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Geotechnical Investigation
Proposed Residential Development
1174 Carp Road
Ottawa, Ontario

GEMTEC Project: 101785.004

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February 25, 2025
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1.0 INTRODUCTION

This report presents the results of the geotechnical investigation carried out for the proposed multi-storey residential development to be located at 1174 Carp Road, Ottawa, Ontario.

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

GEMTEC has carried out a Phase One Environmental Site Assessment (ESA), a Phase Two ESA, and a Record of Site Condition (RSC), all of which are reported under separate covers.

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 BACKGROUND

2.1 Project Description

The site is located at 1174 Carp Road in Ottawa, Ontario. It is proposed to construct a high-rise residential development on the site. Details of the development are shown on a series of drawings prepared by Hobin Architects, dated February 14, 2025. The following is known about the development.

- Building heights will generally range from 5 to 14 storeys, with some areas with 1 storey, and 1 level of underground parking;
- The approximate plan dimension of the development will be about 105 by 85 metres;
- The majority of the site will be excavated to construct an underground parking basement.
- Above ground, the structures will be positioned around a courtyard with a plan area of about 45 by 60 metres, and parkland with a plan area of about 30 by 60 metres on the west side of the site;
- At grade driving lanes and visitors parking is proposed along the east, south and west side of the site.
- It is understood that the below ground portion of the building will not be constructed as ‘water-tight’ structure and drainage measures will be applied.

A slab on grade building and asphalt paved parking area has been constructed on the site which is in use as an RV dealership.

2.2 Previous Geotechnical Investigation by GEMTEC

GEMTEC completed a previous preliminary geotechnical investigation at this site. The information from that investigation was provided in the following report:

- Report titled “Preliminary Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario” dated May 31, 2024 (Report Number 101785.003)

As part of that investigation, GETMEC advanced four boreholes at the site. This investigation is incorporated into this report which supersedes the previous document.

2.3 Previous Investigations at the Site by Others

A previous geotechnical investigation was prepared by others covering several parcels of land which includes the site under consideration in this report. The results of the geotechnical investigation were provided in the following report:

- Report by Paterson Group, prepared for Canril Corporation, titled “Preliminary Geotechnical Investigation, Proposed Commercial Development, Hazeldean Road at Carp Road, Ottawa, Ontario” dated August 28, 2006 (Report No. PG0805-1). This report is referred to further in this report as Paterson (2006).

Eight boreholes from the Paterson (2006) report were advanced on the site. These boreholes are identified as boreholes 1, 3, 4, 5, 15, and 16.

The depth of investigation ranged from about 4.0 to 5.2 metres below ground surface. The subsurface conditions encountered in the boreholes consisted primarily of (uncontrolled) fill material over native deposits of silty sand and sandy silt, over glacial till. In borehole 5 a layer of peat/topsoil was encountered at the base of the fill material, with a thickness of about 460 millimetres. Two of the boreholes were terminated at auger refusal at depths of 4.0 to 4.6 metres. The auger refusal occurred at or within the glacial till. Bedrock coring was not carried out in any of the boreholes. The depth to groundwater was noted at about 2.0 to 2.8 metres below ground surface.

2.4 Site Geology

A review of published surficial geology maps indicates that the site is underlain by glaciofluvial deposits of silty sand to sandy silt and glacial till. Bedrock geology maps indicate that limestone of the Bobcaygeon and/or Gull River Formation is present below the soil cover at depths ranging from about 5 to 10 metres. A bedrock fault is mapped in the vicinity of the site.

The mapped conditions are reasonably similar to those encountered in the Paterson (2006) investigation, with the exception of the uncontrolled fill material (which is typically not identified on the geological maps).

3.0 METHODOLOGY

3.1 Geotechnical Investigation

The fieldwork for this investigation was carried out under 2 separate phases. The initial investigation was carried out between April 6 and 10, 2023. At that time four boreholes identified as 23-01 to 23-04 inclusive were advanced at the site. A second (or supplemental) round of investigation was carried out between July 2 and 3, 2024 at which time five additional boreholes identified as 24-05 to 24-9 inclusive were advanced at the site. These boreholes which were advanced to depths ranging from about 4.3 to 5.6 metres were for geotechnical, hydrogeological and environmental investigation purposes. The approximate locations of the boreholes are shown on the Site Plan, Figure 1.

Boreholes 23-01 and 23-02 were advanced using geoprobe drilling equipment supplied and operated by Strata Drilling Group of Ottawa, Ontario. In these boreholes samples of the soils were recovered using direct push sampling equipment.

Boreholes 23-03 and 23-04 were advanced using a truck mounted drill rig supplied and operated by OGS Inc. of Almonte Ontario, and boreholes 24-05 to 24-09 were advanced using a track mounted drill rig supplied and operated by Aardvark Drilling Inc. of Carleton Place, Ontario. Standard penetration tests were carried out within the overburden deposits in boreholes 23-03, 23-04, and 24-05 to 24-08, and samples of the soils encountered were recovered using split spoon sampling equipment. Borehole 24-09 was advanced through the overburden without sampling.

Upon reaching auger refusal in boreholes 23-03, 24-05, 24-07, and 24-09, the boreholes were then advanced below the depth of refusal using rotary diamond drilling techniques while retrieving NQ or HQ sized core. Coring was carried out to a total depth ranging from about 6.7 to 8.6 metres below the existing ground surface to confirm the depth to bedrock and to obtain information on the type and condition of the bedrock.

The fieldwork was supervised throughout by a member of our engineering staff who directed the drilling operations, observed the in-situ testing, and logged the samples and boreholes.

Following the fieldwork, the soil and bedrock samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples of the soil were tested for water content and grain size distribution testing. One sample of the bedrock was tested for unconfined compressive strength. In addition, one sample of soil recovered from borehole 24-02 and was sent to Paracel Laboratories Ltd. for basic chemical testing relating to corrosion of buried concrete and steel.

The borehole locations were selected and positioned at the site relative to existing site features by GEMTEC personnel. The locations and ground surface elevations of the boreholes were determined using high precision GPS survey instrumentation.

3.1.1 Multi-Channel Analysis of Surface Waves Testing

The average shear wave velocity within the upper 30 metres was measured at the site using the Multi-channel Analysis of Surface Waves (MASW) methodology. MASW is a geophysical surveying method that uses the dispersive characteristics of surface waves to measure shear velocity variations with depth. The surveying was carried out on May 24, 2024 by GEMTEC. The approximate location of the MASW survey is provided on the Site Plan, Figure 1.

3.2 Hydrogeological Investigation

Monitoring wells were installed in boreholes 23-01, 23-02, 24-05, 24-06, 24-07 and 24-08. The monitoring wells consisted of a 50-millimetre diameter screened PVC pipe installed within a surround of filter sand. Above the surround of filter sand, bentonite was used to seal the well screen from overlying materials and the wells were finished with flush-mounted caps. Well depths and screen lengths were chosen based on the material types and inferred groundwater levels encountered during drilling. Details of the well installations are provided on the Borehole Logs in Appendix A.

Hydraulic testing was completed in the monitoring well installed in the overburden in borehole 24-08, and in the monitoring well installed in the bedrock in borehole 24-07. One groundwater quality sample was collected to establish background groundwater conditions and submitted for analysis of City of Ottawa Sewer Use “Baseline Monitoring” parameters.

3.2.1 Water Levels

Groundwater levels were measured in the monitoring wells on April 6, 11 and 20, 2023, August 14 and 21 and November 6, 2024. Preceding groundwater level measurements, monitoring wells were developed using a foot valve and tubing to purge the water column volume three times or until the well was purged dry.

3.2.2 Hydraulic Conductivity Testing

Hydraulic testing was carried out as indicated in Table 4.1. Falling head testing involved introducing an instantaneous pressure increase to the water column within the well screen (equal to the volume of the slug) and monitoring the dissipation of the water level over time using a groundwater data logging pressure transducer together with an electric water level tape. Rising head testing involved introducing an instantaneous pressure decrease to the water column within the well screen (equal to the volume of the slug) and monitoring the recovery of the water level over time using a groundwater data logging pressure transducer together with an electric water level tape. Manual measurements were also taken for 5 minutes following the introduction and removal of the slug.

Table 4.1 – Summary of Hydraulic Testing Program

Borehole ID.	Screened Material	Test Completed	
		Falling Head Test[1]	Rising Head Test
24-07	Limestone Bedrock	✓	✓
24-08	Brown sand, some silt (FILL)	-	✓

Notes: 1. Water level within well screen in borehole 24-08; falling head test not analysed due to well screen effects.

3.2.3 Groundwater Quality Sampling

A groundwater sample was collected from the monitoring well at borehole 24-08 on August 14, 2024. The sample was collected following well purging using dedicated downhole tubing and foot valve and stored in laboratory supplied bottles. The sample was submitted to a CALA-accredited laboratory for the analysis of City of Ottawa Sewer Use "Baseline Monitoring" parameters for comparison to the City of Ottawa storm and sanitary sewer use bylaws.

4.0 SUBSURFACE CONDITIONS

Descriptions of the subsurface conditions logged in the boreholes are provided on the Record of Borehole Sheets in Appendix A. The results of the soil classification testing are provided in Appendix B and on the Record of Borehole Sheets. Photographs of the bedrock core are provided in Appendix C. Borehole logs from previous investigations are provided in Appendix D. Hydraulic conductivity testing is provided in Appendix E. The results of the chemical analysis (corrosivity) are provided in Appendix F. The results of the MASW testing are provided in Appendix G. The results of the water quality testing are provided in Appendix H.

The following presents an overview of the subsurface conditions encountered in the boreholes advanced during the various phases of the investigation.

4.1 Concrete Floor Slab

Boreholes 23-01 and 23-02 were advanced through a concrete floor slab inside the existing building. At the borehole location the slab had a thickness of about 150 millimetres.

4.2 Asphaltic Concrete

Asphaltic concrete was encountered in the parking lot area at boreholes 23-03, 23-04, and 24-07 with a thickness of about 50 millimetres.

4.3 Fill Material

Fill material was encountered below the interior concrete floor slab, exterior asphaltic concrete surfacing, and at the ground surface.

The fill material was not fully penetrated in boreholes 23-01, 23-02, 24-06, and 24-08, i.e., the full depth of fill material present was not established at these locations but is greater than 4.9 metres. The fill material in borehole 23-03, 23-04, 24-05, and 24-07 extends to depths ranging from about 3.4 to 5.0 metres.

The fill material is variable in composition but can generally be described as sand with varying amount of clay, silt and gravel. The fill material also contains infrequent organic matter, wood fragments. Less frequently fine grained layers of fill material were encountered.

Standard penetration tests carried out in the fill material gave N values ranging from 1 to 29 blows per 0.3 metres of penetration, which reflect a very loose to compact relative density, and the variable nature of the fill material. One standard penetration test carried out in the fill material gave an N value of greater than 50 blows for less than 0.3 metres of penetration, however, this likely reflects the presence of hard material, boulders or possibly the bedrock surface rather than the relative density of the fill material.

The results of grain size distribution testing on three sample of the fill material are summarized in Table 4.2. The water content of 20 samples of the fill material range between about 5 to 43 percent.

Table 4.2 – Summary of Grain Size Distribution Testing (Fill)

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-03	3	1.5 – 2.0	1	51	37	11
24-06	4B	2.3 – 2.9	4	70	21	6
24-07	4	2.3 – 2.9	3	78	15	4

4.4 Sandy Silt, Silty Sand, and Sand and Silt

Native deposits of sandy silt, silty sand, and sand and silt with trace gravel were encountered below the fill material in boreholes 23-03, 23-04, 24-05, and 24-07. These deposits are collectively referred to further in this report as sand and silt layers.

In borehole 23-03, 24-05, and 24-07 the sand and silt layers extend to depths ranging from about 4.7 to 5.2 metres below the existing ground surface. In borehole 23-04, the deposit was not fully

penetrated but was proven to a depth of about 4.3 metres below the existing ground surface at which depth auger refusal occurred.

Standard penetration test carried out in the native deposits of sand and silt gave N values ranging from 13 to greater than 50 blows per 0.3 metres of penetration, which reflect a compact to very dense relative density. However, the higher values are likely reflective of the underlaying boulder layer and/or bedrock surface and may not represent the relative density of the sand and silt.

The result of a grain size distribution test on a sample of the sand and silt is summarized in Table 4.3. The water content of eight samples of the native deposits of sand and silt range between about 16 and 24 percent.

Table 4.3 – Summary of Grain Size Distribution Testing (Sand and Silt)

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
24-05	6A	3.8 – 4.4	0	56	41	3

4.5 Glacial Till

Native deposits of glacial till were not encountered directly in the boreholes, but it was encountered in the previous investigation by Paterson. Glacial till is a heterogeneous mixture of all grain sizes; however, at this site, the glacial till can be described as brown to grey silty sand with varying amounts of gravel, cobbles and boulders.

4.6 Auger Refusal

Auger refusal was encountered at depths ranging from about 4.3 to 4.9 metres below the existing ground surface, in all of the boreholes with the exception of 23-01 and 23-02.

Table 4.4 summarizes the depth of refusal and corresponding elevations at the borehole locations, including details form the Paterson (2006) report, as well as the inferred bedrock level from the rotary coring. The refusal elevations are reasonably consistent with the bedrock surface elevations.

Table 4.4 – Summary of Auger Refusal and Bedrock Depths and Elevations

Borehole ID	Ground Surface Elevation (metres)	Depth to Refusal (metres)	Elevation to Refusal (metres)	Depth to Bedrock (metres)	Bedrock Surface Elevation (metres)
23-03	125.0	4.9	120.10	5.6	119.3

Borehole ID	Ground Surface Elevation (metres)	Depth to Refusal (metres)	Elevation to Refusal (metres)	Depth to Bedrock (metres)	Bedrock Surface Elevation (metres)
23-04	124.5	4.3	120.2	Not proven	Not proven
24-05	124.8	4.7	120.2	4.7	120.2
24-06	124.7	4.6	120.1	Not proven	Not proven
24-07	125.1	5.2	119.9	5.2	119.9
24-08	124.5	4.7	119.8	Not proven	Not proven
24-09	124.4	4.3	120.1	4.3	120.1
3 (Paterson, (2006))	124.1	4.0	120.1	Not proven	Not proven
4 (Paterson, (2006))	124.0	3.6	120.4	Not proven	Not proven

4.7 Possible Boulders or Fractured Bedrock

A layer of possible boulders or fractured bedrock with silty sand seams was encountered below the depth of auger refusal at the base of the sand and silt layer in borehole 23-03 at a depth of about 4.9 metres. The boulders or fractured bedrock extends to a depth of about 5.6 metres below the existing ground surface.

4.8 Limestone Bedrock

Grey limestone bedrock was proven in boreholes 23-03, 24-05, 24-07, and 24-09, at depths ranging from about 4.3 to 5.6 metres below the existing ground surface. The limestone bedrock was cored to depths ranging from about 6.7 to 8.5 metres below the existing ground surface. Photographs of the bedrock core are provided on Figures C1 to C4 in Appendix C.

The recovered bedrock core samples have total core recovery (TCR) values ranging from about 93 to 100 percent, solid core recovery (SCR) values ranging from about 41 to 100 percent, and rock quality designation (RQD) values ranging from about 37 to 100 percent. Based on these values, in accordance with the classification system set out in the Canadian Foundation Engineering Manual (5th Edition) the bedrock can be classified as Poor to Excellent Quality.

The result of unconfined compressive strength testing carried out on four samples of recovered bedrock core from boreholes 23-03, 24-05, 24-07 and 24-09 and the resulting rock strength

classification is presented in Table 4.5. The rock strength classification in the Canadian Foundation Engineering Manual (5th Edition) has been applied.

Table 4.5 – Results of Unconfined Compressive Testing of Rock Core

Borehole ID	Depth (metres)	Rock Compressive Strength (MPa)	Rock Strength Classification
23-03	5.7 to 5.9	127	Very Strong
24-05	5.0 to 5.2	100	Strong / Very Strong
24-07	5.4 to 5.6	98	Strong
24-09	5.7 to 6.0	90	Strong

4.9 Groundwater Level

Seven standpipe piezometers (monitoring wells) were installed to measure the groundwater levels, five in the overburden at boreholes 23-01, 23-02, 23-03, 24-06, and 24-08 and two in the bedrock at boreholes 23-05 and 23-07. The depth and elevation of the observed groundwater level at the depth of inspection are summarized in Table 4.6. Electronic dataloggers were installed in monitoring wells 24-07 (bedrock) and 24-08 (overburden) on August 28, 2024, to record water level fluctuations over time. The long-term monitoring program was proposed for a period of eight-weeks and the results will be reported under separate cover.

The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

Table 4.6 – Summary of Groundwater Levels

Borehole ID	Ground Surface Elevation (metres)	Groundwater Depth (metres below ground surface)	Groundwater Level Elevation (metres above sea level)	Date
23-01	125.50	3.1	122.4	April 6, 2023
		3.5	122.1	April 11, 2023
23-02	125.50	3.0	122.5	April 6, 2023
		3.0	122.6	April 11, 2023
23-03	124.98	2.2	122.9	April 20, 2023
		2.3	122.8	November 6, 2024

Borehole ID	Ground Surface Elevation (metres)	Groundwater Depth (metres below ground surface)	Groundwater Level Elevation (metres above sea level)	Date
24-05	124.80	2.4	122.5	July 17, 2024
		2.8	122.1	August 21, 2024
		2.9	122.0	November 6, 2024
24-06	124.70	3.0	121.7	July 17, 2024
		2.5	122.3	August 21, 2024
		2.8	122.0	November 6, 2024
24-07	125.10	2.9	122.2	July 17, 2024
		3.5	121.6	August 14, 2024
		3.5	121.6	August 21, 2024
		3.6	121.5	November 6, 2024
24-08	124.50	3.0	121.5	July 17, 2024
		3.2	121.3	August 14, 2024
		3.3	121.2	August 21, 2024
		3.4	121.0	November 6, 2024

4.10 Hydraulic Conductivity

The results of the hydraulic testing completed in boreholes 24-07 and 24-08 are provided in Table 4.7 and analyses are provided in Appendix E.

It should be noted that the results from the falling head test completed at borehole 24-08 were not analyzed as the well is screened across the water table, and therefore drainage of displaced water into the unsaturated filter pack occurred almost instantaneously. As such, only the rising head test in borehole 24-08 was analyzed.

Estimates of hydraulic conductivity were calculated from the results of the falling/rising head tests using the Bouwer-Rice analysis (refer to Table 4.8 below). The displacement volume of the slug was used in the analysis for all boreholes tested.

With regard to the calculated values, the following should be noted:

- The estimated hydraulic conductivity for the limestone bedrock in borehole 24-07 is within the literature value range for limestone bedrock, which ranges from 10^{-9} to 10^{-5} metres per second (Freeze and Cherry, 1979).

- The estimated hydraulic conductivity for the sand, some silt (fill material) layer in borehole 24-08 is within the literature range for silty sand, which ranges from 10^{-7} to 10^{-3} metres per second (Freeze and Cherry, 1979)

It should be noted that well-executed slug tests yield theoretical minimum values for the horizontal hydraulic conductivity of the tested aquifer due to inefficiencies associated with typical well construction, installation, and development (Butler, 1998); therefore, higher hydraulic conductivity values than presented in Table 4.8 may be applicable to these units.

The results of the testing represent the conditions in the vicinity of the well screen and as distance increases from the well screen the conditions may vary from those reported. Conditions between wells have not been established, therefore variability in hydraulic conductivity within the site should be anticipated.

Table 4.7 – Summary of Hydraulic Testing Results

Borehole ID	Screened Material	Test Type	Static Groundwater Depth (metres)	Displacement (metres)	Recovery Time (minutes)	Recovery (percent)
24-07	Bedrock (Limestone)	Falling Head	3.31	0.42	5	100
24-07	Bedrock (Limestone)	Rising Head	3.31	0.45	5	98
24-08	Sand, some silt (Fill Material)	Rising Head	3.01	0.46	0.5	98

Table 4.8 – Calculated Hydraulic Conductivities

Borehole ID	Screened Geological Unit	Calculated Hydraulic Conductivity, k (metres per second)	
		Falling Head Test	Rising Head Test
24-07	Bedrock (Limestone)	1×10^{-5}	1×10^{-5}
24-08	Sand, some silt (Fill Material)	–	2×10^{-4}

4.11 Groundwater Quality

The groundwater quality analytical results from borehole MW24-08 (overburden) are included in Appendix H. These results were compared against the Provincial Water Quality Objectives and the Ottawa Sewer Use By-law (No. 2003-514) for the analysed parameters, and exceedances of these regulatory limits are summarised as follows:

Ottawa Sewer Use By-law – Storm Sewers:

- Total Suspended Solids (TSS) at 2,230 milligrams per litre exceeds the limits of 15 milligrams per litre.
- Total phosphorus at 0.8 milligrams per litre exceeds the limit of 0.4 milligrams per litre.
- Copper at 0.112 milligrams per litre exceeds the limit of 0.04 milligrams per litre.
    - Field filtered sample (0.45 micron filter) decreased to less than 0.005 milligrams per litre, which is within the limits.
- Manganese at 1.89 mg/L exceeds the limit of 0.05 milligrams per litre.
    - Field filtered sample (0.45 micron filter) decreased to 0.338 milligrams per litre, which exceeds the limits.
- Zinc at 0.13 milligrams per litre exceeds the limit of 0.04 milligrams per litre.
    - Field filtered sample (0.45 micron filter) decreased to 0.021 milligrams per litre, which is within the limits.

