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Geotechnical Investigation
Proposed Shell Service Station
1440 Prince of Wales Drive
Ottawa, Ontario

GEMTEC Project: 100041.011

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Submitted to:

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Geotechnical Investigation
Proposed Shell Service Station
1440 Prince of Wales Drive
Ottawa, Ontario

September 12, 2023
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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation conducted by GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) carried out at the site of an existing Shell service station located at 1440 Prince of Wales Drive in Ottawa, Ontario.

The purpose of the investigation was to identify the general subsurface conditions at the site by means of a limited number of borehole and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations that could influence design decisions.

This investigation was carried out in general accordance with our proposal dated May 9, 2023.

This report is subject to the Conditions and Limitations of This Report, which follows the text of the report, and which are considered an integral part of the report.

2.0 PROJECT AND SITE DESCRIPTION

2.1 Project Description

Plans are being prepared to demolish and rebuild the existing service station located at 1440 Prince of Wales Drive in Ottawa, Ontario.

Based on the Initial Layout plans provided to us by AECOM (CTM Design Drawing, Sheet No. C101-0, June 7, 2023) the proposed development consists of a 211 square metre convenience store, a canopied concrete apron for the fuel pumps and two (2) underground fuel storage tanks. Paved parking areas and access roadways from Meadowlands Drive and Prince of Wales Drive are also to be constructed.

Preliminary design details for the design and construction of the canopy footings and fuel storage tanks were provided. It is understood that at the new fuel tanks will require an excavation depth of 4.6 metres, and the canopy foundations will require an excavation depth of at least 1.8 metres.

2.2 Geology at the Site

Based on our experience in the area (1463 Prince of Wales Drive), it is expected that the subsurface conditions within the general area of the site are characterized primarily by silt and clay overlying glacial till. Limestone bedrock of the Gull River formation is anticipated around a depth of about 10 metres below ground surface.

Based on borehole information provided by AECOM, sandy silt with varying amounts of clay can be expected at this site. It is understood that three (3) monitoring wells exist at this site (MW20 to MW22). Based on the multiple groundwater level measurements collected previously by

others at the site between 2020 and 2022 the groundwater level varies between 1.2 to 4.0 metres below surface grade, depending on the time of year.

Fill material associated with the existing development of the site should be anticipated.

3.0 SUBSURFACE INVESTIGATION

The fieldwork for this investigation was carried out on August 10th and 11th, 2023. At that time, three (3) boreholes were advanced at the site. The boreholes were advanced using a truck mounted drill rig supplied and operated by George Downing Estate Drilling Ltd. of Grenville-Sur-La-Rouge, Quebec. Details of the boreholes are provided below:

- The boreholes (numbered boreholes 23-1 to 23-3, inclusive) were advanced to depths of 9.8 to 10.4 metres below ground surface in the area of the proposed fuel storage tanks, concrete apron and canopy, and the convenience store.

- Well screens were not installed during our field investigation. At AECOM's request existing groundwater monitoring wells were used to measure the stabilized groundwater levels and to undertake hydraulic conductivity testing.

As part of Shell's health and safety policy, the following precautions were undertaken prior to advancing the boreholes at the site:

- The boreholes were daylighted to a depth of about 2 metres below ground surface prior to starting the drilling operation.

- The pumps and covers of the fuel tanks were covered with fire blankets.

Standard penetration tests (SPT) were carried out in the boreholes and samples of the soils encountered were recovered using a 50-millimetre diameter split barrel sampler. In-situ vane shear testing was carried out where possible to measure the undrained shear strength of the silty clay.

The fieldwork was observed by members of our engineering staff who directed the drilling and hydro-vacuuming operations, observed the in-situ testing and logged the samples and boreholes.

Following the borehole drilling work, the soil samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples of the soil were tested for water content, grain size distribution, and Atterberg limits. A sample of the soil recovered from borehole 23-3 was sent to Paracel Laboratories Ltd. for basic chemical testing relating to corrosion of buried concrete and steel.

The approximate locations of the boreholes are shown on the Borehole Location Plan, Figure A1 in Appendix A. Descriptions of the subsurface conditions logged in the boreholes are provided on the Record of Borehole sheets in Appendix B. The results of the laboratory classification testing on the soil samples are provided in Appendix C.

The boreholes were positioned in site relative to existing site features by GEMTEC personnel. Elevations and co-ordinates were measured using our Trimble R10 GPS equipment and are referenced to geodetic datum NAD83 (CSRS) Epoch 2010, vertical network CGVD28.

4.0 SUBSURFACE CONDITIONS

4.1 Existing Pavement Structure

All of the boreholes were initially hydrovacuumed through the pavement structure and encountered about 100 millimetres of asphaltic concrete from ground surface. At borehole 23-1, the asphaltic concrete is underlain by base/subbase material consisting about 350 millimetres of grey clayey sand and gravel. At borehole 23-3, the asphaltic concrete is underlain by a base/subbase material consisting about 510 millimetres of grey brown sand and gravel with trace silt.

The moisture content of the base/subbase sample from borehole 23-1 was 23 percent.

4.2 Fill Material

A layer of unclassified fill material was observed in the open hydrovacuum holes below the asphalt in borehole 23-2 and below the pavement structure at boreholes 23-1 and 23-3. It should be noted that the fill material is within the depth of hydrovacuum excavation and therefore the accuracy of the fill material description and thickness is somewhat limited and may have been affected by the excavation methodology.

In borehole 23-1, the fill material consists of grey brown silty clay with some sand, trace organic material, and extends to a depth of about 1.5 metres below surface grade.

In borehole 23-2, the fill material consists of grey brown clayey gravel with trace to some sand, and extends to a depth of about 1.5 metres below surface grade.

In borehole 23-3, the fill material consists of brown, medium to coarse grained sand overlying grey brown silty clay with trace, and extends to a depth of about 1.65 metres below surface grade.

The moisture content of selected fill material samples ranged from 27 to 41 percent.

4.3 Fine Grained Soil

A native deposit of silty clay was encountered underlying the fill material at all of the borehole locations. The silty clay deposit was encountered at depths ranging from about 1.5 to 1.7 metres below ground surface (elevations 80.9 to 81.1 metres, geodetic datum).

4.3.1.1 Weathered Crust

At all borehole locations, the upper portion of the silty clay has developed a weathered crust. The weathered crust can generally be described as grey brown silty clay with trace amounts of fine sand. The thickness of the weathered crust was measured to range from about 3.2 to 4.3 metres at the borehole locations and extends to depths of 4.9 to 5.8 metres below surface grade (elevation 76.7 to 77.8 metres).

The SPT N values recorded within the weathered crust range between 2 and 15 blows per 0.3 metres of penetration and generally showed a decreasing trend with depth. Based on our local experience and our review of the soil samples, N values within the silty clay deposit which are greater than about 2 blows per 0.3 metres would be indicative of a stiff to very stiff consistency.

Representative samples of the weathered crust were tested for:

- Moisture content;
- Grain size distribution; and,
- Atterberg limits.

Two (2) grain size distribution tests were undertaken on samples of the weathered crust from borehole 23-1. The results are provided in Appendix C and summarized in Table 4.1.

Table 4.1 – Summary of Grain Size Distribution Testing – Weathered Crust

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-1	3	1.8 – 2.4	0	8	24	68
23-1	6	3.8 – 4.4	0	6	25	69

Two (2) Atterberg limits tests were undertaken on samples of the weathered crust from borehole 23-1. The results are provided in Appendix C, on the Record of Borehole sheets in Appendix B, and are summarized in Table 4.2. The moisture content of the samples of the weathered crust range from 37 to 46 percent, and are all below the liquid limit values.

Table 4.2 – Summary of Atterberg Limits and Moisture Content Testing

Borehole ID	Sample Number	Sample Depth (metres)	Moisture (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
23-1	3	1.8 – 2.4	39	49	28	21
23-1	6	3.8 – 4.4	43	49	21	28

4.3.1.2 Sandy Clayey Silt

At the location of borehole 23-1, the silty clay weathered crust is underlain by a layer of grey sandy clayey silt. The sandy clayey silt was encountered at a depth of 4.9 metres below surface grade (elevation 77.7 metres, geodetic), and extends to a depth of about 6.1 metres below surface grade (elevation 76.5 metres).

The SPT N values recorded within the sandy clayey silt range between 2 and 4 blows per 0.3 metres of penetration, which indicates a very loose consistency.

One (1) grain size distribution test was undertaken on a sample of the sandy clayey silt. The results are provided in Appendix C and summarized in Table 4.3. The moisture content of a tested sandy clayey silt sample was about 29 percent.

Table 4.3 – Summary of Grain Size Distribution Testing – Sandy Clayey Silt

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-1	8	5.3 – 5.9	0	29	40	31

4.3.1.3 Grey Silty Clay

Grey silty clay with widely spaced silt seams was encountered below the sandy clayey silt layer at borehole 23-1, and below the weathered crust in boreholes 23-2 and 23-3, at depths of 4.9 to 6.1 metres below ground surface (elevations 76.5 to 77.8 metres, geodetic). The grey silty clay layer extends to depths of 8.2 to 8.4 metres below surface grade (elevations 74.1 to 74.4 metres).

The SPT N values recorded within the grey silty clay range between static weight of hammer ‘WH’, and 2 blows per 0.3 metres of penetration. In-situ shear testing was performed, and the undrained shear strength measured in the grey clayey silt ranged from 42 to 86 kilopascals, which corresponds to a firm to stiff consistency. The corresponding remolded values range from 4 to 12 kilopascals. The ratio of the undrained shear strength to the remolded shear strength indicates that the grey clayey silt deposit is in general, sensitive.

The moisture content of the samples of the grey silty clay from the boreholes range from 26 to 33 percent.

4.3.1.4 Grey Silt

Grey silt with trace to some clay and trace gravel was encountered below the grey silty clay layer at all the borehole locations at depths of 8.2 to 8.4 metres below ground surface (elevations 74.1 to 74.4 metres). The boreholes were terminated within the silt layer at depths of 9.8 to 10.4 metres below surface grade (elevations 72.1 to 72.8 metres).

The SPT N values recorded within the grey silt range between 1 and 17 blows per 0.3 metres of penetration, which reflects a very loose to compact relative density. It should be noted that the lower N values may represent disturbed soil conditions which occurred during drilling.

4.4 Groundwater Conditions

The groundwater levels were measured on July 6, 2023, in well screens MW 20, MW21, and MW 22 installed by SNC Lavalin. The monitoring wells have a total length of 6.1 metres, and have a screened length of 4.6 metres, from 6.1 to 1.5 metres below surface grade. SNC Lavalin classified the soil within the screened portion of the well as sandy silt. At the location of MW21, the upper half of the soil is classified as sand and gravel fill material overlying the sandy silt. The groundwater levels are summarized in Table 4.4.

Table 4.4 – Groundwater Depth and Elevation (July 6, 2023)

Monitoring Well ID	Ground Surface Elevation (metres, geodetic datum)	Groundwater Depth Below Existing Ground Surface (metres)	Groundwater Elevation (metres, geodetic datum)
MW 20	82.6	2.4	80.2
MW 21	82.7	2.5	80.2
MW 22	82.6	2.3	80.3

As previously noted, based on groundwater level previously measured by others at this site, the groundwater at the site can fluctuate between 1.2 and 4 metres below surface grade. It should be noted that groundwater levels will fluctuate seasonally and may be higher during wet periods of the year, such as the early spring or fall, or following periods of heavy precipitation.

4.5 Soil Chemistry Relating to Corrosion

The results of chemical testing on a soil sample recovered from borehole 23-3 are provided in Appendix D and are summarized in Table 4.5.

Table 4.5 – Summary of Corrosion Testing - Soil

Parameter	Borehole 23-3 SA 5 (2.4m to 3.1m)
Chloride Content (µg/g)	1200
Resistivity (Ohm.m)	5.3
pH	7.4
Sulphate Content (µg/g)	182

4.6 Hydraulic Response Testing Results

The results of the hydraulic response testing carried out in the existing monitoring wells MW-20 and MW-22 are provided in Appendix E. Due to the slow recovery encountered, only a falling-head test was conducted at both wells. The hydraulic conductivity calculated from the falling head test in both monitoring wells was approximately 2×10^{-7} m/s, within the sandy silt deposit (as classified by SNC Lavalin). The calculated and interpreted hydraulic conductivities for the sandy silt layer fall within the literature range for silt of 1×10^{-9} to 5×10^{-5} m/s (Freeze & Cherry, 1979).

4.7 Groundwater Quality Results

Analytical results for the groundwater samples along with the associated City of Ottawa Storm and Sanitary / Combined Sewer Use By-Law standards are presented in Appendix F. The Laboratory Certificate of Analysis for the groundwater samples is also provided in Appendix F.

Based on the City of Ottawa Storm Sewer Use standards, the groundwater sample obtained from the monitoring well in MW-21 had exceedances of total and dissolved manganese, benzene, toluene, ethylbenzene, total xylenes, naphthalene. Based on the City of Ottawa Sanitary / Combined Sewer Use standards, the groundwater sample had exceedances of total and dissolved, manganese, benzene, and ethylbenzene.

5.0 GEOTECHNICAL DESIGN GUIDELINES

5.1 Proposed Convenience Store and Pump Canopy

5.1.1 Excavation

The excavation for the proposed convenience store and fuel pump canopy will be carried out through the existing pavement structure, fill material and debris from the demolition of the existing structures (and any other buried structures at the site), as well as the weathered crust.

These soil units should be excavatable using conventional hydraulic excavation equipment, noting that fill material can contain more problematic material such as construction debris boulders, or other hard material such as reinforced concrete. Excavation of remnants of the previous structures which may include former floor slabs, foundations, piping, or tank sections etc. may also be required. Excavation of such elements will be slower and require increased excavation effort.

The sides of the excavations should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the silty clay can be classified as Type 3 and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical extending upwards from the base of the excavation.

If excavation below the groundwater level and into very loose soils is carried out the soils can be classified as Type 4 – noting that where more than one soil Type is encountered in an excavation the highest soil Type is applied over the full depth of the excavation. Therefore, for design purposes if deeper excavations are planned, allowance should be made for 1 horizontal to 3 vertical, or flatter, excavation slopes, or where possible the depth of excavation should be limited.

5.1.2 Groundwater Management

Groundwater inflow from the weathered crust is not anticipated to be significant. The groundwater inflow from the overburden deposits, if any, should be controlled by pumping from sumps within the excavation where required. Suitable detention and filtration will be required before discharging the water to a sewer or ditch.

Perched groundwater zones should be anticipated within granular layers of fill material which may yield significant inflow rates when initially encountered in excavations (but should reduce with time).

