 8.02 415 - 2.92 18.2 207 38.3 20.0 1.63 15.3 0.19 0.48	<0.05 <0.05	2.9
4-May-17 8.10 417 8.67 8.31 460 186 2.64 14.2 209 38.8 21.7 1.87 12.4 0.42 0.59	<0.05 <0.05	3.3
11-May-18 7.93 360 9.05 7.79 396 188 1.59 15.4 222 40.8 20.9 1.26 11.1 0.32 0.39	<0.05 <0.05	3.1
16-May-19 7.52 335 9.68 7.97 366 205 1.58 14.1 215 46.5 21.7 1.07 11.2 0.333 0.75	0.031 <0.010	3.85
12-May-20 7.98 365 9.07 7.90 418 206 1.91 14.7 206 47.4 21.2 1.16 11.0 0.013 0.25	0.296 <0.010	4.36



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	als		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 <i>IMAC</i>	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
24	25-Oct-94			0.02				
cont'd	16-May-95			0.04				
	15-Jun-97			0.30	0.100			
	15-Jun-98			0.15	0.020			
	15-Jun-99			0.13	0.030			
	15-Jun-00			0.15	0.020			
	15-Jun-01			0.12	0.020			
	15-Jun-02			0.40	0.020			
	15-Jun-03			0.40	0.020			
	15-Jun-04			0.30	0.020			
	15-Jun-05			0.06	0.022			
	15-Jun-06			<0.05	0.033			
	29-May-07			0.27	0.077			
	5-Jun-08			<0.05	0.021			
	4-Jun-09			0.371	0.027			
	13-May-10			0.622	0.019			
	15-Jun-11			0.595	0.014			
	23-May-12			0.510	0.013			
	23-May-12			0.54	0.013			
	9-May-13			0.584	0.017			
	9-May-14			0.574	0.015			
	27-May-15			0.551	0.016			
24R	25-May-16			0.042	0.011			
	1-Nov-16	0.051	<0.003	0.17	0.012	<0.17	<0.20	<0.10
	4-May-17	0.046	<0.003	0.33	0.014	<0.17	<0.20	<0.10
	11-May-18	0.053	<0.003	0.368	0.014			
	16-May-19	0.045	<0.00050	0.459	0.0148			
	12-May-20	0.045	<0.00050	<0.010	<0.00050			

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters	i	Ge	neral Param	eters			N	lajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	su	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
24R	11-May-21	7.77	432	8.8	8.29	410	238	2	12	208	59.5	21.8	1.18	11.5	0.4	<0.5	2.48	<0.03	3.7
cont'd	16-May-22	7.85	420	9.2	8.18	406	246	2	17	218	59.8	23.6	1.06	12.4	0.4	<0.5	<0.06	0.03	3.2
25	19-Feb-82				8.1	510	243	21.0		190									100
	29-Apr-82				7.5	580	372	26.0											2.7
	30-Apr-82				7.9	623	326	26.8											1.5
	4-May-82				7.9	602	281	33.0			61.0	31.2							
	2-Sep-82				7.8	600	311	25.0			70.5	70.5							4.0
	30-Mar-83				7.5	490	300	18.0											0.6
	13-Jun-83				7.2	490	288	17.0											1.3
	13-Sep-83				7.5	520	302	21.0											1.3
	13-Dec-83				7.2	560	326	21.0											1.1
	1-May-84				7.4	600	310	20.0											0.6
	6-Nov-84				7.1	590	297	18.0		230	71.0	29.0							0.7
	30-Apr-85				7.74	540	265	19.5		238	59.5	28.2							1.7
	21-Oct-85				7.91	520	252	17.5		240	57.5	26.2							3.5
	30-Apr-86				7.15	399	227	15.0		227	50.5	24.4							2.2
	15-Oct-86				7.40	465	231	13.0		226	53.0	24.0							1.6
	20-Apr-87				7.63	438	211	10.5		214	46.5	23.0							2.4
	6-Oct-87				7.84	433	239	7.6		216	54.0	25.3							1.9
	10-May-88				7.59	434	226	8.3		180	51.7	23.4							1.4
	12-Oct-88				7.60	430	199	10.0		207	45.0	21.0							1.5
	30-Oct-89				7.66	432	205	6.0		218	48.2	20.4							1.1
	7-May-90				8.02	445	211	5.3		231	49.7	21.0							0.7
	29-Oct-90				7.56	377	171	6.9		188	40.9	16.6							2.3
	6-May-91				7.50	389	186	5.9		200	43.7	18.6							
	4-Nov-91				7.48	343	155	6.5		154	35.3	16.2							3.1
	26-May-92				7.40	356	174	6.2		182	40.5	17.7							2.0
	6-Oct-92				7.70	443	230	4.9		221	55.8	22.0							1.3
	3-May-93				7.79	430	206	4.8		233	51.0	19.0							1.3



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
24R	11-May-21	0.043	<0.00008	0.567	0.0168			
cont'd	16-May-22	0.044	0.00025	0.512	0.0158			
25	19-Feb-82			<0.05				
	29-Apr-82							
	30-Apr-82							
	4-May-82							
	2-Sep-82							
	30-Mar-83							
	13-Jun-83							
	13-Sep-83							
	13-Dec-83							
	1-May-84							
	6-Nov-84			0.11				
	30-Apr-85			0.58				
	21-Oct-85			0.27				
	30-Apr-86			0.20				
	15-Oct-86			0.05				
	20-Apr-87			0.01				
	6-Oct-87			0.01				
	10-May-88			0.09				
	12-Oct-88			<0.05				
	30-Oct-89			0.06				
	7-May-90			0.01				
	29-Oct-90			0.54				
	6-May-91			0.08				
	4-Nov-91			0.10				
	26-May-92			<0.01				
	6-Oct-92			0.03				
	3-May-93			0.01				

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters		Ge	neral Param	eters			N	lajor and Mino	rions				Nutrients	and Organic Inc	dicators	
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 <i>MAC</i>	5 AO
25	26-Oct-93				7.77	414	194	4.5		234	49.0	17.3							2.3
cont'd	25-Apr-94				7.44	283	133	4.4		143	32.4	12.5							2.6
	25-Oct-94				8.00	433	211	3.6		228	53.2	18.9							1.1
	16-May-95				7.37	286	138	4.0		150	34.5	12.6							2.5
	15-Jun-97				8.18	402	208	3.1		188	52.6	18.5	2.0	11.1					
	15-Jun-98				8.16	370	197	4.0		200	50.6	17.1	2.33	9.76					
	15-Jun-99				7.65	270	147	4.0		138	40.7	11.0	2.05	6.13					
	15-Jun-00				8.13	442	222	7.0		225	59.1	18.1	1.06	25.3					
	15-Jun-01				7.47	514	294	10.0		256	83.4	20.8	0.95	20.0					
	15-Jun-02				7.15	537	279	14.0		264	76.1	21.5	2.09	12.6					
	15-Jun-03				7.38	785	355	63.0		335	96.7	27.6	6.27	35.5					
	15-Jun-04				7.26	634	253	37.0		299	69.0	19.6	2.62	296					
	15-Jun-05				7.95	949	393	91.4		363	110	32.9	1.1	62.0					
	15-Jun-06				6.99	687	370	53.0		300	109	23.4	5.0	29.3					
	29-May-07				6.93	1518	500	213		500	120	47.9	15.0	88.0					
	5-Jun-08				7.49	1040	370	107		390	95.4	31.9	11.0	60.8					
	4-Jun-09				7.40	835	341	59.3		345	92.4	26.9	7.4	42.2					
	13-May-10	7.47	540	10.0	8.00	547	314	28.1		261	85.3	24.5	2.44	15.4					
	15-Jun-11	7.49	500	11.9	8.02	541	278	27.3		252	75.5	21.8	2.15	14.6					
	23-May-12	6.93	520	12.0	7.87	616	290	34.5		269	77.3	23.5	3.89	22.0					
	9-May-13	7.21	732	9.3	8.22	702	325	38.0		286	88.4	25.4	2.68	20.1					
	9-May-14	6.92	1890	11.5	8.14	789	327	72.1		276	83.0	29.1	2.47	37.8					
	27-May-15	7.02	2208	14.1	7.60 *	3640 *	910 *	571 *	2.8 *	1210 *	183 *	110 *	35.5 *	353 *					
25R	25-May-16	7.70	331	12.5	7.97	418	172	7.00	12.7	212	41.7	16.4	1.62	16.5					
	1-Nov-16	8.40	398	12.8	7.70	392	-	5.37	8.48	195	39.9	15.9	1.65	15.5	0.18	0.18	<0.05	<0.05	1.9
	4-May-17	8.02	404	10.53	8.10	444	184	6.60	8.31	212	45.1	17.3	1.55	12.6	0.19	0.35	<0.05	<0.05	1.9
	10-May-18	7.75	359	11.98	7.89	415	188	8.86	8.46	224	46.9	17.3	1.38	12.1	0.12	0.12	<0.05	<0.05	1.8
	17-May-19	7.88	353	12.49	7.86	408	218	12.8	10.0	218	56.1	19.0	1.31	12.5	0.147	0.32	<0.020	<0.010	2.25
	12-May-20	8.17	357	10.33	7.93	405	160	8.69	4.20	219	35.9	17.1	1.64	27.2	0.060	<0.15	<0.020	<0.010	5.42



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	als		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
25	26-Oct-93			0.43				
cont'd	25-Apr-94			0.01				
	25-Oct-94			0.01				
	16-May-95			0.02				
	15-Jun-97			0.02	0.100			
	15-Jun-98			0.14	0.090			
	15-Jun-99			0.07	0.060			
	15-Jun-00			0.28	0.130			
	15-Jun-01			0.30	0.160			
	15-Jun-02			0.15	0.100			
	15-Jun-03			0.20	0.360			
	15-Jun-04			0.02	0.190			
	15-Jun-05			<0.05	0.150			
	15-Jun-06			0.12	0.165			
	29-May-07			0.07	0.825			
	5-Jun-08			<0.05	0.244			
	4-Jun-09			<0.050	0.184			
	13-May-10			1.90	0.074			
	15-Jun-11			1.78	0.053			
	23-May-12			1.71	0.068			
	9-May-13			1.79	0.110			
	9-May-14			1.39	0.082			
	27-May-15			15.6 *	1.58 *			
25R	25-May-16			0.384	0.026			
	1-Nov-16	0.069	<0.003	0.394	0.025	<0.17	<0.20	<0.10
	4-May-17	0.061	<0.003	0.350	0.025	<0.17	<0.20	<0.10
	10-May-18	0.057	<0.003	0.474	0.026			
	17-May-19	0.047	<0.00050	0.563	0.0258			
	12-May-20	0.068	<0.00050	0.182	0.00549			

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters	i	Gei	neral Param	eters			N	lajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 AO
25R	12-May-21	7.83	444	12.0	8.32	427	206	13	9	206	53.8	17.4	1.30	13.1	0.2	<0.5	0.22	<0.03	2.3
cont'd	17-May-22	780	437	12.8	8.04	415	232	15	7	213	60.1	20.0	1.41	19.3	0.1	<0.5	<0.06	<0.03	2.2
27	5-Apr-83				7.2	500	318	10.0		265	89.0	26.0							0.3
	15-Jun-83				7.3	550	312	12.0		258	75.0	22.0							0.8
	4-Aug-83				7.3	400		13.0											
	19-Aug-83				7.7	545		12.0											
	3-Sep-83																		
	13-Sep-83				7.3	550	328	12.0											0.5
	7-Dec-83				7.3	510	344	13.0											1.0
	30-Apr-84				7.3	630	342	13.0											0.7
	5-Nov-84				7.1	630	335	12.0		257	93.0	25.0							0.4
	29-Apr-85				7.56	650	333	14.5		272	91.5	25.2							0.8
	21-Oct-85				7.76	620	338	14.5		266	92.0	26.2							1.2
	30-Apr-86				7.53	484	323	15.5		272	89.0	24.4							1.9
	15-Oct-86				7.00	620	329	12.0		278	92.0	24.0							1.3
	20-Apr-87				7.43	635	318	15.5		275	87.0	24.4							2.0
	6-Oct-87				7.65	615	357	15.5		283	98.3	27.0							1.5
	10-May-88				7.52	645	358	19.1		236	99.7	26.5							1.1
	12-Oct-88				7.60	610	326	20.0		272	91.0	24.0							0.5
	30-Oct-89				7.62	646	335	19.7		288	92.8	25.0							0.9
	7-May-90				7.84	631	324	19.1		285	88.7	24.7							0.6
	29-Oct-90				7.85	643	327	19.4		286	91.1	24.1							1.1
	6-May-91				7.66	624	330	17.9		281	91.6	24.5							
	4-Nov-91				7.75	644	298	19.5		274	77.6	25.3							1.5
	26-May-92				7.58	642	330	17.8		268	88.7	26.3							1.4
	6-Oct-92				7.70	645	348	19.9		273	94.1	27.3							1.2
	3-May-93				7.54	632	311	17.9		297	83.4	24.8							0.8
	26-Oct-93				7.71		299	20.2		309	80.0	24.1							2.4
	25-Apr-94				7.85	644	339	18.2		304	92.9	25.8							1.8



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vol	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
25R	12-May-21	0.057	0.00013	0.70	0.026			
cont'd	17-May-22	0.061	0.00024	0.875	0.0246			
27	5-Apr-83			0.64				
	15-Jun-83			0.73				
	4-Aug-83							
	19-Aug-83							
	3-Sep-83							
	13-Sep-83							
	7-Dec-83							
	30-Apr-84							
	5-Nov-84			<0.04				
	29-Apr-85			0.76				
	21-Oct-85			0.62				
	30-Apr-86			0.62				
	15-Oct-86			0.83				
	20-Apr-87			0.68				
	6-Oct-87			0.61				
	10-May-88			0.71				
	12-Oct-88			0.57				
	30-Oct-89			0.63				
	7-May-90			0.65				
	29-Oct-90			0.79				
	6-May-91			0.72				
	4-Nov-91			0.59				
	26-May-92			0.43				
	6-Oct-92			0.53				
	3-May-93			0.65				
	26-Oct-93			0.71				
	25-Apr-94			0.80				

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters		Ger	neral Param	eters			N	lajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
27	25-Oct-94				7.71	644	335	18.3		271	92.4	25.2							1.0
cont'd	16-May-95				7.57	628	318	17.2		273	85.5	25.2							1.2
	24-Oct-12	7.35	568	9.5	8.14	620	341	37.2		285	93.7	26.1	1.27	14.4					
	9-May-13	7.45	907	9.6	8.31	843	384	58.3		307	104	30.3	1.45	29.3					
	9-May-14	7.63	659	9.5	8.08	778	360	49.5		301	96.7	28.7	1.40	24.0					
	9-May-14	-	-	-	8.15	773	355	48.6		289	95.0	28.7	1.41	24.2					
	27-May-15	7.72	410	12.5	7.97	684	308	35.2	40.8	272	83.1	24.3	1.31	12.5					
	24-May-16	7.81	630	12.5	8.08	756	362	51.3	42.1	306	99.9	27.4	5.32	22.5					
	1-Nov-16	8.22	736	13.1	7.87	677		38.9	38.1	278	89.1	22.7	1.23	12.1	<0.02	<0.10	<0.25	<0.25	1.0
	4-May-17	7.51	767	9.42	7.93	905	359	62.7	35.9	331	96.1	29.0	1.51	33.6	0.10	0.26	<0.05	<0.05	2.4
	11-May-18	7.34	698	11.35	7.79	761	350	55.0	31.8	340	95.8	26.8	1.40	28.6	0.04	0.10	<0.25	<0.25	1.9
	16-May-19	7.58	565	10.87	7.55	625	352	39.4	32.3	289	96.6	27.0	1.37	14.7	0.034	0.63	<0.020	<0.010	1.74
	11-May-20	7.97	676	8.98	7.67	659	329	38.3	29.5	293	93.4	23.2	1.35	13.9	0.044	<0.15	<0.020	<0.010	2.99
	12-May-21	7.55	700	11.0	8.07	686	361	41	34	284	104	24.4	1.42	15.1	<0.1	<0.5	<0.06	<0.03	1.2
	17-May-22	7.55	713	9.8	8.05	688	395	41	36	305	110	29.1	1.50	18.7	<0.1	<0.5	<0.06	<0.03	1.4
37	5-Apr-83				7.8	480	304	10.0		247	81.0	26.0							10.6
	15-Jun-83				7.3	545	292	12.0		260	71.0	24.0							1.9
	4-Aug-83				7.3	410		12.0											
	15-Aug-83																		
	19-Aug-83				7.6	530		13.0											
	3-Sep-83																		
	14-Sep-83				7.3	540	326	13.0											0.6
	8-Dec-83				7.3	525	335	15.0											1.2
	30-Apr-84				7.3	610	332	13.0											0.6
	5-Nov-84				7.2	630	329	11.0		254	89.0	26.0							0.5
	29-Apr-85				7.70	655	303	14.0		271	78.0	26.2							1.0
	21-Oct-85				7.80	630	324	14.0		290	85.5	26.8							4.9
	30-Apr-86				7.89	394	252	17.0		247	63.0	23.0							3.6
	15-Oct-86				7.10	610	319	13.0		276	85.0	26.0							1.3



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	als		Vol	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
27	25-Oct-94			0.75				
cont'd	16-May-95			0.81				
	24-Oct-12			0.87	0.057			
	9-May-13			1.09	0.063			
	9-May-14			1.01	0.063			
	9-May-14			1.03	0.064			
	27-May-15			0.78	0.063			
	24-May-16			0.925	0.054			
	1-Nov-16	0.099	<0.003	0.718	0.050	<0.17	<0.20	<0.10
	4-May-17	0.225	<0.003	1.01	0.058	<0.17	<0.20	<0.10
	11-May-18	0.266	0.005	1.01	0.065	<0.17	<0.20	<0.10
	16-May-19	0.087	<0.00050	0.920	0.0586	<0.50	<0.50	<0.50
	11-May-20	0.083	<0.00050	0.833	0.0564	<0.50	<0.50	<0.50
	12-May-21	0.084	0.00012	0.92	0.062	<0.2	<0.5	<0.5
	17-May-22	0.084	0.0001	1.00	0.0639	<0.2	<0.5	<0.5
37	5-Apr-83			0.10				
	15-Jun-83			0.21				
	4-Aug-83							
	15-Aug-83							
	19-Aug-83							
	3-Sep-83							
	14-Sep-83							
	8-Dec-83							
	30-Apr-84							
	5-Nov-84			<0.04				
	29-Apr-85			0.68				
	21-Oct-85			0.11				
	30-Apr-86			0.13				
	15-Oct-86			0.24				

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters		Ge	neral Param	eters			N	lajor and Mino	r Ions				Nutrients	and Organic Inc	dicators	
Well	Date	рН	EC	т	pН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	°C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 AO	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 <i>MAC</i>	5 AO
37	16-Oct-86																		
cont'd	20-Apr-87				7.50	640	325	17.0		273	85.5	27.0							2.6
	10-May-88				7.65	640	346	16.7		271	92.3	28.0							2.4
	12-Oct-88				7.80	560	298	18.0		254	78.0	25.0							1.8
	30-Oct-89				7.74	617	316	17.6		277	84.4	25.6							0.8
	7-May-90				7.85	615	325	17.5		271	87.8	25.6							0.5
	29-Oct-90				7.75	611	298	16.9		276	80.1	23.7							1.4
	6-May-91				7.80	552	280	15.3		268	62.9	25.9							
	26-May-92				7.74	613	318	16.3		261	81.9	27.4							1.5
	6-Oct-92				7.78	619	318	21.3		264	80.2	28.5							1.1
	3-May-93				7.56	615	315	16.9		283	83.3	25.8							0.8
	26-Oct-93				7.68	616	291	19.7		283	68.6	28.9							1.0
	25-Apr-94				7.99	597	320	14.7		285	85.3	26.0							1.6
	25-Oct-94				7.79	631	326	13.8		273	86.2	26.7							1.6
	16-May-95				7.77	599	295	14.9		235	75.4	25.8							1.3
	15-Jun-97				7.96	586	328	12.0		263	85.4	27.8	1.0	7.5					
	15-Jun-98				8.02	542	306	12.0		260	80.9	25.3	1.24	7.09					
	15-Jun-99				7.72	546	320	14.0		264	84.6	26.4	1.58	7.46					
	15-Jun-00				8.14	535	281	10.0		280	74.1	23.2	0.32	8.48					
	15-Jun-01				7.84	567	330	11.0		254	88.8	26.2	<0.02	13.8					
	15-Jun-02				7.64	560	300	11.0		260	77.9	25.5	0.92	7.42					
	15-Jun-03				7.79	533	303	11.0		268	80.3	25.0	0.87	7.56					
	15-Jun-04				7.84	557	283	12.0		266	73.2	24.3	0.80	10.2					
	15-Jun-05				8.24	523	317	12.1		278	83.5	26.3	1.2	9.2					
	15-Jun-06				7.70	520	310	12.0		260	85.1	22.9	1.0	7.5					
	29-May-07				7.48	553	270	13.0		270	68.8	23.0	1.0	7.9					
	5-Jun-08				7.98	574	290	15.0		270	77.3	23.9	1.0	10.2					
	4-Jun-09				8.03	589	327	15.9		265	88.3	25.9	1.5	8.9					
	14-May-10	7.76	550	11.2	8.00	544	335	18.7		272	89.7	27.0	1.26	9.27					



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 IMAC	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
37	16-Oct-86			0.24				
cont'd	20-Apr-87			0.26				
	10-May-88			0.15				
	12-Oct-88			0.34				
	30-Oct-89			0.37				
	7-May-90			0.57				
	29-Oct-90			0.46				
	6-May-91			0.43				
	26-May-92			0.16				
	6-Oct-92			0.65				
	3-May-93			0.13				
	26-Oct-93			0.42				
	25-Apr-94			0.12				
	25-Oct-94			0.27				
	16-May-95			0.19				
	15-Jun-97			0.25	0.030			
	15-Jun-98			0.30	0.040			
	15-Jun-99			0.02	0.040			
	15-Jun-00			0.32	0.040			
	15-Jun-01			0.18	0.040			
	15-Jun-02			0.48	0.040			
	15-Jun-03			0.40	0.040			
	15-Jun-04			0.62	0.030			
	15-Jun-05			0.20	0.036			
	15-Jun-06			0.33	0.037			
	29-May-07			0.52	0.045			
	5-Jun-08			<0.05	0.045			
	4-Jun-09			0.427	0.049			
	14-May-10			0.571	0.039			

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	Parameters		Ger	neral Param	eters			N	lajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units ODWQS	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	⁰C 15 <i>AO</i>	SU 6.5 - 8.5 <i>OG</i>	μS/cm nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 <i>MAC</i>	1.0 <i>MAC</i>	5 <i>AO</i>
37	15-Jun-11	7.89	468	11.3	8.10	538	295	20.6		264	78.7	23.8	1.22	9.25					
		7.49	477		8.08	575		20.4		264		23.8	1.20						
cont'd	23-May-12	7.49	674	11.5	8.32	640	294	20.4			78.5 85.9			9.34					
	9-May-13			9.8			323			257		26.4	1.28	10.2					
	9-May-14	7.61	658	10.0	8.14	612	310	22.8	22.2	250	81.8	25.7	1.22	9.92					
	27-May-15	7.85	402	13.4	8.04	617	278	25.1	39.2	253	72.3	23.7	1.22	10.5					
37R	24-May-16	7.33	491	11.2	8.15	611	317	24.9	44.5	265	83.9	26.0	1.54	11.3					
	5-May-17	7.83	623	9.40	8.19	615	304	29.2	42.6	217	80.5	24.9	1.30	10.8	0.15	0.20	<0.25	<0.25	0.8
	11-May-18	7.68	556	10.25	7.94	605	306	28.4	39.3	280	81.3	24.9	1.31	11.1	0.05	<0.10	<0.05	<0.05	1.0
	17-May-19	7.63	509	10.90	7.74	576	493	30.1	40.3	268	140*	34.6	1.75	11.4	0.062	0.37	0.022	<0.010	2.26
	12-May-20	7.83	566	9.12	7.77	649	320	32.2	35.8	286	85.7	25.7	1.37	11.8	0.061	0.18	<0.020	<0.010	2.11
	12-May-21	7.78	690	10.1	8.05	596	316	35	41	238	87.1	24	1.29	12.0	<0.1	<0.5	<0.06	<0.03	<1.0
	17-May-22	7.81	648	11.2	8.05	624	375	38	41	277	101	29.6	1.39	14.8	<0.1	<0.5	<0.06	<0.03	1.1
38	5-Apr-83				7.5	500	314	12.0		266	83.0	27.0							0.8
	15-Jun-83				7.3	540	284	12.0		270	59.0	24.0							1.5
	4-Aug-83				7.6	290		15.0											
	15-Aug-83																		
	19-Aug-83				7.7	540		13.0											
	3-Sep-83																		
	14-Sep-83				7.3	530	318	11.0											0.5
	19-Oct-83																		
	8-Dec-83				7.5	520	330	15.0											1.1
	30-Apr-84				7.4	590	314	13.0											0.7
	5-Nov-84				7.3	600	318	12.0		250	86.0	25.0							0.3
	29-Apr-85				7.70	630	302	14.5		263	78.5	25.6							1.0
	21-Oct-85				7.87	600	306	14.0		280	80.5	25.4							3.7
	30-Apr-86				7.62	493	315	15.5		267	83.5	25.8							1.8
	15-Oct-86				7.30	355	173	8.0		164	48.0	13.0							3.3
	16-Oct-86																		
	20-Apr-87				7.45	377	180	9.5		175	47.5	14.8							4.1



