The Municipality of Middlesex Centre

Level 2 Hydrogeological Assessment

21515 Olalondo Road
Municipality of Thames Centre,
Middlesex County, ON

Project Name
Category 1, Class “A” Licence Application
21515 Olalondo Road, Municipality of Thames Centre,
Middlesex County, Ontario

Project Number
LON-00015778HG

Prepared By:
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London, ON N5V 0A5
Canada

Date Submitted
July 2018

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Legal Notification

This report was prepared by EXP Services Inc. for the account of The Municipality of Middlesex Centre, regarding: **21515 Olalondo Road, Municipality of Thames Centre, Middlesex County.**

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

Executive Summary

EXP Services Inc. (EXP) was retained by the Municipality of Middlesex Centre to conduct a Hydrogeological Assessment for the property located at 21515 Olalondo Road, Lot 1, Concession 6, former London Township, Municipality of Thames Centre, Middlesex County, Ontario. The Hydrogeological Assessment is in relation to a Category 1 - Class A Pit Below Water Licence Application for aggregate extraction. The overall study area is located northeast of the City of London and southwest of the intersection of Medway Road and Olalondo Road. Within this area, a license application is being submitted for a portion of the site to licence for underwater gravel extraction.

It is understood that the Hydrogeological Assessment will be submitted for review and approval by the Ministry of Natural Resources. The objective of this Level 2 Hydrogeological Assessment was to examine the hydrogeological characteristics of the site by conducting a soil and groundwater investigation at the Site, reviewing available information relating to the topography, drainage, quaternary geology, bedrock geology, Ministry of Environment, Conservation and Parks (MECP) well records and reviewing the results of the soil and groundwater investigation provided from a series of sampled boreholes, monitoring wells and test pits at the site. This report also addresses the potential effects of the gravel pit operation on local groundwater and surface water features within the zone of influence of the operation.

Based on the results of Hydrogeological Assessment, the following findings are presented:

1) The predominant surficial materials within the Site include natural deposits of clayey silt, silt, sandy silt/silty sand, sand, sandy gravel/sand & gravel and silty clay till. Generally, the silty clay till was encountered underlying the sand & gravel and sandy gravel layers and continued to borehole and test pit termination depth.

2) The predominant shallow groundwater flow direction (based on the recent groundwater depth measurements) is towards the north.

3) The overall study area is not municipally serviced with water and sewer. Based on a review of the MOECC Well Records, there are eight (8) potable water wells, two (2) shallow observation wells, six (6) test holes and eight (8) abandoned wells in the buffer area located within 500 m of the boundaries of the Site. The actual number of these wells that are still in use is unknown. With the exception of the observation and abandoned wells, the water supply wells in the area are set at various depths, generally ranging from approximately 21.5 to 42.1 m, into water-bearing sand and sand and gravel deposits or the underlying limestone (at depths of approximately 24.4 m or greater below ground surface (Well No. 4104593). The majority of the well logs indicate that thick clay till is found overlying the deeper sand and limestone aquifers.

4) No existing potable groundwater wells were observed onsite during EXP's site work, which was confirmed through review of MECP Well Records.

5) The wells set at intermediate depths (greater than 13 m depth) and below, are not expected to be impacted by gravel-taking operations within the Site. That said, according the MECP Well Records, there are no water supply wells with depths shallower than 21.5 m within 500 m of the Site. Based on a review of the well records recorded by MECP, no significant long-term impacts are anticipated to the intermediate or deep wells, either quantitatively and qualitatively since the depth of the excavations for the gravel-taking operations are not expected to be deep enough to penetrate the underlying water supply aquifers.

6) The Site is located within a Significant Groundwater Recharge Area (SGRA) and is also located in an area that is classified as a highly vulnerable aquifer (HVA).

7) Hydraulic conductivities were estimated based on the results of Grain Size Distribution Analysis and are estimated to range from $4.0x10^{-2}$ cm/s to $6.4x10^{-1}$ cm/s for the gravel deposits. These hydraulic conductivities are consistent with published values for sand and gravel.

8) Excavations could extend to a maximum depth of approximately 1.4 m below the stabilized groundwater level. Active dewatering activities are not anticipated to lower the stabilized water table for below water extraction. Water quantity of the shallow unconfined aquifer may be affected for a short duration of time during gravel extraction as a result of the volume of material being removed, however the stabilized water level is not expected to be impacted on a long-term basis.

9) Groundwater depths were monitored from December 5th, 2017 to April 18th, 2018. The highest groundwater elevations were observed on April 18th, 2018. Once gravel-taking operations are underway, groundwater monitoring should be conducted on a quarterly basis and follow the requirements of the Aggregate Resources Act.

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1 Introduction and Background

EXP Services Inc. (EXP) was retained by the Municipality of Middlesex Centre. to complete a Hydrogeological Assessment for the property located at 21515 Olalondo Road, Lot 1, Concession 6, former London Township, Municipality of Thames Centre, Middlesex County, Ontario hereinafter referred to as the 'Site' (**Drawing 1**). The Hydrogeological Assessment was completed as part of the requirements for a Category 1 - Class "A" Pit Below Water Licence Application under the *Aggregate Resources Act* (ARA) for the Site. The Site is currently an operational gravel pit, with active extraction licence P810343, extracting aggregates from above the water table, and are proposing to continue extraction from below the water table.

The objective of the Level 2 Hydrogeological Assessment was to examine the hydrogeological characteristics of the site by conducting a soil and groundwater investigation at the Site, reviewing available information relating to the topography, drainage, overburden geology, bedrock geology, MECP well records and reviewing the results of the soil and groundwater investigation provided from a series of sampled boreholes, monitoring wells and test pits at the site. This report also addresses the potential effects of the gravel pit operation on local groundwater and surface water features within the zone of influence of the operation. This report is accompanied by Natural Environment Level 1 (in preparation) and Gravel Quantity/Quality Assessment reports (EXP, 2018a).

Based on an interpretation of the factual borehole and test pit data, a review of soil and groundwater information from boreholes and test pits advanced at the site and a review of the available MECP well records, EXP has provided a hydrogeological assessment for the Site to fulfill the Hydrogeological Level 2 evaluation requirements needed for the proposed Category 1 - Class "A" Pit Below Water Licence Application. More specifically, this report provides comments pertaining to a discussion of the potential for impacts of gravel-taking operations on hydrogeological conditions at the site and surrounding areas and provides recommendations, where applicable, to mitigate this potential for impact.

1.1 Scope of Work

The scope of work is intended to address the current groundwater-related ARA Provincial Standards for the Aggregate Licence Application for the Site. Other ARA requirements such as an Environmental Impact Study (EIS) and a Noise Assessment will be reported under separate cover. The scope of work for the Hydrogeological Assessment consisted of the following tasks:

1. Desktop Study:

   This task consisted of a review of existing information including site plans, previous reports, geological maps, geological cross-sections, groundwater level information, borehole logs, and Ontario Ministry of the Environment and Climate Change (MECP) Water Well Records.

2. Field Program

   Installation of monitoring wells and excavation of test pits was carried out as part of the Site Investigation work. Using the monitoring wells, this task consisted of carrying out water level measurements and water quality analysis, for the purposes of characterizing the shallow groundwater conditions at the site. Grain Size Distribution Analyses were also performed on five soil samples collected from the test pits excavated at the Site.

3. Data Evaluation:

   This task consisted of the evaluation of the available field and laboratory data and other information, assessment of the likely dewatering requirements and potential dewatering effects on the surrounding environment.

4. Reporting:

   This task consisted of preparing this Hydrogeological Assessment Report.

1.1.1 Aggregate Resource Act Requirements

The Aggregate Resources Act (ARA) provincial Standards for a Class "A" Pit Below Water License Category 1 Application indicate that technical reports accompanying the licence application must provide information on the following:

- *Hydrogeological Level 1: Preliminary hydrogeological evaluation to determine the final extraction elevation relative to the established groundwater table and the potential for adverse effects to groundwater and surface water resources and their uses;*
- *Hydrogeological Level 2: Where the results of the Hydrogeological Level 1 have identified a potential for adverse effects of the operation on ground water and surface water resources and their uses, an impact assessment is required to determine the significance of the effect and feasibility of mitigation. The assessment should address the potential effects of operation on the following features if located within the zone of influence for extraction below the established groundwater table, where applicable;*
- *A technical report must be prepared by a person with appropriate training and/or experience in hydrogeology to include the following items:*

  a) Water wells;
  b) Springs;
  c) Groundwater aquifers;
  d) Surface water courses and bodies;
  e) Discharge to surface water;
  f) Proposed water diversion, storage and drainage facilities on site;
  g) Methodology;
  h) Description of the physical setting including local geology, hydrogeology and surface water systems;
  i) Water budget;
  j) Impact assessment;
  k) Mitigation measures including trigger mechanisms;
  l) Contingency plan;
  m) Monitoring Plan; and,
  n) Technical support data in the form of tables, graphs and figures, usually appended to a report.

According to the Standards, the Level 1 report provides an assessment of the water table elevation and extraction plan, as well as a general discussion of potential for impact in order to determine the need for a Level 2 report and to develop a scope of the issues to be examined.

This Level 2 report examines the type and scale of any potential impacts, and based on that assessment, identifies any potential for adverse effects on groundwater and surface water resources (and their uses). In addition, the need for monitoring and/or mitigation is also assessed. This Level 2 report also provides recommendations regarding monitoring and/or mitigation.

To facilitate the review of this document, Table 1 is provided with a quick reference to sections and appended material included in this report, for the items listed above (items a through n) for this Level 2 Hydrogeological Report.

Table 1: Reference Location for Key Report Elements

Item	Reference Location
Water wells	Summary – Section 4.4 Impacts - Section 6.2
Springs	Summary – Section 4.8 Impacts – Section 6.6
Groundwater aquifers	Summary – Section 4.4 Impacts - Section 6.2
Surface water courses and bodies	Summary – Section 4.8 Impacts – Section 6.6
Discharge to surface water	Summary – Section 4.8 Impacts – Section 6.6
Proposed water diversion, storage and drainage facilities on site	Summary – Section 4.8 Impacts – Section 6.6
Methodology	Section 2
Description of the physical setting including local geology, hydrogeology and surface water systems	Geology – Section 3.3 Hydrogeology – Section 4 Surface Water Systems – Section 4.8
Water budget	Section 6.4
Impact assessment	Section 6
Mitigation measures including trigger mechanisms	Section 6.7
Contingency plan	Section 6.7
Monitoring Plan	Section 6.7
Technical support data in the form of tables, graphs and figures, usually appended to a report.	Refer to attached Appendices

2 Assessment Methodology

This assessment included a background information review to characterize the Site setting, detailed site-specific field work to characterize local conditions and the use of specific analysis methods for the impact assessment.

Standard hydrogeologic field and analysis methods were used for this study. The specific methodologies used for each step of the characterization and analysis are outlined in the respective Sections of this report.

2.1 Information Review

As part of this Study the following information sources were used:

1. Upper Thames River Conservation Authority website: http://thamesriver.on.ca/water-management/thames-river-levels/
2. Ontario Ministry of Environment, Conservation and Parks Water Wells Database: https://www.ontario.ca/environment-and-energy/map-well-records
3. Upper Thames River Conservation Authority; August 12, 2011: Upper Thames River Source Protection Area Amended Proposed Assessment Report, Revised: http://www.sourcewaterprotection.on.ca/ar_UTRCA.html.
4. Groundwater Science Corp.2007. Hydrogeological Assessment, Demar Aggregates Inc., Proposed Fallon Pit, Part Lot 1, Concession 6, Township of Middlesex Centre. September
5. EXP Services Inc. (EXP). 2015. Level 2 Hydrogeological Assessment, 21558 Olalondo Road, Municipality of Thames Centre, Middlesex County, Ontario. Report No. LON-0012927-EN. October.
6. EXP Services Inc. (EXP). 2018a. Geotechnical Investigation. Olalondo Pit – Underwater Extraction, London, ON. Project No LON-00015778-GE. March.
7. Bedrock Geology of Ontario, Southern Sheet, Map 2544, 1:1,000,000 scale, Ministry of Northern Development and Mines, 1991.
8. Ontario Division of Mines, Map P1048, Quaternary Geology, Lucan Area, Southern Ontario, 1975, Scale 1:50,000.
9. Physiography of Southern Ontario, Map 2715, Ontario Geological Survey, 1:600 000 scale, 1984.
10. Chapman, L.J., and Putnam, D.F.; 2007. The Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.
11. Thornthwaite, C. W. & J. R. Mather. 1957. Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance. Centerton, N.J., Laboratory of Climatology, Publications in Climatology, v. 10, no. 3, p. 185-311.
12. The Ontario Geological Survey. 2003. Surficial Geology of Southern Ontario.
13. Barnett, PJ., Cowan, W.R. and Henry, A.P. 1991. Quaternary Geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556, scale 1:1,000,000.

The Hydrogeological Assessment reports for the proposed Fallon Pit (Groundwater Science Corp, 2007) and 21558 Olalondo Road were consulted due to their close proximity to the current Site (adjacent to the north and to the northeast, respectively). Relevant information from these reports has been reviewed and incorporated into this report, to supplement the current information, where appropriate.

2.2 Site Investigation / Field Program

In order to examine the subsurface soil and groundwater condition, a field program was carried out at the Site beginning in November 2017. At that time, nine (9) boreholes, including five (5) monitoring wells were advanced at the site along with eleven (11) test pits.

2.2.1 Borehole Drilling and Monitoring Well Installation

The borehole drilling program included completion of 9 boreholes across the property with installation of monitoring wells in 5 boreholes (BH1 (MW), BH2 (MW), BH6 (MW), BH7 (MW) and BH9 (MW)) to allow for hydrogeological evaluation. Borehole drilling and monitoring well installation was completed by London Soil Test of London ON under the technical supervision of EXP. The boreholes were advanced to depths of approximately 3.7 to 12.8 m below grade. The location of the boreholes and monitoring wells are shown in **Drawing 2**. The placement of borehole locations was based on best anticipated locations (accounting for existing Site excavation activities), to investigate the soil stratigraphy, the presence/absence and thickness of gravel deposits, measurement of groundwater depths and flow directions within the Site boundaries and to provide general Site coverage.

Boreholes were completed using a track-mounted drill rig and standard 21 cm (8") OD hollow stem auger drilling techniques. During the drilling, the stratigraphy in the boreholes was examined and logged in the field by EXP technical personnel. Representative samples of the soils found in the boreholes were submitted for laboratory testing that included moisture content and gradation. Copies of the field borehole (well) logs are provided in **Appendix B**. Copies of the soil gradation analyses are included in **Appendix C**.

Groundwater monitoring wells were installed within 5 of the boreholes. All wells were constructed from 5.1cm (2") diameter, schedule 40, polyvinyl chloride (PVC), flush-threaded casing. The appropriate number of risers was coupled with screen sections via threaded joints to construct the well. The well screens consisted of PVC pipe with 0.010-inch factory-generated slots. Well construction details are provided in **Table 2**.

A primary filter pack consisting of Silica Sand was placed around the well screen in the borehole and extended above the top of the well screen. Hole Plug, a swelling Bentonite clay that forms an effective barrier to the vertical movement of fluids when installed in a boring, was used as a seal above the filter pack.

Monitoring wells were developed after installation. The wells were developed to:

- remove fine soil particles adjacent to the well screen that may otherwise interfere with water quality analyses;
- restore the groundwater properties that may have been disturbed during the drilling process;
- improve the hydraulic communication between the well and the geologic materials; and,
- remove water, if any, added during the drilling process.

Wells were generally developed by removing a minimum of ten times the volume of water contained in the well casing (casing volume) where possible using rigid high density polyethylene (HDPE) tubing fitted with Waterra™ inertial pumps.

Table 2: Monitoring Well Construction Details

Well ID	Completion Depth (m bgs)	Screen Length (m)	Assumed Ground Surface Elevation (m)	Assumed Top of Pipe Elevation (m)	Screened Strata
BH1 (MW)	8.2	3.0	105.1	106.1	Sandy Gravel
BH2 (MW)	7.0	3.0	105.5	106.5	Sand and Gravel
BH6 (MW)	3.1	1.5	98.1	99.5	Sand and Gravel
BH7 (MW)	12.2	3.0	99.5	100.3	Silty Clay Till
BH9 (MW)	3.4	1.5	98.3	99.1	Sandy Gravel

The current property owner is considered to be the owner of all wells installed at the Site ("well owner", Section 1.0, Regulation 903). When the use of the monitoring wells is no longer required, the well owner must arrange for their abandonment by a licenced well contractor in accordance with the procedure outlined in the Ontario Water Resources Act - R.R.O. 1990, Regulation 903 - Amended to O. Reg. 128/03.

2.2.2 Test Pit Investigation

In addition to the boreholes, eleven (11) test pits were advanced across the Site on November 9, 2017 using a tracked excavator provided by the client. The test pits were excavated to depths from 1.1 m bgs (Test Pit TP4) to 3.8 m bgs (Test Pit TP1). The locations of the test pits are depicted on **Drawing 2** and the Test Pit Logs are included in **Appendix B**. After sample collection, the test pits were backfilled using the excavated soil and nominally compacted using the excavator bucket.

The test pits were arranged in a grid pattern at the Site to characterize the stratigraphy and, more specifically, to characterize the depths and thickness of the sand, sand and gravel and gravel deposits at the Site as well as the thickness of overlying deposits and fill materials above the sand and gravel deposits.

EXP staff continuously monitored the test pit excavation activities to log the geologic details of recovered soil samples and record the depth of soil sample collection and total depth or test pit excavation. Field observations are summarized on the test pit logs provided in **Appendix B**.

2.3 Groundwater Sampling

The groundwater depths below ground surface in Monitoring Wells BH1 (MW), BH2 (MW), BH6 (MW), BH7 (MW) and BH9 (MW) have been measured on a seasonal basis, starting on December 6, 2017 and continuing to April 2018, using an electronic water level meter. The water level readings are summarized in Section 4.3 of this report.

The monitoring wells were equipped with a new dedicated 38 mm diameter polyethylene non-weighted bailer for purging and sampling. Procedure dictates that prior to collecting groundwater samples, the monitoring well(s) be purged of standing water to draw in fresh formation water from the shallow aquifer. Purging continues until either five (5) wetted well volumes are removed, or the well is purged to dryness twice. The monitoring wells were purged as per EXP's standard operating procedures on December 6, 2017.

A summary of the groundwater samples collected from the groundwater monitoring wells and the chemical parameters analyzed is provided in **Table 3**.

Table 3: Summary of Groundwater Samples Submitted for Chemical Analyses

Sample/Monitoring Well ID	Analysis
BH6 (MW)	*RCAP
BH7 (MW)	*RCAP
BH9 (MW)	*RCAP

Note: RCAP – Rapid Chemical Analysis Package includes a suite of metals and other inorganic parameters, dissolved organic carbon and physical parameters such as arsenic, cadmium, chloride, chromium, lead, sodium, zinc, Nitrate-Nitrite, Sulphate, Orthophosphate, Dissolved Organic Carbon, Alkalinity, Conductivity, Hardness, Langlier Index,etc. The full list of analyzed parameters is found in **Appendix D**, Analytical Results.

The samples were labelled using a unique sampling number. The groundwater samples were placed in a chilled and insulated cooler for storage and during transportation to the receiving laboratory, Maxxam, under Chain of Custody protocols within 12 hours of sample collection. New disposable gloves were used for the collection of each groundwater sample to minimize the potential for sample cross-contamination. The samples collected for the analysis were placed in clean new screw capped sample bottles supplied by Maxxam Analytics. Samples collected for the analysis of metal parameters were field filtered prior to placing the sample within the appropriated laboratory supplied metals container.

2.4 Elevation Surveying

The relative elevations of the ground surface at each test pit and borehole/monitoring well were surveyed using a standard surveying transit to a temporary bench mark (TBM – northeast abutment of the weigh scale, northeast corner of the site: Assumed Elevation 100.00 m).

3 Site Description

3.1 Site Location

The gravel pit is located at 21515 Olalondo Road in Middlesex Centre (Concession 6 North Part Lot 1 former London Township, Registered Plan 33R392 Parts 1 and 3. The total area of the property is approximately 25.4 Hectares (63 acres). The Site is approximately rectangular, as shown in **Drawing 1**.

The overall study area is bound by agricultural land to the west, a woodlot to the southwest, gravel pits to the east and forested land bordering the North Thames River to the south. To the north of the site is farmland and a pond which is a rehabilitated gravel pit. The north Thames River is approximately 170 m south of the Site.

3.2 Site Description

The Site is divided into three areas; current production area, farming lands on the west (future extraction area) and the rehabilitated area on the east portion of the site. The future extraction area is approximately 7.0 to 7.5 m higher in elevation compared to the current extraction area and the rehabilitated area. South of the Site, the land slopes down southward towards the North Thames River. There is a woodlot located on the southwest side of the future extraction area.

The overall study area falls within regulated lands of the Upper Thames River Conservation Authority (UTRCA) and is located within the limits of the Plover Mills Corridor Watershed, which is in turn located within the North Thames River sub-Watershed of the Thames River. The site ultimately drains to Lake Erie. Although Ministry of Natural Resources mapping indicates the presence of water bodies, no visible surface or closed drainage features were observed within the Site boundary during EXP Site visits (**Drawing 3**).

The north branch of the Thames River is the major drainage feature in the overall study area, and is located approximately 170 m south of the Site, at its closest point. From here, the river flows southwest into Fanshawe Lake, located approximately 500 m southwest of the Site.

3.3 Geology

3.3.1 Bedrock Geology

The Site is underlain by limestone bedrock of the Dundee Formation (OGS, 2011). This formation consists of 60 to 160 feet (18 to 49 m) of light brown, medium-grained with some minor chert (Hewitt, 1972), and is part of the Algonquin Arch, which forms a ridge along the southwestern Ontario peninsula between the Michigan Basin (to the northwest) and the Appalachian Basin (to the southwest). Bedrock is generally not exposed in the area.

Review of bedrock topography mapping (**Drawing 4**; OGS, 1978) indicates the bedrock surface at an elevation in the range of 850 to 825 ft, which corresponds to an approximate elevation of 259 to 251 m. The bedrock surface generally slopes to the south or southeast in this area.

Review of MECP Well records for the area (**Appendix E**) indicate 10 wells within 500 m of the Site intersected bedrock at depths between 9 and 32 m (30 and 106 ft). Based on an approximate ground surface elevation ranging from 288 to 267 m in the general area of the Site, this equates to a bedrock elevation of approximately 256 m (840 ft), which is consistent with the bedrock topography mapping. Bedrock was not encountered during the investigation completed at the Site.

3.3.2 Overburden Geology

The physiography of Southwestern Ontario was altered significantly by the glacial and interglacial periods that took place throughout the Quaternary period. The overburden deposits which are present in the study area were formed by numerous glacial events during the late Wisconsinan glacial stage approximately 10,000 to 23,000 years before present. There were two distinct glacial lobes present in Southwestern Ontario during this period. The Huron Lobe advanced from Lake Huron southwards, and the Erie Lobe advanced from the northeast, receding to the east.

During the advancement of the glacial ice sheets, bedrock and unconsolidated sediments were eroded. During the recession of the glaciers, the eroded materials were deposited in lakes, rivers and along spillways, contributing to the present configuration of moraines, abandoned spillways, drumlins, eskers, abandoned shorelines, and various still-water sediment deposits.

The physiography of the Site can be generally described as Spillways with Undrumlinized Till Plains to the north of the Site (**Drawing 5)**. The Site is located in the physiographic region called the Stratford Till Plain. The till of the Stratford Till Plain generally is comprised of silty clay, with limited amounts of sand and gravel. This large till plain is interrupted by terminal moraines.

Quaternary mapping completed by Barnett *et. al.* (1981) indicates that the quaternary geology of the Site generally consists of sandy silt to silt matrix till of the Tavistock Till (**Drawing 6**). The Tavistock Till is also described as having a silty clay matrix in the south portions and has moderate to poor clast content.

The Thames River Valley was once a glacial river, and frequently along this water course, glaciofluvial outwash deposits are present (**Drawing 7)**. The surficial soils over the eastern areas of the study area are composed of typical spillway sand, sand and gravel and gravel deposits.

3.3.3 Site Specific Geology

In conjunction with the other Investigations for the Site (EXP, 2018a), 9 boreholes were completed with 5 of the boreholes having monitoring wells installed. The locations of the boreholes are provided in **Drawing 2**. These boreholes were terminated at a maximum depth of between 3.7 to 12.8 m below existing grade. Borehole logs are provided in **Appendix B**. It is noted that boundaries of soil indicated in the logs are inferred from non-continuous sampling and observations. Generalized stratigraphic cross-sections through the Site, as indicated in **Drawing 8**, are provided as **Drawing 19** and **Drawing 10**. The cross sections generally show sand, sandy gravel or sand and gravel below thin layers of surficial topsoil, silt or fill layers.

The sections are based on EXP's site survey conducted in February 2018, and the borehole and test pit observations of the current investigation.

Cross Section A-A' (**Drawing 9**) illustrates the stratigraphy of the undeveloped area on the west side of the site. The section runs north to south and includes the boreholes advanced in the undeveloped area and select test pits in the current production area. The section depicts the slope in the underlying till and variation in groundwater depth in the monitoring wells (99.06 m to 97.54 m from north to south, measured April 18, 2018). The decline in the till and groundwater elevations from north to south identify the southerly groundwater flow direction.

Cross Section B-B' (**Drawing 10**) runs west to east across the centre of the site, approximately 240 m to 275 m north of the North Thames River. The section illustrates the variation in topography in the current configuration of the site (approximately 105 m in the undeveloped area and 98 m in the current production and rehabilitated areas. It also shows the depth of gravel deposits and the relationship between the shallow unconfined groundwater elevations and bottom of gravel deposits in this area.

The Site can generally be divided into 2 sections when summarizing the soils; the west portion and the east portion. The east portion consists of rehabilitated lands (fill soils) were aggregate extraction had previously

occurred. The west portion consists of the current extraction and the future extraction areas. The following summary outlines the soil conditions encountered within each portion of the Site.

West Portion:

Boreholes BH1 (MW) and BH2 (MW) were advanced in the farm area west of the pit operations (future extraction area). From the ground surface, these boreholes encountered 280 and 350 mm of topsoil material, respectively. Beneath the topsoil in BH1 (MW) and BH2 (MW), brown silt was encountered. The thickness of the silt varied from about 0.4 to 1.0 m at the borehole locations. Sand/sandy gravel/sand and gravel was encountered beneath the silt. In the future extraction area, the sand/sandy gravel/sand and gravel ranged in thickness in the from 5.2 m to 7.5 m. In the current production area, the sandy gravel ranged in thickness from 0.5 to 3.5 m. Silty clay till was encountered underlying the sandy gravel on the west portion of the site. All test pits and boreholes were terminated in the till.

East Portion:

The east portion of the site was surfaced with fill materials. The fill materials consisted of silty clay, clayey silt, sandy silt and sand and gravel. Fill materials ranged in thickness from 0.7 to 1.8 m. Underlying the fill sandy gravel/sand and gravel was typically encountered. The sandy gravel/sand and gravel ranged in thickness from 0.6 to 1.6 m. Silty clay till was encountered below the sand and gravel in most test pits and boreholes. Test pits and boreholes were typically terminated in the till.

4 Hydrogeologic Setting

In additional to the shallow groundwater information collected from the boreholes and test pits completed at the Site, the following documents were reviewed to gain an understanding of the hydrogeological conditions in the area:

- Dillon Consulting Limited and Golder Associates Ltd. Middlesex-Elgin Groundwater Study, Final Report, submitted to Middlesex and Elgin Counties, dated July 2004, henceforth referred to as the Middlesex-Elgin Groundwater Study.
- Goff, K and D.R. Brown, 1981. Ground-Water Resources. Thames River Basin Water Management Study Technical Report. Ontario Ministry of the Environment, Water Resources Report 14
- MECP Well Records within 500 m of the perimeter of the Site.
- Thames-Sydenham and Region Source Protection Committee. 2011. Upper Thames River Source Protection Area, Approved Updated Assessment Report. 12 August.

4.1 Regional Aquifer

The bedrock aquifer consists of limestone from the Dundee Formation. The water quality is generally high with elevated levels of iron, sodium and chloride in some wells. As with the intermediate depth and deep overburden aquifers, the bedrock aquifer is confined by the overlying till material, which generally ranges in thickness from 18 to 50 m bgs around the City of London.

Flow direction in the deeper confined aquifer(s) and regional groundwater system has not been assessed as part of this investigation. However, as part of the Middlesex-Elgin Groundwater Study (Dillon and Golder, 2004), groundwater flow within the deeper aquifer was generally in a south-southwest direction.

The limited water level information for the bedrock wells from MECP well records and bedrock topography mapping suggests that the groundwater flow direction generally trends towards the south. This is consistent with the regional information provided in the Dillon and Golder (2004).

4.2 Local Aquifer

In the area of the Site, the near-surface subgrade soils are generally comprised of sand and gravel soils which have a relatively high permeability, and act primarily like as an unconfined aquifer, maximizing infiltration. Shallow overburden aquifers are discontinuous in nature, and are expected to be linked more directly to precipitation and recharge compared to the intermediate and deep overburden aquifers.

Deeper overburden aquifers generally consist of saturated sand and gravel deposits in the overburden and are very discontinuous in nature due to the heterogeneous nature of glacial deposits. Sand and gravel layers are present in the glacial till sheets. These deeper overburden aquifers are generally confined by overlying silt, clay and till deposits which limit vertical migration of shallow groundwater.

Locally, shallow groundwater flow is expected to follow the local topography, and generally drain towards the south towards the Thames River. However, as discussed below, current and historic aggregate excavating practices appear to have influenced shallow groundwater flow in the area. On a regional scale, the deep overburden and bedrock aquifers flow direction is reported to be towards the south-southwest (Dillon and Golder, 2004).

4.3 Site Specific Groundwater Flow

Five monitoring wells were installed between November 28th and December 4th, 2017 at the Site during an investigation conducted by EXP. The five wells (BH1 (MW), BH2 (MW), BH6 (MW), BH7 (MW) and BH9 (MW)) were installed to depths between 3.1 m and 12.2 m below ground surface (bgs).

Stabilized water level measurements have been obtained at the site since December 6, 2017, and are summarized in **Table 4**.

Table 4: Summary of Groundwater Elevations

Date	Depth to Groundwater (m bgs) *(Assumed Groundwater Elevation, m)*[1]				
	BH1 (MW)	**BH2 (MW)**	**BH6 (MW)**	**BH7 (MW)**	**BH9 (MW)**
Assumed Ground Surface Elevation[1]	105.1	105.5	98.1	99.5	98.3
December 6, 2017	Dry	Dry	1.49 *(96.6)*	3.62 *(95.9)*	1.18 *(97.1)*
December 15, 2017	Dry	Dry	1.41 *(96.7)*	3.11 *(96.4)*	1.24 *(97.1)*
December 21, 2017	Dry	Dry	1.07 *(97.0)*	2.98 *(96.6)*	0.92 *(97.4)*
January 16, 2018	Dry	Dry	1.04 *(97.0)*	3.81 *(95.7)*	0.75 *(97.5)*
April 18, 2018	7.60 (97.5)	6.48 *(99.1)*	0.39 *(97.7)*	2.74 *(96.8)*	0.29 *(98.0)*

NOTES
1 – Relative to local datum.

It is important to note that these elevations are indicative of the stabilized shallow water table within the Site, which is generally contained within sandy gravel or sand and gravel deposits which overly the natural silty clay till soils. Shallow groundwater flow across the overall study area is typically affected by the soil permeability (with preferential flow paths through granular soils), following trends in the surface topography and can be influenced by low areas and drainage channels which can cause short term surface water ponding and concentrated infiltration.

Shallow groundwater flow across the overall subject area and within the Site is typically affected by the soil permeability, topography and drainage. Intermediate and deep aquifers are significantly less affected by surface conditions. The groundwater generally appears to be found within the shallow sandy gravel to sand & gravel layer in the boreholes and test pits. Based on the groundwater depth measurements taken at the monitoring wells on April 18, 2018, the inferred direction of shallow groundwater flow is to the north towards a flooded aggregate pit (**Drawing 13**). The groundwater gradient appears to drop an average of approximately 0.75 m over a distance of 200 m. It is noted that the water levels within BH2 (MW) were not included within the groundwater contour map as the water levels were within the bottom of the well screen which is screened within the till layer, and likely represent water that is “trapped” due to the low-permeability of the till in comparison to the overlying permeable sand and sand and gravel.

In seasonally wet conditions, where groundwater levels are high, the gradient may be higher. The highest groundwater elevations observed within Boreholes BH1 (MW), BH2 (MW), BH6 (MW) and BH9 (MW) occur on April 18, 2018. The lowest groundwater elevation was recorded onsite on December 6, 2017.

4.4 Local Water Use

The area surrounding the subject overall study area is not municipally serviced with water or sewer. Based on a review of the Ministry of Environment, Conservation and Parks (MECP) Well Records, there are a total of 23 wells within approximately 500 m of the perimeter of the site. Water uses in the area include eight (8) domestic water supply wells, eight (8) shallow observation or test hole wells and eight (8) abandoned wells in the area located within 500 m of the Site. The approximate locations of identified wells are shown on **Drawing 11**, with a summary of the well completion details provided in **Appendix E**.