Ottawa Sewer Use By-law – Sanitary and Combined Sewers:

- Total suspended solids at 2,230 milligrams per litre exceeds the limits of 350 milligrams per litre.

The groundwater quality results indicate storm and sanitary/combined sewer exceedances for total suspended solids, which is likely associated with fine grained sediments from the vicinity of the well screen and suspended in the water column at the time of sampling. Extended well development may be required to reduce the fine-grained materials. The storm sewer metals exceedances of copper, manganese and zinc are associated with the high TSS levels, which decreased following field filtration. Post-filtration, the manganese concentrations remain above the storm sewer limits and may be naturally occurring, common in the Ottawa area. The removal of sediment prior to discharge to the storm sewer is anticipated to reduce parameter exceedances to within applicable limits, with the exception of manganese that may be naturally occurring and an application for a variance to discharge above the storm sewer limits can be submitted to the sewer use office for review and approvals.

Additional water quality sampling was conducted as part of the Phase Two Environmental Site Assessment completed by GEMTEC, reported under separate cover.

4.12 Chemistry Relating to Corrosion

Two samples of the soil recovered from boreholes 24-05 and 24-07 were sent to an accredited laboratory for basic chemical testing relating to corrosion of buried concrete and steel. The results of the testing are summarized in Table 4.9.

Table 4.9 – Summary of Corrosion Testing

Parameter	Borehole 24-05 Sample 3	Borehole 24-07 Sample 3
Chloride Content (ug/g)	15	12
Resistivity (Ohm·m)	49.2	37.7
pH	7.19	7.24
Sulphate Content (ug/g)	68	161

5.0 GEOTECHNICAL GUIDELINES AND RECOMMENDATIONS

5.1 Grade Raise Restrictions

Based on the boreholes advanced during this investigation, the site is underlain by deposits of fill material, layers of sand and silt, over glacial till followed by bedrock. Therefore, we do not anticipate any grade raise restrictions at this site, from a geotechnical perspective. Notwithstanding, any filling above 3 metres of the original ground level should be assessed by GEMTEC.

Due to the presence of uncontrolled fill material, and if layers of peat and/or former topsoil (as encountered in Paterson (2006)) within and/or below the fill material remain in place, some non-uniform settlement of the ground surface should be anticipated over time, even if minor grade raise filling over these soils is carried out. This settlement may affect roadway and underground services.

5.2 Excavation

For construction of the development, it is anticipated that bulk excavation of the soils and possibly bedrock will be undertaken within the site boundaries. Commentary on overburden and bedrock excavation are provided in the subsections 5.2.1 and 5.2.3 below. Preliminary comments on excavation support are provided in Section 5.3.3. Further details can be provided as the design progresses.

The proposed excavations may affect adjacent existing structures, both above and below ground, due to ground movement and dewatering (both in the short and longer term). Potential impacts

should be considered once more details of the proposed development and surrounding infrastructure are known.

5.2.1 Overburden Excavation

The fill material may contain boulders and other larger fragments of hard material and construction materials which may slow excavation rates. The native soils at this site are anticipated to be readily excavatable using conventional hydraulic excavation equipment, in general. Boulders should be anticipated in the glacial till and also close to the bedrock level. As such, an allowance should be made for removal of boulders during excavation which may require use of larger excavation plant and slower excavation progress.

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. The GEMTEC and Paterson (2006) investigations identified the presence of very loose soils at this site. According to the Act, the very loose soils above and below the groundwater level can be classified as Type 4 and, accordingly, allowance should be made for excavation side slopes of 3 horizontal to 1 vertical extending upwards from the base of the excavation. For excavations in Type 3 soils allowance should be made for excavation side slopes of one horizontal to one vertical extending upwards from the base of the excavation above the groundwater level. Below the groundwater level flatter side slopes may be required, in particular, if sand and silt deposits are encountered in the excavation. Due to the variable conditions, inspection of the soils encountered at the time of excavation should be carried out to verify if Type 3 or Type 4 conditions are applicable.

Where space constraints dictate it may be necessary to support excavations using a temporary retaining system.

5.2.2 Bedrock Excavation

Depending on the proposed underside of footing level and number of basement levels that will be constructed, bedrock excavation may be required.

Shallow bedrock removal could be carried out to shallow depth using large hydraulic excavation equipment in combination with hoe ramming, where fractured bedrock is encountered primarily as boulder sized fragments of rock, such as that encountered in borehole 23-03. Zones of fractured bedrock at the transition between the glacial till and the limestone bedrock is unlikely to behave in a similar manner to the underlying rock layer and should be managed in a similar manner to the soils, i.e. with battered side slopes or retained by a shoring system.

For deeper excavations in the bedrock, or where more competent bedrock is encountered closer to the rock surface, mechanical excavation of the bedrock will likely be inefficient. The rate of bulk bedrock excavation could be increased by using drill and blasting techniques. The blasting program should be designed and carried out under the supervision of a blasting specialist engineer which should consider measures to avoid / minimise blast induced damage. The

contractor/blasting specialist should be made aware of the positions of existing underground services and any other sensitive receivers which may affect the design of the blasting program prior to tendering. Where blasting is to be carried out precondition surveys of nearby existing structures is recommended, and if necessary, measurement of peak particle velocities at nearby structures (including services) could be carried out. Further details on drill and blasting techniques can be provided, if required.

Provided that good bedrock excavation techniques are used, the bedrock could be excavated using near vertical side walls. Any loose bedrock should be scaled from the sides of the excavation. It is noted that the bedrock is known to contain vertical joints and near horizontal bedding planes. Therefore, some vertical and horizontal overbreak of the bedrock should be expected and, as such, the bedrock will likely break below the planned base of the excavation (which may require additional replacement materials). Line drilling on close centres could be used to reduce, not prevent, overbreak and underbreak of the bedrock excavation and to better define the limit of excavation. For the bedrock at this site, it is suggested that allowance be made for line drilling 75 to 100-millimetre diameter holes on 200 to 300 millimetre centres.

5.2.3 Excavation Support / Temporary Retaining Walls

support of the overburden inclusive of boulder layers and fractured bedrock could be provided using a temporary retaining wall system. Depending on the depth of excavation in the bedrock some temporary bedrock support may also be required. The design and implementation of the system is the responsibility of the contractor.

A soldier pile and lagging wall may be acceptable to reduce the impact of excavation on nearby structures which can accommodate a higher degree of ground movement, such as roadways. 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, such as sheet pile, or pile walls may be necessary. Sheet piles and cast in-situ walls can also control or cut off ground water inflow. In addition to 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 depth of excavation in the overburden is likely to exceed that which can be achieved without provided lateral support to the wall (i.e. about 3 to 4 metres). These systems could be implemented in combination with prestressed anchor tiebacks. If anchors extend beyond the site boundary permission from adjacent property owners / stakeholders will be required. The location of existing underground utilities / structures should be considered in the selection on tie-back anchor locations to avoid physical clashes. Alternatively, systems of interior props and braces could be considered, depending on the excavation dimensions and other practical considerations.

Zones of boulders / fractured bedrock identified at the transition between the soil and bedrock should be retained by the shoring system. In order to adequately toe in the shoring system, it

should be planned to install the system through these zones and into the underlying bedrock. Given the potential to encounter hard strata above bedrock consideration could be given to predrilling in advance of installing the retaining wall system.

5.3 Groundwater Pumping and Management

The type of dewatering permit that is required is dependant on the estimated groundwater inflow volumes during construction: An Environmental Activity and Sector Registry (EASR) is required for groundwater takings between 50,000 to 400,000 litres per day, and a Category 3 Permit to Take Water (PTTW) is required for water takings great than 400,000 litres per day for construction dewatering. If permanent groundwater pumping over 50,000 litres per day is required to lower the groundwater level below the underground parking structures, a Category 3 PTTW will be required. Supporting documentation prepared by a Qualified Professional is required to support an EASR or PTTW application.

The amount of water entering the excavation for the construction of the underground parking at this site will depend on the size of the excavation, the material through which the excavation will be advanced, as well as the groundwater elevation at the time of construction.

The recommendations provided below should be re-evaluated following review of detailed design drawings and long-term groundwater level monitoring program.

5.3.1 Construction Stage Permitting

One large excavation is anticipated for the full area of the site (at least 18,300 square metres) and is expected to be advanced to a depth of about 5 metres below the existing ground surface (i.e., to the bedrock surface). The groundwater levels ranged from 2.2 to 3.5 metres below ground surface and the excavation is expected to be advanced below the groundwater table, through sandy soils with an estimated hydraulic conductivity of 2×10^{-4} metres per second (based on hydraulic testing). Surficial geology maps indicate the site is underlain by glaciofluvial river deposits, which would be associated with high permeability soils. A bedrock fault is also mapped in the vicinity of the site which may have a higher permeability compared to the non-faulted bedrock mass.

Based on above mentioned information, excavation below the groundwater table in high permeability sandy soils (glaciofluvial river deposits) is likely to significantly exceed 400,000 litres per day. As such, a Category 3 PTTW is recommended for construction dewatering.

5.3.2 Post Construction / Long-Term Permitting

Further, depending upon the base of excavation level of the proposed underground parking structure, permanent groundwater drainage may exceed 50,000 litres per day. As such, a Category 3 PTTW is recommended for long-term foundation drainage.

Also, for permanent groundwater drainage, the City of Ottawa sewer use office should be contacted to discuss the capacity of the receiving storm sewers. Alternatively, the underground parking structures could be waterproofed to reduce the long-term pumping requirements.

5.3.3 Additional Investigation and Reporting

A supplemental hydrogeological investigation will be required to support the Category 3 PTTW application(s), to include more refined estimates of groundwater inflow based on detailed design drawings and associated impact assessment to nearby receptors, e.g., well users, environment, soil settlement assessment, etc.

Given the potential for significant groundwater inflows from the high permeability sands, additional hydraulic testing (e.g., slug testing and/or pumping tests) is recommended to refine the groundwater pumping estimates for both short-term and long-term dewatering.

The Category 3 PTTW application(s) are submitted to the Ministry of Environment, Conservation and Parks (MECP), which have a 90-day review service standard. The report should also be reviewed by applicable stakeholders for complete details on the findings as well as recommendations on groundwater management.

5.4 Foundation Design

It is understood that the proposed structure within this development will be founded on or within the limestone bedrock or on a layer of lean mix concrete on the bedrock surface.

For preliminary design purposes, the factored net geotechnical resistance at Ultimate Limit States (ULS) for spread footing foundations founded on or within the bedrock may be taken as 2,000 kilopascals.

In instances where the bedrock level is below the underside of foundation level a lean mix concrete may be used as mass fill over bedrock. The required strength of the lean mix concrete should be determined by a structural engineer (but should be no less than the design bearing pressure at the time of application with a suitable factor applied). The strength achieved will depend on the mix design employed for the material.

The value of bearing resistance does nota apply to layers of boulders / highly fractured bedrock which should be cleared from the bearing surface where encountered, or any bedrock which is damaged by the effects of blasting. Similarly, should faulted bedrock be encountered a lower bearing pressure may be applicable, depending on the condition of the bedrock or other measures may be required. Provided the bedrock surface is acceptably cleaned of soil or loose / fractured bedrock (i.e., any bedrock that can easily be removed with a hydraulic excavator), the settlement of footings at the corresponding service (unfactored) load levels will be less than 25 millimetres and therefore Serviceability Limit States (SLS) need not be considered in the foundation design.

Accordingly, the post construction settlement of structural elements which derive their support from footings bearing on bedrock should be negligible.

5.5 Frost Protection of Foundations

All exterior footings should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated, unheated exterior footings adjacent to surfaces which are cleaned of snow cover during the winter months should be provided with a minimum of 1.8 metres of earth cover. It is understood that there will be at least one basement level provided for the structure, and as such, it is likely that these conditions will be met. Further, it is assumed that the underground parking level will be heated.

5.6 Seismic Site Classification

The seismic design provisions of the 2024 Ontario Building Code (OBC) depend, in part, on the shear wave velocity of the upper 30 metres of soil and/or rock below founding level.

As discussed above, the proposed structure will be founded on the bedrock surface, or on a layer of lean mix concrete above the bedrock surface. Based on Table 4.1.8.4.-A of the 2024 OBC, the V_{s30} results for the site (from the proposed underside of footing to 30 metres depth) is about 895 metres per second, resulting in a Site Designation of X_{895}. Based on Table 4.1.8.4.-B of the 2024 OBC, the structure can be assigned a Site Class of B for seismic design purposes. The results of the MASW testing are provided in Appendix G.

It should be noted that as per Table 4.1.8.4.-A, if more than 3 metres of overburden exists between the underside of footing and the bedrock surface, a Site Designation of X_{760} and Seismic Site Class C should be used for seismic design purposes.

5.7 Foundation Wall Backfill and Drainage

In accordance with the Ontario Building Code, the following alternatives could be considered for drainage of the foundation walls above the level of the bedrock:

- Damp proof the exterior of the foundation walls and backfill with free draining, non-frost susceptible sand or sand and gravel such as that meeting OPSS requirements for Granular B Type I or II. OR
- Damp proof the exterior of the foundation walls and install an approved proprietary drainage system on the exterior of the foundation walls and backfill the walls with site won material or imported soil. It is pointed out that the moisture content of the native material may be above the optimum moisture content for compaction. As such, in areas where hard surfacing will abut the buildings, it is suggested that imported sand or sand and gravel be used for foundation backfill material to reduce the potential for post construction settlement of the backfill and damage to the hard surfacing.

The backfill should be compacted in maximum 300 millimetres thick lifts to at least 95 percent of the material's standard Proctor dry density value using suitable vibratory compaction equipment.

Where the backfill will ultimately support areas of hard surfacing (i.e., pavement, sidewalks, 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 compaction equipment. In these areas, 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 1 horizontal to 1 vertical, or flatter. Frost tapers may also be required where differential frost heaving is to be avoided (i.e. between heated and unheated areas).

A perforated plastic foundation drain with a surround of clear crushed stone should be installed on the exterior of the foundation walls. A nonwoven geotextile should be placed between the top of the clear stone and any sandy foundation wall backfill material to avoid loss of sand backfill into the voids in the clear stone (and possible post construction settlement of the ground around the building). The top of the drain should be located below the bottom of the floor slab. The drain should outlet to a sump from which the water is pumped or should drain by gravity to a storm sewer or other suitable outlet.

5.8 Lateral Earth Pressure

The selection of the appropriate value of lateral earth pressure coefficient (i.e., active, or at rest) for design depends on the permissible movement in the retaining structures and the design approach adopted. For instance, relatively large wall movements are typically required to generate "Active" earth pressure conditions, and as such the use of "At Rest" earth pressure coefficients are recommended for preliminary design purposes unless the structures are specifically designed for such movements to occur. Further details can be provided as required.

In addition to the earth pressures, an appropriate value of uniform surcharge at ground surface should be considered to account for construction traffic and other applicable loads as appropriate. We suggest a minimum value of 15 kilopascals be considered.

Please note that the equations in the following sections assume that the foundation walls will be provided with drainage measures and will be installed generally above the bedrock level. Should a water-tight basement be considered, the foundation walls should be designed to resist the additional pressures from groundwater.

Heavy construction traffic should not be allowed to operate adjacent to foundation walls for the proposed buildings (within about 2 metres horizontal) during construction, without the approval of the designers.

5.8.1 Static Geotechnical Design Parameters

Foundation walls that are backfilled with granular material such as that meeting OPSS Granular B Type I or II requirements should be designed to resist “at rest” earth pressures (unless larger movements can be accommodated) calculated using the following formula:

$$\sigma_h = K_o (\gamma\, d+q)$$

where;

- σ_h : lateral earth pressure at depth, d (kilopascals)
- γ: Moist material unit weight (kilonewtons per cubic metre);
- K_o: “At-rest” earth pressure coefficient;
- q: Surcharge at the top of the wall (kilopascals)

5.8.2 Dynamic Geotechnical Design Parameters

Seismic shaking can increase the forces on the foundation walls. The selection of the appropriate value of dynamic earth pressure coefficient (i.e., considering full or 50 percent PGA values) for design depends on the permissible movement in the retaining structures and the design approach adopted. For instance, for non-yielding structures the use of full PGA is recommended, while for yielding structures the reduced PGA value may be applied.

The total pressure due to combined static and seismic loads acting at a specified depth, d, below the top of the wall may be calculated using the following equation:

$$\sigma_h = K_o\, \gamma\, d + (K_{oe} - K_o)\, \gamma\, (H - d)$$

where;

- σ_h : lateral earth pressure at depth d (kilopascals);
- γ: Moist backfill material unit weight (21 kilonewtons per cubic metre);
- K_{oe} : Dynamic “At-rest” earth pressure coefficient;
- H : Wall height (metres);
- K_o : “At-rest” Earth Pressure Coefficient

The static thrust component (P_o) acts at a point located H/3 above the base of the wall. During seismic shaking, the dynamic at rest thrust component (P_o) acts at a point located about 0.6H above the base of the wall.

According to the 2020 National Building Code of Canada, the peak ground acceleration (PGA) for this site is about 0.25 g for Site Class B. The dynamic at rest earth pressure coefficient was calculated using the method suggested by Mononobe and Okabe, assuming a horizontal seismic coefficient, k_h, of 0.248 and assuming that the vertical seismic coefficient, k_v, is zero (i.e. non-yielding walls). For design purposes, the parameters provided in Table 5.1 can be used to calculate the thrust acting on the walls during static and seismic loading conditions.

Table 5.1 – Summary of Design Parameters (Building Foundation Walls)

Parameter	OPSS Granular B Type I	OPSS Granular B Type II
Material Unit Weight, γ (kilonewtons per cubic metre)	22	22
Estimated Friction Angle (degrees)	34	38
"At Rest" Earth Pressure Coefficient, K_o, assuming horizontal backfill behind the structure	0.44	0.38
"Active" Earth Pressure Coefficient, K_a, assuming horizontal backfill behind the structure	0.28	0.24
Dynamic Earth Pressure Coefficient, K_{oe}, assuming horizontal backfill behind the structure	0.45	0.39

It should be noted that the above table assumes that the ground above the wall will be flat (i.e., not sloping). If a sloping ground surface behind the wall is proposed the thrust acting on the wall will be increased.

5.9 Rock Anchors

Rock anchors may be required for the proposed structure to resist overturning and lateral loads, (and potentially uplift and buoyancy forces if a watertight construction approach is adopted). Grouted or mechanical rock anchors may be used for these purposes.

The design, construction, and testing of anchors should be carried out in accordance with OPSS 942. The design of the grouted rock anchors should consider the following failure modes:

- Failure within the rock mass or rock cone pull-out;
- Failure of the rock / grout bond;
- Failure of the grout / tendon bond; and,
- Failure of the steel tendon or top anchorage.

Of the failure modes identified above – failure of the tendon / grout bond, and failure of the tendon or top anchorage should be checked by a structural engineer.

Anchor resistance, (Q_r) for a single anchor against failure within the rock mass can be determined from the equation for the volume of a cone, according to a 60 degree cone apex angle, with apex located at the mid-point of the fixed length section. A 60 degree angle is suggested due to the presence of steeply dipping fractures in the bedrock as indicated by the GEMTEC core recovery. The equation for anchor resistance for failure within the rock mass is provided below, neglecting shear resistance generated along the cone surface:

$$Q_r = Ø*0.33*\pi*\gamma'D^3Tan^2\theta$$

Where:

- γ' = Buoyant unit weight of rock may be taken as about 16 kilonewtons per cubic metre (conservative value)
- Ø = Resistance factor to be applied
- D = cone height (anchor midpoint)
- θ = Half the value of the apex angle.

Where loads are off vertical the capacity of the anchor should be modified according to the angle of application.

Group effects should be considered in assessing anchor capacity where overlapping occurs between adjacent cones. For this case, the volume of a truncated trapezoidal failure zone should be considered. However, for preliminary design purposes we suggest anchors should not be spaced closer than about 1.5 metres to reduce the potential for drillholes to intersect and avoid overstressed areas of bedrock.

For failure of the grout/rock bond the unfactored ULS bond strength at concrete to rock interface pull out use a value of 2,000 kilopascals (assuming a resistance factor of 0.3 to 0.4 is applied). This value assumes that the fixed anchor length is in sound rock (not fractured rock), strong or better. To achieve the bond strength the surface of the rock bores should be rough and all debris and rock flour should be cleared from the bore or the anchor capacity shall be reduced as a result. The required bonded length should be determined according to the factored tensile resistance to be carried.

Long bonded anchor lengths should be avoided i.e., maximum of 8 metres. SLS movement in the anchor can be determined from the elastic elongation of the unbonded portion of the tendon under design load.

Rock anchors to be tested at time of construction by proof load testing to 1.5 times the anchor service load on at least 10 percent of the anchors (or according to Ontario Provincial Standards,

whichever is the more stringent requirement). In this instance a resistance factor of 0.4 could be applied. If more than one type of rock anchor is to be installed it is recommended that one type of each anchor is tested to failure.

Corrosion protection of the anchor system should be provided which is adequate for the design life of the system. For permanent elements the rock anchors 'double corrosion protection' systems should be used.

The use of a specialist rock anchor contractor is recommended for installation of the anchors. The installation and testing of rock anchors shall be observed by a suitably qualified and experienced geotechnical practitioner.

5.10 Floor Slabs

5.10.1 General

The floor slab should be wet cured to minimize shrinkage cracking and slab curling. The slab should be saw cut to about 1/3 the thickness of the slab as soon as curing of the concrete permits, in order to minimize shrinkage cracks.