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vol	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units					μg/L	μg/L	μg/L
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO
37	15-Jun-11			0.606	0.040			
cont'd	23-May-12			0.490	0.031			
	9-May-13			0.604	0.041			
	9-May-14			0.591	0.040			
	27-May-15			0.550	0.042			
37R	24-May-16			0.597	0.033			
	5-May-17	0.052	<0.003	0.660	0.039	<0.17	<0.20	<0.10
	11-May-18	0.056	0.004	0.660	0.041	<0.17	<0.20	<0.10
	17-May-19	0.048	0.0031	3.27	0.211	<0.50	<0.50	<0.50
	12-May-20	0.048	<0.00050	0.718	0.0427	<0.50	<0.50	<0.50
	12-May-21	0.056	0.00009	0.72	0.041	<0.2	<0.5	<0.5
	17-May-22	0.047	<0.0008	0.816	0.0455	<0.2	<0.5	<0.5
38	5-Apr-83			0.27				
	15-Jun-83			0.19				
	4-Aug-83							
	15-Aug-83							
	19-Aug-83							
	3-Sep-83							
	14-Sep-83							
	19-Oct-83							
	8-Dec-83							
	30-Apr-84							
	5-Nov-84			<0.04				
	29-Apr-85			3.05				
	21-Oct-85			0.22				
	30-Apr-86			0.21				
	15-Oct-86			0.03				
	16-Oct-86			0.01				
	20-Apr-87			0.07				

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field	d Parameters		Ge	neral Param	eters			M	ajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	su	μS/cm	°C	su	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
38	10-May-88				7.53	430	227	10.9		158	61.3	17.9							3.0
cont'd	12-Oct-88				7.60	410	203	14.0		200	55.0	16.0							2.2
	30-Oct-89				7.77	525	257	14.5		254	65.4	22.7							1.1
	7-May-90				7.81	528	271	14.4		256	68.8	24.1							1.5
	29-Oct-90				7.83	527	252	14.5		251	64.5	22.1							1.6
	6-May-91				7.88	515	254	13.5		256	64.4	22.6							
	26-May-92				7.70	507	241	6.9		242	66.6	21.7							1.8
	6-Oct-92				7.80	506	259	8.1		229	68.5	21.3							1.5
	3-May-93				7.66	491	242	6.5		248	64.2	19.8							0.7
	26-Oct-93				7.75	482	240	7.3		252	59.4	22.1							2.5
	25-Apr-94				8.00	480	249	5.5		245	66.3	20.1							2.1
	25-Oct-94				7.91	486	243	5.7		235	64.1	20.0							1.5
	16-May-95				7.84	465	239	5.0		232	63.6	19.5							1.3
	15-Jun-97				8.06	453	232	3.5		215	60.8	19.5	1.0	10.4					
	15-Jun-98				7.99	413	231	4.0		210	61.7	18.8	1.38	9.92					
	15-Jun-99				8.03	414	262	4.0		196	74.9	18.3	1.05	10.5					
	15-Jun-00				8.30	415	217	3.0		210	57.7	17.7	0.59	24.5					
	15-Jun-01				7.92	426	237	3.0		208	64.0	18.7	0.44	17.2					
	15-Jun-02				7.74	430	217	4.0		217	56.8	18.3	0.99	11.0					
	15-Jun-03				7.90	433	221	5.0		228	59.0	17.9	0.57	12.0					
	15-Jun-04				7.99	450	215	6.0		228	56.9	17.8	0.54	16.8					
	15-Jun-05				8.31	455	234	7.0		232	62.8	18.7	1.1	13.0					
	15-Jun-06				7.75	416	220	8.0		220	61.7	17.2	<1	10.8					
	29-May-07				7.59	447	300	7.0		230	86.8	19.7	1.0	12.3					
	5-Jun-08				8.01	471	240	9.0		220	65.3	18.8	2.0	15.1					
	4-Jun-09				8.09	473	240	8.6		227	66.2	18.0	1.2	12.1					
	13-May-10	7.94	390	9.4	8.00	445	258	11.1		224	69.7	20.5	1.13	12.3					
	15-Jun-11	7.54	389	10.7	8.26	442	231	11.9		219	62.0	18.5	1.05	12.2					
	15-Jun-11	7.54	389	10.7	8.13	429	228	11.1		218	61.4	18.2	1.1	11.8					



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	ıls		Vola	atile Organic C	ompounds
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene
	Units ODWQS	5.0 IMAC	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO
38	10-May-88		0.00	0.02	0.007.0			C
cont'd	12-Oct-88			<.05				
55 2	30-Oct-89			0.15				
	7-May-90			0.04				
	29-Oct-90			0.02				
	6-May-91			<0.01				
	26-May-92			<0.01				
	6-Oct-92			0.60				
	3-May-93			0.02				
	26-Oct-93			0.41				
	25-Apr-94			<0.01				
	25-Oct-94			0.30				
	16-May-95			0.01				
	15-Jun-97			<0.02	0.050			
	15-Jun-98			<0.02	<0.02			
	15-Jun-99			0.03	0.060			
	15-Jun-00			<0.02	0.040			
	15-Jun-01			<0.02	0.050			
	15-Jun-02			<0.02	0.040			
	15-Jun-03			0.05	0.050			
	15-Jun-04			<0.02	0.050			
	15-Jun-05			0.07	0.056			
	15-Jun-06			0.08	0.076			
	29-May-07			<0.05	0.093			
	5-Jun-08			0.18	0.042			
	4-Jun-09			<0.050	0.051			
	13-May-10			0.499	0.042			
	15-Jun-11			0.529	0.041			
	15-Jun-11			0.55	0.042			

Table D-2: Groundwater Chemical Results - Deep Flow System

	Field	d Parameters		General Parameters			Major and Minor Ions							Nutrients and Organic Indicators				
Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
Units	SU	μS/cm	°C	SU	μS/cm													
ODWQS	6.5 - 8.5 OG	nc	15 <i>AO</i>	6.5 - 8.5 OG	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 MAC	5 AO
23-May-12	7.61	393	11.2	8.08	465	239	11.9		228	64.1	19.1	1.07	12.5					
9-May-13	7.88	541	9.8	8.32	500	248	12.7		212	65.7	20.5	1.14	12.8					
9-May-13	7.88	541	9.8	8.34	515	249	12.8		223	66.5	20.1	1.09	12.7					
9-May-14	7.89	525	10.3	8.09	493	237	13.3		216	62.9	19.5	1.04	12.4					
27-May-15	7.89	329	15.4	8.10	493	228	13.6	22.2	219	60.5	18.6	1.06	13.0					
24-May-16	7.62	405	11.1	8.15	497	245	16.2	25.6	230	64.8	20.1	1.13	13.9					
5-May-17	7.91	517	9.19	8.18	562	237	18.7	23.1	237	62.7	19.6	1.10	13.1	0.13	0.22	<0.05	<0.05	1.3
11-May-18	7.80	481	9.00	7.91	514	242	20.8	23.0	260	64.7	19.6	1.08	13.6	0.07	<0.10	<0.05	<0.05	1.2
17-May-19	7.63	443	10.49	7.81	502	259	23.3	22.6	240	68.9	21.2	1.10	14.4	0.089	<0.15	<0.020	<0.010	2.10
12-May-20	8.00	474	9.72	7.80	551	264	23.0	21.1	234	70.4	21.3	1.15	14.9	0.089	<0.15	<0.020	<0.010	2.37
12-May-21	7.85	520	11.7	8.08	553	260	27	24	237	71.2	19.9	1.10	14.5	<0.1	<0.5	<0.06	<0.03	1.3
17-May-22	7.51	573	11.3	7.98	542	310	31	27	252	83.1	24.8	1.20	18.4	<0.1	<0.5	<0.06	<0.03	1.8
9-May-14	7.73	770	9.8	8.10	722	336	37.3		280	90.2	27.0	1.83	21.7					
27-May-15	7.41	463	12.0	8.01	716	294	37.8	45.1	281	76.3	25.2	1.73	21.8					
24-May-16	7.62	405	11.1	8.14	711	340	36.1	47.7	300	90.3	27.8	1.70	23.1					
1-Nov-16	7.94	711	9.8	8.06	703		39.8	44.7	289	86.8	23.5	1.55	20.0	0.04	<0.10	<0.25	<0.25	1.2
4-May-17	7.90	705	9.08	8.18	773	326	36.8	44.5	312	87.7	25.9	1.64	21.2	0.11	0.36	0.14	<0.05	1.2
10-May-18	7.45	635	9.95	7.93	680	324	33.9	41.9	315	88.5	25.0	1.65	21.0	0.05	0.27	<0.25	<0.25	1.2
16-May-19	7.58	593	10.10	7.52	666	354	38.5	45.2	307	98.0	26.7	1.62	21.8	0.082	0.36	0.494	0.054	3.65
11-May-20	7.71	643	7.78	7.67	703	331	37.2	44.2	303	93.1	24.0	1.61	20.3	0.057	0.33	0.67	0.048	2.00
11-May-21	7.10	730	8.9	8.16	684	374	38	50	275	107	25.7	1.82	21.7	<0.1	<0.5	0.39	0.04	2.0
16-May-22	7.29	704	9.9	8.08	710	379	44	55	300	105	28.3	1.62	23.7	<0.1	<0.5	0.26	0.04	1.2
	Units ODWQS  23-May-12  9-May-13  9-May-14  27-May-15  24-May-16  5-May-17  11-May-18  17-May-20  12-May-21  17-May-21  17-May-15  24-May-16  1-Nov-16  4-May-17  10-May-18  16-May-19  11-May-20  11-May-20  11-May-20	Date         pH           Units ODWQS         SU 6.5 - 8.5 OG           23-May-12         7.61           9-May-13         7.88           9-May-14         7.89           24-May-16         7.62           5-May-17         7.91           11-May-18         7.80           17-May-19         7.63           12-May-20         8.00           12-May-21         7.85           17-May-22         7.51           9-May-14         7.73           27-May-15         7.41           24-May-16         7.62           1-Nov-16         7.94           4-May-17         7.90           10-May-18         7.45           16-May-19         7.58           11-May-20         7.71           11-May-21         7.710	Units         SU         μS/cm           ODWQS         6.5 - 8.5 OG         nc           23-May-12         7.61         393           9-May-13         7.88         541           9-May-14         7.89         525           27-May-15         7.89         329           24-May-16         7.62         405           5-May-17         7.91         517           11-May-18         7.80         481           17-May-19         7.63         443           12-May-20         8.00         474           12-May-21         7.85         520           17-May-22         7.51         573           9-May-14         7.73         770           27-May-15         7.41         463           24-May-16         7.62         405           1-Nov-16         7.94         711           4-May-17         7.90         705           10-May-18         7.45         635           16-May-19         7.58         593           11-May-20         7.71         643           11-May-21         7.10         730	Date         pH         EC         T           Units ODWQS         SU 6.5 - 8.5 OG         μS/cm nc         °C 15 AO           23-May-12         7.61         393         11.2           9-May-13         7.88         541         9.8           9-May-14         7.89         525         10.3           27-May-15         7.89         329         15.4           24-May-16         7.62         405         11.1           5-May-17         7.91         517         9.19           11-May-18         7.80         481         9.00           17-May-19         7.63         443         10.49           12-May-20         8.00         474         9.72           12-May-21         7.85         520         11.7           17-May-22         7.51         573         11.3           9-May-14         7.73         770         9.8           27-May-15         7.41         463         12.0           24-May-16         7.62         405         11.1           1-Nov-16         7.94         711         9.8           4-May-17         7.90         705         9.08           4-May-18	Date         pH         EC         T         pH           Units ODWQS         SU 6.5 - 8.5 OG         nc         15 AO         6.5 - 8.5 OG           23-May-12         7.61         393         11.2         8.08           9-May-13         7.88         541         9.8         8.32           9-May-14         7.89         525         10.3         8.09           27-May-15         7.89         329         15.4         8.10           24-May-16         7.62         405         11.1         8.15           5-May-17         7.91         517         9.19         8.18           11-May-18         7.80         481         9.00         7.91           17-May-19         7.63         443         10.49         7.81           12-May-20         8.00         474         9.72         7.80           12-May-21         7.85         520         11.7         8.08           17-May-22         7.51         573         11.3         7.98           9-May-14         7.73         770         9.8         8.10           27-May-15         7.41         463         12.0         8.01           4-May-16         <	Date         pH         EC         T         pH         EC           Units ODWGS         SU μs/cm         *C         SU μs/cm         nc         15 AO         6.5 - 8.5 OG         nc           23-May-12         7.61         393         11.2         8.08         465           9-May-13         7.88         541         9.8         8.32         500           9-May-13         7.88         541         9.8         8.34         515           9-May-14         7.89         525         10.3         8.09         493           27-May-15         7.89         329         15.4         8.10         493           24-May-16         7.62         405         11.1         8.15         497           5-May-17         7.91         517         9.19         8.18         562           11-May-18         7.80         481         9.00         7.91         514           17-May-19         7.63         443         10.49         7.81         502           12-May-20         8.00         474         9.72         7.80         551           12-May-21         7.85         520         11.7         8.08         553	Date         pH         EC         T         pH         EC         Total Hardness           Units ODWGS         85 - 8.5 OG         nc         15 AO         6.5 - 8.5 OG         nc         80-100 OG           23-May-12         7.61         393         11.2         8.08         465         239           9-May-13         7.88         541         9.8         8.32         500         248           9-May-14         7.89         525         10.3         8.09         493         237           27-May-15         7.89         329         15.4         8.10         493         228           24-May-16         7.62         405         11.1         8.15         497         245           5-May-17         7.91         517         9.19         8.18         562         237           11-May-18         7.80         481         9.00         7.91         514         242           17-May-19         7.63         443         10.49         7.81         502         259           12-May-20         8.00         474         9.72         7.80         551         264           12-May-21         7.85         520         11.7	Date Units Units Othward         pH         EC         T         pH         EC         Total Hardness Total Hardness Policies         Chloride           23-May-12 Othward         7°C         SU         µ8/cm         65 - 8.5 OG         nc         80-100 OG         250 AO           23-May-12 Othward         7.61         393         11.2         8.08         465         239         11.9           9-May-13 Othward         7.88         541         9.8         8.32         500         248         12.7           9-May-14 Othward         7.89         525         10.3         8.09         493         237         13.3           24-May-15 Othward         7.89         329         15.4         8.10         493         228         13.6           24-May-16 Othward         7.62         405         11.1         8.15         497         245         16.2           5-May-17 Othward         7.91         517         9.19         8.18         562         237         18.7           11-May-18 Othward         7.63         443         10.49         7.81         502         259         23.3           12-May-20 Othward         8.00         474         9.72         7.80         551	Date   PH   EC   T   PH   EC   SU   pS/cm	Ph	PH	PH	PH   EC   T   PH   EC   SU   PH   EC   SU   PH   EC   SU   PH   EC   SU   PH   EC   SU   PH   PH   EC   SU   PH   PH   EC   SU   PH   PH   PH   PH   PH   PH   PH   P	Part   Part	Part   Part	Part   Part	Part   Part	Part   Part



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	als		Volatile Organic Compounds					
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene			
	Units ODWQS	5.0 IMAC	0.05 <i>MAC</i>	0.3 <i>AO</i>	0.05 <i>AO</i>	μg/L 1 <i>MAC</i>	μg/L 1 <i>MAC</i>	μg/L 5 MAC 1 AO			
38	23-May-12			0.450	0.038						
cont'd	9-May-13			0.555	0.049						
	9-May-13			0.530	0.044						
	9-May-14			0.579	0.043						
	27-May-15			0.439	0.042						
	24-May-16			0.456	0.039						
	5-May-17	0.048	<0.003	0.464	0.042	<0.17	<0.20	<0.10			
	11-May-18	0.048	<0.003	0.494	0.046	<0.17	<0.20	<0.10			
	17-May-19	0.043	<0.00050	0.554	0.0442	<0.50	<0.50	<0.50			
	12-May-20	0.044	<0.00050	0.592	0.0473	<0.50	<0.50	<0.50			
	12-May-21	0.068	<0.00008	0.56	0.047	<0.2	<0.5	<0.5			
	17-May-22	0.05	0.00010	0.634	0.0503	0.2	<0.5	<0.5			
39	9-May-14			0.183	0.156						
	27-May-15			0.236	0.182						
	24-May-16			0.259	0.133						
	1-Nov-16	0.025	<0.003	0.271	0.131	<0.17	<0.20	<0.10			
	4-May-17	0.026	<0.003	0.268	0.145	<0.17	<0.20	<0.10			
	10-May-18	0.026	0.004	0.249	0.143	<0.17	<0.20	<0.10			
	16-May-19	0.029	<0.00050	0.195	0.149	<0.50	<0.50	<0.50			
	11-May-20	0.027	<0.00050	0.239	0.16	<0.50	<0.50	<0.50			
	11-May-21	0.034	0.00008	0.316	0.165	<0.2	<0.5	<0.5			
	16-May-22	0.034	0.00016	0.398	0.141	<0.2	<0.5	<0.5			

Table D-2: Groundwater Chemical Results - Deep Flow System

		Field Parameters			General Parameters					N	lajor and Mino	r Ions			Nutrients and Organic Indicators				
Well	Date	рН	EC	т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	<b>°</b> C	SU	μS/cm													
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 AO	6.5 - 8.5 <i>OG</i>	nc	80-100 <i>OG</i>	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 <i>MAC</i>	5 AO
42	24-May-16	7.73	770	9.8	8.20	394	177	2.12	5.50	217	31.3	24.0	1.45	21.3					
	1-Nov-16	8.59	425	10.1	7.92	389		1.09	3.64	211	29.2	20.6	1.17	18.3	0.34	0.32	<0.05	<0.05	1.2
	4-May-17	8.38	387	8.91	8.21	422	163	0.60	5.69	217	28.2	22.6	1.19	18.8	0.42	0.51	<0.05	<0.05	0.9
	10-May-18	8.13	382	9.13	7.42	379	161	0.81	4.20	228	28.2	21.9	1.18	18.7	0.29	0.29	<0.05	<0.05	1.2
	16-May-19	8.06	314	10.25	8.06	347	281	0.51	1.61	220	64.6*	29.0	1.33	18.0	0.307	1.09	<0.020	<0.010	2.44
	11-May-20	8.37	361	8.00	8.02	379	173	0.57	1.45	269	34.4	21.1	1.06	18.0	0.301	0.49	0.031	<0.010	1.92
	11-May-21	7.60	400	9.1	8.22	386	198	<1	2	213	42.3	22.5	1.21	19.2	0.4	<0.5	<0.06	<0.03	1.5
	16-May-22	7.52	398	10.7	8.21	381	221	<1	2	221	45.8	26.0	1.16	21.8	0.4	<0.5	<0.06	<0.03	1.1



Table D-2: Groundwater Chemical Results - Deep Flow System

			Meta	als		Volatile Organic Compounds					
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene			
	Units					μg/L	μg/L	μg/L			
	ODWQS	5.0 IMAC	0.05 MAC	0.3 <i>AO</i>	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO			
42	24-May-16			0.038	0.011						
	1-Nov-16	0.051	<0.003	0.070	0.012	<0.17	<0.20	<0.10			
	4-May-17	0.056	<0.003	0.059	0.010	<0.17	<0.20	<0.10			
	10-May-18	0.063	<0.003	0.088	0.011	<0.17	<0.20	<0.10			
	16-May-19	0.053	0.00218	1.77	0.106	<0.50	<0.50	<0.50			
	11-May-20	0.052	<0.00050	0.173	0.010	<0.50	<0.50	<0.50			
	11-May-21	0.048	0.00017	0.177	0.011	<0.2	<0.5	<0.5			
	16-May-22	0.052	<0.00008	0.180	0.0107	<0.2	<0.5	<0.5			

**Table D-3: Groundwater Chemical Results - Private Wells** 

		Fiel	d Parameters	i	General Parameters					N	lajor and Mino	r Ions				Nutrients	and Organic In	dicators	
Well	Date	рН	EC	Т	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	TKN	Nitrate	Nitrite	DOC
	Units	SU	μS/cm	۰c	SU	μS/cm			·	-		•							
	ODWQS	6.5 - 8.5 <i>OG</i>	nc	15 <i>AO</i>	6.5 - 8.5 <i>OG</i>	nc	80-100 OG	250 AO	500 AO	30 - 500 <i>OG</i>	nc	nc	nc	200 AO	nc	nc	10.0 MAC	1.0 <i>MAC</i>	5 AO
D2	27-Feb-79				8.33	515	220	15.0			53.5	21.0	1.1	24.0					
(Roswell)	16-Jul-79				7.35		208	10.5		210	49.0	20.8	0.95	21.4					
	24-Apr-80				7.82	790	356	39.5		288	97.0	27.6	1.85	31.8					
	30-Sep-80				7.83	585	256	16.5		244	65.0	22.6	1.2	26.2					
	17-Jun-81				7.84	615	284	26.0		243	75.0	23.4		28.5					
	14-May-82				7.75	587	256	24.5		237	67.0	21.4	1.0	29.0					
	13-Jul-82				7.60	525	226	15.0		224	57.5	20.0							
	15-Jun-97				8.04	636	294	27.9		279	77.7	24.4	1.80	36.1					
	15-Jun-99				7.44	709	326	35.0		300	88.9	25.2	1.92	37.4					
	15-Jun-00				8.36	770	336	47.0		320	95.3	23.8	3.11	42.7					
	15-Jun-01				7.74	625	320	23.0		257	85.2	26.1	1.36	32.2					
	15-Jun-02				7.90	398	200	1.0		216	42.9	22.5	1.05	12.4					
	15-Jun-03				7.74	666	323	32.0		304	84.9	26.9	1.32	32.4					
	15-Jun-04				7.81	854	347	37.0		364	101.0	23.0	1.92	51.5					
	15-Jun-05				8.27	668	321	28.7		295	83.7	27.0	1.5	34.0					
	15-Jun-06				7.30	749	360	42.0		330	101.0	26.3	2.0	35.7					
	29-May-07				7.41	888	430	44.0		370	122.0	31.6	2.0	41.4					
	5-Jun-08				7.87	853	360	39.0		340	99.2	27.4	2.0	37.2					
	4-Jun-09				7.99	665	292	24.0		275	76.7	24.5	1.5	33.5					
	14-May-10	7.75	610	20.1	8.09	541	280	20.5		242	72.4	24.1	1.36	25.9					
	23-May-12	8.48	547	15.0	8.23	663	<10	24.8		274	0.07	<0.05	0.16	163					
	15-May-13	7.64	-	18.6	8.02	653	<10	28.7		243	0.99	0.41	0.61	149					
D2	27-May-15	7.64	421	17.1	8.17	641	306	29.1	42.0	259	82.3	24.3	1.24	11.0					
(Pearce)	25-May-16	8.32	519	11.3	8.38	698	1.7	34.2	43.0	285	0.48	0.11	0.43	152					
	9-May-17	8.25	750	8.90	8.17	756	4.4	31.8	38.5	286	1.05	0.42	1.01	150	0.12	<0.05	<0.25	<0.25	1.7
	11-May-18	7.50	667	16.80	8.14	684	1.0	30.8	33.1	305	0.29	0.06	1.30	160	<0.02	<0.10	<0.25	<0.25	1.4
	17-May-19	8.14	549	14.70	8.17	641	<0.50	35.4	32.5	285	0.134	<0.050	0.17	159	<0.010	<0.15	<0.020	<0.010	2.19
	12-May-20	8.46	604	12.73	8.15	702	<0.50	34.4	30.0	279	0.089	<0.050	0.08	168	<0.010	0.25	<0.020	<0.010	3.54
	12-May-21	8.38	730	15.9	8.19	689	2.2	37	35	278	0.50	0.236	0.824	160	<0.1	0.5	<0.06	<0.03	1.2
	17-May-22	8.20	720	16.5	8.22	697	1.0	49	40	294	0.28	0.083	0.116	207	<0.1	<0.5	<0.06	<0.03	1.1
		J.20	0	. 5.5	J.22			.0			0.20		510		.5.1		-5.00	10.00	



**Table D-3: Groundwater Chemical Results - Private Wells** 

	•		Meta	als		Vola	Volatile Organic Compounds					
Well	Date	Boron	Chromium	Iron	Manganese	Vinyl Chloride	Benzene	1,4 Dichlorobenzene				
	Units					μg/L	μg/L	μg/L				
	ODWQS	5.0 IMAC	0.05 MAC	0.3 AO	0.05 AO	1 MAC	1 MAC	5 MAC 1 AO				
D2	27-Feb-79			0.08								
(Roswell)	16-Jul-79			0.09								
	24-Apr-80			0.14	0.020							
	30-Sep-80			0.08	0.020							
	17-Jun-81			0.01	0.007							
	14-May-82			0.08								
	13-Jul-82			0.04								
	15-Jun-97			<0.02	<0.01							
	15-Jun-99			0.04	<0.02							
	15-Jun-00			0.09	<0.02							
	15-Jun-01			<0.02	<0.02							
	15-Jun-02			0.51	<0.02							
	15-Jun-03			0.02	<0.02							
	15-Jun-04			<0.02	<0.02							
	15-Jun-05			0.09	0.004							
	15-Jun-06			<0.05	0.002							
	29-May-07			<0.05	0.025							
	5-Jun-08			<0.05	0.002							
	4-Jun-09			<0.050	0.0036							
	14-May-10			<0.010	<0.002							
	23-May-12			<0.01	0.002							
	15-May-13			0.033	0.006							
D2	27-May-15			1.89	0.054							
(Pearce)	25-May-16			<0.010	<0.002							
	9-May-17	0.051	<0.003	<0.010	<0.002	<0.17	<0.20	<0.10				
	11-May-18	0.060	0.004	<0.010	0.005							
	17-May-19	0.053	<0.00050	<0.010	<0.00050							
	12-May-20	0.052	<0.00050	0.017	<0.00050							
	12-May-21	0.051	0.00033	0.09	<0.002							
	17-May-22	0.053	0.00012	0.025	0.00035							