The rate of groundwater inflow from the overburden deposits is not expected to exceed 50,000 litres per day, as such the water takings for this project will likely not be subject to an Environmental Activity and Sector Registry (EASR) in accordance with Environmental Protection Act Part II.2 Section 20.21. To prevent potential construction delays, a provisional EASR may be considered depending on duration of excavation, trench size and to account for contingencies related to stormwater infiltration.

To minimize groundwater management requirements, it is recommended that construction be undertaken during the dry period of the year (i.e. June to September).

The silty clay at this site is sensitive to disturbance from water and construction traffic. To minimize disturbance to the subgrade, excavation to final grade should be carried out with an excavator equipped with a bucket that has a flat blade. Refer to Section 5.2.3 for further considerations.

5.1.3 Foundation Design

The following comments are provided for the design of spread and pad footing foundations for the store and canopy;

- The fill material encountered in all 3 of the boreholes is not considered suitable for the support of the loads from the foundations (or the slab on grade). All fill material should be removed from the structure footprints and foundation zone of influence, including below any slabs on grade.

- The grade raise material within the zone of excavation should consist of OPSS Granular B Type II, should be placed in maximum 200-millimetre-thick lifts and be compacted to at least 98 percent of the standard Proctor dry density value using a 10 tonne vibratory steel drum roller under the supervision of geotechnical personnel.

- To provide adequate spread of load below the structure, any granular material placed should extend at least 0.5 metres horizontally beyond the edge of the structure and down and out from this point at 1 horizontal to 1 vertical, or flatter (which defines the zone of influence for the foundations).

The allowable bearing pressures for spread footing foundations on the native silty clay underling the fill material at this site are based on the necessity to limit the stress increase on the firm, compressible grey silty clay to an acceptable level such that foundation settlements will not be excessive. Four important parameters in calculating the stress increase on the grey silty clay are:

1) The thickness of the silty clay material beneath the bottom of the footings;

2) The size and type (i.e. pad or strip) of the foundations;

3) The amount of surcharge (fill, etc.) in the vicinity of the foundations; and

4) The magnitude and type of ground floor loading.

Bearing values for spread footing foundations for the convenience store bearing upon the native weathered crust, or a pad of engineered fill material over the weathered crust are presented in the Table 5.1. The bearing values for the convenience store assume the underside of footing level will be constructed at a maximum depth of 1.8 metres below the existing ground surface (i.e. elevation 80.7 metres).

Bearing values for spread footing foundations for pad footing foundations for the canopy bearing on the native weathered crust, or a pad of engineered fill material over the weathered crust at a maximum depth of 2.5 metres are presented in the Table 5.2.

Table 5.1 – Preliminary Bearing Values for Convenience Store

Footing Type	Underside of Footing Elevation (metres)	Maximum Footing Size (metres)	Net Geotechnical Reaction at Serviceability Limit State (kilopascals)	Factored Geotechnical Resistance at Ultimate Limit State (kilopascals)
Strip	80.7 or higher	1.0	100	250
Pad	80.7 or higher	3.0 x 3.0	100	250

Table 5.2 – Preliminary Bearing Value for Canopy

Footing Type	Underside of Footing Elevation (metres)	Maximum Footing Size (metres)	Net Geotechnical Reaction at Serviceability Limit State (kilopascals)	Factored Geotechnical Resistance at Ultimate Limit State (kilopascals)
Pad	80.0 or higher	4.0 x 4.0	90	200

The bearing values provided in Tables 5.1 and 5.2 take into account seasonal groundwater lowering up to a depth of 4 metres below the existing finished grade, a sustained floor slab live load of 2.0 kilopascals, and assume a finished grade similar to the existing grade level.

These values are preliminary and should be re-evaluated as the design progresses based on founding depth, footing spacing, and footing sizes. Construction records for the existing structures at the site, if available and provided to GEMTEC, could also be considered in the evaluation of the permissible foundation loads for the proposed structures.

There are many other possible combinations of founding depths, footing sizes and thickness of grade raise fills that might be suitable for this site. All other alternatives, however, must be checked by the geotechnical engineer to ensure that overstressing of the softer silty clay soil

does not occur, as this could result in excessive settlement and cracking/distress of the structures. The allowable bearing pressures given in the above tables may have to be reduced if:

- The footing sizes are larger than those given above or the footings are founded at a different depth;
- The amount of grade raise fill is greater; or
- The sustained ground floor slab live loads exceed about 2.0 kilopascals.

Provided that the soil at and below the founding level is not disturbed, and all loose, disturbed or water softened soil is removed from beneath the foundations, the total and differential settlement of the footings under SLS conditions could be taken as 25 and 20 millimetres, respectively.

In the instance that spread footing foundations are not preferable for this site consideration could also be given to supporting the structures on deep (pile) foundations. Further discussion on suitable pile foundation types can be provided if required.

5.1.4 Frost Protection of Foundations

At least 1.5 metres of earth cover should be provided for footings of heated structures. Isolated, exterior footings constructed in areas that are to be cleared of snow during the winter period, such as the pump island foundation, should be provided with at least 1.8 metres of earth cover for frost protection purposes. Where less than the required depth of soil cover can be provided, the footings can be protected from frost by using a combination of earth cover and extruded polystyrene insulation.

If the foundations and slab on grade are insulated in a manner that will reduce heat flow to the surrounding soil, the foundation depth shall conform to that required for foundations containing no heated space (i.e., 1.8 metres).

An insulation detail could be provided upon request as the design progresses.

5.1.5 Seismic Design of Proposed Structures

In accordance with the 2012 National Building Code of Canada and the Ontario Building Code, Site Class E should be used for the design of the proposed project.

A higher Site Class may be achieved if additional testing by geophysical methods is carried out. The results of the testing may have significant savings for the structural design.

In our opinion, there is no potential for liquefaction of the overburden deposits at this site.

5.1.6 Foundation Wall Backfill and Drainage

The native soil deposits at this site are highly frost susceptible and should not be used as backfill against foundations, tanks or other structures etc.

The backfill material should consist of imported sand or sand and gravel meeting OPSS requirements for Granular B Type I or II. Where the backfill will ultimately support areas of hard surfacing (pavement, sidewalks, parking areas or other similar surfaces), the backfill should be placed in maximum 200 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

Where future landscaped areas will exist next to the proposed structures and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value.

Where areas of hard surfacing (concrete, sidewalk, pavement, etc.) abut the proposed building, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible native materials to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from 1.5 metres below finished grade to the underside of the granular base/subbase material for the hard surfaced areas. The frost tapers should be sloped at 2 horizontal to 1 vertical, or flatter.

Perimeter foundation drainage is not considered necessary for slab on grade structures at this site provided that the floor slab level is above the finished exterior ground surface level.

5.1.7 Slab on Grade Support (Heated Areas Only)

To prevent long term settlement of the floor slabs, all topsoil, fill, organic, loose, wet or deleterious material should be removed from below the slabs on grade. The subgrade surface should then be proof rolled with a vibratory drum roller under dry conditions. However, if moist to wet granular material (i.e. silt, sandy silt, or silty sand) is encountered at the subgrade level, the proof roll should be completed in the presence of experienced geotechnical personnel, without vibration.

The grade could then be raised, where necessary using material meeting OPSS Granular B Type II requirements. The granular base for the proposed slab on grade should consist of at least 300 millimetres of OPSS Granular A.

All imported granular materials placed below the proposed floor slabs should be compacted in maximum 200-millimetre-thick lifts to at least 95 percent of the standard Proctor maximum dry density value.

Underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior ground surface level.

The floor slabs should be constructed in accordance with guidelines provided in ACI 302.1R-04 “Guide for Concrete Floor and Slab Construction”.

A polyethylene vapour barrier should be installed below the floor slabs.

5.2 Proposed Underground Fuel Storage Tanks

It is understood that the service station will contain two (2) underground fuel storage tanks located within the north side of the site.

5.2.1 Open Cut Excavation

Based on information provided to us, an excavation depth of 4.6 metres will be required for the installation of the fuel storage tanks. As such, the excavation for the proposed underground storage tanks will be likely be carried out through pavement structure, fill material, and native deposits of silty clay inclusive of layers of silt or sands.

The sides of the excavations should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act for Type 3 soil, provided the excavations remain within the weathered crust or upper portion of the grey silty clay.

Notwithstanding, due to the proposed locations of the tanks, it is our opinion that it is not practicable to excavate to the base of the proposed fuel tanks without excavations encroaching onto the adjacent property / effecting the soils at the adjacent property. As such, the use of temporary shoring is likely required in order to place the new fuel tanks. The excavation could be carried out near vertically using a temporary soil retaining wall (e.g. driven steel sheet piling) or other shoring system designed specifically for this purpose.

Any groundwater inflow should be pumped from the excavation. Suitable detention and filtration will be required before discharging the water to a sewer or ditch.

The groundwater levels could be higher than those observed during our investigation due to both seasonal fluctuations and water seepage into the granular backfill material, therefore, the design and installation of the tanks should consider the tank manufacturer’s recommendations for managing hydrostatic pressures and buoyant uplift. As a conservative design approach, we recommend that the ground water level be assumed at the underside of the pavement structure for buoyancy calculations.

5.2.2 Temporary Retaining Wall

Different retaining wall systems will provide different amounts of stiffness and ability to resist ground movements, manage groundwater, etc. However, some unavoidable inward horizontal

movement and settlement should be anticipated with all the available options. Retaining wall systems commonly used to provide shoring to excavations include:

- Proprietary trenching / shoring systems;
- Steel soldier piles and lagging (timber or concrete);
- Driven steel interlocking sheet piles;

Proprietary trenching / shoring systems, similar to trench boxes, are advanced as the excavation proceeds and allow some movement of soils around the perimeter of the system to occur. The magnitude of movement depends on how tightly fitting the system is to the surrounding soils. Boulders in soil units below the perimeter of the system require removal and will cause increased disturbance around the perimeter of the system – however would not be anticipated in the weathered crust, or silty clay. In extreme cases instability of the soils around the perimeter of the system may occur. These systems do not provide a cut off to groundwater.

A soldier pile and lagging wall system may be acceptable to reduce the impact of excavation on nearby structures which can accommodate a higher degree of ground movement, such as roadways. The soldier piles (typically steel H sections) would have to be driven through glacial till containing boulders and hence pre-drilling of the piles may be required prior to driving the piles.

Sheet piles can control or cut off ground water inflow. However, sheet piles are generally not suitable for soils in which frequent boulders or other hard strata are anticipated (such as the glacial till). Pre-drilling may also be used to reduce the risk of shallow refusal occurring for sheet pile walls.

Where a smaller magnitude of shoring and ground movement can be tolerated, for instance to protect building foundations within the zone of influence of the retained soil mass, stiffer shoring systems using auger bored cast in-situ concrete piles may be necessary. These types of shoring can also control or cut off ground water inflow. Further details can be provided if these systems are to be considered further.

Depending on the depth of excavation, the shoring methods listed may require some form of lateral support depending on the wall height and configuration. Commonly used lateral restraint systems which may be considered in this instance include:

- Interior struts which are connected to the opposite side of the excavation; and,
- Circular or rectangular waler beams (ring beams).

The design and implementation of the excavation shoring is the responsibility of the contractor. It is recommended that any successful bidder submit a shoring system design, including lateral earth pressure design details, expected movements, and a monitoring plan for review by the geotechnical engineer prior to the start of the shoring construction. The design of the shoring

system to support the excavation must consider: the soil stratigraphy including presence of boulders / obstructions / hard strata, groundwater conditions, methods of groundwater management, possible ground movements associated with the construction of the shoring system, excavation and other potential impacts, and / or requirements to protect the system during freezing weather conditions (if applicable).

When designing shoring, lateral earth pressures resulting from the weight of the retained earth and other dead and surcharge loads will need to be considered. Values of static lateral earth pressure coefficients (at rest, active and passive) are provided in Table 5.3 – noting that some rounding of values has been applied. Hydro-static water pressures should also be accounted for where non-permeable or low permeability wall systems are used, or where there is potential for hydro-static pressures to develop on the wall. The earth pressure distribution used for shoring design is dependent on the shoring wall design and the lateral support provided.

In addition to reducing movement on building foundations, consideration should also be given to the presence of movement sensitive underground utilities in the selection of the appropriate shoring support system. The necessity for rigid shoring systems can be assessed as details of the proposed structure(s) are confirmed.

The silty clay deposit at this site is sensitive to disturbance from ponded water, vibration and construction traffic. As such, it is suggested that final trimming to subgrade level be carried out using a hydraulic shovel equipped with a flat blade bucket.

Table 5.3 – Summary of Soil Parameters for Lateral Earth Pressures, Static Conditions

Parameter	OPSS Granular B Type I	OPSS Granular B Type II, Or Granular A	Silty Clay
Moist / Wet Material Unit Weight, γ (kN/m^3)	22	23	17
Buoyant Unit Weight, γ‘ (kN/m^3)	12	13	7
Estimated Friction Angle (degrees)	34	36	26
“At Rest” Earth Pressure Coefficient, K_o	0.44	0.41	0.56
“Active” Earth Pressure Coefficient, Ka	0.28	0.26	0.39
“Passive” Earth Pressure Coefficient, K_p	3.54	3.87	2.57

5.2.3 Base of Excavation and Subgrade Protection

As noted in Section 5.2, based on the anticipated excavation depth and the subsurface conditions encountered in the boreholes, stiff to very stiff silty clay is anticipated at the design excavation depth. However, the subsurface conditions beyond the borehole locations may slightly differ and as excavation is carried out, there is potential for soils to be encountered which are very sensitive to disturbance from construction traffic, ponded water etc., and which may soften/loosen rapidly. Further, potential exists for some upward groundwater flow to occur at the base of the excavation also leading to softening of the soils. As such, some unavoidable disturbance and softening to the subgrade surface is likely to occur. To reduce the effects of these occurrences, GEMTEC recommends the following:

- Where possible, construction works should be staged to allow for protection of the subgrade to be completed within a working day. Excavations to final levels may be carried out in staged areas where practical;

- Construction traffic over the unprotected subgrade surface should be avoided wherever practical;

- Geotechnical personnel should be available at the time of excavation to the final subgrade surface to carry out inspections as soon as practical and allow for backfilling to commence. Full time supervision of the excavation is preferable to prevent delay;

- Following approval, the exposed surface at the base of excavation could be protected with a mud mat of low strength concrete. Alternatively, a mat of coarse angular rock fill in combination with a non-woven Class II geotextile separator layer – however a mud mat is likely preferable in this case assuming heavy construction equipment will not be operating at the base of the excavation; and,

- Over-excavation or subexcavation should be avoided or minimised wherever practical as deepening the excavation below the groundwater level may present additional constraints.

To further reduce the risk of disturbance of soils during excavation, the groundwater level should be kept at least 0.3 metres below the excavation base where possible. Notwithstanding, some disturbance and loosening of the materials could occur, and allowance should be made for subexcavation and additional engineered fill material placement.