Domestic water supply in the local area wells is generally from the limestone bedrock aquifer or confined sand and gravel aquifers which underlie the clay and clayey silt overburden. Four (4) of the domestic water supply wells were sourced from the bedrock aquifer and had depths ranging from 24.7 to 42.1 m bgs. The other four (4) wells were installed in the confined and or sand and gravel at depths ranging from 21.5 to 32.3 m bgs. Static water levels for all domestic water supply wells was typically between 7.0 and 13.7 m bgs.

It is important to note that well records (sourced from the MECP) have some inherent limitations, and although comprehensive well data is available, the listings may not be entirely complete, and may not accurately record the presence of shallow or dug wells, which were not registered when constructed. In addition, in some cases, wells could have been abandoned in the past but this was not communicated to the MECP. Further, the soil types identified in the well logs have been prepared by well drillers, which may have used a simplified soil characterization nomenclature, which may not be consistent with the Unified Soil Classification system which has been utilized in the Hydrogeological Report for classification of the soils.

Given the location of the Site, and the lack of shallow (< 13 m) water supply wells within 500 m of the Site and the presence of relatively impermeable materials overlying the confined and bedrock aquifers used for water supply, the risk that gravel extraction activities within the shallow sand, sand and gravel and gravel deposits found in the test pits and boreholes on Site to be licenced will impact the potable water supplies in the area is low.

4.5 Significant Groundwater Recharge Areas (SGRA)

As defined in the *Clean Water Act (2006)*, an area is a significant groundwater recharge area if,

1. The area annually recharges water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more; or
2. The area annually recharges a volume of water to the underlying aquifer that is 55% or more of the volume determined by subtracting the annual evapotranspiration for the whole of the related groundwater recharge area from the annual precipitation for the whole of the related groundwater recharge area.

The Thames-Sydenham and Region Source Protection Committee has prepared an assessment report for the Upper Thames River Source Protection Area. As defined by the Clean Water Act (2006) and identified by the Thames-Sydenham and Region Source Protection Committee, the Site is located within a SGRA (**Drawing 14**).

4.6 Highly Vulnerable Aquifers (HVA)

The susceptibility of an aquifer to contamination is a function of the susceptibility of its recharge area to the infiltration of contaminants. As defined in the *Clean Water Act (2006)*, the vulnerability of groundwater within a source protection area shall be assessed using one or more of the following groundwater vulnerability assessment methods:

1. Intrinsic susceptibility index (ISI).

2. Aquifer vulnerability index (AVI).
3. Surface to aquifer advection time (SAAT).
4. Surface to well advection time (SWAT).

In the Thames-Sydenham and Region, HVAs were mapped using the ISI method. The ISI method is an indexing approach using existing provincial Water Well Information System (WWIS) database. The ISI method is described in detail in the MECP's Technical Terms of Reference (2001). However, in short, the ISI method is a scoring system that takes into consideration the unique hydrogeologic conditions at a particular location. The scores are determined using a combination of the saturated thickness of each unit and an index number related to the soil type, and as such, the scores reflect the susceptibility of the aquifer to contamination. As defined in the MECP's 2008 Technical Rules,

- an area having an ISI score of less than 30 is considered to be an area of high vulnerability;
- an area having an ISI score greater than or equal to 30, but less than or equal to 80, is considered to be an area of medium vulnerability; and,
- an area having an ISI score of greater than 80 is considered to be an area of low vulnerability.

The Thames-Sydenham and Region Source Protection Committee has determined, using the ISI method, that the Site is located within an area that is classified as a highly vulnerable aquifer (**Drawing 15**).

4.7 Hydraulic Conductivity of Overburden Materials

Single well response tests were not conducted as part of this investigation. However, grain size distribution analyses were conducted on soil samples collected from five of the test pits excavated onsite, specifically Test Pits TP2, TP3, TP8, TP10, and TP11. Test Pits TP2 and TP3 were located within the current production area. Test Pits TP8, TP10 and TP11 were located within the rehabilitated area on the east portion of the site.

Results are summarized in **Table 5**, and shown graphically in **Appendix C**. Estimated permeability values were determined by the Hazen method which is based on the following formula:

$$K\ (cm/s) = C(D_{10})^2$$

where C is Hazen's empirical coefficient and assumed to be 1 and D_{10} is the diameter of the 10 percentile grain size of the material. The hydraulic conductivities for the sandy gravel materials averaged about $3.3x10^{-1}$ cm/s, and are generally consistent with values reported by Freeze and Cherry (1979) for similar soils.

Table 5: Summary of Grain Size Distribution Analysis and Predicted Hydraulic Conductivities

Soil Sample	Soil Type	Hydraulic Conductivity Predicted by Hazen Formula (cm/s)
Test Pit TP2	Sandy Gravel	4.3×10^{-1}
Test Pit TP3	Sandy Gravel	4.0×10^{-2}
Test Pit TP8	Sandy Gravel	1.2×10^{-1}
Test Pit TP10	Sandy Gravel	4.1×10^{-1}
Test Pit TP11	Sandy Gravel	6.4×10^{-1}

4.8 Surface Water Features

During various site visits to obtain water level measurements and to survey elevations, additional site reconnaissance was conducted to document the drainage characteristics for the overall study area, and to record any significant seeps, springs or other surface water features on the Site. This reconnaissance work was conducted through the fall months of 2017, and at that time, the following observations were recorded for surface water conditions at the within the study area:

- There are no significant surface water features within the proposed current and future extraction areas. There is a tributary to the North Thames River located well north and upgradient of the overall study area.
- The North Thames River is located to the south of the Site. The southern Site boundary approximately 170 m from the North Thames River and a wooded area is located in between the two.
- Following rain events, surface water appears to infiltrate quickly, with minimal surface water ponding.

Based on the site observations noted above, there are no significant surface water features within the current and future extraction areas, although a flooded former excavation is present immediately to the north.

4.9 Groundwater Quality

Three groundwater samples were collected, one from each of monitoring wells BH6 (MW), BH7 (MW) and BH9 (MW), and analyzed for a suite of metals, other inorganic parameters, dissolved organic carbon and a suite of physical parameters.

Complete results are provided in **Appendix D**. No visual evidence of contamination such as separate-phase petroleum product (i.e., visible film or sheen) or olfactory indications such as chemical odours were observed during well purging and groundwater sampling of the wells.

The analytical results indicated that the concentrations of dissolved metals were either not detected in excess of the laboratory RDLs or were detected at concentrations below the applicable Ministry of Environment, Conservation and Parks (MECP) Table 2 groundwater Site Condition Standards (SCSs). All laboratory RDLs were below the applicable MECP Table 2 SCS.

The other inorganic and physical parameters that were analyzed do not have MECP SCSs and are usually applied for the assessment of drinking water quality and compared with the Ontario Drinking Water Objectives (ODWOs). Since the installation of wells within the Site for the purpose of potable water supplies is currently not planned, the analytical results for these additional analyzed parameters were not compared with the ODWOs and were measured for reference purposes in the future should the need arise.

5 Consideration for Gravel Taking Activities

The Site is approximately 25.4 ha in total (hectares) with the current and future extraction area being approximately 9 ha and the rehabilitated area being approximately 16.4 ha. Before aggregate extraction occurs in the future extraction area, the topsoil and subsoil overlying the gravel deposits will be removed from the operational area and the material will be stored onsite generally within berms or used for progressive rehabilitation.

5.1 Excavation below Groundwater

For the purposes of aggregate extraction extending below the groundwater level, the following comments are provided.

- The top of the underlying silty clay till unit as depicted in the cross sections and/or borehole logs and test pit summary, varies from a low of approximately 94.8 m (Test Pit TP1) near the southwest corner of the site, to a maximum of 99.5 m (BH3) at the northern side of the Site.

- The top of the till layer appears to generally slope down from west to east and from north to south within the Site. On April 18, 2018, the water table was above the till at most monitoring wells.

- The extraction plan calls for aggregate extraction down to 0.3 m above the top of the till strata. All maximum extraction depths below the groundwater table reported are to this elevation.

Based on the water depth measurements of April 18th, 2018 in the monitoring wells located where gravel deposits were present, the proposed extraction would remove gravel down to the underlying till unit and therefore would extend approximately up to a maximum of approximately 1.9 m below the top of the water table, when groundwater elevations are at their highest. It should be noted that the location of the largest underwater extraction depth is located at BH9 (MW) (based on April 2018 groundwater measurements) which is located in the rehabilitated area on the east side of the Site and is not expected to be used for production again.

In the current and future extraction areas located on the west side of the Site, extraction of gravel would extend to a maximum of approximately 1.4 m below the top of the groundwater table (based on water observed in Test Pit TP1). Extraction from the northern portion of the current production and future extraction area is expected to be above the top of the groundwater table. Gravel extraction depths below the groundwater table will vary throughout the year depending on the season and precipitation accumulation.

Therefore, gravel extraction onsite below the water table is anticipated to be completed by routine excavation, that is, no dewatering required. In the event that dewatering is deemed necessary for the site operations, it is important to note that any water taking in excess of 50,000 L per day will require an Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW). Refer to Section 5.4 of the report for further discussion in this regard.

The rehabilitation plan should include filling all extraction areas below the water table with onsite excavated overburden to bring the elevation back above the water table so that no extraction ponds are left onsite. This will mean that any ponds created by extraction of gravel from below the water table will be temporary, existing only until backfilling is complete.

When aggregate extraction involves excavation below the water table, it is anticipated that these areas (with a maximum depth of approximately 1.4 m) would be restored such that final rehabilitation will likely be at elevations above the water table. EXP would recommend that the excavated areas from below the water table be backfilled on an ongoing basis as part of a progressive rehabilitation. This is further discussed in Section 6.5.

5.2 Well Decommissioning

No existing potable wells were observed onsite during EXP's site work.

Monitoring wells were installed within the Site, to document stabilized groundwater conditions. Most of the wells are positioned such that they are outside of the current production area. Monitoring wells BH1 (MW) and BH2 (MW) are positioned in the future extraction area and will need to be decommissioned once production begins in that area.

When the wells are determined to be no longer required they should be properly decommissioned in accordance with Ontario Regulation 903. This regulation identifies that only certified and qualified well drilling technicians are permitted to direct the decommissioning work for existing wells.

Decommissioning a well which is no longer in use helps to ensure the safety of those in the vicinity of the well, prevents surface water infiltration into an aquifer via the well, prevents the vertical movement of water within a well, conserves aquifer yield and hydraulic head and can potentially remove a physical hazard.

Care should be taken to ensure that the disturbed soils are suitably restored, to satisfy the intended land use.

5.3 Open Cut Excavations and Groundwater Control

It is understood that excavation below groundwater is being considered for the proposed aggregate extraction activities within the current production area and future extraction area.

Silty clay till was found underlying the sandy gravel/sand and gravel deposits in all of the boreholes and test pits advanced in the proposed underwater extraction areas. Based on test pit observations and the April 18, 2018 groundwater levels, groundwater generally ranges from 0.1 m to 1.7 m above the bottom of the gravel deposits/top of the underlying silty clay till in the current and future production areas. The silty clay till underlying the gravel deposits is relatively impermeable and would act as an aquitard. If dewatering is to take place as part of extraction activities, an EASR or PTTW will likely be required, and is discussed below.

5.4 Permit to Take Water Requirements

The soils information within the Site indicates the presence of aggregate below the stabilized groundwater level, which may be considered for aggregate extraction activities. In this regard, it is anticipated that the gravel-taking excavations could extend to approximately 1.9 m below the water table depth in the rehabilitated area and 1.4 m below the water table in the current and future extraction areas during the seasonally high groundwater levels of the spring time. It is not anticipated that the rehabilitated area will excavated for production again.

The method of extraction is not known at this time, but it is important to mention that for any projects requiring positive groundwater control with a removal rate of 50,000 litres to less than 400,000 litres per day, an Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW) will be required. PTTW applications are required for removal rates more than 400,000 L per day and will need to be approved by the MECP per Sections 34 and 98 of the Ontario Water Resources Act R.S.O. 1990 and the Water Taking and Transfer Regulation O. Reg. 387/04.

The Permit to Take Water Application requires supporting documentation which outlines the construction timing, construction methodology, plans for discharging pumped water, and calculations/analyses prepared by qualified personnel to confirm the estimates of water taking which is required. Water taking volumes must consider stabilized groundwater conditions, as well as seasonal groundwater changes or influences. The application is reviewed to assess potential impacts to surface water, as well as groundwater conditions, including review of potential impacts to nearby features which may be impacted by the proposed development.

The preparation of Supporting Documents for a PTTW can only be carried out when additional information regarding the excavation depths are available. Generic calculations or rough estimates of proposed pumping volumes may be suitable for the tendering process, however the MECP requires more stringent preparation and review of this type of supporting data, prior to issuing a Permit.

Monitoring wells can be left in place for additional water level measurements. It is noteworthy to mention that where high water levels decrease or stabilize at lower levels in the summer and fall months, the requirement and anticipated volumes of water being pumped for excavation dewatering are expected to have a corresponding decrease. This may in fact be the case as seasonal monitoring of the water depths in the monitoring wells installed onsite.

5.5 Site Rehabilitation

Iterative rehabilitation of extraction areas that extend below the water table should be completed on an ongoing basis as extraction proceeds, essentially filling the trailing edge of the pond as the extraction operations proceed across the Site. As recorded in Boreholes BH1 (MW) and BH2 (MW), the overburden used for backfill will be the existing silt that currently overlies the aggregate deposit. In the event that imported materials are utilized to restore grades in the gravel extraction areas, the characteristics of the imported material (such as quality, grain size and moisture content) should be reviewed by the geotechnical consultant to confirm that the material is suitable for use, and will not cause a significant reduction to the post-construction infiltration capacity.

The final proposed land use for the extraction area is agricultural, after the subsoil and topsoil is replaced. The overall surface drainage patterns for the rehabilitated areas of the Site are expected to be similar to current conditions.

6 Proposed Extraction Impacts

6.1 Impacts to the Shallow Water Table

No significant changes or impacts to the shallow groundwater table are anticipated while aggregate extraction remains above the groundwater table, since the presence of granular material extends below the shallow groundwater table, and would still permit shallow groundwater flow to occur below the area of extraction.

When the aggregate extraction activities extend into the shallow groundwater within the current production area and future extraction area, possible changes to the shallow groundwater system may occur. These changes could include temporary lowering of the shallow unconfined (water table) aquifer during gravel-taking operations below the water table due to drainage at the excavation face.

Since the depth of extraction below the water table will be limited and extraction ponds will be temporary, changes to the groundwater system during extraction activities will be relatively small in scale and short in duration.

Temporary ponds created by gravel extractions usually cause a lowering of the depth of the water table in areas located immediately upgradient of the ponds and a rise in the water table immediately downgradient from the ponds.

While detailed calculations of the expected changes in the water table using a boundary problem analysis approach have not been completed, previous calculations for a property located in the immediate vicinity of and to the northeast of the overall study area were completed by Groundwater Science Corp (GSC) in their 2007 assessment of this property, and included underwater extraction. A review of their assessment for this property indicated that the geology and hydrogeology of their property was analogous to the overall study area. Therefore, the expected effects to the water table should be very similar to the results of their calculations. In their analysis GSC calculated a temporary water table effect during extraction activities of approximately 35 cm at distance of 100 m from a pond and less than 10 cm at a distance of 250 m.

The potential for gravel extraction within the current and future extraction areas appears to be shallower (1.4 m compared with 2 m) below the depth of the water table than at the previous GSC property so one can expect a slightly smaller temporary decline and rise in the water table depths at the respective upgradient and downgradient edges of the Site. It should be noted however that backfilling during rehabilitation will reverse this process as the pond elevation will rise as it is backfilled, also raising the local water table.

The replacement of excavated granular materials with the silt backfill materials within the 0.1 to 1.7 m thick unconfined shallow aquifer will likely also result in a rise in the water table elevation after rehabilitation is complete, as water will be perched above the less permeable material. However, the elevation of the unconfined aquifer was likely at its seasonal maximum when measured on April 18th, 2018 and the groundwater depth elevations over the subsequent months indicate that gravel extraction will not extend as far below the water table as indicated by the April 18th measurement results. If we use the April 18th measurements as representative of a worst-case scenario, water table elevation increases up to 1.0 to 1.5 m may occur in some areas. The actual amount will depend on the final depth of extraction, the composition and consistency of the fill material used to restore grades, and the construction staging for the restoration works.

Rehabilitation activities should ensure that the final restored ground surface is above the water table. Rehabilitation is best done as an iterative process with corrective steps taken as needed during progressive rehabilitation.

6.2 Impacts to Potable Wells and Local Water Supply

Based on the review of MECP Well Records, the recorded potable wells in the area are typically sourced from intermediate and deep overburden aquifers, which are generally confined below silt, clay and till strata. Wells set at intermediate depths (greater than 13 m depth) and below, are not expected to be impacted by excavations associated with the proposed gravel-taking operations, given the maximum depths of the gravel deposits. That said, according the MECP Well Records, there are no water supply wells with depths shallower than 21.5 m within 500 m of the Site.

The shallow depth aquifer is generally unconfined. The underlying shallow clayey silt till exhibits a low permeability. The lower clayey silt till strata, contacted in most of the boreholes and test pits during the hydrogeological investigation, will effectively limit both the vertical and horizontal zone of influence impacting the wells, due to the low permeability of these soils. Any temporary dewatering operations which may be required to deal with groundwater seepage from the overlying sandy soils and gravel deposits are not expected to cause any long-term impacts to the aquifers which supply the nearby potable wells.

The proposed aggregate extraction activities are expected to involve up to 1.4 m of excavation below the groundwater table in the current and future extraction areas. In this regard, consideration may be given to conducting a pre-extraction well survey for nearby properties, which do not have municipal water service, to verify the findings in the well records, and to check for the presence of any other non-recorded wells. This information may be helpful in identifying potential wells which could be impacted, or to help alleviate concerns from neighbours who may perceive an issue with their potable groundwater. It is noteworthy to mention that this information may already be available or may be considered redundant, since much of the area to the immediate north and east of the overall study area has already undergone development for gravel-taking operations.

Based on a review of the well records recorded by MECP, no significant long-term impact is anticipated on the intermediate or deep wells, either quantitatively and qualitatively since the depth of the excavations for the gravel-taking operations are not expected to be deep enough to penetrate into the underlying aquifers.

Where significant dewatering is expected to be undertaken, an EASR or PTTW will be required. In this regard, additional work to provide supporting documentation for the Permit application, and estimates of dewatering may be required. Further, recommendations will be provided for groundwater conservations, discharging pumped water, and identifying impacts to nearby structures and natural features. This type of assessment is outside of the current scope of work.

6.3 Impacts to Shallow Groundwater Recharge

As noted previously, the Site is located within a significant groundwater recharge area. While extracting gravel above the stabilized groundwater level, short term impacts to the shallow groundwater quantity are not anticipated.

In the event that future aggregate extraction activities involve excavation below the stabilized groundwater table, the impact to shallow groundwater recharge may be impacted, depending on the size and depth of excavation work, as well as the method of excavation. The length of time where this impact would occur would be limited to the time when active drainage of groundwater into the excavations is occurring or during the time that pumping of the shallow groundwater is being carried out, if required. Excavation activities should be reviewed to ensure that groundwater conservation measures are considered in any dewatering plan, if required.

Once excavation activities are complete and restoration of the gravel extraction area is complete, the shallow groundwater levels would be expected to stabilize. The composition of the material used to restore the area will impact the effective shallow groundwater recharge capacity. Where excavations are left open and surface water can connect directly with shallow groundwater flow, post-construction recharge would be expected to continue, with similar or enhanced recharge occurring.

The overburden soils within the overall study area and within the Site are generally comprised of silt and sand material, which overlies the granular deposits which are to be extracted from the site. This material is expected to be re-used to restore grades within the extracted area, as part of the site rehabilitation work. The onsite silt and sand soils are well suited to allow for infiltration of storm water at the site, and to permit shallow groundwater flow conditions where perched water may be present. This is particularly important, given that the Site has been identified to be within a Significant Groundwater Recharge Area.

Where grades are restored using less permeable soils, surface run-off may increase, and the opportunity for direct groundwater recharge would be expected to be reduced, compared to pre-construction levels. In this regard, it would be prudent to utilize best management practices (BMP's) to enhance post-development infiltration rates. These may include reduced grading and swales for the west portion, if re-grading of this area of the Site is undertaken.

6.4 Water Balance Assessment

6.4.1 Background Information

The water balance assessment for the Site was completed in accordance with the recommendations indicated in the guidance document "Hydrogeological Assessment Submissions: Conservation Authority Guidelines to Support Development Applications" (Conservation Ontario, 2013), and using appropriate site condition values obtained from Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003).

The water balance is based on estimates for a typical annual period, as an expression of the mean annual precipitation, change in groundwater storage, evapotranspiration, surficial run-off and infiltration. The relationship in these factors can be balanced, as shown in the following equation:

Mean Annual Precipitation - Change in Groundwater Storage - Evapotranspiration = Runoff + Infiltration

where:

- Mean Annual precipitation (1011.5 mm/yr) is based on data provided by Environment Canada, based on the 30 year average data for climate normals, using local weather station information (London, ON).

- Long term changes in groundwater storage are assumed to be negligible (i.e. no significant groundwater pumping or withdrawal from the aquifer). Seasonal changes are expected to balance out over the course of a full year.

- Evapotranspiration combines evaporation and transpiration, and refers to the water lost to the atmosphere. The rate of evapotranspiration is a function of the water holding capacity of the soil, and varies with soil and vegetation type and amount of impermeable surface cover. The evapotranspiration values are obtained using the method described by Thornthwaite and Mather (1957), but are sourced from Environment Canada Data using values for water holding capacity derived from Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003).

The difference between the annual precipitation and the annual evapotranspiration represents the surplus water which is available for infiltration and surface run-off. Distribution of the surplus water to infiltration is based on an infiltration factor based on site conditions for topography, cover vegetation and soil.

6.4.2 Pre-development and Post-development Calculations

Pre-development and Post-development water balance calculations have been carried out, and are based on preliminary extraction plans (EXP, 2018a). In general, the site comprises a land area of about 25.4 hectares. Surface drainage for the entire Site is towards the south and therefore the water balance has not been divided into any separate sub-catchments. However, only the western portion (about 9 ha) will be included within the current extraction plan. The remainder of the Site will remain untouched as part of this process.

As the current Site is not developed, there are no impervious areas in the pre-development stage. Post-development will consist of reclaimed lands, with no impermeable surfaces. No water bodies will be present under post-development conditions. The assumed impervious portion of the Site under post-development is about 70%.

The drilling program completed at the Site indicates that the near surface soils at the Site are generally sand and sand and gravels, with some silt layers, and represents soils with high infiltration potential. Based on Ministry of Agriculture, Food and Rural Affairs mapping (**Appendix F**), the Site is categorized as either 60% Hydrological Soil Group (HSG) “A” and 40% HSG “B” (northwestern portion) or 70% Hydrological Soil Group (HSG) “B” and 30% HSG “C”. For the purposes of the water balance calculations, it is assumed that the area to be extracted is 75% within HSG A_{60}/B_{40}, with the remainder within HSG B_{70}/C_{30}. Similarly, the area not included for extraction is assumed to be 65% within HSG A_{60}/B_{40}, with the remainder in HSG B_{70}/C_{30}. It is noted that the surficial soils area to be extracted will likely be modified to more silty sand soils (HSG C) after extraction is complete.

The soil water holding capacities and infiltration rate were determined using values presented in Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003) based on the vegetative

cover (pasture and shrubs) and the hydrologic soil group, as listed above. The pro-rated values based on the Site conditions are presented in the calculations sheets provided in **Appendix F**.

Evapotranspiration values were determined using the method described by Thornthwaite and Mather (1957). It is common practice and an accepted method by most Conservation Authorities to provide estimates of surplus using the Thornthwaite and Mather approach, where surplus is estimated based on precipitation minus evapotranspiration (Steenhuis and Van Der Molen, 1986). The distribution of runoff and infiltration from the surplus water is determined from the infiltration factor for the site. An infiltration factor of 0.85 was used for the Site based on topography (0.3), soil (0.4) and cover (0.15).

Table 6 provides a summary of the pre- and post-development water balance calculations. Calculation worksheets are provided in **Appendix F**. The results suggest that there is little change expected with the overall water balance as a result of the extraction.

Table 6: Summary of Water Balance Estimates

Item	Pre-Extraction m^3/year	Post-Extraction m^3/year
Total Precipitation	273,510	273,510
Estimated Evapotranspiration	155,723	154,130
Estimated Runoff	17,668	17,907
Estimated Infiltration	100,119	101,473

6.5 Environmental Considerations and Water Quality

Analytical testing on the natural subgrade soils was not conducted as part of this investigation. However, it is important to note that Ontario Regulation 153 provides applicable standards for any fill material which will be brought to the Site. For the purpose of importing and stockpiling materials onsite, consideration should be given to selecting material which has concentrations consistent with, or less than the standard concentrations identified in O. Reg. 153 for Table 1 (residential land-use) compliance.

The proposed pit will have a spills action plan in place and controlled use and/or storage of fuel. It should be noted that the proposed pit is located adjacent to existing pits to the north and east which have been in operation for years with similar controls.

Concerns related to water quality during gravel extraction activities are generally limited to leaks and spills from heavy equipment, the use of lubricants, and fuel handling. These should be mitigated by confining fuel handling activities to the east portion of the Site, where it has been rehabilitated and less permeable soil is found and no gravel-taking activities are planned, the use of spill containment equipment where fuel handling occurs, putting a spill action response plan in place and locating appropriate spill response equipment/materials onsite so that any petroleum spills from trucks and heavy equipment (eg. fuel, hydraulic oil) can be quickly addressed.

With the aforementioned measures in place, the use of fuel and lubricants on the Site will not present a significantly increased risk to the groundwater in the area.

6.6 Impact to Surface Water Features

There are no significant surface water features present within the Site boundary. Natural environmental features that may rely on some groundwater contribution such as a tributary creek, are located well north of and up-gradient of the Site.

As discussed earlier, the proposed extraction will not significantly or permanently affect water table elevations or groundwater flow patterns at the Site.

The presence of temporary ponds at the site during the operation and prior to grades being restored with fill material can be expected to result in an increase in the temperature of the very shallow groundwater encountered near surface and immediately down-gradient of the temporary ponds. Given that there is expected to be a buffer between any temporary ponds which are present at the site, and other surface water features (such as the Thames River), it is anticipated that the subsurface flow of the shallow groundwater will help to moderate the temperature of the shallow groundwater. Seasonal variations in the groundwater were observed within the monitoring wells, which further support this conclusion.

Based on the proposed gravel extraction in relation to the hydrogeological setting and natural environmental features on the Site, there is no potential for groundwater impacts to onsite natural environmental features.

6.7 Monitoring, Mitigation and Contingency Plan

It is proposed that the final rehabilitated ground surface elevation within the Site will be above the elevation of the water table, the extraction and rehabilitation plan includes the necessary mitigation to ensure that groundwater impacts are not significant. Considering the scale of the proposed operations and the results of the impact assessment, additional mitigation and contingency plans are not anticipated to be necessary.

Monitoring should consist of routine compliance reporting for the operation, to ensure good operational practices and to ensure that the rehabilitation plan is completed.

On an annual basis, it is recommended that water samples be taken for analytical testing, including analyses for metals, inorganics and hydrocarbons. The general chemistry of the groundwater which is reported in this report (Section 4.9) can be used as baseline conditions for future comparison, where appropriate.

In addition, monitoring of the groundwater depths should continue on a quarterly basis to document the groundwater table elevation changes throughout the seasons.

All groundwater quality data should be reviewed by a qualified professional to identify any signs of potential impacts related to the onsite activities.

An annual report summarizing the above data should be prepared as a due diligence measure.

7 Conclusions and Recommendations

7.1 Conclusions

Based on the results of Hydrogeological Assessment, the following findings are presented:

1) The predominant surficial materials within the Site include deposits of silt, sand & gravel, sandy gravel and silty clay till. Generally, the silty clay till was encountered underlying the sand & gravel and gravel layers and continued to borehole or test pit termination depth.

2) The predominant shallow groundwater flow direction (based on the recent groundwater depth measurements) is towards the north.

3) The overall study area is not municipally serviced with water and sewer. Based on a review of the Ministry of Environment, Conservation and Parks (MECP) Well Records, there are 8 potable water supply wells, 8 observation or test holes and 8 abandoned wells within 500 m of the boundaries of the Site. The actual number of these wells that are still in use is unknown. With the exception of the observation and abandoned wells, the water supply wells in the area are set at various depths, generally ranging from approximately 21.5 to 42.1 m, into water-bearing sand and sand and gravel deposits or the underlying limestone (at depths of approximately 24.4 m or greater below ground surface (Well No. 4104593). The majority of the well logs indicate that thick clay till is found overlying the deeper sand and limestone aquifers.

4) The water supply wells set at intermediate depths (greater than 13 m depth) and below, are not expected to be impacted by gravel-taking operations within the Site. That said, according the MECP Well Records, there are no water supply wells with depths shallower than 21.5 m within 500 m of the Site. Based on a review of the well records recorded by MECP, no significant long-term impacts are anticipated to the intermediate or deep wells, either quantitatively and qualitatively since the depth of the excavations for the gravel-taking operations are not expected to be deep enough to penetrate into the underlying water supply aquifers.

5) No existing potable groundwater wells were observed onsite during EXP's site work. Monitoring wells installed as part of EXP's investigation will be required to be decommissioned in accordance with Ontario Regulation 903 when no longer required. This regulation identifies that only certified and qualified well drilling technicians are permitted to direct the decommissioning work for existing wells.

6) The Site is located within a Significant Groundwater Recharge Area (SGRA) and is also located in an area that is classified as a highly vulnerable aquifer (HVA).

7) Hydraulic conductivities were estimated at Test Pits TP2, TP3, TP8, TP10 and TP11 based on the results of Grain Size Distribution Analysis and calculations using Hazen's Formula. Hydraulic conductivities (K values) estimated for the sandy gravel ranged from 4.0 x 10^{-2} cm/s to 6.4 x10^{-1} cm/s. These hydraulic conductivities are consistent with published values for sandy gravel and sand and gravel.

8) Excavations could extend to a maximum depth of approximately 1.4 m below the stabilized groundwater level in the current and future extraction areas. Active dewatering activities are not anticipated to lower the stabilized water table for below water extraction. Water quantity of the shallow unconfined aquifer may be affected for a short duration of time during gravel extraction as a result of the volume of material being removed, however the stabilized water level is not expected to be impacted on a long-term basis.

9) Groundwater depths were monitored from December 5, 2017 to April 18, 2018. The highest groundwater elevations were observed on April 18th, 2018. Once gravel-taking operations are underway, groundwater monitoring should be conducted on a quarterly basis and follow the requirements of the Aggregate Resources Act.

7.2 Recommendations

Spill Action Response Plan

Fuel handling activities should be directed towards the east portion of the site where it has been rehabilitated. This area is surfaced by less permeable soil is found and no gravel-taking activities are planned. Spill containment equipment should be utilized where fuel handling occurs, and the operators should be aware of the spill action response plan. The location of appropriate spill response equipment/materials should be clearly identified onsite, so that any petroleum spills from trucks and heavy equipment (eg. fuel, hydraulic oil) can be quickly addressed.

Groundwater Monitoring

When gravel extraction below the groundwater table operations commence, monitoring of the groundwater depths should continue on a quarterly basis to document the groundwater table elevations.

On an annual basis, at least two water samples should be taken for analytical testing, including analyses for metals, inorganics and hydrocarbons. The general chemistry of the groundwater which is reported in this report (Section 4.9) can be used as baseline conditions.

All groundwater quality data should be reviewed by a qualified engineer to identify any signs of potential impacts related to the onsite activities. An annual report summarizing the above data should be prepared as a due diligence measure.

Well Decommissioning

When the onsite monitoring wells are determined to be no longer required they should be properly decommissioned in accordance with Ontario Regulation 903.

Site Restoration

For the purpose of importing and stockpiling materials within the Site, consideration should be given to selecting material which has concentrations consistent with, or less than the standard concentrations identified in O. Reg. 153 for Table 1 (residential land-use) compliance.

In the event that imported materials are utilized to restore grades in the gravel extraction areas, the characteristics of the imported material (such as grain size and moisture content) should be reviewed by the geotechnical consultant to confirm that the material is suitable for use, and will not cause a significant reduction to the post-construction infiltration capacity.

Final site grades should ensure the final restored ground surface is above the water table.