FIGURE D-1
TIME-CONCENTRATION GRAPH - CHLORIDE
HOLBROOK LANDFILL - LEACHATE

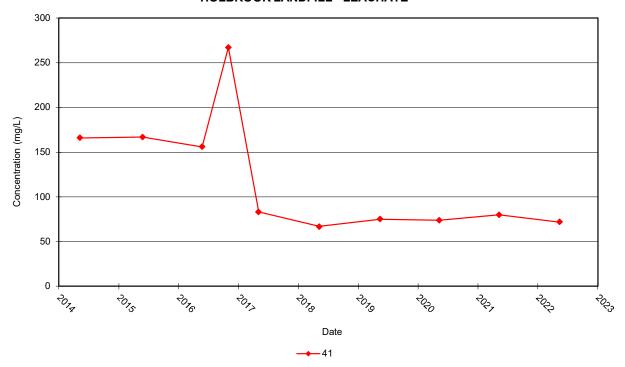


FIGURE D-2
TIME-CONCENTRATION GRAPH - ALKALINITY
HOLBROOK LANDFILL - LEACHATE

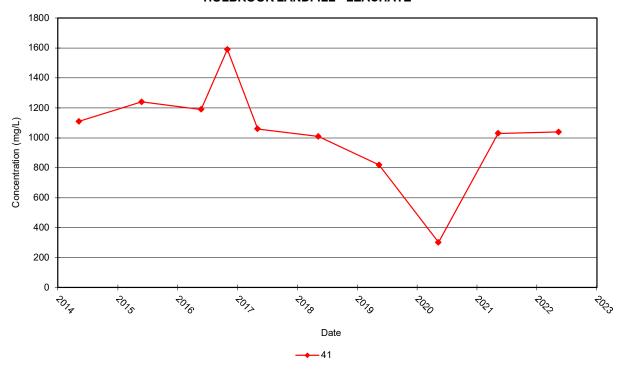


FIGURE D-3
TIME-CONCENTRATION GRAPH - POTASSIUM
HOLBROOK LANDFILL - LEACHATE

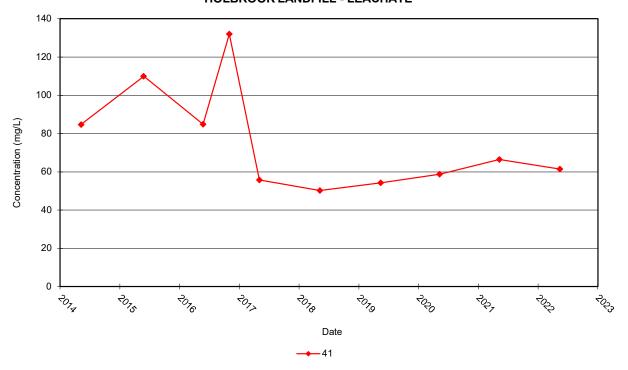


FIGURE D-4
TIME-CONCENTRATION GRAPH - BORON
HOLBROOK LANDFILL - LEACHATE

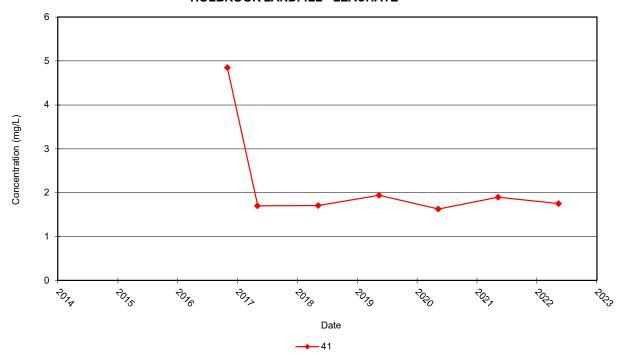




FIGURE D-5
TIME-CONCENTRATION GRAPH - IRON
HOLBROOK LANDFILL - LEACHATE

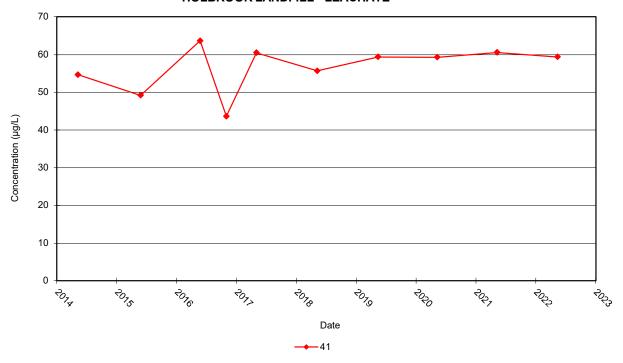


FIGURE D-6
TIME-CONCENTRATION GRAPH - AMMONIA
HOLBROOK LANDFILL - LEACHATE

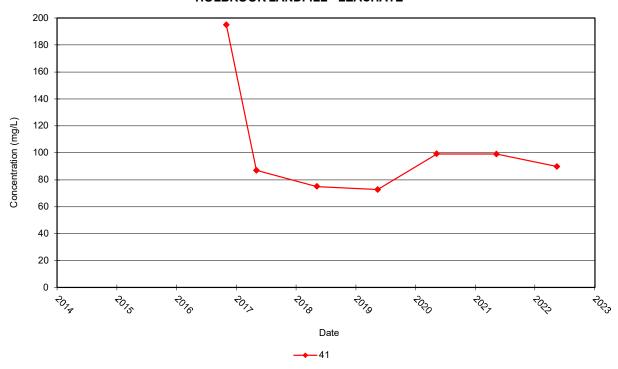


FIGURE D-7 TIME-CONCENTRATION GRAPH - TKN HOLBROOK LANDFILL - LEACHATE

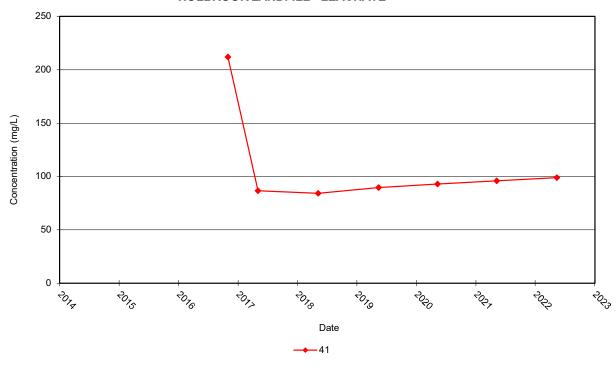
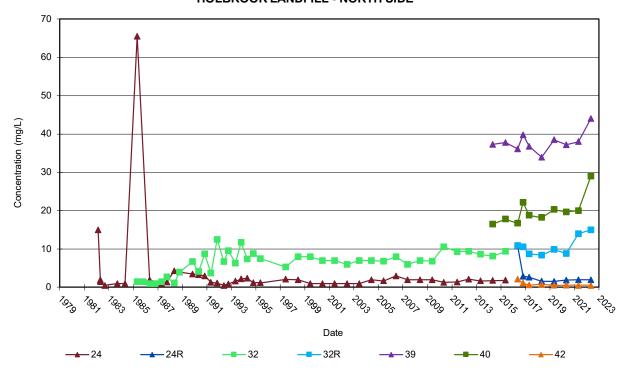