Proper moisture protection with a vapour retarder should be used for any floor slab where the floor will be covered by moisture sensitive flooring material or where moisture sensitive equipment, products or environments will exist. The “Guide for Concrete Floor and Slab Construction”, ACI 302.1R-04 should be considered for the design and construction of vapour retarders below the floor slab.

5.10.2 Slab Support

To provide predictable settlement performance of the basement slab all (uncontrolled) fill material, buried peat and topsoil, other deleterious material, and disturbed soils should be removed from the slab area. This is likely to occur based on the current plan to support the structure on / within the bedrock.

The base of the basement floor slab should consist of at least 200 millimetres of granular A or 19-millimetre clear crushed stone. Any necessary grade raise fill should consist of either OPSS Granular B Type II or 19 millimetre clear crushed stone. The use of clear stone is preferable for a drained basement condition. It is suggested that drainage be provided below the slab by means of plastic perforated pipes spaced at about 5 metres on centre or as required to link any hydraulically isolated areas. The drains should outlet to the sump from which the water is pumped.

The Granular A and B Type II should be compacted in maximum 150 millimetre thick lifts to at least 95 percent of the material’s standard Proctor maximum dry density value using suitable vibratory compaction equipment. The clear crushed stone should be nominally compacted with at least 2 passes of a diesel plate compactor.

OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular B Type II material. Since the source of recycled material cannot be determined or controlled, it is suggested that any imported Granular B Type II materials be composed of 100 percent crushed rock only.

5.11 Corrosion of Buried Concrete and Steel

The measured sulphate concentration in the samples of soil recovered from boreholes 24-05 and 24-07 was 68 and 161 micrograms per gram, respectively. According to Canadian Standards Association (CSA) “Concrete Materials and Methods of Concrete Construction”, the concentration of sulphate can be classified as low. Therefore, any concrete in contact with the native soil could be batched with General Use (GU) cement. The effects of freeze thaw in the presence of de-icing chemical (sodium chloride) use on the roadway should be considered in selecting the air entrainment and the concrete mix proportions for any concrete.

Based on the resistivity and pH of the sample, the soil in this area can be classified as non-aggressive towards unprotected steel. It should be noted that the corrosivity of the soil/groundwater could vary throughout the year due to the application sodium chloride for de-icing.

5.12 Proposed Services

Information on the proposed services/underground utilities were not available at the time of preparing this report. As such, relatively generic guidelines are provided. More tailored guidelines can be provided as further information becomes available.

5.12.1 Excavation for the Site Services

It is anticipated that the proposed services will be installed above a depth of about 3.0 metres. Within the area of bulk excavation the services will be installed within the backfill material. Outside of that area the excavations for the services will be carried out through the topsoil, where encountered, and into the existing uncontrolled fill material and may extend below the groundwater level.

Excavations for the services should be carried out as per Section 5.2. As an alternative to sloped excavations the service installations could be carried out within a tightly fitting, braced steel trench box, which is specifically designed for this purpose, in combination with suitable groundwater management measures. The possible presence of boulders and other hard material within the fill material should be considered. In order to advance the trench box, even boulders / hard material that partially intrude into the sides of the excavation must be removed, which may result in a wider excavation than anticipated.

5.12.2 Pipe Bedding

Outside of the zone of bulk excavation, it is likely that uncontrolled fill material is present which extends below the bedding grade for the utilities. For services installed on existing uncontrolled

fill material, there is a risk that the services will be negatively impacted to some degree by post-construction settlement of these materials - particularly if layers of peat and/or former topsoil are present within or below the fill material.

The bedding for service pipes should consist of at least 150 millimetres of crushed stone meeting OPSS requirements for Granular A. In areas where the subsoil is disturbed or where unsuitable material exists below the pipe subgrade level, the disturbed/unsuitable material should be removed, the base of the trench should be compacted, and a subbedding layer of compacted granular material such as that meeting Granular B Type II or a layer of lean mix concrete should be constructed. A 300 millimetre (minimum) thick layer of Granular B Type II subbedding material should be placed. However, it should be noted that these measures will not necessarily remove the risk of post-construction settlement occurring but are suggested as a method to reduce the impact. The granular bedding and subbedding materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value.

Cover material, from spring line to at least 300 millimetres above the tops of the pipes, should consist of granular material, such as that meeting OPSS Granular A.

The use of clear crushed stone as a bedding, subbedding, or cover material should not be permitted on this project.

5.12.3 Trench Backfill

In areas where the service trenches will be located below or in close proximity to existing or future areas of hard surfacing (pavement, sidewalk, etc.), acceptable excavated fill 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 2.1 metres below finished grade. Where previously excavated fill material 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.

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 material's standard Proctor maximum dry density value using suitable vibratory compaction equipment. The specified density may be reduced to 90 percent of the standard Proctor dry density value in areas where the trench backfill is not located below or in close proximity to existing or future roadways, parking areas, sidewalks, etc. and provided that some settlement above the trench is acceptable.

5.13 Exterior Pavement Design

Information on the pavement layout, zone of bulk excavation, and traffic loading levels are not available at the time of preparing this report. As such relatively generic guidelines are provided. More tailored guidelines can be provided as further information on parking lot/access roadways are available.

5.13.1 Subgrade Preparation

In preparation for the construction of roadways at this site, all surficial topsoil, and any loose/soft, wet, organic or deleterious materials should be removed from the proposed subgrade surface. This need not include removal of the existing fill material provided that some post construction settlement of the roadways can be tolerated.

Any subexcavated areas could be filled with compacted earth borrow. Similarly, should it be necessary to raise the roadway grades at this site, material which meets OPSS specifications for Select Subgrade Material or Earth Borrow may be used. The select subgrade material or earth borrow should be placed in maximum 300 millimetre thick lifts and compacted to at least 95 percent of the material's standard Proctor maximum dry density value using vibratory compaction equipment. Prior to placing granular material for the roadways, the exposed subgrade should be heavily proof rolled under suitable (dry) conditions, and inspected and approved by geotechnical personnel. Any soft areas evident from the proof rolling should be subexcavated and replaced with suitable earth borrow approved by the geotechnical engineer.

The subgrade should be shaped and crowned to promote drainage of the roadway granular materials.

5.13.2 Pavement Structure

The following minimum pavement structure is suggested for exterior roadways and parking areas that will be for light traffic only (i.e., no heavy truck traffic):

- 90 millimetre thick layer of asphaltic concrete (40 millimetres of Superpave 12.5 Traffic Level B over 50 millimetres of Superpave 12.5 Traffic Level B); over
- 150 millimetre thick layer of base (OPSS Granular A); over
- 450 millimetre thick layer of subbase (OPSS Granular B Type II);

The following minimum pavement structure is suggested for exterior roadways for heavy traffic (i.e., garbage and fire trucks):

- 120 millimetre thick layer of asphaltic concrete (50 millimetres of Superpave 12.5 FC1 Traffic Level D over 70 millimetres of Superpave 19.0 Traffic Level D); over
- 150 millimetre thick layer of base (OPSS Granular A); over
- 500 millimetre thick layer of subbase (OPSS Granular B Type II);

The above pavement structures assumes that the roadway subgrade surface is prepared as described in this report. If the roadway subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thickness given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase and/or to incorporate a woven geotextile separator between the roadway subgrade surface and the granular subbase material. The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction. In our experience, a geotextile will likely be required in most cases where the subgrade consists of overburden, if the roadway construction is planned during the wet period of the year (such as the spring or fall).

Similarly, 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.

5.13.3 Granular Material Compaction

The pavement granular materials should be compacted in maximum 300-millimetre-thick lifts to at least 99 percent of material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

5.13.4 Asphaltic Cement

Performance graded PG 58-34 asphaltic cement is recommended for light duty roadways and parking areas while performance graded PG 64-34 asphalt is recommended for heavy duty roadways.

5.13.5 Transition Treatments

In areas where the new pavement structure will abut existing pavements, 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.

5.13.6 Pavement Drainage

Adequate drainage of the pavement granular materials and subgrade is important for the long-term performance of the pavement at this site. It is suggested that storm sewer catch basins be equipped with 3 metre stub drains extending in at least 2 directions. The stub drains should be installed at the subgrade level.

Further details on pavement drainage can be provided as the design progresses.

5.14 Interior Pavement Design

It is unknown at this time if the underground parking garage slab will be trafficked on the concrete slab, or if an asphaltic concrete surface will be constructed. Further guidelines on the interior pavement structure can be provided as the design progresses.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Winter Construction

If construction is required during freezing temperatures, the soil below the proposed houses 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 heaving related damage to structures or services.

6.2 Effects of Construction Induced Vibration

Some of the construction operations (such as granular material compaction, bedrock excavation, 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. The magnitude of the vibrations will be much less than that required to cause damage to the nearby structures or services in good condition.

6.3 Monitoring Well Abandonment

All monitoring wells installed as part of this investigation should be decommissioned by a licensed well technician. The well abandonment could be carried out in advance of or during construction.

6.4 Disposal of Excess Soil and Re-Use of Existing Fill

It is noted that the professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination, including naturally occurring source of contamination, are outside the terms of reference for this report. This report does not constitute a Phase II Environmental Site Assessment (ESA), nor does it constitute a contaminated material management plan.

As indicated above, the existing granular base and subbase could be used for grade raise fill below the new parking areas, or depending on the quality of the material, possibly within the new pavement structure or as grade raise material below the floor slabs (other than in areas where

the use of clear stone has been specified). The material should be carefully separated and stockpiled for evaluation by GEMTEC at the time of construction. Existing, non-deleterious earth fill could likely be used as grade raise material in soft landscaped areas, subject to approval by GEMTEC at the time of construction.

6.5 Design Review and Construction Observation

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed excavations do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design. The subgrade surfaces for the buildings, services, and access roadway/parking areas should be inspected by experienced geotechnical personnel to ensure that suitable materials have been reached and properly prepared. The placing and compaction of earth fill and imported granular materials should be inspected to ensure that the materials used conform to the grading and compaction specifications.

7.0 CLOSURE

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.

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Senior Geotechnical Engineer

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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.

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.

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.

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.

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.

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.

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 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.

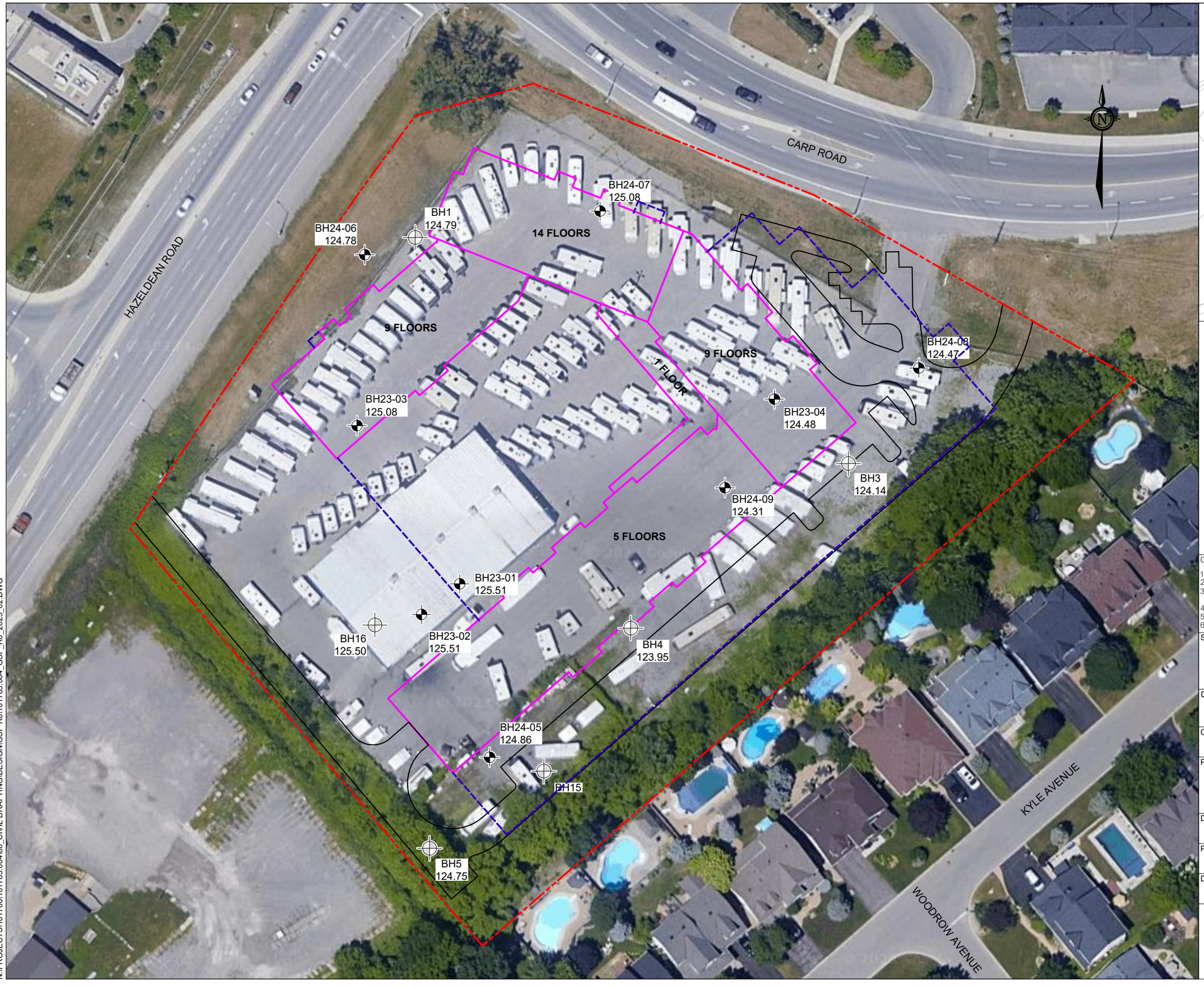
SAMPLE DISPOSAL: GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater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

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.

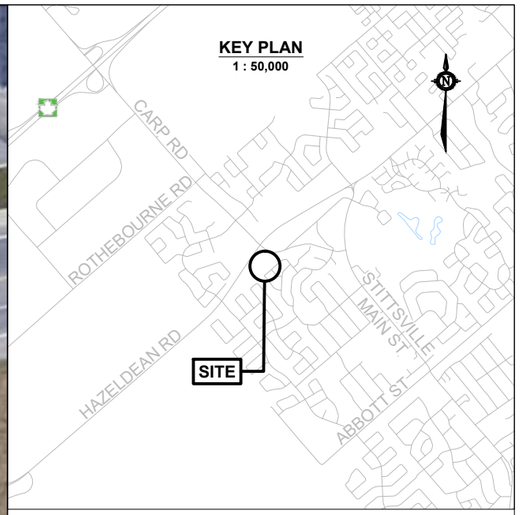
During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and 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.

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.

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.



KEY PLAN
1 : 50,000



LEGEND

- BH # — BOREHOLE ID
- XX.XX — GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM
- **BOREHOLE LOCATION** (CURRENT INVESTIGATION BY GEMTEC)
- **APPROXIMATE BOREHOLE LOCATION** (PREVIOUS INVESTIGATION BY PATERSON GROUP)
- **APPROXIMATE SITE BOUNDARY**
- **LIMIT OF UNDERGROUND PARKING**
- **APPROXIMATE PROPOSED BUILDING FOOTPRINT**
- **APPROXIMATE PROPOSED PAVED AREA**

GENERAL NOTE(S)

1. Coordinate system: NAD83 (CSRS), UTM ZONE 18N, CGVD28
2. Distances, elevations, and coordinates are shown in metres unless denoted otherwise
3. This drawing is a schematic representation and should not be taken as a substitute for a legal survey.
4. Image @2024 Google Maps, CNES / Airbus, First Base Solutions, Maxar Technologies
5. Contains information licensed under the Open Government Licence – Ontario
6. Geographic dataset source: Ontario GeoHub

SCALE 1:750

0 15 30 45m

DRAWING
SITE PLAN

CLIENT
LE GROUPE MAURICE

PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
1174 CARP ROAD
OTTAWA, ONTARIO

DRAWN BY	CHECKED BY
S.L.	W.A.M.
PROJECT NO.	REVISION NO.
101785.004	0
DATE	FIGURE NO.
FEBRUARY 2025	FIGURE 1

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ottawa@gemtec.ca

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APPENDIX A

Record of Borehole Logs
List of Abbreviations and Symbols
Boreholes 23-01 to 23-04 and 24-05 to 24-09

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

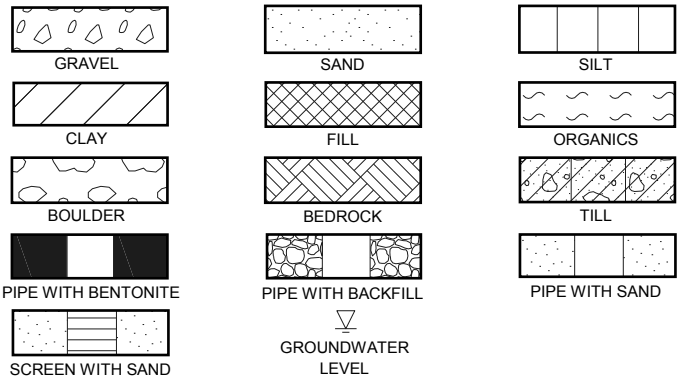
PENETRATION RESISTANCE

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.

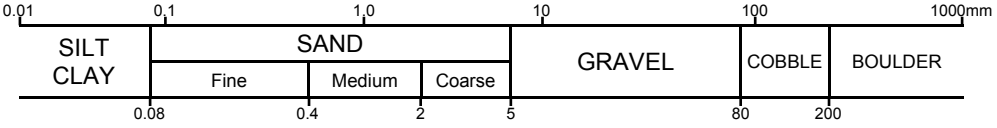
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

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

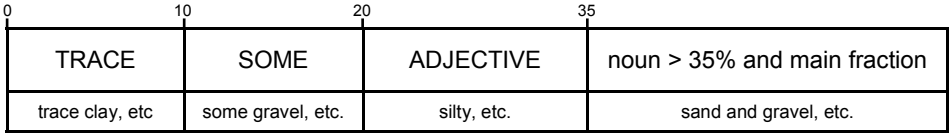


GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE	
Fresh	No visible sign of rock material weathering
Faintly weathered	Weathering limited to the surface of major discontinuities
Slightly weathered	Penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material
Moderately weathered	Weathering extends throughout the rock mass but the rock material is not friable
Completely weathered	Rock is wholly decomposed and in a friable condition but the rock and structure are preserved

CORE CONDITION
Total Core Recovery (TCR) The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run
Solid Core Recovery (SCR) The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.
Rock Quality Designation (RQD) The percentage of solid drill core, greater than 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completed broken core to 100% for core in solid segments.