8 References

1. Upper Thames River Conservation Authority website: http://thamesriver.on.ca/water-management/thames-river-levels/
2. Ontario Ministry of Environment, Conservation and Parks Water Wells Database: https://www.ontario.ca/environment-and-energy/map-well-records
3. Upper Thames River Conservation Authority; August 12, 2011: Upper Thames River Source Protection Area Amended Proposed Assessment Report, Revised: http://www.sourcewaterprotection.on.ca/ar_UTRCA.html.
4. Groundwater Science Corp.2007. Hydrogeological Assessment, Demar Aggregates Inc., Proposed Fallon Pit, Part Lot 1, Concession 6, Township of Middlesex Centre. September
5. EXP Services Inc. (EXP). 2015. Level 2 Hydrogeological Assessment, 21558 Olalondo Road, Municipality of Thames Centre, Middlesex County, Ontario. Report No. LON-0012927-EN. October.
6. EXP Services Inc. (EXP). 2018a. Geotechnical Investigation. Olalondo Pit – Underwater Extraction, London, ON. Project No LON-00015778-GE. March.
7. Bedrock Geology of Ontario, Southern Sheet, Map 2544, 1:1,000,000 scale, Ministry of Northern Development and Mines, 1991.
8. Ontario Division of Mines, Map P1048, Quaternary Geology, Lucan Area, Southern Ontario, 1975, Scale 1:50,000.
9. Physiography of Southern Ontario, Map 2715, Ontario Geological Survey, 1:600 000 scale, 1984.
10. Chapman, L.J., and Putnam, D.F.; 2007. The Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.
11. Thornthwaite, C. W. & J. R. Mather. 1957. Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance. Centerton, N.J., Laboratory of Climatology, Publications in Climatology, v. 10, no. 3, p. 185-311.
12. The Ontario Geological Survey. 2003. Surficial Geology of Southern Ontario.
13. Barnett, PJ., Cowan, W.R. and Henry, A.P. 1991. Quaternary Geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556, scale 1:1,000,000.

9 Qualifications of Assessor

EXP Services Inc. provides a full range of environmental services through a full-time Earth and Environmental Services Group. EXP's Environmental Services Group has developed a strong working relationship with clients in both the private and public sectors and has developed a positive relationship with the Ontario Ministry of the Environment and Climate Change. Personnel in the numerous branch offices form part of a large network of full-time dedicated environmental professionals in the EXP organization.

This report was co-authored by Mr. Eric Buchanan. Mr. Buchanan is an Engineer in Training (EIT) who has been thoroughly trained in conducting geotechnical and hydrogeological assessments. He obtained a Bachelor of Engineering in 2014 from Lakehead University and has been working in the geo-science field for over 7 years. He has authored and reviewed reports for numerous projects including residential and commercial developments that require geotechnical and hydrogeological input, and calculated groundwater removal quantities for short- and long-term construction.

This assessment was co-authored by Mr. Michael Venhuis, P.Geo. Mr. Venhuis is a hydrogeologist and environmental geoscientist with more than 18 years experience in the environmental field, and is a licensed Professional Geoscientist (P.Geo.) in Ontario, Saskatchewan and British Columbia. He obtained a Master's of Science (M.Sc.) in 2001 from the University of Waterloo, and has worked in the Hydrogeological and Geochemical field since that time. His technical undertakings have included work in the following fields: expert review for municipal and government agencies, hydrogeological assessments; contaminated Site investigations; environmental Site characterization; groundwater monitoring program design and reviews, soil and groundwater sampling and data evaluation; data analysis; interpretation and technical report preparation; Phase I, II, and III Environmental Assessments; project coordination; Permit to Take Water application preparation (Ontario); proposal preparation and client liaison.

This assessment was reviewed by Mr. Botel Chiu, P. Eng. who has been thoroughly trained in conducting geotechnical and hydrogeological assessments. He has obtained a Master of Engineering Degree in Geotechnical Engineering specializing in environmental and hydrogeological assessments and is a Qualified Person (QP) registered with the Ontario Ministry of Environment, Conservation and Parks (MECP). Mr. Chiu is the Senior Discipline Manger of Earth and Environment for Southwestern Ontario as well as London Branch Manager and has over 25 years of experience in consulting engineering under the Guideline of Professional Engineers Providing Geotechnical Engineering Services under the Professional Engineers Act in Ontario. He is a recognized technical specialist within the EXP organization and in the industry for the geotechnical and environmental fields. Mr. Chiu has been retained by various developers, municipalities and conservation authorities as the geotechnical expert in hydrogeological assessments and has testified as an expert witness in Ontario Municipal Board hearings and Municipal Councils related to groundwater hydrogeology and geotechnical matters for land development and construction.

10 General Limitations

The information presented in this report is based on a limited investigation designed to provide information to support an assessment of the current hydrogeological conditions within the subject property. The conclusions and recommendations presented in this report reflect site conditions existing at the time of the investigation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent. Should this occur, EXP Services Inc. should be contacted to assess the situation, and the need for additional testing and reporting. EXP has qualified personnel to provide assistance in regards to any future geotechnical and environmental issues related to this property.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the engineering profession. It is intended that the outcome of this investigation assist in reducing the client's risk associated with environmental impairment. Our work should not be considered 'risk mitigation'. No other warranty or representation, either expressed or implied, is included or intended in this report.

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in this report

This report was prepared for the exclusive use of The Municipality of Middlesex Centre and may not be reproduced in whole or in part, without the prior written consent of EXP, or used or relied upon in whole or in part by other parties for any purposes whatsoever. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Appendix A – Drawings

-LEGEND-

Site Boundary

-SCALE-

0 250 500 m

Image Source: Google Earth Pro - Imagery October 2015

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Site Location
Prepared By: E.B.	Reviewed By: M.V.
	EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5
DATE: APRIL 2018	PROJECT NO.: LON-00015778-HG
DWG.: 1	

-NOTES-

1. The site plan was reproduced from Google Maps and should be read in conjunction with EXP Hydrogeological Assessment Report LON-00015778-HG.

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Borehole/Test Pit Location Plan
Prepared By: E.B.	Reviewed By: M.V.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
APRIL 2018	1:5000	LON-00015778-HG	2

Note: Mapping source MNR Mapping; www.giscoeapp.lrc.gov.on.ca

-LEGEND-

Site Boundary

Constructed Drains

-SCALE-

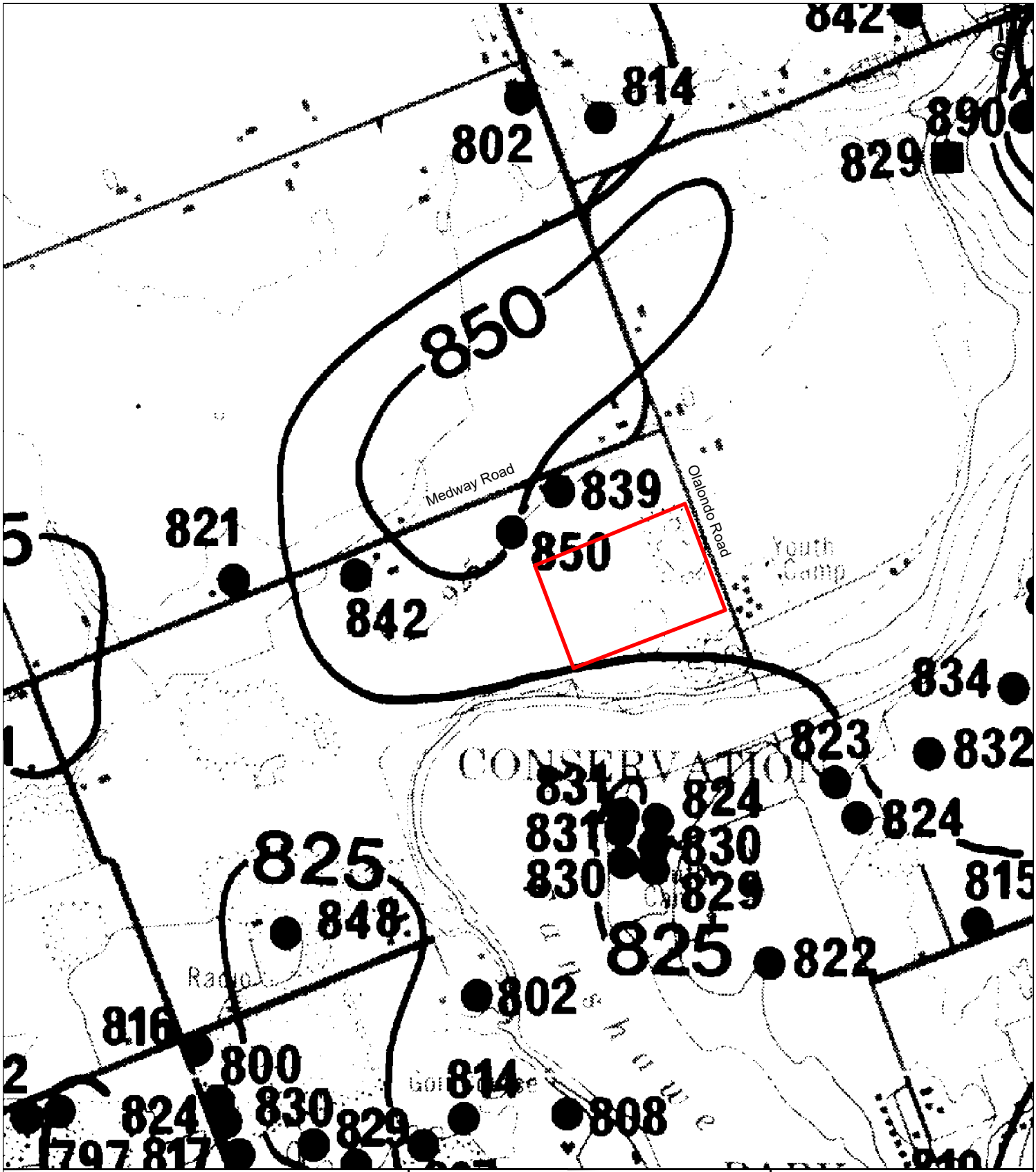
0 250 500 m

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT: The Municipality of Middlesex Centre	
TITLE: Site Drainage	
Prepared By: E.B.	Reviewed By: M.V.
EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5	
DATE: APRIL 2018	PROJECT NO.: LON-00015778-HG
DWG.: 3	



-LEGEND-

Site Boundary

667 — Bedrock surface elevation (ft) in a well or test-hole.

670 — Contours on bedrock surface (ft).

Note: adapted from Ontario Geological Survey. 1968. Bedrock Topography Series: St Thomas Sheet, Southern Ontario, Map P.482.

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

-SCALE-

0 500 1000 m

CLIENT: The Municipality of Middlesex Centre

TITLE: Bedrock Topography

DRAWN BY: E.B.

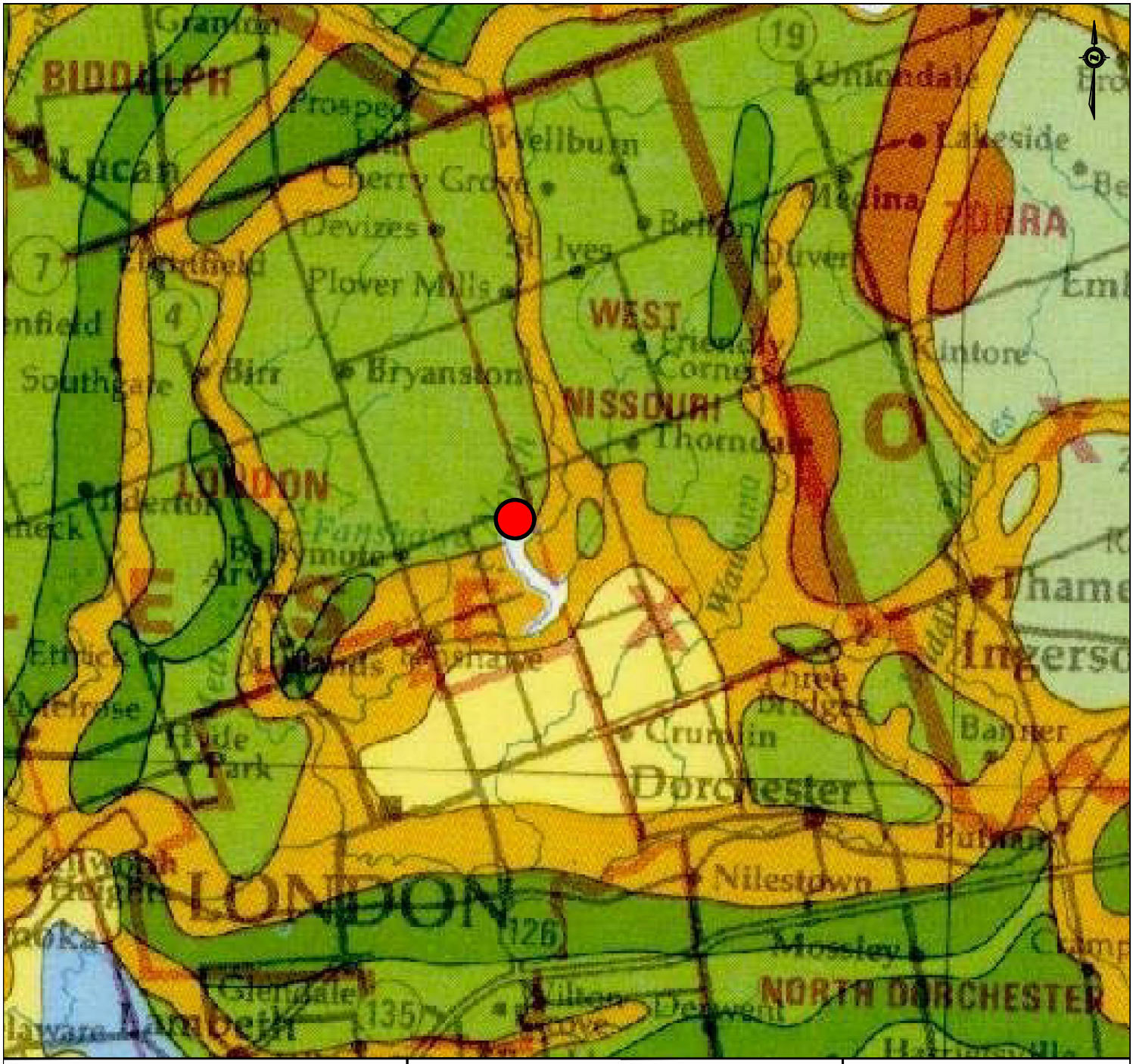
REVIEWED BY: M.V.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE: APRIL 2018

PROJECT NO.: LON-00015778-HG

DWG.: 4



-LEGEND-

Approximate Site Location

Till Moraine

Kame Moraine

Till Plain (drumlinized)

Drumlins

Till Plain (undrumlinized)

Spillway

Beaches and Shorecliffs

Escarpment

Limestone Plain

Shale Plain

Bevelled Till Plain

Shallow Till and Rock Ridges

Bare Rock Ridges and Shallow Till

Clay Plain

Sand Plain

Esker

Note: adapted from Ontario Geological Survey 2010. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV.

-SCALE-

0 5000 10000 m

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT

The Municipality of Middlesex Centre

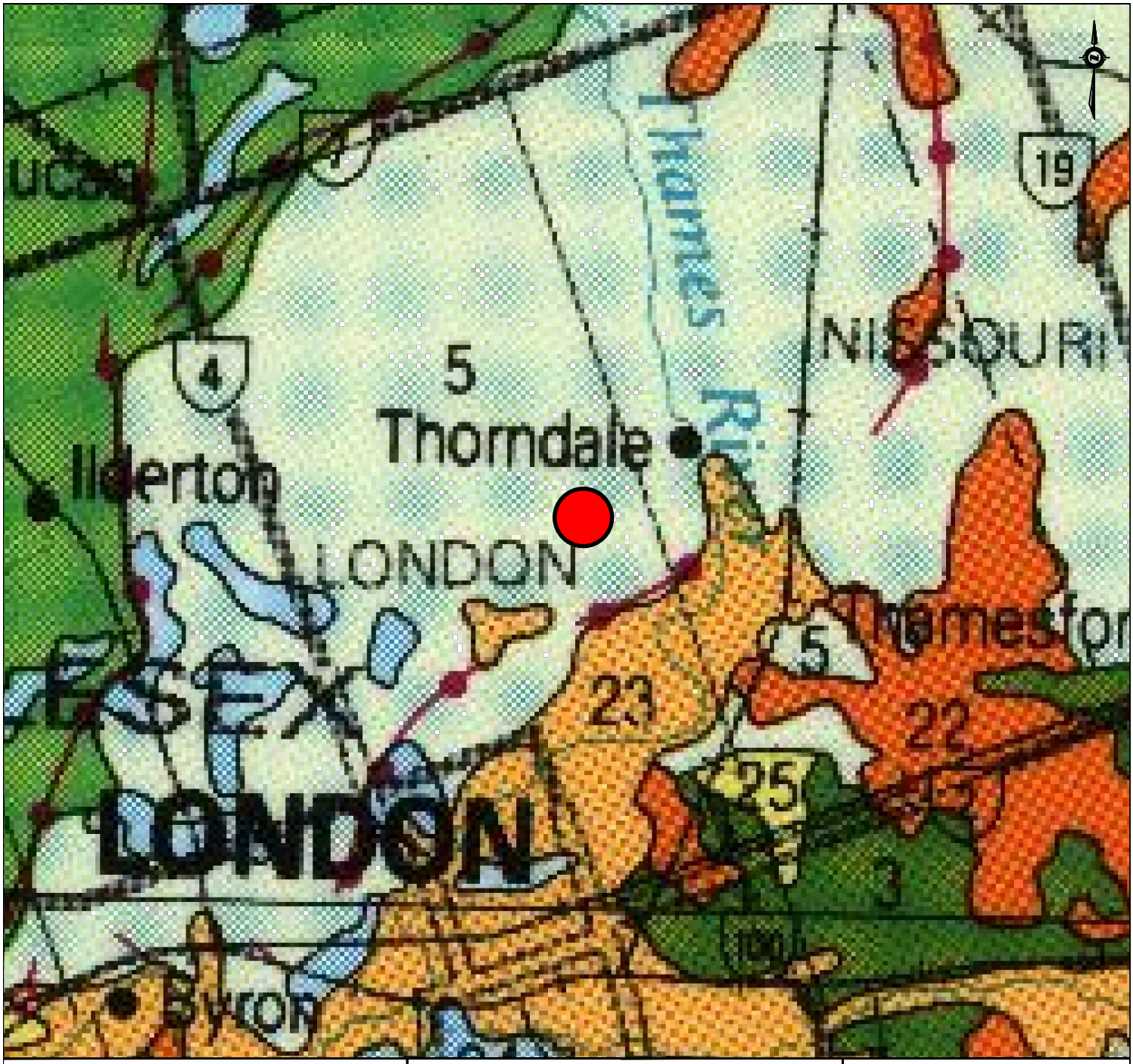
TITLE

Site Physiography

DRAWN BY:	REVIEWED BY:
E.B.	M.V.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE	PROJECT NO.	DWG.
APRIL 2018	LON-00015778-HG	5



-LEGEND-

Approximate Site Location

25	**Glaciolacustrine deposits:** sand, gravelly sand and gravel; nearshore and beach deposits
24	**Glaciolacustrine deposits:** silt and clay, minor sand; basin and quiet water deposits
23	**Glaciofluvial outwash deposits:** gravel and sand; includes proglacial river and deltaic deposits
22	**Glaciofluvial ice-contact deposits:** gravel and sand; minor till; includes esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits
11	**Rannoch Till (Huron–Georgian Bay lobe):** silt to clayey silt matrix becoming finer grained southward, highly calcareous, clast poor
9	**Port Stanley Till (Ontario–Erie lobe):** silt to sandy silt matrix becoming silt to silty clay near Lake Erie, strongly calcareous, moderate to low clast content decreasing southward
5	**Tavistock Till (Huron–Georgian Bay lobe):** sandy silt to silt matrix, silty clay matrix in south and in north, moderate to high carbonate content, clast content decreases from moderate to poor northward
3	**Catfish Creek Till:** sandy silt to silt matrix, strongly calcareous, moderately stony to stony

Note: Figure adapted from Barnett, PJ., Cowan, WR. and Henry, A.P. 1991. Quaternary geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556.

-SCALE-

0 5,000 10,000 m

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT

The Municipality of Middlesex Centre

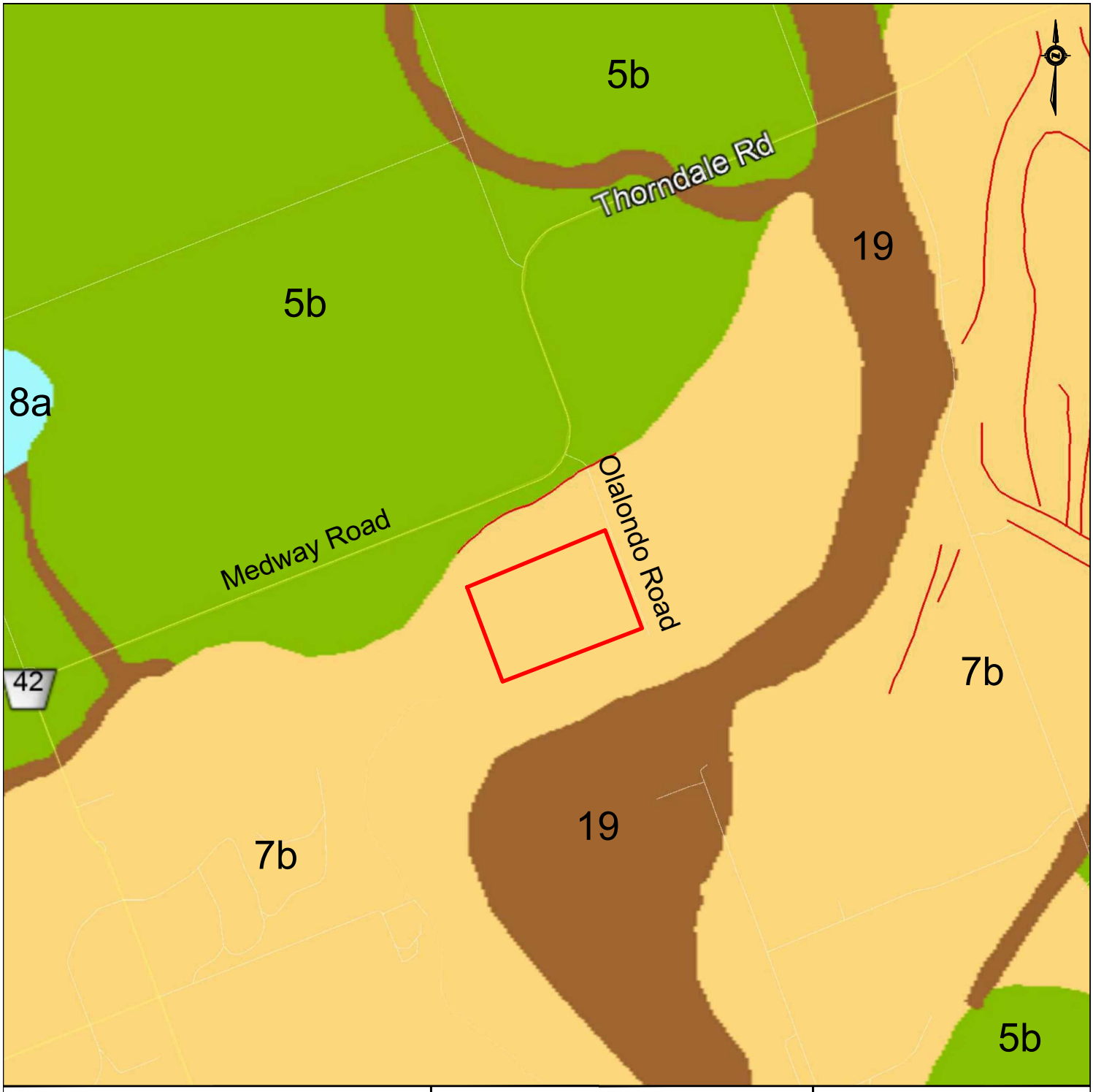
TITLE

Quaternary Geology

DRAWN BY:	REVIEWED BY:
E.B.	M.V.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE	PROJECT NO.	DWG.
APRIL 2018	LON-00015778-HG	6



-LEGEND-

Site Boundary

19 — **Modern alluvial deposits:** clay, silt, sand, gravel, may contain organic remains

8a — **Fine-textured glaciolacustrine deposits:** silt and clay, minor sand and gravel
8a Massive to well laminated

7b — **Glaciofluvial deposits:** river deposits and delta topset facies
7b Gravelly deposits

5b — 5b Stone-poor, sandy silt to silty sand-textured till on Palezoic terrain

Fluvial Terrace

Note: Figure adapted from The Ontario Geological Survey. 2003. Surficial Geology of Southern Ontario

-SCALE-

0 500 1000 m

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT: The Municipality of Middlesex Centre

TITLE: Surficial Geology

DRAWN BY:	REVIEWED BY:
E.B.	M.V.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE	PROJECT NO.	DWG.
APRIL 2018	LON-00015778-HG	7

-NOTES-

1. The site plan was reproduced from Google Maps and should be read in conjunction with EXP Report LON-00015778-HG.

-LEGEND-

- BH8 Approximate Borehole Location
- TP11 Approximate Test Pit Location
- Approximate Site Boundary

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road

Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Cross Section Location Plan
Prepared By: E.B.	Reviewed By: M.V.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
June 2018	1:5000	LON-00015778-HG	8

Generalized Cross Section A - A'

N

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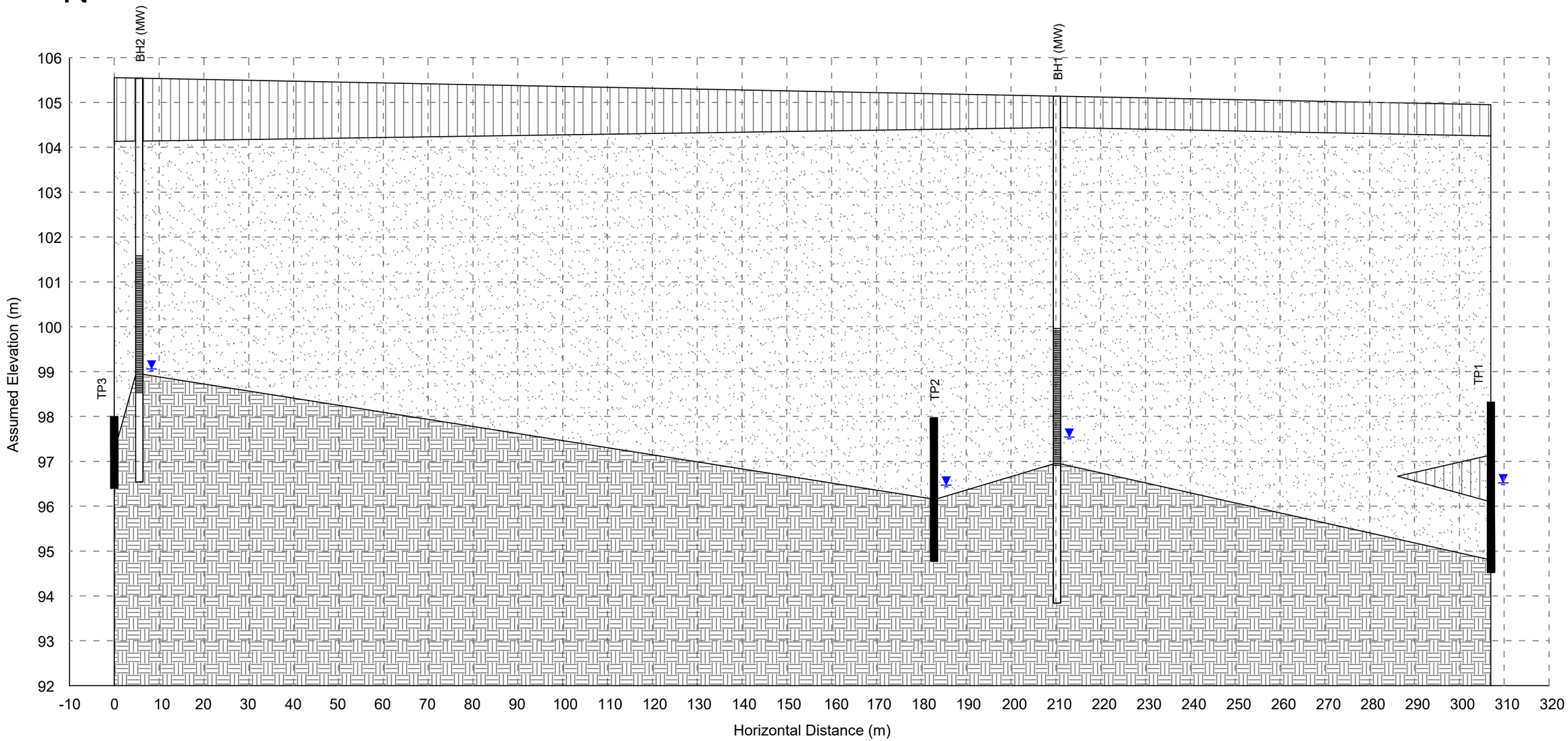


-LEGEND-

- Groundwater Measurement
- Silt
- Sand/Sandy Gravel/Sand and Gravel
- Silty Sand
- Silty Clay Till

-NOTES-

1. The cross section should be read in conjunction with EXP Report LON-00015778-HG.

2. The monitoring well groundwater elevations were measured on April 18, 2018. The test pit groundwater elevations were measured upon completion of test pit excavation.

Hydrogeological Assessment

Olalondo Pit Underwater Extraction
21515 Olalondo Road

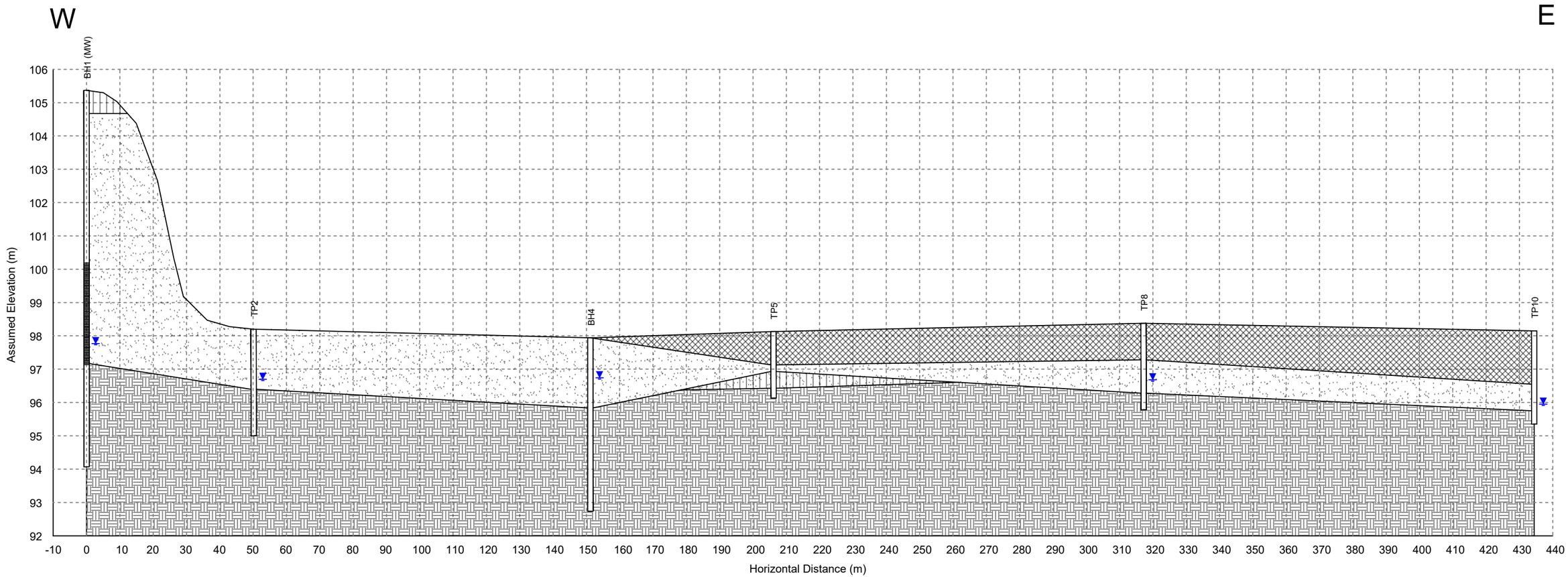
Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Generalized Cross Section A - A'
DRAWN BY:	E.B.
REVIEWED BY:	M.V.
DATE	JUNE 2018

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

SCALE	PROJECT NO.	DWG.
H=1:900, V=1:90 (11x17)	LON-00015778-HG	9

Generalized Cross Section B - B'



-LEGEND-

- Groundwater Measurement
- Possible Fill
- Silt
- Sand/Sandy Gravel/Sand and Gravel
- Silty Sand
- Silty Clay Till

-NOTES-

1. The cross section should be read in conjunction with EXP Report LON-00015778-HG.

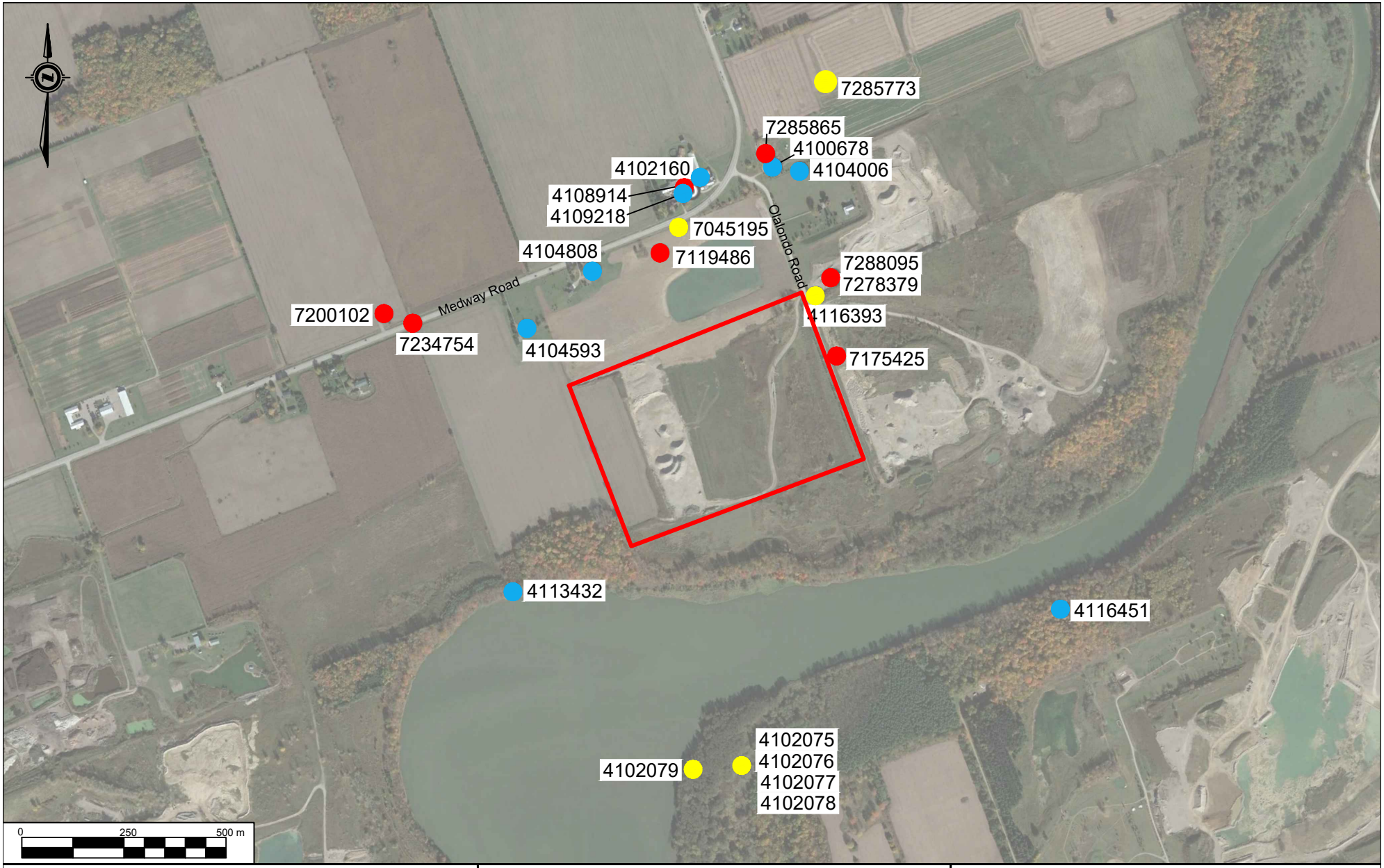
2. The monitoring well groundwater elevations were measured on April 18, 2018. The test pit groundwater elevations were measured upon completion of test pit excavation.