FIGURE D-8
TIME-CONCENTRATION GRAPH - CHLORIDE
HOLBROOK LANDFILL - NORTH SIDE





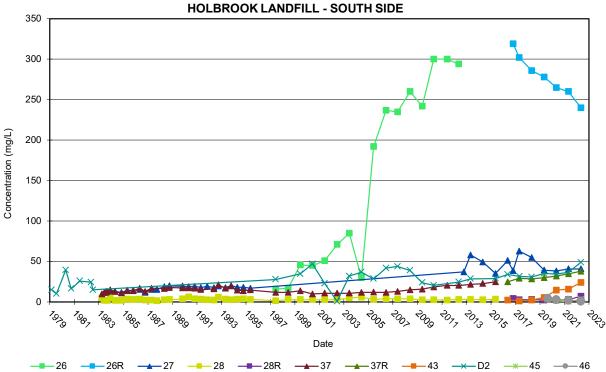




FIGURE D-10
TIME-CONCENTRATION GRAPH - CHLORIDE
HOLBROOK LANDFILL - EAST SIDE

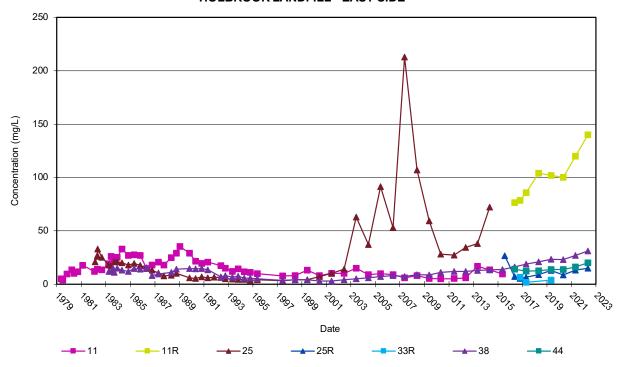


FIGURE D-11
TIME-CONCENTRATION GRAPH - CHLORIDE
HOLBROOK LANDFILL - WEST SIDE

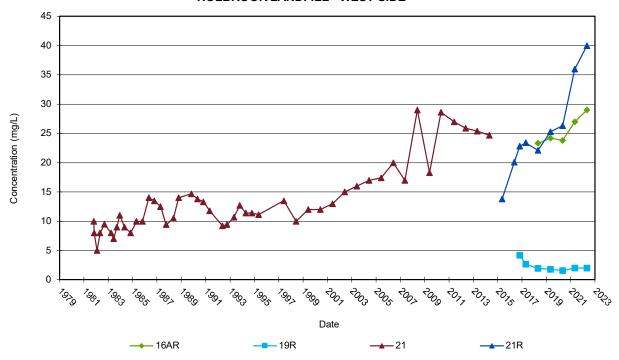


FIGURE D-12 TIME-CONCENTRATION GRAPH - ALKALINITY HOLBROOK LANDFILL - NORTH SIDE

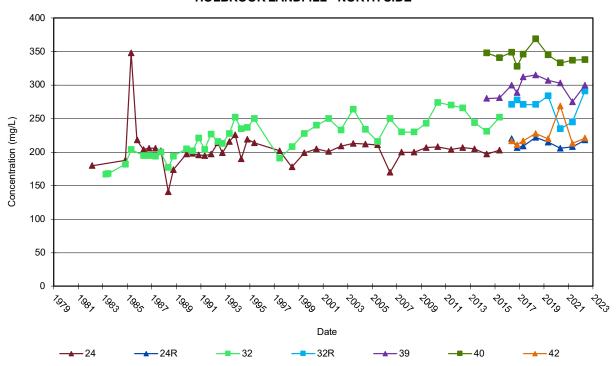


FIGURE D-13
TIME-CONCENTRATION GRAPH - ALKALINITY
HOLBROOK LANDFILL - SOUTH SIDE

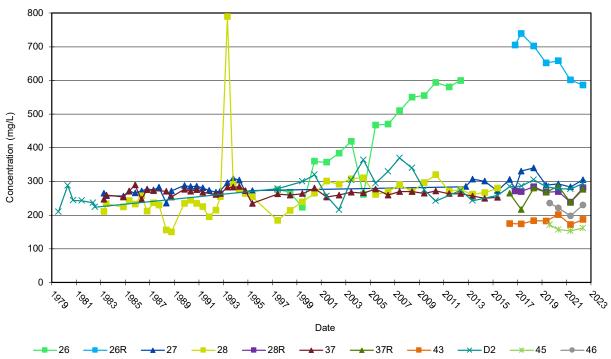


FIGURE D-14
TIME-CONCENTRATION GRAPH - ALKALINITY
HOLBROOK LANDFILL - EAST SIDE

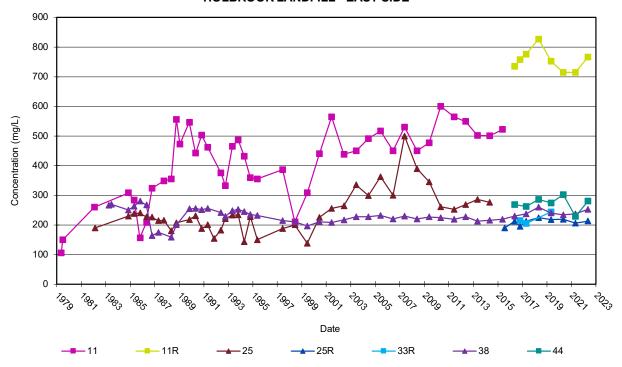


FIGURE D-15
TIME-CONCENTRATION GRAPH - ALKALINITY
HOLBROOK LANDFILL - WEST SIDE

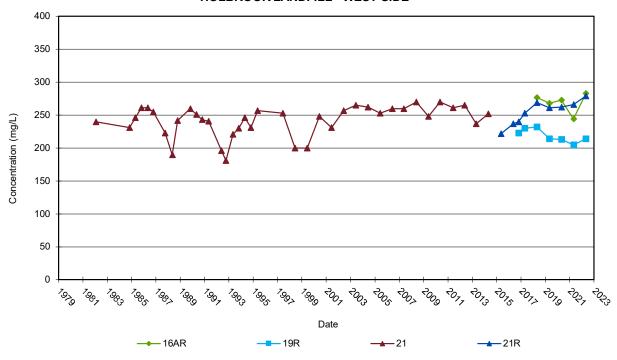


FIGURE D-16
TIME-CONCENTRATION GRAPH - POTASSIUM
HOLBROOK LANDFILL - NORTH SIDE

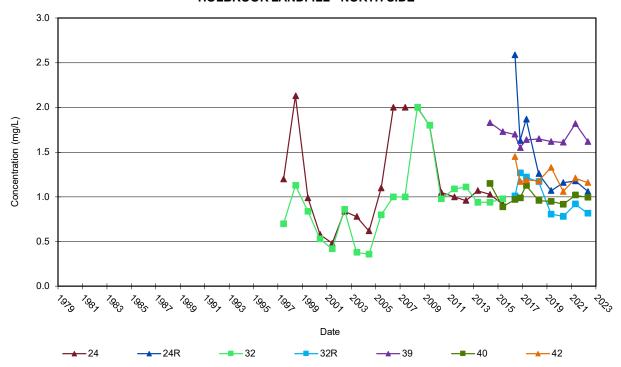


FIGURE D-17
TIME-CONCENTRATION GRAPH - POTASSIUM
HOLBROOK LANDFILL - SOUTH SIDE

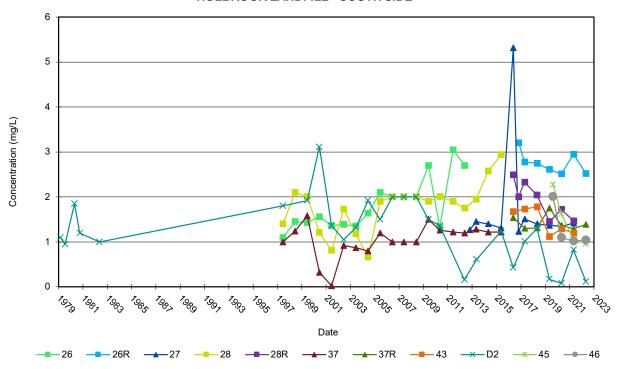


FIGURE D-18
TIME-CONCENTRATION GRAPH - POTASSIUM
HOLBROOK LANDFILL - EAST SIDE

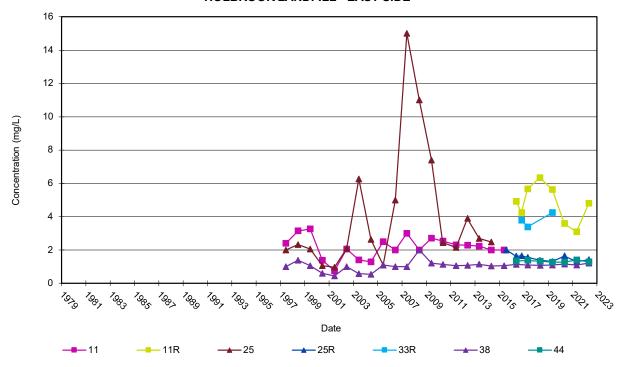


FIGURE D-19
TIME-CONCENTRATION GRAPH - POTASSIUM
HOLBROOK LANDFILL - WEST SIDE

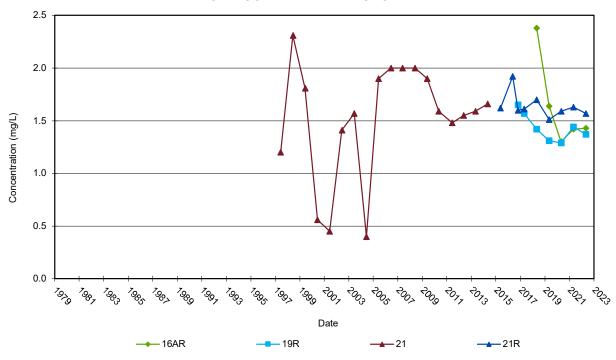


FIGURE D-20
TIME-CONCENTRATION GRAPH - BORON
HOLBROOK LANDFILL - NORTH SIDE

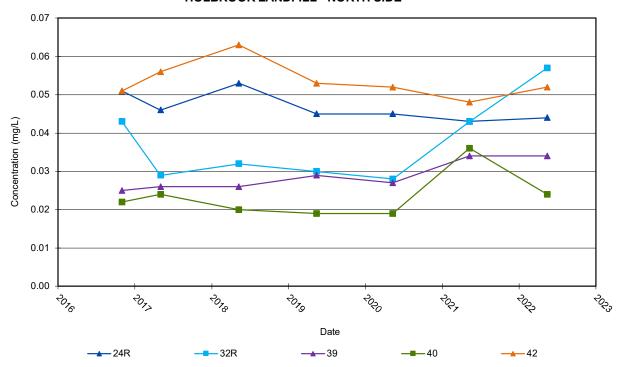


FIGURE D-21
TIME-CONCENTRATION GRAPH - BORON
HOLBROOK LANDFILL - SOUTH SIDE

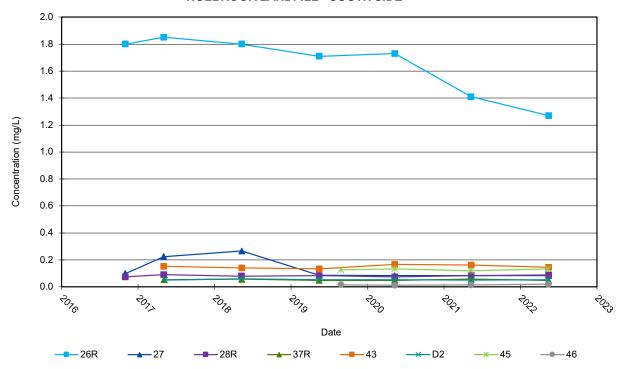


FIGURE D-22
TIME-CONCENTRATION GRAPH - BORON
HOLBROOK LANDFILL - EAST SIDE

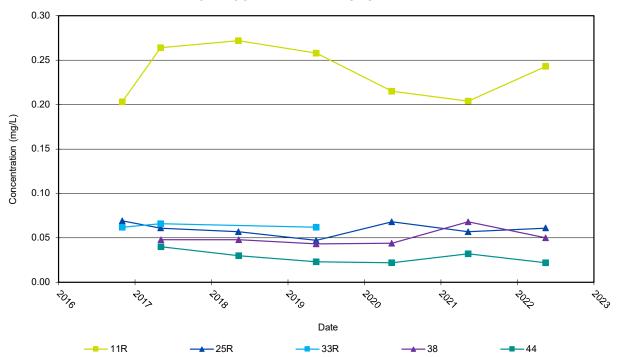


FIGURE D-23
TIME-CONCENTRATION GRAPH - BORON
HOLBROOK LANDFILL - WEST SIDE

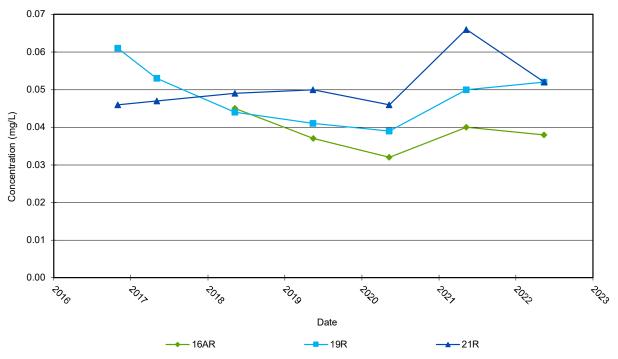




FIGURE D-24
TIME-CONCENTRATION GRAPH - IRON
HOLBROOK LANDFILL - NORTH SIDE

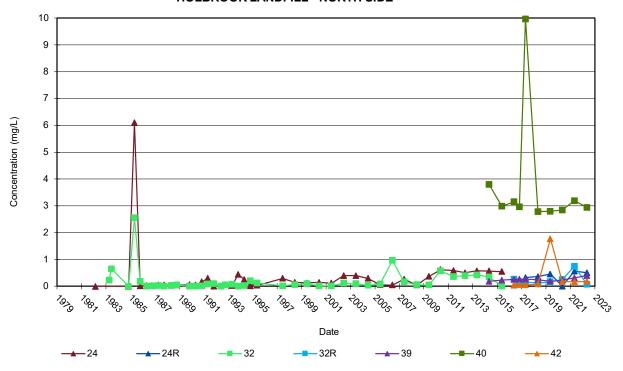


FIGURE D-25
TIME-CONCENTRATION GRAPH - IRON
HOLBROOK LANDFILL - SOUTH SIDE

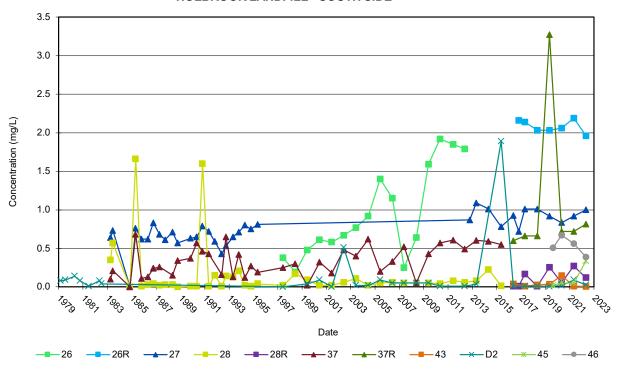


FIGURE D-26
TIME-CONCENTRATION GRAPH - IRON
HOLBROOK LANDFILL - EAST SIDE

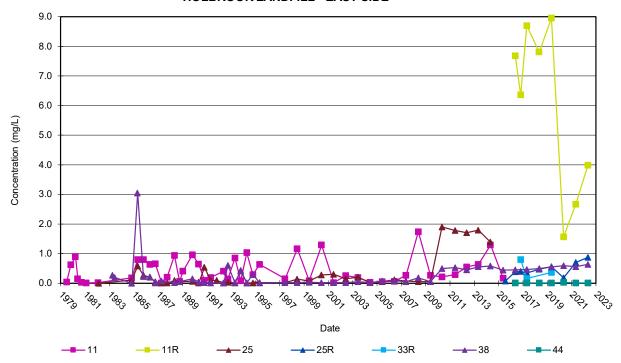


FIGURE D-27
TIME-CONCENTRATION GRAPH - IRON
HOLBROOK LANDFILL - WEST SIDE

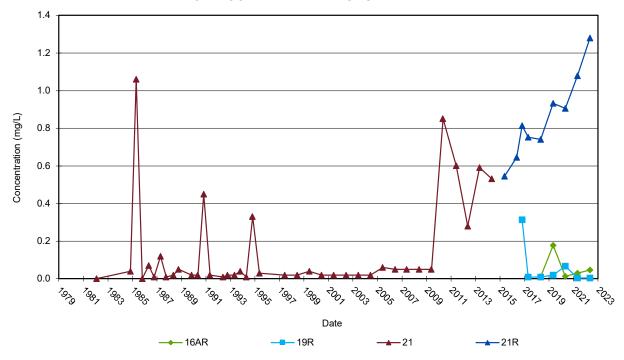


FIGURE D-28
TIME-CONCENTRATION GRAPH - AMMONIA
HOLBROOK LANDFILL - NORTH SIDE

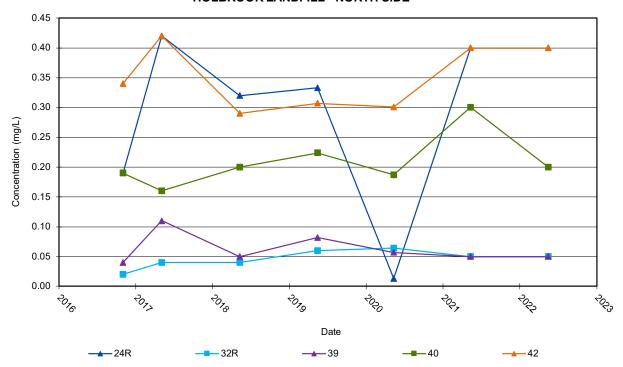


FIGURE D-29
TIME-CONCENTRATION GRAPH - AMMONIA
HOLBROOK LANDFILL - SOUTH SIDE

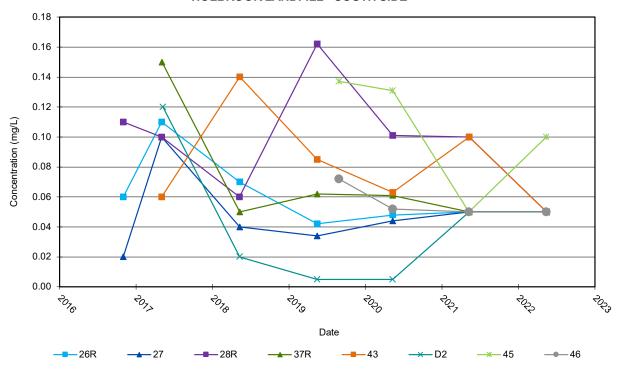


FIGURE D-30
TIME-CONCENTRATION GRAPH - AMMONIA
HOLBROOK LANDFILL - EAST SIDE

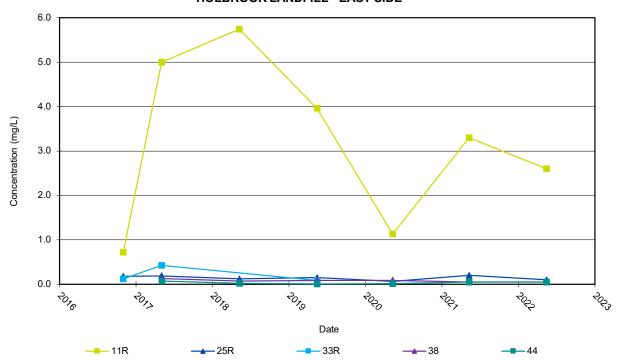


FIGURE D-31
TIME-CONCENTRATION GRAPH - AMMONIA
HOLBROOK LANDFILL - WEST SIDE

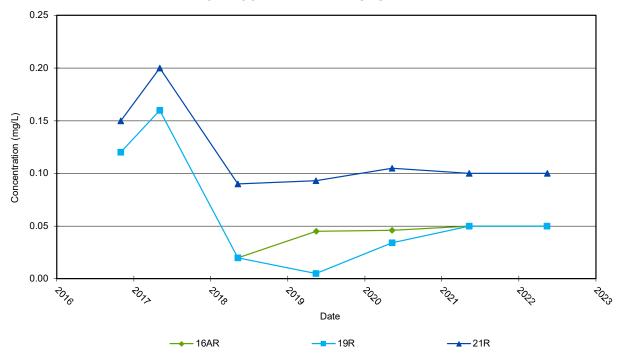


FIGURE D-32 TIME-CONCENTRATION GRAPH - TKN HOLBROOK LANDFILL - NORTH SIDE

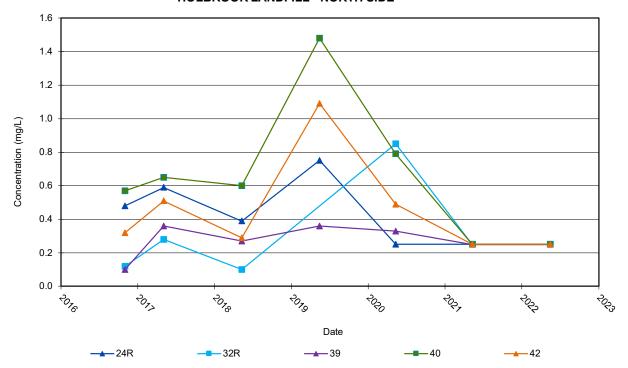


FIGURE D-33
TIME-CONCENTRATION GRAPH - TKN
HOLBROOK LANDFILL - SOUTH SIDE

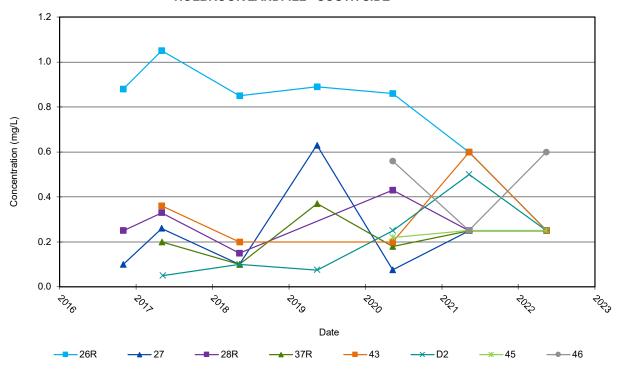


FIGURE D-34
TIME-CONCENTRATION GRAPH - TKN
HOLBROOK LANDFILL - EAST SIDE

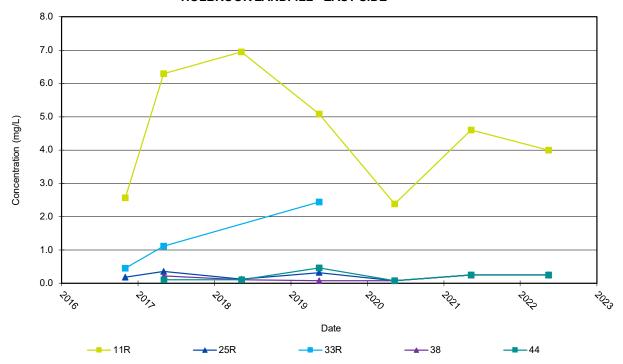
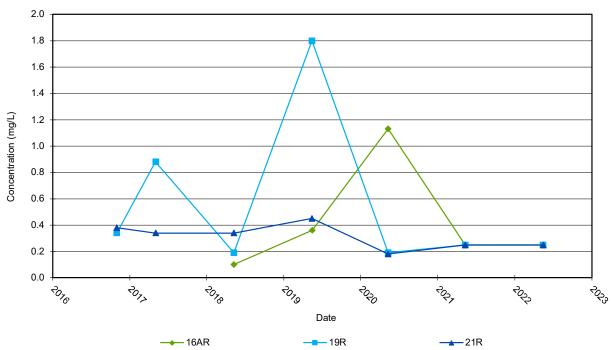


FIGURE D-35
TIME-CONCENTRATION GRAPH - TKN
HOLBROOK LANDFILL - WEST SIDE



## **APPENDIX**

SURFACE WATER
CHEMISTRY

Notation	Description		
	all units in mg/L unless otherwise noted	EC	Electrical Conductivity
mg/L	milligrams per Litre	°C	degrees Celsius
μg/L	micrograms per Litre	μS/cm	microSiemens per centimetre
SU	Scientific Units	Т	Temperature
PWQO	Provincial Water Quality Objectives (July 199	4)	
i	interim PWQO		
nc	no PWQO criteria		
а	alkalinity should not decrease by more than	25% of the na	atural concentration:
	calculated on an event specific basis fro	m background	d station CO6 when sampled
em	equipment malfunction - field parameter data	not available	
DRY	sampling location dry at the time of sampling		
- or blank	parameter not analysed during sampling ever	nt	
< value	parameter not detected above associated lab	oratory report	ted detection limit
*	estimated value / result interpreted with cauti-	on or consider	red questionable

**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Gei	neral Para	meters			Мај	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	tors		Me	etals	
	Date	pН	EC	т	Turbidity	pН	EC	Total									Un-ionized						
Well	Units	SU	μS/cm	°C	NTU	su	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO1	30-Mar-83				1	7.30	380	222	12.0														
	18-Apr-83					7.30	380	222	12.0														
	15-Jun-83					7.30	620	324	2.0														
	20-Jul-83					7.45	670	356	21.0		328	108.0	20.8										
	13-Sep-83					7.20	580	328	26.0														
	14-Nov-83					8.24	640	342	21.8		305	95.0	25.5									0.39	
	8-Dec-83					7.30	510	316	19.0														
	30-Apr-84					7.30	600	318	18.0														
	15-Jun-84					7.94	720	342	22.0		331	96.0	24.8									0.42	
	8-Aug-84					7.92	553	288	17.8		251	83.0	19.5									0.22	
	10-Aug-84					7.48	700	346	23.5		336	100.0	23.4									0.65	
	18-Sep-84					7.65	660	348	21.5		315	99.5	24.0									0.32	
	18-Dec-84					7.88	618	309	22.0		293	86.0	22.8									0.20	
	24-Jun-85					7.77	660	321	22.0		317	89.0	23.8									0.30	
	7-Oct-85					7.57	710	338	18.5		300	97.0	23.2									1.45	
	18-Dec-85					7.51	690	346	22.0		290	98.0	24.4									0.80	
	12-Mar-86					7.46	468	228	18.5		200	68.0	14.0									0.84	
	10-Jun-86					7.81	635	314	20.5		302	90.0	21.6									0.44	
	18-Sep-86					7.60	615	291	23.5		260	80.0	22.0									0.24	
	15-Dec-86					7.56	625	311	21.5		274	85.5	23.6									0.74	
	6-Mar-87					7.81	630	321	20.5		275	90.5	23.0									0.20	
	12-Jun-87					7.61	660	316	25.0		304	86.0	24.4									0.65	
	14-Sep-87					7.52	615	303	28.0			82.0	23.8									0.60	
	14-Dec-87					7.60	595	288	22.8		234	81.6	20.4									0.26	
	7-Mar-88					7.36	625	314	19.9		273	88.1	22.6									0.54	
	6-Sep-88					7.49	550	258	24.0		243	66.2	22.5									0.38	
	12-Dec-88					7.31	733	373	26.0		314	102.0	28.5									0.25	



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Parai	meters			Мај	or and Mino	or lons			Nutri	ents and Orga	anic Indicat	ors		Me	etals	
	Date	pН	EC	т	Turbidity	pН	EC	Total									Un-ionized						
Well	Units	SU	μS/cm	°C	NTU	su	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO1	14-Mar-89					7.66	610	288	20.7		260	80.3	21.2									0.24	
cont'd	14-Mar-89					7.66	610	288	20.7		260	80.3	21.2									0.24	
	13-Jun-89					7.52	498	232	22.0			57.9	21.1									0.38	
	11-Sep-89					7.42	559	311	28.2		256	85.0	24.0									2.40	
	11-Dec-89					7.65	667	335	26.8		280	89.3	27.2									0.61	
	5-Mar-90					7.39	598	291	20.5		272	83.3	20.1									0.41	
	21-Jun-90					7.92	508	252	24.0		231	63.1	22.9									0.23	
	17-Sep-90					7.43	531	273	26.0		237	73.3	21.9									0.44	
	2-Dec-90					8.24	568	272	21.0		246	74.2	21.1									0.06	
	11-Mar-91					7.77	619	307	23.0		271	87.3	21.6									0.09	
	17-Jun-91					7.69	493	213	28.3		201	48.6	22.3									0.54	
	9-Sep-91					7.62	494	218	28.4		183	48.0	23.8									0.58	
	3-Dec-91					7.81	515	253	20.3		221	69.3	19.4									0.09	
	24-Mar-92					7.61	618	303	23.3		273	82.1	23.8									0.26	
	16-Jun-92					7.78	486	223	29.7		166	44.2	27.4									0.75	
	15-Sep-92					7.74	511	244	24.2		212	59.3	23.3									0.53	
	7-Dec-92					7.75	632	349	23.3		285	99.3	24.4									0.44	
	23-Mar-93					7.82	629	338	22.4		272	96.5	23.6									0.47	
	15-Jun-93					7.69	446	204	25.0		198	46.3	21.3									0.56	
	7-Sep-93					7.61	533	274	30.5		227	65.4	26.9									0.76	
	7-Dec-93					8.44	621	325	22.9		243	89.1	24.7									0.19	
	21-Mar-94					7.59	667	373	24.1		296	105.0	26.6									0.28	
	21-Jun-94					7.68	522	253	31.3		248	58.0	26.3									0.98	
	6-Dec-94					7.83	618	321	21.8		268	85.8	25.9									0.19	
	28-Mar-95					7.83	613	316	25.5		252	86.7	24.2									0.21	
	26-Jun-95					7.70	529	251	31.0		208	61.5	23.6									0.64	
	16-May-97					8.42	611	307	27.1		268	84.3	23.4									0.22	0.030



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Para	meters			Maj	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	ors		Me	etals	
Well	Date	рН	EC	т	Turbidity	рН	EC	Total	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
*****	Units	SU	μS/cm	°C	NTU	su	μS/cm	Hardness	Onioride	Outphate	Aikaiiiity	Calcium	magnesium	rotassium	Codidin	Aiiiiioiiia	Ammonia	Milate	Millite	Boron	Cilionilum		manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	а	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO1	16-Oct-97					8.05	630	383	33.0		270	112.0	25.0									0.12	0.040
cont'd	16-Dec-97					7.71	588	253	32.0		238	63.2	23.2									0.66	0.130
	16-May-98					8.40	583	281	33.0		276	74.1	23.2									0.37	0.100
	16-Oct-98					8.15	869	325	51.0		236	81.2	29.7									0.36	0.110
	16-Dec-98					8.33	594	273	44.0		216	65.0	27.0									1.72	0.370
	16-May-99					7.90	670	344	32.0		270	97.4	24.4									0.16	0.070
	16-Jul-99					8.04	561	278	40.0		232	65.6	27.7									1.19	0.370
	16-Oct-99					7.87	888	325	48.0		220	84.3	27.8									1.36	0.180
	16-Dec-99					7.75	666	396	61.9		102	113.0	27.7									2.04	0.720
	16-May-00					7.95	595	329	29.0		262	94.5	22.6									0.16	0.050
	16-Jul-00					7.57	592	317	30.0		260	87.4	24.1									1.08	0.530
	16-Oct-00					7.88	637	335	40.0		261	87.2	28.4									0.26	0.070
	16-Dec-00					7.81	610	352	34.0		281	100.0	24.8									0.50	0.240
	16-May-01					7.69	643	341	37.0		276	96.6	24.3									0.08	0.020
	16-Jul-01					8.24	591	311	45.0		227	78.7	27.8									0.32	0.090
	16-Oct-01					8.05	624	337	43.0		265	85.8	29.7									0.21	0.090
	16-May-02					7.98	717	384	43.0		303	106.0	29.0									0.29	0.090
	16-Jul-02					8.42	667	297	48.0		277	75.1	26.6									0.68	0.410
	16-Oct-02					7.97	713	368	57.0		276	98.1	30.0									1.68	0.410
	16-May-03					8.06	634	288	46.0		233	80.2	21.4									0.27	0.130
	16-Jul-03					7.81	628	344	49.0		254	87.7	30.4									2.73	0.980
	16-Dec-03					7.74	629	316	56.0		266	84.7	25.4									0.63	0.240
	16-May-04					7.96	652	327	50.0		242	87.2	29.1									1.61	0.310
	16-Jul-04					7.68	641	332	49.0		268	85.4	28.8									1.01	0.360
	16-Oct-04					8.15	657	338	48.0		262	90.0	27.6									0.24	0.034
	16-Dec-04					8.12	682	310	57.0		236	73.7	30.6									1.42	0.300
	16-May-05					8.20	700	321	47.4		279	88.4	24.4									0.20	0.043



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Parai	meters			Maj	or and Mino	r lons			Nutr	ents and Orga	anic Indicat	ors		Me	tals	
	Date	pН	EC	т	Turbidity	pН	EC	Total									Un-ionized			_			
Well	Units	SU	μS/cm	°C	NTU	SU	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	а	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO1	16-Jul-05					8.16	646	335	56.9		245	73.8	36.5									2.10	0.540
cont'd	16-Oct-05					8.19	632	330	46.0		235	94.0	24.0									0.53	0.240
	16-Dec-05					8.05	702	267	55.0		253	67.6	23.8									0.46	0.099
	16-May-06					7.83	636	340	45.0		280	89.1	27.4									0.48	0.650
	16-Jul-06					7.75	619	320	57.0		250	78.6	29.6									1.02	0.264
	16-Oct-06					7.60	628	330	42.0		280	99.7	19.6									0.80	0.170
	16-Dec-06					7.60	607	260	60.0		280	63.9	23.4									0.70	0.170
	19-Apr-07					7.77	750	350	49.0		310	91.7	28.8									0.29	0.053
	28-Jun-07					7.68	624	320	61.0		210	64.2	37.6									3.97	0.748
	22-Nov-07					8.09	747	300	79.0		220	81.8	23.9									0.29	0.042
	15-Apr-08					8.10	687	320	50.0		270	84.0	26.0									0.13	0.020
	28-Jun-08					8.00	656	280	58.0		250	65.0	29.0									0.92	0.590
	11-Aug-08					8.00	620	290	45.0		270	77.0	24.0									2.80	2.320
	16-Apr-09					8.03	722	321	52.0		289	93.8	21.1									0.12	0.020
	1-May-09					8.06	554	279	32.7		240	82.9	17.5									0.38	0.059
	1-Oct-09					8.04	672	381	52.0		247	97.3	33.6									1.41	0.422
	1-Dec-09					8.14	762	386	49.2		308	106.0	29.4									1.60	0.336
	15-Mar-10	7.80	610	2.3		8.11	637	298	40.9		261	83.8	21.5									0.20	0.092
	10-May-10	7.92	670	15.2		8.40	572	312	47.3		274	82.7	25.7									0.25	0.059
	14-Jul-10	7.17	540	26		7.69	650	266	59.8		252	61.5	27.4									1.02	0.353
	4-Oct-10	7.65	780	12.1		8.12	666	317	57.1		286	83.9	26.0									0.37	0.160
	11-Apr-11	8.03	645	13.7		8.37	731	329	53.2		288	93.0	23.4									0.07	0.032
	15-Jun-11	7.49	601	20.2		8.10	642	314	46.7		294	86.1	24.1									0.70	0.460
	6-Aug-11	7.32	615	23.3		8.05	589	232	75.4		208	49.3	26.5									0.40	0.140
	24-Oct-11	6.77	525	9.7		7.92	543	272	45.3		242	77.1	19.3									0.18	0.058
	8-Mar-12	7.61	589	6.1		8.26	715	282	50.1		279	78.5	20.9									0.11	0.031
	23-May-12	7.35	551	23.1		8.05	651	253	66.1		251	54.8	28.3									0.47	0.094



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Parai	meters			Maj	or and Mino	or lons			Nutri	ents and Org	anic Indicat	tors		Me	etals	
Well	Date	рН	EC	т	Turbidity	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	Units PQWO	SU 6.5-8.5	μS/cm nc	°C nc	NTU Narrative	SU 6.5-8.5	μS/cm nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO1	13-Aug-12	6.98	558	21.3		7.94	603	232	69.6		207	44.1	29.6									0.67	0.236
cont'd	24-Oct-12	6.76	600	11.9		8.24	692	303	68.5		283	74.4	28.4									0.56	0.183
	9-Apr-13	8.32	826	5.8		8.03	754	293	45.8		298	82.7	20.9									0.20	0.069
	9-May-13	7.94	855	23.6		8.39	828	301	58.6		316	74.2	28.2									0.44	0.149
	7-Aug-13	8.10	707	23		7.48	703	236	66.5		240	52.4	25.5									0.17	0.063
	31-Oct-13	8.18	647	11.2		8.25	595	271	35.7		234	76.9	19.3									0.25	0.044
	28-Mar-14	7.99	807	2		8.05	641	294	43.1		281	81.7	21.8									0.21	0.144
	9-May-14	7.71	724	20.1		8.00	693	299	45.1		265	80.8	23.5									0.30	0.118
	12-Aug-14	8.23	668	21.8		8.09	658	244	53.4		249	56.8	24.9									0.451	0.204
	20-Oct-14	7.90	700	11.2		7.96	799	341	51.1		316	91.6	27.3									0.22	0.061
	6-Apr-15	6.00	610	4.4		7.97	731	322	47.7		307	89.8	23.8									0.15	0.070
	28-May-15	7.56	494	26.3		8.21	740	275	63.4		275	66.5	26.5									0.37	0.201
	26-Aug-15	8.02	720	19.8		8.40	746	268	69.5		262	60.0	28.8									0.75	0.545
	29-Oct-15	7.76	740	8.8		8.17	727	297	60.8		252	79.7	23.9									0.15	0.047
	10-Mar-16	7.76	550	7.6		7.72	695	285	48.1		275	80.1	20.6									0.08	0.089
	25-May-16	7.94	556	13.9		8.20	773	277	69.1		297	67.3	26.5									0.42	0.180
	18-Aug-16	7.52	641	21.6		8.17	873	316	72.8		251	78.1	29.3									0.32	0.127
	17-Oct-16	7.28	1310	17.2		8.10	1290	556	78.4		316	161	37.4									2.66	1.92
	1-Nov-16	7.52	1112	7.10		8.03	1120		79.8	216	308	143	31.8	5.85	40.5	0.23	0.001	<0.25	<0.25	0.573	<0.003	1.12	0.445
	7-Mar-17	7.72	652	3.19		8.19	644	239	43.5		237	66.3	17.8									0.092	0.012
	4-May-17	7.94	700	8.75		8.31	755	290	44.6	17.8	294	81.5	20.9	6.16	27.4	0.21	0.003	1.59	<0.10	0.292	<0.003	<0.010	0.023
	2-Aug-17	7.87	633	20.93		8.18	761	297	66.1		305	72.4	28.2									0.34	0.178
	17-Oct-17	7.11	619	12.49		8.04	766	309	71.8		304	79.9	26.6									0.644	0.395
	2-Apr-18	7.96	707	5.90	8.3	8.01	667	289	55.2	23.5	286	80.1	21.6	7.28	29.9	0.66	0.008	2.79	<0.10	0.325	<0.003	0.027	0.020
	18-Oct-18	8.05	712	6.41	25.2	8.12	743	320	62.1	10.9	348	84.6	26.3	7.92	34.7	0.42	0.006	0.51	<0.10	0.262	<0.003	0.63	0.393
	15-Apr-19	7.78	591	3.91	0.0	7.99	580	256	36.0	14.0	248	72.2	18.4	6.03	24.2	0.203	0.001	2.13	0.017	0.198	0.0019	0.118	0.016
	8-Oct-19	7.99	620	12.29	8.0	7.77	715	306	59.1	13.7	298	72.4	30.4	8.36	38.7	0.281	0.006	0.486	0.020	0.310	<0.0050	0.34	0.189



**Table E-1: Surface Water Chemical Results** 

			Field Pa	arameters		Gei	neral Para	meters			Maj	or and Mino	r lons			Nutr	ients and Orga	anic Indicat	tors		Me	tals	
Well	Date	рН	EC	т	Turbidity	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	Units	SU	μS/cm	°C	NTU	SU	μS/cm	Tiaranooo									7.11111011114						
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO1	8-Apr-20	7.75	614	9.52	2.0	8.23	692	308	48.1	14.1	297	83.5	24.1	8.00	31.2	0.142	0.001	2.12	0.03	0.307	<0.00050	0.099	0.0284
cont'd	15-Oct-20	7.96	624	13.72	2.0	8.10	752	334	60.7	5.99	320	86.3	28.9	7.61	36.8	0.849	0.019	0.103	0.044	0.350	<0.0050	1.62	0.760
	12-Apr-21	7.74	624	14.13	1.0	8.07	677	319	49	15	269	91.4	22.1	8.98	31.8	0.2	0.003	1.03	<0.03	0.397	0.00053	0.15	0.055
	7-Oct-21	7.65	638	17.42	2.0	7.96	728	322	52	12	300	89.1	24.1	7.93	29.2	0.5	0.007	0.35	0.030	0.301	0.00022	0.58	0.511
	6-Apr-22	7.79	664	6.66	9.5	8.02	678	341	54	22	284	95.3	25.2	8.48	33.6	0.5	0.004	2.13	<0.03	0.332	<0.00008	0.12	0.0590
	18-Oct-22	7.84	691	9.24	5.0	8.26	737	296	61	22	274	70.8	28.9	10.6	40.7	0.8	0.010	0.57	<0.03	0.359	<0.00008	0.55	0.276
CO4	20-Mar-80					7.70	490	253	16.0			74.5	16.2									1.34	
	27-May-80					8.00	690	353	25.0			100.0	25.0									0.21	
	17-Sep-80					7.80	745	376	30.5			105.0	27.6									0.08	
	25-Sep-81					7.60	625		26.0														
	2-Oct-81					7.40	595	330	26.0														
	3-Oct-81						635		23.0														
	2-Feb-82					8.00	640	388	25.0		305											0.02	
	4-May-82					7.90	480	344	20.0														
	2-Sep-82					8.00	780	397	32.0			112.0	28.4										
	3-Sep-82					8.00	780	397	32.0			112.0	28.4										
	30-Mar-83					7.80	460	294	16.0														
	18-Apr-83					7.80	460	294	16.0														
	15-Jun-83					7.80	700	400															
	20-Jul-83					7.84	620	329	37.0		302	92.0	24.0										
	14-Sep-83					7.70	610	364	20.0														
	8-Dec-83					7.70	350	200	16.0														
	12-Dec-83					7.70	350	200	16.0														
	30-Apr-84					7.70	670	354	20.0														
	18-Sep-84					7.91	720	212	23.0		356	41.0	26.6									8.15	
	24-Jun-85					7.82	690	329	22.5		310	89.5	25.6									0.30	
	18-Dec-85					7.50	735	374	22.5		308	105.0	25.2									0.10	
	18-Sep-86					8.12	560	256	22.5		212	65.5	22.4									0.21	



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Para	meters			Maj	or and Mino	or lons			Nutri	ents and Orga	anic Indicat	tors		Me	etals	
l	Date	pН	EC	т	Turbidity	рН	EC	Total									Un-ionized						
Well	Units	SU	μS/cm	°C	NTU	SU	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO4	6-Mar-87					7.84	635	324	19.5		275	91.5	23.0									0.26	
cont'd	14-Sep-87					7.53	550	265	27.0			63.0	26.2									0.84	
	7-Mar-88					7.66	695	368	21.8		294	104.4	26.0									0.19	
	12-Dec-88					7.07	1144	748	22.7		457	233.5	40.0									10.40	
	5-Mar-90					7.72	701	347	25.6		318	99.6	23.8									0.01	
	21-Jun-90					7.76	485	234	25.0		199	54.3	23.8									0.96	
	2-Dec-90					8.58	604	280	22.1		264	74.4	22.8									0.13	
	11-Mar-91					7.89	623	303	23.7		270	87.3	20.6									0.22	
	9-Sep-91					7.84	454	198	28.6		150	39.0	24.4									0.60	
	24-Mar-92					7.94	666	328	29.0		209	87.7	26.3									0.18	
	16-Jun-92					8.08	462	213	30.7		145	38.6	28.2									0.38	
	7-Dec-92					7.97	682	343	27.5		302	96.4	24.8									0.13	
	23-Mar-93					7.77	679	370	22.0		306	104.0	26.3									0.26	
	7-Sep-93					7.86	486	234	28.4		188	51.2	25.7									0.44	
	21-Mar-94					7.55	699	381	25.0		306	108.0	26.6									0.26	
	21-Jun-94					7.84	511	240	32.6		219	51.8	26.8									0.77	
	6-Dec-94					8.09	636	304	28.6		230	77.4	26.1									0.18	
	28-Mar-95					8.08	664	306	31.7		231	86.7	26.6									0.34	
	15-Jun-97					8.27	552	324	28.0		268	86.5	26.3									0.30	0.060
	15-Jun-98					8.05	601	298	33.0		275	78.1	25.1									0.41	0.230
	15-Jun-99					8.10	677	348	41.0		300	95.2	26.8									0.42	0.070
	15-Jun-00					8.22	635	371	42.0		236	102.0	28.2									0.44	0.130
	15-Jun-01					7.76	669	353	42.0		289	99.9	25.2									0.40	0.080
	15-Jun-02					8.05	749	392	47.0		317	108.0	29.6									0.48	0.210
	15-Jun-03					8.11	748	370	53.0		295	94.7	32.4									0.68	0.110
	15-Jun-04					8.12	721	337	52.1		294	89.7	26.7									0.70	0.102
	15-Jun-05					8.20	738	335	51.9		298	91.7	25.8									0.40	0.090