BEDDING THICKNESS	
Description	**Thickness**
Thinly laminated	< 6 mm
Laminated	6 - 20 mm
Very thinly bedded	20 - 60 mm
Thinly bedded	60 - 200 mm
Medium bedded	200 - 600 mm
Thickly bedded	600 - 2000 mm
Very thickly bedded	2000 - 6000 mm

DISCONTINUITY SPACING	
Description	**Spacing**
Very close	20 - 60 mm
Close	60 - 200 mm
Moderate	200 - 600 mm
Wide	600 -2000 mm
Very wide	2000 - 6000 mm

ROCK QUALITY	
RQD	**Overall Quality**
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

ROCK COMPRESSIVE STRENGTH	
Comp. Strength, MPa	**Description**
1 - 5	Very weak
5 - 25	Weak
25 - 50	Moderate
50 - 100	Strong
100 - 250	Very strong

RECORD OF BOREHOLE 23-01

CLIENT: Le Groupe Maurice
PROJECT: Preliminary Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.003
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 6 2023

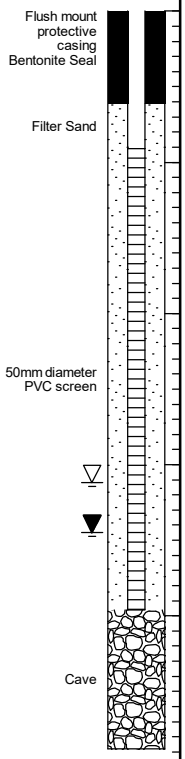
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		125.50				
0		CONCRETE floor slab		125.35				
		Grey brown sand, some gravel, trace silt (FILL MATERIAL)		0.15	1	CA	915	-
1								
					2	CA	1220	-
2	Direct Push / Casing (57mm OD)			123.52				
		Grey brown sand, trace silt (FILL MATERIAL)		1.98				
3					3	CA	1220	-
				121.69				
		Grey sandy silt (FILL MATERIAL)		3.81				
4					4	CA	1220	-
				120.62				
5		End of Borehole		4.88				
6								
7								
8								
9								
10								

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



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
23/04/06	3.1 ▽	122.4
23/04/11	3.5 ▼	122.1

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LOGGED: EW
CHECKED: WAM

RECORD OF BOREHOLE 23-02

CLIENT: Le Groupe Maurice
PROJECT: Preliminary Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.003
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 6 2023

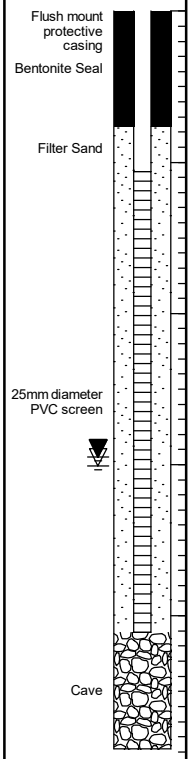
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		125.50				
0	Direct Push Casing (57mm OD)	CONCRETE floor slab		125.35				
		Grey brown sand, some gravel, trace silt (FILL MATERIAL)		0.15	1	CA	365	-
1				124.28				
		Grey brown sand, trace gravel, trace silt (FILL MATERIAL)		1.22	2	CA	1220	-
2				122.91				
		Grey brown sand, some silt, trace gravel (FILL MATERIAL)		2.59	3	CA	1220	-
3				121.84				
		Grey sand and silt, trace gravel (FILL MATERIAL)		3.66	4	CA	1220	-
4				120.62				
		End of Borehole		4.88				
5								
6								
7								
8								
9								
10								

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



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
23/04/06	3.0 ▽	122.5
23/04/11	3.0 ▼	122.6

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CHECKED: WAM

RECORD OF BOREHOLE 23-03

CLIENT: Le Groupe Maurice
PROJECT: Preliminary Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.003
LOCATION: See Site Plan, Figure 1

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

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		125.08							
		ASPHALTIC CONCRETE		0.05							
	Power Auger / Hollow Stem Auger (210mm OD)	Compact to loose, grey brown sand and silt, some clay, trace gravel, with rootlets (FILL MATERIAL)			1	SS	380	15			Flush mount protective casing
1					2	SS	430	5			Auger Cuttings
2				123.10	3	SS	530	9		MH	
		Very loose to loose, grey brown sand, some silt, trace gravel (FILL MATERIAL)		1.98	4	SS	510	2			
3					5	SS	455	8			Bentonite Seal
				121.27							Filter Sand
4		Compact, grey SANDY SILT, trace gravel		3.81	6	SS	510	13			50mm diameter PVC screen
					7	SS	255	> 50			
5	Wash Casing NQ (70mm OD)	Possible nested BOULDERS/fractured BEDROCK with silty sand seams		4.88	8	RC	555	DD			
				119.44							
6	Diamond Rotary Core NQ (70mm OD)	Slightly weathered to fresh, thinly bedded, grey LIMESTONE BEDROCK		5.64	9	RC		TCR= 100% SCR= 100% RQD= 85%		UCs	Bentonite Seal
				118.43							
		End of Borehole		6.65							
7											
8											
9											
10											

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
23/04/20	2.2	122.9
24/11/06	2.3	122.8

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LOGGED: CC
CHECKED: PS

GEO - BOREHOLE LOG 101785.003_BH_LOGS_2023-04-13-01.GPJ GEMTEC 2018.GDT 11/15/24

RECORD OF BOREHOLE 23-04

CLIENT: Le Groupe Maurice
PROJECT: Preliminary Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.003
LOCATION: See Site Plan, Figure 1

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

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface		124.48							
		ASPHALTIC CONCRETE		0.05							
		Compact, brown sand, some gravel, trace silt, with wood fragments and cobbles and boulders (FILL MATERIAL)			1	SS	380	17			
1				122.96							
		Compact to very loose, grey brown sand, trace gravel, trace to some silt (FILL MATERIAL)		1.52	2	SS	405	15			Auger Cuttings
2											
					3	SS	380	2			
3											
					4	SS	430	16			
				120.82							
		Grey SAND and SILT, trace gravel		3.66							
4					5	SS	455	>50			
				120.22							
		End of Borehole Auger Refusal		4.26							
5											
6											
7											
8											
9											
10											

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

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LOGGED: CC
CHECKED: PS

GEO - BOREHOLE LOG 101785.003_BH_LOGS_2023-04-13-01.GPJ GEMTEC 2018.GDT 11/15/24

RECORD OF BOREHOLE 24-05

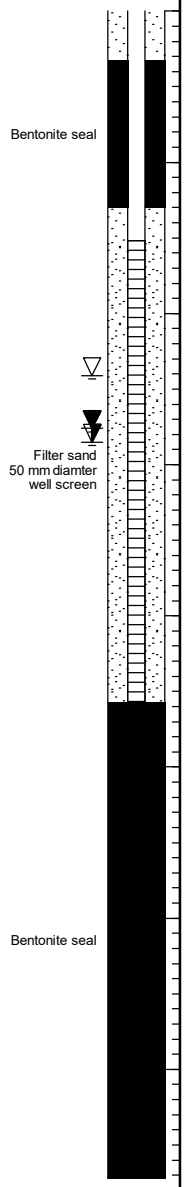
CLIENT: Le Groupe Maurice Inc.
PROJECT: Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.004
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 3 2024

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		124.86					
		Compact, grey brown gravelly sand, trace silt, with cobbles (FILL MATERIAL)			1	SS	455	19	
				124.10 / 0.76					
1		Compact to loose, brown sand, some silt (FILL MATERIAL)			2	SS	405	12	
					3	SS	510	6	
2				122.57 / 2.29					
		Very loose, dark brown silty sand, trace clay, trace gravel, with organics and wood fragments (FILL MATERIAL)			4	SS	255	3	
3				121.51 / 3.35	5	SS	300	1	
		Compact, grey SAND and SILT, trace clay			6	SS	610	14	MH
4				120.21 / 4.65	7	SS	80	>50	
	Diamond Rotary Core HQ (89mm OD)	Slightly weathered to fresh, fine grained, thinly bedded, grey LIMESTONE BEDROCK			8	RC		TCR = 93%; SCR = 80%; RQD = 37%	
5									UCS
					9	RC		TCR = 100%; SCR = 41%; RQD = 43%	
6									
					10	RC		TCR = 100%; SCR = 96%; RQD = 83%	
7				117.14 / 7.72					
		End of borehole							
8									
9									
10									

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

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/07/17	2.4	122.5
24/08/21	2.8	122.1
24/11/06	2.9	122.0

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CHECKED: WAM

GEO - BOREHOLE LOG 101785.004_BH LOGS_2024-07-05.GPJ GEMTEC 2018.GDT 11/15/24

RECORD OF BOREHOLE 24-06

CLIENT: Le Groupe Maurice Inc.
PROJECT: Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.004
LOCATION: See Site Plan, Figure 1

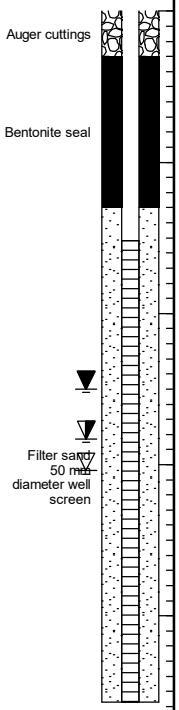
SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 2 2024

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface		124.78					
		TOPSOIL		124.40	1	SS	355	18	
				0.38					
1		Compact to very loose, brown sand, some silt, trace gravel (FILL MATERIAL)			2	SS	405	13	
2					3	SS	255	1	
				122.49					
		Dark brown silty sand, trace gravel, with organics (FILL MATERIAL)		122.34	4	SS	355	11	
				2.44					
3		Compact, brown to grey silty sand, trace gravel, trace clay (FILL MATERIAL)			5	SS	610	25	MH
4					6	SS	610	11	
				120.21					
		End of borehole Auger refusal		4.57					
5									
6									
7									
8									
9									
10									

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

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/07/17	3.0	121.7
24/08/21	2.5	122.3
24/11/06	2.8	122.0

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LOGGED: CC
CHECKED: WAM

GEO - BOREHOLE LOG 101785.004_BH LOGS_2024-07-05.GPJ GEMTEC 2018.GDT 11/15/24

RECORD OF BOREHOLE 24-07

CLIENT: Le Groupe Maurice Inc.
PROJECT: Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.004
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 3 2024

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		125.08							
		ASPHALTIC CONCRETE		0.05							
		Loose to compact, brown sand, some silt, trace gravel (FILL MATERIAL)			1	SS	430	10			Filter sand
1					2	SS	355	14			Bentonite seal
2					3	SS	25	14			
					4	SS	455	18		MH	Auger cuttings
3					5	SS	510	10			
4					6	SS	510	28			
					7	SS	610	29			Bentonite seal
5				120.05							
		Grey brown SILTY SAND		5.03							
	Diamond Rotary Core HQ (89mm OD)	Slightly weathered to fresh, fine grained, thinly bedded, grey LIMESTONE BEDROCK		5.18	8	RC		TCR = 98%; SCR = 96%; RQD = 80%		UCS	
6											
7					9	RC		TCR = 98%; SCR = 97%; RQD = 90%			Filter sand 50 mm diameter well screen
8					10	RC		TCR = 100%; SCR = 100%; RQD = 92%			
		End of borehole		116.47 8.61							
9											
10											

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/08/14	3.5	121.6
24/08/21	3.5	121.5
24/11/06	3.6	121.5

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Consulting Engineers and Scientists

LOGGED: CC
CHECKED: WAM

GEO - BOREHOLE LOG 101785.004_BH LOGS_2024-07-05.GPJ GEMTEC 2018.GDT 11/15/24

RECORD OF BOREHOLE 24-08

CLIENT: Le Groupe Maurice Inc.
PROJECT: Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.004
LOCATION: See Site Plan, Figure 1

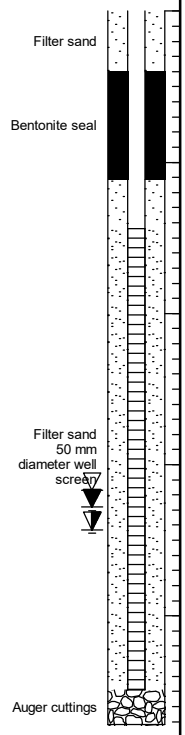
SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 2 2024

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		124.47				
		Compact, grey crushed gravelly sand, trace silt (FILL MATERIAL)		123.71 / 0.76	1	SS	305	18
1		Very loose, dark brown silty sand, some clay, trace gravel, with organics (FILL MATERIAL)		122.79 / 1.68	2	SS	510	3
		Very loose, brown sand, some silt, (FILL MATERIAL)			3	SS	610	1
2					4	SS	455	2
3					5	SS	510	2
		Compact, brown sand, some silt (FILL MATERIAL)		120.66 / 3.81	6	SS	610	28
4		End of borehole Auger refusal		119.75 / 4.72	7	SS	150	>50
5								
6								
7								
8								
9								
10								

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



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
24/08/14	3.2	121.3
24/08/21	3.3	121.2
24/11/06	3.4	121.0

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LOGGED: CC
CHECKED: WAM

GEO - BOREHOLE LOG 101785.004_BH LOGS_2024-07-05.GPJ GEMTEC 2018.GDT 11/15/24

RECORD OF BOREHOLE 24-09

CLIENT: Le Groupe Maurice Inc.
PROJECT: Geotechnical Investigation, Proposed Residential Development, 1174 Carp Road, Ottawa, Ontario
JOB#: 101785.004
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 2 2024

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface		124.31							
		Unsampled Overburden									Auger cuttings
1											
2											
3											
4				120.04							
	Diamond Rotary Core, HQ (89mm OD)	Slightly weathered to fresh, fine grained, thinly bedded, grey LIMESTONE BEDROCK		4.27	1	RC		TCR = 100%; SCR = 100%; RQD = 100%			
5					2	RC		TCR = 98%; SCR = 97%; RQD = 89%		UCS	Bentonite seal
6											
7				116.94	3	RC		TCR = 100%; SCR = 100%; RQD = 89%			
		End of borehole		7.37							
8											
9											
10											

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

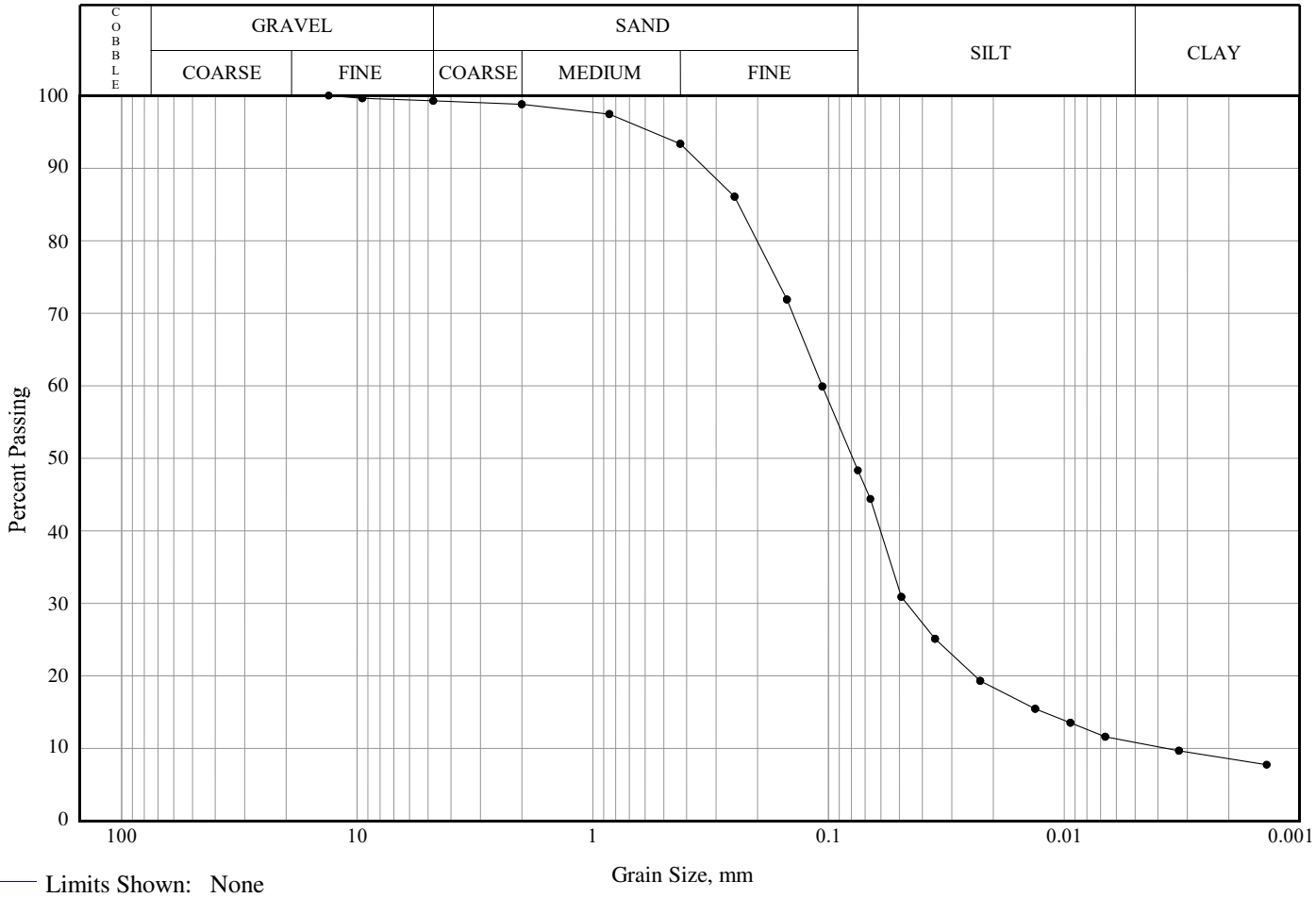
LOGGED: CC
CHECKED: WAM

GEO - BOREHOLE LOG 101785.004_BH LOGS_2024-07-05.GPJ GEMTEC 2018.GDT 11/15/24

APPENDIX B

Laboratory Testing Results
Grain Size Distribution Chart

GEMTEC Consulting Engineers and Scientists	Client: Le Groupe Maurice	Soils Grading Chart (LS-702/ ASTM D-422)
	Project: Preliminary Geotechnical Investigation, Phase I ESA, an	
	Project #: 101785003	

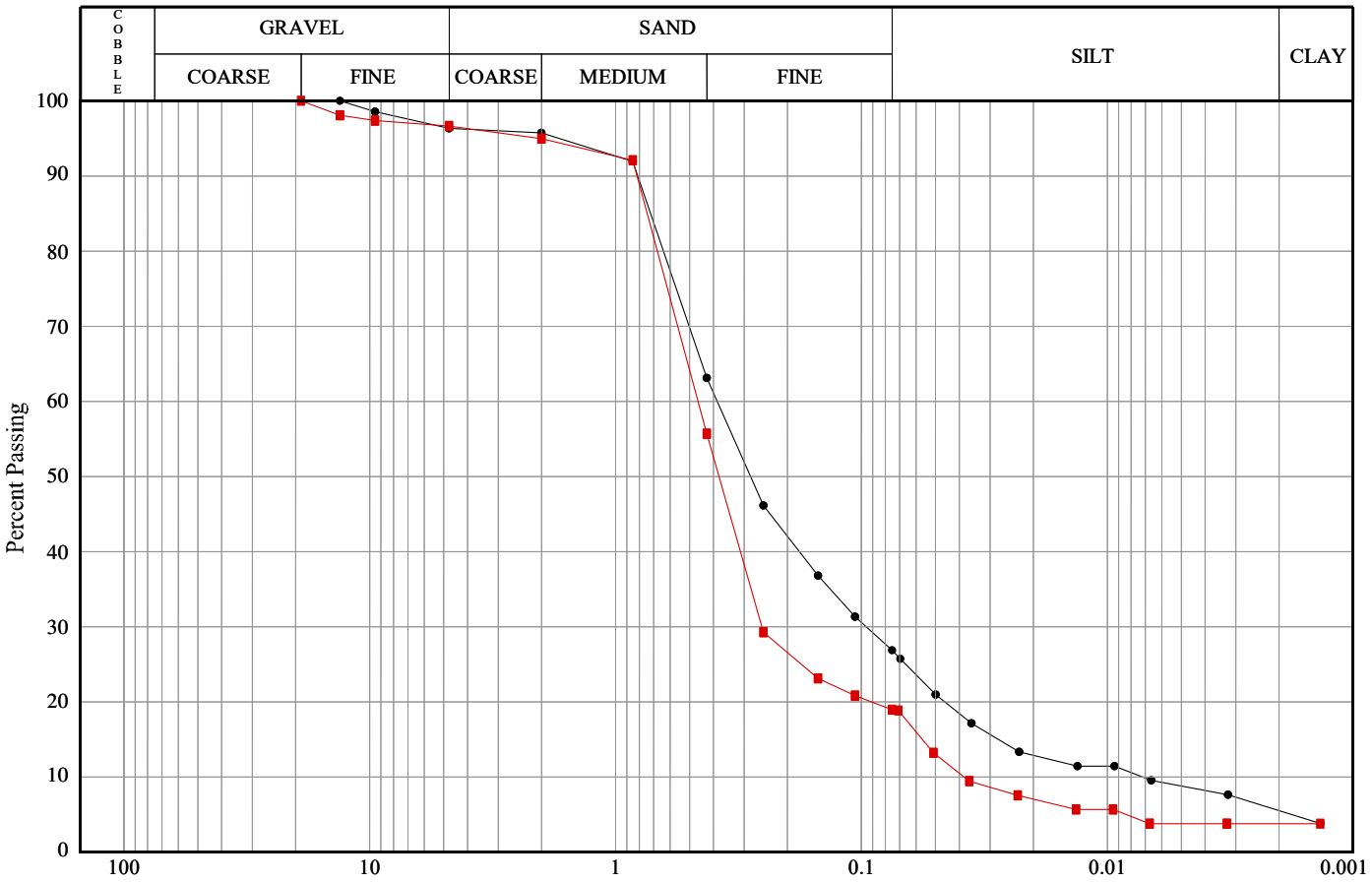


Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	FILL MATERIAL	23-03	SA 3	1.52-1.98	0.7	51.0	37.5	10.8

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Sand and silt , some clay , trace gravel	N/A	0.00	0.01	0.05	0.08	0.11	0.24	37.5

GEMTEC Consulting Engineers and Scientists	Client: Le Groupe Maurice Inc	Soils Grading Chart (LS-702/ ASTM D-422)
	Project: Detailed Geotechnical Investigation and Record of Site C	
	Project #: 101785004	