Hydrogeological Assessment

Olalondo Pit Underwater Extraction
21515 Olalondo Road

Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Generalized Cross Section B - B'
DRAWN BY: E.B. / REVIEWED BY: M.V. / DATE: JUNE 2018	
	EXP Services Inc. 15701 Robin's Hill Road London, ON, N5V 0A5
SCALE: H=1:1200, V=1:120 (11x17) / PROJECT NO.: LON-00015778-HG / DWG.: 10	



—LEGEND—

- Approximate Site Boundary
- Water Supply - Domestic
- Observation/Test Hole
- Abandoned

Image Source: Google Earth Pro - Imagery October 2015

Hydrogeological Assessment

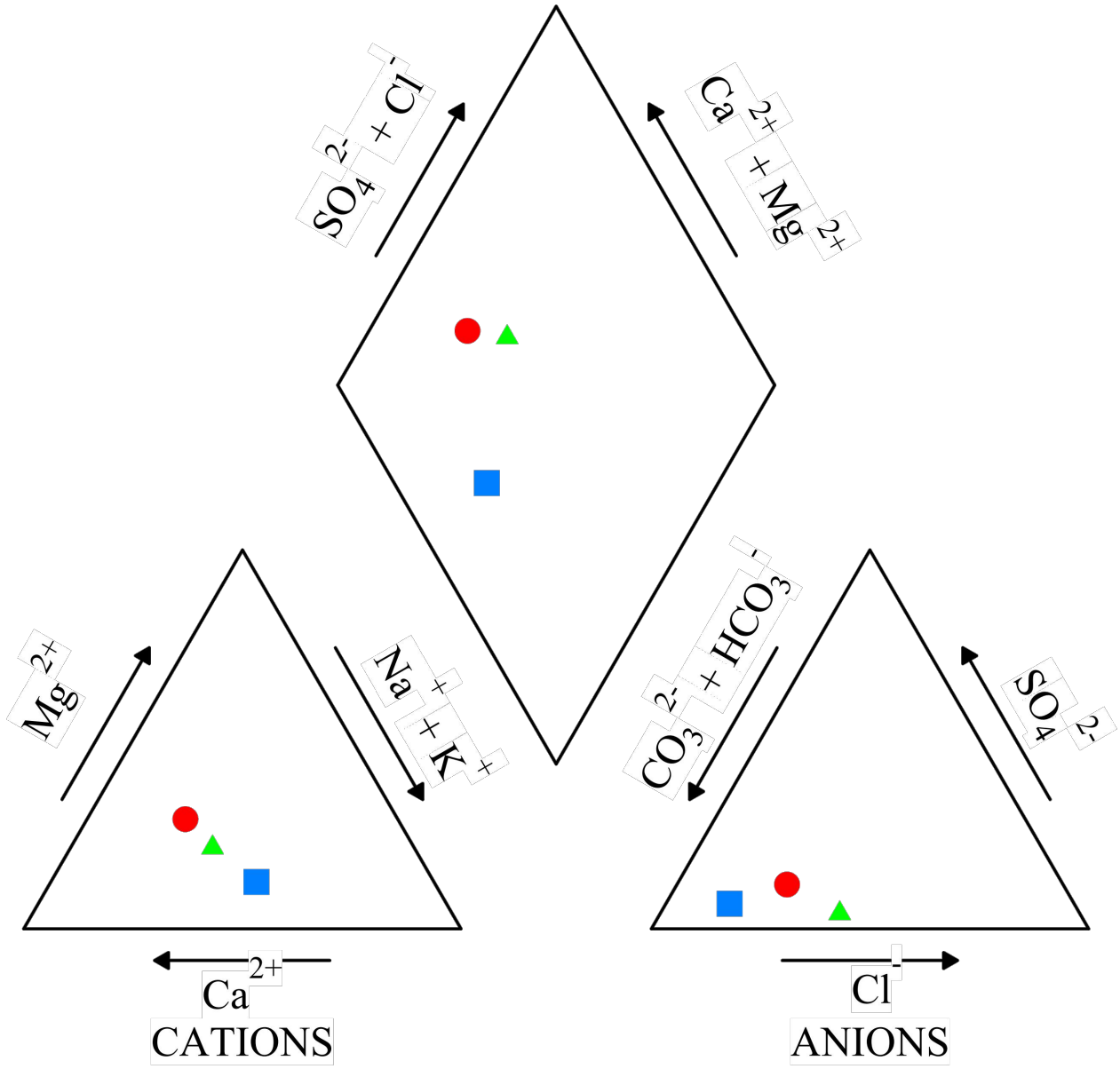
Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Approximate Location of MECP Registered Wells
Prepared By: M.B.	Reviewed By: M.V.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	PROJECT NO.	FIG.
JULY 2018	LON-00015778-HG	11



-LEGEND-

- MW17-9
- MW17-7
- MW17-6

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT	Municipality of Middlesex Centre
TITLE	Piper Diagram
DRAWN BY:	M.B.
REVIEWED BY:	E.B.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE	PROJECT NO.	DWG.
April 2018	LON-00015778-HG	12

-LEGEND-

- Site Boundary
- BH8 — Approximate Borehole Location
- TP11 — Approximate Test Pit Location
- Groundwater Contour
- 97.5 — Groundwater Elevation (April 18, 2018)
- Groundwater Flow Direction

Hydrogeological Assessment

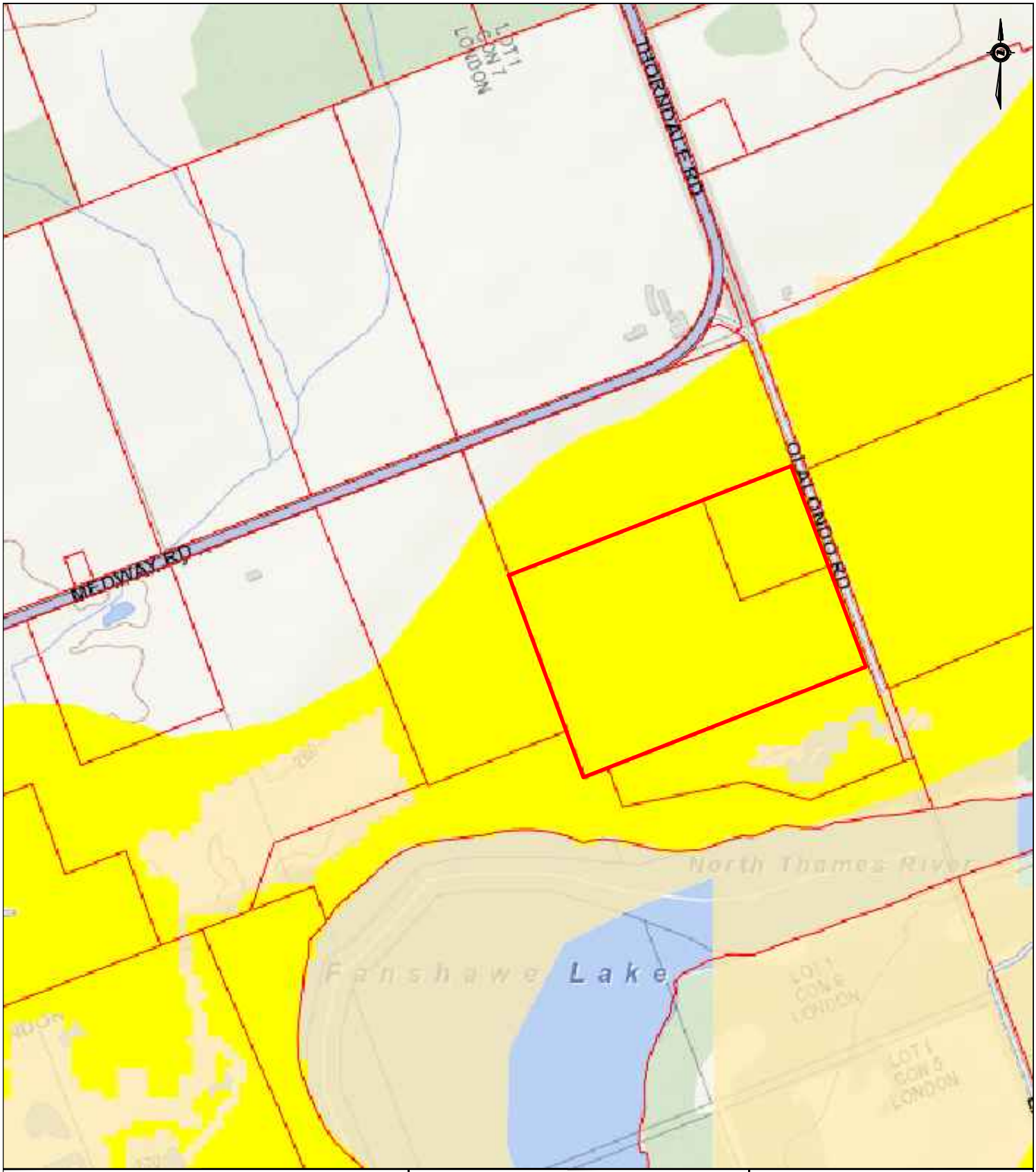
Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Groundwater Contour Map
Prepared By: M.B.	Reviewed By: M.V.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
JULY 2018	1:5000	LON-00015778-HG	13



-LEGEND-

- Approximate Site Boundary
- Vulnerability = 2
- Vulnerability = 4
- Vulnerability = 6

Note: Figure adapted from UTRCA online mapping software; http://maps.thamesriver.on.ca

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

-SCALE-

0 200 400 m

CLIENT: The Municipality of Middlesex Centre

TITLE: Significant Groundwater Recharge Areas

DRAWN BY: E.B.

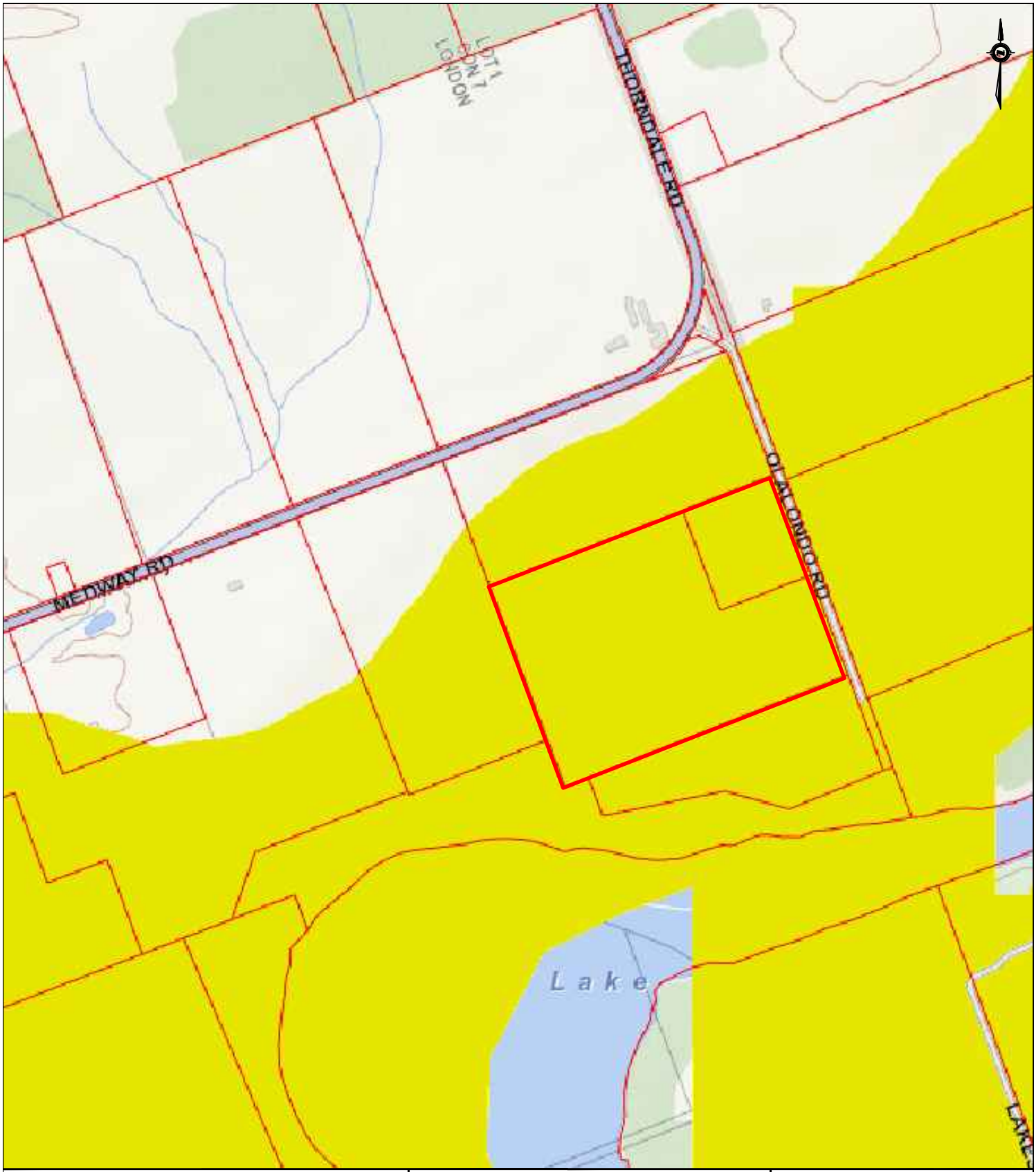
REVIEWED BY: M.V.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE: APRIL 2018

PROJECT NO.: LON-00015778-HG

DWG.: 14



-LEGEND-

Approximate Site Boundary

Highly Vulnerable Aquifer - Approved

Note: Figure adapted from UTRCA online mapping software;
http://maps.thamesriver.on.ca

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

-SCALE-

0 200 400 m

CLIENT: The Municipality of Middlesex Centre

TITLE: Highly Vulnerable Aquifers

DRAWN BY: E.B.

REVIEWED BY: M.V.

EXP Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5

DATE: APRIL 2018

PROJECT NO.: LON-00015778-HG

DWG.: 15

Appendix B – Borehole and Test Pit Logs

BOREHOLE LOG

BH1 (MW)
Sheet 1 of 1

Client The Municipality of Middlesex Centre
Project No. LON-00015778-GE
Project Name Olalondo Pit Underwater Extraction
Datum Assumed
Site Location 21515 Olalondo Road, Middlesex Centre, ON
Boring Date December 4, 2017

DEPTH (ft bgs)	DEPTH (m bgs)	ELEVATION (m) 105.1	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	REMARKS
0.0	0.0	104.9	**TOPSOIL** - 280 mm			SS	S1	500	5	22	Well Stickup: 0.93 m
0.9	0.3	104.5	**SILT** - brown, some clay, trace sand, trace organics, loose, moist								Auger Hole Diameter: 200 mm
2.3	0.7		**SAND AND GRAVEL** - brown, trace to some silt, occasional cobbles, compact to very dense, moist			SS	S2	300	20	2	Standpipe Diameter: 50 mm
						SS	S3	550	54	1	
						SS	S4	450	32	2	
11.0	3.4		- occasional clayey silt/silt pockets encountered near 3.35 m bgs			SS	S5	375	20	8	
						SS	S6	450	20	3	
14.8	4.5	100.6	**SAND** - brown, medium grained, trace silt, compact to dense, moist			SS	S7	500	34	3	Top of Sand Pack Elevation: 100.2 m
18.2	5.6	99.6	**SANDY GRAVEL** - brown, trace to some silt, dense to very dense, moist			SS	S8	275	50*	2	Top of Screen Elevation: 99.9 m
27.0	8.2	96.9				SS	S9	500	46	3	Bottom of Screen Elevation: 96.9 m
32.0	9.8		**SILTY CLAY TILL** - brown, some sand, trace gravel, very stiff to hard, moist - becoming grey near 9.75 m bgs			SS	S10	600	25	15	
37.0	11.3	93.9				SS	S11	250	50*	8	
			End of Borehole at 11.27 m bgs.								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.

SAMPLE LEGEND
AS Auger Sample | SS Split Spoon | ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) | VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent | Measured | Artesian (see Notes)

BOREHOLE LOG

BH2 (MW)
Sheet 1 of 1

Client The Municipality of Middlesex Centre
Project No. LON-00015778-GE
Project Name Olalondo Pit Underwater Extraction
Datum Assumed
Site Location 21515 Olalondo Road, Middlesex Centre, ON
Boring Date December 4, 2017

DEPTH (ft bgs)	DEPTH (m bgs)	ELEVATION (m) 105.5	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	REMARKS
0.0	0.0	105.2	**TOPSOIL** - 350 mm								Well Stickup: 0.92 m
1.1	0.4		**SILT** - brown, some clay, trace sand, trace organics, loose, moist			SS	S1	500	5	28	Auger Hole Diameter: 200 mm
						SS	S2	300	6	17	Standpipe Diameter: 50 mm
4.5	1.4	104.2									
			SAND AND GRAVEL - brown, trace silt, occasional cobbles, compact to very dense, moist			SS	S3	550	19	2	
						SS	S4	450	42	2	
						SS	S5	375	50*	2	Top of Sand Pack Elevation: 102.2 m
											Top of Screen Elevation: 101.6 m
						SS	S6	450	31	4	
21.5	6.6	99.0				SS	S7	500	61	13	
			SILTY CLAY TILL - grey, some sand, trace gravel, hard, moist								Bottom of Screen Elevation: 98.5 m
						SS	S8	275	64	8	
29.5	9.0	96.6				SS	S9	500	58	10	
			End of Borehole at 8.99 m bgs.								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH3
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 28, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	100.30								
	99.54	**FILL** - sand, brown, some gravel, coarse grained, occasional silt pockets, compact, moist			SS	S1	450	20	13
1		**SILTY CLAY TILL** - brown to grey, some sand, trace gravel, occasional cobbles, hard, moist			SS	S2	375	31	10
2					SS	S3	25	46	5
					SS	S4	600	35	9
3	96.64				SS	S5	600	27	12
4		**End of Borehole at 3.66 m bgs.**							
5									
6									
7									
8									
9									
10									
11									
12									
13									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.
4) Borehole open and dry upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH4
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 28, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	97.94	**SAND AND GRAVEL** - brown, occasional cobbles, compact to dense, moist			SS	S1	475	49	7
		- becoming wet near 0.61 m bgs		▽	SS	S2	400	50	7
2	95.81				SS	S3	450	17	13
		SILTY CLAY TILL - grey, some sand, trace gravel, occasional cobbles, hard, moist			SS	S4	400	44	11
3					SS	S5	550	46	11
4									
5	92.76				SS	S6	500	42	14
		End of Borehole at 5.18 m bgs.							
6									
7									
8									
9									
10									
11									
12									
13									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.
4) Borehole open to 1.68 m bgs and ground water measured near 1.22 m bgs upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

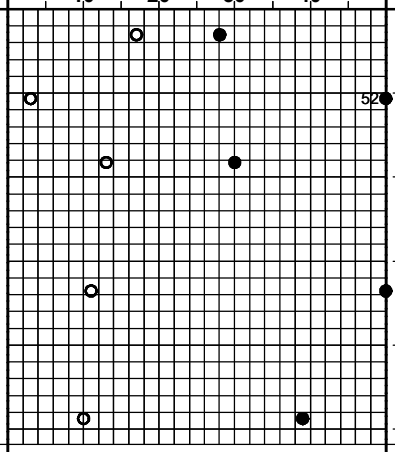
BH5
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 28, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	99.04								
	98.69	**FILL** - silt, brown, trace to some clay, trace sand, compact, moist			SS	S1	600	28	17
1		**SAND AND GRAVEL** - possible fill, brown, trace silt, occasional cobbles, compact to very dense, moist			SS	S2	500	52	3
	97.52								
2		**SILTY CLAY TILL** - brown, some sand, trace gravel, hard, moist			SS	S3	300	30	13
3		- becoming grey near 2.59 m bgs			SS	S4	250	50*	11
4									
5	93.86				SS	S5	400	39	10
		End of Borehole at 5.18 m bgs.							
6									
7									
8									
9									
10									
11									
12									
13									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40



NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.
4) Borehole open and dry upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH6 (MW)
Sheet 1 of 1

Client The Municipality of Middlesex Centre
Project No. LON-00015778-GE
Project Name Olalondo Pit Underwater Extraction
Datum Assumed
Site Location 21515 Olalondo Road, Middlesex Centre, ON
Boring Date December 4, 2017

DEPTH (ft bgs)	DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	REMARKS
		98.1									
0.0	0.0		**FILL** - silt, brown, trace to some clay, some sand, trace gravel, trace topsoil, compact, moist			SS	S1	550	16	18	Well Stickup: 1.41 m Auger Hole Diameter: 200 mm Standpipe Diameter: 50 mm
						SS	S2	300	18	14	
6.0	1.8	96.3									Top of Sand Pack Elevation: 96.9 m Top of Screen Elevation: 96.6 m
			SAND AND GRAVEL - brown, trace silt, occasional cobbles, dense, wet			SS	S3	425	37	14	
8.0	2.4	95.7									
			SILTY CLAY TILL - brown, some sand, trace gravel, very stiff to hard, moist			SS	S4	550	20	12	
10.0	3.1		- becoming grey near 3.05 m bgs			SS	S5	400	36	11	Bottom of Screen Elevation: 95.1 m
17.0	5.2	92.9				SS	S6	500	50*	12	
			End of Borehole at 5.18 m bgs.								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.

SAMPLE LEGEND
AS Auger Sample | SS Split Spoon | ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) | VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent | Measured | Artesian (see Notes)

BOREHOLE LOG

BH7 (MW)
Sheet 1 of 1

Client The Municipality of Middlesex Centre
Project No. LON-00015778-GE
Project Name Olalondo Pit Underwater Extraction
Datum Assumed
Site Location 21515 Olalondo Road, Middlesex Centre, ON
Boring Date November 27, 2017

DEPTH (ft bgs)	DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	REMARKS
		99.5									
0.0	0.0		**SAND** - possible fill, brown, some gravel, some clay, compact, moist			SS	S1	450	20		Well Stickup: 0.74 m Auger Hole Diameter: 200 mm Standpipe Diameter: 50 mm
4.2	1.3					SS	S2	370	17		
6.0	1.8	97.7	- trace organics and wood encountered near 1.27 m bgs			SS	S3	75	47		
			SILTY CLAY TILL - brown, some sand, trace gravel, occasional cobbles, very stiff to hard, moist			SS	S4	450	39		
10.0	3.1		- becoming grey near 3.05 m bgs			SS	S5	50	55		
						SS	S6	450	34		
						SS	S7	100	69		
						SS	S8	500	48		
						SS	S9	400	17		Top of Sand Pack Elevation: 90.7 m Top of Screen Elevation: 90.1 m
						SS	S10	550	27		
42.0	12.8	86.7				SS	S11	400	30		Bottom of Screen Elevation: 87.3 m
			End of Borehole at 12.80 m bgs.								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) * denotes: 50 blows recorded before 150 mm spoon sampler penetration.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH8
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 27, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.89	**SAND AND GRAVEL** - possible fill, brown, trace clay, occasional silt pockets, compact, moist to wet			SS	S1	550	6		
1					SS	S2	400	20		
	97.06									
2		**SILTY CLAY TILL** - grey, some sand, trace gravel, occasional cobbles, hard, moist			SS	S3	300	46		
					SS	S4	400	46		
3					SS	S5	300	39		
4				▽						
5	93.71				SS	S6	75	79		
		End of Borehole at 5.18 m bgs.								
6										
7										
8										
9										
10										
11										
12										
13										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40
79

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.
3) Borehole open to 4.57 m bgs and ground water measured near 4.27 m bgs upon completion of drilling.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH9 (MW)
Sheet 1 of 1

Client The Municipality of Middlesex Centre
Project No. LON-00015778-GE
Project Name Olalondo Pit Underwater Extraction
Datum Assumed
Site Location 21515 Olalondo Road, Middlesex Centre, ON
Boring Date November 28, 2017

DEPTH (ft bgs)	DEPTH (m bgs)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	REMARKS
		98.3									
0.0	0.0		**CLAYEY SILT** - possible fill, brown, some sand, some gravel, trace organics, moist			SS	S1	250		29	Well Stickup: 0.81 m Auger Hole Diameter: 200 mm
3.3	1.0	97.3				SS	S2	400	25	9	Standpipe Diameter: 50 mm
4.9	1.5		**SANDY GRAVEL** - brown, some silt to silty, occasional cobbles, compact to very dense, moist - becoming wet near 1.52 m bgs			SS	S3	350	56	9	Top of Sand Pack Elevation: 96.8 m Top of Screen Elevation: 96.5 m
8.0	2.4	95.9				SS	S4	550	26	14	
			SILTY CLAY TILL - grey, some sand, trace gravel, occasional cobbles, very stiff to hard, moist			SS	S5	350	24	10	Bottom of Screen Elevation: 95.0 m
17.0	5.2	93.1				SS	S6	400	81	10	
			End of Borehole at 5.18 m bgs.								

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Logs must be read in conjunction with EXP Report LON-00015778-GE.
2) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP1
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.32	**SANDY GRAVEL** - brown, fine to coarse grained								
1	97.12	**SILTY SAND** - brown								
2	96.12	**SAND AND GRAVEL** - dense, wet		▽						
3	94.82	**SILTY CLAY TILL** - grey, some sand, trace gravel								
	94.52	**End of Test Pit at 3.8 m bgs.**								
4										
5										
6										
7										

SHEAR STRENGTH
● S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 1.8 m bgs after 3 hours.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP2
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	97.97	**SANDY GRAVEL** - brown, fine to coarse grained **Grain Size Analysis** Gravel 74% Sand 24% Silt 2%		▽						
1										
	96.17									
2		**SILTY CLAY TILL** - brown, some sand, trace gravel - becoming grey near 2.4 m bgs								
3	94.77									
		End of Test Pit at 3.2 m bgs.								
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 1.5 m bgs.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP3
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**

PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**

LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.00	**SANDY GRAVEL** - brown, fine to coarse grained, occasional cobbles								
	97.50	**Grain Size Analysis** Gravel 66% Sand 26% Silt 8%								
1		**SILTY CLAY TILL** - grey, some sand, trace gravel								
	96.40	**End of Test Pit at 1.6 m bgs.**								
2										
3										
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Test pit dry at completion.
3) bgs denotes below ground surface.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

TEST PIT LOG

TP4
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	99.41	**SILTY CLAY TILL** - brown, some sand, trace gravel - becoming grey and hard near 0.3 m bgs								
1	98.31	**End of Test Pit at 1.1 m bgs.**								
2										
3										
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
SPT N Value Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Test pit dry at completion.
3) bgs denotes below ground surface.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

TEST PIT LOG

TP5
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.13	**SILTY CLAY** - possible fill, brown, with sand and gravel								
	97.13									
1	96.93	**SAND AND GRAVEL** - brown								
		SANDY SILT - brown								
	96.43									
	96.13	**SILTY CLAY TILL** - grey, some sand, trace gravel								
2		**End of Test Pit at 2.0 m bgs.**								
3										
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Test pit dry at completion.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP6
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**

PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**

LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	97.85	**CLAYEY SILT** - possible fill, brown, with sand and gravel								
1	96.85	**CLAYEY SILT** - brown, some sand, trace gravel								
2	96.05	**SAND** - brown, fine to medium grained, trace gravel, wet - some water seepage near 1.8 m bgs		▽						
3	94.85	**SILTY CLAY TILL** - grey, some sand, trace gravel								
	94.45	**End of Test Pit at 3.4 m bgs.**								
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 2.0 m bgs.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP7
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	97.60	**SAND AND GRAVEL** - possible fill, brown, with clay and silt								
	96.70									
1		**SILTY SAND** - brown to grey - becoming wet near 1.6 m bgs		▽						
2	95.20									
		SILTY CLAY TILL - grey, some sand, trace gravel								
3	94.60	**End of Test Pit at 3.0 m bgs.**								
4										
5										
6										
7										

SHEAR STRENGTH
● S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 1.6 m bgs.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP8
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.38	**SILTY SAND** - possible fill, brown, with clay and gravel								
1	97.28	**SANDY GRAVEL** - brown, fine to coarse grained **Grain Size Analysis** Gravel 76% Sand 18% Silt 6%		▽						
2	96.28	**SILTY CLAY TILL** - grey, some sand, trace gravel								
	95.78	**End of Test Pit at 2.6 m bgs.**								
3										
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 1.7 m bgs.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP9
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.85	Silty **SAND AND GRAVEL** - possible fill, brown, some clay								
	98.15									
1		**CLAYEY SILT** - brown, some sand, trace gravel								
	97.15									
2		**SILTY CLAY TILL** - grey, some sand, trace gravel								
	96.55									
		End of Test Pit at 2.3 m bgs.								
3										
4										
5										
6										
7										

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Test pit dry at completion.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP10
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**

PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**

LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.15	**SANDY SILT** - possible fill, brown, with clay and gravel								
	96.55									
		SANDY GRAVEL - brown, fine to coarse grained, wet **Grain Size Analysis** Gravel 69% Sand 27% Silt 4%		▽						
	95.75	- caving near 2.3 m bgs								
	95.35	**SILTY CLAY TILL** - grey, some sand, trace gravel								
		End of Test Pit at 2.8 m bgs.								