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Gei	neral Parar	neters			Maj	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	tors		Me	etals	
Well	Date	рН	EC	т	Turbidity	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	Units	su	μS/cm	°C	NTU	SU	μS/cm																
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO4	15-Jun-06					7.90	693	340	53.0		290	87.9	30.1									1.10	0.279
cont'd	19-Apr-07					7.85	790	380	52.0		330	101.0	30.3									0.56	0.072
	15-Apr-08					8.10	740	350	49.0		310	92.0	29.0									0.47	0.040
	16-Apr-09					8.18	747	316	61.2		306	89.1	22.8									0.52	0.071
	10-May-10	8.16	680	14.8		8.17	530	306	54.3		280	77.9	27.1									0.40	0.058
	11-Apr-11	7.95	723	14.8		8.32	791	345	55.9		322	97.4	24.8									0.35	0.060
	8-Mar-12	7.79	632	7.0		8.34	776	312	50.0		329	87.6	22.7									0.31	0.041
	9-Apr-13	8.39	924	8.7		8.13	879	328	56.8		349	92.4	23.6									0.47	0.110
	28-Mar-14	7.98	896	2.7		8.15	822	329	48.2		339	92.2	23.9									0.20	0.209
	6-Apr-15	7.68	655	8.0		8.15	788	339	52.3		338	94.8	24.9									0.42	0.116
	10-Mar-16	7.50	640	9.6		8.20	859	332	63.3		337	92.3	24.7									0.08	0.042
	7-Mar-17	7.88	782	5.95		8.24	778	283	48.9		306	78.1	21.3									0.422	0.166
	2-Apr-18	8.12	819	8.81	10.7	8.09	765	315	58.1	24.8	338	85.5	24.7	9.49	35.2	5.54	0.121	0.96	<0.25	0.421	<0.003	0.172	0.045
	15-Apr-19	7.97	725	5.78	0.0	8.02	718	304	47.9	21.7	297	83.3	23.4	7.96	30.0	4.20	0.051	0.841	0.019	0.317	<0.00050	0.263	0.0577
	8-Apr-20	7.95	682	11.17	10.1	8.26	768	332	54.1	18.5	328	88.3	27.0	9.37	35.4	4.73	0.084	0.748	0.034	0.374	<0.00050	0.309	0.0593
	12-Apr-21	7.89	683	16.33	1.0	8.11	737	320	52	30	285	86.9	25.0	9.95	33.4	5.3	0.121	0.43	0.04	0.417	0.00045	0.34	0.103
	6-Apr-22	8.36	766	9.42	17.7	8.27	803	382	62	25	338	107	28.2	9.79	38.1	6.2	0.242	0.78	<0.03	0.389	0.00040	0.29	0.0776
CO6	20-Jul-83					7.27	660	294	16.0		308	87.5	18.2										
	15-Jun-84					7.21	340	175	2.0		158	52.0	11.0									3.00	
	18-Dec-85					7.45	705	287	14.5		308	85.5	17.8									33.80	
	12-Mar-86					7.13	432	202	17.5		175	61.5	11.6									7.80	
	14-Dec-87					7.59	650	328	16.7		79	102.8	17.2									0.12	
	7-Dec-93					4.50	586	300	13.4		111	92.5	16.8									0.45	
	15-Jun-97																						
	15-Jun-98																						
	15-Jun-99					7.69	617	348	15.0		237	107.0	19.6									0.71	0.120
	15-Jun-00					7.95	488	280	18.0		200	87.3	15.0									0.29	0.040



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Gei	neral Para	meters			Maj	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	ors		Me	etals	
	Date	pН	EC	т	Turbidity	pН	EC	Total									Un-ionized			_	<u>.</u> .		
Well	Units	SU	μS/cm	°C	NTU	su	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
CO6	15-Jun-01					7.72	545	297	38.0		242	92.9	15.9									0.07	0.020
cont'd	15-Jun-02					7.93	586	322	39.0		239	100.0	17.6									0.26	0.060
	15-Jun-03					7.86	622	321	49.0		220	97.6	18.7									0.18	0.080
	15-Jun-04					7.92	491	257	30.7		221	87.2	15.2									0.17	0.022
	15-Jun-05					8.15	518	241	29.9		213	74.8	13.1									<0.1	<0.005
	15-Jun-06					7.72	482	290	30.0		230	89.8	16.6									0.23	0.029
	19-Apr-07					7.58	572	290	35.0		250	86.6	16.9									0.18	0.018
	15-Apr-08					8.00	487	230	38.0		180	69.0	14.0									0.10	
	16-Apr-09					7.87	593	266	54.7		232	87.0	11.9									0.12	0.007
	10-May-10	7.55	590	12.4		8.31	657	338	26.7		289	105.0	18.3									3.00	0.323
	11-Apr-11	7.75	511	11.5		8.23	571	255	48.1		214	80.2	13.2									<0.01	0.003
	11-Apr-11	7.75	511	11.5		8.29	575	247	48.4		207	78.1	12.6									<0.01	0.003
	8-Mar-12	7.57	414	4.7		8.21	514	214	30.2		210	66.9	11.5									0.01	0.005
	9-Apr-13	8.25	541	4.9		7.77	480	196	27.1		194	61.5	10.3									<0.01	<0.002
	28-Mar-14	7.96	605	0.4		8.11	548	238	32.7		229	72.9	13.5									0.21	0.058
	6-Apr-15	8.03	412	5.0		7.91	523	253	33.2		222	78.9	13.5									<0.01	0.008
	10-Mar-16	7.56	355	8.0		7.96	465	233	19.6		207	72.3	12.7									<0.01	0.005
	7-Mar-17	7.67	556	4.89		8.01	559	204	58.1		171	63.2	11.2									0.013	0.010
	4-May-17	8.15	625	8.53		8.32	657	249	47.2	11.9	243	77.6	13.4	1.21	24.1	0.12	0.003	0.20	<0.10	0.015	<0.003	<0.010	0.008
	2-Apr-18	7.43	566	8.25	12.3	7.85	508	234	44.6	15.9	208	72.9	12.6	1.23	18.2	<0.02	<0.001	1.00	<0.10	0.018	<0.003	<0.010	0.002
	18-Oct-18	D	R	Υ																			
	15-Apr-19	7.84	521	3.92	0.0	7.80	509	226	45.9	8.25	201	68.4	13.3	1.49	25.1	0.049	<0.001	1.12	0.015	0.011	<0.00050	0.225	0.0149
	8-Oct-19	D	R	Υ																			
	8-Apr-20	7.97	567	8.75	2.0	8.07	604	274	45.4	7.52	259	82.8	16.2	1.47	26.4	0.027	<0.001	0.192	<0.010	0.014	<0.00050	0.078	0.0114
	15-Oct-20	D	R	Υ																			
	12-Apr-21	7.64	511	13.84	0.0	8.05	549	280	30	14	237	89.5	13.9	1.82	13.2	<0.1	<0.001	0.11	<0.03	0.026	0.00041	0.11	0.0334
	7-Oct-21	7.55	662	10.37	22.8	8.05	754	382	41	<2	342	122	18.8	2.19	22.6	<0.1	<0.001	0.76	<0.03	0.034	0.00072	0.60	0.243
	6-Apr-22	7.69	558	6.86	10.4	8.13	592	298	52	15	253	91.5	16.9	1.27	27.8	<0.1	<0.001	0.22	<0.03	0.040	0.00032	0.05	0.0342
	18-Oct-22	D	R	Υ																			



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Para	meters			Maj	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	ors		Me	etals	
Well	Date	рН	EC	т	Turbidity	pН	EC	Total	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
11011	Units	SU	μS/cm	°C	NTU	SU	μS/cm	Hardness	Onioride	Ourpriate	Aikaiiiiky	Calcium	magnesiani	i otassium	oodidiii	Ammonia	Ammonia	Miliate	Millio	Boron	Onionnum	11011	manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	а	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
NE1	20-Jul-83					7.44	330	169	4.5		156	54.0	8.2										
	18-Sep-84					8.00	425	163	24.0		153	53.0	7.4									<0.04	
	24-Jun-85					7.64	510	167	31.5		210	44.5	13.6									1.10	
	18-Dec-85					7.57	580	242	22.0		236	79.5	10.6									0.60	
	18-Sep-86					8.30	227	96	5.0		89	31.5	4.2									1.85	
	6-Mar-87					8.03	309	142	7.0		128	46.5	6.2									0.44	
	7-Mar-88					7.65	254	128	4.3		89	42.5	5.2									2.30	
	12-Dec-88					7.28	506	230	13.6		211	75.8	9.9									0.50	
	5-Mar-90					7.05	241	120	2.9		105	41.5	4.0									0.09	
	21-Jun-90					8.12	553	266	15.2		283	87.9	11.2									1.14	
	2-Dec-90					8.20	605	260	22.4		261	86.2	10.9									0.05	
	11-Mar-91					6.68	646	32	0.9		25	10.4	1.5									0.06	
	24-Mar-92					7.39	336	165	9.7		105	52.4	8.3									0.02	
	16-Jun-92					7.75	699	316	20.1		329	98.9	16.6									1.14	
	7-Dec-92					7.30	425	208	9.3		212	68.9	8.6									0.40	
	23-Mar-93					6.80	1047	507	21.8		513	170.0	19.8									30.60	
	21-Mar-94					7.12	234	117	4.9		109	40.8	3.6									0.11	
	21-Jun-94					7.62	604	287	15.1		245	93.9	12.8									2.23	
	28-Mar-95					7.44	367	181	7.4		173	60.3	7.3									0.15	
	15-Jun-97					8.31	565	314	13.0		321	103.0	13.7									0.28	0.030
	15-Jun-98					7.60	639	344	18.0		278	112.0	18.0									1.41	0.440
	15-Jun-99					8.17	798	413	26.0		346	140.0	26.0									0.18	<0.02
	15-Jun-00					7.64	703	428	15.0		300	144.0	15.0									0.55	0.080
	15-Jun-01					7.21	437	256	7.0		224	86.1	7.0									0.22	0.030
	15-Jun-02					7.72	795	399	28.0		385	130.0	28.0									0.56	0.250
	15-Jun-03					7.72	659	361	23.0		311	118.0	23.0									0.35	0.270
	15-Jun-04					7.97	657	357	21.2		337	102.0	21.2									0.92	0.034
	15-Jun-05					8.16	730	318	33.4		334	99.3	33.4									0.10	0.029



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Gei	neral Para	meters			Мај	or and Mino	r lons			Nutr	ients and Orga	anic Indicat	ors		Me	etals	
Well	Date	pН	EC	т	Turbidity	pН	EC	Total	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	Units	SU	μS/cm	°C	NTU	SU	μS/cm	Hardness	Omorido	Culpilato	7u	ouioiuiii	magnooram	, oracoram	Coulum	7	Ammonia	11111111		20.0	· · · · · · · · · · · · · · · · · · ·		manganooo
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	а	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
NE1	15-Jun-06					7.55	637	370	14.0		340	121.0	14.0									0.78	0.053
cont'd	19-Apr-07					7.25	642	340	13.0		320	110.0	16.1									0.34	0.023
	15-Apr-08					7.60	380	210	4.0		180	67.0	10.0									0.09	0.010
	16-Apr-09					7.63	717	341	19.0		350	115.0	13.0									0.21	0.014
	10-May-10	7.69	630	11.8		8.02	599	308	25.9		314	98.0	15.4									0.66	0.082
	11-Apr-11	7.78	421	13.1		8.15	491	241	14.7		221	81.2	9.35									0.01	0.028
	8-Mar-12	7.84	126	6.7		7.84	258	113	5.18		123	38.1	4.22									0.12	0.069
	9-Apr-13	8.29	227	5.6		7.75	240	104	5.09		112	34.2	4.40									0.02	0.048
	28-Mar-14	7.97	378	1.8		7.90	306	150	4.76		153	47.9	7.30									0.38	0.196
	6-Apr-15	8.30	220	10		7.69	260	120	8.30		115	38.9	5.48									<0.01	0.048
	10-Mar-16	7.71	267	8.9		7.77	399	152	21.7		156	47.9	7.88									<0.01	0.035
	7-Mar-17	7.52	593	5.3		8.05	585	237	14.3		255	77.9	10.2									<0.010	0.088
	2-Apr-18	7.64	465	9.56	8.5	7.89	429	232	4.29	8.75	239	77.3	9.40	2.50	2.82	0.40	0.003	0.88	<0.10	0.046	<0.003	0.016	0.069
	15-Apr-19	8.16	585	5.18	0.0	7.55	480	244	6.75	5.33	237	79.7	10.9	3.81	5.74	1.67	0.030	3.53	0.035	0.054	<0.00050	0.071	0.00734
	8-Apr-20	8.09	493	9.35	2.8	7.85	618	323	6.29	5.50	326	106	14.0	3.60	5.35	1.91	0.041	2.50	0.069	0.060	<0.00050	0.039	0.0233
	12-Apr-21	7.67	590	14.82	2.0	8.02	639	318	30	4	296	104	13.9	10.1	17.3	1.2	0.015	<0.06	<0.03	0.143	0.00031	0.73	0.103
	6-Apr-22	8.11	607	8.77	17.0	7.73	656	391	7	5	371	132	14.8	4.35	4.58	2.4	0.051	0.32	<0.03	0.077	0.00029	0.33	0.0566
PO1	18-Sep-84					8.30	365	179	9.0		133	52.0	12.0									<0.04	
	24-Jun-85					8.21	350	150	14.0		146	29.5	18.4									2.00	
	18-Dec-85					7.47	715	338	27.5		283	96.5	23.4									0.46	
	18-Sep-86					8.26	279	122	7.5		113	33.0	9.6									0.18	
	6-Mar-87					7.87	454	233	7.5		208	66.5	16.2									0.78	
	14-Sep-87					9.00	262	116	3.5			21.5	15.0									0.46	
	7-Mar-88					7.71	192	97	4.1		72	30.9	4.8									0.80	
	12-Dec-88					7.77	538	255	10.8		231	72.6	17.9									0.37	
	13-Jun-89					8.20	429	187	23.0			36.3	23.4									0.14	
	11-Sep-89					7.78	335	191	10.3		142	46.0	18.4									1.75	
	5-Mar-90					7.66	471	235	10.6		203	66.5	16.6									0.38	
	21-Jun-90					8.32	405	207	8.9		182	56.4	15.9									1.05	



**Table E-1: Surface Water Chemical Results** 

		Field Parameters					General Parameters				Maj	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	ors		Me	etals	
	Date	pН	EC	т	Turbidity	pН	EC	Total									Un-ionized			_			
Well	Units	su	μS/cm	°C	NTU	su	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	а	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
PO1	2-Dec-90					8.56	436	212	11.6		195	60.9	14.4									0.24	
cont'd	11-Mar-91					7.58	378	186	6.7		169	55.6	11.4									0.63	
	9-Sep-91					7.64	359	163	7.1		155	41.4	14.5									0.73	
	24-Mar-92					8.18	408	208	7.8		178	57.7	15.5									0.22	
	16-Jun-92					8.78	259	132	6.4		95	22.2	18.6									2.35	
	7-Dec-92					8.20	427	226	4.5		216	61.2	17.8									0.35	
	23-Mar-93					7.33	336	134	11.7		133	42.9	6.5									3.46	
	7-Sep-93					7.73	343	169	7.9		155	35.1	19.8									1.87	
	21-Mar-94					7.36	339	175	6.3		148	53.2	10.3									1.94	
	21-Jun-94					7.50	312	156	2.4		156	36.5	15.8									<0.01	
	6-Dec-94					7.98	310	157	4.8		147	38.7	14.7									1.36	
	28-Mar-95					8.69	261	136	2.6		121	30.6	14.5									0.62	
	15-Jun-97					8.45	350	195	8.2		182	50.8	16.6									1.01	0.170
	15-Jun-98					8.42	323	189	10.0		168	45.1	18.6									1.91	0.100
	15-Jun-99					8.21	410	217	6.0		178	81.2	15.5									0.29	0.030
	15-Jun-00					8.28	532	316	18.0		210	92.9	20.4									0.11	0.040
	15-Jun-01					7.88	524	256	21.0		246	72.4	18.2									0.29	0.060
	15-Jun-02					8.06	560	284	18.0		259	79.2	21.0									0.57	0.040
	15-Jun-03					8.05	560	315	21.0		227	88.3	22.9									0.07	0.020
	15-Jun-04					8.01	432	222	18.9		181	57.0	18.7									0.31	0.061
	15-Jun-05					8.15	496	231	16.2		190	63.0	17.9									0.22	0.070
	15-Jun-06					7.97	414	210	24.0		180	50.6	21.4									0.58	0.056
	19-Apr-07					8.13	378	180	13.0		170	39.4	20.1									0.30	0.013
	15-Apr-08					8.20	443	200	16.0		180	51.0	18.0									0.16	0.010
	16-Apr-09					8.16	478	197	26.9		197	53.0	15.6									0.10	0.009
	10-May-10	8.36	390	14.7		8.34	534	208	12.7		258	51.1	19.6									0.30	0.029
	11-Apr-11	8.12	450	17.7		8.39	491	226	13.0		223	65.6	15.1									0.06	0.020



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Gei	neral Parai	neters			Maj	or and Mino	r lons			Nutr	ients and Orga	anic Indicat	tors		Me	Nutrients and Organic Indicators Metals							
Well	Date	pН	EC	т	Turbidity	рН	EC	Total Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese						
	Units	SU	μS/cm	°C	NTU	SU	μS/cm	naruness									Ammonia												
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	а	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc						
PO1	8-Mar-12	7.93	416	7.1		8.34	592	234	24.8		261	66.5	16.4									0.14	0.012						
cont'd	9-Apr-13	8.46	471	8.4		8.00	421	192	5.72		199	53.3	14.2									0.07	0.011						
	28-Mar-14	8.41	215	1.9		8.02	237	115	1.26		120	37.7	5.03									0.08	0.004						
	6-Apr-15	6.50	420	7.4		7.91	488	268	4.21		254	83.0	14.8									0.06	0.025						
	10-Mar-16	7.64	540	10.1		8.05	522	238	14.9		237	70.8	14.8									<0.01	0.018						
	7-Mar-17	7.76	457	5.2		8.19	459	208	6.35		212	63.5	12.1									0.123	0.021						
	2-Apr-18	8.07	495	6.33	9.9	8.08	455	222	14.1	9.18	232	63.8	15.3	6.92	10.5	0.21	0.003	1.87	<0.10	0.118	<0.003	0.104	0.010						
	15-Apr-19	7.85	476	6.5	5.0	7.76	422	186	9.45	4.16	212	56.5	10.9	3.17	3.45	0.078	0.001	1.25	0.016	0.038	<0.00050	0.208	0.0183						
	8-Apr-20	8.12	421	11.55	10.4	8.22	472	238	11.4	6.85	235	65.6	17.9	7.57	9.71	0.061	0.002	1.78	0.036	0.135	<0.00050	0.216	0.0318						
	12-Apr-21	8.12	363	16.03	0.0	8.12	366	326	9	8	175	88.5	25.6	10.5	34.3	<0.1	<0.004	0.72	<0.03	0.45	0.00036	0.34	0.102						
	6-Apr-22	8.26	431	9.62	16.5	8.2	456	249	10	8	234	71.5	17.1	4.37	6.11	<0.1	<0.003	0.34	<0.03	0.085	0.00017	0.17	0.0201						
PO2	15-Jun-84					7.67	780	369	24.5		331	104.0	26.4									0.18							
	18-Dec-84					7.73	670	251	21.0		271	59.0	25.0									0.48							
	7-Oct-85					8.02	605	275	20.5		218	70.5	24.0									0.10							
	12-Mar-86					8.12	120	39	6.0		40	12.5	1.8									2.52							
	10-Jun-86					7.97	670	328	23.0		282	89.0	25.6									0.19							
	15-Dec-86					7.37	640	302	20.5		285	83.0	23.0									0.17							
	12-Jun-87					7.91	615	284	26.0		252	69.0	27.0									0.45							
	14-Dec-87					8.04	645	319	22.4		263	89.6	23.1									0.25							
	6-Sep-88					7.94	505	234	24.0		198	54.9	23.6									0.18							
	14-Mar-89					7.54	680	321	23.3		290	89.1	23.9									0.23							
	11-Dec-89					7.86	689	349	24.8		297	95.3	27.0									0.07							
	11-Jun-90					8.52	453	216	25.2		173	46.3	24.3									0.21							
	17-Sep-90					7.98	474	213	25.7		183	47.9	22.6									0.13							
	17-Jun-91					8.20	440	181	27.6		160	34.7	22.9									0.16							
	3-Dec-91					8.17	571	279	26.1		229	71.2	24.6									0.16							
	15-Sep-92					8.16	487	228	26.7		188	52.3	23.6									0.20							



**Table E-1: Surface Water Chemical Results** 

			Field Pa	rameters		Ger	neral Parai	meters			Мај	or and Mino	r lons			Nutri	ents and Orga	anic Indicat	tors		Me	etals	
Well	Date	рН	EC	т	Turbidity	pН	EC	Total	01.1	0.1.1	All-ell-ele-	0-1-1		D-4l	0 - 41	A	Un-ionized	NI44-	Nitrite		01		
weii	Units	su	μS/cm	°C	NTU	SU	μS/cm	Hardness	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Ammonia	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
PO2	15-Jun-93					8.27	390	173	25.6		152	32.7	22.1									0.20	
cont'd	7-Dec-93					8.09	605	338	26.0		222	91.2	26.8									0.20	
	26-Jun-95					8.27	468	209	32.0		170	41.9	25.2									0.20	
	15-Jun-97					8.34	567	327	29.2		269	87.8	26.2									0.41	0.110
	15-Jun-98					8.28	599	300	34.0		256	79.3	24.8									0.42	0.210
	15-Jun-99					8.03	712	364	40.0		313	99.9	27.7									0.38	0.100
	15-Jun-00					8.61	377	203	10.0		174	48.9	19.6									0.54	0.040
	15-Jun-01					7.67	678	376	44.0		292	107.0	26.5									0.42	0.090
	15-Jun-02					8.01	770	387	48.0		321	107.0	29.0									0.45	0.200
	15-Jun-03					8.13	731	389	50.0		286	103.0	31.9									0.90	0.090
	15-Jun-04					7.89	521	321	27.2		289	94.7	18.7									0.51	0.100
	15-Jun-05					8.10	745	333	49.9		301	91.4	25.5									0.40	0.090
	15-Jun-06					7.59	481	310	22.0		240	97.0	17.5									0.59	0.115
	19-Apr-07					7.84	777	380	52.0		330	102.0	31.3									0.55	0.061
	15-Apr-08					8.10	741	360	49.0		310	95.0	30.0									0.42	0.050
	16-Apr-09					8.20	763	305	57.4		296	85.8	22.1									0.34	0.014
	10-May-10	7.88	760	18.1		8.25	374	327	51.6		195	87.4	26.5									0.29	0.067
	11-Apr-11	7.70	780	14.4		8.27	863	363	64.1		343	102	26.4									0.22	0.055
	8-Mar-12	7.58	8.28	8		8.37	861	325	65.3		348	89.1	25.0									0.44	0.050
	9-Apr-13	8.42	928	8.9		8.05	885	333	58.3		349	93.7	24.0									0.54	0.149
	28-Mar-14	7.63	948	2.6		8.10	876	342	55.8		365	94.9	25.4									0.32	0.233
	28-Mar-14	7.63	948	2.6		8.15	882	341	54.6		366	95.0	25.2									0.37	0.219
	6-Apr-15	7.30	720	9.1		7.93	898	372	65.4		372	102	28.4									0.91	0.127
	10-Mar-16	7.52	519	10.4		8.12	691	321	35.8		308	97.5	18.8									<0.01	0.084
	7-Mar-17	7.84	844	6.98		8.21	819	282	56.4		322	75.7	22.5									0.170	0.023
	2-Apr-18	8.13	784	7.88	26.2	8.06	795	323	60.2	23.8	357	86.5	25.9	10.5	37.4	8.47	0.176	0.29	<0.25	0.453	<0.003	0.210	0.023
	15-Apr-19	7.60	807	6.40	0.0	7.90	774	319	57.0	18.8	335	84.6	26.1	9.56	36.9	6.93	0.038	0.414	0.017	0.386	0.00150	0.375	0.0556