5.2.4 Buoyant Uplift

The tanks should be designed to resist hydrostatic uplift due to water pressures acting on the base of the tanks. The groundwater levels could be higher than the levels provided in this

document, as a result of seasonal fluctuations, elevated groundwater levels, and surface water seepage into the granular backfill material, therefore, as a conservative design approach, we recommend that the ground water level be assumed near ground surface to determine the uplift force acting on the tanks / for buoyancy computations.

In the case that additional resistance to uplift is required, it could be provided by one or a combination of the following:

- Fixing the tanks to a concrete base and extending the base beyond the tank walls;
- Increasing the dead weight of the tank or installing the tanks in a concrete chamber; and/or,
- Installation of anchors (although the suitability of this measure at the site would need to be investigated further).

The design and installation of the tanks should consider the tank manufacturer's recommendations for managing hydrostatic uplift pressures / buoyancy.

5.2.5 Tank Bedding

The bedding (and haunching materials) for the tanks should conform to the tank manufacturer's requirements for grain size distribution and compaction requirements.

If a concrete slab is provided below the tank bedding the guidance provided in Section 5.1.7 should be considered.

5.2.6 Tank Backfilling

To prevent frost adhesion and possible heaving, the tanks should be backfilled with a free draining, non-frost susceptible granular material which meets the tank manufacturer's requirements. OPSS Granular A may be suitable for this purpose, depending on the manufacturer's requirements around material grading (which would supersede our recommendations). Controlled low strength material (CLSM), or flowable fill may also be a possible option.

Where the backfill will ultimately support areas of hard surfacing (pavement, sidewalks or other similar surfaces), the backfill should be placed in suitable lift thicknesses and should be compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment. The size and type of vibratory equipment used should not cause damage to the tanks. Unless otherwise approved by the tank manufacturer the backfill material should be placed concurrently on the sides of the tank such that the difference in levels of backfill on the sides at any transverse section does not exceed 0.2 metres.

Where future landscaped areas will exist next to the proposed tanks and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value.

Where areas of hard surfacing (concrete, sidewalk, pavement, etc.) abut the proposed tanks, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular backfill and those areas underlain by existing frost susceptible soil to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from the maximum depth of frost penetration (i.e. 1.8 metres below ground surface). The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

5.2.7 Earth Pressures on Tank Walls

For design purposes, the earth pressure parameters previously provided in Table 5.3 could be used to calculate the lateral earth pressure on the underground fuel storage tank under static loading conditions in combination with hydrostatic water pressures. The lateral pressures due to compaction should also be considered in the design. The magnitude of the compaction surcharge pressure depends on the mass and type of compaction equipment. Typical values can be provided if required.

Seismic loading may cause increased earth pressures on the tank walls. Additional information on this aspect can be provided as the design progresses and the details of the tank configuration and backfilling approach are known.

5.3 Corrosion of Buried Concrete and Steel

The measured sulphate concentration in the soil sample recovered from borehole 23-3 is 182 micrograms per gram. According to Canadian Standards Association (CSA) “Concrete Materials and Methods of Concrete Construction”, the concentration of sulphate in the soil and groundwater can be classified as low. For low exposure conditions, any concrete that will be in contact with the native soil or groundwater should be batched with General Use (formerly Type 10) cement. The design of any concrete should take into consideration freeze thaw effects and the presence of chlorides.

Based on the resistivity and pH of the soil sample recovered from borehole 23-3, the soil and groundwater can be classified as slightly aggressive towards unprotected steel. The manufacturer of any buried steel elements that will be in contact with the soil and groundwater should be consulted to determine the durability of the product used. It is noted that the corrosivity of the ground water could vary throughout the year due to the application sodium chloride for de-icing.

5.4 Site Services

5.4.1 Excavation for the Services

The planned depth of services was not known at the time the report was written. However, it is anticipated that the excavations for the site services will likely be carried out through overburden materials composed of pavement structure, fill material, and weathered crust.

The excavation for services in these materials should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the clayey silt can be classified as Type 3 and allowance should be made for 1 horizontal to 1 vertical side slopes extending upwards from the base of the excavation. Alternatively, the excavations could be carried out near vertically within a tightly fitting, braced steel trench box designed specifically for this purpose.

Groundwater inflow into the excavations for the proposed sewer and watermain services should be handled by pumping from within the excavations. It is not expected that short term pumping during excavation will have a significant effect on nearby structures and services. It is noted that the existing sewers and watermain likely have a bedding and surround composed of granular material and that water inflow into the trenches through the bedding and surround could be significant, at least initially.

5.4.2 Pipe Bedding

The bedding for the proposed sewers and watermain should be in accordance with Ontario Provincial Standard Drawing (OPSD) 802.010 for Type 3 Soil. The pipe bedding material should consist of at least 150 millimetres of well graded crushed stone meeting Ontario Provincial Standard Specification (OPSS) for Granular A.

In areas where the subsoil is disturbed or where unsuitable material (such as fill, organic soil, or existing trench backfill material) exists below the pipe subgrade level, the disturbed/unsuitable material should be removed and replaced with a subbedding layer of compacted granular material, such as that meeting OPSS Granular B Type II (50 or 100 millimetre minus crushed stone). Allowance should be made to place a 150-to-300-millimetre thick subbedding layer of OPSS Granular B Type II below the bedding material if soft to firm, grey silty clay / clayey silt is encountered at the level of the service pipe. The use of clear crushed stone as a bedding or subbedding material should not be permitted.

It is noted that the silty clay deposits at this site are sensitive to disturbance and construction traffic. Disturbance to the clay silt subgrade can occur during excavation due to flow of soil between the teeth on a standard bucket. To reduce disturbance, the excavating equipment could be equipped with a bucket with a flat blade.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A.

The subbedding, bedding and cover materials should be compacted in maximum 200-millimetre-thick lifts to at least 95 percent of the standard Proctor dry density value.

5.4.3 Trench Backfill

In areas where the service trench will be located below or in close proximity to existing or future areas of hard surfacing (pavement, sidewalk, etc.), acceptable native materials should be used as backfill between the roadway subgrade level and the depth of seasonal frost penetration in order to reduce the potential for differential frost heaving between the area over the trench and the adjacent hard surfaced area. The depth of frost penetration in exposed areas can normally be taken as 1.8 metres below finished grade. Where native backfill is used, it should match the native materials exposed on the trench walls. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material or imported granular material conforming to OPSS Granular B Type I.

It is anticipated that most of the inorganic overburden materials encountered during the subsurface investigation will be acceptable for reuse as trench backfill. Any topsoil or organic soil should be wasted from the trench.

To minimize future settlement of the backfill and achieve an acceptable subgrade for the roadways, sidewalks, etc., the trench backfill should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. The specified density may be reduced to 90 percent of the standard Proctor dry density in areas where the trench backfill is not located below or in close proximity to existing or future roadways, parking areas, sidewalks, etc. (i.e. landscaped areas) and provided that some settlement above the trench is acceptable.

The grey silty clay/clayey silt deposits likely have water contents that are too high for adequate compaction. Furthermore, depending on the weather conditions at the time of construction, some wetting of materials could occur. As such, the specified densities may not be possible to achieve and, as a consequence, some settlement of these backfill materials should be expected. Consideration could be given to implementing one or a combination of the following measures to reduce post construction settlement above the trenches, depending on the weather conditions encountered during the construction:

- Allow the overburden materials to dry prior to compaction;

- Reuse any wet materials in the lower part of the trenches and make provision to defer final placement of the final lift of the asphaltic concrete for 3 months, or longer, to allow

some of the trench backfill settlement to occur and thereby improve the final pavement appearance.

- Avoid reusing any wet material within the trench. If additional material is required for trench backfill, consideration could be given to using imported relatively dry earth fill material or imported OPSS Select Subgrade Material below the zone of frost penetration.

5.4.4 Seepage Barriers

To prevent the granular bedding in the services trench from acting as a “French Drain” and thereby promoting groundwater lowering below that which was assumed in the analysis, seepage barriers should be installed along the service trenches just inside the property lines. The seepage barriers should begin at subgrade level and extend vertically through the granular pipe bedding and granular surround to within the native backfill materials, and horizontally across the full width of the service trench excavation. The seepage barriers could consist of 1.5-metre-wide dykes of compacted weathered silty clay. The weathered silty clay should be compacted in maximum 300-millimetre-thick lifts to at least 95 percent of the standard Proctor dry density value. The locations of the seepage barriers could be provided at the final design stage.

5.5 Access Roadways and Parking Areas

5.5.1 Subgrade Preparation

In preparation for the construction of the access roadway and parking area at this site, all surficial topsoil, and any loose/soft, wet, organic or deleterious materials should be removed from the proposed subgrade surface.

Where fill material is encountered it may not be necessary to remove all of the fill material from within the roadway / parking areas, subject to inspection by a geotechnical practitioner and provided that some future settlement of the surface and pavement cracking can be tolerated. It is, however, suggested that any exposed fill material or former topsoil which contains an abundance of organic material or otherwise deleterious material be subexcavated and replaced.

Any subexcavated areas could be filled with compacted earth borrow. Any grade raise fills for the roadway and parking could consist of material which meets OPSS specifications for Granular B Type I or II, Select Subgrade Material, or suitable earth borrow. The Granular B Type I or II, Select Subgrade Material or earth borrow should be placed in maximum 300 millimetres thick lifts and compacted to at least 95 percent of the standard Proctor maximum dry density value using vibratory compaction equipment. It is noted, however, that silt and clay earth borrow materials are sensitive to changes in moisture content, precipitation and frost heaving. As such, unless the earth material placement is planned during the dry period of the

year (June to September), precipitation and freezing conditions may restrict or delay adequate compaction of these materials. Based on our experience, silt and clay materials should be compacted within 0 to 4 percent above the optimum moisture content, as defined by the standard Proctor test, to reduce the post construction settlement of the fill material. Depending on the weather conditions, it may be necessary to allow the material to dry prior to compaction.

The subgrade surfaces should be proof rolled with a 10 tonne (minimum) smooth steel drum roller and shaped and crowned to promote drainage of the granular materials. If wet subgrade conditions exist, the proof rolling should be omitted as this would likely result in disturbance to the subgrade.

5.5.2 Flexible Pavement Structures for the Parking Lots and Access Roadways

It is suggested that roadway and parking areas be constructed using the following minimum pavement structure:

- 100 millimetres asphaltic concrete, over
- 150 millimetres of OPSS Granular A base, over
- 450 millimetres of OPSS Granular B Type II subbase

The 100 millimetres asphaltic concrete surface should consist of 40 millimetres of Superpave 12.5 (Traffic Level B) over 60 millimetres of Superpave 19.0 (Traffic Level B). Performance grade PG 58-34 asphaltic concrete should be specified. This pavement structure is suitable for both light and heavy-duty vehicle access.

Where the new pavement will abut existing pavement, the depths of the granular materials should taper up or down at 5 horizontal to 1 vertical, or flatter to match the depths of the granular material(s) exposed in the existing pavement.

If the granular pavement materials are to be used by construction traffic, it may be necessary to increase the thickness of the Granular B Type II, install a woven geotextile separator between the roadway subgrade surface and the granular subbase material, or a combination of both, to prevent pumping and disturbance to the subbase material. The contractor should be made responsible for their construction access.

Adequate drainage of the pavement granular materials and subgrade is important for the long term performance of the pavement at this site. The subgrade surfaces should be crowned and shaped to drain to the ditches and the catch basins to promote drainage of the pavement granular materials.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Basal Instability

For excavations in firm silt and clay, basal instability results when the shear strength of the soil below an excavation is not able to support the loads imposed by the differences in grades inside and outside of the excavation. The factor of safety against basal instability depends on excavation geometry, as well as the shear strength and unit weight of the surrounding soil. Based on the subsurface conditions and anticipated maximum excavation depth of 4.6 metres, the excavation will have an adequate factor of safety against basal instability (i.e., the shear strength of the soil below the excavation is able to support the loads imposed by the differences in grade inside and outside of the excavation). For excavations below 4.6 metres depth, additional analysis is required to determine the potential for basal instability during excavation.

6.2 Backfilling following Removal of Existing Tanks

It is recommended that where excavations for removal of existing / former tanks and other buried structures is carried out, in areas where excavation is located below or in close proximity to existing or future areas of hard surfacing (pavement, sidewalk, etc.), acceptable materials matching the native materials exposed on the excavation walls should be used in the upper portion of the backfill between the roadway subgrade level and the depth of seasonal frost penetration. The depth of frost penetration in exposed areas can normally be taken as 1.8 metres below finished grade.

Backfill below the zone of seasonal frost penetration in the excavation could be infilled with compacted acceptable native material from other excavations at the site, or imported materials such as OPSS Select Subgrade Material, or granular material conforming to OPSS Granular B Type I or II requirements.

This is recommended to reduce the potential for differential frost heaving between the area over the excavation and the adjacent hard surfaced area.

6.3 Effects of Construction Induced Vibration

Some of the construction operations (such as granular material compaction, excavation, pile driving, etc.) will cause ground vibration on and off of the site. The vibrations will attenuate with distance from the source but may be felt at nearby structures. We recommend that preconstruction surveys be carried out on the adjacent structures to mitigate potential claims.

6.4 Winter Construction

If construction is required during freezing temperatures, the soil below the proposed structures should be protected immediately from freezing using straw, propane heaters and insulated tarpaulins, or other suitable means.

Any open excavations should be opened for as short a time as practicable. The materials on the sides of the excavation should not be allowed to freeze. In addition, the backfill should be excavated, stored and replaced without being disturbed by frost or contaminated by snow or ice.

Provision must be made to prevent freezing of any soil below the level of any existing structures or services. Freezing of the soil could result in damage to structures or services.

7.0 CLOSING

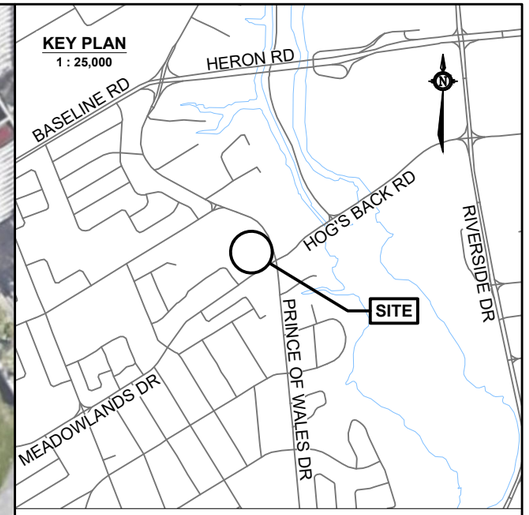
We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Luc Bouchard, P.Eng., ing.