SHEAR STRENGTH: ✤ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane; 100 200 kPa

Atterberg Limits and Moisture: W_P W W_L; ● SPT N Value × Dynamic Cone; 10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 2.2 m bgs.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

TEST PIT LOG

TP11
Sheet 1 of 1

CLIENT **The Municipality of Middlesex Centre** PROJECT NO. **LON-00015778-GE**
PROJECT **Olalondo Pit Underwater Extraction** DATUM **Assumed**
LOCATION **21515 Olalondo Road, Middlesex Centre, ON** DATES: Boring **November 9, 2017** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.23	**SANDY SILT** - possible fill, brown, with clay and gravel								
1	96.83	**SANDY GRAVEL** - brown, fine to coarse grained **Grain Size Analysis** Gravel 73% Sand 24% Silt 3% - caving near 2.2 m bgs		▽						
2										
3	95.23	**SILTY CLAY TO CLAYEY SILT** - grey, some sand, trace gravel								
	94.73	**End of Test Pit at 3.5 m bgs.**								
4										
5										
6										
7										

SHEAR STRENGTH
● S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test Pit Log interpretation requires assistance by EXP before use by others. Test Pit Log must be read in conjunction with EXP Report LON-00015778-GE.
2) Groundwater measured near 1.9 m bgs.
3) bgs denotes below ground surface.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

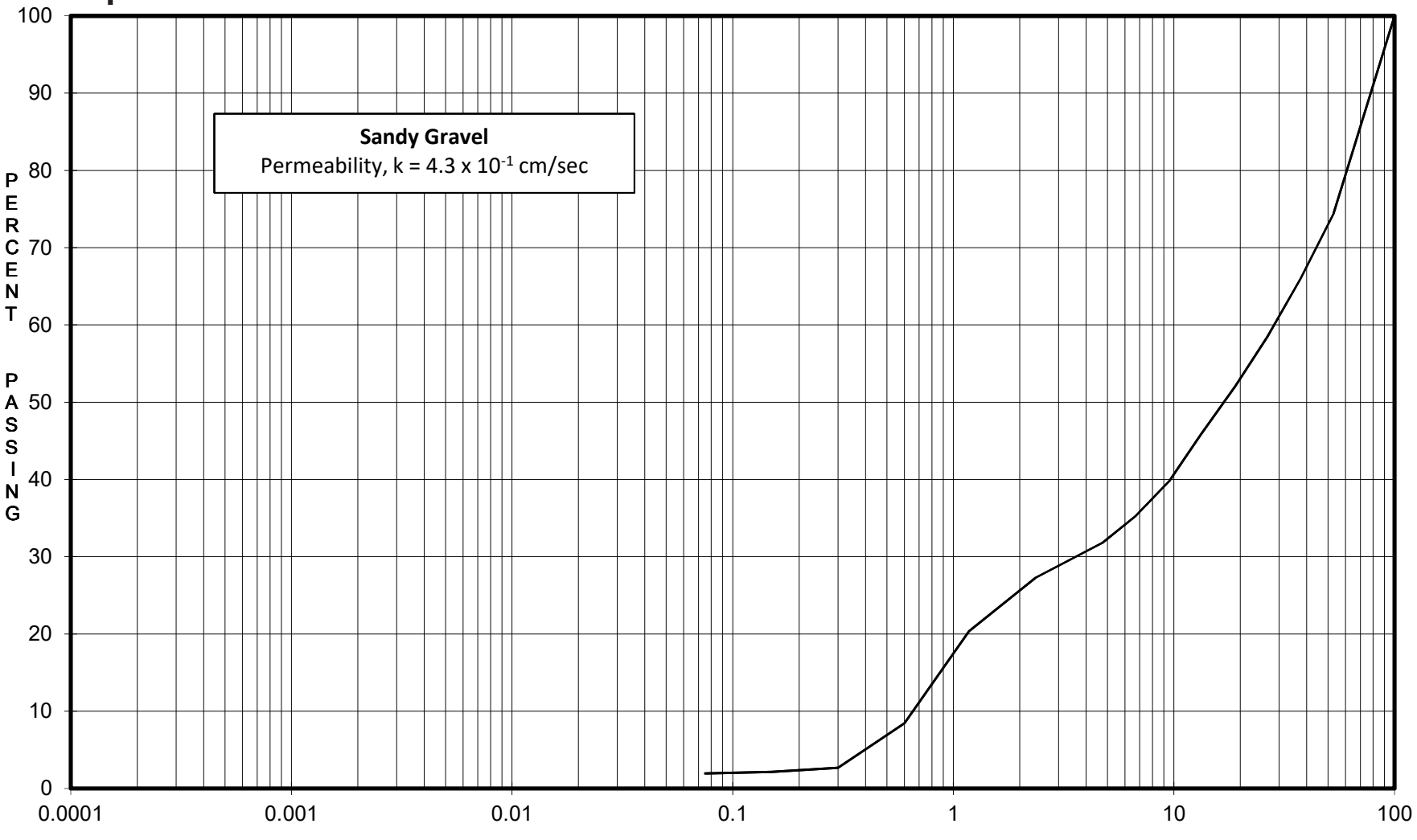
OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

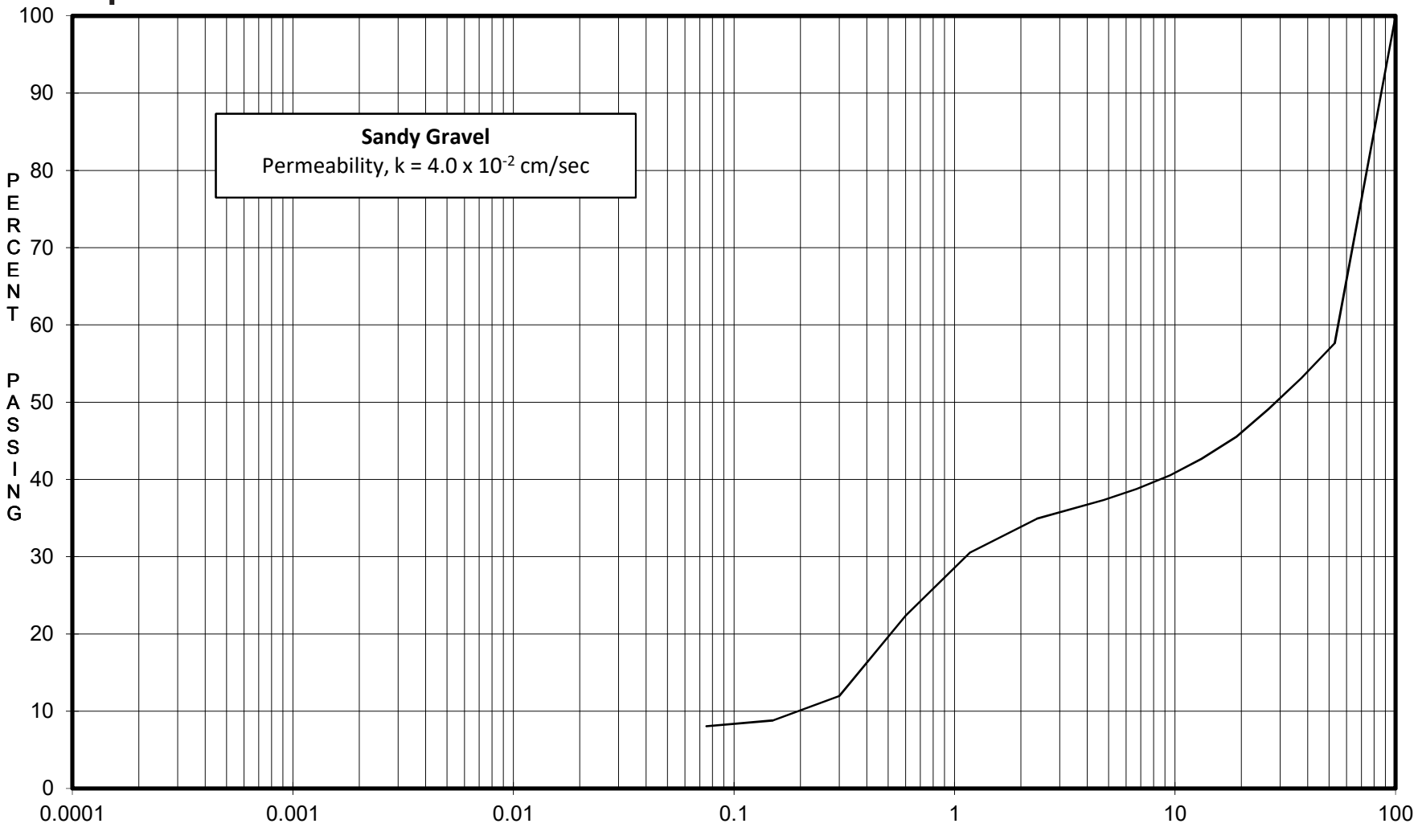
Appendix C - Grain Size Distribution Analysis Data

MECHANICAL GRAIN SIZE ANALYSIS



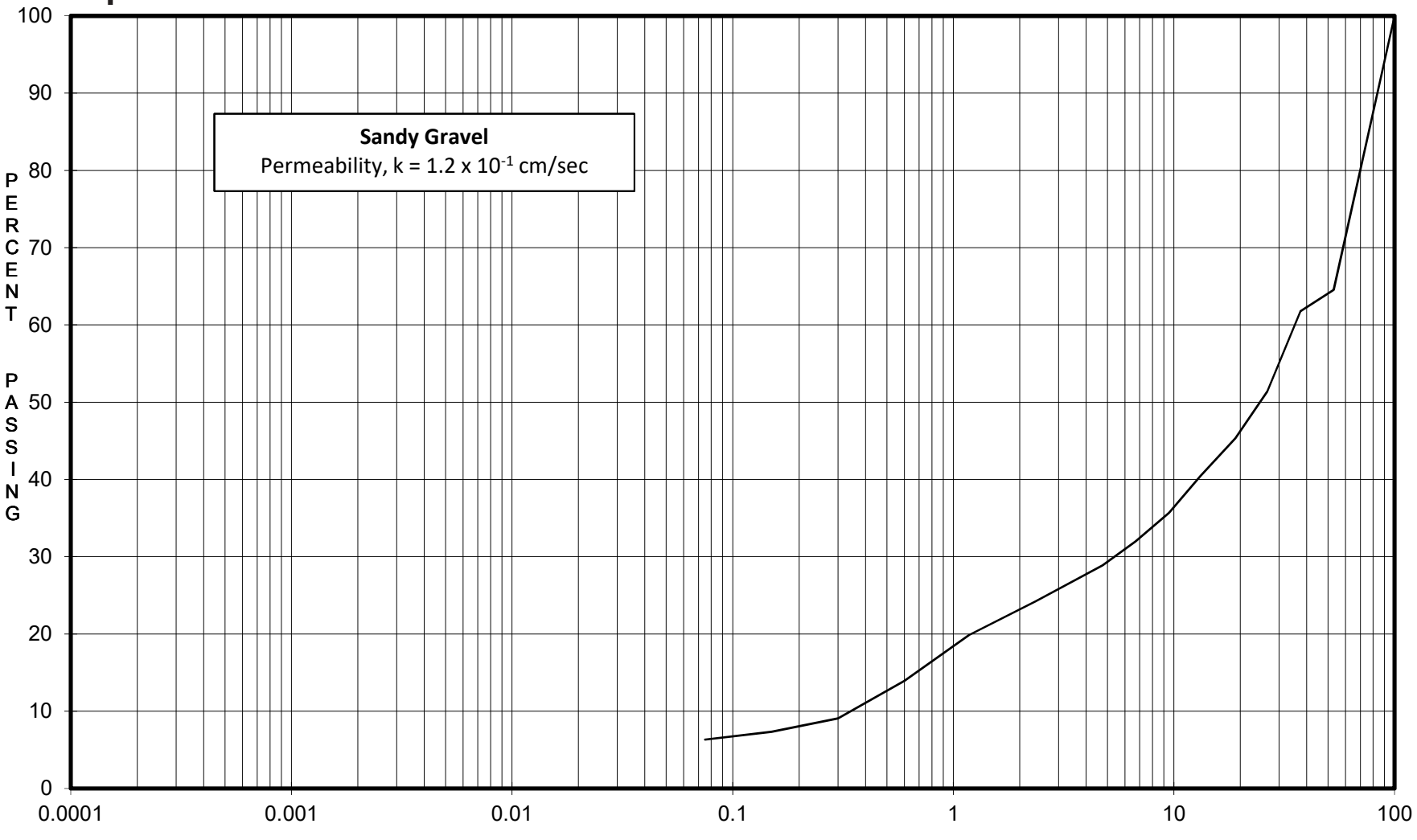
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description: Test Pit 2**						**Olalondo Pit Extraction Project: LON00015778HG**			**Figure 1**

MECHANICAL GRAIN SIZE ANALYSIS



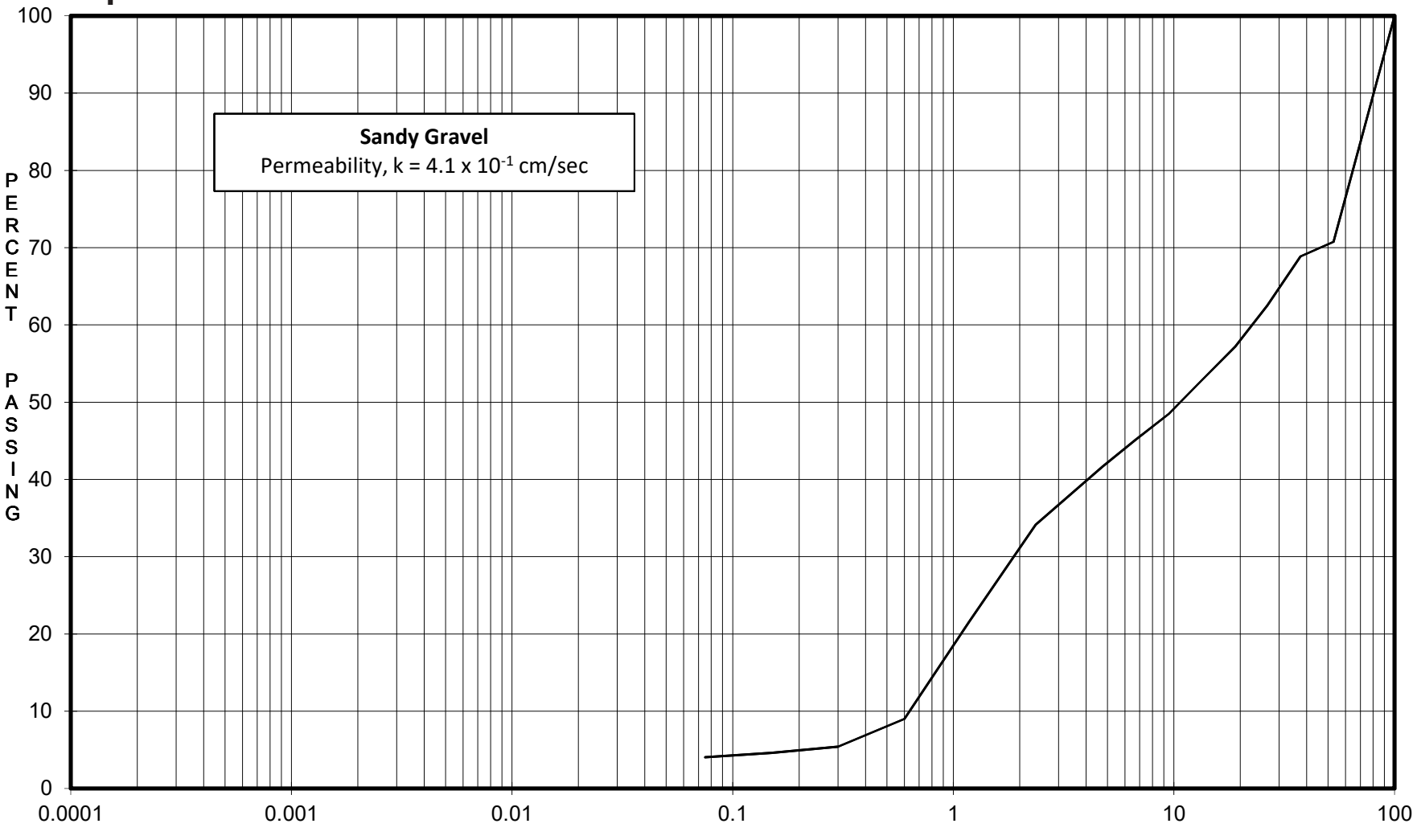
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description: Test Pit 3**			**Olalondo Pit Extraction Project: LON00015778HG**						**Figure 2**

MECHANICAL GRAIN SIZE ANALYSIS



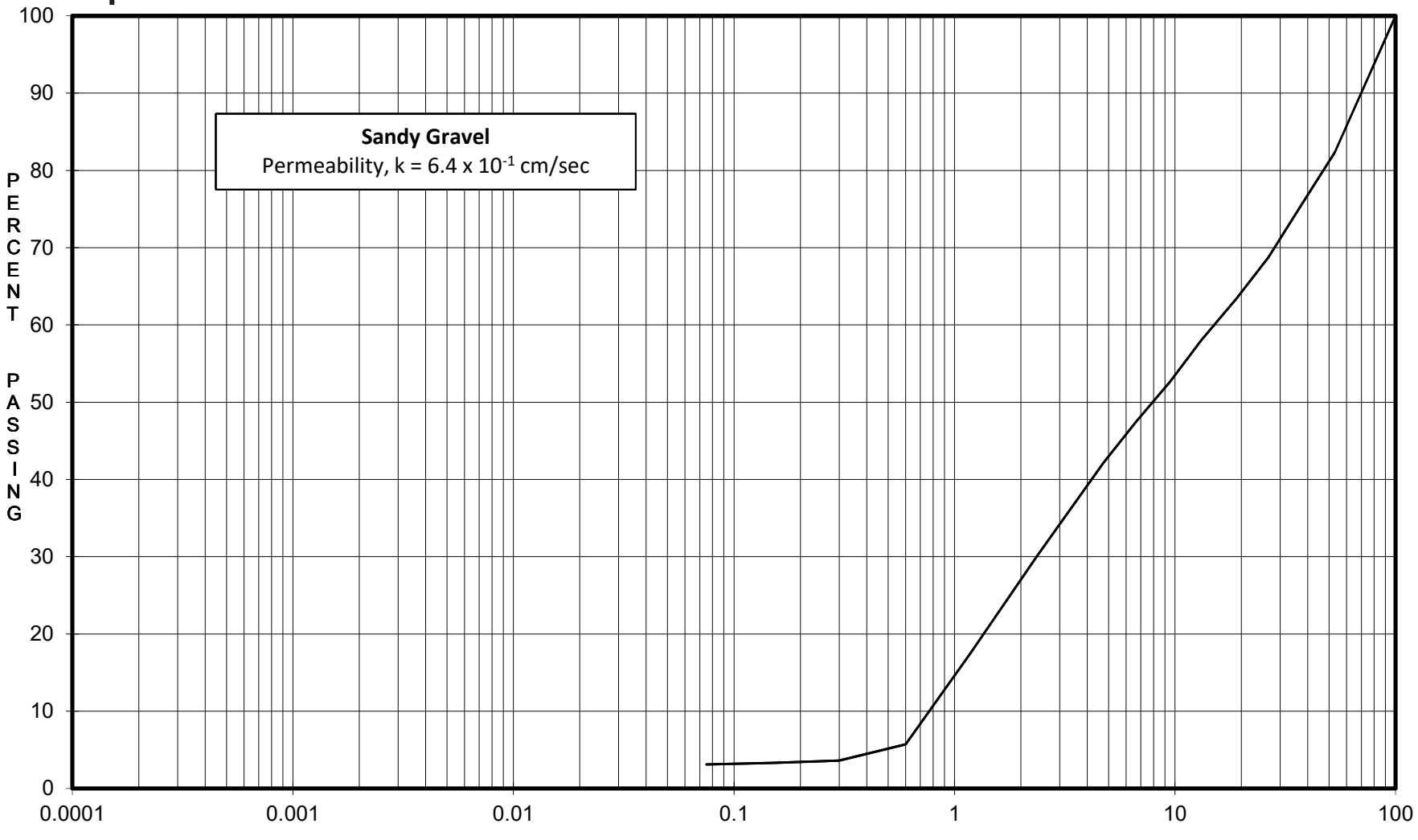
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description: Test Pit 8**						**Olalondo Pit Extraction Project: LON00015778HG**			**Figure 3**

MECHANICAL GRAIN SIZE ANALYSIS



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description: Test Pit 10**			**Olalondo Pit Extraction Project: LON00015778HG**						**Figure 4**

MECHANICAL GRAIN SIZE ANALYSIS



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description: Test Pit 11**			**Olalondo Pit Extraction Project: LON00015778HG**						**Figure 5**

Appendix D – Analytical Results

LON-00015778-HG
Olalondo Pit Underwater Extraction

Water Quality

	UNITS	Table 2	21-Dec-17 BH6 (MW)	21-Dec-17 BH7 (MW)	21-Dec-17 BH9 (MW)
Calculated Parameters					
Anion Sum	me/L		10.3	11.4	7.60
Bicarb. Alkalinity (calc. as CaCO3)	mg/L		420	340	250
Calculated TDS	mg/L		530	620	410
Carb. Alkalinity (calc. as CaCO3)	mg/L		2.8	2.6	2.1
Cation Sum	me/L		9.47	11.7	7.38
Hardness (CaCO3)	mg/L		250	390	280
Ion Balance (% Difference)	%		4.45	1.12	1.46
Langelier Index (@ 20C)	N/A		0.876	0.976	0.768
Langelier Index (@ 4C)	N/A		0.628	0.728	0.519
Saturation pH (@ 20C)	N/A		6.97	6.94	7.18
Saturation pH (@ 4C)	N/A		7.22	7.19	7.43
Inorganics					
Total Ammonia-N	mg/L		0.52	0.32	0.34
Conductivity	umho/cm		920	1200	720
Dissolved Organic Carbon	mg/L		5.3	3.5	2.0
Orthophosphate (P)	mg/L		0.015	<0.010	<0.010
pH	pH		7.84	7.91	7.95
Dissolved Sulphate (SO4)	mg/L		28	20	37
Alkalinity (Total as CaCO3)	mg/L		420	340	260
Dissolved Chloride (Cl)	mg/L	790,000	46	150	59
Total Phosphorus	mg/L				
Nitrite (N)	mg/L		<0.010	0.016	0.018
Nitrate (N)	mg/L		<0.10	<0.10	0.23
Nitrate + Nitrite (N)	mg/L		<0.10	<0.10	0.24
Metals					
Dissolved Aluminum (Al)	ug/L		<5.0	18	98
Dissolved Antimony (Sb)	ug/L	6	<0.50	<0.50	<0.50
Dissolved Arsenic (As)	ug/L	25	1.4	1.5	2.0
Dissolved Barium (Ba)	ug/L	1,000	52	210	96
Dissolved Beryllium (Be)	ug/L	4	<0.50	<0.50	<0.50
Dissolved Bismuth (Bi)	ug/L				
Dissolved Boron (B)	ug/L	5,000	78	160	95
Dissolved Cadmium (Cd)	ug/L	2.7	<0.10	<0.10	<0.10
Dissolved Calcium (Ca)	ug/L		76000	110000	72000
Dissolved Chromium (Cr)	ug/L	50	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	ug/L	3.8	1.2	<0.50	1.0
Dissolved Copper (Cu)	ug/L	87	1.0	<1.0	<1.0
Dissolved Iron (Fe)	ug/L		<100	<100	<100
Dissolved Lead (Pb)	ug/L	10	<0.50	<0.50	<0.50
Dissolved Lithium (Li)	ug/L				
Dissolved Magnesium (Mg)	ug/L		14000	31000	26000
Dissolved Manganese (Mn)	ug/L		710	72	190
Dissolved Molybdenum (Mo)	ug/L	70	19	13	8.5
Dissolved Nickel (Ni)	ug/L	100	3.8	1.6	2.8
Dissolved Phosphorus (P)	ug/L		<100	<100	<100
Dissolved Potassium (K)	ug/L		1800	6600	9200
Dissolved Selenium (Se)	ug/L	10	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	ug/L		4100	7500	6400
Dissolved Silver (Ag)	ug/L	1.5	<0.10	<0.10	<0.10
Dissolved Sodium (Na)	ug/L	490,000	100000	85000	33000
Dissolved Strontium (Sr)	ug/L		330	2100	490
Dissolved Tellurium (Te)	ug/L				
Dissolved Thallium (Tl)	ug/L	2	<0.050	<0.050	<0.050
Dissolved Tin (Sn)	ug/L				
Dissolved Titanium (Ti)	ug/L		<5.0	<5.0	<5.0
Dissolved Tungsten (W)	ug/L				
Dissolved Uranium (U)	ug/L	20	2.5	1.3	1.5
Dissolved Vanadium (V)	ug/L	6.2	<0.50	<0.50	0.51
Dissolved Zinc (Zn)	ug/L	1,100	<5.0	<5.0	12
Dissolved Zirconium (Zr)	ug/L				

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Your Project #: LON00015778
Site Location: OLALONDO PIT
Your C.O.C. #: 479287-05-01

Attention: Michael Venhuis

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2018/01/02
Report #: R4926631
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7T1311
Received: 2017/12/21, 16:15

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	3	N/A	2018/01/02	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	3	N/A	2018/01/02	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	3	N/A	2018/01/02	CAM SOP-00463	EPA 325.2 m
Conductivity	3	N/A	2018/01/02	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	3	N/A	2017/12/28	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	3	N/A	2017/12/29	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	3	N/A	2017/12/29	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	3	N/A	2018/01/02		
Anion and Cation Sum	3	N/A	2018/01/02		
Total Ammonia-N	3	N/A	2017/12/28	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	3	N/A	2017/12/29	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	3	N/A	2018/01/02	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	3	N/A	2018/01/02	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	3	N/A	2018/01/02		
Sat. pH and Langelier Index (@ 4C)	3	N/A	2018/01/02		
Sulphate by Automated Colourimetry	3	N/A	2018/01/02	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	3	N/A	2018/01/02		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise

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Your Project #: LON00015778
Site Location: OLALONDO PIT
Your C.O.C. #: 479287-05-01

Attention: Michael Venhuis

exp Services Inc
London Branch
15701 Robin's Hill Rd
Unit 2
London, ON
CANADA N5V 0A5

Report Date: 2018/01/02
Report #: R4926631
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7T1311
Received: 2017/12/21, 16:15
agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: CGripton@maxxam.ca
Phone# (800)268-7396 Ext:250

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7T1311
Report Date: 2018/01/02

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		FUZ995		FUZ996		FUZ997		
Sampling Date		2017/12/21 15:00		2017/12/21 14:45		2017/12/21 15:20		
COC Number		479287-05-01		479287-05-01		479287-05-01		
	UNITS	MW17-9	RDL	MW17-7	RDL	MW17-6	RDL	QC Batch
Calculated Parameters								
Anion Sum	me/L	7.60	N/A	11.4	N/A	10.3	N/A	5333392
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	250	1.0	340	1.0	420	1.0	5333389
Calculated TDS	mg/L	410	1.0	620	1.0	530	1.0	5333395
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.1	1.0	2.6	1.0	2.8	1.0	5333389
Cation Sum	me/L	7.38	N/A	11.7	N/A	9.47	N/A	5333392
Hardness (CaCO3)	mg/L	280	1.0	390	1.0	250	1.0	5333390
Ion Balance (% Difference)	%	1.46	N/A	1.12	N/A	4.45	N/A	5333391
Langelier Index (@ 20C)	N/A	0.768		0.976		0.876		5333393
Langelier Index (@ 4C)	N/A	0.519		0.728		0.628		5333394
Saturation pH (@ 20C)	N/A	7.18		6.94		6.97		5333393
Saturation pH (@ 4C)	N/A	7.43		7.19		7.22		5333394
Inorganics								
Total Ammonia-N	mg/L	0.34	0.25	0.32	0.050	0.52	0.25	5333790
Conductivity	umho/cm	720	1.0	1200	1.0	920	1.0	5335988
Dissolved Organic Carbon	mg/L	2.0	0.50	3.5	0.50	5.3	0.50	5333328
Orthophosphate (P)	mg/L	<0.010	0.010	<0.010	0.010	0.015	0.010	5336072
pH	pH	7.95		7.91		7.84		5335990
Dissolved Sulphate (SO4)	mg/L	37	1.0	20	1.0	28	1.0	5336071
Alkalinity (Total as CaCO3)	mg/L	260	1.0	340	1.0	420	1.0	5335984
Dissolved Chloride (Cl)	mg/L	59	1.0	150	2.0	46	1.0	5336069
Nitrite (N)	mg/L	0.018	0.010	0.016	0.010	<0.010	0.010	5334321
Nitrate (N)	mg/L	0.23	0.10	<0.10	0.10	<0.10	0.10	5334321
Nitrate + Nitrite (N)	mg/L	0.24	0.10	<0.10	0.10	<0.10	0.10	5334321
Metals								
Dissolved Aluminum (Al)	ug/L	98	5.0	18	5.0	<5.0	5.0	5334609
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	5334609
Dissolved Arsenic (As)	ug/L	2.0	1.0	1.5	1.0	1.4	1.0	5334609
Dissolved Barium (Ba)	ug/L	96	2.0	210	2.0	52	2.0	5334609
Dissolved Beryllium (Be)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	5334609
Dissolved Boron (B)	ug/L	95	10	160	10	78	10	5334609

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam Job #: B7T1311
Report Date: 2018/01/02

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		FUZ995		FUZ996		FUZ997		
Sampling Date		2017/12/21 15:00		2017/12/21 14:45		2017/12/21 15:20		
COC Number		479287-05-01		479287-05-01		479287-05-01		
	UNITS	MW17-9	RDL	MW17-7	RDL	MW17-6	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.10	0.10	<0.10	0.10	<0.10	0.10	5334609
Dissolved Calcium (Ca)	ug/L	72000	200	110000	200	76000	200	5334609
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	<5.0	5.0	5334609
Dissolved Cobalt (Co)	ug/L	1.0	0.50	<0.50	0.50	1.2	0.50	5334609
Dissolved Copper (Cu)	ug/L	<1.0	1.0	<1.0	1.0	1.0	1.0	5334609
Dissolved Iron (Fe)	ug/L	<100	100	<100	100	<100	100	5334609
Dissolved Lead (Pb)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	5334609
Dissolved Magnesium (Mg)	ug/L	26000	50	31000	50	14000	50	5334609
Dissolved Manganese (Mn)	ug/L	190	2.0	72	2.0	710	2.0	5334609
Dissolved Molybdenum (Mo)	ug/L	8.5	0.50	13	0.50	19	0.50	5334609
Dissolved Nickel (Ni)	ug/L	2.8	1.0	1.6	1.0	3.8	1.0	5334609
Dissolved Phosphorus (P)	ug/L	<100	100	<100	100	<100	100	5334609
Dissolved Potassium (K)	ug/L	9200	200	6600	200	1800	200	5334609
Dissolved Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	<2.0	2.0	5334609
Dissolved Silicon (Si)	ug/L	6400	50	7500	50	4100	50	5334609
Dissolved Silver (Ag)	ug/L	<0.10	0.10	<0.10	0.10	<0.10	0.10	5334609
Dissolved Sodium (Na)	ug/L	33000	100	85000	100	100000	100	5334609
Dissolved Strontium (Sr)	ug/L	490	1.0	2100	1.0	330	1.0	5334609
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	<0.050	0.050	5334609
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	<5.0	5.0	<5.0	5.0	5334609
Dissolved Uranium (U)	ug/L	1.5	0.10	1.3	0.10	2.5	0.10	5334609
Dissolved Vanadium (V)	ug/L	0.51	0.50	<0.50	0.50	<0.50	0.50	5334609
Dissolved Zinc (Zn)	ug/L	12	5.0	<5.0	5.0	<5.0	5.0	5334609

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B7T1311
Report Date: 2018/01/02

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

TEST SUMMARY

Maxxam ID: FUZ995
Sample ID: MW17-9
Matrix: Water

Collected: 2017/12/21
Shipped:
Received: 2017/12/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5335984	N/A	2018/01/02	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5333389	N/A	2018/01/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	5336069	N/A	2018/01/02	Deonarine Ramnarine
Conductivity	AT	5335988	N/A	2018/01/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5333328	N/A	2017/12/28	Nimarta Singh
Hardness (calculated as CaCO3)		5333390	N/A	2017/12/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5334609	N/A	2017/12/29	Matthew Ritenburg
Ion Balance (% Difference)	CALC	5333391	N/A	2018/01/02	Automated Statchk
Anion and Cation Sum	CALC	5333392	N/A	2018/01/02	Automated Statchk
Total Ammonia-N	LACH/NH4	5333790	N/A	2017/12/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5334321	N/A	2017/12/29	Amanpreet Sappal
pH	AT	5335990	N/A	2018/01/02	Surinder Rai
Orthophosphate	KONE	5336072	N/A	2018/01/02	Deonarine Ramnarine
Sat. pH and Langelier Index (@ 20C)	CALC	5333393	N/A	2018/01/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5333394	N/A	2018/01/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5336071	N/A	2018/01/02	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	5333395	N/A	2018/01/02	Automated Statchk

Maxxam ID: FUZ996
Sample ID: MW17-7
Matrix: Water

Collected: 2017/12/21
Shipped:
Received: 2017/12/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5335984	N/A	2018/01/02	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5333389	N/A	2018/01/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	5336069	N/A	2018/01/02	Deonarine Ramnarine
Conductivity	AT	5335988	N/A	2018/01/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5333328	N/A	2017/12/28	Nimarta Singh
Hardness (calculated as CaCO3)		5333390	N/A	2017/12/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5334609	N/A	2017/12/29	Matthew Ritenburg
Ion Balance (% Difference)	CALC	5333391	N/A	2018/01/02	Automated Statchk
Anion and Cation Sum	CALC	5333392	N/A	2018/01/02	Automated Statchk
Total Ammonia-N	LACH/NH4	5333790	N/A	2017/12/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5334321	N/A	2017/12/29	Amanpreet Sappal
pH	AT	5335990	N/A	2018/01/02	Surinder Rai
Orthophosphate	KONE	5336072	N/A	2018/01/02	Deonarine Ramnarine
Sat. pH and Langelier Index (@ 20C)	CALC	5333393	N/A	2018/01/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5333394	N/A	2018/01/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5336071	N/A	2018/01/02	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	5333395	N/A	2018/01/02	Automated Statchk

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Maxxam Job #: B7T1311
Report Date: 2018/01/02

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

TEST SUMMARY

Maxxam ID: FUZ997
Sample ID: MW17-6
Matrix: Water

Collected: 2017/12/21
Shipped:
Received: 2017/12/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5335984	N/A	2018/01/02	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5333389	N/A	2018/01/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	5336069	N/A	2018/01/02	Deonarine Ramnarine
Conductivity	AT	5335988	N/A	2018/01/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5333328	N/A	2017/12/28	Nimarta Singh
Hardness (calculated as CaCO3)		5333390	N/A	2017/12/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5334609	N/A	2017/12/29	Matthew Ritenburg
Ion Balance (% Difference)	CALC	5333391	N/A	2018/01/02	Automated Statchk
Anion and Cation Sum	CALC	5333392	N/A	2018/01/02	Automated Statchk
Total Ammonia-N	LACH/NH4	5333790	N/A	2017/12/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5334321	N/A	2017/12/29	Amanpreet Sappal
pH	AT	5335990	N/A	2018/01/02	Surinder Rai
Orthophosphate	KONE	5336072	N/A	2018/01/02	Deonarine Ramnarine
Sat. pH and Langelier Index (@ 20C)	CALC	5333393	N/A	2018/01/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5333394	N/A	2018/01/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5336071	N/A	2018/01/02	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	5333395	N/A	2018/01/02	Automated Statchk

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Maxxam Job #: B7T1311
Report Date: 2018/01/02

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C

Results relate only to the items tested.