**Table E-1: Surface Water Chemical Results** 

		Field Parameters			Gei	neral Para	neters			Maj	or and Mino	r lons			Nutri	ients and Orga	anic Indicat	tors		Ме	etals		
Well	Date	рН	EC	т	Turbidity	pН	EC	Total	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Potassium	Sodium	Ammonia	Un-ionized	Nitrate	Nitrite	Boron	Chromium	Iron	Manganese
· · ·	Units	SU	μS/cm	°C	NTU	SU	μS/cm	Hardness	Onioride	Outpriate	Aikaiiiity	Calcium	magnesium	rotassium	Codidin	Aiiiiioiiia	Ammonia	Miliate	Millio	Boron	Omomun	11011	manganese
	PQWO	6.5-8.5	nc	nc	Narrative	6.5-8.5	nc	nc	nc	nc	a	nc	nc	nc	nc	nc	0.02	nc	nc	0.2 i	0.0089	0.3	nc
PO2	8-Apr-20	7.92	715	11.81	2.0	8.18	795	334	57.2	17.2	341	87.1	28.2	10.3	37.5	6.56	0.115	0.256	0.014	0.383	<0.00050	0.472	0.0844
cont'd	12-Apr-21	7.77	736	17.66	2.0	8.13	799	316	63	20	306	83.0	26.3	11.8	37.9	7.5	0.144	0.27	<0.03	0.435	0.00035	0.36	0.104
	6-Apr-22	7.56	889	8.51	15.6	8.1	864	402	71	26	373	110	31.0	12.3	45.5	9.7	0.058	0.32	<0.03	0.443	0.00023	0.56	0.0833
PO3	15-Jun-84					7.57	495	209	21.5		198	63.0	12.6									1.30	
	18-Dec-84					7.64	730	297	55.0		181	87.0	19.2									0.35	
	12-Mar-86					7.54	423	132	30.0		122	41.0	7.2									4.70	
	15-Dec-86					7.52	273	136	12.0		106	45.0	5.6									0.68	
	14-Dec-87					8.01	328	150	12.6		101	49.9	6.1									1.18	
	6-Sep-88					7.78	680	162	8.3		87	52.6	7.3									22.8	
	14-Mar-89					7.60	208	94	5.8		65	30.5	4.2									1.02	
	3-Dec-91					7.64	468	204	24.7		175	63.5	11.0									0.63	
	15-Sep-92					7.68	412	197	6.1		199	63.9	9.1									1.60	
	7-Dec-92					8.02	631	307	24.3		246	96.9	15.8									0.20	
	15-Jun-00					8.23	635	358	43.0		234	98.4	27.3									0.37	0.110
	15-Jun-04					7.91	531	331	7.2		302	106.0	18.7									0.27	0.062
	15-Jun-05					8.21	597	330	6.8		307	102.0	18.4									<0.1	0.042
	15-Jun-06					7.84	512	350	10.0		300	103.0	21.4									0.31	0.086
	19-Apr-07					7.72	548	300	7.0		300	87.4	19.2									0.26	0.018
	15-Apr-08					8.10	493	250	10.0		240	76.0	15.0									0.15	0.020
	16-Apr-09					8.12	637	327	19.0		315	101.0	18.1									0.068	0.023
	11-Apr-11	7.86	397	14.9		8.31	448	207	11.1		208	64.6	11.1									<0.01	0.006
	8-Mar-12	8.16	97	2.5		8.10	264	95	10.9		110	28.9	5.6									0.016	0.004
	7-Mar-17	8.04	525	4.68		8.14	543	200	17.4		233	62.3	10.8									0.053	0.003
	2-Apr-18	7.90	686	8.97	13.4	8.00	575	244	27.8	6.56	274	75.7	13.3	13.4	21.3	1.92	0.026	3.50	<0.10	0.417	<0.003	<0.010	0.002
	15-Apr-19	7.99	558	2.87	0.0	7.85	531	233	19.3	3.12	258	70.9	13.7	14.0	18.5	2.95	0.030	2.71	0.017	0.368	<0.00050	0.053	0.00629
	8-Apr-20	8.13	583	9.54	2.4	8.11	657	337	14.8	17.6	329	102	20.2	12.4	14.9	0.176	0.004	1.98	0.032	0.525	<0.00050	0.113	0.0242
	6-Apr-22	7.94	555	8.01	12.0	8.09	593	369	9	34	301	111	22.2	6.92	5.72	<0.1	<0.001	<0.06	<0.03	0.389	0.00035	0.02	0.00215



Figure E-1
Concentration Versus Time - Surface Water Station CO1
Holbrook Landfill Site - Surface Water

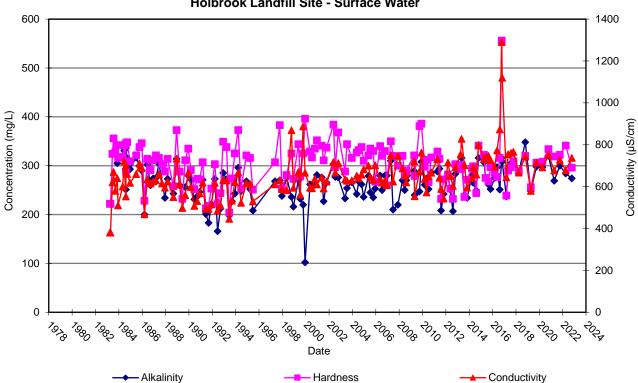


Figure E-2
Concentration Versus Time - Surface Water Station CO1
Holbrook Landfill Site - Surface Water

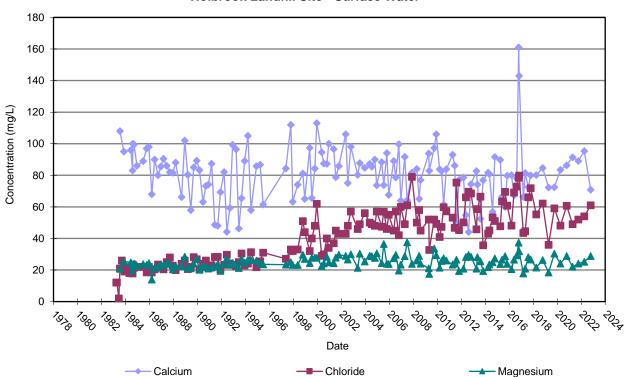




Figure E-3
Concentration Versus Time - Surface Water Station CO1
Holbrook Landfill Site - Surface Water

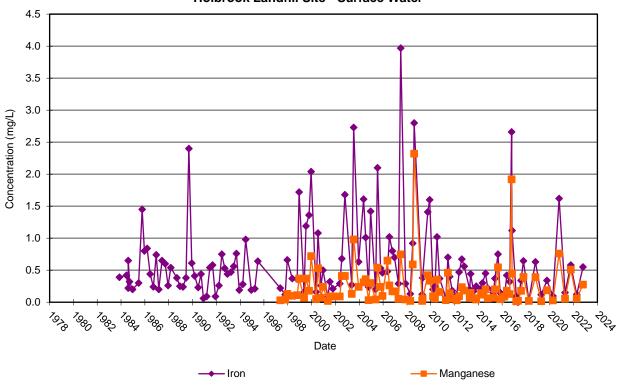


Figure E-4
Concentration Versus Time - Surface Water Station CO4
Holbrook Landfill Site - Surface Water

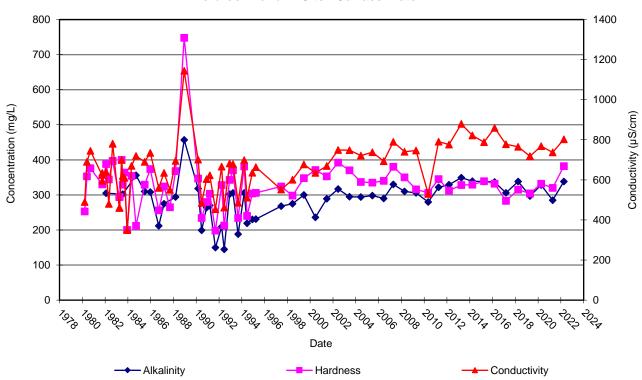




Figure E-5
Concentration Versus Time - Surface Water Station CO4
Holbrook Landfill Site - Surface Water

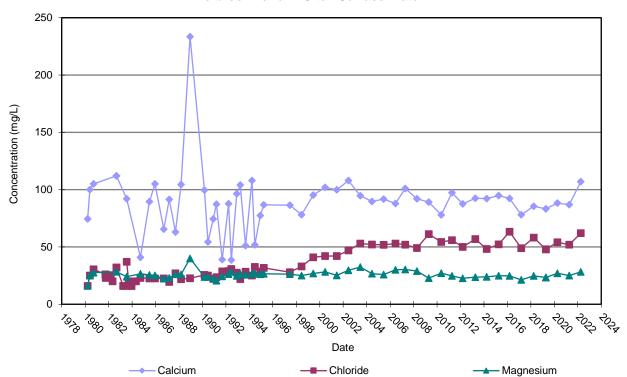


Figure E-6
Concentration Versus Time - Surface Water Station CO4
Holbrook Landfill Site - Surface Water

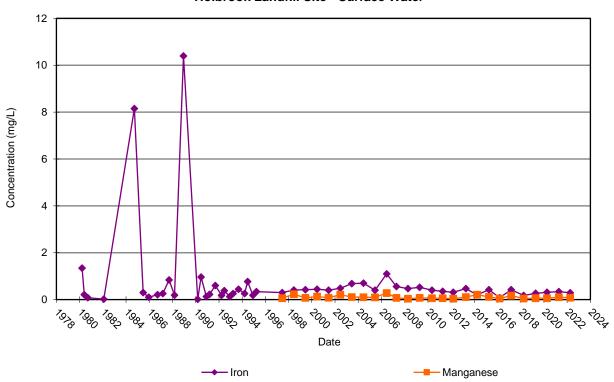




Figure E-7
Concentration Versus Time - Surface Water Station CO6
Holbrook Landfill Site - Surface Water

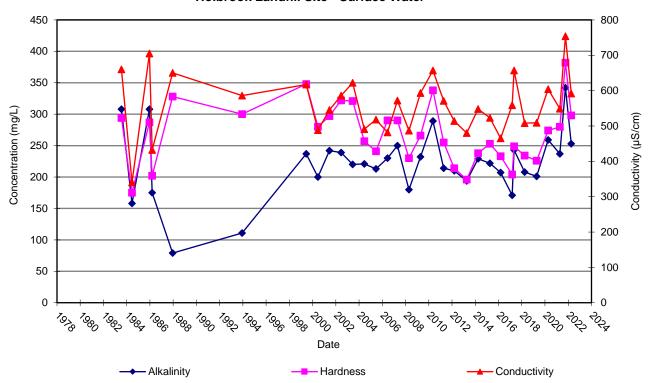


Figure E-8
Concentration Versus Time - Surface Water Station CO6
Holbrook Landfill Site - Surface Water

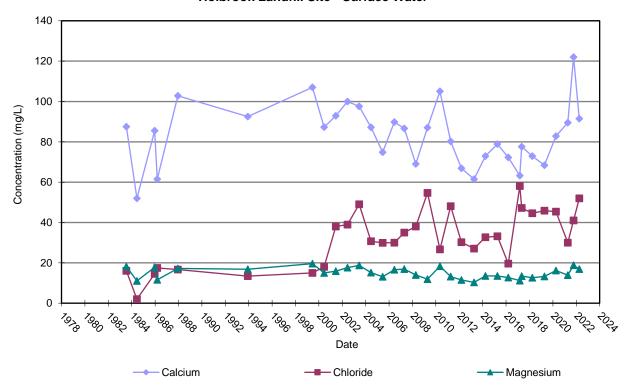




Figure E-9
Concentration Versus Time - Surface Water Station CO6
Holbrook Landfill Site - Surface Water

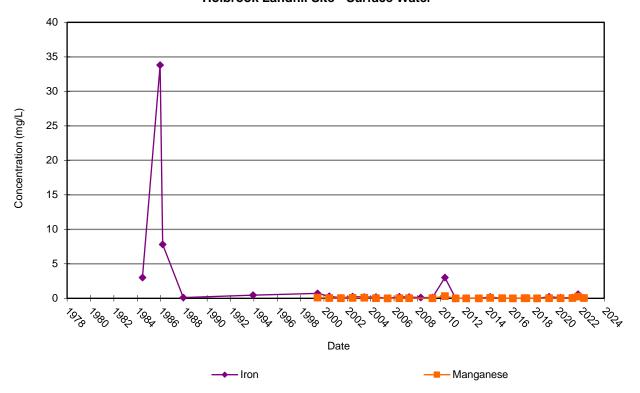


Figure E-10
Concentration Versus Time - Surface Water Station NE1
Holbrook Landfill Site - Surface Water

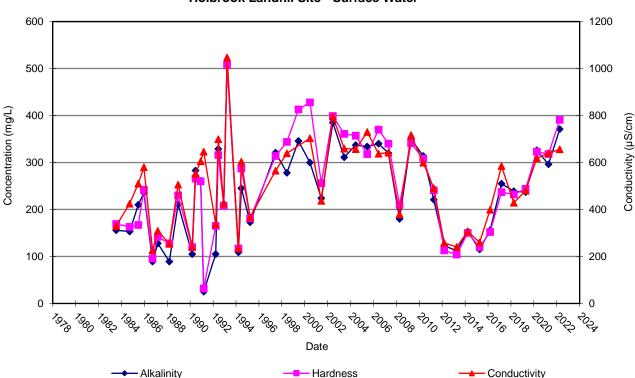




Figure E-11
Concentration Versus Time - Surface Water Station NE1
Holbrook Landfill Site - Surface Water

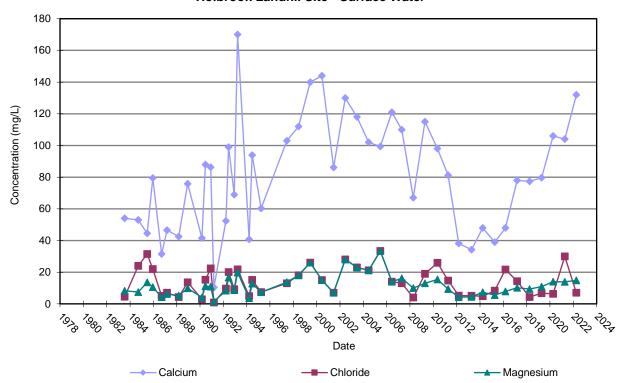


Figure E-12
Concentration Versus Time - Surface Water Station NE1
Holbrook Landfill Site - Surface Water

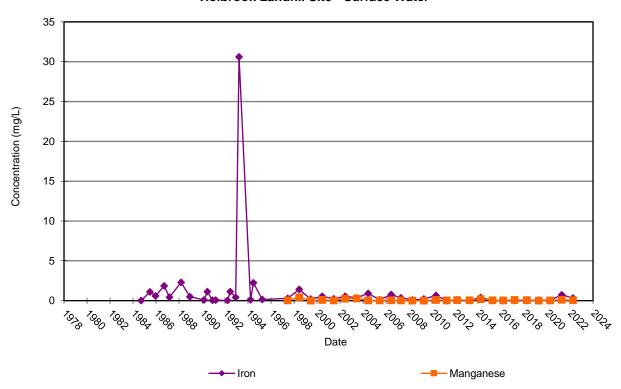




Figure E-13
Concentration Versus Time - Surface Water Station PO1
Holbrook Landfill Site - Surface Water

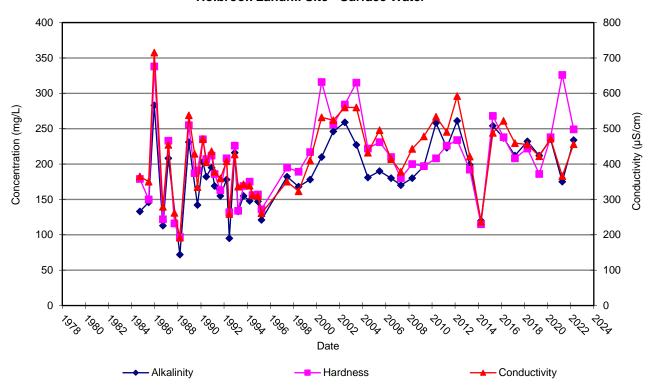


Figure E-14
Concentration Versus Time - Surface Water Station PO1
Holbrook Landfill Site - Surface Water

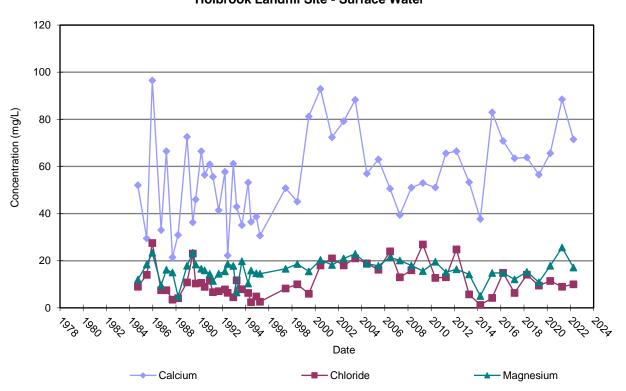




Figure E-15
Concentration Versus Time - Surface Water Station PO1
Holbrook Landfill Site - Surface Water

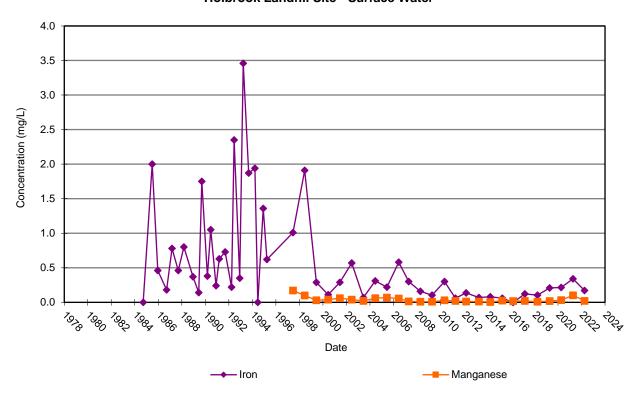


Figure E-16
Concentration Versus Time - Surface Water Station PO2
Holbrook Landfill Site - Surface Water

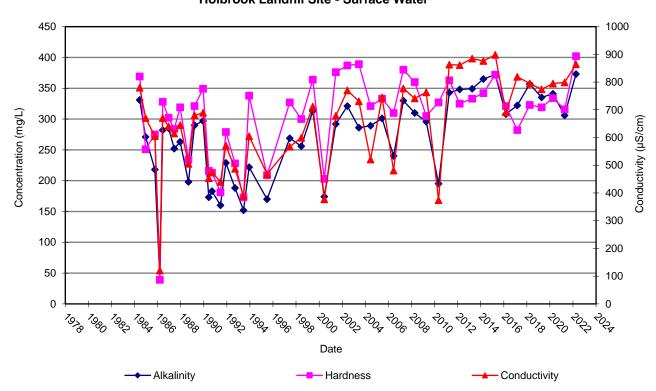




Figure E-17
Concentration Versus Time - Surface Water Station PO2
Holbrook Landfill Site - Surface Water

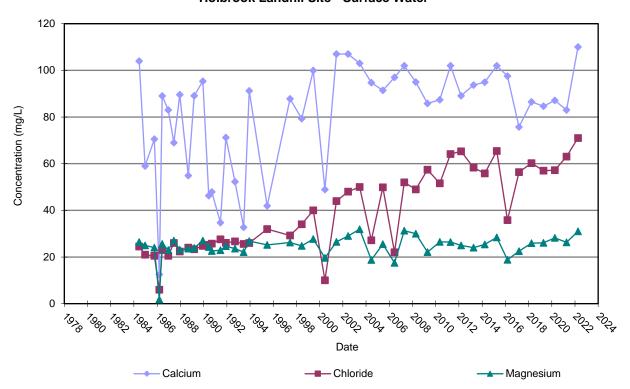


Figure E-18
Concentration Versus Time - Surface Water Station PO2
Holbrook Landfill Site - Surface Water

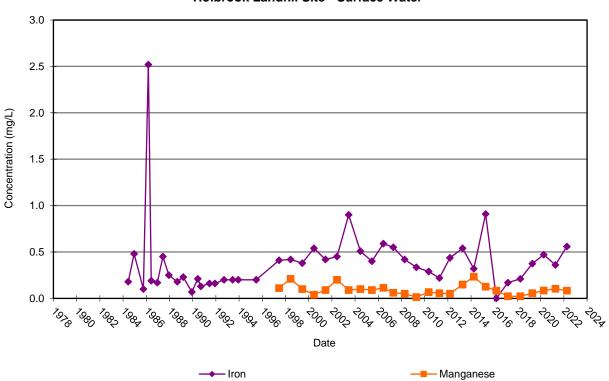




Figure E-19
Concentration Versus Time - Surface Water Station PO3
Holbrook Landfill Site - Surface Water

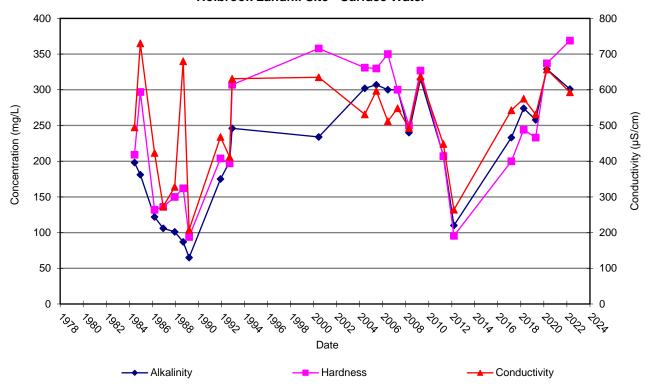


Figure E-20
Concentration Versus Time - Surface Water Station PO3
Holbrook Landfill Site - Surface Water

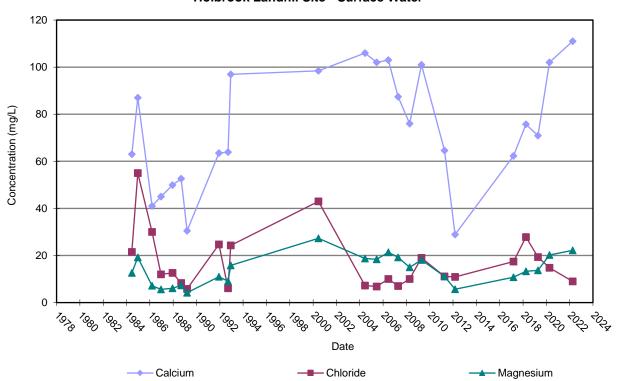
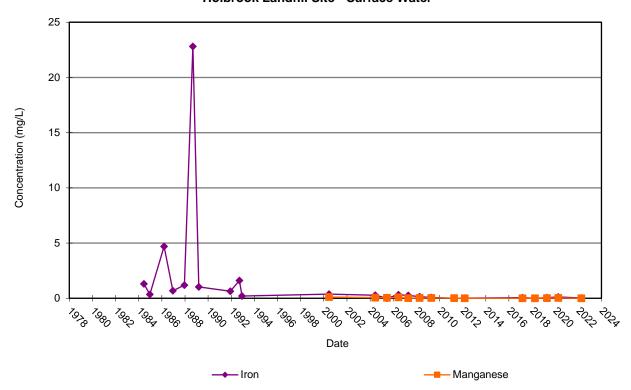




Figure E-21
Concentration Versus Time - Surface Water Station PO3
Holbrook Landfill Site - Surface Water





# **APPENDIX**

F

LABORATORY
CERTIFICATES OF ANALYSIS



P.O. Box 4300 - 185 Concession St. Lakefield - Ontario - KOL 2HO

Phone: 705-652-2000 FAX: 705-652-6365

**WSP Canada Inc.** 

Attn: Albert Siertsema

55 King Street, Suite 700 St. Catharines, ON L2R 3H5, Canada

Phone: 905-687-1771 x 240

Fax:

**Project:** 111-53037-06-100-1002,

Holbrook Landfill Site SW

13-April-2022

Date Rec.: 06 April 2022 LR Report: CA40097-APR22

Reference: 111-53037-06-100-1002,

Albert Siertsema

Copy:

# CERTIFICATE OF ANALYSIS Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: 6: Client RL Reporting Limits	7: PWQO Limits
Sample Date & Time						
Temp Upon Receipt [°C]	***	***	***	***	*** ***	***
pH [No unit]	07-Apr-22	12:51	08-Apr-22	11:13	0.05	6.5-8.5
Conductivity [uS/cm]	07-Apr-22	12:51	08-Apr-22	11:13	2	
Alkalinity [mg/L as CaCO3]	07-Apr-22	12:51	08-Apr-22	11:13	2	
CI [mg/L]	07-Apr-22	20:03	08-Apr-22	19:54	1	
SO4 [mg/L]	07-Apr-22	20:59	11-Apr-22	10:50	2	
NO3 [as N mg/L]	07-Apr-22	23:18	13-Apr-22	11:44	0.06	
NO2 [as N mg/L]	07-Apr-22	23:18	13-Apr-22	11:44	0.03	
NH3+NH4 [as N mg/L]	07-Apr-22	22:25	08-Apr-22	13:11	0.1	
Ca (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52		
Mg (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52		
Na (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52		
K (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52		
Hardness [mg/L as CaCO3]	12-Apr-22	09:38	13-Apr-22	11:52		
B (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52	0.002	
Cr (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52	8e-005	
Fe (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52		0.3
Mn (tot) [mg/L]	12-Apr-22	09:38	13-Apr-22	11:52	1e-005	

Analysis	8: NE 1	9: PO3	10: CO6	11: PO2	12: CO4
Sample Date & Time	06-Apr-22 09:30	06-Apr-22 09:50	06-Apr-22 10:15	06-Apr-22 10:40	06-Apr-22 11:00
Temp Upon Receipt [°C]	***	***	***	***	***
pH [No unit]	7.73	8.09	8.13	8.10	8.27



P.O. Box 4300 - 185 Concession St. Lakefield - Ontario - KOL 2HO

Phone: 705-652-2000 FAX: 705-652-6365

Project: 111-53037-06-100-1002, LR Report: Holbrook Landfill Site SW

**Analysis** 8: 9: 10: 11: 12: NE<sub>1</sub> **PO3 CO6** P<sub>0</sub>2 CO<sub>4</sub> Conductivity [uS/cm] 656 593 592 864 803 Alkalinity [mg/L as CaCO3] 371 301 253 373 338 7 9 CI [mg/L] 52 71 62 5 34 26 25 SO4 [mg/L] 15 NO3 [as N mg/L] 0.32 < 0.06 0.22 0.32 0.78 NO2 [as N mg/L] < 0.03 < 0.03 < 0.03 < 0.03 < 0.03 NH3+NH4 [as N mg/L] 2.4 < 0.1 < 0.1 9.7 6.2 Ca (tot) [mg/L] 132 111 91.5 110 107 Mg (tot) [mg/L] 14.8 22.2 16.9 31.0 28.2 Na (tot) [mg/L] 4.58 5.72 27.8 45.5 38.1 K (tot) [mg/L] 4.35 6.92 1.27 12.3 9.79 Hardness [mg/L as CaCO3] 391 369 298 402 382 B (tot) [mg/L] 0.077 0.389 0.040 0.443 0.389 Cr (tot) [mg/L] 0.00029 0.00035 0.00032 0.00023 0.00040 0.33 0.02 0.05 0.56 0.29 Fe (tot) [mg/L] 0.0566 0.0342 0.0833 Mn (tot) [mg/L] 0.00215 0.0776