LB/DC

APPENDIX A

Borehole Location Plan, Figure A1



LEGEND

BH/ MW # — BOREHOLE/ MONITORING WELL ID

XX.XX — GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

BOREHOLE LOCATION (current investigation by GEMTEC)

APPROXIMATE SITE BOUNDARY

GENERAL NOTE(S)

1. Coordinate system: NAD83, UTM ZONE18N.
2. Contains information licensed under the Open Government Licence – Ontario.
3. Maps Data: Google, @2023 CNES / Airbus, First Base Solutions, Maxar Technologies.
4. Geographic dataset source: Ontario GeoHub.
5. "Site Initial Layout" plan is provided by AECOM, Sheet Number: C101-0, date: 2023-06-07

SCALE 1:1000

0 20 40 60m

DRAWING

BOREHOLE LOCATION PLAN

CLIENT

AECOM

PROJECT

GEOTECHNICAL INVESTIGATION
1440 PRINCE OF WALES DRIVE
OTTAWA, ONTARIO

DRAWN BY	CHECKED BY
S.L.	L.B.
PROJECT NO.	REVISION NO.
100041.011	1
DATE	FIGURE NO.
AUGUST 2023	**FIGURE A1**

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS
32 Steacie Drive
Ottawa, ON, K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

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APPENDIX B

Record of Borehole Sheets
List of Abbreviations and Terminology

RECORD OF BOREHOLE 23-1

CLIENT: AECOM Canada Ltd.
PROJECT: 1440 Prince of Wales Drive, Ottawa, Ontario
JOB#: 100041.011
LOCATION: See Borehole Location Plan, Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Aug 10 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		82.59						
0	Hydrovacuum	100mm ASPHALTIC CONCRETE		82.49 / 0.10						Backfilled with crushed stone and topped with cold patch asphalt
		Grey clayey sand and gravel (BASE/SUBBASE MATERIAL)		82.14 / 0.45	1	GS		-		
1		Grey brown silty clay, some sand, trace organic material (FILL MATERIAL)			2	GS		-		
				81.07 / 1.52						
2		Stiff to very stiff, grey brown silty clay, trace fine sand (WEATHERED CRUST)			3	SS	610	9	MH	
					4	SS	610	15		
3					5	SS	610	7		
4					6	SS	610	3	MH	
				77.72 / 4.87	7	SS	610	4		
5	Power Auger Hollow Stem Auger (210mm OD)	Stiff, grey SANDY CLAYEY SILT								Backfilled with bentonite
					8	SS	610	2	MH	
6				76.49 / 6.10						
		Stiff, grey SILTY CLAY								
7					9	SS	610	WH		
				74.37 / 8.22						
8		Very loose to compact, grey SILT, trace to some clay, trace gravel			10	SS	610	3		
9					11	SS	610	17		
				72.84 / 9.75						
10		End of Borehole								
11										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

GEMTEC
Consulting Engineers and Scientists

LOGGED: C.C.
CHECKED: L.B.

GEO - BOREHOLE LOG 100041.011_GINT LOGS V01_2023-08-14.GPJ GEMTEC 2018.GDT 23/9/7

RECORD OF BOREHOLE 23-2

CLIENT: AECOM Canada Ltd.
PROJECT: 1440 Prince of Wales Drive, Ottawa, Ontario
JOB#: 100041.011
LOCATION: See Borehole Location Plan, Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Aug 11 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0		Ground Surface		82.46				
		100mm ASPHALTIC CONCRETE		82.36				
	Hydrovacuum	Grey brown clayey gravel, trace to some sand (FILL MATERIAL)		0.10	1	GS		-
1					2	GS		-
				80.94				
		Stiff to very stiff, grey brown silty clay, trace fine sand (WEATHERED CRUST)		1.52	3	GS		-
2					4	SS	610	10
					5	SS	610	8
3					6	SS	610	4
4					7	SS	610	2
5					8	SS	610	2
	Power Auger / Hollow Stem Auger (210mm OD)			76.67				
6		Stiff to firm, grey SILTY CLAY, trace to some silt seams		5.79	9	SS	610	WH
7								
8					10	SS	610	2
				74.08				
		Loose, grey SILT, some clay, trace gravel		8.38	11	SS	610	8
9								
					12	SS	610	6
10					13	SS	610	8
				72.10				
		End of Borehole		10.36				
11								

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, % — W_P W W_L
10 20 30 40 50 60 70 80 90

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Backfilled with crushed stone and topped with cold patch asphalt

Backfilled with bentonite

GEMTEC
Consulting Engineers and Scientists

LOGGED: C.C.
CHECKED: L.B.

GEO - BOREHOLE LOG 100041.011_GINT LOGS V01_2023-08-14.GPJ GEMTEC 2018.GDT 23/9/7

RECORD OF BOREHOLE 23-3

CLIENT: AECOM Canada Ltd.
PROJECT: 1440 Prince of Wales Drive, Ottawa, Ontario
JOB#: 100041.011
LOCATION: See Borehole Location Plan, Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Aug 11 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		82.69				
0	Hydrovacuum	100mm ASPHALTIC CONCRETE		82.59				
		Grey brown sand and gravel, trace silt (BASE/SUBBASE MATERIAL)		0.10 82.08				
		Brown medium to coarse sand, trace silt (FILL MATERIAL)		0.61 81.79	1	GS		-
1		Grey brown silty clay, trace sand (FILL MATERIAL)		0.90 81.04	2	GS		-
				1.65	3	GS		-
2		Stiff to very stiff, grey brown silty clay (WEATHERED CRUST)			4	SS	610	6
					5	SS	610	5
3					6	SS	610	6
4					7	SS	610	2
				77.82 4.87	8	SS	610	1
5	Power Auger Hollow Stem Auger (210mm OD)	Stiff to firm, grey SILTY CLAY, trace silt seams						
6					9	SS	610	WH
7								
8					10	SS	610	1
				74.31 8.38				
		Very loose to loose, grey SILT, some clay, trace gravel			11	SS	610	1
9								
					12	SS	610	4
10					13	SS	610	6
				72.33 10.36				
		End of Borehole						
11								

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P W W_L
10 20 30 40 50 60 70 80 90

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Backfilled with crushed stone and topped with cold patch asphalt

Backfilled with bentonite

GEMTEC
Consulting Engineers and Scientists

LOGGED: C.C.
CHECKED: L.B.

GEO - BOREHOLE LOG 100041 011_GINT LOGS V01_2023-08-14.GPJ GEMTEC 2018.GDT 23/9/7

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

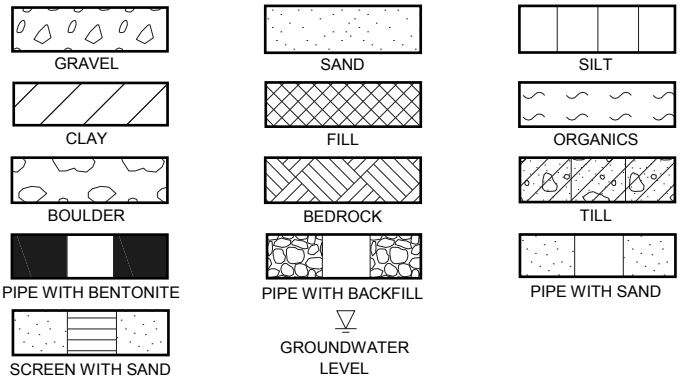
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

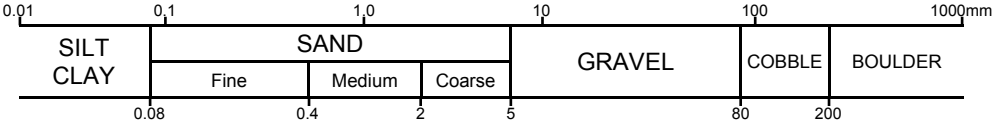
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	**Description**	**Cu, kPa**	**Description**
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard

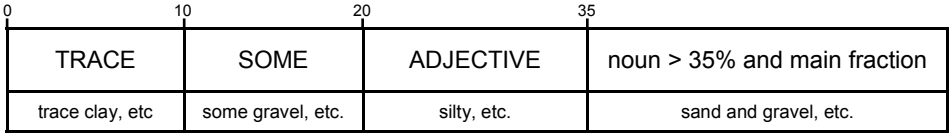


GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

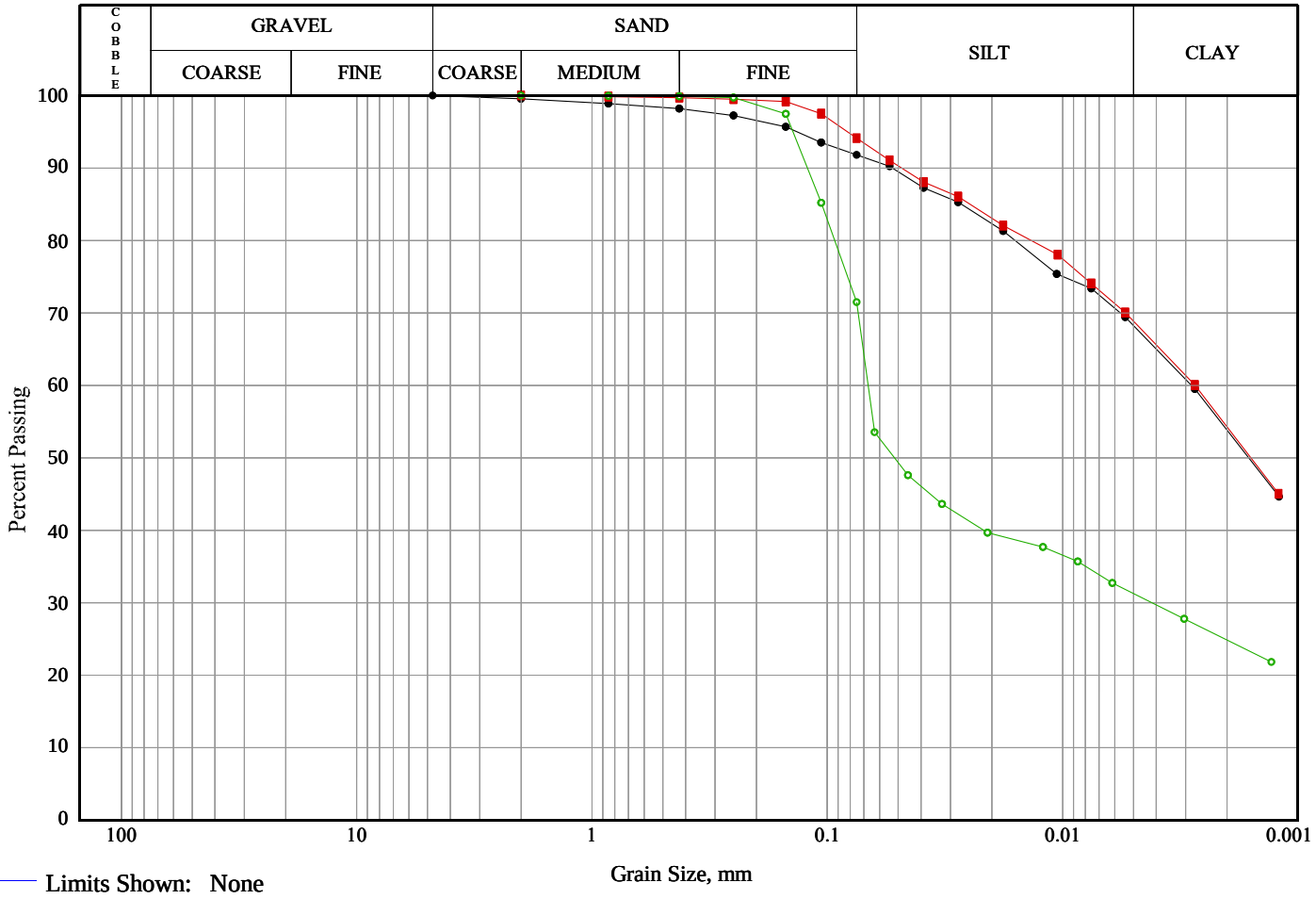
(Based on the CANFEM 4th Edition)



APPENDIX C

Results of Geotechnical Classification Testing

GEMTEC Consulting Engineers and Scientists	Client: AECOM Canada Ltd.	Soils Grading Chart (LS-702/ ASTM D-422)
	Project: Geotechnical Investigation, Inspection and Testing – Pro	
	Project #: 100041011	

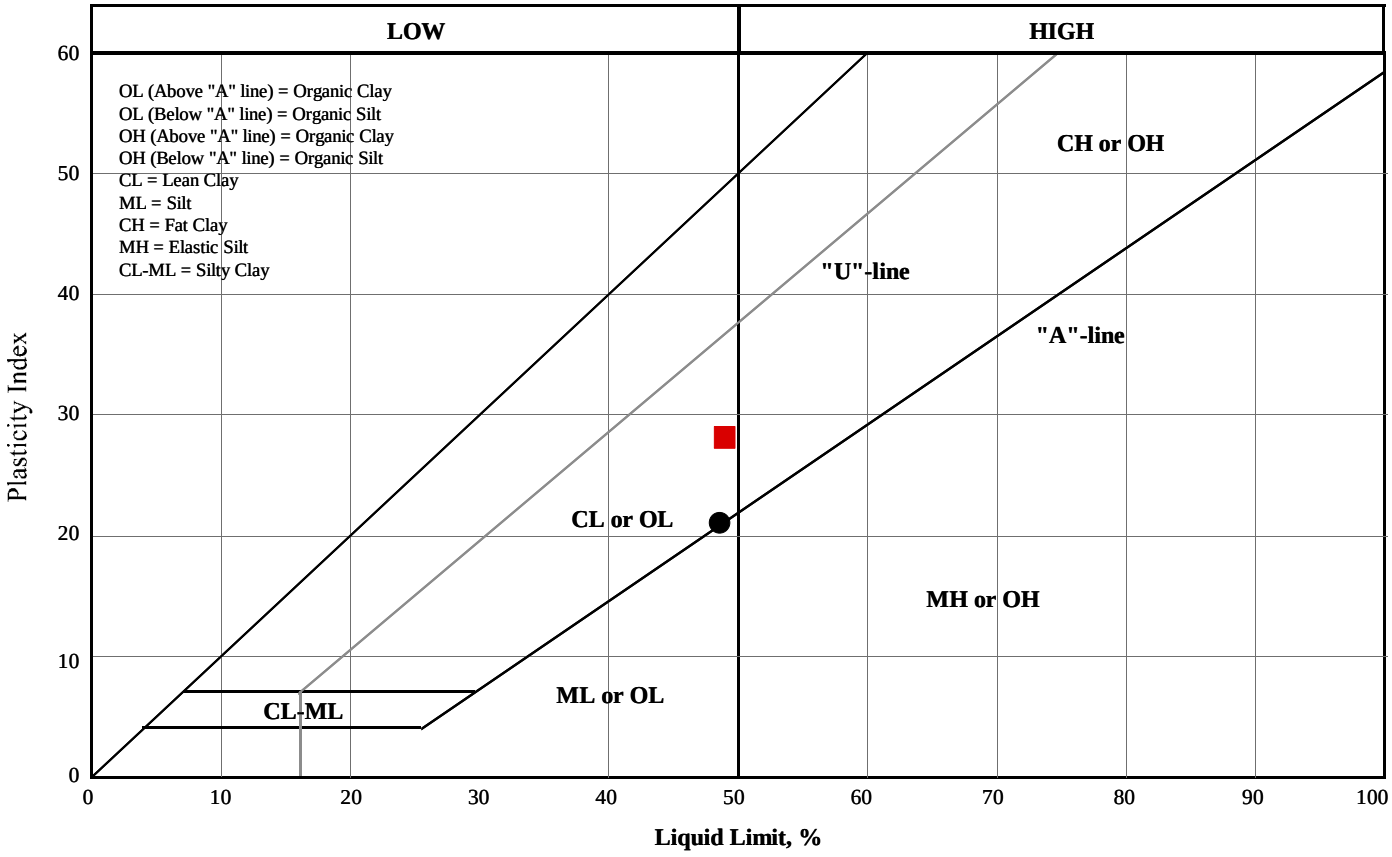


Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●	Weathered Crust	23-01	03	1.83-2.44	0.0	8.2	23.6	68.2
■	Weathered Crust	23-01	06	3.81-4.42	0.0	5.9	25.3	68.9
○		23-01	08	5.33-5.94	0.0	28.5	40.2	31.3