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Maxxam Job #: B7T1311
Report Date: 2018/01/02

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5333328	Dissolved Organic Carbon	2017/12/28	99	80 - 120	103	80 - 120	<0.50	mg/L	1.5	20
5333790	Total Ammonia-N	2017/12/28	96	75 - 125	98	80 - 120	<0.050	mg/L	8.7	20
5334321	Nitrate (N)	2017/12/29	91	80 - 120	99	80 - 120	<0.10	mg/L	0.22	20
5334321	Nitrite (N)	2017/12/29	96	80 - 120	102	80 - 120	<0.010	mg/L	NC	20
5334609	Dissolved Aluminum (Al)	2017/12/29	100	80 - 120	100	80 - 120	<5.0	ug/L		
5334609	Dissolved Antimony (Sb)	2017/12/29	99	80 - 120	97	80 - 120	<0.50	ug/L	3.9	20
5334609	Dissolved Arsenic (As)	2017/12/29	98	80 - 120	98	80 - 120	<1.0	ug/L	2.3	20
5334609	Dissolved Barium (Ba)	2017/12/29	94	80 - 120	96	80 - 120	<2.0	ug/L	0.76	20
5334609	Dissolved Beryllium (Be)	2017/12/29	107	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
5334609	Dissolved Boron (B)	2017/12/29	102	80 - 120	105	80 - 120	<10	ug/L	0.20	20
5334609	Dissolved Cadmium (Cd)	2017/12/29	98	80 - 120	97	80 - 120	<0.10	ug/L	NC	20
5334609	Dissolved Calcium (Ca)	2017/12/29	97	80 - 120	100	80 - 120	<200	ug/L		
5334609	Dissolved Chromium (Cr)	2017/12/29	99	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
5334609	Dissolved Cobalt (Co)	2017/12/29	94	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
5334609	Dissolved Copper (Cu)	2017/12/29	98	80 - 120	100	80 - 120	<1.0	ug/L	0	20
5334609	Dissolved Iron (Fe)	2017/12/29	97	80 - 120	98	80 - 120	<100	ug/L		
5334609	Dissolved Lead (Pb)	2017/12/29	92	80 - 120	93	80 - 120	<0.50	ug/L	NC	20
5334609	Dissolved Magnesium (Mg)	2017/12/29	91	80 - 120	100	80 - 120	<50	ug/L		
5334609	Dissolved Manganese (Mn)	2017/12/29	96	80 - 120	94	80 - 120	<2.0	ug/L		
5334609	Dissolved Molybdenum (Mo)	2017/12/29	101	80 - 120	99	80 - 120	<0.50	ug/L	1.9	20
5334609	Dissolved Nickel (Ni)	2017/12/29	90	80 - 120	94	80 - 120	<1.0	ug/L	NC	20
5334609	Dissolved Phosphorus (P)	2017/12/29	116	80 - 120	111	80 - 120	<100	ug/L		
5334609	Dissolved Potassium (K)	2017/12/29	92	80 - 120	102	80 - 120	<200	ug/L		
5334609	Dissolved Selenium (Se)	2017/12/29	99	80 - 120	98	80 - 120	<2.0	ug/L	NC	20
5334609	Dissolved Silicon (Si)	2017/12/29	103	80 - 120	101	80 - 120	<50	ug/L		
5334609	Dissolved Silver (Ag)	2017/12/29	86	80 - 120	94	80 - 120	<0.10	ug/L	NC	20
5334609	Dissolved Sodium (Na)	2017/12/29	89	80 - 120	99	80 - 120	<100	ug/L	2.9	20
5334609	Dissolved Strontium (Sr)	2017/12/29	94	80 - 120	94	80 - 120	<1.0	ug/L		
5334609	Dissolved Thallium (Tl)	2017/12/29	90	80 - 120	92	80 - 120	<0.050	ug/L	4.5	20
5334609	Dissolved Titanium (Ti)	2017/12/29	100	80 - 120	101	80 - 120	<5.0	ug/L		
5334609	Dissolved Uranium (U)	2017/12/29	95	80 - 120	97	80 - 120	<0.10	ug/L	0.34	20

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7T1311
Report Date: 2018/01/02

QUALITY ASSURANCE REPORT(CONT'D)

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5334609	Dissolved Vanadium (V)	2017/12/29	97	80 - 120	96	80 - 120	<0.50	ug/L	2.5	20
5334609	Dissolved Zinc (Zn)	2017/12/29	94	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5335984	Alkalinity (Total as CaCO3)	2018/01/02			96	85 - 115	<1.0	mg/L	0.060	20
5335988	Conductivity	2018/01/02			101	85 - 115	<1.0	umho/cm	0.44	25
5335990	pH	2018/01/02			101	98 - 103			0.0050	N/A
5336069	Dissolved Chloride (Cl)	2018/01/02	91	80 - 120	103	80 - 120	<1.0	mg/L	1.0	20
5336071	Dissolved Sulphate (SO4)	2018/01/02	99	75 - 125	100	80 - 120	<1.0	mg/L	0.77	20
5336072	Orthophosphate (P)	2018/01/02	92	75 - 125	103	80 - 120	<0.010	mg/L	NC	25

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

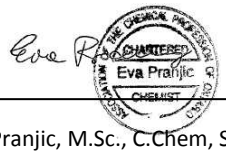
Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7T1311
Report Date: 2018/01/02

exp Services Inc
Client Project #: LON00015778
Site Location: OLALONDO PIT
Sampler Initials: MB

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

B7 T1311

Affix Job Label Here

Presence of Visible Particulate/Sediment

Maxxam Analytics
CAM FCD-01013/5

When there is >1cm of visible particulate/sediment, the amount will be recorded in the field below

Bottle Types

	Sample ID	All	Inorganics: Nutrients CrVI	Inorganics: CN	Inorganics: General	Inorganics: ~~BOD~~ ~~Hg~~	Inorganics: DOC Metals (Diss.)	Organics: Organic 1 of 2	Organics: Organic 2 of 2	Organics: PCB 1 of 2	Organics: PCB 2 of 2	Organics: Pest/Herb 1 of 2	Organics: Pest/Herb 2 of 2	Organics: SVOC/ABN 1 of 2	Organics: SVOC/ABN 2 of 2	Organics: PAH 1 of 2	Organics: PAH 2 of 2	Organics: Dioxin/Furan	Hydrocarbons: F1 Vial 1	Hydrocarbons: F1 Vial 2	Hydrocarbons: F1 Vial 3	Hydrocarbons: F1 Vial 4	Hydrocarbons: F2-F4 1 of 2	Hydrocarbons: F2-F4 2 of 2	Hydrocarbons: F4G	Volatiles: VOC Vial 1	Volatiles: VOC Vial 2	Volatiles: VOC Vial 3	Volatiles: VOC Vial 4	Other
1	MW17-9		4.1		5.9		3.5																						
2	MW17-7		S		S		S																						
3	MW17-6		3.2		3.9	2.8																							
4																													
5																													
6																													
7																													
8																													
9																													
10																													

Comments: Except Metals and Dissolved Metals bottles.

Legend:	
P	Suspended Particulate
TS	Trace Settled Sediment (just covers bottom of container or less)
S	Sediment greater than (>) Trace, but less than (<) 1 cm

Recorded By: (signature/print) SIMRAT KAUR

Maxxam

Maxxam Analytics International Corporation o/a Maxxam Analytics
109 & 110 – 4023 Meadowbrook Drive, London, Ontario Canada N6L 1E7 Tel:(519) 652-9444 Toll-Free:800-563-6266 Fax:(519) 652-8189 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page of

INVOICE INFORMATION:		REPORT INFORMATION(if differs from invoice):		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#28124 exp Services Inc	Company Name:	EXP	Quotation #:	B31817	Maxxam Job #:	Bottle Order #:
Contact Name:	Michael Veenhuis	Contact Name:	Michael Veenhuis	P.O. #:			479287
Address:	15701 Robin's Hill Rd Unit 2	Address:	15701 Robin's Hill Rd	Project #:	LON-00015778	Chain of Custody #:	Project Manager:
	London ON N5V 0A5			Project Name:	Olalondo Pit	C#479287-05-01	Hina Siddiqui
Phone:	(519) 963-3000 Fax: (519) 963-1152	Phone:	519 963-3000 Fax:	Site #:			
Email:		Email:	Michael.veenhuis@exp.com	Sampled By:	M. Beckers		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
☐ Table 1 ☐ Res/Park ☐ Medium/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ For RSC
☐ Table ___

Other Regulations
☐ CCME ☐ Sanitary Sewer Bylaw
☐ Reg 558 ☐ Storm Sewer Bylaw
☐ MISA Municipality ___
☐ PWQO
☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): (Metals / Hg / Cr VI)	RCAP anions/cations	Hardness	Cond & Bicarb Alk	O.Reg 153 VOCs Nitrate, Nitrite, grain size	Chloride	TDS	# of Bottles	Comments
1		MW17-9	Dec 21/17	3:00 PM	GW	X	✓	✓	✓	✓	✓	✓	4	
2		MW17-7	"	2:45 PM	GW	X	✓	✓	✓	✓	✓	✓	4	
3		MW17-6	"	3:20 PM	GW	X	✓	✓	✓	✓	✓	✓	4	
4														
5														
6														
7														
8														
9														REC'D IN LONDON
10														

21-Dec-17 16:15
Hina Siddiqui
B7T1311
SK8 ENV-1083

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
	17/12/21			17/12/21	16:15	
			FRANCINE CHONG	2017/12/22	18:00	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
	7, 7, 7°C	Present		
		Intact		

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

1/1/1 #408064

Appendix E – MECP Well Records

TABLE E1 - Summary of MECP Well Records

Well ID	Date Drilled (dd/mm/yy)	Depth (m)	Bottom Lithology	Static Water Level (m)	Water Use	Water Status
4100678	10-Aug-66	23.16	Sand	11.28	Water Supply	Domestic
4102075	18-Oct-56	12.80	Rock		Test Hole	
4102076	18-Oct-56	12.80	Rock		Test Hole	
4102077	23-Oct-56	9.45	Rock		Test Hole	
4102078	23-Oct-56	9.45	Rock		Test Hole	
4102079	28-Sep-56	10.67	Shale		Test Hole	
4102160	20-Jun-67	21.49	Sand	9.75	Water Supply	Domestic
4104006	18-Jul-62	17.98	Sand and Gravel	8.53	Test Hole	
4104593	21-Dec-68	24.69	Limestone	7.62	Water Supply	Domestic
4104808	2-Oct-69	31.09	Limestone	13.72	Water Supply	Domestic
4108914	23-Aug-79	32.61	Limestone	15.24	Abandoned	
4109218	8-May-80	42.06	Limestone	13.41	Water Supply	Domestic
4113432	5-Jul-95	32.31	Sand and Gravel	7.01	Water Supply	Domestic
4116393	18-Oct-05	7.60	Silt	6.10	Observation Well	Monitoring
4116451	5-Aug-05	35.97	Limestone	7.32	Water Supply	Domestic
7045195	23-Apr-07	3.70	Silt		Observation Well	Monitoring
7119486	6-Feb-09	6.10			Abandoned	
7175425	20-Nov-11	27.12			Abandoned	
7200102	7-May-12	17.68			Abandoned	
7234754	8-Dec-14	7.32			Abandoned	
7278379	7-Dec-16	29.87			Abandoned	
7285773	3-Apr-17	29.26	Gravel	13.72	Water Supply	Domestic
7285865	18-Apr-17	9.75			Abandoned	
7288095	12-May-17	29.26			Abandoned	

40P36

F

UTM 17 Z 485100 E
5 R 4769860 N

41 № 678

5

Elev. 4 R 0930

The Ontario Water Resources Commission Act

WATER WELL RECORD

Basin 23

County or District MIDDLESEX Township, Village, Town or City WEST NISSOURI

Con. 1 Lot 14 Date completed 10 (day) AUG (month) 1966 (year)

[redacted] ress RR 1 ARVA ONT

Casing and Screen Record

Inside diameter of casing 5"

Total length of casing 70

Type of screen Stainless steel Johnson well screen

Length of screen 3 ft.

Depth to top of screen 70 ft.

Diameter of finished hole 5"

Pumping Test

Static level 37 ft.

Test-pumping rate 15 G.P.M.

Pumping level 38 ft.

Duration of test pumping 13 h.

Water clear or cloudy at end of test clear

Recommended pumping rate 8 G.P.M.

with pump setting of 60 ft. feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
clay and stones	0	30		
clay hardpan	30	68		
fine sand	68	71		
coarse sand	71	75	70 to 76	fresh
fine sand	75	76		

For what purpose(s) is the water to be used? domestic and stock

Is well on upland, in valley, or on hillside? upland

Drilling or Boring Firm Mervin Jones

Address R.R 3 Thorndale ont.

Licence Number 2008

Name of Driller or Borer Lawrence Barber

Address Thamesford Ont.

Date Aug 10. 1966

Mervin Jones

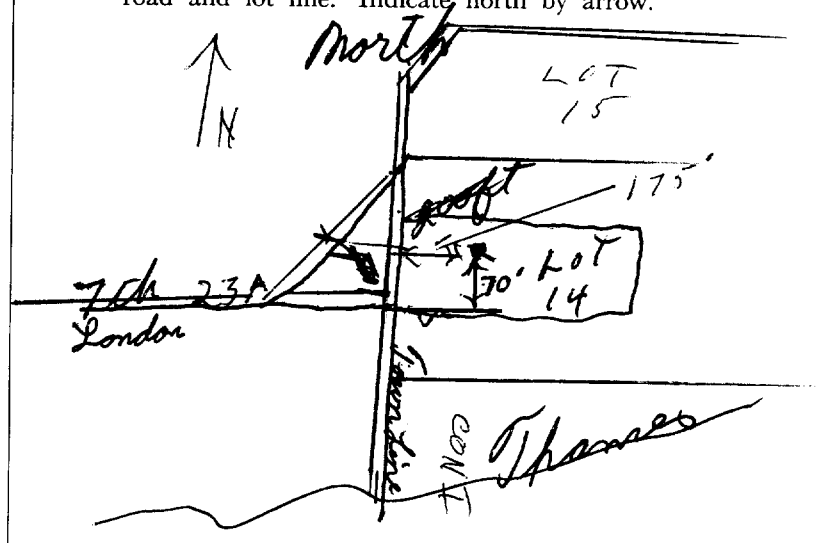
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS 58

UTM 17 Z 485020 E
9 R 4768410 N
Elev. 9 R 0865
Basin 23 VI
Con 6 Lot-12

Copy

ONTARIO

The Water-well Drillers Act, 1954
Department of Mines

Orig [redacted]
Sent back for Corr
Copy rec'd No 4 1958

Water-Well Record

County or Territorial District Middlesex Township, ~~Village, Town or City~~ London
Con 6 Lot 1 Street and Number (if in Village, Town or City)
Owner Public Utilities Commission Address London, Ontario
Date completed 18 October 1956
(day) (month) (year)

Pipe and Casing Record

Casing diameter(s) 10" casing pulled
Length(s)
Type of screen
Length of screen

Pumping Test

Static level test
Pumping rate No
Pumping level pump
Duration of test

Well Log

Overburden and Bedrock Record	From ft.	To ft.
Black loam	0	1
Red clay, gravel	1	9
Blue clay, gravel	9	15
Gravel, blue clay	15	30
Dirty coarse gravel	30	33
Clean gravel, sand	33	37
Dirty gravel, sand	37	41
Rock	41	42

Water Record

Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, or sulphur)

For what purpose(s) is the water to be used? T.H.
Is water clear or cloudy?
Is well on upland, in valley, or on hillside?

Drilling firm International Water Supply Ltd.
Address 12 Maitland Street
London, Ontario
Name of Driller I. Larouche
Address unknown

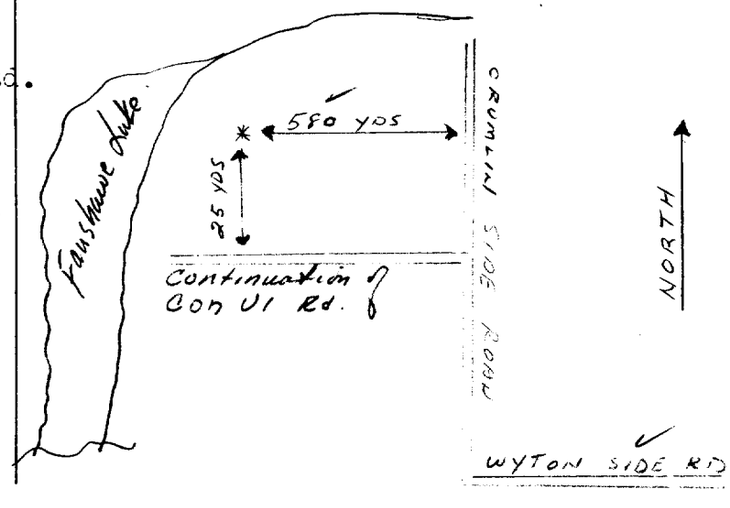
Licence Number unknown

I certify that the foregoing statements of fact are true.

Date 6/20/58 I. Larouche
Signature of Licensee

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 5

CSS.58

UTM 17 485020 E
9 R 4968410 N
Elev. 17 R 08465
Basin 2 2

COV VII
LOT 1

ONTARIO

The Well Drillers Act
Department of Mines, Province of Ontario

No. 2076

Water Well Record

County or Territorial District Middlesex ..... Township, Village, Town or City London Township .....
Con. 6 ... Lot 1 ..... Street and Number (if in Village, Town or City) .....
Owner Thames Valley Conservation Authority ..... Address P.O. London .....
Date Completed 17 (day) Oct (month) 1956 (year) ..... Cost of Well (excluding pump) .....

Pipe and Casing Record

Casing pulled

Casing diameter(s) ..... 10" .....
Length(s) of casing(s) .....
Type of screen .....
Length of screen .....
Distance from top of screen to ground level .....
Is well a gravel-wall type? .....

Pumping Test

Date .....
Static level .....
Pumping level .....
Pumping rate .....
Duration of test .....
Distance from cylinder or bowls to ground level .....

Water Record

Kind (fresh or mineral) .....
Quality (hard, soft, contains iron, sulphur, etc.) .....
Appearance (clear, cloudy, coloured) .....
For what purpose(s) is the water to be used? .....
.....
How far is well from possible source of contamination? .....
What is the source of contamination? .....
Enclose a copy of any mineral analysis that has been made of water .....

Depth(s) to Water Horizon(s)	Kind of Water	No. of Feet Water Rises

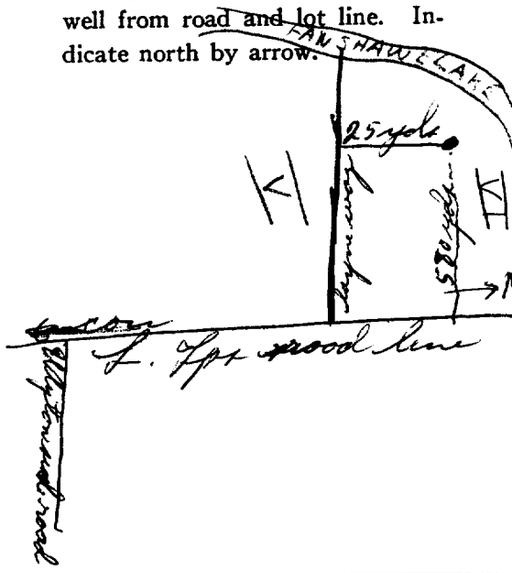
Well Log

Overburden and Bedrock Record	From	To
	0 ft.	...ft.
black loam		
red clay gravel	1	9
blue clay gravel	9	15
gravel blue clay	15	30
dirty coarse gravel	30	33
clean gravel sand	33	37
dirty gravel sand	37	41
rock	41	42

Location of Well

TH 579

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Situation: Is well on upland, in valley, or on hillside? Valley
Drilling Firm. International Water Supply Ltd
Address 12 Maitland St. London Ont.
Name of Driller Irenee Jaroucha ..... Address 788 Hamilton Rd.
Date 20 Oct 1956 ..... Licence Number 982

Irenee Jaroucha
Signature of Licensee

FORM 5

CSS.58

582

UTM 17 Z 485020 E
19 R 4768410 N
Elev. 19 R 0865
Basin [redacted]
Lot - 12

Copy
ONTARIO

Orig [redacted]7.
Sent Back for Corr.
Copy Rec'd Jun. 20/58
Acc'd No. 10778

The Water-well Drillers Act, 1954
Department of Mines

Water-Well Record

County or Territorial District Middlesex Township, ~~Village, Town or City~~ London
Con. VI Lot 1 Street and Number (if in Village, Town or City)
Owner Public Utilities Commission Address London, Ontario
Date completed 23 (day) October (month) 1956 (year)

Pipe and Casing Record

Casing diameter(s) 10" casing pulled
Length(s)
Type of screen
Length of screen

Pumping Test

Static level
Pumping rate No test
Pumping level
Duration of test

Well Log

Overburden and Bedrock Record	From ft.	To ft.
Black loam	0	1
Red clay, boulders	1	5
gravel	5	15
Red clay, gravel	15	24
Blue clay, gravel	24	29
Gravel, sand	29	30
Dirty gravel	30	31
Rock		

Water Record

Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, or sulphur)

For what purpose(s) is the water to be used? T.H.
Is water clear or cloudy?
Is well on upland, in valley, or on hillside?

Drilling firm International Water Supply Ltd.
Address 12 Maitland Street
London, Ontario
Name of Driller I. Larouche
Address unknown

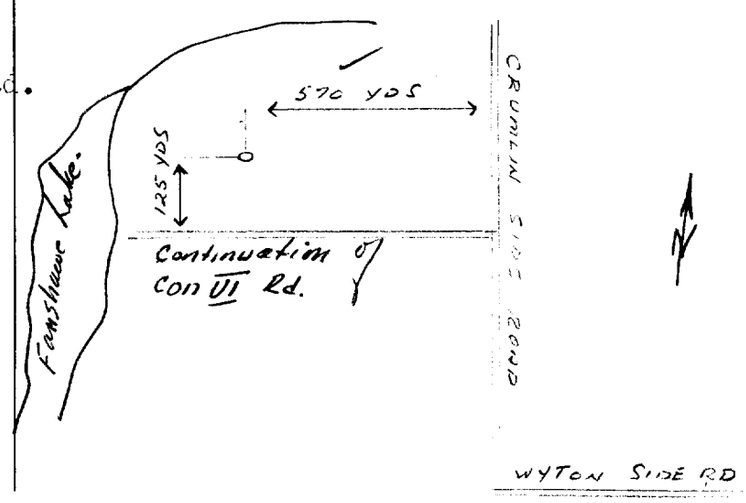
Licence Number unknown

I certify that the foregoing statements of fact are true.

Date 6/20/58 I. Larouche
Signature of Licensee

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 5

CSS.58

UTM 17 Z 485020 E
9 R 4768410 N
Elev. 9 R 0865
Basin 2

CON 2 VI
LOT 1

ONTARIO

The Well Drillers Act
Department of Mines, Province of Ontario

RECEIVED
MAR 20 1957
GEOLOGICAL BRANCH
DEPARTMENT of MINES

No. 2078

Water Well Record

County or Territorial District: Middlesex ... Township, Village, Town or City: London Township
Con. 6 ... Lot 1 ... Street and Number (if in Village, Town or City)
Owner: Thames Valley Conservation Authority ... Address: P.O. London
Date Completed: 23 (day) Oct (month) 1956 (year) ... Cost of Well (excluding pump)

Pipe and Casing Record

Casing gutted

Casing diameter(s): 10"
Length(s) of casing(s):
Type of screen:
Length of screen:
Distance from top of screen to ground level:
Is well a gravel-wall type?

Pumping Test

Date:
Static level:
Pumping level:
Pumping rate:
Duration of test:
Distance from cylinder or bowls to ground level:

Water Record

Kind (fresh or mineral):
Quality (hard, soft, contains iron, sulphur, etc.):
Appearance (clear, cloudy, coloured):
For what purpose(s) is the water to be used?:
How far is well from possible source of contamination?:
What is the source of contamination?:
Enclose a copy of any mineral analysis that has been made of water:

Depth(s) to Water Horizon(s)	Kind of Water	No. of Feet Water Rises

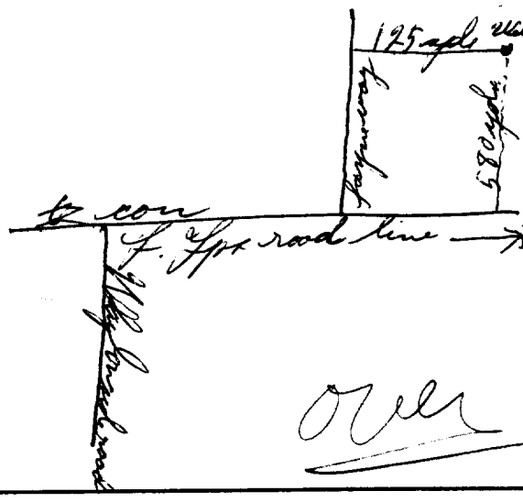
Well Log

Overburden and Bedrock Record	From	To
	0 ft.	...ft.
black loam		
red clay boulder gravel	1	5
red clay gravel	5	15
blue clay gravel	15	24
gravel sand	24	29
dirty gravel	29	30
rock	30	31

Location of Well

TH 582

In diagram below show distances of well from road and lot line. Indicate north by arrow.



over

Situation: Is well on upland, in valley, or on hillside? Valley
Drilling Firm: International Water Supply Ltd
Address: 12 Maitland St. London Ont
Name of Driller: Irene Farouche ... Address: 988 Hamilton rd
Date: 25 Oct 1956 ... Licence Number: 977
Irene Farouche
Signature of Licensee

FORM 5

CSS.88

UTM 17 Z 484900 E
9 R 4768400 N
Elev. 9 R 0865
Basin 2

ONTARIO

41 No 2079

The Well Drillers Act
Department of Mines, Province of Ontario

Water Well Record

County or District Middlesex Tp. [redacted] Con. 6 Lot .... Pt. Lot ....
Acres ....
(...cluding pump) ....

Pipe and Casing Record

Casing diameter(s) 10"
Length(s) of casing(s) ....
Length of screen ....
Type of screen ....
Type of pump ....
Capacity of pump ....
Depth of pump setting ....

Pumping Test

Date ....
Developed Capacity ....
Duration of Test ....
Pumping Rate ....
Drawdown ....
Static level of completed well ....
Is well a gravel-wall type? ....

Water Record

Kind (fresh or mineral) ....
Quality (hard, soft, contains iron, sulphur etc.) ....
Appearance (clear, cloudy, coloured) ....
For what purpose(s) is the water to be used? ....
How far is well from possible source of contamination? ....
What is source of contamination? ....
Enclose a copy of any mineral analysis that has been made of water ....

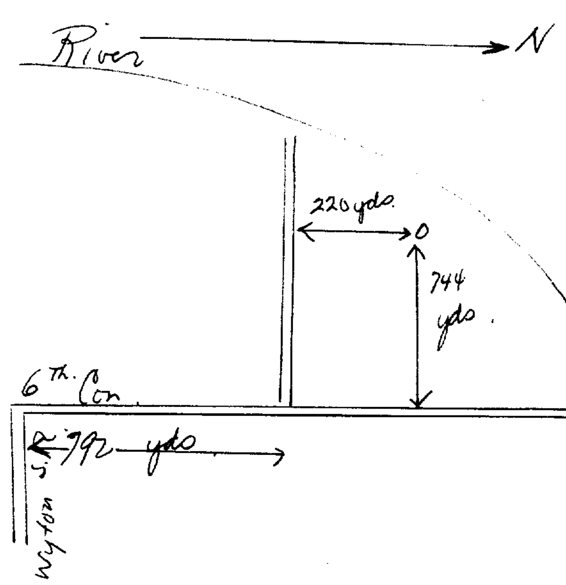
Depth(s) to Water Horizon(s)	Kind of Water	No. of Feet Water Rises

Well Log

Drift and Bedrock Record	From	To
gravel, brown clay	0 ft.	4 ft.
coarse sand fine gravel	4	5
brown clay, gravel	5	12
boulder, brown clay, gravel	12	16
gravel, clay	16	30
blue clay, gravel	30	34
shale	34	3

Location of Well

In diagram below show distances of well from road and lot line



Situation: Is well on upland, in valley, or on hillside? ....
Drilling Firm International
Address ....
Recorded by L. Larouche .... Address ....
Date .... Licence Number ....

CSS.S8

UTM 17 Z 481920 E
5 R 4769830 N

Elev. 4 R 0930

Basin 230

WATER WELL RECORD

The Ontario Water Resources Commission Act

WATER RESOURCES DIVISION
41 JUN 30 1967 2160
ONTARIO WATER RESOURCES COMMISSION

County or District MIDDLESEX Township, Village, Town or City LONDON

Con. 7 Lot 1 Date completed 20 (day) JUNE (month) 1967 (year)

[redacted] ess R.R. Arva Ont.

Casing and Screen Record

Inside diameter of casing 5"

Total length of casing 70 ft.

Type of screen none

Length of screen

Depth to top of screen

Diameter of finished hole 5"

Pumping Test

Static level 32 ft.

Test-pumping rate 8 G.P.M.

Pumping level 43 ft.

Duration of test pumping 2 hrs.

Water clear or cloudy at end of test clear

Recommended pumping rate 6 G.P.M.

with pump setting of 50 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
sandy clay and stones	0	44		
clay hardpan	44	65		
cemented sand	65	69-6	69 to 70-6	fresh.
coarse sand	69-6	70-6		

For what purpose(s) is the water to be used? domestic and stock

Is well on upland, in valley, or on hillside? upland

Drilling or Boring Firm Mervin Jones

Address RR 3 Thorndale. Ont.