Analysis	13: PO1	14: CO1	15: SW Dup
Sample Date & Time	06-Apr-22 11:30	06-Apr-22 11:45	06-Apr-22
Temp Upon Receipt [°C]	***	***	***
pH [No unit]	8.20	8.02	7.99
Conductivity [uS/cm]	456	678	690
Alkalinity [mg/L as CaCO3]	234	284	287
CI [mg/L]	10	54	54
SO4 [mg/L]	8	22	22
NO3 [as N mg/L]	0.34	2.13	2.12
NO2 [as N mg/L]	< 0.03	< 0.03	< 0.03
NH3+NH4 [as N mg/L]	< 0.1	0.5	0.5
Ca (tot) [mg/L]	71.5	95.3	94.2
Mg (tot) [mg/L]	17.1	25.2	24.7
Na (tot) [mg/L]	6.11	33.6	32.5
K (tot) [mg/L]	4.37	8.48	8.34
Hardness [mg/L as CaCO3]	249	341	337
B (tot) [mg/L]	0.085	0.332	0.347
Cr (tot) [mg/L]	0.00017	< 0.00008	0.00025
Fe (tot) [mg/L]	0.17	0.12	0.12
Mn (tot) [mg/L]	0.0201	0.0590	0.0591

PWQO - Provincial Water Quality Objectives Limits based on MOE PIBS 3303E publication July 1994 reprinted February 1999 a PWQO limit based on pH >6.5-9.0 (at pH 4.5-5.5 PWQO = 15ug/L, pH >5.5-6.5 PWQO 10% above background levels in geological area.

regulation



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**Project:** 111-53037-06-100-1002, LR Report : Holbrook Landfill Site SW

PWQ0 limit based on Hardness <75 mg/L (For Hardness >75 mg/L PWQ0 = 1100 ug/L) PWQ0 limit based on Hardness 0-100 mg/L(For Hardness >100 mg/L PWQ0 = 0.5 ug/L) PWQ0 limit based on Cr VI (PWQ0 limit for Cr III = 8.9 ug/L)

d

PWQO limit based on Hardness 0-20 (For Hardness >20 mg/L PWQO = 5 ug/L)
PWQO limit based on Hardness <30 (For Hardness 30-80 PWQO = 3 ug/L, & >80 PWQO=5)

Temperature of Sample upon Receipt: 8 degrees C

Cooling Agent Present: Yes Custody Seal Present: Yes

Chain of Custody Number: N/A

## Method Descriptions

Parameter	Description	SGS Method Code
Alkalinity	Alkalinity by Titration	ME-CA-[ENV]EWL-LAK-AN-006
Ammonia+Ammonium (N)	NH3+NH4 by Skalar - solution	ME-CA-[ENV]SFA-LAK-AN-007
Boron (total)	B by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Calcium (total)	Ca by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Chloride	Chloride by discrete colourmetric analysis	ME-CA-[ENV]EWL-LAK-AN-026
Chromium (total)	Cr by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Conductivity	Conductivity by Conductivity Meter	ME-CA-[ENV]EWL-LAK-AN-006
Hardness	Hardness (CaCO3) by ICP-MS	ME-CA-[ENV]SPE-LAK-AN-006
Iron (total)	Fe by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Magnesium (total)	Mg by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Manganese (total)	Mn by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Nitrate (as N)	Nitrate by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
Nitrite (as N)	Nitrite by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
рН	pH - solution	ME-CA-[ENV]EWL-LAK-AN-006
Potassium (total)	K by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Sodium (total)	Na by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Sulphate	Sulphate by discrete colourmetric analysis	ME-CA-[ENV]EWL-LAK-AN-026

Maarit Wolfe, Hon.B.Sc

Project Specialist,

Environment, Health & Safety



Phone: 705-652-2000 FAX: 705-652-6365

**Project:** 111-53037-06-100-1002, Holbrook Landfill

LR Report : Site Saw 097-APR22

## **Quality Control Report**

				Ino	rganic Analys	is							
Parameter	Reporting	Unit	Method		Dupl	icate		LC	CS / Spike Blan	k	Matrix Spik	ce / Reference	Material
	Limit		Blank	Result 1	Result 2	RPD	Acceptance Criteria	Spike Recovery (%)	Recovery I		Spike Recovery (%)	Recovery L	
							%		Low	High		Low	High
Alkalinity - QCBatchID: EWL0128-APR22													
Alkalinity	2	mg/L as Ca	< 2			2	20	100	80	120	NA		
Ammonia by SFA - QCBatchID: SKA0074-APR22													
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			0	10	98	90	110	98	75	125
Ammonia by SFA - QCBatchID: SKA0075-APR22													
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			ND	10	98	90	110	101	75	125
Anions by discrete analyzer - QCBatchID: DIO5030-APR2	22										<u> </u>		
Chloride	1	mg/L	<1			3	20	109	80	120	120	75	125
Anions by discrete analyzer - QCBatchID: DIO5031-APR2	22		•	•		•			•		<u> </u>		
Sulphate	2	mg/L	<2			4	20	112	80	120	120	75	125
Anions by IC - QCBatchID: DIO0145-APR22			•			<u> </u>	'		'		<u> </u>	<u> </u>	
Nitrate (as N)	0.06	mg/L	<0.06			0	20	97	90	110	98	75	125
Nitrite (as N)	0.03	mg/L	< 0.03			ND	20	99	90	110	100	75	125
Anions by IC - QCBatchID: DIO0146-APR22	•			•		•			•		<u> </u>		
Nitrate (as N)	0.06	mg/L	<0.06			ND	20	97	90	110	97	75	125
Nitrite (as N)	0.03	mg/L	< 0.03			ND	20	99	90	110	102	75	125
Conductivity - QCBatchID: EWL0128-APR22			•		•				'				
Conductivity	2	uS/cm	< 2			0	20	99	90	110	NA		
Metals in aqueous samples - ICP-MS - QCBatchID: EMSO	0066-APR22	,	•		•	•	<u>'</u>						
Boron (total)	0.002	mg/L	<0.002			20	20	107	90	110	97	70	130
Calcium (total)	0.01	mg/L	<0.01			5	20	108	90	110	108	70	130
Chromium (total)	0.00008	mg/L	<0.00008			14	20	92	90	110	80	70	130
Iron (total)	0.01	mg/L	<0.007			4	20	106	90	110	95	70	130
Magnesium (total)	0.001	mg/L	<0.001			1	20	102	90	110	101	70	130
Manganese (total)	0.00001	mg/L	<0.00001			2	20	96	90	110	88	70	130
Potassium (total)	0.009	mg/L	<0.009			4	20	100	90	110	100	70	130
Sodium (total)	0.01	mg/L	<0.01			2	20	102	90	110	105	70	130
pH - QCBatchID: EWL0128-APR22	1	, ,			1		1						
pH	0.05	No unit	NA			0		100			NA		



Phone: 705-652-2000 FAX: 705-652-6365

### **WSP Canada Inc.**

Attn: Albert Siertsema

1821 Provincial Road, Unit 10, Windsor

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**Project:** 111-53037-06-100-1002 Holbrook Landfill

Site GW

15-June-2022

**Date Rec.**: 19 May 2022 **LR Report: CA15315-MAY22** 

**Reference:** 111-53037-06-100-1002 Holbrook

Landfill Site GW, Albert Siertsema

Copy: 2

# CERTIFICATE OF ANALYSIS Final Report - Revised

Analysis	1:		3:	4:	5:	6:	7:	8:	9:	10:
	Analysis Start Date	Analysis Start Time Co	Analysis ompleted Date Co	Analysis npleted Time	RL	24R	32R	39	40	42
Sample Date & Time						17-May-22 10:00	17-May-22 10:30	17-May-22 11:00	17-May-22 11:15	17-May-22 11:45
Temp Upon Receipt [°C]	***	***	***	***	***	***	***	***	***	***
pH [No unit]	20-May-22	11:15	25-May-22	09:39	0.05	8.18	8.08	8.08	7.95	8.21
Conductivity [uS/cm]	20-May-22	11:15	25-May-22	09:39	2	406	582	710	699	381
Alkalinity [mg/L as CaCO3]	20-May-22	11:15	25-May-22	09:39	2	218	291	300	338	221
DOC [mg/L]	24-May-22	18:51	27-May-22	09:43	1.0	3.2	1.6	1.2	5.8	1.1
CI [mg/L]	01-Jun-22	12:08	06-Jun-22	11:41	1	2	15	44	29	< 1
SO4 [mg/L]	01-Jun-22	10:55	06-Jun-22	11:41	2	17	33	55	51	2
TKN [as N mg/L]	25-May-22	15:48	31-May-22	10:30	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
NO2 [as N mg/L]	23-May-22	16:03	31-May-22	10:53	0.03	0.03	< 0.03	0.04	< 0.03	< 0.03
NO3 [as N mg/L]	23-May-22	16:03	31-May-22	10:53	0.06	< 0.06	0.41	0.26	0.08	< 0.06
NO2+NO3 [as N mg/L]	23-May-22	16:03	31-May-22	10:53	0.06	< 0.06	0.41	0.30	0.08	< 0.06
NH3+NH4 [as N mg/L]	24-May-22	22:31	27-May-22	16:55	0.1	0.4	< 0.1	< 0.1	0.2	0.4
Ca (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	0.01	59.8	87.0	105	131	45.8
Ca (diss) [mg/L]	15-Jun-22	10:30	15-Jun-22	13:21						
Mg (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	0.001	23.6	28.8	28.3	25.3	26.0
Na (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	0.01	12.4	9.88	23.7	13.4	21.8
K (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	0.009	1.06	0.816	1.62	0.995	1.16
Hardness [mg/L as CaCO3]	26-May-22	22:00	27-May-22	13:48	0.05	246	335	379	431	221
B (diss) [mg/L]	26-May-22	22:00	31-May-22	14:17	0.002	0.044	0.057	0.034	0.024	0.052



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Project: 111-53037-06-100-1002 Holbrook Landfill

SiteCAV315-MAY22 LR Report :

Analysis	1: Analysis Start A Date	•	3: Analysis ompleted Date Co	4: Analysis mpleted Time	5: RL	6: 24R	7: 32R	8: 39	9: 40	10: 42
Cr (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	8e-005	0.00025	0.00009	0.00016	0.00045	< 0.00008
Fe (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	0.007	0.512	0.082	0.398	2.94	0.180
Mn (diss) [mg/L]	26-May-22	22:00	27-May-22	13:48	1e-005	0.0158	0.0871	0.141	0.238	0.0107
Vinyl Chloride [mg/L]	20-May-22	09:23	31-May-22	14:21	0.2		< 0.0002	< 0.0002	< 0.0002	< 0.0002
Benzene [mg/L]	20-May-22	09:23	31-May-22	14:21	0.5		< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,4-Dichlorobenzene [mg/L]	20-May-22	09:23	31-May-22	14:21	0.5		< 0.0005	< 0.0005	< 0.0005	< 0.0005

Analysis	11: 16AR	12: 45	13: 46	14: 19R	15: 26R	16: 27	17: 43	18: 28R
					<b>-</b> 0.1	<del>-</del> -		
Sample Date & Time	17-May-22 13:00	17-May-22 14:00	17-May-22 14:30	17-May-22 15:30	17-May-22 08:15	17-May-22 08:30	17-May-22 10:00	17-May-22 10:30
Temp Upon Receipt [°C]	***	***	***	***	***	***	***	***
pH [No unit]	8.13	8.23	8.24	8.15	7.88	8.05	8.18	8.24
Conductivity [uS/cm]	659	324	431	428	1590	688	418	525
Alkalinity [mg/L as CaCO3]	283	162	230	214	586	305	187	281
DOC [mg/L]	1.3	1.2	2.1	1.1	8.2	1.4	1.7	2.2
CI [mg/L]	29	3	1	2	240	41	24	7
SO4 [mg/L]	95	32	37	35	24	36	34	75
TKN [as N mg/L]	< 0.5	< 0.5	0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
NO2 [as N mg/L]	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
NO3 [as N mg/L]	0.14	0.17	0.14	0.24	< 0.06	< 0.06	0.11	0.18
NO2+NO3 [as N mg/L]	0.14	0.17	0.14	0.24	< 0.06	< 0.06	0.11	0.18
NH3+NH4 [as N mg/L]	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ca (diss) [mg/L]	84.1	60.8	74.0	64.4	150	110	31.9	62.8
Ca (diss) [mg/L]		41.6						
Mg (diss) [mg/L]	37.8	17.1	22.3	25.8	56.9	29.1	15.5	30.2
Na (diss) [mg/L]	26.3	28.0	2.18	16.3	186	18.7	63.5	37.1
K (diss) [mg/L]	1.43	0.963	1.04	1.37	2.52	1.50	1.27	1.69
Hardness [mg/L as CaCO3]	365	222	276	267	609	395	144	281
B (diss) [mg/L]	0.038	0.133	0.020	0.052	1.27	0.084	0.145	0.089
Cr (diss) [mg/L]	0.00009	0.00039	0.00020	0.00019	0.00057	0.00010	0.00015	0.00019
Fe (diss) [mg/L]	0.047	0.336	0.386	< 0.007	1.96	1.00	< 0.007	0.119
Mn (diss) [mg/L]	0.0217	0.0375	0.0156	0.00010	0.0394	0.0639	0.00340	0.0194
Vinyl Chloride [mg/L]		< 0.0002	< 0.0002		< 0.0002	< 0.0002	< 0.0002	
Benzene [mg/L]		< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	
1,4-Dichlorobenzene [mg/L]		< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	



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Project: 111-53037-06-100-1002 Holbrook Landfill

SiteCAV5315-MAY22 LR Report :

Analysis	19: 41	20: 21R	21: 11R	22: 25R	23: 37R	24: 38	25: 44	26: D2
	41	ZIN	IIK	ZJN	3/1	30	***	DZ
Sample Date & Time	17-May-22 11:30	17-May-22 09:30	17-May-22 13:00	17-May-22 13:30	17-May-22 14:30	17-May-22 15:00	17-May-22 15:15	17-May-22 15:45
Temp Upon Receipt [°C]	***	***	***	***	***	***	***	***
pH [No unit]	7.30	8.06	7.76	8.04	8.05	7.98	7.99	8.22
Conductivity [uS/cm]	2010	593	1540	415	624	542	735	697
Alkalinity [mg/L as CaCO3]	1040	279	767	213	277	252	280	294
DOC [mg/L]	28.4	1.6	19.0	2.2	1.1	1.8	1.0	1.1
CI [mg/L]	72	40	140	15	38	31	20	49
SO4 [mg/L]	7	8	5	7	41	27	50	40
TKN [as N mg/L]	98.9	< 0.5	4.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
NO2 [as N mg/L]	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
NO3 [as N mg/L]	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	19.1	< 0.06
NO2+NO3 [as N mg/L]	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	19.1	< 0.06
NH3+NH4 [as N mg/L]	89.9	0.1	2.6	0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ca (diss) [mg/L]	190	91.2	197	60.1	101	83.1	112	0.28
Ca (diss) [mg/L]							106	
Mg (diss) [mg/L]	45.7	30.5	76.2	20.0	29.6	24.8	37.4	0.083
Na (diss) [mg/L]	59.4	15.4	71.2	19.3	14.8	18.4	7.60	207
K (diss) [mg/L]	61.4	1.57	4.80	1.41	1.39	1.20	1.28	0.116
Hardness [mg/L as CaCO3]	663	353	806	232	375	310	434	1.0
B (diss) [mg/L]	1.75	0.052	0.243	0.061	0.047	0.050	0.022	0.053
Cr (diss) [mg/L]	0.00247	0.00016	0.00051	0.00024	< 0.00008	0.00010	0.00078	0.00012
Fe (diss) [mg/L]	59.4	1.28	3.99	0.875	0.816	0.634	0.007	0.025
Mn (diss) [mg/L]	0.392	0.0416	0.0598	0.0246	0.0455	0.0503	0.00081	0.00035
Vinyl Chloride [mg/L]	0.0004				< 0.0002	0.0002	< 0.0002	
Benzene [mg/L]	0.0155				< 0.0005	< 0.0005	< 0.0005	
1,4-Dichlorobenzene [mg/L]	0.0159				< 0.0005	< 0.0005	< 0.0005	

Analysis	27:	28:	29:
	Trip Blank	GW DUP 1	GW DUP 2
Sample Date & Time	17-May-22	17-May-22	17-May-22
Temp Upon Receipt [°C]	***	***	***
pH [No unit]		7.84	8.18
Conductivity [uS/cm]		1590	694
Alkalinity [mg/L as CaCO3]		583	295
DOC [mg/L]		8.1	1.0
CI [mg/L]		250	48



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SiteCAV5315-MAY22 LR Report :

Analysis	27: Trip Blank	28: GW DUP 1	29: GW DUP 2
SO4 [mg/L]		24	40
TKN [as N mg/L]		< 0.5	< 0.5
NO2 [as N mg/L]		< 0.03	< 0.03
NO3 [as N mg/L]		< 0.06	< 0.06
NO2+NO3 [as N mg/L]		< 0.06	< 0.06
NH3+NH4 [as N mg/L]		< 0.1	< 0.1
Ca (diss) [mg/L]		143	0.08
Ca (diss) [mg/L]			
Mg (diss) [mg/L]		54.7	0.039
Na (diss) [mg/L]		179	204
K (diss) [mg/L]		2.42	0.109
Hardness [mg/L as CaCO3]		583	0.36
B (diss) [mg/L]		1.19	0.058
Cr (diss) [mg/L]		0.00055	0.00020
Fe (diss) [mg/L]		1.92	0.020
Mn (diss) [mg/L]		0.0385	0.00018
Vinyl Chloride [mg/L]	< 0.0002		
Benzene [mg/L]	< 0.0005		
1,4-Dichlorobenzene [mg/L]	< 0.0005		

Temperature of Sample upon Receipt: 8 degrees C Cooling Agent Present: Yes Custody Seal Present: Yes

Revision 1 - Ca re-assay data included for samples 12 and 25

### Method Descriptions

Parameter	Description	SGS Method Code
1,4-Dichlorobenzene	VOC wtr	ME-CA-[ENV]GC-LAK-AN-004
Alkalinity	Alkalinity by Titration	ME-CA-[ENV]EWL-LAK-AN-006
Ammonia+Ammonium (N)	NH3+NH4 by Skalar - solution	ME-CA-[ENV]SFA-LAK-AN-007
Benzene	VOC wtr - BTEX	ME-CA-[ENV]GC-LAK-AN-004
Boron (dissolved)	B by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Calcium (dissolved)	Ca by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Calcium (dissolved)	Ca by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006



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LR Report : SiteCAV3315-MAY22

Parameter	Description	SGS Method Code
Chloride	Chloride by discrete colourmetric analysis	ME-CA-[ENV]EWL-LAK-AN-026
Chromium (dissolved)	Cr by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Conductivity	Conductivity by Conductivity Meter	ME-CA-[ENV]EWL-LAK-AN-006
Dissolved Organic Carbon	DOC by Combustion/Oxidation	ME-CA-[ENV]EWL-LAK-AN-023
Hardness (dissolved)	Hardness (CaCO3) by ICP-MS dissolved	ME-CA-[ENV]SPE-LAK-AN-006
Iron (dissolved)	Fe by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Magnesium (dissolved)	Mg by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Manganese (dissolved)	Mn by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Nitrate (as N)	Nitrate by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
Nitrate + Nitrite (as N)	Total Nitrate/Nitrite by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
Nitrite (as N)	Nitrite by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
рН	pH - solution	ME-CA-[ENV]EWL-LAK-AN-006
Potassium (dissolved)	K by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Sodium (dissolved)	Na by ICP-MS solution (dissolved)	ME-CA-[ENV]SPE-LAK-AN-006
Sulphate	Sulphate by discrete colourmetric analysis	ME-CA-[ENV]EWL-LAK-AN-026
Total Kjeldahl Nitrogen	Tot. kjeldahl Nitrogen by Skalar	ME-CA-[ENV]SFA-LAK-AN-002
Vinyl Chloride	VOC wtr	ME-CA-[ENV]GC-LAK-AN-004

Brad Moore Hon. B.Sc

Project Specialist,

Environment, Health & Safety



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**Project:** 111-53037-06-100-1002 Holbrook Landfill

LR Report : Site CAY 315-MAY22

## **Quality Control Report**

				Oı	rganic Analysi								
Parameter	Reporting Unit Method		Duplicate				LCS / Spike Blank			Matrix Spil	ke / Reference	Material	
	Limit		Blank	Result 1	Result 2	RPD	Acceptance Criteria	Spike Recovery (%)	Recovery	Limits (%)	Spike Recovery (%)	Recovery L	imits (%)
							%		Low	High		Low	High
Volatile Organics - QCBatchID: GCM0354-MAY22													
1,4-Dichlorobenzene	0.0005	mg/L	<0.0005			ND	30	97	60	130	99	50	140
Benzene	0.0005	mg/L	<0.0005			ND	30	94	60	130	99	50	140
Vinyl Chloride	0.0002	mg/L	<0.0002			ND	30	94	50	140	97	50	140
				Inc	organic Analys	is							
Parameter	Reporting	Unit	Method		Dupl	icate		LC	CS / Spike Blar	ık	Matrix Spil	ke / Reference	Material
	Limit		Blank	Result 1	Result 2	RPD	Acceptance Criteria	Spike Recovery (%)	Recovery	Limits (%)	Spike Recovery (%)	Recovery L	imits (%)
							%	` ′	Low	High	i i	Low	High
Alkalinity - QCBatchID: EWL0496-MAY22				•	•						<u> </u>		
Alkalinity	2	mg/L as Ca	< 2			0	20	102	80	120	NA		
Ammonia by SFA - QCBatchID: SKA0238-MAY22					•								
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			ND	10	99	90	110	90	75	125
Ammonia by SFA - QCBatchID: SKA0250-MAY22					•								
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			ND	10	95	90	110	89	75	125
Ammonia by SFA - QCBatchID: SKA0261-MAY22													
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			3	10	102	90	110	93	75	125
Ammonia by SFA - QCBatchID: SKA0273-MAY22					•								
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			ND	10	97	90	110	98	75	125
Anions by discrete analyzer - QCBatchID: DIO5002-JUN2	2												
Chloride	1	mg/L	<1			0	20	106	80	120	79	75	125
Sulphate	2	mg/L	<2			0	20	111	80	120	107	75	125
Anions by discrete analyzer - QCBatchID: DIO5020-JUN2	2												
Chloride	1	mg/L	<1			1	20	101	80	120	101	75	125
Sulphate	2	mg/L	<2			ND	20	110	80	120	119	75	125
Anions by IC - QCBatchID: DIO0483-MAY22													
Nitrate (as N)	0.06	mg/L	<0.06			ND	20	102	90	110	99	75	125
Nitrate + Nitrite (as N)	0.06	mg/L	<0.06			NA		NA			NA		
Nitrite (as N)	0.03	mg/L	<0.03			ND	20	99	90	110	95	75	125
Anions by IC - QCBatchID: DIO0493-MAY22													
Nitrate (as N)	0.06	mg/L	<0.06			ND	20	102	90	110	102	75	125
Nitrate + Nitrite (as N)	0.06	mg/L	<0.06			NA		NA			NA		
Nitrite (as N)	0.03	mg/L	<0.03			ND	20	97	90	110	100	75	125
Anions by IC - QCBatchID: DIO0494-MAY22													
Nitrate (as N)	0.06	mg/L	<0.06			7	20	99	90	110	101	75	125
Nitrate + Nitrite (as N)	0.06	mg/L	<0.06			NA		NA			NA		



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SiteCAV5315-MAY22 LR Report :

				Inc	rganic Analys								
Parameter	Reporting	l i i a i i			Duplicate				S / Spike Blan	k	Matrix Spik	ke / Reference	Material
	Limit		Blank	Result 1	Result 2	RPD	Acceptance Criteria	Spike Recovery (%)	Recovery L	imits (%)	Spike Recovery (%)	Recovery L	imits (%)
							%		Low	High		Low	High
Nitrite (as N)	0.03	mg/L	<0.03			ND	20	101	90	110	105	75	12
Anions by IC - QCBatchID: DIO0500-MAY22	<u> </u>			•							<u>.</u>		
Nitrate (as N)	0.06	mg/L	<0.06			ND	20	101	90	110	103	75	12
Nitrate + Nitrite (as N)	0.06	mg/L	<0.06			NA		NA			NA		
Nitrite (as N)	0.03	mg/L	< 0.03			ND	20	97	90	110	100	75	12
Carbon by Combustion/Oxidation - QCBatchID: E	WL0543-MAY22			•							·	•	
Dissolved Organic Carbon	1.0	mg/L	<1.0			ND	20	102	90	110	98	75	12
Carbon by Combustion/Oxidation - QCBatchID: E	WL0559-MAY22											•	
Dissolved Organic Carbon	1.0	mg/L	<1.0			0	20	102	90	110	98	75	12
Conductivity - QCBatchID: EWL0496-MAY22													
Conductivity	2	uS/cm	< 2			1	20	99	90	110	NA		
Metals in aqueous samples - ICP-MS - QCBatchIL	D: EMS0123-JUN22			•							<u> </u>		
Calcium (dissolved)	0.01	mg/L	<0.01			1	20	99	90	110	104	70	1:
Metals in aqueous samples - ICP-MS - QCBatchIL	D: EMS0197-MAY22										<u> </u>		
Boron (dissolved)	0.002	mg/L	<0.002			16	20	103	90	110	81	70	13
Calcium (dissolved)	0.01	mg/L	<0.01			2	20	108	90	110	112	70	13
Chromium (dissolved)	0.00008	mg/L	<0.00008			0	20	104	90	110	98	70	1:
Iron (dissolved)	0.007	mg/L	<0.007			2	20	96	90	110	125	70	1:
Magnesium (dissolved)	0.001	mg/L	<0.001			4	20	104	90	110	102	70	13
Manganese (dissolved)	0.00001	mg/L	<0.00001			1	20	100	90	110	108	70	13
Potassium (dissolved)	0.009	mg/L	<0.009			3	20	105	90	110	106	70	13
Sodium (dissolved)	0.01	mg/L	0.01			2	20	110	90	110	103	70	13
Metals in aqueous samples - ICP-MS - QCBatchIL	D: EMS0252-MAY22		•	•	•			•	•		<u> </u>		
Boron (dissolved)	0.002	mg/L	<0.002			1	20	92	90	110	93	70	13
pH - QCBatchID: EWL0496-MAY22					•			'	<u>'</u>		'	1	
pH	0.05	No unit	NA			0		100			NA		
Total Nitrogen - QCBatchID: SKA0255-MAY22				•									
Total Kjeldahl Nitrogen	0.5	as N mg/L	<0.5			5	10	99	90	110	101	75	12
Total Nitrogen - QCBatchID: SKA0280-MAY22	<u> </u>	•	•	•	•				•		<u> </u>		
Total Kjeldahl Nitrogen	0.5	as N mg/L	<0.5			ND	10	109	90	110	110	75	1:
Total Nitrogen - QCBatchID: SKA0296-MAY22	,			•	•			'	<u>'</u>				
Total Kjeldahl Nitrogen	0.5	as N mg/L	<0.5			ND	10	103	90	110	97	75	1:



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04-November-2022

Attn: Albert Siertsema

Date Rec.: 19 October 2022 LR Report: CA40149-OCT22

**Project:** 111-53037-06-100-1002,

**Reference:** PO#:111-53037-06-100-100

2. Holbrook Landfill Site -SW, Albert Siertsema

Holbrook Landfill Site - SW

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## **WSP Canada Inc.**

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# CERTIFICATE OF ANALYSIS **Final Report**

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Completed Date	4: Analysis Completed Time	5: 6: Client RL Reporting Limits	7: PWQO Limits
Sample Date & Time						
Temp Upon Receipt [°C]	***	***	***	***	*** ***	***
pH [No unit]	20-Oct-22	09:28	24-Oct-22	14:54	0.05	6.5-8.5
Conductivity [uS/cm]	20-Oct-22	09:28	24-Oct-22	14:54	2	
Alkalinity [mg/L as CaCO3]	20-Oct-22	09:28	24-Oct-22	14:54	2	
CI [mg/L]	31-Oct-22	09:21	02-Nov-22	20:03	1	
SO4 [mg/L]	31-Oct-22	09:41	02-Nov-22	20:03	2	
NO3 [as N mg/L]	23-Oct-22	19:12	04-Nov-22	12:12	0.06	
NO2 [as N mg/L]	23-Oct-22	19:12	04-Nov-22	12:12	0.03	
NH3+NH4 [as N mg/L]	25-Oct-22	18:34	27-Oct-22	13:41	0.1	
Ca (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39		
Mg (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39		
Na (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39		
K (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39		
Hardness [mg/L as CaCO3]	28-Oct-22	18:00	31-Oct-22	16:39		
B (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39	0.002	
Cr (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39	8e-005	
Fe (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39		0.3
Mn (tot) [mg/L]	28-Oct-22	18:00	31-Oct-22	16:39	1e-005	

Analysis	8: C01	9: SW DUP
Sample Date & Time	18-Oct-22 10:00	18-Oct-22 10:00
Temp Upon Receipt [°C]	***	***



P.O. Box 4300 - 185 Concession St. Lakefield - Ontario - KOL 2HO

Phone: 705-652-2000 FAX: 705-652-6365

**Project:** 111-53037-06-100-1002, LR Report : Holbrook Landfill Site - SW

Analysis	8: C01	9: SW DUP
pH [No unit]	8.26	8.23
Conductivity [uS/cm]	737	742
Alkalinity [mg/L as CaCO3]	274	275
CI [mg/L]	61	61
SO4 [mg/L]	22	22
NO3 [as N mg/L]	0.57	0.59
NO2 [as N mg/L]	< 0.03	< 0.03
NH3+NH4 [as N mg/L]	0.8	0.8
Ca (tot) [mg/L]	70.8	74.6
Mg (tot) [mg/L]	28.9	30.0
Na (tot) [mg/L]	40.7	41.4
K (tot) [mg/L]	10.6	11.1
Hardness [mg/L as CaCO3]	296	310
B (tot) [mg/L]	0.359	0.396
Cr (tot) [mg/L]	< 0.00008	< 0.00008
Fe (tot) [mg/L]	0.55	0.58
Mn (tot) [mg/L]	0.276	0.287

PWQO - Provincial Water Quality Objectives Limits based on MOE PIBS 3303E publication July 1994 reprinted February 1999 a PWQO limit based on pH >6.5-9.0 (at pH 4.5-5.5 PWQO = 15ug/L, pH >5.5-6.5 PWQO 10% above background levels in geological area.

PWQO limit based on Hardness <75 mg/L (For Hardness >75 mg/L PWQO = 1100 ug/L)
PWQO limit based on Hardness 0-100 mg/L(For Hardness >100 mg/L PWQO = 0.5 ug/L)

PWQQ limit based on Cr VI (PWQQ limit for Cr III = 8.9 ug/L)
PWQQ limit based on Hardness 0-20 (For Hardness >20 mg/L PWQQ = 5 ug/L)
PWQQ limit based on Hardness <30 (For Hardness 30-80 PWQQ = 3 ug/L, & >80 PWQQ=5)

Temperature of Sample upon Receipt: 4 degrees C Cooling Agent Present: Yes Custody Seal Present: Yes

Chain of Custody Number: n/a

## Method Descriptions

		01.0
Parameter	Description	SGS Method Code
Alkalinity	Alkalinity by Titration	ME-CA-[ENV]EWL-LAK-AN-006
Ammonia+Ammonium (N)	NH3+NH4 by Skalar - solution	ME-CA-[ENV]SFA-LAK-AN-007
Boron (total)	B by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Calcium (total)	Ca by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Chloride	Chloride by discrete colourmetric analysis	ME-CA-[ENV]EWL-LAK-AN-026
Chromium (total)	Cr by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Conductivity	Conductivity by Conductivity Meter	ME-CA-[ENV]EWL-LAK-AN-006
Hardness	Hardness (CaCO3) by ICP-MS	ME-CA-[ENV]SPE-LAK-AN-006
Iron (total)	Fe by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Magnesium (total)	Mg by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006



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Project: 111-53037-06-100-1002, LR Report: Holbrook Landfill Site - SW

Parameter	Description	SGS Method Code
Manganese (total)	Mn by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Nitrate (as N)	Nitrate by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
Nitrite (as N)	Nitrite by Ion Chromatography	ME-CA-[ENV]IC-LAK-AN-001
рН	pH - solution	ME-CA-[ENV]EWL-LAK-AN-006
Potassium (total)	K by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Sodium (total)	Na by ICP-MS solution	ME-CA-[ENV]SPE-LAK-AN-006
Sulphate	Sulphate by discrete colourmetric analysis	ME-CA-[ENV]EWL-LAK-AN-026

Maarit Wolfe, Hon.B.Sc

Project Specialist,

Environment, Health & Safety



Phone: 705-652-2000 FAX: 705-652-6365

**Project:** 111-53037-06-100-1002, Holbrook Landfill

LR Report : SiteCAS0749-OCT22

## **Quality Control Report**

				Inc	rganic Analys	sis							
Parameter	Reporting				Dupl	licate		LC	S / Spike Blan	nk	Matrix Spike / Reference Material		
	Limit		Blank	Result 1	Result 2	RPD	Acceptance Criteria	Spike Recovery (%)	Recovery	Limits (%)	Spike Recovery (%)	Recovery I	Limits (%)
							%		Low	High		Low	High
Alkalinity - QCBatchID: EWL0464-OCT22													
Alkalinity	2	mg/L as Ca	< 2			2	20	104	80	120	NA		
Ammonia by SFA - QCBatchID: SKA0262-OCT22													
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			0	10	102	90	110	83	75	125
Ammonia by SFA - QCBatchID: SKA0279-OCT22													
Ammonia+Ammonium (N)	0.1	as N mg/L	<0.1			0	10	94	90	110	100	75	125
Anions by discrete analyzer - QCBatchID: DIO5129-OCT	22												
Chloride	1	mg/L	<1			ND	20	101	80	120	102	75	125
Sulphate	2	mg/L	<2			ND	20	109	80	120	107	75	125
Anions by IC - QCBatchID: DIO0461-OCT22				•	•	•					<u> </u>	•	
Nitrate (as N)	0.06	mg/L	<0.06			0	20	99	90	110	NV	75	125
Nitrite (as N)	0.03	mg/L	< 0.03			ND	20	100	90	110	102	75	125
Anions by IC - QCBatchID: DIO0467-OCT22	•			•									
Nitrate (as N)	0.06	mg/L	<0.06			ND	20	100	90	110	103	75	125
Nitrite (as N)	0.03	mg/L	<0.03			ND	20	96	90	110	102	75	125
Conductivity - QCBatchID: EWL0464-OCT22												•	
Conductivity	2	uS/cm	< 2			0	20	98	90	110	NA		
Metals in aqueous samples - ICP-MS - QCBatchID: EMS	0163-OCT22											•	
Boron (total)	0.002	mg/L	<0.002			8	20	97	90	110	93	70	130
Calcium (total)	0.01	mg/L	<0.01			1	20	97	90	110	98	70	130
Chromium (total)	0.00008	mg/L	<0.00008			ND	20	98	90	110	110	70	130
Iron (total)	0.01	mg/L	<0.007			11	20	99	90	110	100	70	130
Magnesium (total)	0.001	mg/L	<0.001			11	20	98	90	110	107	70	130
Manganese (total)	0.00001	mg/L	<0.00001			2	20	100	90	110	110	70	130
Potassium (total)	0.009	mg/L	<0.009			15	20	101	90	110	93	70	130
Sodium (total)	0.01	mg/L	<0.01			13	20	98	90	110	105	70	130
pH - QCBatchID: EWL0464-OCT22	•					•							
pH	0.05	No unit	NA			0		100			NA		

# **APPENDIX**

MONITORING AND
SCREENING CHECKLIST

## Appendix D-Monitoring and Screening Checklist General Information and Instructions

General Information: The checklist is to be completed, and submitted with the Monitoring Report.

**Instructions:** A complete checklist consists of:

- (a) a completed and signed checklist, including any additional pages of information which can be attached as needed to provide further details where indicated.
- (b) completed contact information for the Competent Environmental Practitioner (CEP)
- (c) self-declaration that CEP(s) meet(s) the qualifications as set out below and in Section 1.2 of the Technical Guidance Document.

### **Definition of Groundwater CEP:**

For groundwater, the CEP must have expertise in hydrogeology and meet one of the following:

- (a) the person holds a licence, limited licence or temporary licence under the *Professional Engineers Act*; or
- (b) the person holds a certificate of registration under the *Professional Geoscientists Act, 2000* and is a practicing member, temporary, member or limited member of the Association of Professional Geoscientists of Ontario. O. Reg. 66/08, s. 2..

#### **Definition of Surface water CEP:**

A CEP for surface water assessments is a scientist, professional engineer or professional geoscientist as described in (a) and (b) above with demonstrated experience and post-secondary education, either a diploma or degree, in hydrology, aquatic ecology, limnology, aquatic biology, physical geography with specialization in surface water, and/or water resource management.

The type of scientific work that a CEP performs must be consistent with that person's education and experience. If an individual has appropriate training and credentials in both groundwater and surface water and is responsible for both areas of expertise, the CEP may then complete and validate both sections of the checklist.

	Monitoring Report and Site Information						
Waste Disposal Site (WDS) Name	Holbrook Landfill Site						
Location (e.g. street address, lot, concession)	Part of Lots 20 and 21, Concession III, Township of Norwich						
GPS Location (taken within the property boundary at front gate/front entry)	NAD 83, Zone 17, N 4759736 E 525949						
Municipality	Township of Norwich						
Client and/or Site Owner	County of Oxford						
Monitoring Period (Year)	2022						
This	Monitoring Report is being submitted under the following:						
Environmental Compliance Approval (ECA) Number (formerly "Certificate of Approval" (C of A)):	Amended ECA No. A070702 - dated September 8, 2016 Notice No. 1 - dated March 6, 2018						
Director's Order No.:							
Provincial Officer's Order No.:							

Other:			
Report Submission Frequency	<ul><li>Annual</li><li>Other</li></ul>		
The site is: (Operation Status)		○ Open ○ Inactive ⑥ Closed	
Is there an active waste transfer station at the site?		○ Yes	
Does this WDS have a Closure Plan?		Not yet submitted Submitted and under re Submitted and approve	
Total Approved Capacity		Units	Tonnes
Maximum Approved Fill Rate		Units	
Total Waste Received within Monitoring Period (Year)		Units	Tonnes
<b>Total Waste Received within Monitoring Period (Year)</b> Describe the methodology used to determine this quantity			
Estimated Remaining Capacity		Units	Cubic Metres
<b>Estimated Remaining Capacity</b> Describe the methodology used to determine this quantity			
<b>Estimated Remaining Capacity</b> Date Last Determined			
Non-Hazardous Approved Waste Types	Domestic Industrial, Commercial & Institutional (IC&I) Source Separated Organics (Green Bin) Tires	Contaminated Soil Wood Waste Blue Box Material Processed Organics Leaf and Yard Waste	Food Processing/Preparation Operations Waste  Hauled Sewage  Other:
Subject Waste Approved Waste Classes: Hazardous & Liquid Industrial (separate waste classes by comma)			

<b>Year Site Opened</b> (enter the Calendar Year <u>only</u> )	1970	Current ECA Issue Date	9/8/2016
Is your Site required to submit Fina	ncial Assurance?	○ •	Yes No
Describe how your WDS is designed	d.	Natural Attenuation or     Partially engineered Fa	
Does your Site have an approved C	ontaminant Attenuation Zone?	•	Yes No
If closed, specify ECA, control or au date:	thorizing document closure	Select Date	
Has the nature of the operations at the site changed during this monitoring period?		○ Yes	
If yes, provide details:			

Have any measurements been taken since the last reporting period that indicate landfill gas volumes have exceeded the MOE limits for subsurface or adjacent buildings? (i.e. exceeded the LEL for methane)		<ul><li>Yes</li><li>No</li></ul>	
Groundwater WDS Verifi	cation:		
Based on all available information	about the site and site knowled  Sampling and Monitor		<b>:</b>
1) The monitoring program continues to effectively characterize site conditions and any groundwater discharges from the site. All monitoring wells are confirmed to be in good condition and are secure:	<ul><li>Yes</li><li>No</li></ul>		
2) All groundwater, leachate and landfill gas sampling and monitoring for the monitoring period being reported on was successfully completed as required by ECA or other relevant authorizing/control document(s):	<ul><li>● Yes</li><li>○ No</li></ul>	If no, list exceptions below or attach information.	
Groundwater Sampling Location	Description/Explanation for cha (change in name or location, ad		Date
All groundwater sampling and monitoring was successfully completed as required.			

<ol> <li>a) Some or all groundwater, lessampling and monitoring requestablished or defined outside or control document.</li> </ol>		○ Yes	ble
<ul> <li>b) If yes, the sampling and mon for the monitoring period bein completed in accordance with frequencies, locations, and pan Technical Guidance Document</li> </ul>	g reported on was successfully established protocols, ameters developed as per the	<ul><li>Yes</li><li>No</li><li>Not Applicable</li></ul>	If no, list exceptions below or attach additional information.
Groundwater Sampling Location	Description/Explanation for cha (change in name or location, ad		Date

4)	All field work for groundwater investigations was done in accordance with Standard Operating Procedures (SOP) as established/outlined per the Technical Guidance Document (including internal/external QA/QC requirements) (Note: A SOP can be from a published source, developed internally by the site owner's consultant, or adopted by the consultant from another organization):	<ul><li>Yes</li><li>No</li></ul>	Field work for groundwater monitoring was completed in accordance with standard operating procedures. The field QA/QC program included blind duplicate field duplicates; however, travel spiked blanks were not part of the field QA/QC program.  The laboratory QA/QC control program was extensive and included method blanks, duplicates, spiked blanks, matrix spikes, and surrogate recovery.
		nitoring Program Resu	Ilts/WDS Conditions and Assessment:
5)	The site has an adequate buffer, Contaminant Attenuation Zone (CAZ) and/or contingency plan in place. Design and operational measures, including the size and configuration of any CAZ, are adequate to prevent potential human health impacts and impairment of the environment.	<ul><li>Yes</li><li>No</li></ul>	
6)	The site meets compliance and assessment criteria.	<ul><li>Yes</li><li>No</li></ul>	Please see Sections 4.2.4, 4.2.5, and 4.2.6 of the 2022 Water Monitoring Report.
7)	The site continues to perform as anticipated. There have been no unusual trends/ changes in measured leachate and groundwater levels or concentrations.	<ul><li>● Yes</li><li>○ No</li></ul>	

1)	Is one or more of the following risk reduction practices in place at the site:  (a) There is minimal reliance on natural attenuation of leachate due to the presence of an effective waste liner and active leachate collection/ treatment; or  (b) There is a predictive monitoring program inplace (modeled indicator concentrations projected over time for key locations); or  (c) The site meets the following two conditions (typically achieved after 15 years or longer of site operation):  i.The site has developed stable leachate mound(s) and stable leachate plume geometry/ concentrations; and ii.Seasonal and annual water levels and water quality fluctuations are well understood.	<ul><li>Yes</li><li>No</li></ul>	Note which practice(s):	☐ (a) ☐ (b) ☑ (c)	
9)	Have trigger values for contingency plans or site remedial actions been exceeded (where they exist):	<ul><li>Yes</li><li>No</li><li>Not Applicable</li></ul>	Please see Section 4.2.6 of t	he 2022 Water Monitoring Report.	
I andef reli rep I hadoo and gui the (E)- min If a opi Wh	Groundwater CEP Declaration:  I am a licensed professional Engineer or a registered professional geoscientist in Ontario with expertise in hydrogeology, as defined in Appendix D under Instructions. Where additional expertise was needed to evaluate the site monitoring data, I have relied on individuals who I believe to be experts in the relevant discipline, who have co-signed the compliance monitoring report or monitoring program status report, and who have provided evidence to me of their credentials.  I have examined the applicable Environmental Compliance Approval and any other environmental authorizing or control documents that apply to the site. I have read and followed the Monitoring and Reporting for Waste Disposal Sites Groundwater and Surface Water Technical Guidance Document (MOE, 2010, or as amended), and associated monitoring and sampling guidance documents, as amended from time to time. I have reviewed all of the data collected for the above-referenced site for the monitoring period(s) identified in this checklist. Except as otherwise agreed with the ministry for certain parameters, all of the analytical work has been undertaken by a laboratory which is accredited for the parameters analysed to ISO/IEC 17025:2005 (E)- General requirements for the competence of testing and calibration laboratories, or as amended from time to time by the ministry.  If any exceptions or potential concerns have been noted in the questions in the checklist attached to this declaration, it is my opinion that these exceptions and concerns are minor in nature and will be rectified for the next monitoring/reporting period. Where this is not the case, the circumstances concerning the exception or potential concern and my client's proposed action have been documented in writing to the Ministry of the Environment District Manager in a letter from me dated:				

Recommendations:			
Based on my technical review of th	e monitoring results for the waste disposal site:		
No changes to the <ul><li>monitoring program are recommended</li></ul>			
The following change(s) to  the monitoring program is/ are recommended:			
No Changes to site design  and operation are recommended			
The following change(s) to the site design and operation is/are recommended:			
Name:	Albert Siertsema		
Seal:	Add Image  A. M. SIERTSEMA  100168317  March 2, 2023		

Signature:	All Sint	Date:	2-Mar-2023	
CEP Contact Information:	Albert Siertsema			
Company:	WSP Canada Inc.			
Address:	1821 Provincial Rd, Suite 100, Windsor, ON N8W 5V7			
Telephone No.:	519-383-0366	Fax No. :		
E-mail Address:	albert.siertsema@wsp.com			
Co-signers for additional expertise	Co-signers for additional expertise provided:			
Signature:		Date:		
Signature:		Date:		
Surface Water WDS Verification:				
Provide the name of surface water body/bodies potentially receiving the WDS effluent and the approximate distance to the waterbody (including the nearest surface water body/bodies to the site):				
Name (s)	Branch Creek			

istance(s)  Crosses Site, +/- 150 m from the fill area			
Based on all available information	and site knowledge, it is my opi	nion that:	
	Sampling and Monitor	ing Program Status	:
1) The current surface water monitoring program continues to effectively characterize the surface water conditions, and includes data that relates upstream/background and downstream receiving water conditions:	<ul><li>Yes</li><li>No</li></ul>	If no, identify issues (Type H	lere):
2) All surface water sampling for the monitoring period being reported was successfully completed in accordance with the ECA or relevant authorizing/control document(s) (if applicable):	<ul><li>Yes</li></ul>	If no, specify below or provi	de details in an attachment.
Surface Water Sampling Location	Description/Explanation for change (change in name or location, additions, deletions)		Date
3) a) Some or all surface water sampling and monitoring program requirements for the monitoring period have been established outside of a ministry ECA or authorizing/control document.		○ Yes	le
b) If yes, all surface water sampling and monitoring identified under 3 (a) was successfully completed in accordance with the established program from the site, including sampling protocols, frequencies, locations and parameters) as developed per the Technical Guidance Document:		ONe	If no, specify below or provide details in an attachment.

Surface Water Sampling Location	Description/Explanation for change (change in name or location, additions, deletions)		Date	
4) All field work for surface water investigations was done in accordance with SOP, including internal/external QA/QC requirements, as established/outlined as per the Technical Guidance Document, MOE 2010, or as amended. (Note: A SOP can be from a published source, developed internally by the site owner's consultant, or adopted by the consultant from another organization):	<ul><li>Yes</li><li>No</li></ul>	accordance with standard of QC program included blind travel spiked blanks were n The laboratory QA/QC cont	monitoring was completed in operating procedures. The field QA/l duplicates; however, ot part of the field QA/QC program. rol program was extensive and uplicates, spiked blanks, matrix ery.	
Sampling and Monitoring Program Results/WDS Conditions and Assessment:				
5) The receiving water body meets surface water-related compliance criteria and assessment criteria: i.e., there are no exceedances of criteria, based on MOE legislation, regulations, Water Management Policies, Guidelines and Provincial Water Quality Objectives and other assessment criteria (e.g., CWQGs, APVs), as noted in Table A or Table B in the Technical Guidance Document (Section 4.6):				
-	If no, list parameters that exceed criteria outlined above and the amount/percentage of the exceedance as per the table on the following page or provide details in an attachment:			

Parameter	Compliance or Assessment Criteria or Background	Amount by which Compliance or Assessment Criteria or Background Exceeded
e.g. Nickel	e.g. ECA limit, PWQO, background	e.g. X% above PWQO
Please refer to Section 5.0 of the 2022 Water Monitoring Report		
6) In my opinion, any exceedances listed in Question 5 are the result of non-WDS related influences (such as background, road salting, sampling site conditions)?	<ul><li>Yes</li><li>● No</li></ul>	Weak landfill influences are likely observed in the surface water quality in retention pond P02, and in the on-site stream at intermediate station C04. The retention pond and the on-site stream are inferred to receive shallow groundwater flow from beneath the landfill. At station C01, which monitors surface water quality leaving the site, landfill influences from upstream portions of the on-site stream, shallow groundwater discharge, and possibly road salting practices have likely affected the surface water quality at the station.

7)	All monitoring program surface water parameter concentrations fall within a stable or decreasing trend. The site is not characterized by historical ranges of concentrations above assessment and compliance criteria.	<ul><li></li></ul>	
8)	For the monitoring program parameters, does the water quality in the groundwater zones adjacent to surface water receivers exceed assessment or compliance criteria (e.g., PWQOs, CWQGs, or toxicity values for aquatic biota (APVs)):	<ul><li>Yes</li><li>No</li><li>Not Known</li><li>Not Applicable</li></ul>	The retention pond and on-site stream are inferred to receive shallow groundwater flow from beneath the landfill. As such, weak leachate impacts are observed in the on-site stream.
9)	Have trigger values for contingency plans or site remedial actions been exceeded (where they exist):	<ul><li>Yes</li><li>No</li><li>Not Applicable</li></ul>	

Surface Water CEP Declarati	on:
Instructions, holding the necessary le	nat I am a Competent Environmental Practitioner as defined in Appendix D under evel of experience and education to design surface water monitoring and sampling e water investigations and interpret the related data as it pertains to the site for this
documents that apply to the site. I have Groundwater and Surface Water Techni sampling guidance documents, as ame referenced site for the monitoring perio parameters, all of the analytical work have	nmental Compliance Approval and any other environmental authorizing or control e read and followed the Monitoring and Reporting for Waste Disposal Sites ical Guidance Document (MOE, 2010, or as amended) and associated monitoring and inded from time to time. I have reviewed all of the data collected for the aboveod(s) identified in this checklist. Except as otherwise agreed with the ministry for certain as been undertaken by a laboratory which is accredited for the parameters analysed to ments for the competence of testing and calibration laboratories, or as amended from time
opinion that these exceptions and conc not the case, the circumstances concern	have been noted in the questions in the checklist attached to this declaration, it is my erns are minor in nature or will be rectified for future monitoring events. Where this is ning the exception or potential concern and my client's proposed action have been of the Environment District Manager in a letter from me dated:
Recommendations:	
Based on my technical review of the mo	nitoring results for the waste disposal site:
No Changes to the monitoring program are recommended	
The following change(s) to the  monitoring program is/are recommended:	
No changes to the site design  and operation are recommended	
The following change(s) to the  site design and operation is/ are recommended:	

CEP Signature	Alla Sinto	
Relevant Discipline	Geological Engineer	
Date:	2-Mar-2023	
CEP Contact Information:	Albert Siertsema	
Company:	WSP Canada Inc.	
Address:	1821 Provincial Rd, Suite 100, Windsor, ON N8W 5V7	
Telephone No.:	519-383-0366	
Fax No.:		
E-mail Address:	albert.siertsema@wsp.com	
Save As		Print Form