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
●	Silty clay , trace sand	CL	---	---	---	0.00	0.00	0.03	22.4
■	Silty clay , trace sand	CL	---	---	---	0.00	0.00	0.02	24.1
○	Sandy clayey silt	N/A	---	---	0.00	0.05	0.07	0.11	40.2

GEMTEC Consulting Engineers and Scientists	Client: AECOM Canada Ltd.	Plasticity Chart (D4318)
	Project: Geotechnical Investigation, Inspection and Testing – Pro	
	Project #: 100041011	



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	23-01	03	1.83-2.44	48.6	27.5	21.1	☐	39.77
■	23-01	06	3.81-4.42	48.9	20.8	28.1	☐	43.09

Note: More information available upon request

APPENDIX D

Chemical Analyses of Soil
Samples Relating to Corrosion
Order No. 2333496

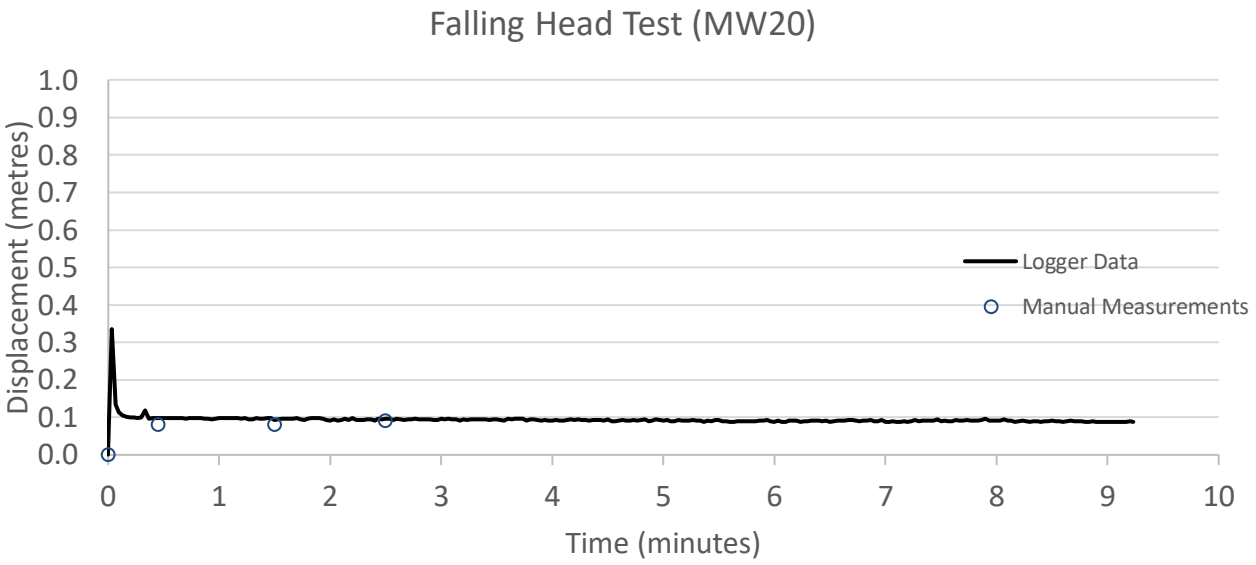
	Client ID:	BH 23-03 SA5 Depth 8'-10'	-	-	-		
	Sample Date:	10-Aug-23 14:00	-	-	-	-	-
	Sample ID:	2333496-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	69.3	-	-	-	-	-
General Inorganics							
Conductivity	5 uS/cm	1900	-	-	-	-	-
pH	0.05 pH Units	7.40	-	-	-	-	-
Resistivity	0.1 Ohm.m	5.3	-	-	-	-	-
Anions							
Chloride	10 ug/g	1200	-	-	-	-	-
Sulphate	10 ug/g	182	-	-	-	-	-

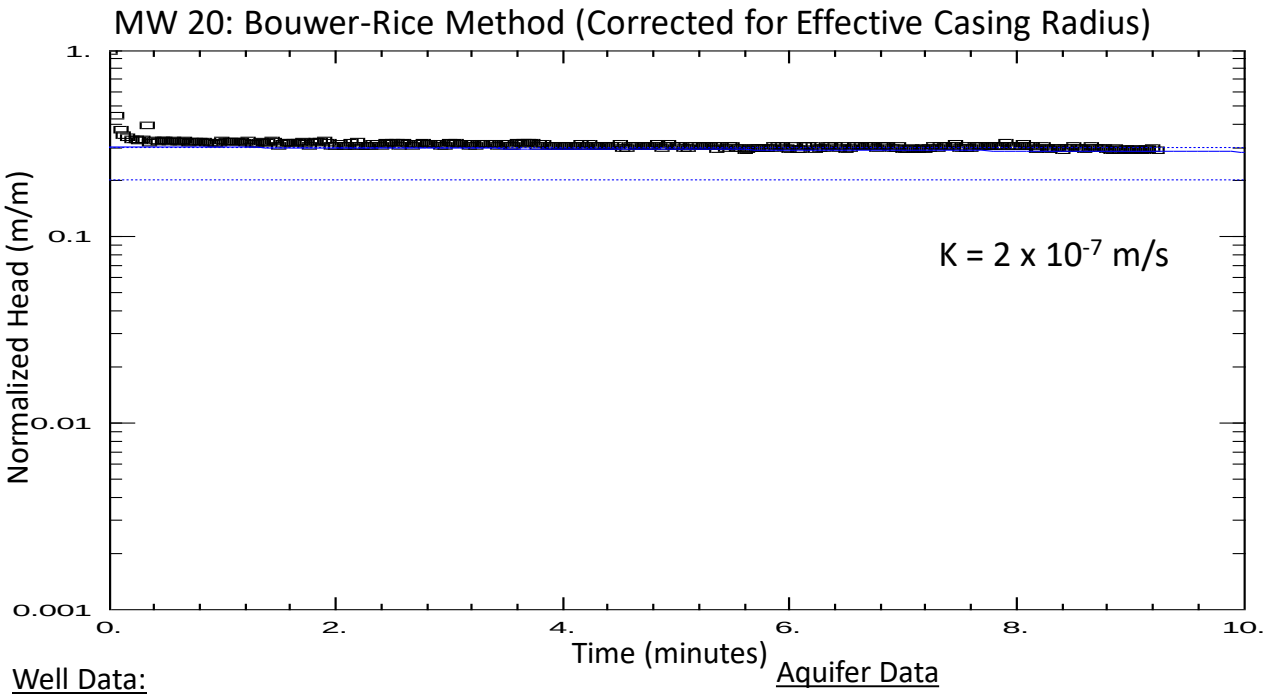
APPENDIX E

Hydraulic Conductivity Testing Results

Hydraulic Test Data

FIGURE E1





Well Data:

Displacement observed (slug size): 0.34 metres (S)
Well Depth: 6.71 metres
Screen Length: approx. 4.5 metres
Well Radius: 0.025 metres

Aquifer Data

Saturated Thickness: 8 metres (est.)
Anisotropy Ratio (Kz/Kr): 0.1
Aquifer Model: Bouwer-Rice
Static Water Level: 2.39 metres bgs

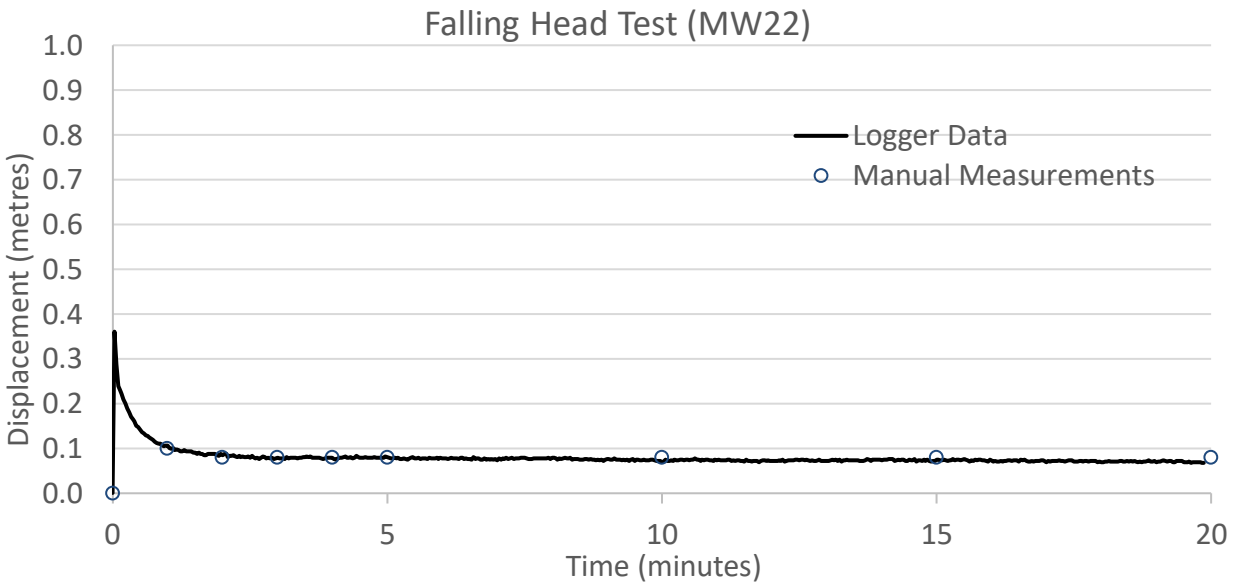
GEMTEC
Consulting Engineers and Scientists

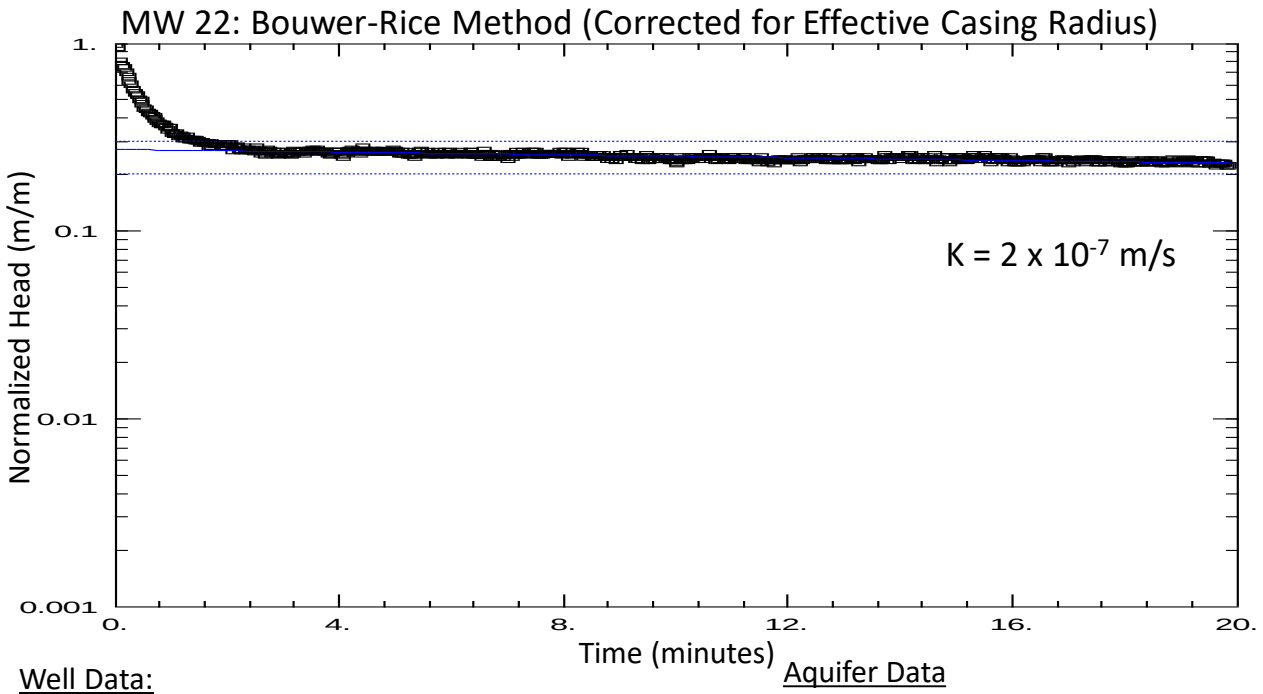
Date: September 2023

Project: 100041.011

Hydraulic Test Data

FIGURE E2





Well Data:

Displacement observed (slug size): 0.36 metres (S)
Well Depth: 7.46 metres
Screen Length: approx. 4.5 metres
Well Radius: 0.025 metres

Aquifer Data

Saturated Thickness: 8 metres (est.)
Anisotropy Ratio (Kz/Kr): 0.1
Aquifer Model: Bouwer-Rice
Static Water Level: 2.30 metres bgs

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Date: September 2023

Project: 100041.011

APPENDIX F

Water Quality Sampling Results

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Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited
32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Samuel Esenwa

Client PO: 1440 Prince of Wales
Project: 100041.011
Custody: 71314

Report Date: 18-Jul-2023
Order Date: 7-Jul-2023

Order #: 2327319

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2327319-01	MW21
2327319-02	MW21 (Filtered)

Approved By:

Dale Robertson, BSc
Laboratory Director

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Hexachlorobenzene	EPA 8081B - GC-ECD	11-Jul-23	11-Jul-23
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	7-Jul-23	10-Jul-23
Metals, ICP-MS	EPA 200.8 - ICP-MS	10-Jul-23	10-Jul-23
Ottawa - San/Comn: SVOCs w/o PAHs	EPA 625	13-Jul-23	15-Jul-23
PAHs by GC-MS, SU Addnl	based on EPA 8270 - GC-MS, extraction	13-Jul-23	18-Jul-23
PAHs by GC-MS, Sewer Use	based on EPA 8270 - GC-MS, extraction	13-Jul-23	17-Jul-23
PCBs, total	EPA 608 - GC-ECD	11-Jul-23	11-Jul-23
pH	EPA 150.1 - pH probe @25 °C	10-Jul-23	11-Jul-23
PHC F1	CWS Tier 1 - P&T GC-FID	7-Jul-23	8-Jul-23
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	11-Jul-23	12-Jul-23
Phosphorus, total, water	EPA 365.4 - Auto Colour, digestion	10-Jul-23	11-Jul-23
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	10-Jul-23	11-Jul-23
Total Suspended Solids	SM 2540D - Gravimetric	10-Jul-23	11-Jul-23
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	7-Jul-23	8-Jul-23
Volatile Suspended Solids	SM 2540D - Gravimetric, 550C	10-Jul-23	11-Jul-23

	Client ID:	MW21	MW21 (Filtered)	-	-		
	Sample Date:	06-Jul-23 09:30	06-Jul-23 09:30	-	-	-	-
	Sample ID:	2327319-01	2327319-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
General Inorganics							
pH	0.1 pH Units	7.3	-	-	-	-	-
Phosphorus, total	0.01 mg/L	0.12	-	-	-	-	-
Total Suspended Solids	2 mg/L	10	-	-	-	-	-
Volatile Suspended Solids	2 mg/L	6	-	-	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.5	-	-	-	-	-
Metals							
Aluminum	0.010 mg/L	-	<0.010	-	-	-	-
Antimony	0.001 mg/L	-	<0.001	-	-	-	-
Arsenic	0.010 mg/L	-	<0.010	-	-	-	-
Bismuth	0.005 mg/L	-	<0.005	-	-	-	-
Boron	0.050 mg/L	-	0.430	-	-	-	-
Cadmium	0.001 mg/L	-	<0.001	-	-	-	-
Chromium	0.050 mg/L	-	<0.050	-	-	-	-
Cobalt	0.001 mg/L	-	<0.001	-	-	-	-
Copper	0.005 mg/L	-	<0.005	-	-	-	-
Lead	0.001 mg/L	-	0.001	-	-	-	-
Mercury	0.0001 mg/L	-	<0.0001	-	-	-	-
Manganese	0.050 mg/L	-	8.18	-	-	-	-
Molybdenum	0.005 mg/L	-	<0.005	-	-	-	-
Nickel	0.005 mg/L	-	<0.005	-	-	-	-
Selenium	0.005 mg/L	-	<0.005	-	-	-	-
Silver	0.001 mg/L	-	<0.001	-	-	-	-
Tin	0.010 mg/L	-	<0.010	-	-	-	-
Titanium	0.010 mg/L	-	<0.010	-	-	-	-
Vanadium	0.001 mg/L	-	0.001	-	-	-	-

	Client ID:	MW21	MW21 (Filtered)	-	-	-	-
	Sample Date:	06-Jul-23 09:30	06-Jul-23 09:30	-	-		
	Sample ID:	2327319-01	2327319-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Metals							
Zinc	0.020 mg/L	-	<0.020	-	-	-	-
Metals - Total							
Aluminum	0.01 mg/L	<0.01	-	-	-	-	-
Antimony	0.001 mg/L	<0.001	-	-	-	-	-
Arsenic	0.01 mg/L	<0.01	-	-	-	-	-
Bismuth	0.005 mg/L	<0.005	-	-	-	-	-
Boron	0.05 mg/L	0.28	-	-	-	-	-
Cadmium	0.001 mg/L	<0.001	-	-	-	-	-
Chromium	0.05 mg/L	<0.05	-	-	-	-	-
Cobalt	0.001 mg/L	<0.001	-	-	-	-	-
Copper	0.005 mg/L	<0.005	-	-	-	-	-
Lead	0.001 mg/L	0.002	-	-	-	-	-
Mercury	0.0001 mg/L	<0.0001	-	-	-	-	-
Manganese	0.05 mg/L	5.05	-	-	-	-	-
Molybdenum	0.005 mg/L	<0.005	-	-	-	-	-
Nickel	0.005 mg/L	<0.005	-	-	-	-	-
Selenium	0.005 mg/L	<0.005	-	-	-	-	-
Silver	0.001 mg/L	<0.001	-	-	-	-	-
Tin	0.01 mg/L	<0.01	-	-	-	-	-
Titanium	0.01 mg/L	<0.01	-	-	-	-	-
Vanadium	0.001 mg/L	0.002	-	-	-	-	-
Zinc	0.02 mg/L	<0.02	-	-	-	-	-
Volatiles							
Acetone	0.0050 mg/L	<0.0050	-	-	-	-	-
Benzene	0.0005 mg/L	0.277	-	-	-	-	-

	Client ID:	MW21	MW21 (Filtered)	-	-	-	-
	Sample Date:	06-Jul-23 09:30	06-Jul-23 09:30	-	-		
	Sample ID:	2327319-01	2327319-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Volatiles							
Bromodichloromethane	0.0005 mg/L	<0.0005	-	-	-	-	-
Bromoform	0.0005 mg/L	<0.0005	-	-	-	-	-
Bromomethane	0.0005 mg/L	<0.0005	-	-	-	-	-
Carbon Tetrachloride	0.0002 mg/L	<0.0002	-	-	-	-	-
Chlorobenzene	0.0005 mg/L	<0.0005	-	-	-	-	-
Chloroethane	0.0010 mg/L	<0.0010	-	-	-	-	-
Chloroform	0.0005 mg/L	<0.0005	-	-	-	-	-
Chloromethane	0.0030 mg/L	<0.0030	-	-	-	-	-
Dibromochloromethane	0.0005 mg/L	<0.0005	-	-	-	-	-
Dichlorodifluoromethane	0.0010 mg/L	<0.0010	-	-	-	-	-
1,2-Dibromoethane	0.0002 mg/L	<0.0002	-	-	-	-	-
1,2-Dichlorobenzene	0.0005 mg/L	<0.0005	-	-	-	-	-
1,3-Dichlorobenzene	0.0005 mg/L	<0.0005	-	-	-	-	-
1,4-Dichlorobenzene	0.0005 mg/L	<0.0005	-	-	-	-	-
1,1-Dichloroethane	0.0005 mg/L	<0.0005	-	-	-	-	-
1,2-Dichloroethane	0.0005 mg/L	<0.0005	-	-	-	-	-
1,1-Dichloroethylene	0.0005 mg/L	<0.0005	-	-	-	-	-
cis-1,2-Dichloroethylene	0.0005 mg/L	<0.0005	-	-	-	-	-
trans-1,2-Dichloroethylene	0.0005 mg/L	<0.0005	-	-	-	-	-
1,2-Dichloroethylene, total	0.0005 mg/L	<0.0005	-	-	-	-	-
1,2-Dichloropropane	0.0005 mg/L	<0.0005	-	-	-	-	-
cis-1,3-Dichloropropylene	0.0005 mg/L	<0.0005	-	-	-	-	-
trans-1,3-Dichloropropylene	0.0005 mg/L	<0.0005	-	-	-	-	-
1,3-Dichloropropene, total	0.0005 mg/L	<0.0005	-	-	-	-	-
Ethylbenzene	0.0005 mg/L	0.281	-	-	-	-	-

Certificate of Analysis

Report Date: 18-Jul-2023

Client: **GEMTEC Consulting Engineers and Scientists Limited**

Order Date: 7-Jul-2023

Client PO: **1440 Prince of Wales**

Project Description: 100041.011

	Client ID:	MW21	MW21 (Filtered)	-	-	-	-
	Sample Date:	06-Jul-23 09:30	06-Jul-23 09:30	-	-		
	Sample ID:	2327319-01	2327319-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Volatiles							
Hexane	0.0010 mg/L	<0.0010	-	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	0.0050 mg/L	<0.0050	-	-	-	-	-
Methyl Butyl Ketone (2-Hexanone)	0.0100 mg/L	<0.0100	-	-	-	-	-
Methyl Isobutyl Ketone	0.0050 mg/L	<0.0050	-	-	-	-	-
Methyl tert-butyl ether	0.0020 mg/L	<0.0020	-	-	-	-	-
Methylene Chloride	0.0050 mg/L	<0.0050	-	-	-	-	-
Styrene	0.0005 mg/L	<0.0005	-	-	-	-	-
1,1,1,2-Tetrachloroethane	0.0005 mg/L	<0.0005	-	-	-	-	-
1,1,2,2-Tetrachloroethane	0.0005 mg/L	<0.0005	-	-	-	-	-
Tetrachloroethylene	0.0005 mg/L	<0.0005	-	-	-	-	-
Toluene	0.0005 mg/L	0.0249	-	-	-	-	-
1,1,1-Trichloroethane	0.0005 mg/L	<0.0005	-	-	-	-	-
1,1,2-Trichloroethane	0.0005 mg/L	<0.0005	-	-	-	-	-
Trichloroethylene	0.0005 mg/L	<0.0005	-	-	-	-	-
Trichlorofluoromethane	0.0010 mg/L	<0.0010	-	-	-	-	-
1,3,5-Trimethylbenzene	0.0005 mg/L	<0.0005	-	-	-	-	-
Vinyl chloride	0.0005 mg/L	<0.0005	-	-	-	-	-
m,p-Xylenes	0.0005 mg/L	0.210	-	-	-	-	-
o-Xylene	0.0005 mg/L	0.0079	-	-	-	-	-
Xylenes, total	0.0005 mg/L	0.218	-	-	-	-	-
Dibromofluoromethane	Surrogate	85.7%	-	-	-	-	-
Toluene-d8	Surrogate	84.2%	-	-	-	-	-
4-Bromofluorobenzene	Surrogate	85.0%	-	-	-	-	-
Hydrocarbons							
F1 PHCs (C6-C10)	0.025 mg/L	<0.025	-	-	-	-	-

	Client ID:	MW21	MW21 (Filtered)	-	-	-	-
	Sample Date:	06-Jul-23 09:30	06-Jul-23 09:30	-	-		
	Sample ID:	2327319-01	2327319-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Hydrocarbons							
F2 PHCs (C10-C16)	0.1 mg/L	<0.1	-	-	-	-	-
F3 PHCs (C16-C34)	0.1 mg/L	<0.1	-	-	-	-	-
F4 PHCs (C34-C50)	0.1 mg/L	<0.1	-	-	-	-	-
Semi-Volatiles							
1-Methylnaphthalene	0.00005 mg/L	0.00170	-	-	-	-	-
2-Methylnaphthalene	0.00005 mg/L	<0.00005	-	-	-	-	-
7H-Dibenzo[c,g]carbazole	0.0005 mg/L	<0.0005	-	-	-	-	-
Anthracene	0.00001 mg/L	<0.00001	-	-	-	-	-
Benzo [a] anthracene	0.00001 mg/L	<0.00001	-	-	-	-	-
Benzo [a] pyrene	0.00001 mg/L	<0.00001	-	-	-	-	-
Benzo [b] fluoranthene	0.00005 mg/L	<0.00005	-	-	-	-	-
Benzo [e] pyrene	0.0005 mg/L	<0.0005	-	-	-	-	-
Benzo [g,h,i] perylene	0.00005 mg/L	<0.00005	-	-	-	-	-
Benzo [j] fluoranthene	0.0005 mg/L	<0.0005	-	-	-	-	-
Benzo [k] fluoranthene	0.00005 mg/L	<0.00005	-	-	-	-	-
Biphenyl	0.00005 mg/L	<0.00005	-	-	-	-	-
Chrysene	0.00005 mg/L	<0.00005	-	-	-	-	-
Dibenzo [a,h] anthracene	0.00005 mg/L	<0.00005	-	-	-	-	-
Dibenzo [a,i] pyrene	0.0005 mg/L	<0.0005	-	-	-	-	-
Dibenzo [a,j] acridine	0.0005 mg/L	<0.0005	-	-	-	-	-
Fluoranthene	0.00001 mg/L	<0.00001	-	-	-	-	-
Fluorene	0.00005 mg/L	<0.00005	-	-	-	-	-
Indeno [1,2,3-cd] pyrene	0.00005 mg/L	<0.00005	-	-	-	-	-
Naphthalene	0.00005 mg/L	0.0118	-	-	-	-	-
Perylene	0.0005 mg/L	<0.0005	-	-	-	-	-