Licence Number 2441

Name of Driller or Borer Lawrence Barber

Address Thamesford ont

Date June 28, 1967

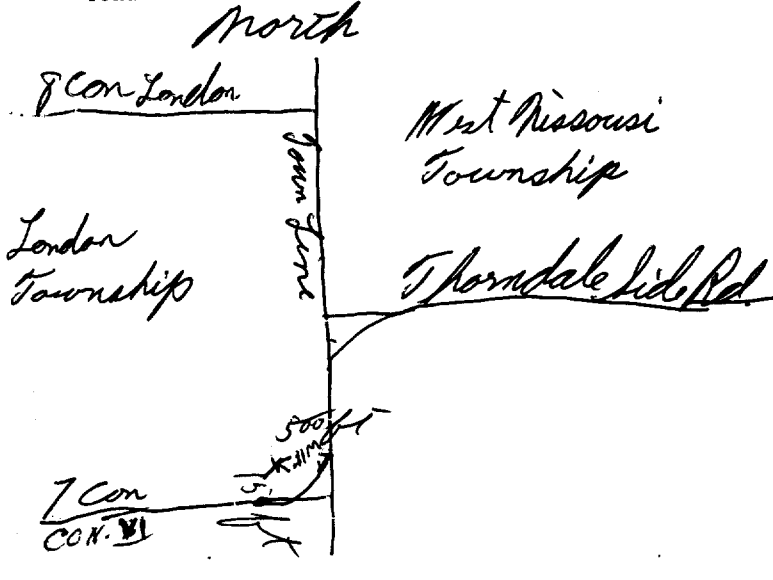
Mervin Jones
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.S8

UTM | 17 | Z | 418511615 | E
| 15 | R | 4716191851 0 | N
Elev. | 4 | R | 0 | 9 | 3 | 10 |
Basin | | | | |

The Ontario Water Resources Commission Act

WATER WELL RECORD

41 NW 4006

County or District MIDDLESEX Township, Village, Town or City EAST NISSOURI

Con. 1 Lot 14 S½ Date completed 15 (day) July (month) 1962 (year)

[redacted] dress RR 1 Arva

Casing and Screen Record

Inside diameter of casing 5"
Total length of casing 57 ft.
Type of screen —
Length of screen —
Depth to top of screen —
Diameter of finished hole 5"

Pumping Test

Static level 25 ft
Test-pumping rate 15 G.P.M.
Pumping level 40
Duration of test pumping 3 hrs.
Water clear or cloudy at end of test clear
Recommended pumping rate 15 G.P.M.
with pump setting of 42 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Sandy clay	0	7		fresh
Gravel	7	21		
Sandy clay	21	56		
Sand & Gravel	56	59	57	

For what purpose(s) is the water to be used? Farm

Is well on upland, in valley, or on hillside? Upland

Drilling or Boring Firm Steinmayer & Baird

Address Bright

Licence Number 665

Name of Driller or Borer Hank Steinmayer

Address Bright

Date July 15/62

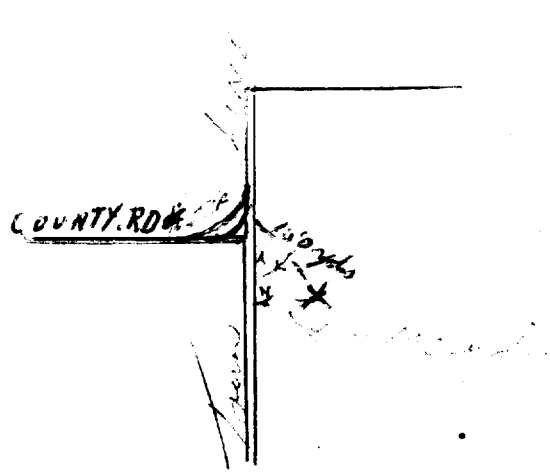
Hank Steinmayer
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M Sets 60-5930

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.58

JTM 17 484 5010 Con VI Lot 2 CODED

CK 17 476 974 710

5 093 0

213

4194593

DIVISION OF WATER RESOURCES
JAN 7 1969
ONTARIO WATER RESOURCES COMMISSION

The Ontario Water Resources Commission Act

WATER WELL RECORD

County or District Middlesex Township, Village, Town or City London

Con. ~~7~~ VI Lot 2 Date completed 21 (day) December (month) 196 8 (year)

[redacted] Address RR#1 Arva

Casing and Screen Record

Inside diameter of casing 3 5/8 in.

Total length of casing ~~81~~ ft. 26'

Type of screen none

Length of screen none

Depth to top of screen none

Diameter of finished hole 3 5/8

Pumping Test

Static level 25 ft.

Test-pumping rate 8 G.P.M.

Pumping level 35 ft.

Duration of test pumping 1 hr.

Water clear or cloudy at end of test clear

Recommended pumping rate 8 G.P.M.

with pump setting of 50 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
previously drilled	0	55		
fine sand	55	80		
lime rock	80	81	81	fresh

For what purpose(s) is the water to be used? domestic and stock

Is well on upland, in valley, or on hillside? upland

Drilling or Boring Firm Mervin Jones

Address RR#3 Thorndale Ont.

Licence Number 2789

Name of Driller or Borer Mervin Jones

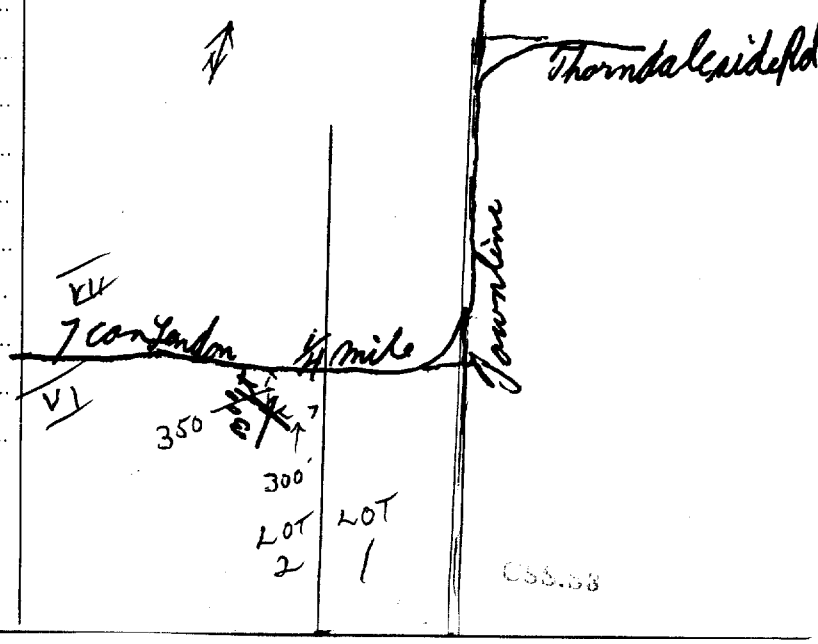
Address RR#3 Thorndale, Ont.

Date December 21, 1968

Mervin Jones
(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 7
OWRC COPY

The Ontario Water Resources Commission Act

WATER WELL RECORD

Water management in Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 4104808 | MUNICIP. 41008 | CON. CON | .06

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Middlesex	London	VI	001

[redacted] 21 Arva — DATE COMPLETED DAY 02 MO. 10 YR. 69

UTM ZONE 769610 | RC. 4 | ELEVATION 0930 | RC. 5 | BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH – FEET FROM	DEPTH – FEET TO
black	fill			0	3
brown	clay	stones	hard	3	26
grey	sand	clay and stones	layered	26	60
grey	gravel	fine sand	cemented	60	91
grey	limestone		hard	91	102

31 0003801 | 0026051/2 | 0006209 05/2 | 0091/2 1/08 | 0102 1/05

32

41 WATER RECORD

WATER FOUND AT – FEET	KIND OF WATER
0094 ~~94 102~~	1 ☒ FRESH 3 ☐ SULPHUR; 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR; 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR; 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR; 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR; 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH – FEET FROM	DEPTH – FEET TO
05	1 ☒ STEEL; 2 ☐ GALVANIZED; 3 ☐ CONCRETE; 4 ☐ OPEN HOLE	.244	0	0091 ~~91~~
	1 ☐ STEEL; 2 ☐ GALVANIZED; 3 ☐ CONCRETE; 4 ☒ OPEN HOLE		91	0102
	1 ☐ STEEL; 2 ☐ GALVANIZED; 3 ☐ CONCRETE; 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT – FEET FROM	DEPTH SET AT – FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: ☒ 1 PUMP ☐ 2 BAILER

PUMPING RATE: 0010 GPM. | DURATION OF PUMPING: 04 HOURS 00 MINS.

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: ☒ 1 PUMPING ☐ 2 RECOVERY	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
045 FEET	055 FEET		055 FEET	055 FEET	055 FEET	055 FEET

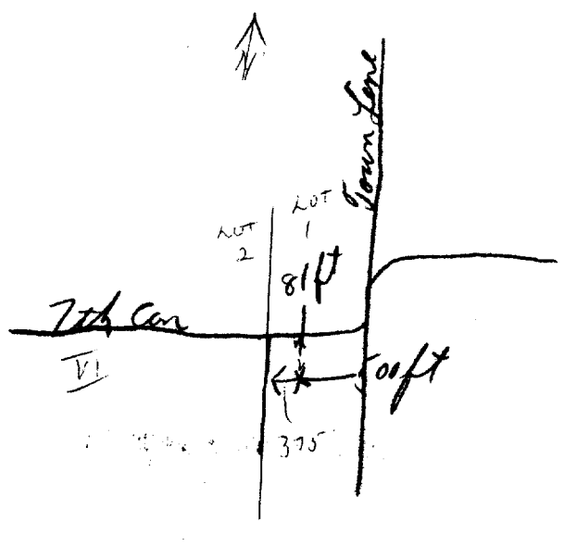
IF FLOWING, GIVE RATE: GPM. | PUMP INTAKE SET AT: 60 FEET | WATER AT END OF TEST: ☒ 1 CLEAR ☐ 2 CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING: 060 FEET | RECOMMENDED PUMPING RATE: 0008 GPM.

50-53 001.0 GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL

54 — 1 ☒ WATER SUPPLY; 2 ☐ OBSERVATION WELL; 3 ☐ TEST HOLE; 4 ☐ RECHARGE WELL; 5 ☐ ABANDONED, INSUFFICIENT SUPPLY; 6 ☐ ABANDONED, POOR QUALITY; 7 ☐ UNFINISHED

WATER USE

55-56 — 1 ☒ DOMESTIC; 2 ☒ STOCK; 3 ☐ IRRIGATION; 4 ☐ INDUSTRIAL; 5 ☐ COMMERCIAL; 6 ☐ MUNICIPAL; 7 ☐ PUBLIC SUPPLY; 8 ☐ COOLING OR AIR CONDITIONING; ☐ OTHER; 9 ☐ NOT USED

12

METHOD OF DRILLING

57 — 1 ☒ CABLE TOOL; 2 ☐ ROTARY (CONVENTIONAL); 3 ☐ ROTARY (REVERSE); 4 ☐ ROTARY (AIR); 5 ☐ AIR PERCUSSION; 6 ☐ BORING; 7 ☐ DIAMOND; 8 ☐ JETTING; 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Mervin Jones | LICENCE NUMBER: 3266

ADDRESS: RR#3 Thorndale, Ont.

NAME OF DRILLER OR BORER: L. Barber | LICENCE NUMBER:

SIGNATURE OF CONTRACTOR: Mervin Jones | SUBMISSION DATE: DAY 10 MO. 10 YR. 69

OFFICE USE ONLY

DATA SOURCE 58: 1 | CONTRACTOR 59-62: 3009 | DATE RECEIVED 63-68: 231069

DATE OF INSPECTION: 4, 1, 70 | INSPECTOR: 71P

REMARKS:

CSS.55

OWRC COPY

Ministry of the Environment
Ontario

(35)

The Ontario Water Resources Act 40 P/3B

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

(11) 4108914

MUNICIP. 41008 CON. CON 07

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC	LOT 25-27
[redacted]	London	7	001

[redacted] R. #1 Arva Ont.

DATE COMPLETED 48-53: DAY 23 MO 08 YR. 79

[redacted] 769800 RC. 4 ELEVATION 0936 RC 4 BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
	top soil			0	1
brown	clay	sand and stones		1	10
grey	clay	gravel and stones		10	106
brown	limestone		broken	106	107

Well abandoned. 8/5/80

Well would not produce water pump was not installed for several mo.

casing pulled and well plugged by driller

(31) 0001 02 | 0010605 28/2 | 0106205 11/2 | 0107 15 71

32

(41) WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0107	☒ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL

(51) CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
05	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	188	0	0106
05	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE		106	0107
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

(61) PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

(71) PUMPING TEST

PUMPING TEST METHOD: ☐ PUMP ☒ BAILER
PUMPING RATE: 0020 GPM
DURATION OF PUMPING: 01 HOURS 00 MINS

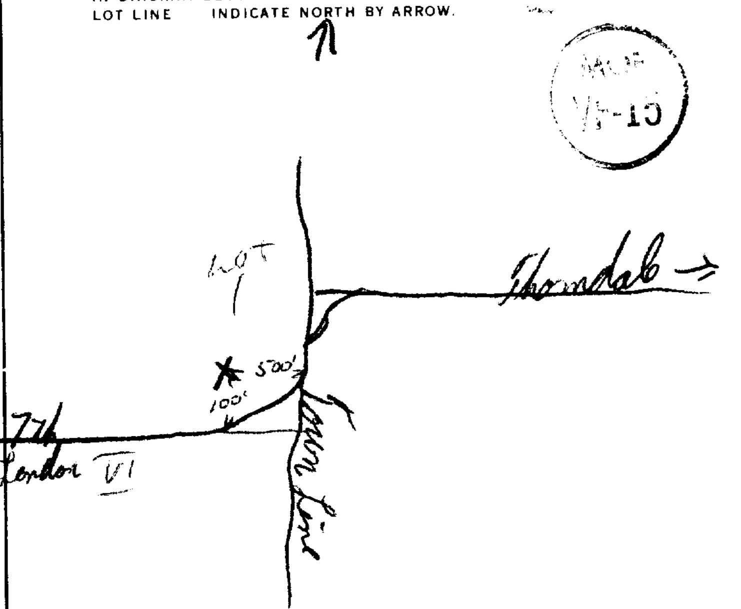
STATIC LEVEL: 050 FEET
WATER LEVEL END OF PUMPING: 090 FEET
WATER LEVELS DURING: ☒ PUMPING ☐ RECOVERY
15 MINUTES: 090 FEET | 30 MINUTES: 090 FEET | 45 MINUTES: 090 FEET | 60 MINUTES: 090 FEET

IF FLOWING GIVE RATE: GPM
PUMP INTAKE SET AT: FEET
WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 090 FEET
RECOMMENDED PUMPING RATE: 0015 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE INDICATE NORTH BY ARROW.



DRILLERS REMARKS

FINAL STATUS OF WELL: 1
☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED
Casing Pulled

WATER USE: 02
☐ DOMESTIC ☒ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF DRILLING: 2
☐ CABLE TOOL ☒ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Mervin Jones — LICENCE NUMBER 3009
ADDRESS: R. R. 3 Thorndale Ont.
NAME OF DRILLER OR BORER: Murray S. Jones — LICENCE NUMBER 3034
SIGNATURE OF CONTRACTOR: Mervin Jones — SUBMISSION DATE DAY 23 MO. 8 YR. 79

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 3009 | DATE RECEIVED: 040979
DATE OF INSPECTION: 19 8 80 | INSPECTOR:
REMARKS:
CSS.S8

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506-4-77

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 4109218 MUNICIP. 4/008 CON. CON 07

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC	LOT
[redacted]	London	7	001

[redacted] R. 1 Arva Ontario. DATE COMPLETED DAY 08 MO 05 YR 80

21 | UTM 17 | 69800 | RC 4 | ELEVATION 0930 | RC 44 | BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
brown	clay	stones		0	6
grey	clay	stones and gravel		6	106
brown	limestone			106	138

31 9006605/12 0106205/12/11 0138615

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0138	1 ☒ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	0106
05	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		106	0138
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER | PUMPING RATE: 0015 GPM | DURATION OF PUMPING: 02 HOURS 00 MINS

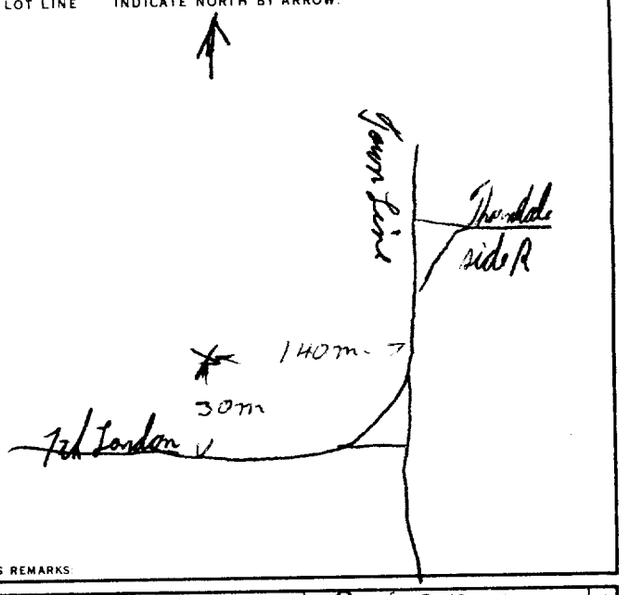
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
044 FEET	080 FEET	080 FEET	080 FEET	080 FEET	080 FEET

IF FLOWING, GIVE RATE: GPM | PUMP INTAKE SET AT: FEET | WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING: 050 FEET | RECOMMENDED PUMPING RATE: 0015 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL 1	1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED
WATER USE 12	1 ☒ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED
METHOD OF DRILLING 2	1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: ☒ Mervin Jones — LICENCE NUMBER: 3009

ADDRESS: R. R. 3 Thorndale Ont.

NAME OF DRILLER OR BORER: Murray S. Jones — LICENCE NUMBER: 3034

SIGNATURE OF CONTRACTOR: Mervin Jones — SUBMISSION DATE: DAY 8 MO 5 80

OFFICE USE ONLY

DATA SOURCE 1 | CONTRACTOR 3009 | DATE RECEIVED 040780

DATE OF INSPECTION: 8, 9, 81 | INSPECTOR

REMARKS: CSS.S8

FORM NO. 0506-4-77

MINISTRY OF THE ENVIRONMENT COPY

Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

11 (1 2)

4113432

Municipality 41008 (10–14) Con. CON 06 (15–22 23 24)

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot (25–27)
MIDDLESEX	LONDON	6	2
[redacted]	Address	Date completed: 5 day, 7 month, 95 year	

21 (1 2) UTM: Zone (10) Easting (12–17) Northing (18–24) RC (25) Elevation (26) RC (30) Basin Code (31) ii iii iv (47)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
BLACK	TOPSOIL		LOOSE	0	1
BROWN	CLAY	STONES	DENSE PACKED	1	21
BROWN	GRAVEL	SAND	COARSE	21	22
GREY	CLAY	STONEY	HARD PACKED	22	36
GREY	COARSE SAND		LOOSE	36	41
GREY	CLAY	STONES	GRAVELLY	41	81
GREY	COARSE SAND AND GRAVEL			81	105
GREY	BOULDERS		HARD	105	106

31
32

SLOT 18 (BOTTOM 4 FT.

41 WATER RECORD

Water found at – feet	Kind of water		
81 (10–13)	1 ☑ Fresh, 2 ☐ Salty	3 ☐ Sulphur, 4 ☐ Minerals, 6 ☐ Gas	(14)
105 (15–18)	1 ☑ Fresh, 2 ☐ Salty	3 ☐ Sulphur, 4 ☐ Minerals, 6 ☐ Gas	(19)
(20–23)	1 ☐ Fresh, 2 ☐ Salty	3 ☐ Sulphur, 4 ☐ Minerals, 6 ☐ Gas	(24)
(25–28)	1 ☐ Fresh, 2 ☐ Salty	3 ☐ Sulphur, 4 ☐ Minerals, 6 ☐ Gas	(29)
(30–33)	1 ☐ Fresh, 2 ☐ Salty	3 ☐ Sulphur, 4 ☐ Minerals, 6 ☐ Gas	(34) (68)

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
5 (10–11)	1 ☐ Steel (12), 2 ☐ Galvanized, 3 ☐ Concrete, 4 ☐ Open hole, 5 ☑ Plastic	1/4"	+2	94 (13–16)
4 (17–18)	1 ☐ Steel (19), 2 ☐ Galvanized, 3 ☐ Concrete, 4 ☐ Open hole, 5 ☐ Plastic	STAINLESS STEEL SCREEN	93	105 (20–23)
(24–25)	1 ☐ Steel (26), 2 ☐ Galvanized, 3 ☐ Concrete, 4 ☐ Open hole, 5 ☐ Plastic			(27–30)

SCREEN

Sizes of opening (Slot No.) (31–33)	Diameter (34–38)	Length (39 40)
12 (4FT) TOP	4 inches	12 feet
Material and type	**Depth at top of screen (41–44)**	(30)
STAINLESS	93 feet	

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
0 (10–13)	90 (14–17)	CLAY SLURRY
(18–21)	(22–25)	AND HOLEPLUG
(26–29)	(30–33)	(80)

71 PUMPING TEST

Pumping test method: AIR (1 ☐ Pump, 2 ☐ Bailer) Pumping rate: 45 GPM (11–14) Duration of pumping: 4 Hours (15–16) 0 Mins (17–18)

Static level	Water level end of pumping	Water levels during (25): 1 ☐ Pumping 2 ☐ Recovery			
23 (19–21) feet	23 (22–24) feet	15 minutes: 23 (26–28) feet	30 minutes: 23 (29–31) feet	45 minutes: 23 (32–34) feet	60 minutes: 23 (35–37) feet
If flowing give rate (38 41) GPM	Pump intake set at: 67 feet	Water at end of test (42): ☑ Clear ☐ Cloudy			
Recommended pump type: ☐ Shallow ☑ Deep	Recommended pump setting: 67 (43–45) feet	Recommended pump rate: 15 (46–49) GPM			

(50–53)

FINAL STATUS OF WELL (54)

1 ☑ Water supply; 2 ☐ Observation well; 3 ☐ Test hole; 4 ☐ Recharge well; 5 ☐ Abandoned, insufficient supply; 6 ☐ Abandoned, poor quality; 7 ☐ Abandoned (Other); 8 ☐ Dewatering; 9 ☐ Unfinished; 10 ☐ Replacement well

WATER USE (55 56)

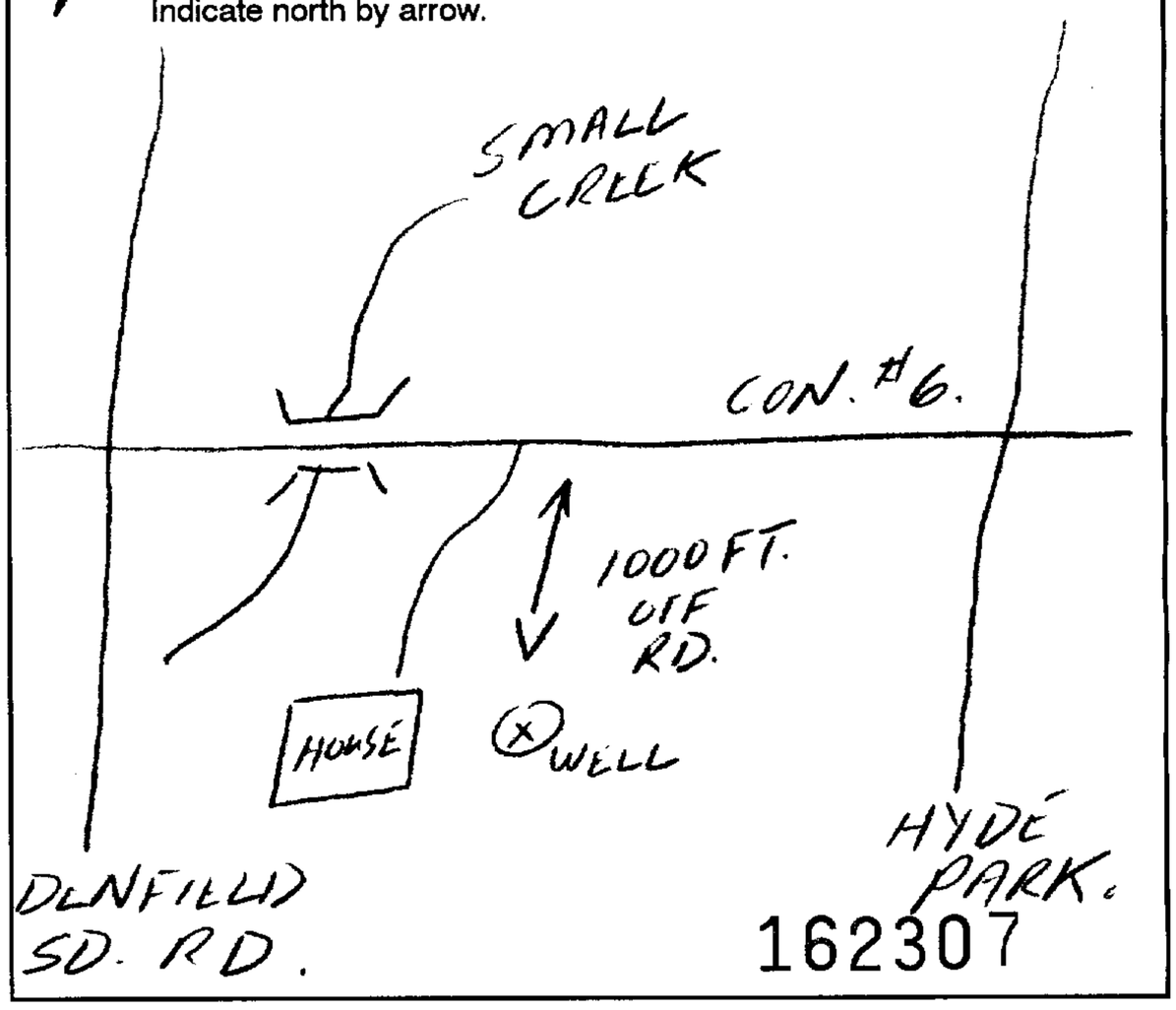
1 ☑ Domestic; 2 ☐ Stock; 3 ☑ Irrigation; 4 ☐ Industrial; 5 ☐ Commercial; 6 ☐ Municipal; 7 ☐ Public supply; 8 ☐ Cooling & air conditioning; 9 ☐ Not used; 10 ☐ Other

METHOD OF CONSTRUCTION (57)

1 ☐ Cable tool; 2 ☑ Rotary (conventional); 3 ☐ Rotary (reverse); 4 ☐ Rotary (air); 5 ☐ Air percussion; 6 ☐ Boring; 7 ☐ Diamond; 8 ☐ Jetting; 9 ☐ Driving; 10 ☐ Digging; 11 ☐ Other

LOCATION OF WELL

In diagram below show distances of well from road and lot line.
Indicate north by arrow.



162307

Name of Well Contractor	Well Contractor's Licence No.
HAYDEN WATER WELLS	2552
Address: R.R. #1 LUCAN	
Name of Well Technician: J. HAYDEN	Well Technician's Licence No.: T1034
Signature of Technician/Contractor	Submission date: day mo yr

MINISTRY USE ONLY

Data source (58)	Contractor (59–62)	Date received (63–68)	(80)
	2552	MAR 2 1 1996	
Date of inspection	Inspector		
Remarks			

CSS.ES

0506 (07/94) Front Form 9

2 - MINISTRY OF ENVIRONMENT & ENERGY COPY

Ontario Ministry of the Environment

Well Tag Number A028285 (A028285)

Well Record

Regulation 903 Ontario Water Resources Act

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Instructions for Completing Form

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- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

Ministry Use Only

MUN | CON | LOT

Well Owner's Information and Location of Well Information

[redacted]

Middlesex County | 14 | 1

RR#/Street Number/Name | City/Town/Village: Thames Centre | Site/Compartment/Block/Tract etc.

GPS Reading | NAD: 83 | Zone: 17 | Easting: 485215 | Northing: 4769771 | Unit Make/Model: Magellan | Mode of Operation: ☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To (Metres)
Brown	SILT*	sand		0	1.8
Brown	SAND, GRAVEL	stones		1.8	6.15
Grey	SILT	clay	dense	6.15	7.6

Hole Diameter

Depth From	Depth To (Metres)	Diameter (Centimetres)
0	7.6	20

Water Record

Water found at Metres / Kind of Water

6.1 m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was ☐ Clear and sediment free ☐ Other, specify

Chlorinated ☐ Yes ☒ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To (Metres)
Casing				
5.0	☐ Steel ☐ Fibreglass ☒ Plastic ☐ Concrete ☐ Galvanized	.4	+0.3	4.2
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam 6.1	☐ Steel ☐ Fibreglass ☒ Plastic ☐ Concrete ☐ Galvanized	Slot No. 010	4.2	7.6
No Casing or Screen				
	☐ Open hole			

Test of Well Yield

Pumping test method	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Pump intake set at - (metres)	Static Level			
Pumping rate - (litres/min)	1		1	
Duration of pumping ___hrs +___ min	2		2	
Final water level end of pumping ___metres	3		3	
Recommended pump type. ☐ Shallow ☐ Deep	4		4	
Recommended pump depth. ___metres	5		5	
Recommended pump rate. (litres/min)	10		10	
If flowing give rate - (litres/min)	15		15	
If pumping discontinued, give reason.	20		20	
	25		25	
	30		30	
	40		40	
	50		50	
	60		60	

Plugging and Sealing Record ☒ Annular space ☐ Abandonment

Depth set at - Metres From	To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	4.1	Bentonite	
4.1	7.6	Sand	

Method of Construction

☐ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging
☐ Rotary (conventional) ☐ Air percussion ☐ Jetting ☒ Other MSA
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

☐ Domestic ☐ Industrial ☐ Public Supply ☒ Other MONITORING
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☐ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☒ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Well Contractor/Technician Information

Name of Well Contractor: All-Terrain Drilling Ltd. | Well Contractor's Licence No.: 1129

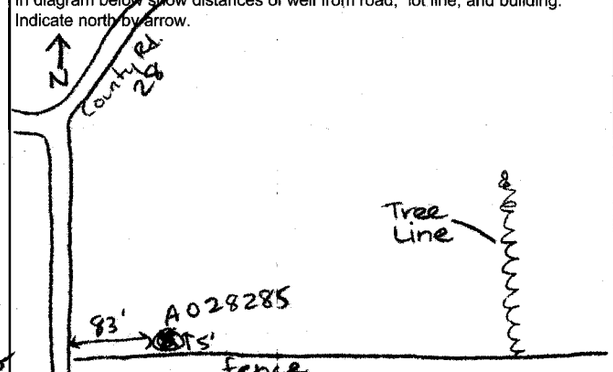
Business Address (street name, number, city etc.): 3-661 Colby Dr. Waterloo, ON N2V 1C2

Name of Well Technician (last name, first name): Buckley, Rick | Well Technician's Licence No.: 2827

Signature of Technician/Contractor: X | Date Submitted: 2006 03 04

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 37123 | Date Well Completed: 2005 10 18

Was the well owner's information package delivered? ☐ Yes ☒ No | Date Delivered

Ministry Use Only

Data Source | Contractor: 1129

Date Received: MAR 14 2006 | Date of Inspection

Remarks | Well Record Number

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☒ Well Owner's Copy ☐ *Cette formule est disponible en français*

Ontario Ministry of the Environment

Well Tag Number (Place sticker and print number below): A 009954

Well Record

Regulation 903 Ontario Water Resources Act

page 1 of 1

Instructions for Completing Form

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- Please print clearly in blue or black ink only.

Ministry Use Only

MUN | CON | LOT

Well Owner's Information and Location of Well Information

[redacted]

MIDDLESEX | W. NISSOURI | 11 | 1

RR#/Street Number/Name: WYTON ROAD

City/Town/Village: LONDON

Site/Compartment/Block/Tract etc.

GPS Reading: NAD 83 | Zone 17 | Easting 485810 | Northing 4769010

Unit Make/Model: MAG.

Mode of Operation: ☑ Undifferentiated ☐ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions) IMPERIAL MEASUREMENT

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To
BLACK	TOPSOIL		LOAMY	0	1
BROWN	GRAVEL		DRY	1	17
GREY	CLAY		STONEY	17	58
GREY	HARDPAN	BOULDERS	HARD	58	82
BROWN	LIMESTONE		FIRM	82	118

* WELL PUMPS 25 G.P.M. OF FRESH WATER. *

Hole Diameter

Depth From	Depth To	Diameter Centimetres
0	82	9"
82	118	6"

Water Record

Water found at Metres	Kind of Water
98 m	☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
112 m	☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
m	☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was: ☑ Clear and sediment free ☐ Other, specify

Chlorinated ☑ Yes ☐ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To
Casing				
6"	☑ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188 WALL	+2	82
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☐ Open hole		82	118

Test of Well Yield

Pumping test method: PUMP

Pump intake set at - (metres): 70

Pumping rate - (litres/min): 25

Duration of pumping: 2 hrs + 0 min

Final water level end of pumping: 24 metres

Recommended pump type: ☐ Shallow ☑ Deep

Recommended pump depth: 70 metres

Recommended pump rate: 25 (litres/min)

If flowing give rate - (litres/min)

If pumping discontinued, give reason: CLEAR

	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Static Level		24		24
	1	24	1	
	2	24	2	
	3	24	3	
	4	24	4	
	5	24	5	
	10	24	10	
	15	24	15	
	20	24	20	
	25	24	25	
	30	24	30	
	40	24	40	
	50	24	50	
	60	24	60	24

Plugging and Sealing Record ☑ Annular space ☐ Abandonment

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	25	BENTONITE GROUT	1.2
25	82	QUICKGEL SLURRY	2.8

Method of Construction

☐ Cable Tool ☑ Rotary (air) ☐ Diamond ☐ Digging
☑ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

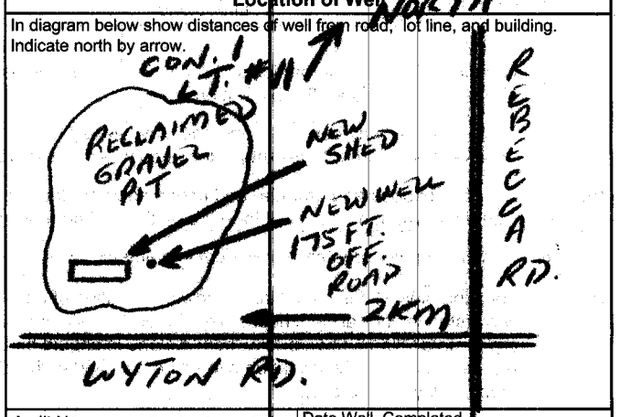
☑ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☑ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☐ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Location of Well NORTH

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 32697

Date Well Completed: YYYY 05 MM 08 DD 05

Was the well owner's information package delivered? ☑ Yes ☐ No

Date Delivered: YYYY 05 MM 08 DD 05

Well Contractor/Technician Information

Name of Well Contractor: HAYDEN WATER WELLS

Well Contractor's Licence No.: 7090

Business Address (street name, number, city etc.): LUCAN ONT.