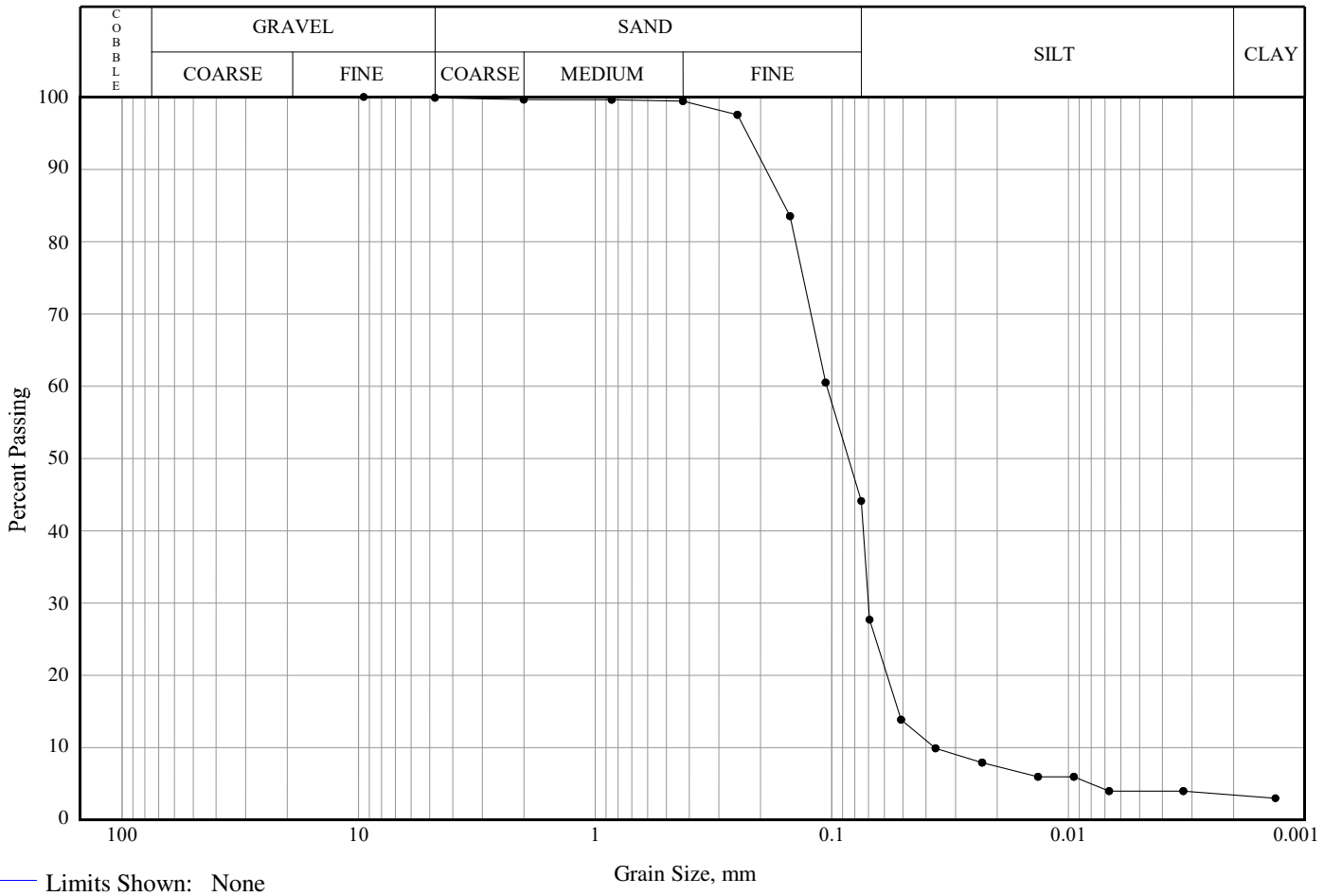
Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●	FILL MATERIAL	24-06	4B	2.28-2.89	3.7	69.5	21.3	5.5
■	FILL MATERIAL	24-07	4	2.4-2.89	3.4	77.7	15.2	3.8

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
●	Silty sand , trace gravel, trace clay	N/A	0.007	0.028	0.10	0.28	0.39	0.72	21.3
■	Sand , some silt , trace gravel, trace clay	N/A	0.038	0.057	0.25	0.38	0.46	0.74	15.2

Note: More information available upon request

GEMTEC Consulting Engineers and Scientists	Client: Le Groupe Maurice Inc Project: Detailed Geotechnical Investigation and Record of Site C Project #: 101785004	Soils Grading Chart (LS-702/ ASTM D-422)



Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	SAND and SILT, trace clay	24-05	6A	3.81-4.42	0.1	55.8	40.7	3.4

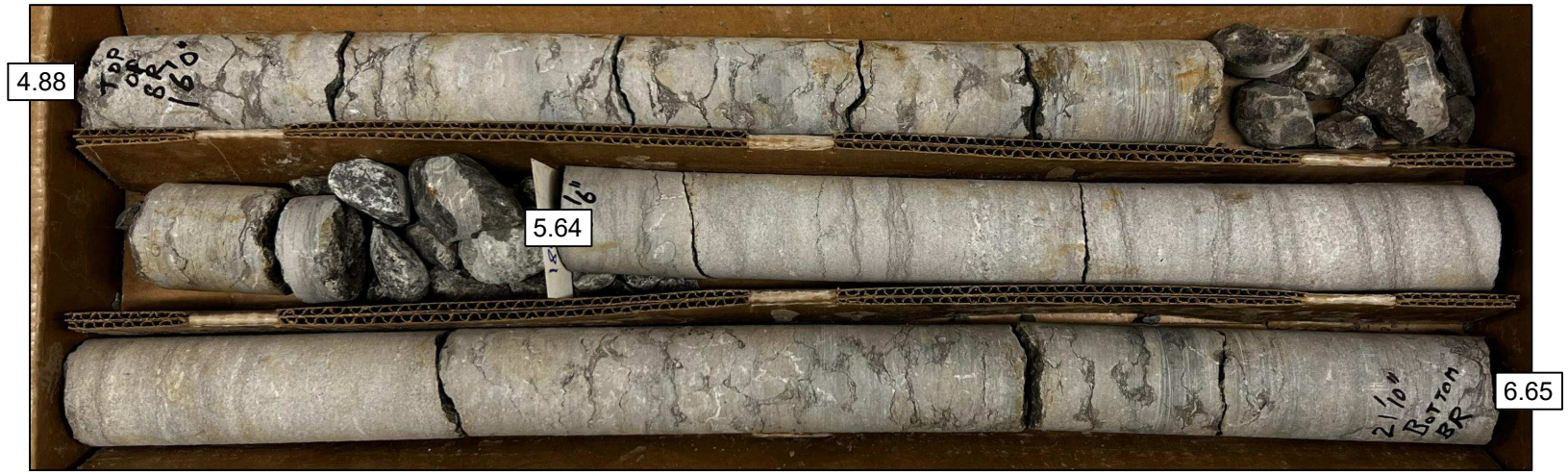
Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Sand and silt , trace gravel, trace clay	N/A	0.037	0.052	0.07	0.08	0.10	0.16	40.7

Note: More information available upon request

APPENDIX C

Bedrock Core Photographs
Figures C1 to C4
Compressive Strength of Rock Core

BOREHOLE: 23-03
BORING DATE: APRIL 10, 2023
DEPTH: 4.88 to 6.65 METRES



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Project LE GROUPE MAURICE
PRELIMINARY GEOTECHNICAL INVESTIGATION
1174 CARP ROAD
OTTAWA, ONTARIO

FIGURE C1

File No. 101785.003

ROCK CORE PHOTOGRAPH
BOREHOLE 23-03

BOREHOLE: 24-05
BORING DATE: JULY 3, 2024
DEPTH: 4.65 to 7.72 mbgs

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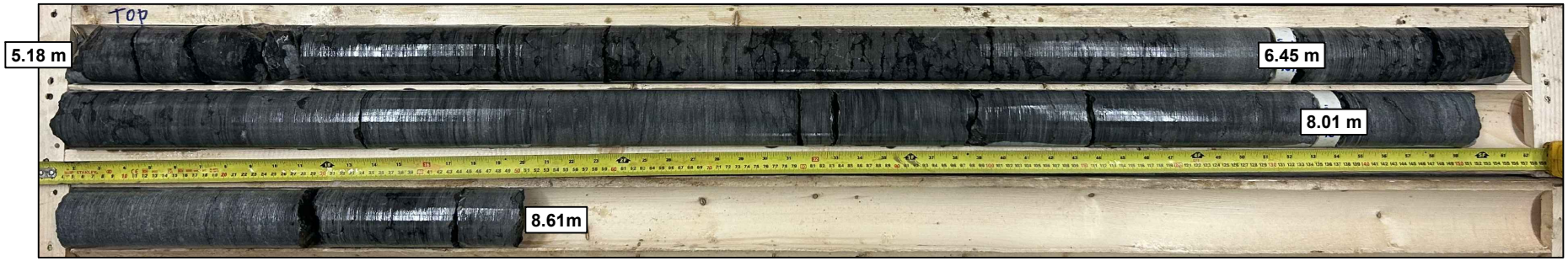
Project
PROPOSED RESIDENTIAL DEVELOPMENT
1174 CARP ROAD
OTTAWA, ONTARIO

FIGURE C2

File No.
101785.004

ROCKCORE PHOTOGRAPH
BOREHOLE 24-05

BOREHOLE: 24-07
BORING DATE: JULY 3, 2024
DEPTH: 5.18 to 8.61 mbgs



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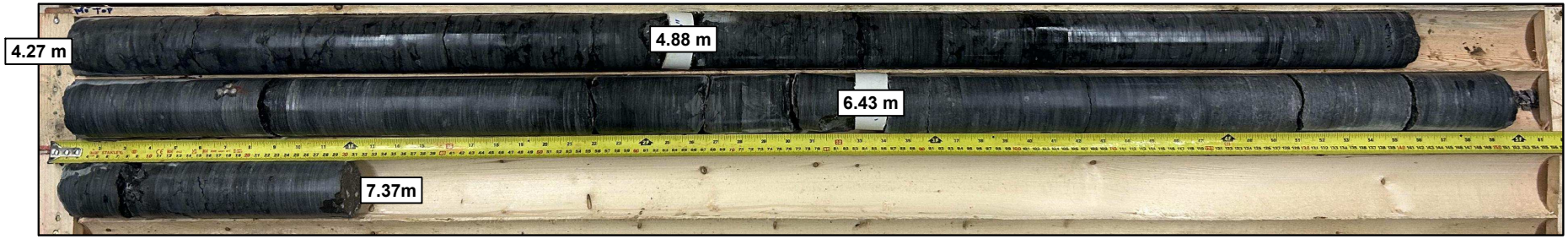
1174 CARP ROAD
OTTAWA, ONTARIO

FIGURE C3

File No.
101785.004

ROCKCORE PHOTOGRAPH
BOREHOLE 24-07

BOREHOLE: 24-09
BORING DATE: JULY 2, 2024
DEPTH: 4.27 to 7.37 mbgs



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Project
PROPOSED RESIDENTIAL DEVELOPMENT
1174 CARP ROAD
OTTAWA, ONTARIO

FIGURE C4

File No.
101785.004

ROCKCORE PHOTOGRAPH
BOREHOLE 24-09

GEMTEC
Consulting Engineers and Scientists

GEMTEC Consulting Engineers and Scientists Limited
32 Steacie Drive
Ottawa, ON
K2K 2A9
Tel.: 613-836-1422
Fax.:613-836-9731

COMPRESSIVE STRENGTH of ROCK CORE

CLIENT: Le Groupe Maurice **PROJECT No.:** 101785.003

Project: 1174 Carp Road **REPORT NO:** 1

Date Received: 12-Apr-23 **Date Tested:** 13-Apr-23

Lab no.						
Cylinder ID	BH23-03 RC9					
Depth (m)	5.69-5.86					
Cut length (mm)	94.64					
Ground length (mm)	91.31					
Diameter (mm)	47.32					
Ground Mass (kg)	0.43					
Length:Diameter ratio	1.93					
Correction factor	0.99					
Failure load (kN)	226.05					
Uncorrected Strength (MPa)	128.50					
Corrected Strength (MPa)	**127.20**					

Remarks

More information may be provided upon request

Checked by: Krystle Smith, Laboratory Manager

Reviewed by: Steve Goodman, Ph.D., P.Eng.

GEMTEC
Consulting Engineers and Scientists

Client: Le Groupe Maurice Inc

Project: Detailed Geotechnical Investigation and Record of Site Condition, 1174 Carp Road,

Project #: 101785004

Rock Core Compressive Strength

Date/Time Sampled: 24/07/08 1:52:00 PM	Date/Time Tested: 24/07/10 1:53:32 PM

BH	Sample No	Depth	Description	Diameter, mm	Area, mm²	Length After Capping, mm	L/D	Load, kN	Comp. Str., MPa
24-05	1	5.03-5.18		60.5	2872	116	1.92	288.810	100.0
24-07	1	5.43-5.64		61.4	2961	123	2.01	288.900	97.6
24-09	1	5.71-6.04		60.8	2903	118	1.94	263.170	90.1

APPENDIX D

Borehole Logs – Previous Investigation
Previous Investigation by Paterson Group (PG0805)
Boreholes 1, 3, 4, 5, 15, and 16

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Preliminary Geotechnical Investigation
Hazeldean Road at Carp Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PG0805

REMARKS

HOLE NO. BH 1

BORINGS BY CME 75 Power Auger

DATE 18 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	124.79
Asphaltic concrete 0.05							
FILL: Brown silty sand with gravel 0.76		SS	1	42	14	1	123.79
FILL: Brown silty sand - topsoil from 1.5m depth		SS	2	58	3	2	122.79
2.21		SS	3	50	8		
Loose to compact, brown **SILTY SAND**		SS	4	58	5	3	121.79
		SS	5	67	11	4	120.79
4.42 **GLACIAL TILL:** Very dense, grey silty sand/sandy silt with gravel, cobbles and boulders		SS	6	62	62+	5	119.79
5.18 End of Borehole							
(GWL @ 2.46m-Apr. 25/06)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Preliminary Geotechnical Investigation
Hazeldean Road at Carp Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PG0805

REMARKS

HOLE NO. BH 3

BORINGS BY CME 75 Power Auger DATE 18 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	124.14
FILL: brown silty sand with gravel		SS	1	42	20	1	123.14
		SS	2	12	4	2	122.14
Loose to compact, brown **SILTY SAND**		SS	3	67	3	3	121.14
		SS	4	33	11		
3.73							
GLACIAL TILL: Very dense, grey silty sand/sandy silt with gravel, cobbles and boulders 3.96		SS	5	100	50+		
End of Borehole							
Practical refusal to augering @ 3.96m depth							
(GWL @ 2.70m-Apr. 25/06)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Preliminary Geotechnical Investigation
Hazeldean Road at Carp Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PG0805

REMARKS

HOLE NO. BH 4

BORINGS BY CME 75 Power Auger DATE 18 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	123.95		
FILL: Brown silty sand with gravel									
0.76									
FILL: Brown silty sand		SS	1	50	19	1	122.95		
		SS	2	50	14				
2.21						2	121.95		
Very loose, brown SILTY SAND with organic matter		SS	3	75	3				
2.90									
GLACIAL TILL: Compact, brown silty sand/sandy silt with gravel, cobbles and boulders		SS	4	50	19	3	120.95		
3.56									
End of Borehole									
Practical refusal to augering @ 3.56m depth									
(GWL @ 2.03m-Apr. 25/06)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Preliminary Geotechnical Investigation
Hazeldean Road at Carp Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Fairhall, Moffatt and Woodland Ltd.

FILE NO. PG0805

REMARKS

HOLE NO. BH 5

BORINGS BY CME 75 Power Auger DATE 18 APR 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	124.75
FILL: Brown silty sand with gravel		SS	1	25	27	1	123.75
- occasional cobbles by 1.4m depth		SS	2	25	25	2	122.75
		SS	3	8	21		
- with organic matter by 2.9m depth						3	121.75
3.20 PEAT/TOPSOIL		SS	4	25	4		
3.66 Compact, grey SANDY SILT		SS	5	58	11	4	120.75
4.42 GLACIAL TILL: Very dense, grey silty sand/sandy silt with gravel, cobbles and boulders		SS	6	62	60+	5	119.75
5.18 End of Borehole							
(GWL @ 2.82m-Apr. 25/06)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Preliminary Geotechnical Investigation
Hazeldean Road at Carp Road
Ottawa, Ontario

DATUM

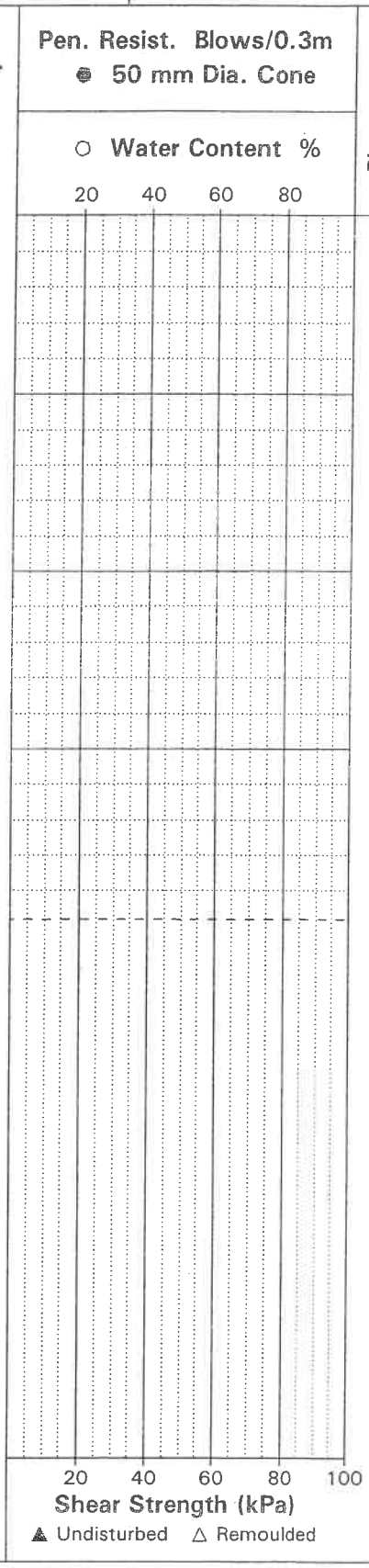
REMARKS

BORINGS BY Portable Drill DATE 20 APR 06

FILE NO. PG0805

HOLE NO. BH15

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE										
TOPSOIL	0.15									
FILL: Brown sandy silty clay with gravel and cobbles			SS	1	42	9				
			SS	2	67	20				
	1.45									
FILL: Light brown silty sand with gravel			SS	3	62					
	2.34		SS	4	92	6				
FILL: Dark brown sandy silty clay to clayey sand with wood pieces to 3.4m depth			SS	5	33	9				
	3.60		SS	6		22				
Compact, green-brown SANDY SILT	3.96									
End of Borehole										



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Preliminary Geotechnical Investigation
Hazeldean Road at Carp Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Portable Drill DATE 20 APR 06

FILE NO. PB0805

HOLE NO. BH16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Concrete slab 0.10							
Asphalt 0.60							
		SS	1	71	2	1	
		SS	2	75	5		
FILL: Light brown to grey-brown sand		SS	3	75	18	2	
		SS	4	100	11		
		SS	5	92	13	3	
- orange-brown by 3.7m depth		SS	6	100	11		
						4	
4.72 End of Borehole							
(GWL @ 2.90m-Apr. 25/06)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

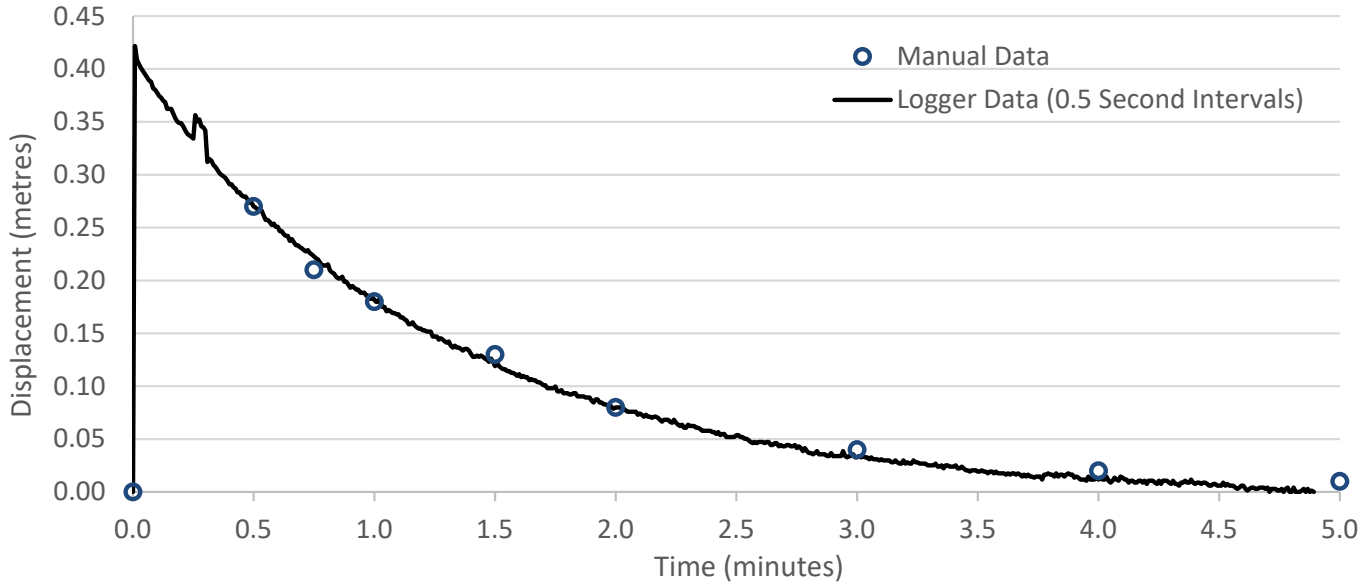
▲ Undisturbed △ Remoulded

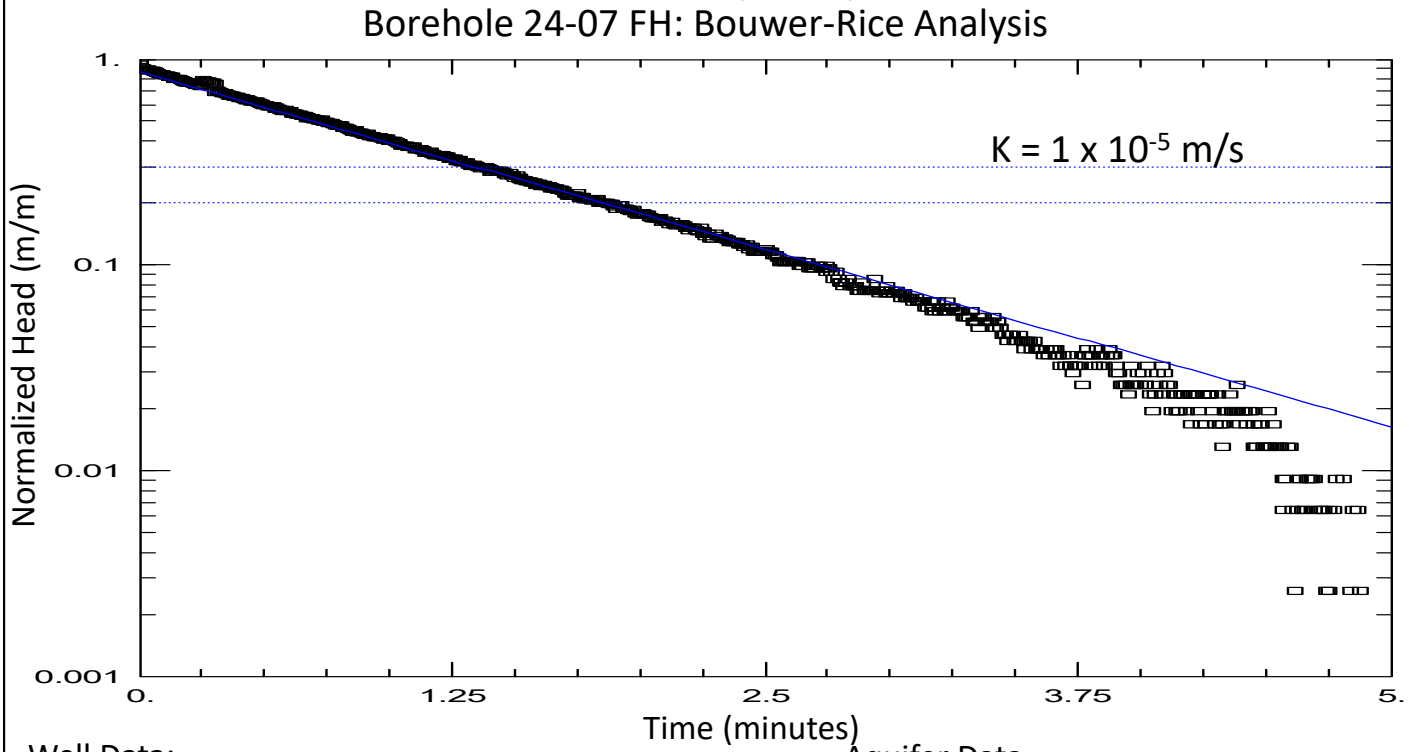
APPENDIX E

Hydraulic Conductivity Testing
Figures E1, E2, and E3

Slug Test Data

FIGURE E1





Well Data:

Displacement observed (slug size): 0.42 metres (0.90 m)
Well Depth: 8.53 metres bgs
Screen Length: 1.52 metres
Well Radius: 0.0255 metres

Aquifer Data

Saturated Thickness: 3.43 metres
Anisotropy Ratio (Kz/Kr): 0.1
Aquifer Model: Unconfined, Bouwer-Rice
Static Water Level: 3.31 metres bgs

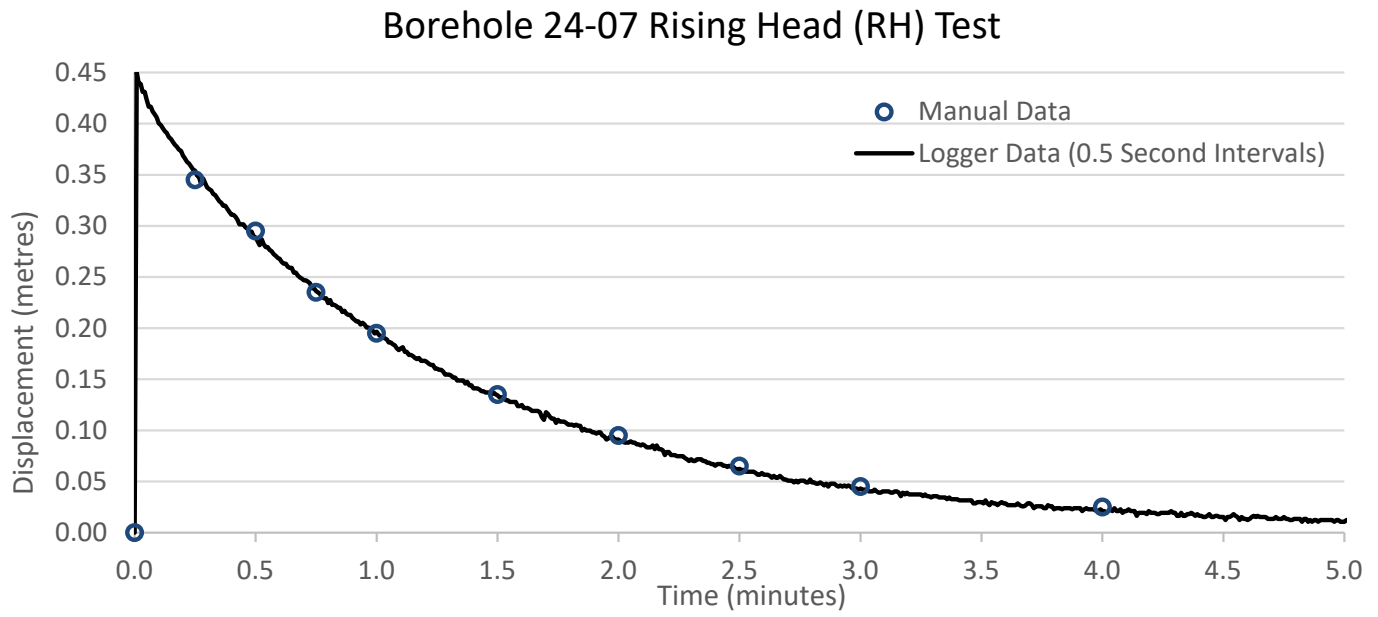
GEMTEC
Consulting Engineers and Scientists

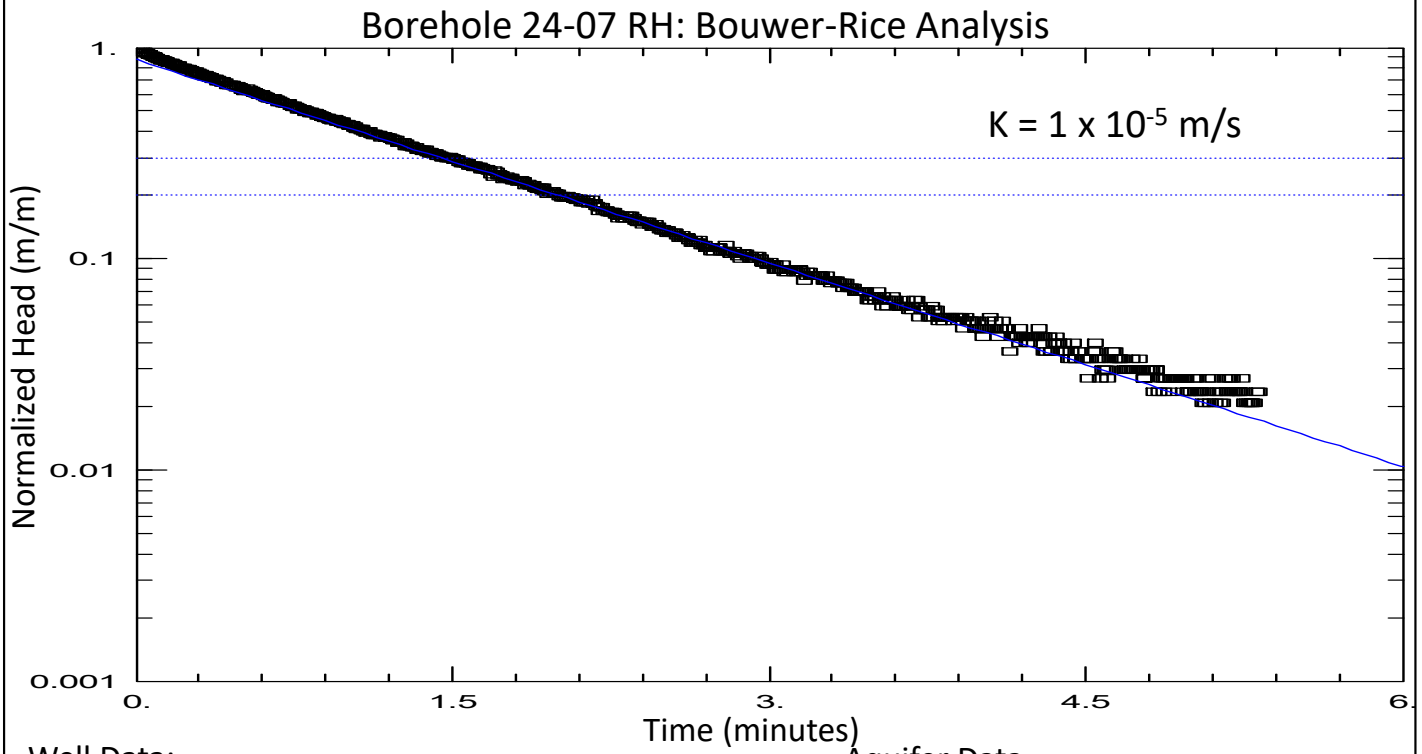
Date: August 2024

Project: 101785.004

Slug Test Data

FIGURE E2





Well Data:

Displacement observed (slug size): 0.45 metres (0.90 m)
Well Depth: 8.53 metres bgs
Screen Length: 1.52 metres
Well Radius: 0.0255 metres

Aquifer Data

Saturated Thickness: 3.43 metres
Anisotropy Ratio (Kz/Kr): 0.1
Aquifer Model: Unconfined, Bouwer-Rice
Static Water Level: 3.31 metres bgs

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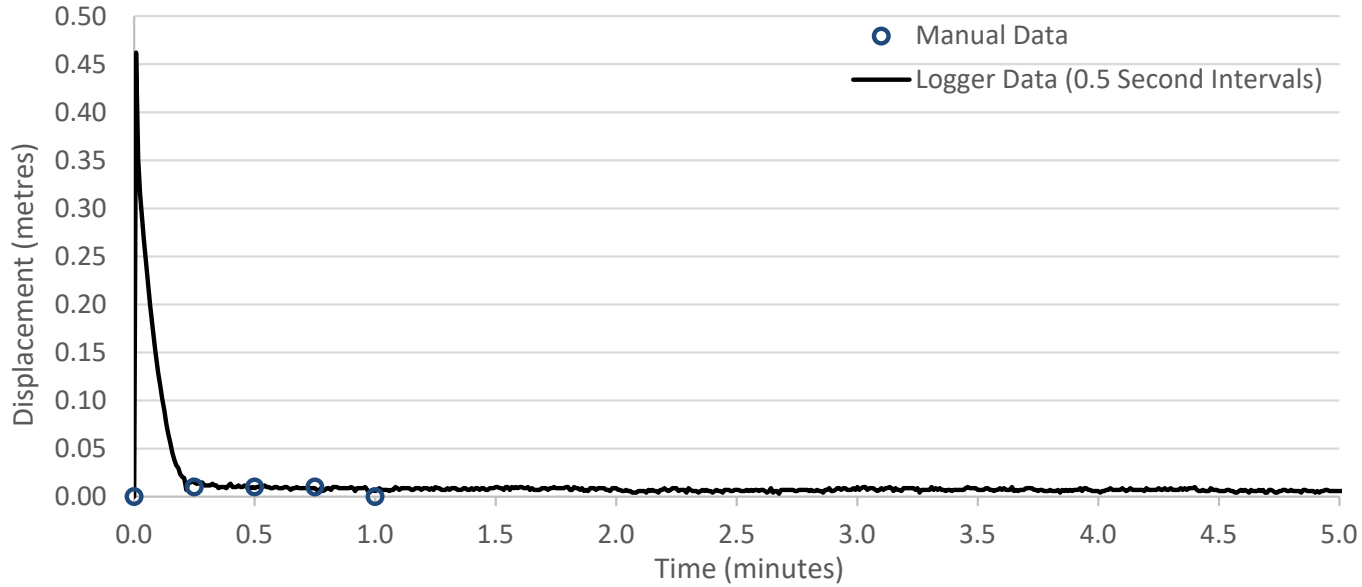
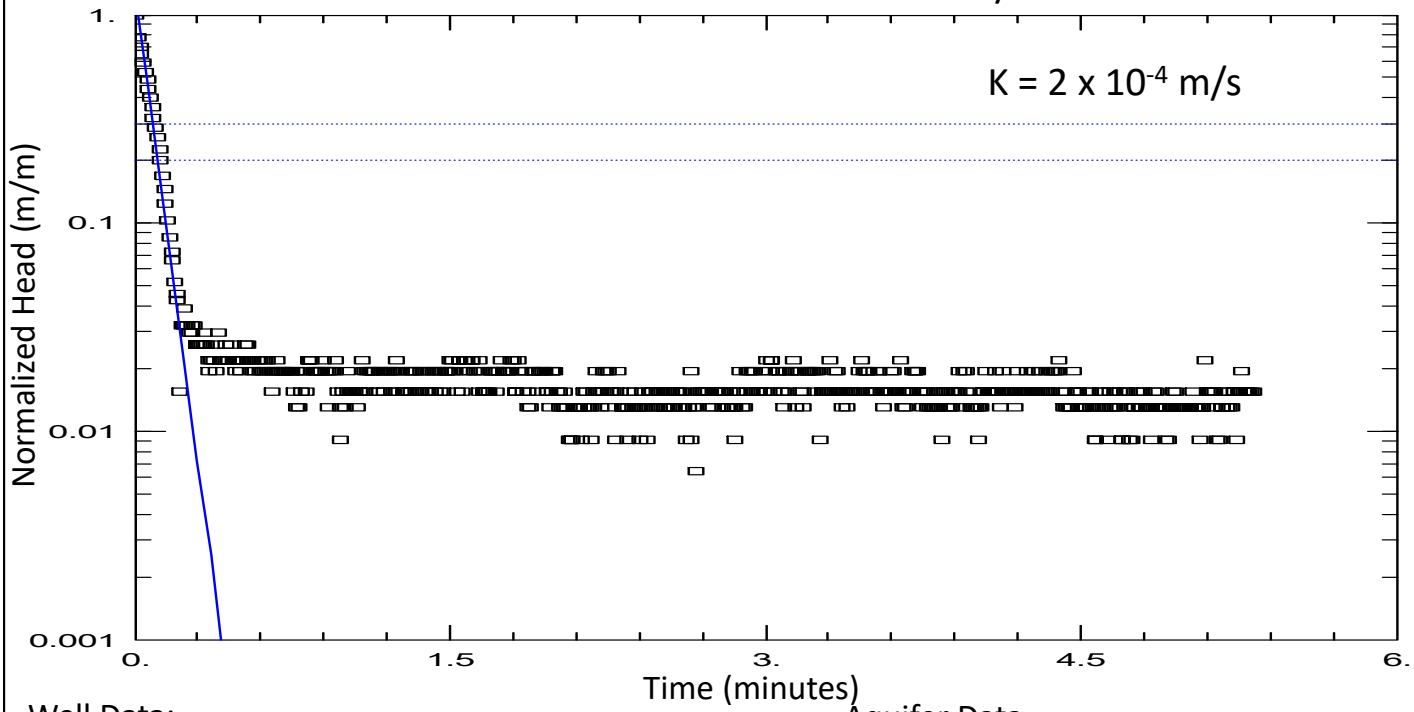
Slug Test Data

FIGURE E3

Borehole 24-08 Rising Head (RH) Test



Borehole 24-08 RH: Bouwer-Rice Analysis



<u>Well Data:</u>

Displacement observed (slug size): 0.46 metres (0.90 m)
Well Depth: 4.38 metres bgs
Screen Length: 1.52 metres
Well Radius: 0.0255 metres

<u>Aquifer Data</u>

Saturated Thickness: 5 metres
Anisotropy Ratio (Kz/Kr): 0.1
Aquifer Model: Unconfined, Bouwer-Rice
Static Water Level: 3.01 metres bgs

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Date: August 2024

Project: 101785.004

APPENDIX F

Chemical Analysis of Soil Samples
Sample Relating to Corrosion
(Paracel Laboratories Ltd. Order No. 2424228)

	Client ID:	24-05 SA3 Bottom 5' - 7'	24-07 SA3 5' - 7'	-	-		
	Sample Date:	02-Jul-24 10:00	02-Jul-24 10:00	-	-	-	-
	Sample ID:	2429363-01	2429363-02	-	-		
	Matrix:	Soil	Soil	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	88.2	85.3	-	-	-	-
General Inorganics							
Conductivity	5 uS/cm	203	265	-	-	-	-
pH	0.05 pH Units	7.16	7.24	-	-	-	-
Resistivity	0.1 Ohm.m	49.2	37.7	-	-	-	-
Anions							
Chloride	10 ug/g	15	12	-	-	-	-
Sulphate	10 ug/g	68	161	-	-	-	-

APPENDIX G

MASW Testing Results

GEMTEC
Consulting Engineers and Scientists

GEMTEC Consulting Engineers and Scientists Limited
11 Akerley Boulevard, Suite 450
Dartmouth, NS, Canada
B3B 1V7

tel: 902.832.5999
halifax@gemtec.ca
www.gemtec.ca

August 22, 2024

File: 101785.004_Rev2

Le Groupe Maurice Inc
2400, rue des Nations, Office 137
Saint-Laurent, Quebec
H4R 3G4

Attention: Benoit Poitras (BPoitras@legroupemaurice.com)

Re: Multi-channel Analysis of Surface Waves (MASW) Investigation
1174 Carp Road, Ottawa, Ontario

INTRODUCTION

A Multichannel Analysis of Surface Waves (MASW) investigation was carried out for a proposed residential structure located at 1174 Carp Road, Ottawa, Ontario (Figure 1 – Site Plan). The investigation was completed to confirm the Seismic Site Class for the proposed structure.

Fieldwork for the investigation was completed on May 24, 2024 by GEMTEC Consulting Engineers and Scientists Limited (GEMTEC). Fieldwork for the investigation included a single MASW survey line to characterize and assess the shear wave velocities in the near surface soils and rock units at the site. At the time of the investigation the general air temperature was approximately 15 degrees Celsius, and the ground surface consisted of an open stretch of grass adjacent to Carp Road . During field work, weather conditions were calm with no wind or precipitation.

Investigation results using MASW methods, provide a time-averaged shear wave velocity for the upper 30 metres of the site (V_{s30}) and are used in conjunction with the 2020 National Building Code of Canada (2020 NBC) to provide a Seismic Site Class for structural design considerations.

Survey methodology, procedures, data processing, and results are described in the following sections.

BASIC PRINCIPLES OF MASW SURVEYING

Unlike typical intrusive investigations, the MASW method characterizes the dispersive nature of Rayleigh-type surface waves to evaluate material properties in the near subsurface (Figure 2). Normally, surface waves are considered noise in seismic reflection or refraction investigations but during MASW surveys, these waves help characterize the elastic properties of the near subsurface.

During an MASW investigation, the dispersion of the surface waves (assuming a heterogeneous medium) is related to the different phase velocities of the individual frequency components of the wave. Dispersion curves from seismic records are identified using the fundamental mode of the Rayleigh wave after plotting phase velocity versus frequency. The dispersion curve characteristics are utilized in an inversion routine to fit the data to a model using an iterative process to produce a shear wave velocity profile as a function of depth.

DATA ACQUISITION

Surveying was completed over a stretch of grass adjacent to Carp Road and parallel to the northeastern side of the proposed structure. MASW surveying utilized a 12-channel survey layout consisting of twelve 4.5 hertz vertical geophones, a 12-channel geophone cable, a 24-channel geometrics geode, a high-impact polyethylene plate, and a 9-kilogram sledgehammer that functioned as the main seismic source (during active surveying). Geophones were placed firmly into the soils using soil penetrating spikes and were positioned at 3 metre intervals for an overall survey line length of 33 metres. During active surveying, six shot locations were occupied and included both forward and reverse shot locations at distances ranging from 3 to 15 metres from end geophones.

Passive data records were also collected as part of the MASW investigation to collect low-frequency ambient noise to supplement active surveying results and provide more information at depth/lower frequencies. Passive results were combined with active data to provide the final composite record and Site Class results.

Tables 1 and 2, outline the parameters used during both active and passive surveying.

Table 1 Acquisition Parameters for Active Surveying

Acquisition Parameters	Description
Geophones	4.5 Hertz geophones (12 total)
Geophone Interval	3 metres
Survey Line Length	33 metres
Shot Records	6 shot records at 3 - 15 metres from end geophones
Source	9-kilogram sledgehammer and 30 x 30 x 7.5 centimetre impact plate
Sample Interval	0.125 milliseconds
Record Length	2 seconds
Stacking	Up to 6 stacks per shot location

Table 2 Acquisition Parameters for Passive Surveying.

Acquisition Parameters	Description
Geophones	4.5 Hertz geophones (12 total)
Geophone Interval	3 metres
Shot Records	20 shot records (no stacking)
Source	Ambient noise from cultural sources
Sample Interval	2 milliseconds
Record Length	32 seconds

MASW DATA PROCESSING

Data Processing Procedure

MASW shot records were processed by GEMTEC using the SeisimagerSW™ software package (V 6.0.2.1). Initial processing included the conversion of shot records from the time domain to the frequency domain using a Fast Fourier Transform (FFT). The converted data for each of the active shot records were then displayed as phase velocity vs. frequency plots to show fundamental mode dispersion curves (Figure 3). The dispersion curves were used to pick the fundamental mode for each of the shot locations/records.

The next processing step included the compilation and smoothing of picked data into a composite record for input into an inversion routine. Inverting the data utilized a Least Squares Method (LSM) to fit the data to a model over five iterations of the inversion. The initial models were constructed using six horizontally layered units to define the upper 30 metres of soil and rock and also the upper 30 metres from the proposed footing depth from 5 – 35 metres, which places the footings on bedrock.

Passive Data Records – Ambient Noise

A total of twenty passive data records were collected during survey procedures, which attempt to utilize the long offset and low frequency ambient seismic noise typically generated by cultural sources (e.g., vehicular traffic, industrial activities, construction etc.) from surrounding areas. The vehicular traffic and construction working in various directions around the survey was a significant source of passive data and results were favourable due to these conditions.

DISCUSSION

MASW Survey Results

The results of the MASW survey are attached in Figure 4 and are displayed as one-dimensional vertical seismic profiles. The profiles include a time-averaged shear wave velocity (V_{s30}) of 678 metres per second for the upper 30 metres of the site and an additional V_{s30} value of 895 metres per second for the depth interval ranging from 5 – 35 metres, which corresponds to the proposed footing depth of the proposed structure. These V_{s30} results provide Site Designation (X_v) values of **X_{678} and X_{895}**, respectively.

Based on the above noted Site Designations of **X_{678} and X_{895}**, these values result in a **Site Class C or B**, respectively. To achieve the MASW based Site Class C or B, the ground profile characteristics and corresponding exceptions must also be reviewed for the site, which are detailed in section 4.1.8 of the 2020 NBC, and specifically tables 4.1.8.4.A and B.

Discussion of Results

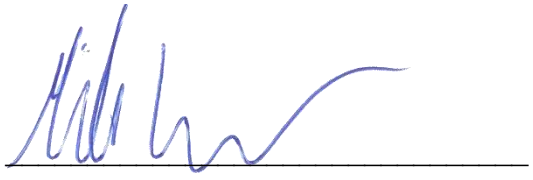
MASW results are indirect measurements of the near subsurface and their corresponding V_{s30} values are time-averaged shear wave velocities for the site. When V_{s30} values and corresponding Site Designations are used in conjunction with Tables 4.1.8.4.-A and B (2020 NBC) to determine a Site Class, these determinations must also consider the ground profile characteristics outlined in section 4.1.8 of the 2020 NBC.

GEMTEC's opinion on the applicable Seismic Site Class is based on the data obtained at the time of surveying, as indicated in this document. For best results, MASW surveying requires relatively homogenous and horizontal strata, and avoiding velocity reversals (i.e., asphalt and / or frost over overburden) across the entirety of the survey line.

In completing this investigation, the Geological Survey of Canada Open File 7078, Shear Wave Velocity Measurement Guidelines for Canadian Seismic Site Characterization in Soil and Rock (2012) was used as a guide and consulted throughout the duration of the project.

CLOSURE

GEMTEC trusts this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact the below.



Mike West, M.Sc., P.Geo., P.Eng.

MW/pb

Enclosures
N:\Projects\101700\101785.004\05_Technical Work\MASW\101785.004_LTR_MASW_2024-08-22_Rev2.docx

Attachments:
Figure 1 – Site Plan
Figure 2 – Surface Wave Illustration
Figure 3 – Phase Velocity vs Frequency Plot Showing Fundamental Mode
Figure 4 – MASW Vertical Seismic Profile

426285 426335 426385 426435

5013101

5013051

N

426285 426335 426385 426435

GEMTEC
Consulting Engineers and Scientists

FREDERICTON OFFICE
191 DOAK ROAD
FREDERICTON, NB.
E3C 2E6

TEL: (506) 453 1025
FAX: (506) 453 9470
EMAIL: fredericton@gemtec.ca

MASW Survey Line

Scale 1:500

0 5 10 15 20

(meters)

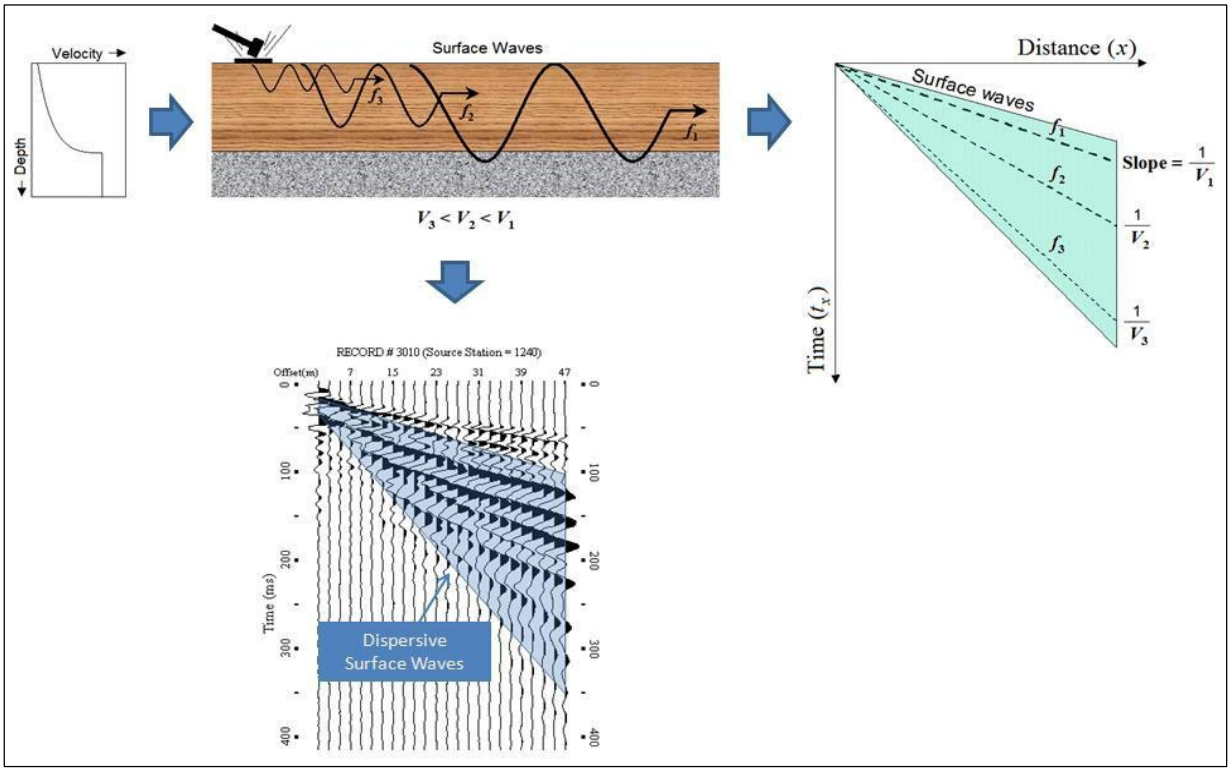
NAD 1983 UTM Zone 18N

101785.004
MASW Survey
1174 Carp Road
Ottawa, Ontario

MASW Survey Location

Figure 1

Surface Wave Dispersive Properties and Arrival Data Records (illustrative).	FIGURE 2



www.parkseismic.com/SurfaceWaveSurvey.html

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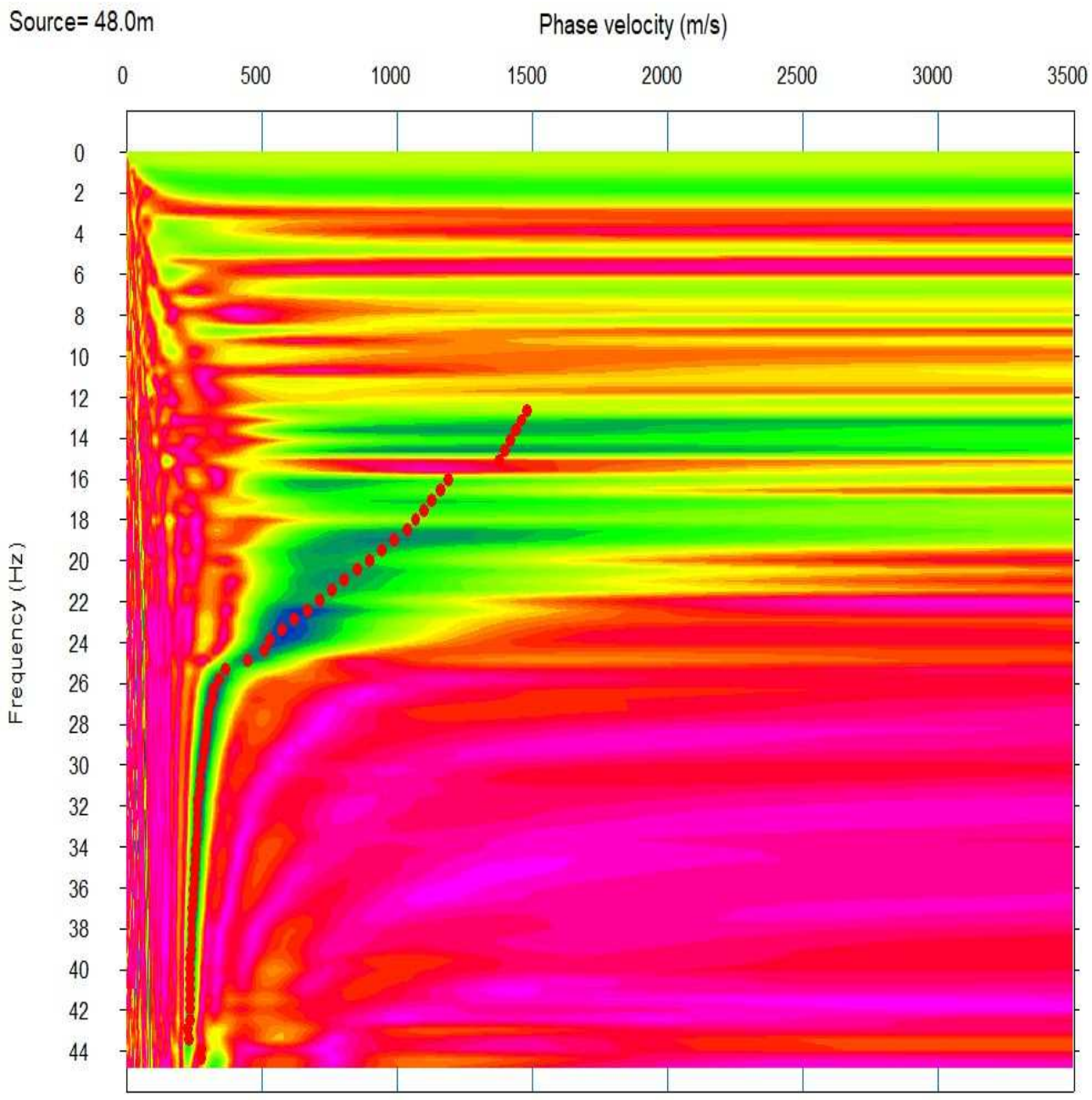
Consulting Engineers and Scientists

Date: May 2024
Project: 101785.004

Phase Velocity vs Frequency Plot Displaying the Dispersion Curve and Picks for the an Active Shot Record	FIGURE 3



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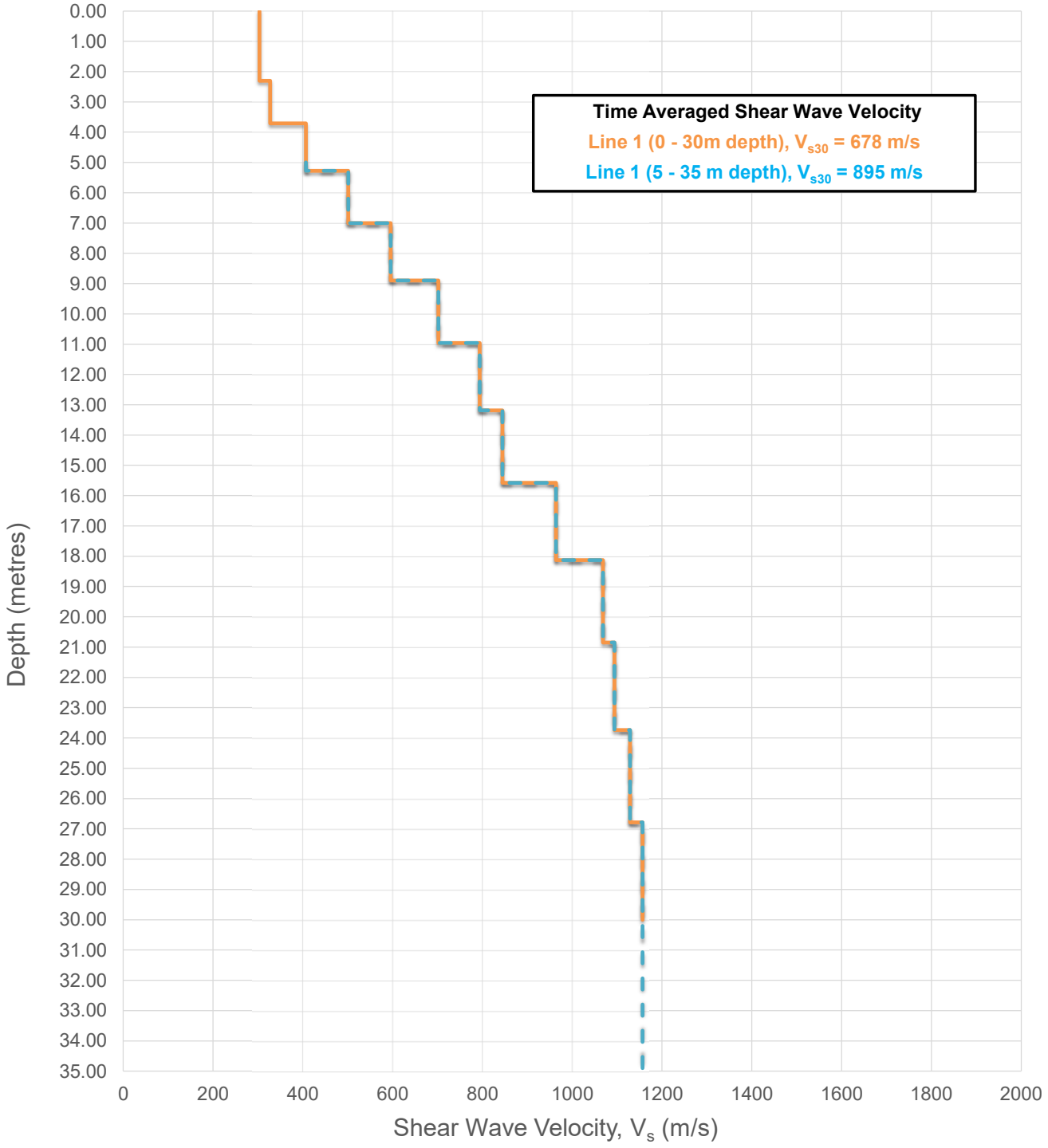
Consulting Engineers and Scientists

Date: May 2024
Project: 101785.004

1174 Carp Road, Ottawa, Ontario
Shear Wave Velocity (V_s) vs Depth

FIGURE 4



GEMTEC
Consulting Engineers and Scientists

Date: August 2024
Project: 101785.004

APPENDIX H

Water Quality Testing Results

Paracel Laboratories Ltd. Order No. 2424228

PARACEL LABORATORIES LTD. | TRUSTED. RESPONSIVE. RELIABLE.

1-800-749-1947
www.paracellabs.com

Certificate of Analysis

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

Client PO: 1174 Carp Road
Project: 101785.004
Custody: 72083

Report Date: 22-Aug-2024
Order Date: 14-Aug-2024

Revised Report

Order #: 2433430

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

Paracel ID	Client ID
2433430-01	MW24-08
2433430-02	MW24-08 (Filtered)

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Hexachlorobenzene	EPA 8081B - GC-ECD	15-Aug-24	15-Aug-24
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	15-Aug-24	15-Aug-24
Metals, ICP-MS	EPA 200.8 - ICP-MS	16-Aug-24	16-Aug-24
Ottawa - San/Comb: SVOCs with PAHs	EPA 625 - GC-MS, extraction	15-Aug-24	16-Aug-24
PCBs, total	EPA 608 - GC-ECD	15-Aug-24	15-Aug-24
pH	EPA 150.1 - pH probe @25 °C	16-Aug-24	16-Aug-24
PHC F1	CWS Tier 1 - P&T GC-FID	15-Aug-24	15-Aug-24
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	16-Aug-24	16-Aug-24
Phosphorus, total, water	EPA 365.4 - Auto Colour, digestion	16-Aug-24	20-Aug-24
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	16-Aug-24	20-Aug-24
Total Suspended Solids	SM 2540D - Gravimetric	16-Aug-24	17-Aug-24
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	22-Aug-24	15-Aug-24
Volatile Suspended Solids	SM 2540D - Gravimetric, 550C	16-Aug-24	17-Aug-24

	Client ID:	MW24-08	MW24-08 (Filtered)	-	-	-	-
	Sample Date:	14-Aug-24 11:45	14-Aug-24 11:45	-	-		
	Sample ID:	2433430-01	2433430-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
General Inorganics							
pH	0.1 pH Units	7.2	-	-	-	-	-
Phosphorus, total	0.01 mg/L	0.80	-	-	-	-	-
Total Suspended Solids	2 mg/L	2230	-	-	-	-	-
Volatile Suspended Solids	2 mg/L	110	-	-	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.9	-	-	-	-	-
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	-	<0.050	-	-	-	-
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	-	0.338	-	-	-	-
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:	MW24-08	MW24-08 (Filtered)	-	-	-	-
	Sample Date:	14-Aug-24 11:45	14-Aug-24 11:45	-	-		
	Sample ID:	2433430-01	2433430-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Metals							
Zinc	0.020 mg/L	-	0.021	-	-	-	-
Metals - Total							
Aluminum	0.01 mg/L	19.7	-	-	-	-	-
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	<0.05	-	-	-	-	-
Cadmium	0.001 mg/L	<0.001	-	-	-	-	-
Chromium	0.05 mg/L	<0.05	-	-	-	-	-
Cobalt	0.001 mg/L	0.028	-	-	-	-	-
Copper	0.005 mg/L	0.112	-	-	-	-	-
Lead	0.001 mg/L	0.022	-	-	-	-	-
Manganese	0.05 mg/L	1.89	-	-	-	-	-
Mercury	0.0001 mg/L	<0.0001	-	-	-	-	-
Molybdenum	0.005 mg/L	<0.005	-	-	-	-	-
Nickel	0.005 mg/L	0.055	-	-	-	-	-
Selenium	0.005 mg/L	0.006	-	-	-	-	-
Silver	0.001 mg/L	<0.001	-	-	-	-	-
Tin	0.01 mg/L	<0.01	-	-	-	-	-
Titanium	0.01 mg/L	1.11	-	-	-	-	-
Vanadium	0.001 mg/L	0.062	-	-	-	-	-
Zinc	0.02 mg/L	0.13	-	-	-	-	-
Volatiles							
Acetone	0.0050 mg/L	<0.0050	-	-	-	-	-
Benzene	0.0005 mg/L	<0.0005	-	-	-	-	-

	Client ID:	MW24-08	MW24-08 (Filtered)	-	-		
	Sample Date:	14-Aug-24 11:45	14-Aug-24 11:45	-	-	-	-
	Sample ID:	2433430-01	2433430-02	-	-		
	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	<0.0005	-	-	-	-	-

	Client ID:	MW24-08	MW24-08 (Filtered)	-	-	-	-
	Sample Date:	14-Aug-24 11:45	14-Aug-24 11:45	-	-		
	Sample ID:	2433430-01	2433430-02	-	-		
	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	<0.0005	-	-	-	-	-
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	<0.0005	-	-	-	-	-
o-Xylene	0.0005 mg/L	<0.0005	-	-	-	-	-
Xylenes, total	0.0005 mg/L	<0.0005	-	-	-	-	-
4-Bromofluorobenzene	Surrogate	125%	-	-	-	-	-
Dibromofluoromethane	Surrogate	103%	-	-	-	-	-
Toluene-d8	Surrogate	110%	-	-	-	-	-
Hydrocarbons							
F1 PHCs (C6-C10)	0.025 mg/L	<0.025	-	-	-	-	-

	Client ID:	MW24-08	MW24-08 (Filtered)	-	-	-	-
	Sample Date:	14-Aug-24 11:45	14-Aug-24 11:45	-	-		
	Sample ID:	2433430-01	2433430-02	-	-		
	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	<0.00005	-	-	-	-	-
2-Methylnaphthalene	0.00005 mg/L	<0.00005	-	-	-	-	-
7H-Dibenzo[c,g]carbazole	0.00050 mg/L	<0.00050	-	-	-	-	-
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 [e] pyrene	0.00005 mg/L	<0.00005	-	-	-	-	-
Benzo [b&j] fluoranthene	0.00005 mg/L	<0.00005	-	-	-	-	-
Benzo [g,h,i] perylene	0.00005 mg/L	<0.00005	-	-	-	-	-
Benzo [k] fluoranthene	0.00005 mg/L	<0.00005	-	-	-	-	-
Benzylbutylphthalate	0.00050 mg/L	<0.00050	-	-	-	-	-
Biphenyl	0.00005 mg/L	<0.00005	-	-	-	-	-
Bis(2-chloroethoxy)methane	0.00100 mg/L	<0.00100	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.00100 mg/L	<0.00100	-	-	-	-	-
Chrysene	0.00005 mg/L	<0.00005	-	-	-	-	-
Dibenzo [a,h] anthracene	0.00005 mg/L	<0.00005	-	-	-	-	-
Dibenzo [a,i] pyrene	0.00050 mg/L	<0.00050	-	-	-	-	-
Dibenzo [a,j] acridine	0.00050 mg/L	<0.00050	-	-	-	-	-
Diethylphthalate	0.00100 mg/L	<0.00100	-	-	-	-	-
Di-n-butylphthalate	0.00100 mg/L	<0.00100	-	-	-	-	-
Di-n-octylphthalate	0.00100 mg/L	<0.00100	-	-	-	-	-