	Client ID:	MW21	MW21 (Filtered)	-	-	-	-
	Sample Date:	06-Jul-23 09:30	06-Jul-23 09:30	-	-		
	Sample ID:	2327319-01	2327319-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Semi-Volatiles							
Phenanthrene	0.00005 mg/L	<0.00005	-	-	-	-	-
Pyrene	0.00001 mg/L	0.00023	-	-	-	-	-
PAHs, Total	0.0034 mg/L	<0.00340	-	-	-	-	-
2-Fluorobiphenyl	Surrogate	117%	-	-	-	-	-
Terphenyl-d14	Surrogate	74.8%	-	-	-	-	-
Benzylbutylphthalate	0.001 mg/L	<0.001	-	-	-	-	-
bis(2-Chloroethoxy)methane	0.001 mg/L	<0.001	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.001 mg/L	<0.001	-	-	-	-	-
Diethylphthalate	0.001 mg/L	<0.001	-	-	-	-	-
Di-n-butylphthalate	0.001 mg/L	0.01	-	-	-	-	-
Di-n-octylphthalate	0.001 mg/L	<0.001	-	-	-	-	-
Indole	0.001 mg/L	<0.001	-	-	-	-	-
2,4-Dichlorophenol	0.001 mg/L	<0.001	-	-	-	-	-
2-Fluorobiphenyl	Surrogate	85%	-	-	-	-	-
Nitrobenzene-d5	Surrogate	121%	-	-	-	-	-
Terphenyl-d14	Surrogate	122%	-	-	-	-	-
2,4,6-Tribromophenol	Surrogate	82%	-	-	-	-	-
2-Fluorophenol	Surrogate	30%	-	-	-	-	-
Phenol-d6	Surrogate	26%	-	-	-	-	-
Pesticides, OC							
Hexachlorobenzene	0.00001 mg/L	<0.00001	-	-	-	-	-
Decachlorobiphenyl	Surrogate	70.9%	-	-	-	-	-
PCBs							
PCBs, total	0.05 ug/L	<0.05	-	-	-	-	-
Decachlorobiphenyl	Surrogate	99.6%	-	-	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics								
Phosphorus, total	ND	0.01	mg/L					
Total Suspended Solids	ND	2	mg/L					
Volatile Suspended Solids	ND	2	mg/L					
Total Kjeldahl Nitrogen	ND	0.1	mg/L					
Hydrocarbons								
F1 PHCs (C6-C10)	ND	0.025	mg/L					
F2 PHCs (C10-C16)	ND	0.1	mg/L					
F3 PHCs (C16-C34)	ND	0.1	mg/L					
F4 PHCs (C34-C50)	ND	0.1	mg/L					
Metals								
Aluminum	ND	0.010	mg/L					
Antimony	ND	0.001	mg/L					
Arsenic	ND	0.010	mg/L					
Bismuth	ND	0.005	mg/L					
Boron	ND	0.050	mg/L					
Cadmium	ND	0.001	mg/L					
Chromium	ND	0.050	mg/L					
Cobalt	ND	0.001	mg/L					
Copper	ND	0.005	mg/L					
Lead	ND	0.001	mg/L					
Mercury	ND	0.0001	mg/L					
Manganese	ND	0.050	mg/L					
Molybdenum	ND	0.005	mg/L					
Nickel	ND	0.005	mg/L					
Selenium	ND	0.005	mg/L					
Silver	ND	0.001	mg/L					
Tin	ND	0.010	mg/L					
Titanium	ND	0.010	mg/L					
Vanadium	ND	0.001	mg/L					
Zinc	ND	0.020	mg/L					
Metals - Total								
Aluminum	ND	0.01	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Antimony	ND	0.001	mg/L					
Arsenic	ND	0.01	mg/L					
Bismuth	ND	0.005	mg/L					
Boron	ND	0.05	mg/L					
Cadmium	ND	0.001	mg/L					
Chromium	ND	0.05	mg/L					
Cobalt	ND	0.001	mg/L					
Copper	ND	0.005	mg/L					
Lead	ND	0.001	mg/L					
Mercury	ND	0.0001	mg/L					
Manganese	ND	0.05	mg/L					
Molybdenum	ND	0.005	mg/L					
Nickel	ND	0.005	mg/L					
Selenium	ND	0.005	mg/L					
Silver	ND	0.001	mg/L					
Tin	ND	0.01	mg/L					
Titanium	ND	0.01	mg/L					
Vanadium	ND	0.001	mg/L					
Zinc	ND	0.02	mg/L					
PCBs								
PCBs, total	ND	0.05	ug/L					
Surrogate: Decachlorobiphenyl	*0.621*		*%*	*124*	*60-140*			
Pesticides, OC								
Hexachlorobenzene	ND	0.00001	mg/L					
Surrogate: Decachlorobiphenyl	*0.00044*		*%*	*88.4*	*50-140*			
Semi-Volatiles								
1-Methylnaphthalene	ND	0.00005	mg/L					
2-Methylnaphthalene	ND	0.00005	mg/L					
7H-Dibenzo[c,g]carbazole	ND	0.0005	mg/L					
Anthracene	ND	0.00001	mg/L					
Benzo [a] anthracene	ND	0.00001	mg/L					
Benzo [a] pyrene	ND	0.00001	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Benzo [b] fluoranthene	ND	0.00005	mg/L					
Benzo [e] pyrene	ND	0.0005	mg/L					
Benzo [g,h,i] perylene	ND	0.00005	mg/L					
Benzo [j] fluoranthene	ND	0.0005	mg/L					
Benzo [k] fluoranthene	ND	0.00005	mg/L					
Biphenyl	ND	0.00005	mg/L					
Chrysene	ND	0.00005	mg/L					
Dibenzo [a,h] anthracene	ND	0.00005	mg/L					
Dibenzo [a,i] pyrene	ND	0.0005	mg/L					
Dibenzo [a,j] acridine	ND	0.0005	mg/L					
Fluoranthene	ND	0.00001	mg/L					
Fluorene	ND	0.00005	mg/L					
Indeno [1,2,3-cd] pyrene	ND	0.00005	mg/L					
Naphthalene	ND	0.00005	mg/L					
Perylene	ND	0.0005	mg/L					
Phenanthrene	ND	0.00005	mg/L					
Pyrene	ND	0.00001	mg/L					
Surrogate: 2-Fluorobiphenyl	*0.0159*		*%*	*79.4*	*76-125*			
Surrogate: Terphenyl-d14	*0.0166*		*%*	*83.2*	*70-125*			
Benzylbutylphthalate	ND	0.001	mg/L					
bis(2-Chloroethoxy)methane	ND	0.001	mg/L					
Bis(2-ethylhexyl)phthalate	ND	0.001	mg/L					
Diethylphthalate	ND	0.001	mg/L					
Di-n-butylphthalate	ND	0.001	mg/L					
Di-n-octylphthalate	ND	0.001	mg/L					
Indole	ND	0.001	mg/L					
2,4-Dichlorophenol	ND	0.001	mg/L					
Surrogate: 2-Fluorobiphenyl	*0.0136*		*%*	*68.2*	*76-125*			S-GC
Surrogate: Nitrobenzene-d5	*0.0177*		*%*	*88.7*	*68-125*			
Surrogate: Terphenyl-d14	*0.0242*		*%*	*121*	*70-125*			
Surrogate: 2,4,6-Tribromophenol	*0.0464*		*%*	*116*	*56-125*			
Surrogate: 2-Fluorophenol	*0.0110*		*%*	*27.5*	*14-125*			