Name of Well Technician (last name, first name): J. HAYDEN

Well Technician's Licence No.: T1034

Signature of Technician/Contractor

Date Submitted: YYYY 2006 MM 01 DD 01

Ministry Use Only

Data Source | Contractor 7090

Date Received: MAR 17 2006 YYYY MM DD | Date of Inspection YYYY MM DD

Remarks | Well Record Number

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☑ Well Owner's Copy ☐

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Ontario Ministry of the Environment

Well Tag Numbe A 049698

A049698

Well Record

Regulation 903 Ontario Water Resources Act

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Instructions for Completing Form

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- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

Ministry Use Only

[redacted]

Address of Well Location (County/District/Municipality): Corner of Medway Rd. and Olalondo Rd. | Township: Middlesex Centre | Lot: 1 | Concession: 6

RR#/Street Number/Name | City/Town/Village | Site/Compartment/Block/Tract etc.

GPS Reading: NAD 83 | Zone 17 | Easting 484884 | Northing 4769936 | Unit Make/Model: Magellan | Mode of Operation: ☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To (Metres)
Brown	Silt / Sand		fine sand and silt	0	2.6
Brown	Silt	clay	clayey silt till, dense	2.6	3.7

Hole Diameter

Depth From	Depth To (Metres)	Diameter (Centimetres)
0	3.7	25

Water Record

Water found at ___ Metres / Kind of Water

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was ☐ Clear and sediment free ☐ Other, specify

Chlorinated ☐ Yes ☒ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To (Metres)
Casing				
5.0	☐ Steel ☐ Fibreglass ☒ Plastic ☐ Concrete ☐ Galvanized	.4	0	2.2
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☒ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
6.1		010	2.2	3.7
No Casing or Screen				
	☐ Open hole			

Test of Well Yield

Pumping test method	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Pump intake set at - (metres)	Static Level			
Pumping rate - (litres/min)	1		1	
Duration of pumping ___hrs +___ min	2		2	
Final water level end of pumping ___metres	3		3	
Recommended pump type. ☐ Shallow ☐ Deep	4		4	
Recommended pump depth. ___metres	5		5	
Recommended pump rate. (litres/min)	10		10	
	15		15	
If flowing give rate - (litres/min)	20		20	
	25		25	
If pumping discontinued, give reason.	30		30	
	40		40	
	50		50	
	60		60	

Plugging and Sealing Record

☒ Annular space ☐ Abandonment

Depth set at - Metres From	To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	2.1	Bentonite	
2.1	3.7	Sand	

Method of Construction

☐ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging
☐ Rotary (conventional) ☐ Air percussion ☐ Jetting ☒ Other HSA
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

☐ Domestic ☐ Industrial ☐ Public Supply ☒ Other MONITORING
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☐ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☒ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Well Contractor/Technician Information

Name of Well Contractor: All-Terrain Drilling Ltd. | Well Contractor's Licence No.: 1129

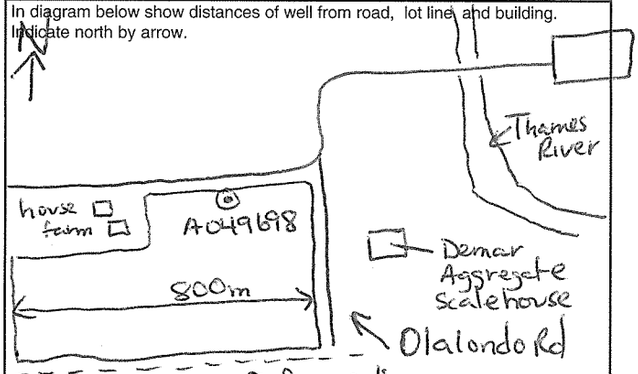
Business Address (street name, number, city etc.): 3-661 Colby Drive Waterloo ON N2V 1C2

Name of Well Technician (last name, first name): Grant, Don | Well Technician's Licence No.: 3311

Signature of Technician/Contractor | Date Submitted: 2007 06 08

Location of Well

In diagram below show distances of well from road, lot line and building. Indicate north by arrow.



Audit No. Z 65261 | Date Well Completed: 2007 04 23

Was the well owner's information package delivered? ☐ Yes ☒ No | Date Delivered

Ministry Use Only

Data Source | Contractor 1129

Date Received JUN 18 2007 | Date of Inspection

Remarks | Well Record Number

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Ontario Ministry of the Environment

Well Tag Number (Place sticker and print number below) N/A

Well Record

Regulation 903 Ontario Water Resources Act

page 1 of 1

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- Please print clearly in blue or black ink only.

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MUN | CON | LOT

Well Owner's Information and Location of Well Information

[redacted]

Middlesex | Middlesex Centre | 1 | 6

RR#/Street Number/Name: 16161 Medway Rd R.R.#1 Arva | City/Town/Village: Arva | Site/Compartment/Block/Tract etc.

GPS Reading: NAD 83 | Zone 17 | Easting 484838 | Northing 4769875 | Unit Make/Model: Mag 315 | Mode of Operation: ☐ Undifferentiated ☐ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To
			Abandon 3' round Stone dug well 20' deep.		

Hole Diameter

Depth From	Depth To	Diameter Centimetres

Water Record

Water found at ___ Metres / Kind of Water

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was ☐ Clear and sediment free ☐ Other, specify

Chlorinated ☐ Yes ☐ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To

Casing

☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized

☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized

☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized

Screen

Outside diam | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | Slot No.

No Casing or Screen

☐ Open hole

Test of Well Yield

Pumping test method	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Pump intake set at - (metres)	Static Level			
Pumping rate - (litres/min)	1		1	
Duration of pumping ____hrs +____ min	2		2	
Final water level end of pumping ____metres	3		3	
Recommended pump type. ☐ Shallow ☐ Deep	4		4	
Recommended pump depth. ____metres	5		5	
Recommended pump rate. (litres/min)	10		10	
	15		15	
If flowing give rate - (litres/min)	20		20	
	25		25	
If pumping discontinued, give reason.	30		30	
	40		40	
	50		50	
	60		60	

Plugging and Sealing Record ☐ Annular space ☑ ~~Abandonment~~

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
20'	17'	Bentonite 3/8	8 bags
17'	8'	Clean Sand	4 yards
8'	5'	Bentonite 3/8	6 bags
5'	0'	Back Fill	

Method of Construction

☐ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging
☐ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

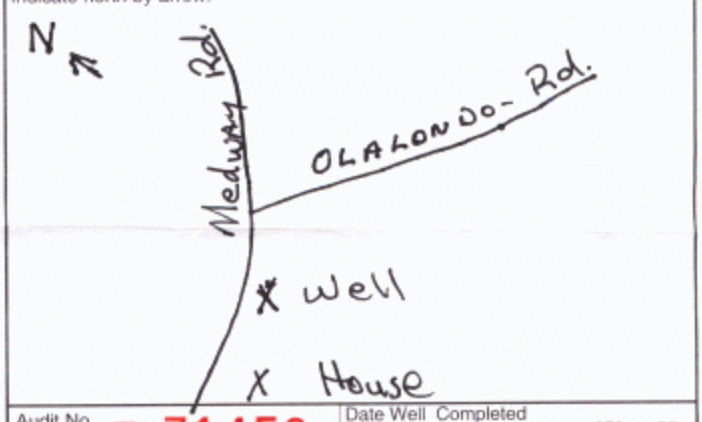
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☐ Water Supply ☐ Recharge well ☐ Unfinished ☑ ~~Abandoned, (Other)~~
☐ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 71453

Date Well Completed YYYY MM DD: 2009 02 06

Was the well owner's information package delivered? ☐ Yes ☐ No

Date Delivered YYYY MM DD

Well Contractor/Technician Information

Name of Well Contractor: Double Diamond Construction | Well Contractor's Licence No.: 6909

Business Address (street name, number, city etc.): 627 Wright St. Strathroy ON N7G-3H8

Name of Well Technician (last name, first name): Carter David | Well Technician's Licence No.: T-2494

Signature of Technician/Contractor: X [signature] | Date Submitted YYYY MM DD: 2009 02 13

Ministry Use Only

Data Source | Contractor

Date Received FEB 23 2009 YYYY MM DD | Date of Inspection YYYY MM DD

Remarks | Well Record Number

0506E (08/2006) **Ministry's Copy** *Cette formule est disponible en français*

Ontario — Ministry of the Environment

Measurements recorded in: [X] Metric [ ] Imperial

Well Tag No. *(Place Sticker and/or Print Below)*: NO TAG

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	[ ] Well Constructed by Well Owner
CBM	AGGREGATES		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
55 INDUSTRIAL STREET.	TORONTO	ON	M4G3W9	416 423 3100

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
21428 OLALONDO ROAD.	WEST NISSOURI	13	1

County/District/Municipality	City/Town/Village	Province	Postal Code
MIDDLESEX	THORNDALE.	Ontario	N0M2P0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD	8	3			

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	ABANDONMENT OF 16.8cm. WELL WITH 12.8cm PVC LINER. TOTAL WELL DEPTH = 27.12m BELOW GROUND. TOTAL OF 18.9m OF PVC LINER				
	CASING AND LINER REMOVED.				
	NO ORIGINAL RECORD FOUND. ADDITIONAL DETAILS UNKNOWN.				

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
27.12	0	BENTONITE CHIPS	1.4

Method of Construction

[ ] Cable Tool [ ] Diamond
[ ] Rotary (Conventional) [ ] Jetting
[ ] Rotary (Reverse) [ ] Driving
[ ] Boring [ ] Digging
[ ] Air percussion
[ ] Other, *specify* _____

Well Use

[ ] Public [ ] Commercial [X] Not used
[ ] Domestic [ ] Municipal [ ] Dewatering
[ ] Livestock [ ] Test Hole [ ] Monitoring
[ ] Irrigation [ ] Cooling & Air Conditioning
[ ] Industrial
[ ] Other, *specify* _____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

[ ] Water Supply
[ ] Replacement Well
[ ] Test Hole
[ ] Recharge Well
[ ] Dewatering Well
[ ] Observation and/or Monitoring Hole
[ ] Alteration (Construction)
[ ] Abandoned, Insufficient Supply
[ ] Abandoned, Poor Water Quality
[X] Abandoned, other, *specify* CONSTRUCTION
[ ] Other, *specify*

Water Details

Water found at Depth (m/ft)	Gas	Kind of Water: [ ] Fresh [ ] Untested [ ] Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)

Results of Well Yield Testing

After test of well yield, water was:
[ ] Clear and sand free
[ ] Other, *specify* _____

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping _____ hrs + _____ min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

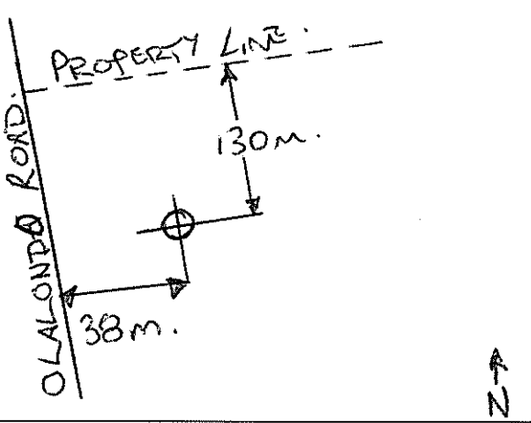
Well production *(l/min / GPM)*

Disinfected? [ ] Yes [ ] No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
COMPLETE WATER WELL SERVICES	7189

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
796 STONEGATE DRIVE.	WOODSTOCK	ON	N4W4H5	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
5199539330	ROWNTREE, REGAN.	2801		2012/1/12

Well owner's information package delivered	Date Package Delivered	Date Work Completed
[ ] Yes [X] No		2012/1/12

Ministry Use Only

Audit No. Z137400

Received JAN 23 2012

Ministry's Copy

Ontario — Ministry of the Environment

Well Tag No. *(Place Sticker and/or Print Below)*

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☐ Imperial

Page _____ of _____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
Arlea Farms			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
15205 Eight Mile Rd. RR#1	Arva	Ontario	N0M1C0	5196595002

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
1160160 Medway Rd. RR #1	Middlesex Centre-London	2	7

County/District/Municipality	City/Town/Village	Province	Postal Code
Middlesex	Arva	Ontario	N0M1C0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	424167	4769727		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
			clean washed sand	58	54
			holeplug	54	5
			native fill	5	0
			Well Abandonment		
			- 6" drilled well		
			- no previous well record found		

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify* _____

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify* _____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify* _____

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping _____ hrs + _____ min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

Well production *(l/min / GPM)*

Disinfected? ☐ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.

Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Stainton's Ltd	4876

Business Address (Street Number/Name)	Municipality
21937 Highbury Ave. N, RR #1	Arva

Province	Postal Code	Business E-mail Address
Ontario	N0M1C0	staintonsexplornet.com

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5196593359	Stainton Brent F.

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
1485		

Well owner's information package delivered ☐ Yes ☐ No

Date Package Delivered: YYYY MM DD

Date Work Completed: 2012 05 07

Ministry Use Only

Audit No. Z136940

Received APR 08 2013

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Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

[redacted]

Address of Well Location (Street Number/Name)	Township	Lot	Concession
MEDWAY ROAD	MIDDLESEX CENTRE (London)	2	7

County/District/Municipality	City/Town/Village	Province	Postal Code
MIDDLESEX	ARVA	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	474238	4769705		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Grey	Clay			0	8
	Bentonite			8	10
	Stone			10	24

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify*

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify*

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☒ Abandoned, other, *specify*

Decommissioned

☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Kind of Water	
☐ Gas	☐ Fresh ☐ Untested	☐ Other, *specify*
☐ Gas	☐ Fresh ☐ Untested	☐ Other, *specify*
☐ Gas	☐ Fresh ☐ Untested	☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping
hrs + min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

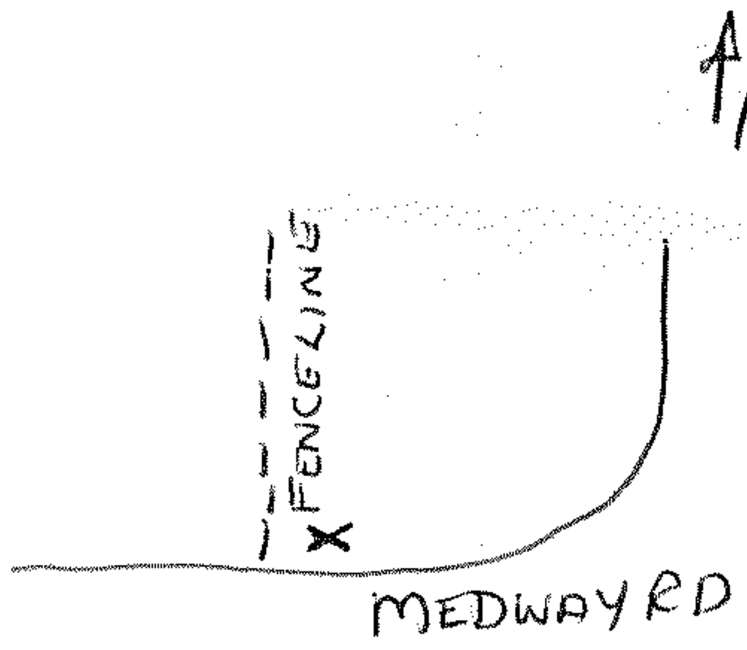
Well production *(l/min / GPM)*

Disinfected?
☐ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
MERVIN JONES DRILLING LTD.	3009

Business Address (Street Number/Name)	Municipality
22264 Fairview Rd. R.R. #3	THORNDALE

Province	Postal Code	Business E-mail Address
ON	N0M2P0	mjdrill@start.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
5194610956	Jones, Murray S.

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
0068	Murray S Jones	20141209

Comments:
49 feet to MEDWAY RD
26 feet to Fenceline

Well owner's information package delivered
☐ Yes
☒ No

Date Package Delivered

Date Work Completed
2014 12 08

Ministry Use Only

Audit No. Z171917

Received JAN 05 2015

Ministry's Copy

Well ID

Well ID Number: 7278379
Well Audit Number: *Z236309*
Well Tag Number: *A047800*
This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	21558 OLALONDO RD
Township	WEST NISSOURI TOWNSHIP
Lot	014
Concession	CON 01
County/District/Municipality	MIDDLESSEX
City/Town/Village	THORNDALE
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 485258.00 Northing: 4769814.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	10 ft	FILL	
10 ft	98 ft	BENTONITE	

Method of Construction & Well Use

Method of Construction	Well Use

Status of Well
Abandoned-Other

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To

Well Contractor and Well Technician Information
Well Contractor's Licence Number: 3009

Results of Well Yield Testing

After test of well yield, water was

If pumping discontinued, give reason

Pump intake set at

Pumping Rate

Duration of Pumping

Final water level

If flowing give rate

Recommended pump depth

Recommended pump rate

Well Production

Disinfected?

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level
SWL			

1	1
2	2
3	3
4	4
5	5
10	10
15	15
20	20
25	25
30	30
40	40
45	45
50	50
60	60

Water Details

Water Found at Depth	Kind

Hole Diameter

Depth From	Depth To	Diameter

Audit Number: Z236309

Date Well Completed: December 07, 2016

Date Well Record Received by MOE: January 03, 2017

Updated: March 20, 2017

Well ID Number: 7285773
Well Audit Number: *Z246292*
Well Tag Number: *A216516*

This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	21558 OLALONDO RD
Township	WEST NISSOURI TOWNSHIP
Lot	014
Concession	CON 01
County/District/Municipality	MIDDLESSEX
City/Town/Village	THORNDALE
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 485242.00 Northing: 4770288.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	GRVL			0 ft	3 ft
GREY	HPAN			3 ft	91 ft
GREY	GRVL		PCKD	91 ft	95 ft
GREY	CLAY	STNS		95 ft	96 ft

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	90 ft	BENTONITE- BENSEAL / EZ MUD	
90 ft	96 ft	GRAVEL	

Method of Construction & Well Use

Method of Construction	Well Use
Rotary (Convent.)	Domestic

Status of Well

Water Supply

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To
6.25 inch	STEEL	-2 ft	91 ft
6.25 inch	STEEL	95 ft	96 ft

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To
9.625 inch	STAINLESS STEEL	91 ft	95 ft

Well Contractor and Well Technician Information

Well Contractor's Licence Number: 7343

Results of Well Yield Testing

After test of well yield, water was	CLEAR
If pumping discontinued, give reason	
Pump intake set at	90 ft
Pumping Rate	4 GPM
Duration of Pumping	3 h:0 m
Final water level	84 ft
If flowing give rate	
Recommended pump depth	90 ft
Recommended pump rate	4 GPM
Well Production	
Disinfected?	Y

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level
SWL	45 ft		
1	47.6 ft	1	73.4 ft
2	49.9 ft	2	70.9 ft
3	52.1 ft	3	68.5 ft
4	54.6 ft	4	67.1 ft
5	56.2 ft	5	65.9 ft
10	60.7 ft	10	62.4 ft
15	63.1 ft	15	58.8 ft
20	65.8 ft	20	55.3 ft
25	68.2 ft	25	52.6 ft
30	69 ft	30	50.2 ft
40	72.3 ft	40	48.9 ft
45		45	
50	75.5 ft	50	46.3 ft
60	76.3 ft	60	45.8 ft

Water Details

Water Found at Depth	Kind
91 ft	Fresh

Hole Diameter

Depth From	Depth To	Diameter
0 ft	96 ft	9 inch

Audit Number: Z246292

Date Well Completed: April 03, 2017

Date Well Record Received by MOE: May 01, 2017

Updated: February 2, 2018
Rate Rate

Well ID

Well ID Number: 7285865
Well Audit Number: *Z236313*
Well Tag Number:
This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	21558 OLALONDO RD
Township	WEST NISSOURI TOWNSHIP
Lot	014
Concession	CON 01
County/District/Municipality	MIDDLESSEX
City/Town/Village	THORNDALE
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 485097.00 Northing: 4770109.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
				0 ft	

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	8 ft	CLAY	
8 ft	10 ft	BENTONITE	
10 ft	32 ft	SAND	

Method of Construction & Well Use

Method of Construction	Well Use

Status of Well
Abandoned-Other

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To

Well Contractor and Well Technician Information
Well Contractor's Licence Number: 3009

Results of Well Yield Testing

After test of well yield, water was

If pumping discontinued, give reason

Pump intake set at

Pumping Rate

Duration of Pumping

Final water level

If flowing give rate

Recommended pump depth

Recommended pump rate

Well Production

Disinfected?

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level

SWL	
1	1
2	2
3	3
4	4
5	5
10	10
15	15
20	20
25	25
30	30
40	40
45	45
50	50
60	60

Water Details

Water Found at Depth	Kind

Hole Diameter

Depth From	Depth To	Diameter

Audit Number: Z236313

Date Well Completed: April 18, 2017

Date Well Record Received by MOE: May 03, 2017

Updated: March 20, 2017

Well ID

Well ID Number: 7288095
Well Audit Number: *Z258984*
Well Tag Number:
This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	21534 OLALONDO RD
Township	WEST NISSOURI TOWNSHIP
Lot	014
Concession	CON 01
County/District/Municipality	MIDDLESSEX
City/Town/Village	THORNDALE
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 485253.00 Northing: 4769814.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
				0 ft	

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	25 ft	BENTONITE BENSEAL / EZMUD 1.2M3	
0 ft	25 ft	GREY BENTONITE BENSEAL/EZ-MUD	
25 ft	96 ft	BENTONITE HOLEPLUG 0.68M3	
25 ft	96 ft	GREY BENTONITE 3/8 HOLEPLUG	

Method of Construction & Well Use

Method of Construction	Well Use

Rotary (Convent.)

Not Used

Status of Well

Abandoned-Other

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To

Well Contractor and Well Technician Information

Well Contractor's Licence Number: 7343

Results of Well Yield Testing

After test of well yield, water was

If pumping discontinued, give reason

Pump intake set at

Pumping Rate

Duration of Pumping

Final water level

If flowing give rate

Recommended pump depth

Recommended pump rate

Well Production

Disinfected? Y

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level
SWL			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
45		45	
50		50	
60		60	

Water Details

Water Found at Depth	Kind

Hole Diameter

Depth From	Depth To	Diameter
0 ft	96 ft	6.125 inch

Audit Number: Z258984

Date Well Completed: May 12, 2017

Date Well Record Received by MOE: June 12, 2017

Updated: March 20, 2017

Appendix F – Water Balance

WATER BALANCE ASSESSMENT

Pre Extraction

Project Number: LON-0015778
Project Name: Ololando Pit
Location: Ololando Road, Middlesex
Calculated By: M. Venhuis
Date: 6-Jul-18

		Area 1		Area 2		Area 3		Area 4		TOTAL
Infiltration										
	Soil Type	Sand/Silt		Sand/Silt		Sand/Silt		Sand/Silt		
	Soil Group	60A/40B		30C/70B		60A/40B		30C/70B		
		Water Holding Capacity (mm)	Fraction of Site Coverage	Water Holding Capacity (mm)	Fraction of Site Coverage	Water Holding Capacity (mm)	Fraction of Site Coverage	Water Holding Capacity (mm)	Fraction of Site Coverage	
Vegetation	Urban Lawns/Shallow Rppted Crops	60	0	90	0	60	0	90	0	
	Moderately Rooted Crops	105	0	165	0	105	0	165	0	
	Pasture and Shrubs	120	1	180	1	120	1	180	1	
	Mature Forests	270	0	330	0	270	0	330	0	
	Weighted Average	120		180		120		180		
	Infiltration Factor									
	Topgraphy ---	0.3		0.3		0.3		0.3		
	Soil ---	0.4		0.4		0.4		0.4		
	Cover ---	0.15		0.15		0.15		0.15		
	Total ---	0.85		0.85		0.85		0.85		

		Area 1			Area 2			Area 3			Area 4			TOTAL
		Impervious	Pervious	Total	Impervious	Pervious	Total	Impervious	Pervious	Total	Impervious	Pervious	Total	Wetland/Drain
Percent		0	1	1	0	1	1	0	1	1	0	1	1	
Area	ha	0	6.75	6.75	0	2.25	2.25	0	10.66	10.66	0	7.38	7.38	27.04
Area	m^2	0	67,500	67,500	0	22,500	22,500	0	106,600	106,600	0	73,800	73,800	270,400
Total Precipitation	mm/yr	1011.5	1011.5		1011.5	1011.5		1011.5	1011.5		1011.5	1011.5		
Estimated Actual Evapotranspiration	mm/yr	580.6	580.6		567.4	567.4		580.6	580.6		567.4	567.4		
Estimated Surplus	mm/yr	430.9	430.9		444.1	444.1		430.9	430.9		444.1	444.1		
Estimated Runoff	mm/yr	430.9	64.6		444.1	66.6		430.9	64.6		444.1	66.6		
Estimated Infiltration	mm/yr	0.0	366.3		0.0	377.5		0.0	366.3		0.0	377.5		
Total Precipitation	m^3/year	0	68,276	68,276	0	22,759	22,759	0	107,826	107,826	0	74,649	74,649	273,510
Estimated Actual Evapotranspiration	m^3/year	0	39,191	39,191	0	12,767	12,767	0	61,892	61,892	0	41,874	41,874	155,723
Estimated Runoff	m^3/year	0	4,363	4,363	0	1,499	1,499	0	6,890	6,890	0	4,916	4,916	17,668
Estimated Infiltration	m^3/year	0	24,723	24,723	0	8,493	8,493	0	39,044	39,044	0	27,858	27,858	100,119

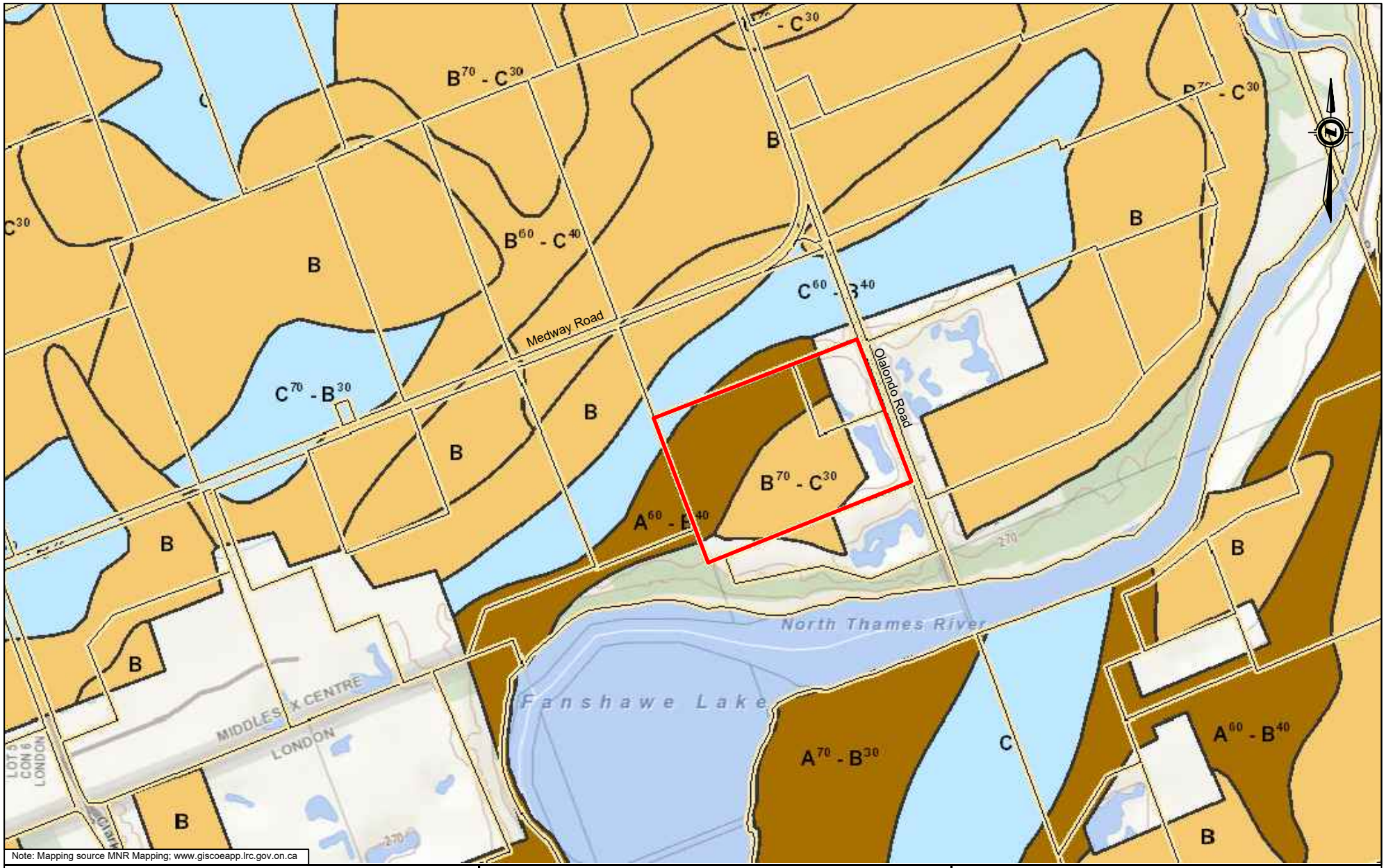
WATER BALANCE ASSESSMENT

Post Extraction

Project Number: LON-0015778
Project Name: Ololando Pit
Location: Ololando Road, Middlesex
Calculated By: M. Venhuis
Date: 6-Jul-18

		Area 1		Area 2		Area 3		Area 4		TOTAL
Infiltration										
	Soil Type	Silt		Silt		Sand/Silt		Sand/Silt		
	Soil Group	C		C		60A/40B		30C/70B		
		Water Holding Capacity (mm)	Fraction of Site Coverage	Water Holding Capacity (mm)	Fraction of Site Coverage	Water Holding Capacity (mm)	Fraction of Site Coverage	Water Holding Capacity (mm)	Fraction of Site Coverage	
Vegetation	Urban Lawns/Shallow Rppted Crops	125	0	125	0	60	0	90	0	
	Moderately Rooted Crops	200	0	200	0	105	0	165	0	
	Pasture and Shrubs	250	1	250	1	120	1	180	1	
	Mature Forests	400	0	400	0	270	0	330	0	
	Weighted Average	250		250		120		180		
	Infiltration Factor									
	Topgraphy ---	0.3		0.3		0.3		0.3		
	Soil ---	0.4		0.4		0.4		0.4		
	Cover ---	0.15		0.15		0.15		0.15		
	Total ---	0.85		0.85		0.85		0.85		

		Area 1			Area 2			Area 3			Area 4			TOTAL
		Impervious	Pervious	Total	Impervious	Pervious	Total	Impervious	Pervious	Total	Impervious	Pervious	Total	Wetland/Drain
Percent		0	1	1	0	1	1	0	1	1	0	1	1	
Area	ha	0	6.75	6.75	0	2.25	2.25	0	10.66	10.66	0	7.38	7.38	27.04
Area	m^2	0	67,500	67,500	0	22,500	22,500	0	106,600	106,600	0	73,800	73,800	270,400
Total Precipitation	mm/yr	1011.5	1011.5		1011.5	1011.5		1011.5	1011.5		1011.5	1011.5		
Estimated Actual Evapotranspiration	mm/yr	559.6	559.6		559.6	559.6		580.6	580.6		567.4	567.4		
Estimated Surplus	mm/yr	451.9	451.9		451.9	451.9		430.9	430.9		444.1	444.1		
Estimated Runoff	mm/yr	451.9	67.8		451.9	67.8		430.9	64.6		444.1	66.6		
Estimated Infiltration	mm/yr	0.0	384.1		0.0	384.1		0.0	366.3		0.0	377.5		
Total Precipitation	m^3/year	0	68,276	68,276	0	22,759	22,759	0	107,826	107,826	0	74,649	74,649	273,510
Estimated Actual Evapotranspiration	m^3/year	0	37,773	37,773	0	12,591	12,591	0	61,892	61,892	0	41,874	41,874	154,130
Estimated Runoff	m^3/year	0	4,575	4,575	0	1,525	1,525	0	6,890	6,890	0	4,916	4,916	17,907
Estimated Infiltration	m^3/year	0	25,928	25,928	0	8,643	8,643	0	39,044	39,044	0	27,858	27,858	101,473



Note: Mapping source MNR Mapping; www.giscoeapp.lrc.gov.on.ca

-LEGEND-

- Hydrologic Soil - Group A
- Hydrologic Soil - Group B
- Hydrologic Soil - Group C
- Approximate Site Boundary

-SCALE-

0 250 500 m

Hydrogeological Assessment

Olalondo Pit Underwater Extraction

21515 Olalondo Road, Middlesex Centre, Ontario

CLIENT	The Municipality of Middlesex Centre
TITLE	Site Hydrologic Soil Group
Prepared By: E.B.	Reviewed By: M.V.
	EXP Services Inc. 15701 Robin's Hill Road, London, ON, N5V 0A5
DATE: July 2018	PROJECT NO.: LON-00015778-HG
DWG NO.: F1	