	Client ID:	MW24-08	MW24-08 (Filtered)	-	-	-	-
	Sample Date:	14-Aug-24 11:45	14-Aug-24 11:45	-	-		
	Sample ID:	2433430-01	2433430-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Semi-Volatiles							
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	-	-	-	-	-
Indole	0.00100 mg/L	<0.00100	-	-	-	-	-
Naphthalene	0.00005 mg/L	<0.00005	-	-	-	-	-
Phenanthrene	0.00005 mg/L	<0.00005	-	-	-	-	-
Perylene	0.00050 mg/L	<0.00050	-	-	-	-	-
Pyrene	0.00001 mg/L	<0.00001	-	-	-	-	-
2,4-Dichlorophenol	0.00100 mg/L	<0.00100	-	-	-	-	-
PAHs, Total	0.0025 mg/L	<0.0025	-	-	-	-	-
2-Fluorobiphenyl	Surrogate	69.5%	-	-	-	-	-
Nitrobenzene-d5	Surrogate	57.6%	-	-	-	-	-
Terphenyl-d14	Surrogate	80.5%	-	-	-	-	-
2,4,6-Tribromophenol	Surrogate	88.3%	-	-	-	-	-
2-Fluorophenol	Surrogate	5.89% [5]	-	-	-	-	-
Phenol-d6	Surrogate	6.56% [5]	-	-	-	-	-
Pesticides, OC							
Hexachlorobenzene	0.00001 mg/L	<0.00001	-	-	-	-	-
Decachlorobiphenyl	Surrogate	68.0%	-	-	-	-	-
PCBs							
PCBs, total	0.05 ug/L	<0.05	-	-	-	-	-
Decachlorobiphenyl	Surrogate	60.6%	-	-	-	-	-

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	*0.472*		*%*	*94.4*	*60-140*			
Pesticides, OC								
Hexachlorobenzene	ND	0.00001	mg/L					
Surrogate: Decachlorobiphenyl	*.00035*		*%*	*70.0*	*50-140*			
Semi-Volatiles								
1-Methylnaphthalene	ND	0.00005	mg/L					
2-Methylnaphthalene	ND	0.00005	mg/L					
7H-Dibenzo[c,g]carbazole	ND	0.00050	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&j] fluoranthene	ND	0.00005	mg/L					
Benzo [e] pyrene	ND	0.00005	mg/L					
Benzo [g,h,i] perylene	ND	0.00005	mg/L					
Benzo [k] fluoranthene	ND	0.00005	mg/L					
Benzylbutylphthalate	ND	0.00050	mg/L					
Biphenyl	ND	0.00005	mg/L					
Bis(2-chloroethoxy)methane	ND	0.00100	mg/L					
Bis(2-ethylhexyl)phthalate	ND	0.00100	mg/L					
Chrysene	ND	0.00005	mg/L					
Dibenzo [a,h] anthracene	ND	0.00005	mg/L					
Dibenzo [a,i] pyrene	ND	0.00050	mg/L					
Dibenzo [a,j] acridine	ND	0.00050	mg/L					
Diethylphthalate	ND	0.00100	mg/L					
Di-n-butylphthalate	ND	0.00100	mg/L					
Di-n-octylphthalate	ND	0.00100	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					
Indole	ND	0.00100	mg/L					
Naphthalene	ND	0.00005	mg/L					
Phenanthrene	ND	0.00005	mg/L					
Perylene	ND	0.00050	mg/L					
Pyrene	ND	0.00001	mg/L					
2,4-Dichlorophenol	ND	0.00100	mg/L					
Surrogate: 2-Fluorobiphenyl	*0.0166*		%	*83.0*	*50-140*			
Surrogate: Nitrobenzene-d5	*0.0134*		%	*67.2*	*50-140*			
Surrogate: Terphenyl-d14	*0.0168*		%	*83.9*	*50-140*			
Surrogate: 2,4,6-Tribromophenol	*0.0388*		%	*97.1*	*50-140*			
Surrogate: 2-Fluorophenol	*0.00295*		%	*7.39*	*50-140*			S-GC
Surrogate: Phenol-d6	*0.00328*		%	*8.20*	*50-140*			S-GC
Volatiles								
Acetone	ND	0.0050	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
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					
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					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,1,2-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	*0.0960*		*%*	*120*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0825*		*%*	*103*	*50-140*			
Surrogate: Toluene-d8	*0.0869*		*%*	*109*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	7.9	0.1	pH Units	7.9			0.5	3.3	
Phosphorus, total	ND	0.01	mg/L	0.015			NC	15	
Total Suspended Solids	ND	2	mg/L	ND			NC	10	
Volatile Suspended Solids	115	10	mg/L	110			4.4	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	4.41	0.100	mg/L	4.48			1.6	20	
Antimony	ND	0.010	mg/L	ND			NC	20	
Arsenic	ND	0.100	mg/L	ND			NC	20	
Bismuth	ND	0.050	mg/L	ND			NC	20	
Boron	ND	0.500	mg/L	ND			NC	20	
Cadmium	ND	0.010	mg/L	ND			NC	20	
Chromium	ND	0.500	mg/L	ND			NC	20	
Cobalt	0.0127	0.010	mg/L	0.0129			1.4	20	
Copper	0.0774	0.050	mg/L	0.0788			1.8	20	
Lead	0.0178	0.010	mg/L	0.0177			0.6	20	
Mercury	ND	0.0001	mg/L	ND			NC	20	
Manganese	0.812	0.500	mg/L	0.812			0.1	20	
Molybdenum	ND	0.050	mg/L	ND			NC	20	
Nickel	ND	0.050	mg/L	ND			NC	20	
Selenium	ND	0.050	mg/L	ND			NC	20	
Silver	ND	0.010	mg/L	ND			NC	20	
Tin	ND	0.100	mg/L	ND			NC	20	
Titanium	0.171	0.100	mg/L	0.210			20.6	20	QR-04
Vanadium	0.0179	0.010	mg/L	0.0186			3.6	20	
Zinc	ND	0.200	mg/L	ND			NC	20	
Metals - Total									
Aluminum	1.12	0.01	mg/L	1.17			4.3	20	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Antimony	ND	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	0.06	0.05	mg/L	0.08			NC	20	
Cadmium	ND	0.001	mg/L	ND			NC	20	
Chromium	ND	0.05	mg/L	ND			NC	20	
Cobalt	ND	0.001	mg/L	ND			NC	20	
Copper	0.094	0.005	mg/L	0.100			6.8	20	
Lead	0.002	0.001	mg/L	0.002			4.6	20	
Mercury	ND	0.0001	mg/L	ND			NC	20	
Manganese	ND	0.05	mg/L	ND			NC	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	0.01	mg/L	ND			NC	20	
Titanium	ND	0.01	mg/L	ND			NC	20	
Vanadium	ND	0.001	mg/L	ND			NC	20	
Zinc	0.029	0.02	mg/L	0.039			NC	20	
Volatiles									
Acetone	ND	0.0050	mg/L	ND			NC	30	
Benzene	ND	0.0005	mg/L	ND			NC	30	
Bromodichloromethane	0.00512	0.0005	mg/L	0.00547			6.6	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	0.00879	0.0005	mg/L	0.00758			14.8	30	
Chloromethane	ND	0.0030	mg/L	ND			NC	30	
Dibromochloromethane	0.00399	0.0005	mg/L	0.00435			8.6	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	
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	
m,p-Xylenes	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
o-Xylene	ND	0.0005	mg/L	ND			NC	30	
Surrogate: 4-Bromofluorobenzene	*0.0996*		*%*		*124*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0834*		*%*		*104*	*50-140*			
Surrogate: Toluene-d8	*0.0875*		*%*		*109*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Phosphorus, total	1.02	0.01	mg/L	0.015	100	80-120			
Total Suspended Solids	19.0	2	mg/L	ND	88.4	75-125			
Total Kjeldahl Nitrogen	0.96	0.1	mg/L	ND	95.7	81-126			
Hydrocarbons									
F1 PHCs (C6-C10)	2.02	0.025	mg/L	ND	101	85-115			
F2 PHCs (C10-C16)	1.5	0.1	mg/L	ND	91.8	60-140			
F3 PHCs (C16-C34)	3.7	0.1	mg/L	ND	94.9	60-140			
F4 PHCs (C34-C50)	2.0	0.1	mg/L	ND	79.3	60-140			
Metals									
Aluminum	93.4	0.010	mg/L	44.8	97.2	80-120			
Arsenic	46.2	0.010	mg/L	0.2	91.9	80-120			
Bismuth	44.2	0.005	mg/L	0.1	88.2	80-120			
Boron	50.4	0.050	mg/L	3.2	94.4	80-120			
Cadmium	45.4	0.001	mg/L	ND	90.8	80-120			
Chromium	51.6	0.050	mg/L	ND	103	80-120			
Cobalt	48.4	0.001	mg/L	0.1	96.5	80-120			
Copper	47.6	0.005	mg/L	0.8	93.5	80-120			
Lead	44.1	0.001	mg/L	0.2	87.8	80-120			
Mercury	0.00256	0.0001	mg/L	ND	85.4	70-130			
Manganese	56.9	0.050	mg/L	8.1	97.6	80-120			
Molybdenum	44.1	0.005	mg/L	0.2	87.9	80-120			
Nickel	48.1	0.005	mg/L	0.4	95.3	80-120			
Selenium	45.4	0.005	mg/L	0.1	90.6	80-120			
Silver	47.8	0.001	mg/L	ND	95.6	80-120			
Tin	46.3	0.010	mg/L	0.1	92.5	80-120			
Titanium	55.3	0.010	mg/L	2.1	106	80-120			
Vanadium	51.5	0.001	mg/L	0.2	103	80-120			
Zinc	45.8	0.020	mg/L	1.8	87.9	80-120			
Metals - Total									
Aluminum	157	0.01	mg/L	117	79.8	80-120			QM-07

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Arsenic	47.2	0.01	mg/L	0.127	94.1	80-120			
Bismuth	51.7	0.005	mg/L	0.102	103	80-120			
Boron	54.7	0.05	mg/L	8.24	92.9	80-120			
Cadmium	46.6	0.001	mg/L	0.003	93.2	80-120			
Chromium	53.6	0.05	mg/L	0.163	107	80-120			
Cobalt	49.8	0.001	mg/L	0.033	99.5	80-120			
Copper	56.9	0.005	mg/L	10.0	93.7	80-120			
Lead	45.9	0.001	mg/L	0.189	91.4	80-120			
Mercury	0.0025	0.0001	mg/L	ND	84.3	70-130			
Manganese	53.3	0.05	mg/L	2.66	101	80-120			
Molybdenum	45.8	0.005	mg/L	0.175	91.3	80-120			
Nickel	49.0	0.005	mg/L	0.269	97.4	80-120			
Selenium	46.3	0.005	mg/L	0.078	92.4	80-120			
Silver	48.6	0.001	mg/L	0.005	97.2	80-120			
Tin	48.9	0.01	mg/L	0.754	96.3	80-120			
Titanium	54.4	0.01	mg/L	0.495	108	80-120			
Vanadium	53.5	0.001	mg/L	0.055	107	80-120			
Zinc	47.6	0.02	mg/L	3.88	87.4	80-120			
PCBs									
PCBs, total	1.17	0.05	ug/L	ND	117	65-135			
Surrogate: Decachlorobiphenyl	*0.502*		*%*		*100*	*60-140*			
Pesticides, OC									
Hexachlorobenzene	0.00060	0.00001	mg/L	ND	121	50-140			
Surrogate: Decachlorobiphenyl	*0.000315*		*%*		*63.0*	*50-140*			
Semi-Volatiles									
1-Methylnaphthalene	0.00933	0.00005	mg/L	ND	93.3	50-140			
2-Methylnaphthalene	0.00935	0.00005	mg/L	ND	93.5	50-140			
7H-Dibenzo[c,g]carbazole	0.00880	0.00050	mg/L	ND	88.0	50-140			
Anthracene	0.00868	0.00001	mg/L	ND	86.8	50-140			
Benzo [a] anthracene	0.00915	0.00001	mg/L	ND	91.5	50-140			
Benzo [a] pyrene	0.00814	0.00001	mg/L	ND	81.4	50-140			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Benzo [b&j] fluoranthene	0.0100	0.00005	mg/L	ND	100	50-140			
Benzo [e] pyrene	0.00922	0.00005	mg/L	ND	92.2	50-140			
Benzo [g,h,i] perylene	0.00752	0.00005	mg/L	ND	75.2	50-140			
Benzo [k] fluoranthene	0.00900	0.00005	mg/L	ND	90.0	50-140			
Benzylbutylphthalate	0.00634	0.00050	mg/L	ND	63.4	50-140			
Biphenyl	0.00890	0.00005	mg/L	ND	89.0	50-140			
Bis(2-chloroethoxy)methane	0.00809	0.00100	mg/L	ND	80.9	50-140			
Bis(2-ethylhexyl)phthalate	0.00628	0.00100	mg/L	ND	62.8	50-140			
Chrysene	0.00914	0.00005	mg/L	ND	91.4	50-140			
Dibenzo [a,h] anthracene	0.0102	0.00005	mg/L	ND	102	50-140			
Dibenzo [a,i] pyrene	0.0101	0.00050	mg/L	ND	101	50-140			
Dibenzo [a,j] acridine	0.00948	0.00050	mg/L	ND	94.8	50-140			
Diethylphthalate	0.00919	0.00100	mg/L	ND	91.9	50-140			
Di-n-butylphthalate	0.00941	0.00100	mg/L	ND	94.1	50-140			
Di-n-octylphthalate	0.00582	0.00100	mg/L	ND	58.2	50-140			
Fluoranthene	0.0102	0.00001	mg/L	ND	102	50-140			
Fluorene	0.00888	0.00005	mg/L	ND	88.8	50-140			
Indeno [1,2,3-cd] pyrene	0.00939	0.00005	mg/L	ND	93.9	50-140			
Indole	0.00906	0.00100	mg/L	ND	90.6	50-140			
Naphthalene	0.00857	0.00005	mg/L	ND	85.7	50-140			
Phenanthrene	0.00925	0.00005	mg/L	ND	92.5	50-140			
Perylene	0.00917	0.00050	mg/L	ND	91.7	50-140			
Pyrene	0.00759	0.00001	mg/L	ND	75.9	50-140			
2,4-Dichlorophenol	0.00775	0.00100	mg/L	ND	77.5	50-140			
Surrogate: 2-Fluorobiphenyl	*0.0196*		*%*		*98.1*	*50-140*			
Surrogate: Nitrobenzene-d5	*0.0164*		*%*		*81.9*	*50-140*			
Surrogate: Terphenyl-d14	*0.0196*		*%*		*97.8*	*50-140*			
Surrogate: 2,4,6-Tribromophenol	*0.0491*		*%*		*123*	*50-140*			
Surrogate: 2-Fluorophenol	*0.00342*		*%*		*8.56*	*50-140*			*S-GC*
Surrogate: Phenol-d6	*0.00545*		*%*		*13.6*	*50-140*			*S-GC*

Volatiles

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Acetone	0.0879	0.0050	mg/L	ND	87.9	50-140			
Benzene	0.0432	0.0005	mg/L	ND	108	60-130			
Bromodichloromethane	0.0400	0.0005	mg/L	ND	99.9	60-130			
Bromoform	0.0414	0.0005	mg/L	ND	104	60-130			
Bromomethane	0.0394	0.0005	mg/L	ND	98.5	50-140			
Carbon Tetrachloride	0.0379	0.0002	mg/L	ND	94.7	60-130			
Chlorobenzene	0.0432	0.0005	mg/L	ND	108	60-130			
Chloroethane	0.0458	0.0010	mg/L	ND	115	50-140			
Chloroform	0.0416	0.0005	mg/L	ND	104	60-130			
Chloromethane	0.0421	0.0030	mg/L	ND	105	50-140			
Dibromochloromethane	0.0415	0.0005	mg/L	ND	104	60-130			
Dichlorodifluoromethane	0.0333	0.0010	mg/L	ND	83.4	50-140			
1,2-Dibromoethane	0.0435	0.0002	mg/L	ND	109	60-130			
1,2-Dichlorobenzene	0.0394	0.0005	mg/L	ND	98.4	60-130			
1,3-Dichlorobenzene	0.0412	0.0005	mg/L	ND	103	60-130			
1,4-Dichlorobenzene	0.0399	0.0005	mg/L	ND	99.7	60-130			
1,1-Dichloroethane	0.0463	0.0005	mg/L	ND	116	60-130			
1,2-Dichloroethane	0.0431	0.0005	mg/L	ND	108	60-130			
1,1-Dichloroethylene	0.0388	0.0005	mg/L	ND	96.9	60-130			
cis-1,2-Dichloroethylene	0.0407	0.0005	mg/L	ND	102	60-130			
trans-1,2-Dichloroethylene	0.0392	0.0005	mg/L	ND	98.1	60-130			
1,2-Dichloropropane	0.0408	0.0005	mg/L	ND	102	60-130			
cis-1,3-Dichloropropylene	0.0465	0.0005	mg/L	ND	116	60-130			
trans-1,3-Dichloropropylene	0.0438	0.0005	mg/L	ND	110	60-130			
Ethylbenzene	0.0386	0.0005	mg/L	ND	96.6	60-130			
Hexane	0.0366	0.0010	mg/L	ND	91.6	60-130			
Methyl Ethyl Ketone (2-Butanone)	0.108	0.0050	mg/L	ND	108	50-140			
Methyl Butyl Ketone (2-Hexanone)	0.113	0.0100	mg/L	ND	113	50-140			
Methyl Isobutyl Ketone	0.112	0.0050	mg/L	ND	112	50-140			
Methyl tert-butyl ether	0.131	0.0020	mg/L	ND	131	50-140			
Methylene Chloride	0.0416	0.0050	mg/L	ND	104	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Styrene	0.0397	0.0005	mg/L	ND	99.2	60-130			
1,1,1,2-Tetrachloroethane	0.0386	0.0005	mg/L	ND	96.5	60-130			
Tetrachloroethylene	0.0352	0.0005	mg/L	ND	88.0	60-130			
Toluene	0.0436	0.0005	mg/L	ND	109	60-130			
1,1,1-Trichloroethane	0.0403	0.0005	mg/L	ND	101	60-130			
1,1,2-Trichloroethane	0.0449	0.0005	mg/L	ND	112	60-130			
Trichloroethylene	0.0362	0.0005	mg/L	ND	90.4	60-130			
Trichlorofluoromethane	0.0437	0.0010	mg/L	ND	109	60-130			
1,3,5-Trimethylbenzene	0.0393	0.0005	mg/L	ND	98.2	60-130			
Vinyl chloride	0.0368	0.0005	mg/L	ND	92.0	50-140			
m,p-Xylenes	0.0813	0.0005	mg/L	ND	102	60-130			
o-Xylene	0.0393	0.0005	mg/L	ND	98.4	60-130			
Surrogate: 4-Bromofluorobenzene	*0.0866*		*%*		*108*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0819*		*%*		*102*	*50-140*			
Surrogate: Toluene-d8	*0.0823*		*%*		*103*	*50-140*			

Qualifier Notes:

Sample Qualifiers :

5: Surrogate recovery outside of control limits. The data was accepted based on valid recovery of the remaining surrogate.

QC Qualifiers:

QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.
QR-04	Duplicate results exceeds RPD limits due to non-homogeneous matrix.
S-GC	Surrogate recovery outside of control limits. The data was accepted based on valid recovery of the remaining surrogate.

Sample Data Revisions:

None

Work Order Revisions / Comments:

Revision 1 - This report includes an updated VOC parameter list.

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.

PARACEL LABORATORIES

Paracel ID: 2433430

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Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2433430	№ 72083

Client Name: Gemtec
Contact Name: Samuel Sserwa
Address:
Telephone:

Project Ref: 101785.004 / 1174 Cedar Road
Quote #: 24-135
PO #:
E-mail: Samuel.Sserwa@gemtec.ca

Page __ of __

Turnaround Time

☐ 1 day ☐ 3 day
☐ 2 day ☑ Regular
Date Required:

☐ REG 153/04 ☐ REG 406/19

☐ Table 1 ☐ Res/Park ☐ Med/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other
☐ Table ___
For RSC: ☐ Yes ☐ No

Other Regulation

☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☑ SU - Sani ☑ SU - Storm
Mun: Ottawa
☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Required Analysis: Baseline monitoring, Ottawa	Required Analysis: Filtered metals
1	MW 24-08	GW		12	Aug 14/24	11:45	/	/
2								
3								
4								
5								
6								
7								
8								
9								
10								

Comments:

Method of Delivery: Walkin

Relinquished By (Sign):	Received at Depot:	Received at Lab: SS	Verified By:
Relinquished By (Print): Jeffrey Gauthier	Date/Time: Aug 14/24 [illegible]	Date/Time: 14 Aug 24 1558	Date: Aug 14, 16:04
Date/Time: Aug 14/24 14:00	Temperature: 15.4 °C	Temperature: 15.3 °C	pH Verified: ☐ By:

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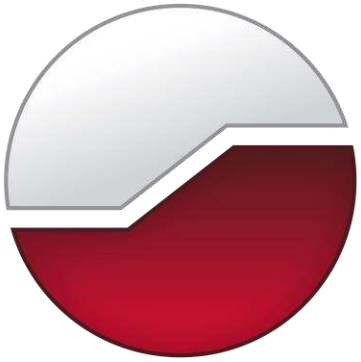

civil	civil
geotechnical	géotechnique
environmental	environnement
structural	structures
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

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