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Phenol-d6	*0.0172*		*%*	*42.9*	*5-112*			
Volatiles								
Acetone	ND	0.0050	mg/L					
Benzene	ND	0.0005	mg/L					
Bromodichloromethane	ND	0.0005	mg/L					
Bromoform	ND	0.0005	mg/L					
Bromomethane	ND	0.0005	mg/L					
Carbon Tetrachloride	ND	0.0002	mg/L					
Chlorobenzene	ND	0.0005	mg/L					
Chloroethane	ND	0.0010	mg/L					
Chloroform	ND	0.0005	mg/L					
Chloromethane	ND	0.0030	mg/L					
Dibromochloromethane	ND	0.0005	mg/L					
Dichlorodifluoromethane	ND	0.0010	mg/L					
1,2-Dibromoethane	ND	0.0002	mg/L					
1,2-Dichlorobenzene	ND	0.0005	mg/L					
1,3-Dichlorobenzene	ND	0.0005	mg/L					
1,4-Dichlorobenzene	ND	0.0005	mg/L					
1,1-Dichloroethane	ND	0.0005	mg/L					
1,2-Dichloroethane	ND	0.0005	mg/L					
1,1-Dichloroethylene	ND	0.0005	mg/L					
cis-1,2-Dichloroethylene	ND	0.0005	mg/L					
trans-1,2-Dichloroethylene	ND	0.0005	mg/L					
1,2-Dichloroethylene, total	ND	0.0005	mg/L					
1,2-Dichloropropane	ND	0.0005	mg/L					
cis-1,3-Dichloropropylene	ND	0.0005	mg/L					
trans-1,3-Dichloropropylene	ND	0.0005	mg/L					
1,3-Dichloropropene, total	ND	0.0005	mg/L					
Ethylbenzene	ND	0.0005	mg/L					
Hexane	ND	0.0010	mg/L					
Methyl Ethyl Ketone (2-Butanone)	ND	0.0050	mg/L					
Methyl Butyl Ketone (2-Hexanone)	ND	0.0100	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Methyl Isobutyl Ketone	ND	0.0050	mg/L					
Methyl tert-butyl ether	ND	0.0020	mg/L					
Methylene Chloride	ND	0.0050	mg/L					
Styrene	ND	0.0005	mg/L					
1,1,1,2-Tetrachloroethane	ND	0.0005	mg/L					
1,1,2,2-Tetrachloroethane	ND	0.0005	mg/L					
Tetrachloroethylene	ND	0.0005	mg/L					
Toluene	ND	0.0005	mg/L					
1,1,1-Trichloroethane	ND	0.0005	mg/L					
1,1,2-Trichloroethane	ND	0.0005	mg/L					
Trichloroethylene	ND	0.0005	mg/L					
Trichlorofluoromethane	ND	0.0010	mg/L					
1,3,5-Trimethylbenzene	ND	0.0005	mg/L					
Vinyl chloride	ND	0.0005	mg/L					
m,p-Xylenes	ND	0.0005	mg/L					
o-Xylene	ND	0.0005	mg/L					
Xylenes, total	ND	0.0005	mg/L					
Surrogate: 4-Bromofluorobenzene	*0.0334*		*%*	*105*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0356*		*%*	*111*	*50-140*			
Surrogate: Toluene-d8	*0.0232*		*%*	*72.3*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	7.8	0.1	pH Units	7.5			3.4	3.3	QR-05, Z-01
Phosphorus, total	ND	0.01	mg/L	ND			NC	15	
Total Suspended Solids	10.0	2	mg/L	10.0			0.0	10	
Volatile Suspended Solids	5.0	2	mg/L	6.0			NC	10	
Total Kjeldahl Nitrogen	ND	0.1	mg/L	ND			NC	16	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	0.025	mg/L	ND			NC	30	
Metals									
Aluminum	ND	0.010	mg/L	ND			NC	20	
Antimony	ND	0.001	mg/L	ND			NC	20	
Arsenic	ND	0.010	mg/L	ND			NC	20	
Bismuth	ND	0.005	mg/L	ND			NC	20	
Boron	0.440	0.050	mg/L	0.430			2.4	20	
Cadmium	ND	0.001	mg/L	ND			NC	20	
Chromium	ND	0.050	mg/L	ND			NC	20	
Cobalt	ND	0.001	mg/L	ND			NC	20	
Copper	ND	0.005	mg/L	ND			NC	20	
Lead	0.0013	0.001	mg/L	0.0014			1.9	20	
Mercury	ND	0.0001	mg/L	ND			NC	20	
Manganese	8.19	0.050	mg/L	8.18			0.1	20	
Molybdenum	ND	0.005	mg/L	ND			NC	20	
Nickel	ND	0.005	mg/L	ND			NC	20	
Selenium	ND	0.005	mg/L	ND			NC	20	
Silver	ND	0.001	mg/L	ND			NC	20	
Tin	ND	0.010	mg/L	ND			NC	20	
Titanium	ND	0.010	mg/L	ND			NC	20	
Vanadium	0.0017	0.001	mg/L	0.0015			11.4	20	
Zinc	ND	0.020	mg/L	ND			NC	20	
Metals - Total									
Aluminum	1.33	0.01	mg/L	1.36			1.9	20	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Antimony	0.003	0.001	mg/L	ND			NC	20	
Arsenic	ND	0.01	mg/L	ND			NC	20	
Bismuth	ND	0.005	mg/L	ND			NC	20	
Boron	ND	0.05	mg/L	ND			NC	20	
Cadmium	ND	0.001	mg/L	ND			NC	20	
Chromium	ND	0.05	mg/L	ND			NC	20	
Cobalt	0.002	0.001	mg/L	0.002			7.6	20	
Copper	0.011	0.005	mg/L	0.011			3.1	20	
Lead	0.002	0.001	mg/L	0.002			11.1	20	
Mercury	ND	0.0001	mg/L	ND			NC	20	
Manganese	0.288	0.05	mg/L	0.292			1.3	20	
Molybdenum	0.006	0.005	mg/L	0.006			5.8	20	
Nickel	0.007	0.005	mg/L	0.007			1.6	20	
Selenium	ND	0.005	mg/L	ND			NC	20	
Silver	ND	0.001	mg/L	ND			NC	20	
Tin	ND	0.01	mg/L	ND			NC	20	
Titanium	0.062	0.01	mg/L	0.058			6.5	20	
Vanadium	0.005	0.001	mg/L	0.005			6.2	20	
Zinc	ND	0.02	mg/L	ND			NC	20	
Volatiles									
Acetone	ND	0.0050	mg/L	ND			NC	30	
Benzene	ND	0.0005	mg/L	ND			NC	30	
Bromodichloromethane	ND	0.0005	mg/L	ND			NC	30	
Bromoform	ND	0.0005	mg/L	ND			NC	30	
Bromomethane	ND	0.0005	mg/L	ND			NC	30	
Carbon Tetrachloride	ND	0.0002	mg/L	ND			NC	30	
Chlorobenzene	ND	0.0005	mg/L	ND			NC	30	
Chloroethane	ND	0.0010	mg/L	ND			NC	30	
Chloroform	ND	0.0005	mg/L	ND			NC	30	
Chloromethane	ND	0.0030	mg/L	ND			NC	30	
Dibromochloromethane	ND	0.0005	mg/L	ND			NC	30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Dichlorodifluoromethane	ND	0.0010	mg/L	ND			NC	30	
1,2-Dibromoethane	ND	0.0002	mg/L	ND			NC	30	
1,2-Dichlorobenzene	ND	0.0005	mg/L	ND			NC	30	
1,3-Dichlorobenzene	ND	0.0005	mg/L	ND			NC	30	
1,4-Dichlorobenzene	ND	0.0005	mg/L	ND			NC	30	
1,1-Dichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,2-Dichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1-Dichloroethylene	ND	0.0005	mg/L	ND			NC	30	
cis-1,2-Dichloroethylene	ND	0.0005	mg/L	ND			NC	30	
trans-1,2-Dichloroethylene	ND	0.0005	mg/L	ND			NC	30	
1,2-Dichloropropane	ND	0.0005	mg/L	ND			NC	30	
cis-1,3-Dichloropropylene	ND	0.0005	mg/L	ND			NC	30	
trans-1,3-Dichloropropylene	ND	0.0005	mg/L	ND			NC	30	
Ethylbenzene	ND	0.0005	mg/L	ND			NC	30	
Hexane	ND	0.0010	mg/L	ND			NC	30	
Methyl Ethyl Ketone (2-Butanone)	ND	0.0050	mg/L	ND			NC	30	
Methyl Butyl Ketone (2-Hexanone)	ND	0.0100	mg/L	ND			NC	30	
Methyl Isobutyl Ketone	ND	0.0050	mg/L	ND			NC	30	
Methyl tert-butyl ether	ND	0.0020	mg/L	ND			NC	30	
Methylene Chloride	ND	0.0050	mg/L	ND			NC	30	
Styrene	ND	0.0005	mg/L	ND			NC	30	
1,1,1,2-Tetrachloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1,2,2-Tetrachloroethane	ND	0.0005	mg/L	ND			NC	30	
Tetrachloroethylene	ND	0.0005	mg/L	ND			NC	30	
Toluene	ND	0.0005	mg/L	ND			NC	30	
1,1,1-Trichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1,2-Trichloroethane	ND	0.0005	mg/L	ND			NC	30	
Trichloroethylene	ND	0.0005	mg/L	ND			NC	30	
Trichlorofluoromethane	ND	0.0010	mg/L	ND			NC	30	
1,3,5-Trimethylbenzene	ND	0.0005	mg/L	ND			NC	30	
Vinyl chloride	ND	0.0005	mg/L	ND			NC	30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
m,p-Xylenes	ND	0.0005	mg/L	ND			NC	30	
o-Xylene	ND	0.0005	mg/L	ND			NC	30	
Surrogate: 4-Bromofluorobenzene	*0.0330*		*%*		*103*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0372*		*%*		*116*	*50-140*			
Surrogate: Toluene-d8	*0.0227*		*%*		*70.8*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Phosphorus, total	0.952	0.01	mg/L	ND	95.2	80-120			
Total Suspended Solids	21.0	2	mg/L	ND	97.7	75-125			
Total Kjeldahl Nitrogen	0.95	0.1	mg/L	ND	95.3	81-126			
Hydrocarbons									
F1 PHCs (C6-C10)	1.95	0.025	mg/L	ND	97.6	68-117			
F2 PHCs (C10-C16)	1.6	0.1	mg/L	ND	101	60-140			
F3 PHCs (C16-C34)	3.6	0.1	mg/L	ND	92.7	60-140			
F4 PHCs (C34-C50)	2.5	0.1	mg/L	ND	99.9	60-140			
Metals									
Antimony	41.7	0.001	mg/L	0.07	83.3	80-120			
Bismuth	50.0	0.005	mg/L	0.03	100	80-120			
Cadmium	57.3	0.001	mg/L	ND	115	80-120			
Lead	52.8	0.001	mg/L	0.1	105	80-120			
Mercury	0.00265	0.0001	mg/L	ND	88.4	70-130			
Molybdenum	57.1	0.005	mg/L	ND	114	80-120			
Selenium	52.9	0.005	mg/L	0.08	106	80-120			
Silver	48.6	0.001	mg/L	0.007	97.1	80-120			
Tin	57.2	0.010	mg/L	0.03	114	80-120			
Zinc	56.7	0.020	mg/L	0.3	113	80-120			
Metals - Total									
Aluminum	180	0.01	mg/L	136	89.4	80-120			
Arsenic	47.0	0.01	mg/L	0.156	93.6	80-120			
Boron	44.0	0.05	mg/L	2.49	83.0	80-120			
Cadmium	42.9	0.001	mg/L	0.012	85.8	80-120			
Chromium	49.2	0.05	mg/L	0.276	97.8	80-120			
Cobalt	47.5	0.001	mg/L	0.216	94.7	80-120			
Copper	46.0	0.005	mg/L	1.12	89.8	80-120			
Lead	40.6	0.001	mg/L	0.182	80.8	80-120			
Mercury	0.0027	0.0001	mg/L	ND	88.8	70-130			
Manganese	77.0	0.05	mg/L	29.2	95.7	80-120			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Molybdenum	45.6	0.005	mg/L	0.571	90.1	80-120			
Nickel	46.8	0.005	mg/L	0.672	92.4	80-120			
Selenium	41.1	0.005	mg/L	0.160	82.0	80-120			
Silver	41.3	0.001	mg/L	0.026	82.5	80-120			
Tin	43.5	0.01	mg/L	0.062	86.8	80-120			
Titanium	57.4	0.01	mg/L	5.80	103	80-120			
Vanadium	49.2	0.001	mg/L	0.450	97.6	80-120			
Zinc	42.5	0.02	mg/L	0.755	83.6	80-120			
PCBs									
PCBs, total	1.20	0.05	ug/L	ND	120	65-135			
Surrogate: Decachlorobiphenyl	*0.690*		*%*		*138*	*60-140*			
Pesticides, OC									
Hexachlorobenzene	0.00068	0.00001	mg/L	ND	137	50-140			
Surrogate: Decachlorobiphenyl	*0.000455*		*%*		*90.9*	*50-140*			
Semi-Volatiles									
1-Methylnaphthalene	0.00441	0.00005	mg/L	ND	44.1	25-127			
2-Methylnaphthalene	0.00425	0.00005	mg/L	ND	42.5	21-119			
Anthracene	0.00407	0.00001	mg/L	ND	40.7	29-126			
Benzo [a] anthracene	0.00565	0.00001	mg/L	ND	56.5	29-126			
Benzo [a] pyrene	0.00536	0.00001	mg/L	ND	53.6	29-111			
Benzo [b] fluoranthene	0.00593	0.00005	mg/L	ND	59.3	26-111			
Benzo [g,h,i] perylene	0.00588	0.00005	mg/L	ND	58.8	23-128			
Benzo [k] fluoranthene	0.00490	0.00005	mg/L	ND	49.0	23-135			
Biphenyl	0.00712	0.00005	mg/L	ND		50-140			
Chrysene	0.00518	0.00005	mg/L	ND	51.8	29-137			
Dibenzo [a,h] anthracene	0.00556	0.00005	mg/L	ND	55.6	20-131			
Fluoranthene	0.0119	0.00001	mg/L	ND	119	24-131			
Fluorene	0.00411	0.00005	mg/L	ND	41.1	28-123			
Indeno [1,2,3-cd] pyrene	0.00613	0.00005	mg/L	ND	61.3	20-128			
Naphthalene	0.00371	0.00005	mg/L	ND	37.1	29-118			
Phenanthrene	0.00454	0.00005	mg/L	ND	45.4	34-108			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Pyrene	0.0112	0.00001	mg/L	ND	112	29-131			
Surrogate: 2-Fluorobiphenyl	*0.0153*		*%*		*76.5*	*76-125*			
Surrogate: Terphenyl-d14	*0.0175*		*%*		*87.5*	*70-125*			
Benzylbutylphthalate	0.01	0.001	mg/L	ND	105	50-140			
bis(2-Chloroethoxy)methane	0.01	0.001	mg/L	ND	99.8	50-140			
Bis(2-ethylhexyl)phthalate	0.01	0.001	mg/L	ND	119	50-140			
Diethylphthalate	0.01	0.001	mg/L	ND	102	50-140			
Di-n-butylphthalate	0.01	0.001	mg/L	ND	128	50-140			
Di-n-octylphthalate	0.01	0.001	mg/L	ND	107	50-140			
2,4-Dichlorophenol	0.009	0.001	mg/L	ND	86.0	50-140			
Surrogate: 2-Fluorobiphenyl	*0.0189*		*%*		*94.6*	*76-125*			
Surrogate: Nitrobenzene-d5	*0.0235*		*%*		*118*	*68-125*			
Surrogate: Terphenyl-d14	*0.0242*		*%*		*121*	*70-125*			
Surrogate: 2,4,6-Tribromophenol	*0.0496*		*%*		*124*	*56-125*			
Surrogate: 2-Fluorophenol	*0.0108*		*%*		*27.0*	*14-125*			
Surrogate: Phenol-d6	*0.0208*		*%*		*52.0*	*5-112*			
Volatiles									
Acetone	0.106	0.0050	mg/L	ND	106	50-140			
Benzene	0.0437	0.0005	mg/L	ND	109	60-130			
Bromodichloromethane	0.0485	0.0005	mg/L	ND	121	60-130			
Bromoform	0.0482	0.0005	mg/L	ND	121	60-130			
Bromomethane	0.0444	0.0005	mg/L	ND	111	50-140			
Carbon Tetrachloride	0.0493	0.0002	mg/L	ND	123	60-130			
Chlorobenzene	0.0458	0.0005	mg/L	ND	115	60-130			
Chloroethane	0.0489	0.0010	mg/L	ND	122	50-140			
Chloroform	0.0484	0.0005	mg/L	ND	121	60-130			
Chloromethane	0.0489	0.0030	mg/L	ND	122	50-140			
Dibromochloromethane	0.0479	0.0005	mg/L	ND	120	60-130			
Dichlorodifluoromethane	0.0496	0.0010	mg/L	ND	124	50-140			
1,2-Dibromoethane	0.0404	0.0002	mg/L	ND	101	60-130			
1,2-Dichlorobenzene	0.0342	0.0005	mg/L	ND	85.4	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,3-Dichlorobenzene	0.0340	0.0005	mg/L	ND	85.0	60-130			
1,4-Dichlorobenzene	0.0360	0.0005	mg/L	ND	89.9	60-130			
1,1-Dichloroethane	0.0472	0.0005	mg/L	ND	118	60-130			
1,2-Dichloroethane	0.0420	0.0005	mg/L	ND	105	60-130			
1,1-Dichloroethylene	0.0476	0.0005	mg/L	ND	119	60-130			
cis-1,2-Dichloroethylene	0.0348	0.0005	mg/L	ND	86.9	60-130			
trans-1,2-Dichloroethylene	0.0488	0.0005	mg/L	ND	122	60-130			
1,2-Dichloropropane	0.0386	0.0005	mg/L	ND	96.5	60-130			
cis-1,3-Dichloropropylene	0.0339	0.0005	mg/L	ND	84.7	60-130			
trans-1,3-Dichloropropylene	0.0374	0.0005	mg/L	ND	93.6	60-130			
Ethylbenzene	0.0416	0.0005	mg/L	ND	104	60-130			
Hexane	0.0444	0.0010	mg/L	ND	111	60-130			
Methyl Ethyl Ketone (2-Butanone)	0.0625	0.0050	mg/L	ND	62.5	50-140			
Methyl Butyl Ketone (2-Hexanone)	0.0644	0.0100	mg/L	ND	64.4	50-140			
Methyl Isobutyl Ketone	0.0648	0.0050	mg/L	ND	64.8	50-140			
Methyl tert-butyl ether	0.0920	0.0020	mg/L	ND	92.0	50-140			
Methylene Chloride	0.0490	0.0050	mg/L	ND	122	60-130			
Styrene	0.0375	0.0005	mg/L	ND	93.8	60-130			
1,1,1,2-Tetrachloroethane	0.0480	0.0005	mg/L	ND	120	60-130			
1,1,2,2-Tetrachloroethane	0.0451	0.0005	mg/L	ND	113	60-130			
Tetrachloroethylene	0.0423	0.0005	mg/L	ND	106	60-130			
Toluene	0.0490	0.0005	mg/L	ND	122	60-130			
1,1,1-Trichloroethane	0.0470	0.0005	mg/L	ND	117	60-130			
1,1,2-Trichloroethane	0.0422	0.0005	mg/L	ND	105	60-130			
Trichloroethylene	0.0403	0.0005	mg/L	ND	101	60-130			
Trichlorofluoromethane	0.0466	0.0010	mg/L	ND	116	60-130			
1,3,5-Trimethylbenzene	0.0291	0.0005	mg/L	ND	72.8	60-130			
Vinyl chloride	0.0442	0.0005	mg/L	ND	110	50-140			
m,p-Xylenes	0.0888	0.0005	mg/L	ND	111	60-130			
o-Xylene	0.0460	0.0005	mg/L	ND	115	60-130			
Surrogate: 4-Bromofluorobenzene	*0.0190*		*%*		*59.4*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Dibromofluoromethane	*0.0340*		*%*		*106*	*50-140*			
Surrogate: Toluene-d8	*0.0251*		*%*		*78.5*	*50-140*			

Qualifier Notes:

QC Qualifiers:

QR-05	Duplicate RPDs higher than normally accepted. Remaining batch QA\QC was acceptable. May be sample effect.
Z-01	Duplicate analyzed from the second bottle

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.

- F1 range corrected for BTEX.

- F2 to F3 ranges corrected for appropriate PAHs where available.

- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.

- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

- When reported, data for F4G has been processed using a silica gel cleanup.

PARACE LABORATORIES LTD

Paracel ID: 2327319

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2327319	№ 71314

Client Name: Gemtec	Project Ref: 100041.011 / 1440 Prince of Wales	Page __ of __
Contact Name: Samuel Esenwa	Quote #:	Turnaround Time
Address:	PO #:	☐ 1 day ☐ 3 day
	E-mail: Samuel.Esenwa@gemtec.ca	☐ 2 day ☑ Regular
Telephone:		Date Required:

☐ REG 153/04 ☐ REG 406/19	Other Regulation	Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)
☐ Table 1 ☐ Res/Park ☐ Med/Fine	☐ REG 558 ☐ PWQO	Required Analysis
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ CCME ☐ MISA	
☐ Table 3 ☐ Agri/Other	☑ SU - Sani ☑ SU - Storm	
☐ Table ___	Mun: Ottawa	
For RSC: ☐ Yes ☐ No	☐ Other:	

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Standard Sewer use package + VOCs + PAHs
1	MW21	GW	/	12	06-07-23	9:30	✓
2							
3							
4							
5							
6							
7							
8							
9							
10							

Comments: —

Method of Delivery: Drop Box

Relinquished By (Sign):	Received By Driver/Depot:	Received By:	Verified By:
Relinquished By (Print): Samuel Esenwa	Date/Time:	Date/Time: Jul. 7/2023 8:15	Date/Time: Jul 7/2023 845
Date/Time: 06-07-2023; 18:00	Temperature: °C	Temperature: 6.6 °C	pH Verified: ☐ By:

Chain of Custody (Blank).xlsx

Revision 4.0

APPENDIX G

Report Conditions and Limitations

CONDITIONS AND LIMITATIONS OF THIS REPORT

1. **Standard of Care:** GEMTEC has prepared this report in a manner consistent with generally accepted engineering or environmental consulting practice in the jurisdiction in which the services are provided at the time of the report. No other warranty, expressed or implied is made.
2. **Copyright:** The contents of this report are subject to copyright owned by GEMTEC, save to the extent that copyright has been legally assigned by us to another party or is used by GEMTEC under license. To the extent that GEMTEC owns the copyright in this report, it may not be copied without our prior written agreement for any purpose other than the purpose indicated in this report. The methodology (if any) contained in this report is provided to the Client in confidence and must not be disclosed or copied to third parties without the prior written agreement of GEMTEC. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests.
3. **Complete Report:** This report is of a summary nature and is not intended to stand alone without reference to the instructions given to GEMTEC by the Client, communications between GEMTEC and the Client and to any other reports prepared by GEMTEC for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. GEMTEC cannot be responsible for use of portions of the report without reference to the entire report.
4. **Basis of Report:** This Report has been prepared for the specific site, development, design objectives and purposes that were described to GEMTEC by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this report expressly addresses the proposed development, design objectives and purposes. Any change of site conditions, purpose or development plans may alter the validity of the report and GEMTEC cannot be responsible for use of this report, or portions thereof, unless GEMTEC is requested to review any changes and, if necessary, revise the report.
5. **Time Dependence:** If the proposed project is not undertaken by the Client within 18 months following the issuance of this report, or within the timeframe understood by GEMTEC to be contemplated by the Client, the guidance and recommendations within the report should not be considered valid unless reviewed and amended or validated by GEMTEC in writing.
6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.
7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.
8. **Decrease in Property Value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
9. **Reliance on Provided Information:** The evaluation and conclusions contained in this report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions,

misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fill materials or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

experience • knowledge • integrity

civil	civil
geotechnical	géotechnique
environmental	environnement
structural	structures
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité