GEMTEC

www.gemtec.ca

Hydrogeological Investigation & Terrain Analysis
Proposed Industrial Subdivision
3112 Carp Road
Ottawa, Ontario

GEMTEC
www.gemtec.ca

Submitted to:
TLC Holdings Limited
1380 Howie Road
Ottawa, Onrtario
K0A 1L0

Hydrogeological Investigation & Terrain Analysis
Proposed Industrial Subdivision
3112 Carp Road
Ottawa, Ontario

March 26, 2026
Project: 102151.001 – Rev2

experience • knowledge • integrity

TABLE OF CONTENTS

TABLE OF CONTENTS II

1.0 INTRODUCTION 1

1.1 Site and Development Description 1
1.2 Scope and Objectives 2

2.0 REVIEW OF BACKGROUND INFORMATION 2

2.1 Technical Consultation Meeting 2
2.2 Previous Hydrogeological Investigation and Terrain Analysis - GEMTEC (2020) 3
2.3 Geotechnical Investigation by GEMTEC (2026a) 3
2.4 Phase I and II Environmental Site Assessment GEMTEC (2023 and 2024) 3
Environmental Impact Statement (EIS) by GEMTEC (2026b) 4
2.5 Available Background Reports by Others 4
2.5.1 Carp Road Corridor, Community Design Plan, CoO (2004) 5
2.5.2 Carp Road Corridor, Groundwater Study, Dillon (2004). 6
2.5.3 Mississippi Valley Source Protection Region, MVSPR (2011) 8
2.5.4 Aggregate Resources Inventory of the City of Ottawa, OGSARI (2013). 8
2.5.5 Carp Road Corridor Nitrate Impact Assessment, CoO (2016) 9

3.0 SITE CHARACTERIZATION 9

3.1 Physical Setting, Land Use, Cover, and Potential Impacts 9
3.2 Topography 10
3.3 Drainage 10
3.4 Regional Surficial and Bedrock Geology 10
3.5 MECP Water Well Records 11

4.0 TERRAIN EVALUATION 12

4.1 Field Procedure 12
4.2 Soil and Groundwater Conditions 12
4.2.1 General 12
4.2.2 Topsoil 13
4.2.3 Silty Sand to Sandy Silt, and Sand 13
4.2.4 Silty Clay 13
4.2.5 Sand and Silt 14
4.2.6 Glacial Till 14
4.2.7 Auger Refusal and Bedrock 15
4.3 Groundwater Levels 16
4.4 Soil Infiltration Testing 17

5.0 IMPACT ASSESSMENT 18

5.1 Sewage Disposal Systems....18
5.2 Hydrogeological Sensitivity....18
5.2.1 Background Nitrate Concentrations....20
5.3 Groundwater Impacts....21
6.0 GROUNDWATER SUPPLY....23
6.1 Test Well Construction....23
6.2 Pumping Test Field Procedure....24
6.2.1 Water Level Measurements....24
6.2.2 Flow Rate Measurements....25
6.2.3 Groundwater Sampling....26
6.1 Test Well Water Quality....26
6.1.1 Bacteriological Parameters....27
6.1.2 Other Health Related Parameters....28
6.1.3 Operational Guideline Exceedances....28
6.1.4 Aesthetic Objective Exceedances....29
6.2 Long-Term Test Well Water Quality....29
6.3 Off-site Test Well Water Quality....30
6.4 Pumping Test Analysis....31
6.4.1 Pump Test Analysis Overview....31
6.4.2 Transmissivity Analysis....33
6.4.3 Unified Aquifer Parameters....34
6.5 Hydraulic Interference Effects....35
7.0 HYDROGEOLOGICAL CONCEPTUAL MODEL....36
7.1 Site Specific Geology....36
7.2 Hydrogeological Conceptual Model....36
Conceptual Lot Development Plan....37
8.0 WATER BALANCE....37
8.1 Water Balance Method....37
8.1.1 Pre-Development....38
8.1.2 Post-Development....39
8.1.3 Water Balance Summary....39
9.0 SUMMARY AND CONCLUSIONS....41
10.0 RECOMMENDATIONS....44
10.1 General Recommendations....44
10.2 Groundwater Impact Mitigation Recommendations....45
10.3 Well Construction Recommendations....45

10.4 Septic System Recommendations 46
10.5 Drinking Water Supply Recommendations 47

11.0 CLOSURE 48

12.0 REFERENCES 49

LIST OF TABLES

Table 3.1 – Summary of Land Use in Study Area 9
Table 3.2 – Summary of Water Well Records Search Results 11
Table 4.1 – Summary of Grain Size Distribution Testing (Silty Sand) 13
Table 4.2 – Summary of Grain Size Distribution Testing (Weathered Crust) 13
Table 4.3 – Summary of Grain Size Distribution Testing (Glacial Till) 14
Table 4.4 – Summary of Auger Refusal and Bedrock Depths and Elevations 15
Table 4.5 – Summary of Groundwater Levels 16
Table 5.1 – Summary of Monitoring Well Sampling Results 20
Table 6.1 – Summary of Test Well Construction Details 24
Table 6.2 – Field Equipment Overview 26
Table 6.3 – Pumping Tests Details 32
Table 6.4 – Summary of Transmissivity Parameters 35
Table 6.5 – Summary of Storage Coefficients 35
Table 7.1 – Framework of Hydrogeological Conceptual Model 37
Table 8.1 – Water Balance Targets 40

LIST OF FIGURES (FOLLOWING TEXT OF THE REPORT)

Figure 1: Detailed Site Plan
Figure 2: Natural Features
Figure 3: Topography and Drainage
Figure 4: Mapped Surficial Geology
Figure 5: Mapped Bedrock Geology
Figure 6: Inferred Surficial Geology
Figure 7: Cross Section A-A’
Figure 8: Overburden Thickness Map
Figure 9: Well Interference Groundwater Contours
Figure 10: Conceptual Lot Development Plan

LIST OF APPENDICES

Appendix A	Development Plan
Appendix B	Pre-Consultation Meeting Notes
Appendix C	MECP Water Well Record Summary
Appendix D	Record of Test Pit and Borehole Sheets
Appendix E	Soil Grain Size Analyses
Appendix F	Guelph Permeameter Infiltration Testing
Appendix G	Laboratory Certificates of Analysis – Overburden Monitoring Wells
Appendix H	Nitrate Dilution Calculations
Appendix I	MECP Water Well Records – Test Wells
Appendix J	Pumping Test Analysis and Water Level Monitoring
Appendix K	Test Well Water Quality Summary
Appendix L	Laboratory Certificates of Analysis – Test Wells and Private Wells
Appendix M	Water Balance Calculations

NOTE: This document and any attachments are confidential and intended solely for the use of the individual or entity to whom they are addressed. If you have received this document in error, please notify the sender immediately and delete the document from your system. Any unauthorized disclosure, copying, distribution, or reliance on the contents of this document is prohibited. Thank you for your cooperation.

1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by TLC Holdings Limited (TLC) to carry out a Hydrogeological Investigation and Terrain Analysis for a proposed commercial / industrial subdivision to be located at 3112 Carp Road, Ottawa, Ontario (hereafter referred to as 'the Site'). The location of the Site is shown in the Detailed Site Plan, Figure 1.

A previous investigation was conducted at the Site by GEMTEC in support of the proposed commercial / industrial subdivision. This and other investigations are described in detail in Section 2 of this report.

This report is Revision 2 of the initial report dated August 9, 2024. It incorporates additional field work and updated reports prepared by others that were conducted to address comments received by the technical reviewer from the City of Ottawa.

This report is subject to the *Conditions and Limitations of this Report*, which are included following the main text and figures and are considered an integral part of the report.

1.1 Site and Development Description

The Site consists of a 23.42-hectare (57.89 acre) land parcel that is legally described as Con 2 Pt Lots 11 & 12; RP5R7272 Part 1 & 3 Less; RP5R10733 Parts 1 & 2, and is zoned as Rural Commercial, Subzone 9 (RC9). The Site Development Plan provided by TLC is provided in Appendix A.

Since the initiation of the project, the southwestern most lot has been severed and is now addressed 3160 Carp Road. A hydrogeological investigation and terrain analysis report for the severed lot was prepared under separate cover. However, for the purposes of this report, 3160 Carp Road is considered part of the Site area (Figure 2).

The proposed development will consist of industrial lots serviced with on-site septic disposal systems and water supply wells. Current municipal zoning for the Site is as follows: Rural General Industrial Zone – RG5 Subzone; and Rural Commercial Zone – RC9 Subzone (Highway Commercial Restricted). These zones allow for 50% and 25% lot coverage (building area) with a minimum lot size of 0.4 ha.

The Site is currently undeveloped grassland with occasional small trees; more mature trees can be found along the northern and eastern border of the Site. Fill material has also been brought onto the Site for future lot grading. Existing developments are concentrated primarily along Carp Road and includes a golf course north of the Site and the Carp Airport to the west.

1.2 Scope and Objectives

This investigation and assessment have been completed in general accordance with guidance documents provided by the Ministry of the Environment, Conservation and Parks (MECP), including *D-5-5 Private Wells: Water Supply Assessment* and *D-5-4 Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment*. A technical consultation meeting was also held with relevant City of Ottawa regulatory agencies to confirm the scope of work required for the investigation, which is discussed in more detail in Section 2.1.

The investigation and assessment have also considered the following documents:

- Carp Road Corridor Community Design Plan (CDP) specific requirement relating to the nitrate impact assessment; and
- City memo: *Carp Road Corridor – Nitrate Impact Assessment Recommendations*, provides guidance in the application of the MECP Guideline D-5-4 within the Carp Road Corridor.

Specific objectives of this investigation are as follows:

- To review available background information to assist in characterization of subsurface conditions in the vicinity of the Site and develop a hydrogeological conceptual model;
- To identify and characterize the shallow subsurface conditions on the Site as they relate to the design of septic sewage disposal systems under the Ontario Building Code (OBC);
- To assess the potential for impact on the receiving aquifer(s) and any nearby surface water features from on-site septic disposal systems;
- To investigate the potential quantity and quality of groundwater available from drilled test wells on the Site for potential commercial / light industrial supply; and
- To assess the long-term impacts on groundwater supply from existing developments on drilled water supply wells in the vicinity of the Site.

2.0 REVIEW OF BACKGROUND INFORMATION

2.1 Technical Consultation Meeting

A Technical Consultation Meeting was held with the City of Ottawa hydrogeologist (Tessa Di Iorio) and reviewing hydrogeologist from Blumetric Environmental (Russell Chown) on July 4, 2023. The meeting notes are provided in Appendix B. Important information from the meeting for the proposed subdivision application is summarized below:

- Well owner interviews/information regarding nearby well in the vicinity of the Site is required.

- An 8-hour pumping test must be conducted on four test wells located on the proposed severance lot (i.e., 3160 Carp Road).
    - The well should be tested for volatile organic compounds (VOCs) after 8-hours of pumping.
    - Previous investigations indicate elevated sulphide concentrations in the test wells. The study should address feasibility including financial/maintenance impacts on future homeowners.
- Based on previous investigations, the test well yields are relatively low, and therefore an interference analysis will be required.
- The Site may be hydrogeologically sensitive due to the presence of high permeability soils. Grain size analyses will be required to confirm soil texture and distribution to confirm if the Site is hydrogeologically sensitive.
- A predictive nitrate impact assessment will be required, as well as a conceptual development plan showing the locations of future well, development, and septic systems.
- A water balance with pre-development and post-development scenarios should be presented.

2.2 Previous Hydrogeological Investigation and Terrain Analysis - GEMTEC (2020)

A previous Hydrogeological Investigation and Terrain Analysis was completed by GEMTEC at the Site. The fieldwork was completed in 2018 – 2019 which included excavation of 15 test pits, installation of 5 overburden monitoring wells, drilling 4 groundwater test wells, groundwater pumping tests, water sample collection, soil infiltration testing, soil sample collection and grain size distribution testing.

The findings of that investigation and analysis were presented in GEMTEC's report titled "Hydrogeological Investigation & Terrain Analysis, Proposed Industrial Subdivision, 3160 Carp Road, Ottawa, Ontario" and dated July 10, 2020. This report is referred to herein as GEMTEC (2020).

2.3 Geotechnical Investigation by GEMTEC (2026a)

A geotechnical investigation was completed for the Site, which included advancement of 11 boreholes. The findings of the geotechnical investigation are presented in GEMTEC's report titled "Geotechnical Investigation, Proposed Industrial Development, 3112 Carp Road, Ottawa, Ontario" and dated March 23, 2026, which is referred to further as GEMTEC (2026a).

2.4 Phase I and II Environmental Site Assessment GEMTEC (2023 and 2024)

A Phase One Environmental Site Assessment (ESA) for the Site was completed by GEMTEC. The findings were presented in GEMTEC's report titled "Phase One Environmental Site

Assessment, Proposed Plan of Subdivision, 3160 Carp Road, Ottawa, Ontario" report dated June 26, 2023, which is referred to further as GEMTEC (2023).

GEMTEC (2023b) identified the following areas of potential environmental concern (APEC) for the Site;

1) historic pesticide usage with potential impacts to soils;

2) two areas of fill material of unknown origin with potential impacts to soils; and

3) An above ground storage tank located approximately 20 metres south of the Site with potential impacts to soil and groundwater.

A Phase II ESA titled "Phase Two Environmental Site Assessment, Proposed Plan of Subdivision, 3160 Carp Road, Ottawa, Ontario" and dated April 24, 2024, was prepared by GEMTEC to address the APECs identified in the Phase I ESA (2023). The Phase II ESA Site investigations included drilling of nine additional on-site boreholes numbered 24-1 to 24-9, inclusive – refer to Figure 1 for borehole locations. One monitoring well was installed in BH24-9.

The Phase II ESA did not identify any soil exceedances of the application Site Condition Standards. Groundwater sampling was not completed due to insufficient water within the well screen. Field observations at this location showed no evidence of staining or odours. In addition, concentrations of contaminants of potential concern in the associated soil sample(s) (BH24-9) were below detection limits and did not exceed the applicable Site Condition Standards. No additional testing was recommended.

Environmental Impact Statement (EIS) by GEMTEC (2026b)

The findings of the EIS are presented in GEMTEC's report titled "Draft Environmental Impact Statement, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario" and dated March 6, 2026, which is referred to further as GEMTEC (2026b).

The EIS report concludes that impacts to the natural environmental are anticipated to be minimal from construction of the proposed commercial/industrial subdivision, provided the recommended mitigation measures are followed. Mitigation measures that are applicable to Site development from a hydrogeological perspective include a minimum setback of 15 metres from watercourses. It is understood that existing on-site headwater drainage features will be infilled and realigned along the roadways and rear lots abutting the neighbouring properties, all flowing towards the on-site stormwater management pond.

2.5 Available Background Reports by Others

Several background reports and documents were reviewed as part of this assignment. These included the following:

- “Carp Road Corridor, Community Design Plan” prepared by the City of Ottawa and dated June 2004 (Publication No. 3-08). This report is referred to herein as CoO (2004).
- “Carp Road Corridor, Groundwater Study” prepared by Dillon Consulting Limited and dated November 30, 2004 (ref: 04-3219). This report will herein be referred to as Dillon (2004).
- “Mississippi-Rideau Source Protection Region, Assessment Report, Mississippi Valley Source Protection Area” prepared by Mississippi Valley Conservation and Rideau Valley Conservation Authority and dated August 4, 2011. This report will herein be referred to as MVSPR (2011).
- “Aggregate Resources Inventory of the City of Ottawa, Southern Ontario” prepared by the Ontario Geological Survey Aggregate Resources Inventory (Paper 191) and dated 2013. This report will herein be referred to as OGSARI (2013).
- “Carp Road Corridor – Nitrate Impact Assessment Recommendations”, prepared by the City of Ottawa, dated September 27, 2016. This document will herein be referred to as “CoO (2016)”.

A summary of relevant information from each of these documents is provided in the report subsections below.

2.5.1 Carp Road Corridor, Community Design Plan, CoO (2004)

CDP (2004) was reviewed for relevant information pertaining to the development of the Site. The following was noted:

- Development of the Site should preserve and add as many trees as possible and the use of landscaping, decorative fences, trees and/or shrubs in front of fencing to screen unsightly uses.
- The environmental features of the Site (Schedule 2 CDP Report) shall be protected by implementing the polices in Section 4.7 of the Official Plan. In areas identified as groundwater recharge areas shown on Schedule 2, a groundwater impact assessment may be required to support development applications to determine the potential for impact on groundwater resources.
- A groundwater impact assessment may be required for development applications to support land uses that may pose a high risk to the groundwater resource or uses that use large volumes of water or dispose of large volumes of liquid or solid waste, as per Section 4.7.5 of the Official Plan.
- Schedule 2 indicates that the western half of the Site is located in a moderate recharge area. When reviewing development applications in areas identified as groundwater recharge areas, the City will consider the potential for impact on groundwater resources. A groundwater impact assessment may be required where the City has identified that the

lands play a role in the management of the groundwater resources, or the need is indicated in other available information such as subwatershed plans or local knowledge as per Section 4.7.5 of the Official Plan.

2.5.2 Carp Road Corridor, Groundwater Study, Dillon (2004).

Dillon (2004) was reviewed for relevant information pertaining to the development of the Site. The following recommendations were noted:

- Applicants of future high risk commercial and industrial development should demonstrate that the proposed development will not impact groundwater prior to receiving approval. Elements of the proponent's proposal may include: assessment of the hydrogeological characteristics, the design of protection engineering systems to reduce risk of chemical discharges, identification and abandonment of unused wells, the design of a groundwater monitoring system, establishment of a spill response plan, plans to encourage natural infiltration and possible posting of bonds to cover future environmental clean-up efforts.
- For existing land uses, it is recommended that mitigation actions be enacted primarily through voluntary mechanisms, including promotion of best management practices, education of the public on the aquifer sensitivities, development of incentive programs to reduce contamination risk, and the review of road salting practices to reduce salt loading.
- For development of new subdivisions, a hydrogeological assessment following City of Ottawa protocols should be performed as a condition of approval. For development by consent, neighbouring wells should be sampled and favourable chemistry results obtained prior to approval being granted.
- The Carp Road Corridor Groundwater Study should be updated every 5 years to ensure that development on private services has not impacted the environment, and to reassess whether future development on private services remains feasible.

The Surficial Geology & Aquifer Location map provided in Dillon (2004) indicates that:

- The Site has nearshore sediments of the Champlain Sea consisting of sand and gravel (west half) and offshore marine clay and silt (east half).
- The lands immediately adjacent to the eastern boundary of the Site have nearshore sediments of the Champlain Sea consisting of gravel and sand.
- The closest glaciofluvial deposits of sand and gravel to the Site are mapped to the south of Richardson Side Road (which is greater than 3.5 kilometres from the closest boundary of the Site).
- The map notes indicate that the information conveyed by this map is regional in nature and is not suitable for use in site-specific evaluations.

The Bedrock Geology & Aquifer Location map provided in Dillon (2004) indicates that:

- The Site bedrock geology is mapped as Paleozoic bedrock consisting of limestone and shale of the Verulam Formation.
- The closest MECP Recorded Well Location and Aquifer Pumped symbols indicate an unconfined limestone aquifer.
- The map notes indicate that the information conveyed by this map is regional in nature and is not suitable for use in site-specific evaluations.

The Groundwater Flow map provided in Dillon (2004) indicates that:

- groundwater flow in the region of the Site is expected to flow to the north (or to the northeast from the Site's frame of reference).
- The map notes indicate that the information conveyed by this map is regional in nature and is not suitable for use in site-specific evaluations.

The Groundwater Infiltration map provided in Dillon (2004) indicates that:

- Groundwater infiltration is high for the sand and gravel deposits on the west half of the Site and low for the clay and silt on the east half.
- The map notes indicate that the information conveyed by this map is regional in nature and is not suitable for use in site-specific evaluations.

The Recharge/Discharge Areas map provided in Dillon (2004) indicates that:

- The Site as being in a recharge zone with weak vertical groundwater gradients on the eastern portion of the property and strong downward vertical groundwater gradients on the west side of the Site.
- The map notes indicate that the information conveyed by this map is regional in nature and is not suitable for use in site-specific evaluations.

The Aquifer Vulnerability map provided in Dillon (2004) indicates that:

- The western portion of the Site (as is much of the Carp Road Development Corridor) is located in a high vulnerability aquifer area and

- The eastern portion is situated in a low to moderate vulnerability area.
- The map notes indicate that the information conveyed by this map is regional in nature and is not suitable for use in site-specific evaluations.

2.5.3 Mississippi Valley Source Protection Region, MVSPR (2011)

MVSPR (2011) was reviewed for relevant information pertaining to the development of the Site. the following was noted:

- Figure 5-1d (Mississippi-Rideau Source Protection Region - Highly Vulnerable Aquifers (HVA's) map indicates that the Site is in a highly vulnerable aquifer zone. However, it should be noted that much of the Carp Road Development Corridor, the Waste Management West Carleton Environmental Centre and the Karson Quarry are also all located in the highly vulnerable aquifer zone.
- Figure 5-10 indicates that the closest corner of the Site is located about 1 kilometre south of the outermost boundary of the Carp Wellhead Protection Area (Zone D: 25 year travel time). In addition, the closest corner of the Site to the Carp Communal well is approximately 3 kilometres.

2.5.4 Aggregate Resources Inventory of the City of Ottawa, OGSARI (2013).

OGSARI (2013) was reviewed for relevant information pertaining to the development of the Site. The following was noted:

- The Site is shown as being located partly within a glaciomarine sand deposit (1.5m to 3m thick) of tertiary significance;
- The land 500 metres to the west of the Site contains two abandoned sand pits previously developed within a buried geological and aggregate thickness boundary of sand and gravel. The former northern pit appears to have been closed down for a number of years and is filled with water. Limited resources may still be available in the southern pit, which is also filled with water;
- An active sand pit located about 1.4 kilometres southwest of the closest boundary of the Site on the west side of William Mooney Road is completed in a glaciomarine plain deposit and is predominately a source of sand; and
- The aggregate available from the existing and former sand pits to the southwest of the Site is reported to have less than 5% gravel.

2.5.5 Carp Road Corridor Nitrate Impact Assessment, CoO (2016)

CoO (2016) provides additional guidance for the application of the MECP D-5-4 guidelines within the Carp Road Corridor. The memo allows proponents to undertake a modified nitrate attenuation predictive assessment using nitrogen reduction treatment systems. Available systems can achieve a minimum of 50% reduction in nitrogen and as a result, the modified minimum concentration of nitrate used in the nitrate attenuation assessment can be reduced to 20 mg/L.

3.0 SITE CHARACTERIZATION

3.1 Physical Setting, Land Use, Cover, and Potential Impacts

Based on a review of aerial photographs and information from the property owner, GEMTEC infers that much of the Site was used as agriculture land until the mid-1990s.

Currently the northeastern portion of the Site is used as agricultural lands as indicated by presence of grassland and pasture. Wooded areas are also present on the Site. Figure 2 (Appendix A) displays the natural features within 500 metres of the Site.

Land use within 500 metres of the Site consists of agricultural land use, commercial / light industrial developments – inclusive of the Carp Airport, and residential properties. These are understood to all be utilising private services. Specific land uses near the Site boundaries are documented in Table 3.1.

Table 3.1 – Summary of Land Use in Study Area

Site Boundary	Existing Land Use
North	• Landscaping products sales centre • Agricultural fields and patchy wooded areas • Golf course • Unevaluated wetlands
South	• Commercial / light industrial properties along Carp Rd and John Cavanaugh Dr. • Agricultural fields
East	• Agricultural fields • Cemetery
West	• Carp Road • Commercial properties: general contractor, REL Controls, etc.

Site Boundary	Existing Land Use
	• Residential properties • Cemetery – west side of Carp Road • Carp Airport

Potential impacts to groundwater quality from adjacent lands within 500 metres of the Site boundary are anticipated to be limited based on the present land uses. A small cemetery is located up gradient of the Site on the west side of the Carp Road. A second, larger cemetery is located along the eastern boundary of the Site. Although the Carp Airport property is situated within 500 metres of the Site, the nearest airport infrastructure is located more than 750 metres away from the Site.

Potential impacts to groundwater quality due to on-site activities are possible, due to the proposed usage of a commercial subdivision. Potential on-site activities that may impact groundwater quality include commercial/industrial practices, fuel storage, and future septic system effluent.

No large-scale water takings capable of causing adverse impacts to groundwater quantity were identified within 500 metres of the Site boundary (https://www.ontario.ca/page/map-permits-take-water; accessed December 13, 2023).

3.2 Topography

Elevation data from Ontario Basic Mapping on-line resource indicates that ground surface across the Site is relatively flat, sloping northeast at 1 to 2%. Ground elevations range from approximately 116 metres above sea level near the Carp Road to 110 metres on the east side of the property.

3.3 Drainage

Assuming drainage follows topography, the current drainage of the Site is anticipated to be generally north to northeast, towards the Carp River as shown on Figure 3. A small water course traverses a portion of the southern lot line starting near the southeast corner of the property. The water course flows northeast towards the Carp River. The Site is situated in the Carp River watershed.

3.4 Regional Surficial and Bedrock Geology

Based on the surficial geology maps (OGS, 2010), the western portion of the Site is underlain by coarse textured glaciomarine deposits comprising sand, gravel and minor amounts of silt and clay and the eastern portion of the Site is underlain by fine-textured glaciomarine deposits comprising silt and clay, with minor sand and gravel (refer to Figure 4). It is noted that the Carp Road

Development Corridor is primarily located within zones of coarse textured glaciomarine deposits and glacial till (Dillon, 2004).

The bedrock geology maps (Armstrong and Dodge, 2007) indicate the Site is underlain by Paleozoic bedrock consisting of Shadow Lake Formation limestone, dolostone shale, and arkose sandstone of the Simcoe Group (refer to Figure 5). There are no mapped faults or bedrock contacts within 500 metres of the Site and the nearest mapped bedrock outcrops are situated approximately 550 metres to the south.

Karst geology maps (Brunton and Dodge, 2008) indicate that the closest boundary of the Site to any potential or inferred karst bedrock features is greater than 1.8 kilometres. The closest known karst bedrock feature is approximately 11 kilometres north of the Site.

3.5 MECP Water Well Records

The MECP Water Well Records within 500 meters of the Site were obtained to determine the characteristics of existing wells. Thirty-nine (39) well records were obtained, and a summary of these records is provided in Appendix C along with a map showing the reported locations of the wells. Most of the wells are situated up gradient, west and south of the Site.

Table 3.2 provides a summary of the well characteristics for the well records inclusive of depth to water found, static water levels, depth to bedrock and total well depth.

The MECP Water Well Records for drinking water wells surrounding the Site indicate that the depth to bedrock averages 7.6 metres within 500 metres of the Site and increases up to 24.1 meters west of the Site, as indicated by Well Record ID 1517689.

Table 3.2 – Summary of Water Well Records Search Results

Parameter	10th Percentile	90th Percentile	Average / Geometric Mean
Depth Water Found (m)	14.9	58.6	37.4/31.8
Static Water Level (m)	2.5	6.9	4.8/4.3
Depth to Bedrock (m)	2.4	13.7	7.6/4.7
Casing Length below ground surface (m)	4.5	15.5	10.5/8.5
Total Well Depth (m)	19.3	72.3	45.2/38.8

Parameter	10th Percentile	90th Percentile	Average / Geometric Mean
Recommended Pumping Rate (LPM[1])	11.7	33.7	20.6/ 17.9

Notes:
1. LPM =Litres per minute.

4.0 TERRAIN EVALUATION

4.1 Field Procedure

Various field investigations involving test pits and boreholes have been carried out at the Site as described in Section 2.0 of this report. The locations of the test pits and boreholes are shown on the Detailed Site Plan, Figure 1. The locations and ground surface elevations of the test pits and boreholes were determined using high precision GPS survey instrumentation.

The fieldwork for each investigation was supervised throughout by a member of our engineering staff who directed the drilling operations, logged the samples and carried out the in-situ testing. Following the fieldwork, the soil samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples of soil were tested for water content testing, and grain size distribution testing. One soil sample was submitted to an accredited laboratory for chemical testing relating to corrosion of buried steel and concrete.

Descriptions of the subsurface conditions logged in the test pits and boreholes are provided on the Record of Test Pit/Borehole sheets provided in Appendix D, and the grain size analysis laboratory sheets are provided in Appendix E. Refer to the previously referenced reports for full details of the field investigation procedures followed.

4.2 Soil and Groundwater Conditions

4.2.1 General

The findings of the GEMTEC 2020 and GEMTEC 2023 investigations are comparable, in that both investigations identified a thin layer of topsoil, underlain by a silty sand to sandy silt and sand deposit, followed by a silty clay, and a glacial till deposit at depth.

The following presents an overview of the subsurface conditions encountered in the boreholes advanced during the GEMTEC 2023 investigations.

The results of the GEMTEC 2020 investigation are only referenced below with respect to refusal depths, bedrock and groundwater levels.

4.2.2 Topsoil

A layer of topsoil was encountered at the ground surface at all borehole locations with thicknesses ranging from about 150 to 300 millimetres.

4.2.3 Silty Sand to Sandy Silt, and Sand

Native deposits of silty sand to sandy silt and sand with varying amounts of gravel and clay were encountered below the topsoil in all the boreholes, with the exception of borehole 23-10. These deposits are collectively referred to further in this report as silty sand. The silty sand to sandy silt extends to depths ranging from about 0.8 to 3.4 metres below the existing ground surface. The silty sand deposits also contain trace to some clay or silty clay seams at some locations.

Standard penetration tests carried out in the sandy deposits gave N values ranging from 1 to 21 blows per 0.3 metres of penetration, which reflect a very loose to compact relative density.

The results of a grain size distribution test carried out on one sample of the silty sand are provided in Appendix E and summarized in Table 4.1. The measured water contents of eight samples of the silty sand to sandy silt ranged between about 21 and 35%.

Table 4.1 – Summary of Grain Size Distribution Testing (Silty Sand)

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-04	3	1.5 to 2.1	1	44	35	20

4.2.4 Silty Clay

Native deposits of silty clay were encountered below the silty sand in boreholes 23-01, 23-03, 23-08, 23-13, and 23-15. The full depth of the silty clay in the boreholes has been weathered to a grey-brown crust. The weathered crust extends to depths ranging from about 1.5 to 3.8 metres below the existing surface grade.

Standard penetration tests carried out in the weathered silty clay gave SPT N values ranging from 2 to 8 blows per 0.3 metres of penetration, which reflect a stiff to very stiff consistency.

The results of grain size distribution testing carried out on one sample of the weathered silty clay crust are provided in Appendix E and are summarized in Table 4.2.

Table 4.2 – Summary of Grain Size Distribution Testing (Weathered Crust)

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-08	2	0.7 to 1.4	0	1	48	51

4.2.5 Sand and Silt

A native deposit of sand and silt was encountered below the weathered silty clay crust in borehole 23-08. The sand and silt layer has a thickness of about 0.8 metres and extends to a depth of about 2.9 metres below the existing ground surface.

The measured water content of one sample of the sand and silt was about 33%.

4.2.6 Glacial Till

Native deposits of glacial till were encountered below the topsoil, silty clay, and/or sand and silt deposits, where encountered, in the boreholes. The glacial till was not fully penetrated in the boreholes but was proven to depths ranging from about 2.5 to 9.0 metres below the existing ground surface.

Glacial till is a heterogeneous mixture of all grain sizes, and at this Site, the glacial till can be described as silty sand to sandy silt, with varying amounts of clay and gravel to sandy silt and clay with trace gravel. Although not directly encountered in the boreholes, the glacial till deposit is known to contain cobbles and boulders.

Standard penetration tests carried out in the glacial till gave N values ranging from weight of hammer to greater than 50 blows per 0.3 metres of penetration, which reflect a very loose to very dense relative density. The higher blow counts likely represent the presence of cobbles and boulders or the surface of the bedrock rather than the relative density of the glacial till.

The results of a grain size distribution testing carried out on one sample of the glacial till are provided in Appendix E and summarized in Table 4.3. The water contents of 29 samples of the glacial till range between about 4 and 35%.

Table 4.3 – Summary of Grain Size Distribution Testing (Glacial Till)

Borehole ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-06	10B	7.0 to 7.5	21	46	22	10
23-08	5	3.1 to 3.2	2	27	35	35

4.2.7 Auger Refusal and Bedrock

Boreholes 23-06, 23-07, 23-08, 23-10, 23-14, and 23-15, from the GEMTEC 2023 investigations encountered practical auger refusal at depths ranging from about 2.6 to 8.5 metres below the existing ground surface. Boreholes 19-1D, 19-3D, and 19-4S from GEMTEC 2021 investigations encountered practical auger refusal at depths ranging from about 5.6 to 9.1 metres below the existing ground surface. Auger refusal may occur on cobbles and boulders within the glacial till or on the bedrock surface.

Practical refusal to excavating was encountered in test pits 18-2, 18-3, 18-6, 18-9, 18-10, 18-11, 18-12, 18-13, and 18-14 at depths ranging from about 1.8 to 3.1 metres below the existing ground surface.

Bedrock was encountered in the test wells at depths ranging from about 7.0 to 8.2 metres below the existing ground surface. The depth to bedrock at the test well locations was inferred from the drilling resistance and the drill cuttings.

A summary of the refusal depths and elevations from the GEMTEC 2019 and 2023 investigations are summarized in Table 4.4.

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

Test hole ID	Ground Surface Elevation (metres)	Depth to Refusal (metres)	Refusal/Bedrock Elevation (metres)
BH 23-06	110.3	8.5[1]	101.8[1]
BH 23-07	112.8	3.3	109.6
BH 23-08	110.3	4.4	105.8
BH 23-10	114.1	4.2	109.9
BH 23-13	111.7	4.0[2]	107.6[2]
BH 23-14	116.3	2.6	113.8
BH 23-15	111.5	5.0	106.4
BH 19-1D	115.8	9.2	106.6
BH 19-3D	115.2	6.5	108.7
BH 19-4S	117.1	5.6	111.5
TW-1	115.8	7.9[3]	107.9[3]
TW-2	112.8	7.6[3]	105.2[3]
TW-3	115.3	7.0[3]	108.3[3]
TW-4	117.3	8.2[3]	109.1[3]
TP 18-2	114.7	2.9	111.8

Test hole ID	Ground Surface Elevation (metres)	Depth to Refusal (metres)	Refusal/Bedrock Elevation (metres)
TP 18-3	113.1	2.4	110.7
TP 18-6	114.5	2.9[4]	111.6[4]
TP 18-9	116.2	3.1[4]	113.2[4]
TP 18-10	114.1	3.1[4]	111.0[4]
TP 18-11	111.6	2.3[4]	109.4[4]
TP 18-12	116.3	2.9[4]	113.4[4]
TP 18-13	111.8	3.1[4]	108.8[4]
TP 18-14	115.5	1.8	113.6

Notes:

1. Practical auger refusal was encountered in borehole 23-06 at a depth of about 8.5 metres below the ground surface, however, an SPT advanced past auger refusal to a depth of about 9.0 metres below the existing ground surface.
2. Borehole 23-13 encountered SPT refusal (not auger refusal). SPT refusal likely represents cobbles and boulders, rather than the bedrock surface.
3. The depth to bedrock in the test wells is inferred from the drilling resistance and the drill cuttings.
4. Refusal to excavator advancement was encountered in test pits 18-6 and 18-9 to 18-13 on possible cobbles and boulders within the glacial till.

4.3 Groundwater Levels

Monitoring wells were installed in borehole 23-07 from the GEMTEC (2023) investigations, borehole 24-9 from the GEMTEC (2024) investigation and boreholes 19-1D, 19-1S, 19-3D, 19-3S, and 19-4S from the GEMTEC (2019) investigations to measure the groundwater levels. Four test wells were advanced at the Site for pumping testing and groundwater level measurements during the previous investigation.

The measured groundwater levels in the monitoring wells and test wells installed in the boreholes are presented in Appendix D and the highest recorded groundwater levels in each monitoring well are summarized in Table 4.5. The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

Table 4.5 – Summary of Groundwater Levels

Borehole ID	Ground Surface Elevation (metres)	Groundwater Depth (metres below ground surface)	Groundwater Level Elevation (metres)	Date
TW 19-1 (bedrock)	115.8	4.2	111.6	Aug 8, 2019

Borehole ID	Ground Surface Elevation (metres)	Groundwater Depth (metres below ground surface)	Groundwater Level Elevation (metres)	Date
TW 19-2 (bedrock)	112.8	1.5	111.3	Aug 8, 2019
TW 19-3 (bedrock)	115.3	3.0	112.3	Apr 27, 2023
TW 19-4 (bedrock)	117.3	3.9	113.4	Apr 27, 2023
BH 23-07	112.8	2.8	110.0	Apr 27, 2023
BH 19-1D	115.8	4.6	111.2	Aug 8, 2019
BH 19-1S	115.8	Dry (3.05)	Dry (112.8)	Aug 6, 2019
BH 19-3D	115.2	2.9	112.3	Apr 27, 2023
BH 19-3S	115.3	3.0	112.3	Apr 27, 2023
BH 19-4S	117.1	4.6	112.5	Apr 27, 2023
BH24-9	117.5	Dry (3.35)	Dry (114.1)	Feb 28, 2024

4.4 Soil Infiltration Testing

As part of GEMTEC (2023a) field infiltration tests were carried out at seven (7) locations across the Site in order to estimate infiltration rates. Shallow hand-auger holes were advanced 0.4 to 1.2 metres below ground surface (mbgs) in the immediate vicinity of test pits 18-1, 18-3, 18-5, 18-9, 18-10 and 18-14. The soils conditions above the depth of infiltration testing consists of grey to brown sands with varying amounts of silt/clay and gravel. The hand auger and infiltration testing depths are summarized in Appendix F.

A Guelph Permeameter was used to estimate the saturated hydraulic conductivity in the vadose zone (ASTM D5126 – 90: Standard Guide for Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone). The field saturated hydraulic conductivity (K_{fs}) was calculated using the single head method, following Soil Moisture's K_{fs} calculation (refer to Appendix F). The single head method was conducted using hydraulic head heights of 5 to 15 cm.

The field measurements of saturated hydraulic conductivity were converted to infiltration rates based on the relationship between field saturated hydraulic conductivity and infiltration rates presented in "Ontario Ministry of Municipal Affairs and Housing (OMMAH), 1997, Supplementary Guidelines to Ontario Building Code 1997, SG-6 Percolation Times and Soil Descriptions, Toronto, Ontario".

The calculated saturated field hydraulic conductivities range from 1.1 x 10^{-2} to 1.1 x 10^{-5} cm/s. The corresponding estimated infiltration rates, based on K_{fs}, ranged from 26 to 163 mm/hour.

Soil samples were collected from the bottom 15 cm of each hand auger hole and submitted for grain size analyses (Appendix E). Soil classifications are variable ranging from sand with a trace of silt and clay to sandy clayey silt.

Calculated saturated field hydraulic conductivities were also estimated based on grain size analysis and soil texture classification of samples from the hand auger holes, which ranged from 5.3 x 10^{-6} to 3.6 x 10^{-2} cm/s. The infiltration rates based on the soil texture classification for the hand auger samples are presented in Appendix F.

5.0 IMPACT ASSESSMENT

The potential impact on groundwater and surface water resources due to wastewater treatment and disposal by individual on-site sewage disposal systems on the Site are assessed in the following sections.

5.1 Sewage Disposal Systems

It is understood that the use of advanced technologies for the treatment of septic effluent (advanced treatment) is being proposed for the development. Advanced sewage treatment systems are permitted under the Ontario Building Code (OBC), and these technologies are capable of treating effluent prior to the effluent being disposed to a Class IV leaching bed (Type A or Type B), including a reduction in the nitrate concentration. This section discusses the results of the terrain evaluation as they relate to the feasibility of installing advanced sewage treatment systems on the Site for on-site wastewater treatment and disposal.

CoO (2016) provides additional guidance for the application of MECP Guideline D-5-4 within the Carp Road Corridor. The memo allows proponents to undertake a modified nitrate attenuation predictive assessment using nitrogen reduction treatment systems. Available systems are able to achieve a minimum of 50% reduction in nitrogen; as a result, the modified minimum concentration of nitrate used in the nitrate attenuation assessment can be reduced to 20 mg/L.

It should be noted that the following information is provided for general guidance purposes only. All septic systems installed at the Site should be designed on a lot-by-lot basis. Test holes should be advanced during the lot development to identify the subsurface conditions at the location of the proposed septic system. In all cases, the septic system design must conform to OBC requirements.

5.2 Hydrogeological Sensitivity

Areas of thin soils cover, fractured bedrock exposed at ground surface, and karst environments contribute to the hydrogeological sensitivity of a site, which may not allow for sufficient attenuative

processes for the effluent of on-site septic systems, resulting in impacts to the receiving aquifer. Areas of thin soil cover, generally taken to be less than two metres, were limited to the southeastern corner of the Site where test pit TP18-14 was terminated on possible bedrock at a depth of 1.8 metres. Most of the Site is covered with 6 to 8 metres of fine-grained overburden soils; however, based on the depth of auger refusal in boreholes BH23-14 and BH23-15, which reported auger refusal at 2.56 and 5.03 mbgs, it is evident that the soil thins towards the southeast portion of the Site (i.e., Lot 7 in Figure 1). Soils consist of low hydraulic conductivity soils such as silty clay and glacial till.

Karst mapping (Brunton and Dodge, 2008) does not indicate the presence of any inferred or potential karstic features, and no karstic features were observed on-site.

Grain size distribution and Guelph Permeameter testing results were reviewed in conjunction with the soil depths to assess hydrogeological sensitivity across the Site. Although samples taken from TP18-1 and GP18-1D exhibited low fines content (3.8 to 4.2%) and correspondingly higher estimated hydraulic conductivity, the sandier interval encountered in TP18-1 (see Appendix D) was less than 1 metre thick, laterally discontinuous based on surrounding test pits and boreholes, and underlain by lower-permeability glacial till. Using the measured coefficient of permeability of approximately $\mathrm{K} = 1 \times 10^{-2}$ cm/s from the Guelph Permeameter testing in TP18-1, the percolation time calculated in accordance with MMAH Supplementary Standard SB-6 is in the range of 4 to 12 minutes per centimetre. Under SB-6, a percolation time of <1 centimetre per minute is considered very permeable and is not acceptable for effluent treatment; the calculated value is therefore above the threshold for very permeable soils. The nearby shallow monitoring well MW19-1S was dry to a depth of 3.0 metres, indicating that the sandier layer is unsaturated and not part of the active aquifer. Based on multiple lines of evidence, including limited thickness and extent of coarse soils, underlying till, calculated percolation characteristics, and groundwater level measurements, the Site is not considered to exhibit highly permeable soils that would compromise long-term effluent attenuation in the bedrock aquifer.

Only one location within the southeast portion of Lot 7 (TP18-14) reported less than 2 metres of overburden, and this test pit was terminated on refusal rather than at a confirmed bedrock contact. Surrounding boreholes and test pits (BH23-15, TP18-15, BH19-3D, and BH23-14) all recorded overburden thicknesses greater than 2 metres, with several locations indicating up to approximately 5 metres of soil. The stratigraphy in this area also includes at least 1 metre of lower-permeability glacial till, which provides an effective barrier limiting vertical migration and reducing the potential for hydrogeological sensitivity associated with thin soils. Based on the spatial distribution of overburden thickness and the absence of any continuous shallow bedrock or rapid-transport pathways, the southeast portion of Lot 7 is not considered to require additional mitigative measures, nor is it identified as less suitable for septic system placement.

5.2.1 Background Nitrate Concentrations

The background nitrate concentration of the bedrock aquifer is less than 0.1 mg/L (lab reporting limit) based on samples collected from four Site test wells during the previous investigations (GEMTEC, 2020) and current investigations (GEMTEC 2023a), and two private wells located within 500 metres of the Site during previous investigations (GEMTEC, 2020).

During the GEMTEC (2020) investigation, shallow groundwater was encountered in three of the five monitoring wells installed in the glacial till. Water levels in monitoring wells MW19-1D, MW19-3S and MW19-3D ranged from 4.0 to 4.8 metres below the ground surface, but only wells MW19-1D and MW19-3D had sufficient water for sampling purposes. Nitrate levels in groundwater samples from the two monitoring wells ranged from non-detect (<0.1 mg/L) to 1.6 mg/L, averaging 1.0 mg/L over two sampling rounds (laboratory Certificates of Analysis provided in Appendix G). The glacial till is not considered a viable water supply aquifer.

To determine long-term nitrate concentrations in the overburden, nitrate samples were collected from available monitoring wells during the fall (September 2023) and Spring (June 2024) seasonal periods. The results and laboratory Certificates of Analysis are provided in Appendix G and are summarized in Table 5.1.

Table 5.1 – Summary of Monitoring Well Sampling Results

Parameter	Units	MW19-1D	MW19-3D	MW19-3S	MW23-7
08/29/2019					
Nitrate as N	mg/L	ND (0.1)	1.6	-	-
Nitrite as N	mg/L	ND (0.05)	ND (0.05)	-	-
11/05/2019					
Nitrate as N	mg/L	0.8	1.6	-	-
Nitrite as N	mg/L	0.05	ND (0.05)	-	-
09/13/2023					
Nitrate as N	mg/L	0.5	1.6	1.6	ND (0.1)
Nitrite as N	mg/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
06/11/2024					
Nitrate as N	mg/L	0.5	0.7	1.6	ND (0.1)
Nitrite as N	mg/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)

Nitrate concentrations in the monitoring wells sampled ranged from less than 0.1 mg/L (non-detectable) to 1.6 mg/L, and averaged approximately 1 mg/L, which is consistent with the results from the GEMTEC (2020) investigation. Based on the nitrate concentrations of the samples collected during previous investigations, concentrations do not appear to be increasing over time, and seasonal fluctuations are minor.

The low levels of nitrate reported in the overburden monitoring wells is likely associated with historical agricultural practices/fertilizer use in the area, which should decrease over time as inputs are removed. Based on the absence of nitrates in the bedrock water supply aquifer, it is expected that the bedrock aquifer is at least partially hydraulically separated from the receiving overburden unit.

Additionally, water levels were not recorded to decrease in the overburden monitoring wells during the pumping of the bedrock test wells during the eight-hour pumping test (Appendix J), suggesting no direct hydraulic connection between the overburden aquifer and the deeper bedrock aquifer.

5.3 Groundwater Impacts

The potential risk to groundwater resources on- and off the Site was assessed in accordance with MECP Guideline D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment. To evaluate the groundwater impacts, nitrate dilution calculations for commercial properties outlined in MECP Guideline D-5-4 were followed.

The risk of individual on-site septic systems was assessed using nitrate-nitrogen contaminant loading. The maximum allowable concentration of nitrate in the groundwater at the boundaries of the Site is 10 milligrams per litre as per MECP Guideline D-5-4, dated August 1996.

The septic impact assessment was completed on a lot-by-lot basis, to determine the nitrate concentrations at the boundaries of each lot. The calculations are provided in Appendix H, and the information used in the calculations is provided below:

- Individual lot sizes were estimated using the Concept Plan provided in Appendix A.
- Topography factor of 0.19, corresponding to rolling land (0.2) and hilly (0.1).
- Vegetation factor of 0.10, corresponding to cultivated land cover.
- Soil factor varies from 0.15 to 0.30 based on reclassified surficial geology (Figure 6):
  - Silty sand, sand and silt, glacial till 0.30 (refer to Figure 6 for lot coverage), and
  - Silty clay and clayey silt 0.15 (refer to Figure 6 for lot coverage).
- Water holding capacity of soils (WHC) based on information obtained from Table 3.1 of the MECP Stormwater Management Planning and Design Manual, dated March 2003. The water surplus values assume post-development landscaping generally characterized by urban lawns and shallow rooted crops as opposed to pre-development pasture and shrubs;

- 75 mm: Urban lawns/shallow rooted crops, silty sand, sandy silt, glacial till (refer to Figure 6 for lot coverage).
- 100 mm: Urban lawns/shallow rooted crops, sandy clayey silt (refer to Figure 6 for lot coverage). .
- 250 mm: Pasture and shrubs, sandy clayey silt (refer to Figure 6 for lot coverage)

- An annual water surplus data from the Carleton Place - Appleton weather station data, Environment Canada Water Surplus Datasets, (attached in Appendix H).
- An area weighted average was used to estimate the infiltration coefficient and total infiltration volume based on the Site terrain coverage (refer to Figure 6).
- Post-development hard surface area – Scenarios with 40%, 50%, and 60%.
- The use of tertiary treatment systems in the construction of the septic systems at the commercial lot, capable of reducing the concentration of nitrate in the effluent exiting the treatment unit to a maximum of 20 mg/L. This concentration value was utilized when re-simplifying the formula provided in MECP Guideline D-5-4 for the purpose of determining the factor used to determine the maximum allowable flow for each lot from the determined available infiltration volume; the factor becomes 1 versus 3 as is the case without tertiary treatment.

The maximum allowable flows are based on the nitrate concentration, available infiltration and background nitrate concentrations. The maximum allowable flows are calculated using the following formula provided in MECP Guideline D-5-4:

$$\frac{40\frac{mg}{L}\,x\,Flow}{Flow + Infiltration} = 10\frac{mg}{L} - Background\ Nitrate$$

where;

40 mg/L	represents the value for nitrate-nitrogen in the discharge from a Class 4 or Class 6 system (with no advanced treatment technologies),
flow	is the maximum allowable septic flows,
infiltration	is the available water for dilution and
background nitrates	are based on the background nitrate concentrations in the receiving aquifer. For septic systems with advanced treatment technologies, the value for nitrate-nitrogen is reduced to 20 mg/L.

The septic flow for the commercial lot is based on information provided in Section 5.6.3 of MECP Guideline D-5-4, the Carp Road Corridor Nitrate Impact Assessment Recommendations memo dated September 27, 2016, and the MECP SWM Planning and Design Manual, dated March 2003.

Based on the nitrate impact assessment for commercial/industrial properties, the allowable daily design sanitary sewage flow (DDSSF) for the proposed commercial lots assuming 40% hard surface coverage ranges from 531 L/day to 2,455 L/day for conventional systems, and 1,593 L/day to 7,366 L/day for advanced treatment systems. The nitrate dilution calculations and corresponding maximum allowable flows for each individual lot for 40%, 50% and 60% hard surface scenarios are provided in Appendix H.

6.0 GROUNDWATER SUPPLY

A groundwater supply investigation was carried out in accordance with the MECP *D-5-5 Private Wells: Water Supply Assessment*, to determine the quantity and quality of groundwater available for domestic water supply. The results of the groundwater supply investigation are summarized in the following sections.

6.1 Test Well Construction

The MECP Guideline D-5-5 indicates that a minimum of four (4) test wells are required for sites more than 15 hectares and less than 25 hectares. Four (4) test wells were drilled at the Site by Air Rock Drilling Co. Ltd. under Well Contractor License No. 1119 which is appropriate for the size of the Site. The wells were completed in July 2019; copies of the MECP Water Well Records and the Certificates of Well Compliance are provided in Appendix I. The test wells are sufficient to characterize the hydrogeology and meet the MECP Guideline D-5-5 minimum test well requirements.

Well grouting inspections were carried out by GEMTEC staff during the sealing of the well casings in all test wells. The test wells were constructed using a nominal 159 millimetre inside diameter steel casing, installed a minimum of 4.57 metres (15 feet) into competent bedrock. The construction details of the test wells are summarized in Table 6.1.

The test wells intersected more overburden, are deeper and found water at greater depths than a typical well, based on compiled well statistics from the area. As previously noted, most existing wells are situated west and south of the Site.

Table 6.1 – Summary of Test Well Construction Details

Test Well	Depth to Bedrock (mbgs)	Depth of Well Casing (mbgs)	Depth Water Found (mbgs)	Total Well Depth (mbgs)
TW 1	7.9	12.8	57.9	61
TW 2	7.6	12.2	16.1 & 51.8	61
TW 3	7.0	11.6	56.4	61
TW4	8.2	12.8	58.8	61
Typical Well (geometric mean, WWR search)	4.7	8.5	31.8	38.8

Notes: mbgs - metres below ground surface

All four test wells produced low initial yields during drilling and subsequently required hydrofracking. Hydrofracking was successfully completed on each well, resulting in improved yields. Future on-site wells will likely require hydrofracking at the time of drilling to achieve sufficient well yields.

6.2 Pumping Test Field Procedure

A six-hour duration constant discharge rate pumping test was conducted in each test well as part of GEMTEC (2020).

During GEMTEC (2023a), eight-hour constant rate pumping tests were completed on the Site, in accordance with the City of Ottawa Hydrogeological and Terrain Analysis Guidelines (2021) for commercial/industrial properties. Two test wells - TW1 and TW4 were pumped simultaneously to assess well interference.

The pump discharge was directed to the ground surface at a distance ranging from 5 to 10 metres from the test wells and in a manner such that the flow of water on the ground surface was directed away from the test wells.

The water level measurements for the drawdown and recovery data for the pumping tests from the pumping tests completed in the previous investigations and current investigations are provided in Appendix J.

6.2.1 Water Level Measurements

Water level measurements were taken at regular intervals in the well being pumped using an electric water level tape and also on a continuous basis using electronic data loggers. After the pump was shut off, water level data was collected until a minimum of 95% of the drawdown in

water level had recovered in the test wells. The water level measurements for the drawdown and recovery data for the pumping tests from the pumping tests are provided in Appendix J. The drawdown data was measured with reference to the top of the well casings.

Water level measurements were also taken from other on-site test wells and overburden monitoring wells (observation wells) prior to, during and after the pumping of each of the test wells to determine potential interference effects, water level fluctuations and influence from precipitation. Water level measurements taken in the observation wells are provided in Appendix J.

During the monitoring period, groundwater levels in bedrock test wells TW1 to TW4 ranged between approximately 110.33 metres and 111.50 metres elevation (Appendix J). Aside from the minor drawdown observed during the test well pumping tests, water level fluctuations within each individual were less than 0.2 metres during the monitoring period between September 6th and September 21st, 2023 (Appendix J). No noticeable drawdown was observed in the wells related to well interference from off-site pumping, or precipitation events.

Based on the measured water levels, groundwater flow in the bedrock aquifer is approximately northeast across the Site, with a very small decrease in water level elevations of less than 0.50 meters from the front of the Site (bounding Carp Rd) to the back of the Site (northeast boundary).

6.2.2 Flow Rate Measurements

The wells were pumped using a 1.5 HP electric submersible pump and portable generator supplied by Air Rock Drilling Ltd. The flow rate of the pump discharge hose was constantly monitored using a timed-volume method. Multiple flow measurements were taken within the first hour of the pumping test and then at 60-minute intervals throughout the remainder of the pumping test to ensure that the discharge rate maintained a constant flow rate (i.e., within 5%). The test wells were pumped at rates of 21 to 28 litres per minute (refer to Table 6.3 below for pumping details).

The pumping rates of 21 L/min and 28 L/min were selected based on the observed well yields during well yield testing and represent pumping near the upper end of what the wells could sustainably produce under test conditions. These rates therefore provide a reasonable and conservative basis for evaluating available water quantity at the Site.

For the Rural Commercial Subzone 9 (RC9) permitted uses, actual water demand will be governed by the scale of future development, which is constrained by lot size and the maximum allowable septic system design flows. As summarized in Appendix H, the highest anticipated septic design flow for a lot using advanced treatment is approximately 7,366 L/day. This value provides a reasonable proxy for maximum daily water demand, as water use is typically aligned with septic loading.

The constant-rate pumping test at 21 L/min over an 8-hour duration demonstrates that the wells can sustain a withdrawal of approximately 10,000 L/day. This exceeds the maximum likely daily demand associated with the permitted uses on the proposed lots. Accordingly, the selected pumping rates are appropriate and demonstrate that the wells can support the anticipated water demands for RC9-permitted uses at the scale feasible on the proposed lots.

6.2.3 Groundwater Sampling

Total chlorine tests were conducted in the field to ensure that chlorine levels were at 0.0 mg/L prior to sampling for bacteriological testing. The temperature, conductivity, total dissolved solids, pH, turbidity and total chlorine levels of the groundwater were measured at periodic intervals during the pumping tests and are summarized in Appendix K. The field equipment used during the pumping test is calibrated monthly by GEMTEC and the details of field equipment are provided in Table 6.2.

Table 6.2 – Field Equipment Overview

Field Parameters	Manufacturer	Model No.
Total Chlorine	Hach	DR900
pH, temperature, TDS and Conductivity	Horiba	U-50
Turbidity	Hanna	HI 98703
Colour	Hach	DR900

Groundwater samples were collected for laboratory analysis from the test wells after eight (8) hours of pumping. The samples were collected in laboratory supplied bottles and prepared/preserved in the field in accordance with the industry standard sampling, handling and preservation procedures required by the laboratory. All water samples, including samples for metal analysis, were unfiltered. All test well groundwater samples were subsequently submitted to Paracel laboratories in Ottawa, Ontario for subdivision package, and the samples from TW1 and TW4 were submitted for volatile organic compounds (VOCs) and trace metals package in addition.

6.1 Test Well Water Quality

The results of the chemical, physical and bacteriological analyses on the water samples from the test wells are summarized Appendix K and the laboratory results from Paracel Laboratories Ltd.

Is provided in Appendix L. The test well water quality results from GEMTEC (2023) are provided in the following sections, and a comparison to the results from the previous GEMTEC (2020) investigation is made in Section 6.2 to interpret long term groundwater quality.

The groundwater quality sampling program included analysis of 'subdivision package', 'trace metals', volatile organic compounds parameters.

Only TW1 and TW4 were analyzed for VOCs and trace metals because these wells are located closest to the potential off-site contaminant sources associated with the commercial properties along Carp Road. The Phase II ESA completed for the Site evaluated all identified Areas of Potential Environmental Concern and did not report any exceedances of applicable standards. Given the absence of identified impacts, the lack of on-site contaminant sources, and the positioning of TW1 and TW4 as the wells most likely to intercept any potential off-site influence, the existing VOC and trace-metal sampling program is considered sufficient. Additional testing of TW2 and TW3 is not anticipated to provide further meaningful information regarding groundwater quality or potential contaminant migration.

Further, no additional parameters were considered necessary to evaluate potential contaminants of concern based on a review of GEMTEC (2024). To note, pesticides associated with nearby agricultural or golf course use were not identified as a contaminant of concern for the bedrock groundwater system, as pesticides typically exhibit strong sorption to organic matter in surficial soils, which significantly limits their mobility and potential for leaching to groundwater. As part of the Phase II ESA, soil samples were analyzed for organochlorine pesticides. All reported concentrations were non-detectable. Based on the chemical behaviour of these compounds and the analytical results, pesticides are not considered a concern at this Site.

6.1.1 Bacteriological Parameters

Total chlorine measurements made at regular intervals during the pumping test from GEMTEC (2023) confirmed that total chlorine was non-detectable in the well water at the time of bacteriological sampling.

Total coliform bacteria were detected in the 8-hr sample from TW2 at 1 count per 100 ml of sample. Bacteria species (i.e., total coliform, fecal coliform, and *E. coli*) were not detected in any of the other water samples. Based on water samples collected from the on-site test wells, bacteria counts did not exceed applicable standards for bacteriological parameters.

While the stated ODWQS for Total Coliform is 0 counts per 100 ml of sample, it is recognized that the objective has been set as an indicator of inadequate disinfection within the distribution systems associated with water works. For private water wells not subject to approval under the OWRA, the MECP and Health Units have historically used the limit of <5 counts per 100 ml in the absence of a chlorine residual as indicating acceptable water quality. For the purposes of the assessment described by MECP Guideline D-5-5, total coliform counts of less than 6 per

100 ml of sample are considered as indicative of acceptable water quality, under the condition that *E. coli* and fecal coliforms are non-detect.

Based on the bacteriological testing carried out during GEMTEC (2023) - the water is suitable for consumption.

6.1.2 Other Health Related Parameters

Sodium concentrations in three of the four test wells sampled during GEMTEC (2023) exceeded the ODWQS warning level of 20 mg/L for persons on sodium-restricted diets; however, the sodium concentration, ranging from 24.3 mg/L to 87.6 mg/L, was below the aesthetic objective of the ODWQS of 200 mg/L and the maximum concentration considered reasonably treatable (MCCRT) of 200 mg/L.

Based on the absence of bacteria in the water supply aquifer, disinfection is not required for future drinking water wells on the Site.

6.1.3 Operational Guideline Exceedances

Operational related exceedances of the Ontario Drinking Water Standards (ODWS) were noted for hardness in all test wells sampled during GEMTEC (2023).

The concentration of hardness in water samples obtained from all four (4) test wells under GEMTEC (2023) ranged from 176 to 339 mg/L as $CaCO_3$ and was higher than the operational guideline of 80 to 100 mg/L of $CaCO_3$ as specified in the ODWS.

Water having a hardness level above 80 to 100 mg/L as CaCO3 is often softened for domestic use. MECP Guideline D-5-5 states that water having a hardness value more than 300 mg/L is considered “very hard”. The MECP publication entitled “Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines”, states that water with hardness in excess of 500 mg/L is considered to be unacceptable for most domestic purposes. There is no upper treatable limit for hardness specified in MECP Guideline D-5-5.

The concentrations of hardness in all the test wells are below the reported threshold of 500 mg/L as $CaCO_3$ as specified in the Technical Support Document for the ODWS. The concentration of hardness observed in all of the test wells is considered to be reasonably treatable using a conventional water softener. Most water supply wells within rural eastern Ontario are equipped with water softeners.

Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water that may be of concern to persons on a sodium restricted diet. The use of potassium chloride in the water softener (which adds potassium to the water instead of sodium); could be considered as a means of keeping sodium concentrations in the water at background levels. Consideration could also be given to providing a bypass of the

water softener for drinking water purposes (for example, a bypass of the softener to the cold-water kitchen tap).

6.1.4 Aesthetic Objective Exceedances

The aesthetic objective exceedances of the ODWQS were sulphide in all test wells. The exceedance is discussed in the following section:

The concentration of sulphide in water samples obtained from all four (4) test wells ranged from 0.13 to 0.77 mg/L, which exceeds the ODWQS aesthetic objective of 0.05 mg/L.

Sulphide can be related to an unpleasant odour and taste, and can produce black stains on laundered items, pipes and fixtures. Although ingestion of large quantities of hydrogen sulphide can produce toxic effects on humans, it is not likely that an individual would ingest a harmful dose in drinking water because of the taste and odour.

Hydrogen sulfide can be reduced or removed by activated carbon filtration, shock chlorination, oxidizing chemical injection, oxidizing filtration, or water heater modification. The level of treatment depends on the overall water chemistry and performance specifications provided by treatment system manufacturers. It should be noted that MECP Guideline D-5-5 does not list a maximum concentration considered to be reasonably treatable.

To confirm practical treatment options for this Site, GEMTEC consulted a local water-treatment specialist. They recommended an aeration-based system (Digital X-Factor Vorprox Iron/Sulphur Remover), which is rated to reduce hydrogen sulphide concentrations up to approximately 3.0 mg/L. The estimated cost is roughly $2,500 and is not expected to be overly cost prohibitive for future commercial well users. Future lot owners should consult with a water quality treatment specialist for treatment of aesthetic parameters.

6.2 Long-Term Test Well Water Quality

The results from the GEMTEC 2020 investigations were comparted to the GEMTEC 2023 investigations to assess changing groundwater conditions between 2020 and 2023.

Six-hour pumping tests were conducted during the GEMTEC (2020) investigation, and water quality samples were collected after six hours of pumping (summary of results and laboratory certificates provided in Appendix L). The following exceedances were reported, in accordance with the Ontario Drinking Water Quality Standards:

- Operational Exceedances
  - Hardness, all test wells, reported to range between 172 to 309 mg/L, exceeding ODWQS of 80-100 mg/L.

- Aesthetic Exceedances:
  - Turbidity, TW2, TW3, TW4, reported to range between 1.0 NTU and 92.2 NTU, exceeding the ODWQS of 5 NTU.
  - Iron, TW1, TW2, TW3, reported to range between 0.1 mg/L and 2.0 mg/L, exceeding the ODWQS of 0.3 mg/L.
  - Sulphide, all test well, reported to range between 0.05 mg/L and 2.02 mg/L, exceeding the ODWQS of 0.05 mg/L.
  - Colour, all test wells, reported to range between < 2 TCU and 80 mg/L, exceeding the ODWQS of 5 TCU.

The water quality results from GEMTEC, (2020) reported similar water quality to the 2023 GEMTEC investigations, with slightly elevated hardness and sulphide concentrations and decreases in turbidity concentrations corresponding to additional well development. There is no evidence of worsening water quality on the Site.

Elevated levels of turbidity and (suspended) iron, and colour in the test wells from GEMTEC, (2020) are likely associated with fine sediments introduced during the drilling or naturally occurring sediments around the interval of the borehole open to bedrock. This is supported by the absence of elevated turbidity or iron in the neighbouring wells previously sampled under GEMTEC (2020), which further justifies that the elevated turbidity is not a long-term issue in the aquifer. The neighbouring well sampling program is discussed in more detail in Section 6.3.

6.3 Off-site Test Well Water Quality

Two groundwater samples (PW19-1 and PW19-2) were obtained from wells on private business properties in the area surrounding the Site during GEMTEC (2020). Samples were submitted to an analytical laboratory for analysis of parameters included in the Subdivision Package (bacteria and general inorganics). The sampling locations are shown in Figure 1, and the laboratory water quality and certificates of analysis are provided in Appendix L.

Based on analytical results from the off Site well samples, the following summary is presented:

- Sample PW2 had a total coliform count of 1, which exceeds the ODWS maximum acceptable concentration, but does not exceed the MECP D-5-5 guideline of 6 per 100 ml. The concentration of other bacteria indicator species, such as *E. coli* and fecal coliform, were non-detectable in both water samples.
- No other maximum acceptable concentration limits of the ODWQS were exceeded in the samples collected from the off-site private wells. This includes fluoride, nitrate and nitrite.
- No operational or aesthetic related exceedances of the ODWS were noted.

The groundwater quality in the off-site private wells is similar to that in PW1 and PW2 with elevated hardness and sodium (PW1 only).

6.4 Pumping Test Analysis

A summary of the pumping test analyses for the four pumping tests conducted on the test wells under GEMTEC (2023a) are presented in the following sections.

The current City of Ottawa Hydrogeological and Terrain Analysis Guidelines (2021) require eight-hour constant rate pumping tests completed in representative test wells to test for water quality which the GEMTEC (2023a) pumping tests are compliant with.

6.4.1 Pump Test Analysis Overview

Test well TW 1 was pumped at a constant rate of 21 L/min for 480 minutes. The drawdown in the pumped well increased to approximately 4.2 m following 30 minutes of pumping and the final drawdown was 5.0 m after 480 minutes of pumping. The water level in the test well recovered > 95% within 12 hours after the pump was shut off and was fully recovered when measured the next morning. The specific capacity of the well at the time of maximum drawdown was 4.2 L/min/m. During the pump test, the maximum drawdown noted in observation wells TW2 and TW3 was approximately 0.71, and 0.33 m, respectively. TW4 was pumped simultaneously at the same rate over approximately the same time interval, and displayed a maximum drawdown of 11.2 m.

Test well TW 2 was pumped at a constant rate of 28 L/min for 480 minutes. The drawdown in the pumped well increased to approximately 14.5 m following 30 minutes of pumping and increased to 18.3 m by the end of the test. The water level in the test well recovered > 95% approximately 12 hours after the pump was shut off. The specific capacity of the test well at the time of maximum drawdown was 1.1 L/min/m. During the pump test, the maximum drawdown noted in observation wells TW1 and TW3 was approximately 0.84 and 0.81 m, respectively.

Test well TW 3 was pumped at a constant rate of 21 L/min for 480 minutes. The drawdown in the pumped well increased to approximately 5.8 m following 30 minutes of pumping and increased to 7.5 m by the end of the test. The water level in the test well recovered > 95% within 12 hours of the pump was shut off. The specific capacity of the test well at the time of maximum drawdown was 2.8 L/min/m. During the pump test, the maximum drawdown noted in observation wells TW1 and TW2 was approximately 0.45 and 0.66 m, respectively.

Test well TW 4 was pumped at a constant rate of 21 L/min for 480 minutes. The drawdown in the pumped well increased to approximately 8.7 m following 30 minutes of pumping and increased to 11.2 m by the end of the test. The water level in the test well recovered > 95% within 2 hours after the pump was shut off. The specific capacity of the test well at the time of maximum drawdown was 1.9 L/min/m. A momentary decrease in flow rate occurred between approximately 82 minutes and 100 minutes, which is expected to be related to mechanical issues with the temporary pump and/or generator. The flow rate was increased back to the original flow rate of 21 L/min at 100 minutes. The pumping test length was increased by 100 minutes, as to complete an eight-hour constant rate test after the reduction in flow rate. During the pump test, the maximum drawdown

noted in observation wells TW2 and TW3 was approximately 0.73 and 0.40 meters respectively. TW4 was pumped simultaneously at the same rate over approximately the same time interval, and displayed a maximum drawdown of 5.0 m.

The drawdown and recovery water level data from the four pumping tests conducted on test wells TW1 to TW4 are provided in Appendix J. The details of the pumping tests carried out on the test wells are provided in Table 6.3. All depths provided are in metres below ground surface (mbgs).

Table 6.3 – Pumping Tests Details

Parameter	TW 1		TW 2		TW 3		TW 4	
	2020	2023	2020	2023	2020	2023	2020	2023
Duration (minutes)	360	480	360	480	360	480	360	480
Flow Rate (litres per minute)	19	21	19	28	19	21	19	21
Static Water Level (mbgs)	4.21	4.10	1.56	1.70	3.83	4.06	5.26	5.33
Well Depth (mbgs)	61	61	61	61	61	61	61	61
Available Drawdown (m)	49.8	50.0	52.4	52.3	50.2	49.9	48.7	48.7
Water Level at End of Pumping (mbgs)	8.41	9.04	7.69	20.38	10.62	11.57	15.62	16.19
Observed Drawdown at End of Pumping (m)	4.2	5.06	6.13	18.68	6.79	7.51	10.36	10.86
Drawdown Utilized (%)	8	10	12	36	14	15	21	22

Notes:
1. TOC = top of casing.
2. BGS = below ground surface.
3. Available drawdown assumes pump is set at the recommended pump depth of 57 metres and is measured from static water level to 3 meters above the pump.

Each test well was pumped at a flow rate of at least 21 litres per minute for 8 hours during the current investigations. The flow rate of 21 litres per minute and 10,000 litres over an eight-hour period is considered to be representative of the water usage expected for future commercial tenants. The current zoning of the Site is Rural Commercial, Subzone 9 (RC9). The permitted

uses of the Site should be consulted at Site Plan to confirm that the tested water quantity of approximately 10,000 litres per day is sufficient for the proposed Site/lot usage.

The maximum drawdown observed at the end of pumping was 18.68 metres in test well TW 2 which is equivalent to approximately 36% of the available drawdown in the test well, but the test well was pumped at a higher flow rate of 28 litres per minute compared to 21 litres per minute in the other test wells. The drawdown utilized in the remaining test wells ranged from 10 to 22%. Based on these results, all of the Site test wells are capable of supplying water at a rate greater than 21 litres per minute for a period greater than eight hours. The total volume pumped of approximately 10,100 litres from each test well.

To conservatively estimate the maximum daily water requirements, the maximum allowable septic flow for the Site (Lot 4, using assuming advanced treatment) can be multiplied by a factor of 1.5. As displayed during in Appendix H, the maximum allowable flow is 6,912 L/day for Lot 4, using an advanced treatment system, corresponding to a maximum water taking requirement of approximately 10,000 Litres per day (1.5 safety factor). As displayed during the eight-hour pumping tests, the test wells produced approximately 10,100 litres over an eight-hour period, and therefore supply sufficient water quantity for the proposed commercial development.

The pumping test results from GEMTEC (2020) are also provided in Table 6.4 and the following is noted:

- The results of the GEMTEC (2020) testing are generally comparable to the results of the GEMTEC (2023a) testing, with similar drawdowns observed in each test well. A slightly large percent of available drawdown was utilized during the GEMTEC (2023a) testing, but this can be attributed to the slightly higher pumping rates used, and the longer duration of pumping.
- TW 2 in GEMTEC (2023a) displayed a significantly higher percentage of drawdown utilized compared to the previous testing in GEMTEC (20230), which is a result of the higher pumping rate used in the current investigation (28 litres/min vs 19 litres/min).

6.4.2 Transmissivity Analysis

The transmissivity of the water supply aquifer was estimated by GEMTEC from the pump test drawdown data using Aqtesolv version 4.5, a commercially available software program from HydroSOLVE Inc.

An analysis of the pump test data was carried out using the drawdown in pumping well using the Papadopulos-Cooper method, which incorporates wellbore storage, and provided the most suitable match for the observation well drawdown curves. Aquifer parameters were calculated using water level data from the closest non-pumping test well (observation well).

The Theis Recovery Method was also used to analyze the water level recovery after the pump was shut off.

The results of the Aqtesolv 4.5 analysis are provided in Appendix J.

6.4.2.1 Pumping Test TW 1

Aquifer parameters were evaluated using drawdown and recovery data from the pumping well. Aquifer transmissivity of approximately 7 m^2/day was calculated using the recovery data. Using data from the pumping well and observation well TW2, the transmissivity was estimated to be 8 m^2/day and storage coefficient was 9 x 10^{-6}.

6.4.2.2 Pumping Test TW 2

Aquifer parameters were evaluated using drawdown and recovery data from the pumping well. Aquifer transmissivity of approximately 1 m^2/day was calculated using the recovery data. Using data from the pumping well and observation well TW1, the transmissivity was estimated to be 4 m^2/day and storage coefficient was 3 x 10^{-6}.

6.4.2.3 Pumping Test TW 3

Aquifer parameters were evaluated using drawdown and recovery data from the pumping well. Aquifer transmissivity of approximately 4 m^2/day was calculated using the recovery data. Using data from the pumping well and observation well TW2, the transmissivity was estimated to be 6 m^2/day and storage coefficient was 6 x 10^{-6}.

6.4.2.4 Pumping Test TW 4

Aquifer parameters were evaluated using drawdown and recovery data from the pumping well. Aquifer transmissivity of approximately 1 m^2/day was calculated using the recovery data. Using data from the pumping well and observation well TW2, the transmissivity was estimated to be 8 m^2/day and storage coefficient was 9 x 10^{-6}.

6.4.3 Unified Aquifer Parameters

The transmissivity estimate from the current study were tabulated and are summarized in Table 6.4, and the storage coefficients in Table 6.5. Based on the pumping test analyses, the mean transmissivity of the aquifer was calculated to be 5 m^2/day. The storage coefficient of the aquifer was calculated to be 7x10^{-6} using observation well drawdowns that were accurately represented by the model used in the analysis (Papadopulos-Cooper).

Table 6.4 – Summary of Transmissivity Parameters

Transmissivity – Drawdown					
Pumping Well		TW 1	TW 2	TW 3	TW 4
Observation Wells	TW1	-	4	-	-
	TW 2	8	-	6	-
	TW 3	-	-	-	8
	TW 4	-	-	-	-
Transmissivity – Recovery					
Pumping Well		TW 1	TW 2	TW 3	TW 4
Observation Wells	TW 1	7	-	-	-
	TW 2	-	1	-	-
	TW 3	-	-	4	-
	TW 4	-	-	-	1
Mean Transmissivity = 5 m^2/d					

Table 6.5 – Summary of Storage Coefficients

Storage Coefficient – Drawdown					
Pumping Well		TW 1	TW 2	TW 3	TW 4
Observation Wells	TW 1	-	$3x10^{-6}$	-	-
	TW 2	$9x10^{-6}$	-	$7x10^{-6}$	$9x10^{-6}$
	TW 3	-	-	-	-
	TW 4	-	-	-	-
Mean Storage Coefficient = $7x10^{-6}$					

6.5 Hydraulic Interference Effects

During the pumping of the on-site test wells, water level measurements were recorded at the remaining three bedrock observation wells using electric dataloggers, recording at 10-minute intervals (Appendix J). The change in water level measurements in bedrock monitoring wells (test wells not being pumped) during the pumping tests on TW1 to TW4 was less than 1 metre. The largest drawdown was 0.84 m, observed in TW1 during the pumping of TW2, which are separated by approximately 292 metres.

The 16-day water level monitoring program from September 6 to 21, 2023 was intended specifically to assess potential hydraulic interference between existing residential and commercial wells along Carp Road. This duration captures typical weekday and weekend pumping patterns

and is sufficient to evaluate whether any observable hydraulic connection or drawdown response occurs under normal operating conditions.

The results of the water level monitoring are provided in Appendix J. Aside from the minor drawdown observed during the test well pumping tests, water level fluctuations within each individual bedrock well were less than 0.2 metres during the monitoring period. No noticeable drawdown was observed in the wells related to well interference from off-site pumping, or precipitation events. TW4 is located within 100 meters of three commercial properties of similar size, and within an area of higher expected well density than the proposed commercial subdivision and did not display any evidence of drawdown related to well interference from neighbouring properties.

Water level monitoring was also completed in the overburden monitoring wells between September 6th and September 21st, 2023 (Appendix J). No drawdown in the overburden wells was observed during the bedrock pumping tests, which suggests that there is no hydraulic connection between the bedrock aquifer and the overburden aquifer. Therefore, no interference is expected with neighbouring overburden well users, if present.

Based on the minimal drawdown observed during the pumping test in the bedrock or observation wells during the pumping test and long-term monitoring, the absence of evidence of off-site pumping well interference, and the large lot sizes proposed for the commercial development (average lot size of approximately 1.95 hectares) and corresponding sparse supply well distribution, no well interference impacts to on-site or off-site wells are expected.

7.0 HYDROGEOLOGICAL CONCEPTUAL MODEL

7.1 Site Specific Geology

In general, the overburden thickness across most of the Site ranges from 6 to 8 metres, except near test pit TP18-14 where the test pit was terminated on inferred bedrock at a depth of 1.8 metres, and in the vicinity of test pits TP18-2 and TP18-3 where the overburden was 2.9 m and 2.4 m thick, respectively.

Water well records indicate sandstone with grey limestone bedrock at all test well locations. Based on the Ontario Geologic Survey (OGS) mapping, the bedrock is characterized as Simcoe Group limestone, dolostone, shale, and arkose sandstone of the Shadow Lake Formation. The site-specific geology findings are consistent with the findings of the available background information.

7.2 Hydrogeological Conceptual Model

The geologic framework for the hydrogeological conceptual model for the Site is summarized in Table 7.1 below.

A hydrogeological cross-section (Figure 7) for southwest to northeast alignment across the Site, was prepared based information from available geologic mapping, test pit investigations, on-site test wells, and select neighbouring water well records. Please note that the boundaries between zones indicated on the cross-section have been interpreted based on available information and may differ somewhat from that indicated.

Table 7.1 – Framework of Hydrogeological Conceptual Model

Stratigraphic Unit	Generalized Composition	Thickness (m)
Overburden	sand, silty sand, sandy silt	0.3 to 1.0 metres
	silt and clay / glacial till	0.35 to 8 metres
Bedrock	limestone / dolostone and sandstone	> 54 metres

The bedrock elevation at the test wells ranges from 105.2 to 109.1 metres Above Mean Sea Level (AMSL) and the base of the well casings range from 100.3 to 104.2 metres AMSL. The elevation of the water bearing zones (depth water found) ranges from 58.5 to 96.6 metres AMSL and the elevation of the bottom of test wells ranged from 51.8 to 58.8 metres AMSL.

Conceptual Lot Development Plan

A Conceptual Lot Development Plan (Figure 10) is presented to demonstrate that the proposed lots can be serviced with on-site well and septic meeting applicable setbacks. The well and septic locations shown are conceptual. Their general placement (e.g., front yard versus side yard) should be maintained to ensure that future systems do not conflict with those on neighbouring lots. If adjustments to well or septic locations are required at the Site Plan Control stage, a Qualified Professional should review the revised placements to confirm that they will not interfere with the future well and septic systems of adjacent properties.

8.0 WATER BALANCE

8.1 Water Balance Method

GEMTEC has calculated pre-development and post-development water budgets for the Site to assess the impact of the proposed development on groundwater recharge. The water balance of the Site was assessed using following equation:

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

where:

Mean annual precipitation is based on data provided by Environment Canada, from the Ottawa International weather station for the period of 1939-2020.

Long term changes to groundwater storage are assumed to be negligible. *Short term or seasonal changes to storage* are anticipated to balance out (e.g., increased groundwater recharge following spring freshet, followed by dry conditions in the summer months).

Evapotranspiration is calculated based on the Thornthwaite and Mather (1955) model, run by Environment Canada. The technical documentation provided by Environment Canada is titled "Water Balance Tabulations for Canadian Climate Stations", written by Johnstone and Louie, Hydrometeorology Division, Canadian Climate Centre, Atmospheric Environmental Services (undated).

The hydrologic factors used to estimate *infiltration*, such as topography, soil, cover and water holding capacities are based on the MECP Stormwater Management Planning and Design Manual Section 3.0 (MECP, 2003) and the Ministry of the Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (MOEE, 1995). The hydrologic factors are based on site-specific field conditions and have been divided into two distinct terrain units (Figure 6). The terrain units at the Site include:

- Terrain Unit 1: Fine Sandy Loam representative of Silty sand, sand and silt, glacial till (approximately 42% coverage)

- Terrain Unit 2: Clay Loam representative of Silty clay and clayey silt (approximately 58% coverage)

8.1.1 Pre-Development

Based on the Site terrain units and Site characteristics, the weighted average infiltration factor was estimated for each lot (Appendix M), based on the following information:

- Topography factor of 0.19 –Rolling land with an average slope between 2.8 m to 3.8m /km;
- Soil factors ranging from 0.15 to 0.30.
    - Fine Sandy loam = 0.30
    - Clay loam = 0.15
- Cover factor of 0.10 – Cultivated land; and
    - The Site consists of grasses and shrubs. Applies to all lots.
- Water holding capacity based on soil factor and cover factor:
    - Fine Sandy loam, pasture and shrubs: water holding capacity of 150 mm

- Water surplus = 342 mm/year

- Clay loam, pasture and shrubs: water holding capacity of 250 mm
  - Water surplus = 320 mm/year

The estimated soil water holding capacities were selected from Table 3.1 of the MECP Stormwater Management Planning and Design Manual (MECP, 2003) with the pasture and shrubs vegetation type.

8.1.2 Post-Development

The post-development conditions at the Site are expected to consist of commercial/industrial buildings, paved parking lots and landscaped lawns / vegetated areas. The maximum hard surface area per commercial/industrial lot will be variable and three scenarios are presented: 40%, 50%, and 60% hard surface coverage. Impervious surfaces consisting of buildings and paved or gravel parking areas, reducing the infiltration factor to 0.

The post-development water holding capacities are as follows:

- Fine Sandy loam, urban lawns/shallow rooted crops: water holding capacity of 75 mm
  - Water surplus = 383 mm/year
- Clay loam, urban lawns/shallow rooted crops: water holding capacity of 100 mm
  - Water surplus = 367 mm/year

Lots with different soil types (refer to Figure 6) have weighted average water surplus values (only applied to lots where there is notable differences in soil types, considering that the boundaries between the two geologic units are inferred). The surplus was provided by Environment Canada, from the Carleton place – Appleton weather station for the period of 1985-2020.

The post-development conditions and calculations are summarized in Appendix M.

8.1.3 Water Balance Summary

Based on the water balance calculations, the post-development infiltration on a per lot basis reduces by about 33 to 56% depending on the hard surface coverage, assuming 40 to 60% hard surface (refer to water balance calculations in Appendix M.

The western half of the Site is underlain by more permeable soils and capable of infiltration through implementation of Low Impact Development (LID) features. These soils are thought to provide important recharge to natural features and surficial and bedrock water supplies in the area. To maintain the high recharge along the Carp Road Corridor, consideration should be given to maintaining the pre-development infiltration rates for the Site post-development to maintain groundwater levels and protect groundwater users.

It should be noted that Lots 3, 6, 7, 8, 11 and 12 are located within mapped low permeability soils (refer to reclassified surficial geology Figure 6). As per Appendix 10 of the City of Ottawa Sewer Design Guidelines (City of Ottawa, 2025), LID features will not be permitted for lots underlain by clay and silt soils.

Table 8.1 below outlines the post-development infiltration targets for each lot, which is the additional infiltration required through Low Impact Development measures to maintain 85% groundwater recharge compared to pre-development conditions. The technical pre-consultation notes (Appendix B) provided by the City of Ottawa (email from Derek Kulyk) note that there may be a 15% reduction in the difference from pre to post development groundwater recharge.

Table 8.1 – Water Balance Targets

Lot ID	Variable Hard Surface Area	Infiltration Targets[1] (mm/year)		
		40% Hard Surface Area	50% Hard Surface Area	60% Hard Surface Area
1	-	60	98	135
2	-	49	81	114
3[(2)]	-	38	65	92
4 - SWMP	-12[3]	-	-	-
5	0[(4)]	-	-	-
6[(2)]	-	38	65	92
7[(2)]	-	38	65	92
8[(2)]	-	38	65	92
9	-	49	81	114
10	-	60	98	135
11[(2)]	-	38	62	92
12[(2)]	-	38	62	92
13	-	49	81	114
14	-	60	98	135

Lot ID	Variable Hard Surface Area	Infiltration Targets[1] (mm/year)		
		40% Hard Surface Area	50% Hard Surface Area	60% Hard Surface Area
Street A	92	-	-	-

Notes:.
1. Infiltration targets required post-development to maintain 85% pre-development recharge.
2. Lots primarily underlain by low permeability soils that are not suitable for implementation of LID features as per City of Ottawa Sewer Design Guidelines – Appendix 10.
3. Assumes 20% hard surface area for the SWMP area to account for roadways. Post-development infiltration targets negative as the increased post-development water surplus (change from pasture shrubs to urban lawns) sufficiently increases the overall groundwater recharge more than the 20% increased infiltration reduction.
4. Block 5 assumes 0% hard surface area.
5. Street A right of way assumes 50% hard surface area.

9.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydrogeological investigation, the following conclusions and professional opinions are provided:

- The Site geology consists of fine and coarse grained glaciomarine deposits overlying the proposed bedrock water supply aquifer.
  - The overburden at the Site consists of sand, silty sand and sandy silt (0.25 to 3.4 metres thick) and silty clay (0.35 to 3.8 metres thick), underlain by glacial till (1.0 to 9.2 metres thick). The Site overburden thickness ranges from approximately 1.8 to 9.2 metres.
  - Based on the top 1 metre of overburden, three distinct terrain units are present across the Site: 1) sand, 2) silty sand to sandy silt, till and 3) sandy clayey silt.
  - The bedrock water supply aquifer is characterized as Paleozoic bedrock consisting of Shadow Lake Formation limestone, dolostone, shale, and arkose sandstone of the Simcoe Group.
- Fine grained soils ranging in thickness from approximately 1.8 to 9.2 meters, with soils thicknesses thinning towards the southeast of the Site, and Lot 7. Karst was not identified on the Site.
  - The soil conditions encountered at TP18-14 (i.e., Lot 7) is considered to be hydrogeologically sensitive due to thin soil cover to bedrock. Hydrogeological investigations in support of Site Plan Control for Lot 7 should consider the hydrogeological sensitivity with regards to well and septic placements. Given the large lot size, future well and septic systems should not be located in areas of thin soils and/or

additional protective measures should be considered (e.g., increased casing depth, increased separation distance between well and septic, etc.).

- Negative impacts to the bedrock aquifer are not anticipated. The nitrate dilution predictive assessment for industrial/commercial developments, as outlined in MECP Guideline D-5-4 guidelines demonstrates that the Site can support the proposed lot density.
  - The maximum allowable daily design sanitary sewage flow (DDSF) for the proposed commercial lots range from 531 L/day to 2,455 L/day for conventional systems, and 1,593 L/day to 7,366 L/day for advanced systems assuming 40% hard surface coverage. Refer to Appendix H for additional maximum septic flow scenarios based on 50 and 60% hard surface coverage.
  - With the use of best management practices and the recommended protective measures, the impact to the receiving aquifer will be mitigated.
- The test well construction is typical of future water supply wells in the development.
  - Well casing installed a minimum of 4.57 metres (15 feet) into competent bedrock.
  - Maximum recommended depth of 61 metres below ground surface.
  - Hydro-fracking to increase well yield.
- The water quality available from drilled wells on the Site is safe for consumption based on the absence of health-related exceedances. To note, total coliform exceeded the ODWQS in TW2 with a concentration of 1 count per 100mL; however, the total coliform counts of less than 6 CFU/100mL in all test wells meets MECP Guideline D-5-5 for acceptable drinking water quality. The quality of the groundwater meets the Ontario Drinking Water Quality Standards, Guidelines and Objectives with the exception of hardness, sodium, and sulphide.
  - The levels of hardness are considered to be reasonably treatable using a conventional water softener.
  - The levels of sodium remain well below the 200 mg/L aesthetic objective; however, three of the four test wells exceed the 20 mg/L warning limit for persons on sodium restricted diets.
  - The levels of hydrogen sulphide exceed the ODWS aesthetic objective of 0.05 mg/L. An unofficial addendum to MECP Guideline D-5-5 (July 6, 1995) indicates that sulphide concentrations of up to 2.5 mg/L can be reasonably treated with manganese greensand filters.
  - The water quality results from the previous investigations (GEMTEC, 2020) reported similar groundwater quality with slightly elevated hardness and hydrogen sulphide.

- The water quality from neighbouring private wells (PW1 and PW2) are similar to the water quality found in the proposed subdivision. The ODWQS exceedances in PW1 and PW2 include operational guideline of hardness (PW1 and PW2), maximum acceptable concentration of total coliform (PW2), which is less than 6 CFU/100mL and meets MECP Guideline D-5-5 for acceptable drinking water quality and the warning level for persons on sodium restricted diets (PW1).
- No negative water quality impacts from neighbouring properties have been identified.
    - Potential sources of groundwater contamination from neighbouring cemeteries are associated with toxic chemicals from coffins, embalming fluids and dental fillings. Trace metals associated with cemeteries include manganese, nickel, copper, vanadium, mercury, arsenic, barium, lead, cadmium and chromium. The trace metals tested from TW2 and TW4 reported non-detectable concentrations or concentrations well below the applicable maximum acceptable concentration, aesthetic objective or operational guideline.
        - 3149 Carp Road – approx. 0.66-hectare parcel located upgradient to groundwater flow; and
        - 2037 McGee Side Road – approx. 45-hectare parcel (current cemetery footprint of approx. 17.5 hectares currently) and located cross-gradient to groundwater flow.
- The water quality determined in the course of this investigation is representative of long-term water quality from which future lot owners are likely to obtain from their wells constructed in accordance with the well construction recommendations.
- The quantity of groundwater available from the proposed water supply aquifer is more than sufficient for the proposed development and will sustain repeated pumping at the test rate and duration at 24-hour intervals over the long term. The well yields determined in the course of this investigation are representative of the long-term yields which future lot owners are likely to obtain from their wells constructed in accordance with the well construction recommendations.
- Additional water quantity testing is recommended should future lot owners require groundwater in excess of the maximum allowable septic flows (e.g., processing waters).
    - The current zoning of the Site is Rural Commercial, Subzone 9 (RC9). The permitted uses of the Site should be consulted at Site Plan to confirm that the tested water quantity of approximately 10,000 litres per day is sufficient for the proposed Site usage.
    - Potential Site usages that may require additional water quantity testing include: car wash, hotel, campground, etc.

- Interference between drinking water wells is expected to be acceptable under typical usage for commercial/industrial developments.
    - No significant drawdown was observed in the bedrock monitoring wells during the individual pumping tests, or the muti well pumping test (pumping TW1 and TW4 simultaneously), with a maximum observed drawdown of 0.84 metres in the bedrock monitoring wells.
    - Long term water level monitoring in the bedrock test wells reported drawdown of less than 0.2 metres over a two-week period. Negligible drawdown related to off-site pumping or precipitation events was observed.
    - Background studies along Carp Road that were reviewed as part of the investigation (CoO, 2004 & Dillon, 2004) do not indicate water quantity concerns in the area.
- Based on the water balance calculations, the percentage decrease in infiltration will decrease by approximately 67% % from pre- to post-development conditions on the proposed severance lot, depending on the hard surface coverage after development.
    - Consideration should be given to maintaining the pre-development infiltration volumes for each lot post-development to sustain groundwater levels and protect groundwater users. This can be supported through the placement through the use of Low Impact Development (LID) measures.

10.0 RECOMMENDATIONS

The following provides general recommendations and recommendations regarding well construction specifications, water quality and septic system design:

10.1 General Recommendations

The accepted GEMTEC hydrogeological report entitled “Hydrogeological Assessment and Terrain Analysis, Proposed Commercial/Industrial Subdivision, 3112 Carp Road, Township of Huntley, Ottawa, Ontario”, dated March 26, 2026 shall be made available to lot purchasers as a guide to development.

The well and septic locations shown are conceptual – refer to Figure 10. Their general placement (e.g., front yard versus side yard) should be maintained to ensure that future systems do not conflict with those on neighbouring lots. If adjustments to well or septic locations are required at the Site Plan Control stage, a Qualified Professional should review the revised placements to confirm that they will not interfere with the future well and septic systems of adjacent properties.

10.2 Groundwater Impact Mitigation Recommendations

- Low Impact Development (LID) and stormwater management measures are recommended to maintain at least 85% of pre-development infiltration rates for lots underlain by permeable soils. The infiltration targets for individual lots are provided in Table 8.1.
    - It is noted that Appendix 10 of the City of Ottawa Sewer Design Guidelines (December 2025) do not permit LID features in silt and clay soils, which applies to Lots 3, 6, 7, 8, 11 and 12. Groundwater recharge should be maintained in lots underlain by more preamble soils, being Lots 1, 2, 9, 10, 13 and 14.
- The post-development water balance indicates significant increase in runoff, which will need to be addressed as part of the stormwater for the Site. Potential impacts from the runoff from a contaminant perspective include winter maintenance (road salting) and fuel spills from potential fuel storage / parking lots. It is recommended that BMP for road salting and fuel storage/spills be followed.
    - It is recommended that the best management practices for the application of road salts should follow the City of Ottawa's "Material Application Policy, Revision 3.2, October 31, 2011" Salt Management Plan.
    - It is recommended that the best management practices for fuel storage follow the Liquid Fuels Handling Code and the Ontario Water Resources Act.

10.3 Well Construction Recommendations

- Any original test wells which are not located in suitable locations for future development use and any other existing wells located on the property should be abandoned by a licensed well driller in accordance with MECP regulations following draft plan approval of the subdivision;.
- Wells should be located so that they meet the minimum setback distances from septic systems, property lines and any other sources of contamination, as required in the Ontario Building Code and/or Ontario Reg. 903. If possible, the setback distance for the location of drinking water wells should be maximized.
- All wells shall remain accessible for future inspection and testing and to large equipment for future maintenance, repair, and replacement.
- All wells that are drilled in the subdivision should be constructed in accordance with MECP regulations (Ontario Reg. 903).
- All wells that are drilled in the subdivision should be maintained in accordance with the document entitled 'Water Supply Wells – Requirements and Best Management Practices' (MECP December 2009).

- Well casings should be extended at least 11.6 metres below ground surface. The entire annular space between the steel casing and the overburden/bedrock should be filled with a suitable cement or bentonite grout.
    - In addition to the minimum recommended well casing lengths specified in the preceding recommendation, all well casings should be completed a minimum of 4.57 metres into sound, competent bedrock.
- A well grouting certification inspection should be conducted during the installation and grouting of the well casing for all future wells installed on the Site. The well grouting certification inspection should be conducted under the supervision of a professional engineer or professional geoscientist.
- Hydrofracturing of all four on-site test wells was required to obtain the minimum pumping requirements of MECP Guideline D-5-5. Future lot owners should be aware that additional well development such as hydrofracturing, surging and/or additional pumping may be required to reach the well yields demonstrated in this report.
    - Muti-day well development may be required to reduce turbidity levels in newly drilled wells on the Site. If a newly drilled well is required at the time of Site Plan Control for the Site, a qualified professional should be retained to confirm that turbidity levels are at acceptable levels after well development.
- The test wells completed for this study were completed at depths of 61 metres below ground surface. Future drinking water wells completed on the Site at depths greater than 61 metres may encounter different hydrogeological conditions and the quality and quantity of water available from drilled wells may differ than that presented in this study.

10.4 Septic System Recommendations

- The proposed lots will be serviced by either conventional or advanced treatment septic sewage disposal systems that achieve a minimum of 50% reduction in nitrogen, approved under the Ontario Building Code, prior to the effluent being disposed to a Class IV leaching bed (Type A or Type B). A site-specific investigation should be conducted on each lot for the design of the septic system.
    - It is required that the property owners enter a maintenance agreement with authorized agents of the advanced treatment septic system manufacturer for the service life of the system.
    - If advanced treatment systems are utilized, the City of Ottawa requires that they be NSF/ANSI 245 and/or CAN/BNQ 3680-600 certified. For 50% nitrate reduction.
- In view of the percolation time of the native soils, a sand mantle and partially to fully raised leaching beds should be allowed for on some the proposed lots. The suitability of the native soils should be assessed on a lot-by-lot basis by a qualified septic designer.

- It should be noted that when determining hard surface coverage for the future lots, that gravel surfaces are included. Gravel surfaces are considered impermeable, as they are likely to be compacted over time.
- The maximum allowable daily design sanitary sewage flow (DDSF) for the proposed commercial lots ranges depends on the total hard surface coverage and type of septic system (conventional vs advanced treatment). Refer to Appendix H for the individual lot maximum septic flows based on the hard surface coverage.
    - If during Site Plan Control the proposed septic system design flow exceeds the preliminary septic flow recommendation for a specific lot, then it is recommended that a detailed groundwater impact assessment be conducted. If the detailed groundwater impact assessment demonstrates that additional septic flow can be accommodated on the lot, then the preliminary septic flow recommendation for that lot should be amended accordingly.
    - If the proposed septic flow for a site development application is less than the preliminary septic flow recommendation, then no additional groundwater impact assessment work is required for that lot.

10.5 Drinking Water Supply Recommendations

- It is recommended that the following information be registered on title for the created lots:
    - Background sodium levels in the drinking water wells at the Site may exceed the warning level for persons on sodium restricted diets and should be reported to the Local Medical Officer of Health;
    - The following water quality parameters may not meet the ODWS operational guidelines in drinking water wells completed at the Site:
        - Hardness – Hardness levels in the on-site test wells were greater than the operational guideline for hardness and can be expected in future wells drilled at the property.
    - The following water quality parameters may not meet the ODWQS aesthetic objectives in drinking water wells completed at the Site:
        - Sulphide – Sulphide levels in all four of the on-site test wells exceeded the ODWQS aesthetic objective for sulphide and may be encountered in future wells drilled on the subject site. Although ingestion of large quantities of sulphide can produce toxic effects on humans, it is unlikely that an individual would consume a harmful dose in drinking water because of the associated unpleasant taste and odour. Sulfide, in association with iron, produces black stains on laundered items and black deposits on pipes and fixtures. Hydrogen sulphide can be effectively treated through the use of activated charcoal filters, chlorination, manganese greensand filters and other forms of oxidizing treatment. It is recommended that a water quality treatment specialist be retained to appropriate design and size the treatment systems.

- The maximum groundwater quantity per lot tested as part of this investigation is 10,080 litres per day. Additional pumping tests and well interference assessments are recommended for higher groundwater demands.

11.0 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.





Andrius Paznekas, M.Sc., P.Geo.
Hydrogeologist

SE/DC/BR/JKA/AP

12.0 REFERENCES

- Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219

- Brunton, F.R. and Dodge, J.E.P. 2008. Karst of southern Ontario and Manitoulin Island; Ontario Geological Survey, Groundwater Resources Study 5.

- City of Ottawa (2025). Appendix 10 Technical Bulletin IWSTB-2024-04, Screening Criteria – Infiltration Type LIDs for Development, September 12th, 2024. Ottawa Sewer Design Guidelines, December 2025.

- Cuddy, S., Chan, G.S., and Post, R. 2013. Hydrogeological Assessment Submissions, Conservation Authority Guidelines for Development Applications. Lake Simcoe Region Conservation Authority.

- Credit Valley Conservation Authority. 2011. Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0, 2011.

- Ministry of Environment, Conservation and Parks. 2011. Soil, Ground Water and Sediment Standards for Use Under XV.1. of the Environmental Protection Act. PIBS # 7382e01 dated April 15, 2011.

- Ontario Geological Survey. 2010. Surficial geology of Southern Ontario. Ontario Geological Survey, Miscellaneous Release-Data 128-Revision 1.

- Ontario Geological Survey. 2011. 1:250 000 scale bedrock geology of Ontario. Ontario Geological Survey, Miscellaneous Release-Data 126-Revision 1.

- Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.

- Ontario Ministry of Municipal Affairs and Housing, Building and Development Branch. 2006. Building Code Compendium. December 31, 2006.

- Ontario Ministry of the Environment, Conservation and Parks. 1982. Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems. May 1982.

- Ontario Ministry of the Environment, Conservation and Parks. 1996. Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment.

- Ontario Ministry of the Environment, Conservation and Parks. 1996. Procedure D-5-4, Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment.

- Ontario Ministry of the Environment, Conservation and Parks. 2008. Ontario Drinking Water Quality Standards, Safe Drinking Water Act, 2002, Ontario Regulation 169/03 as amended by Ontario Regulation 327/08.

- Ontario Ministry of Environment, Conservation and Parks. 2006. Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines.

- Ontario Ministry of the Environment, Conservation and Parks. 1995. MOEE Hydrogeological Technical Requirements for Land Development Applications.

CONDITIONS AND LIMITATIONS OF THIS REPORT

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

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

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

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

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

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

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

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

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

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

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

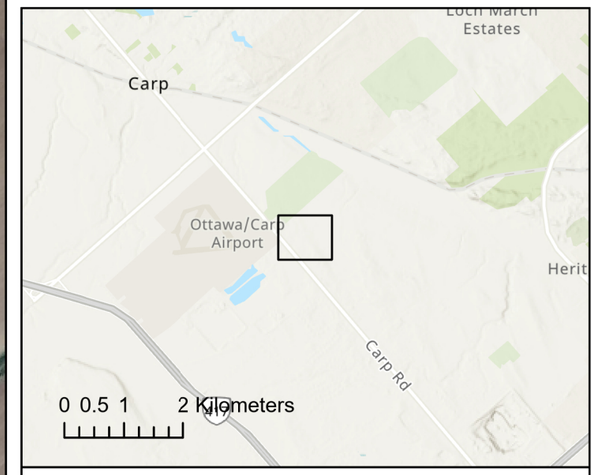
14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically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



Legend

BH/MW # ← BOREHOLE / MONITORING WELL ID
XX.XX ← GROUND SURFACE ELEVATION, IN METERS
GEODETIC DATUM

- Borehole Location (current investigation)
- Test Pit Location (previous investigation by GEMTEC)
- Borehole/ Test Well Location (previous investigation by GEMTEC)
- Approximate Property Boundary
- Lot Line



Scale
1:3,000
40 20 0 40 80 120 160 m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client:	Project No.:
TLC Holdings LTD.	102151.001

Project
Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By:	Chkd By:	
S.L.	A.P.	Detailed Site Plan

Date: March 2026	Rev.	
© King's Printer for Ontario	0	Figure: 1

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Google Earth: © OpenStreetMap (and) contributors, CC-BY-SA



Legend

- Proposed Severance
- Retained Lands
- 500m Buffer from Site Boundary
- Wetland
- Ground Surface Elevation, metres
- MECP Well
- Private Wells Sampled (previous investigation by GEMTEC, 2019)

Scale 1:7,000

90 45 0 90 180 270 360 m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client: TLC Holdings LTD.

Project No.: 102151.001

Project: Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By: C.Z.

Chkd By: B.R.

Natural Features

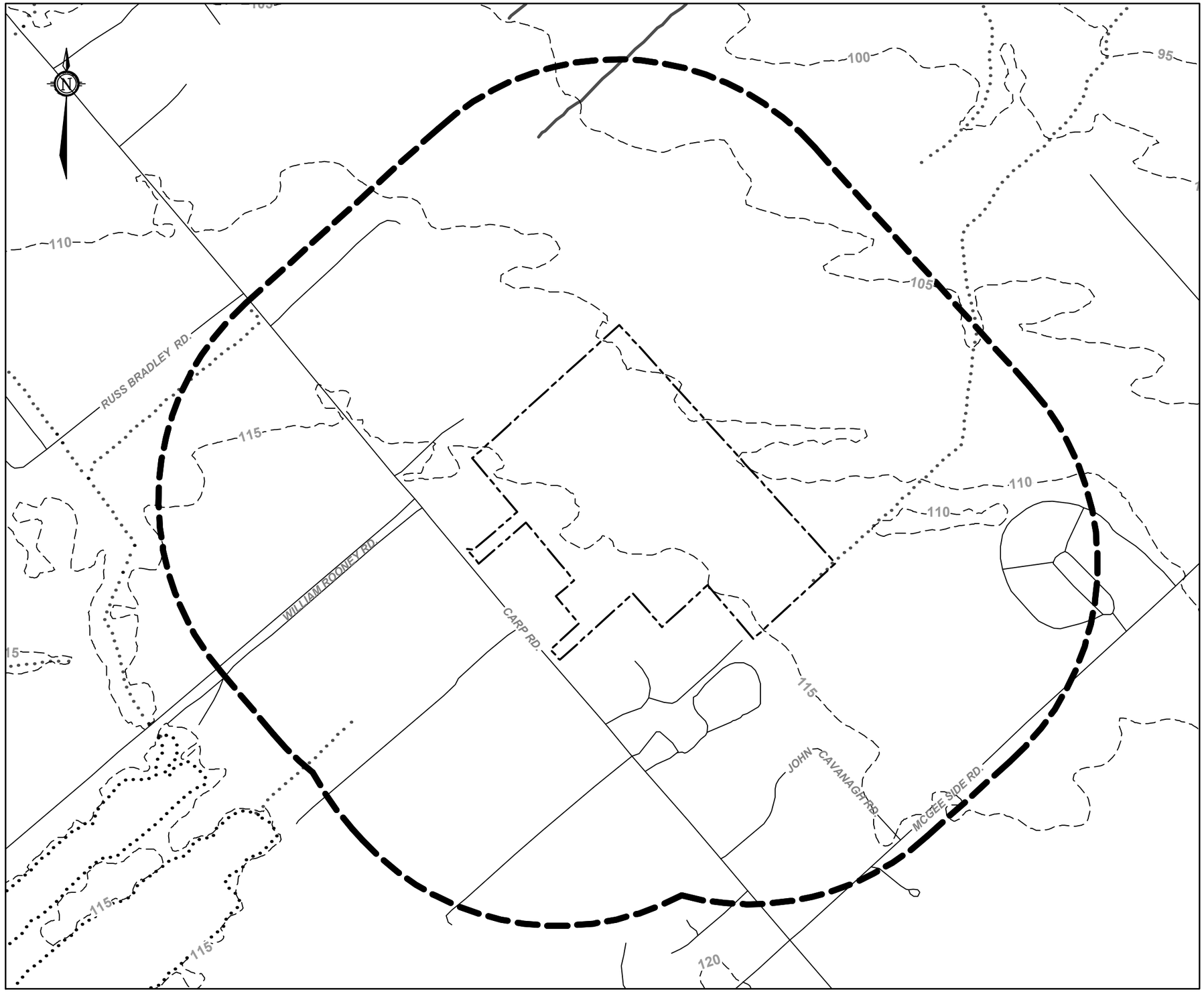
Date: March 2026

Rev. 0

Figure: 2

© King's Printer for Ontario

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Google Earth: © OpenStreetMap (and) contributors, CC-BY-SA



Legend

- Subject Site
- Study Area
  500m around Subject Site
- Contour Interval, in metres (100)
- Waterbodies

Scale 1:7500

0 150 300 450m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

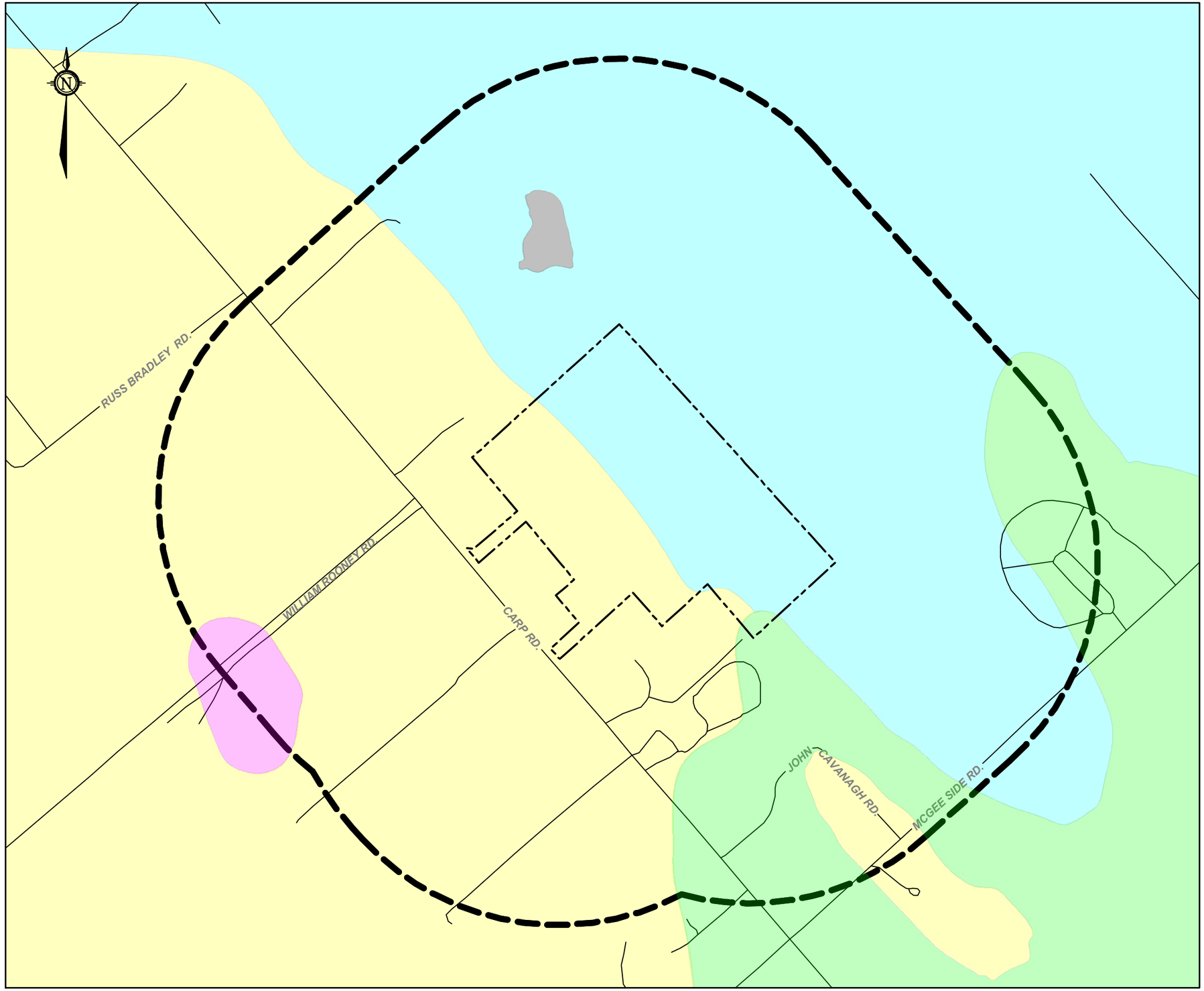
Client:	Project No.:
TLC Holdings LTD.	102151.001

Project
Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By:	Chkd By:	
C.Z./S.L.	B.R.	Topography and Drainage

Date: August 2024	Rev.	Figure: 3
© King's Printer for Ontario	0	

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada



Legend

- Subject Site
- Study Area
  500m around Subject Site
- Fine-Textured Glaciomarine Deposits
- Course-Textured Glaciomarine Deposits
- Till
- Organic Deposits
- Paleozoic Bedrock

Scale 1:7500

0 150 300 450m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client: TLC Holdings LTD.

Project No.: 102151.001

Project: Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By: C.Z./S.L.

Chkd By: B.R.

Mapped Surficial Geology

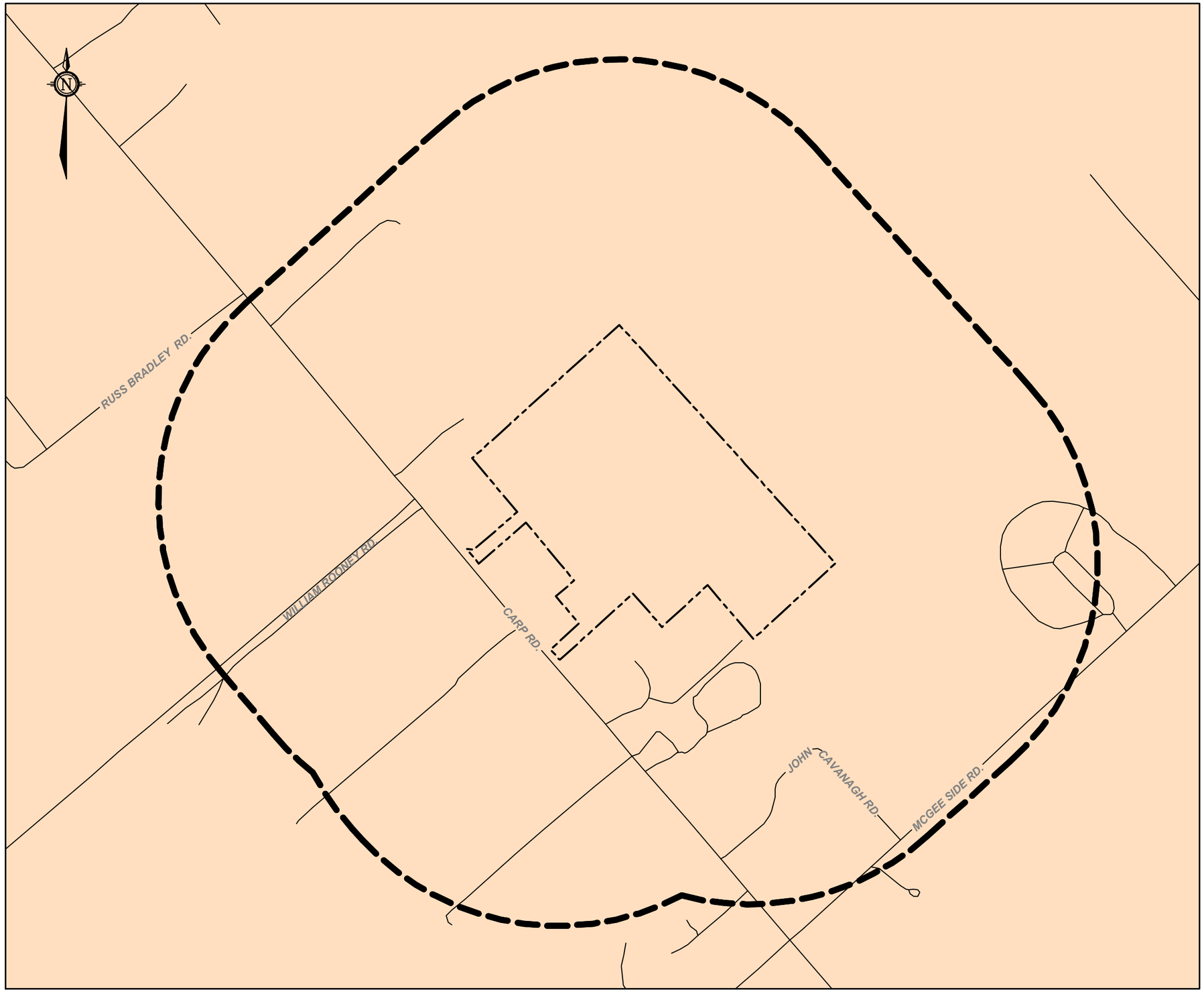
Date: August 2024

© King's Printer for Ontario

Rev. 0

Figure: 4

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada



Legend

- Subject Site
- Study Area
  500m around Subject Site
- Limestone, dolostone, shale, arkose, sandstone
  (Ottawa Group; Simcoe Group; Shallow Lake Formation)

Scale 1:7500

0 150 300 450m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client: TLC Holdings LTD.

Project No.: 102151.001

Project: Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By: C.Z./S.L.

Chkd By: B.R.

Mapped Bedrock Geology

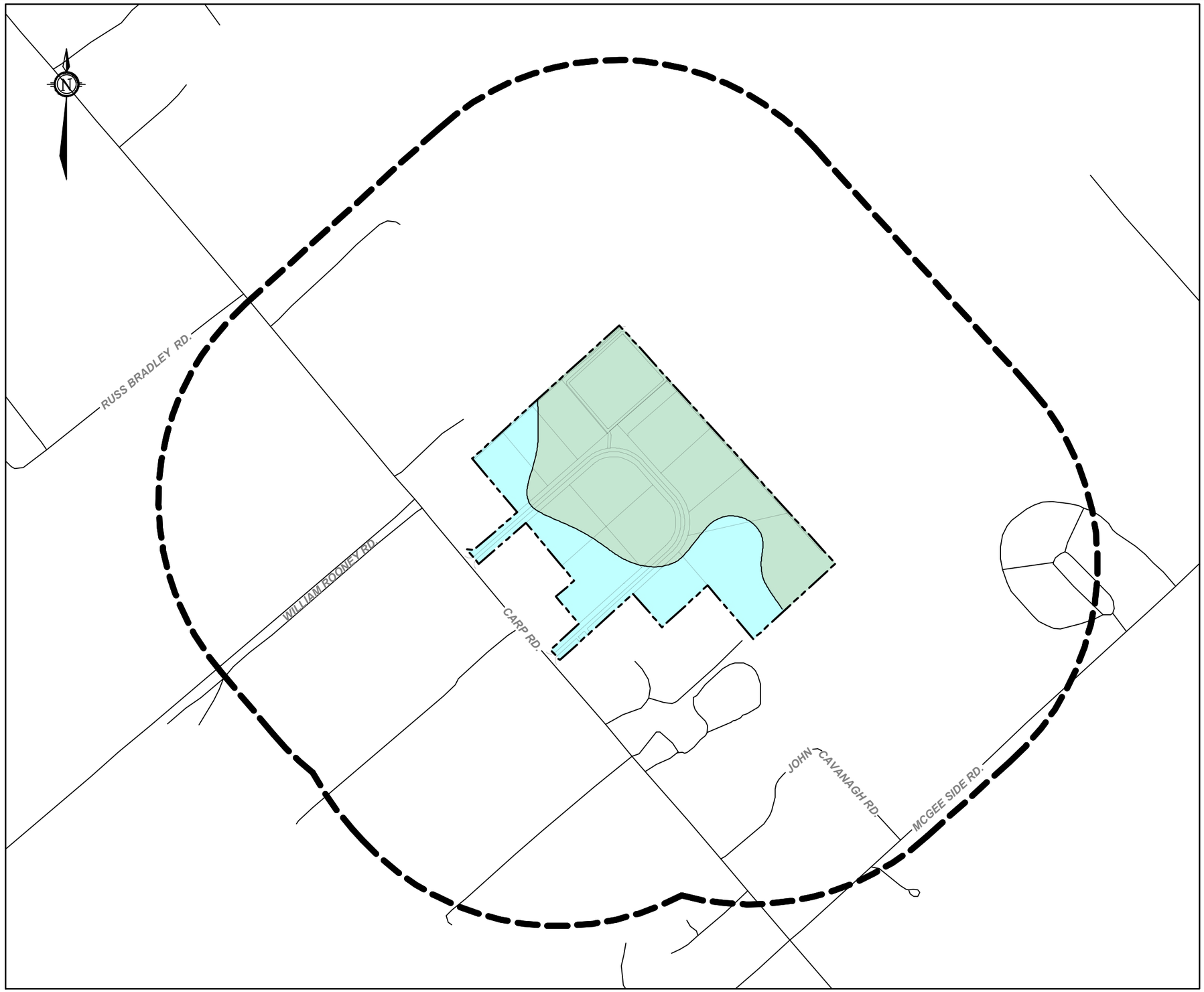
Date: August 2024

© King's Printer for Ontario

Rev. 0

Figure: 5

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada



Legend

- Subject Site
- Study Area
  500m around Subject Site
- Lot Line
- Silty Sand, Sand and Silt, Till
- Silty Clay, Clayey Silt

Scale 1:7500

0 150 300 450m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client: TLC Holdings LTD.

Project No.: 102151.001

Project
Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By: C.Z./S.L.

Chkd By: B.R.

Inferred Surficial Geology

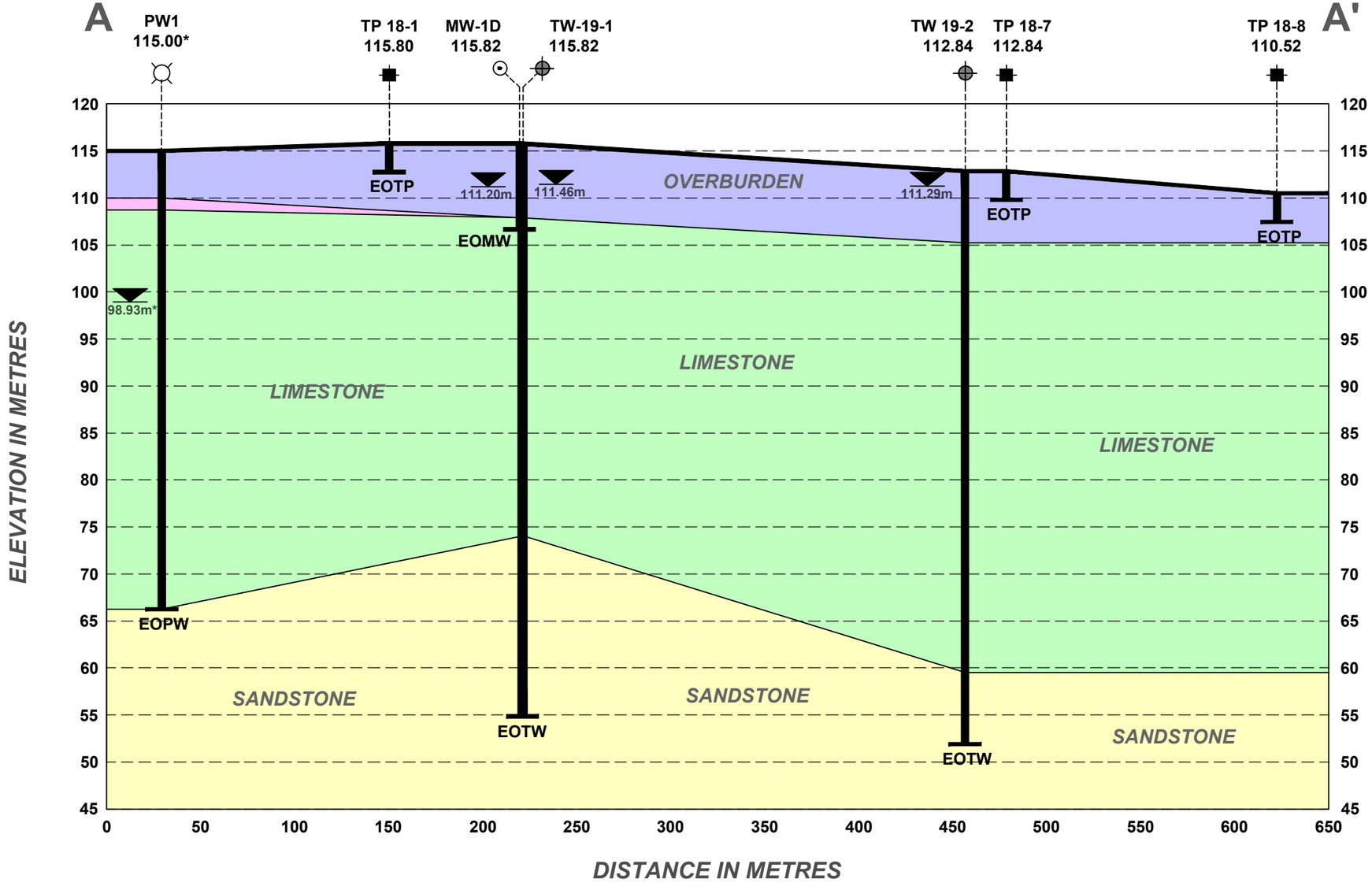
Date: March 2026

© King's Printer for Ontario

Rev. 0

Figure: 6

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada



Legend

- Overburden
- Limestone
- Shale
- Sandstone

EOPW	End of Private Well
EOTP	End of Test Pit
EOTW	End of Test Well
EOMW	End of Monitoring Well

100.00m — Static Water Elevations, in metres (Measured January 10, 2020)

* Elevation is approximate based on the available topographic information.



Horizontal Scale
1:2500
0 50 100 150m

Vertical Scale
1:500
0 10 20 30m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client: TLC Holdings LTD.

Project No.: 102151.001

Project: Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By: C.Z./S.L.

Chkd By: B.R.

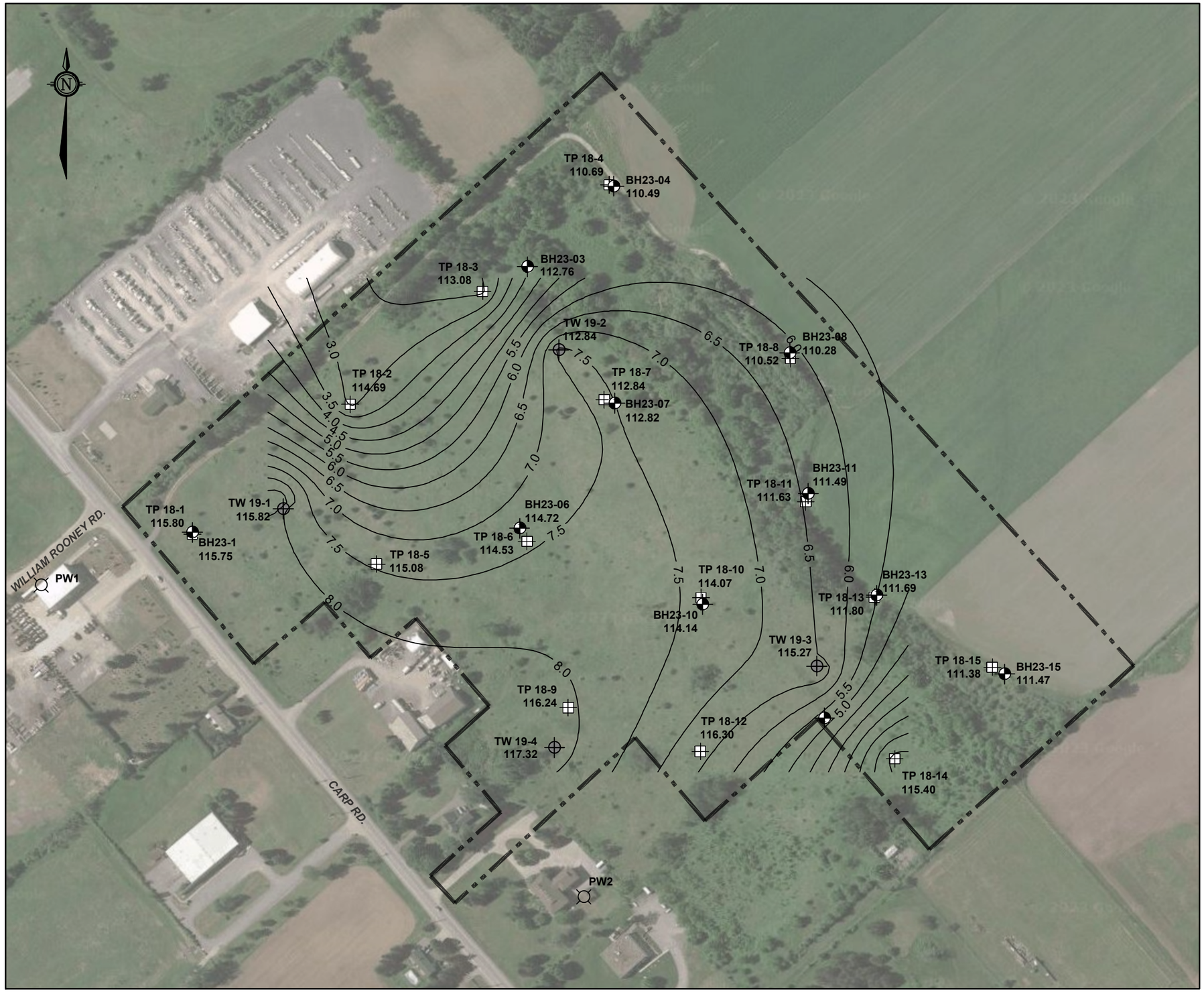
Cross Section A-A'

Date: August 2024

© King's Printer for Ontario

Rev. 0

Figure: 7



Legend

- Subject Site
- Study Area
  500m around Subject Site
- 4.0 Overburden thickness contours in metres
- **Borehole Location**
  (current investigation by GEMTEC)
- **Test Pit Location**
  (previous investigation by GEMTEC)
- **Borehole/ Test Well Location**
  (previous investigation by GEMTEC)
- **Private Well Location**
  (approx.)
- XXX ← ID
- XX.XX ← Ground Surface Elevation, in metres
  Geodetic Datum

Scale 1:7500

0 150 300 450m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client:	Project No.:
TLC Holdings LTD.	102151.001

Project
Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By:	Chkd By:	
C.Z./S.L.	B.R.	Overburden Thickness Map

Date: August 2024	Rev.	
© King's Printer for Ontario	0	Figure: 8

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada



Legend

- Subject Site
- Study Area
  500m around Subject Site
- 4.0 Well Interference Contours in metres

Scale 1:7500

0 150 300 450m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client:	Project No.:
TLC Holdings LTD.	102151.001

Project
Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By:	Chkd By:	
C.Z./S.L.	B.R.	Well Interference Groundwater Contours

Date: August 2024

© King's Printer for Ontario

Rev. 0

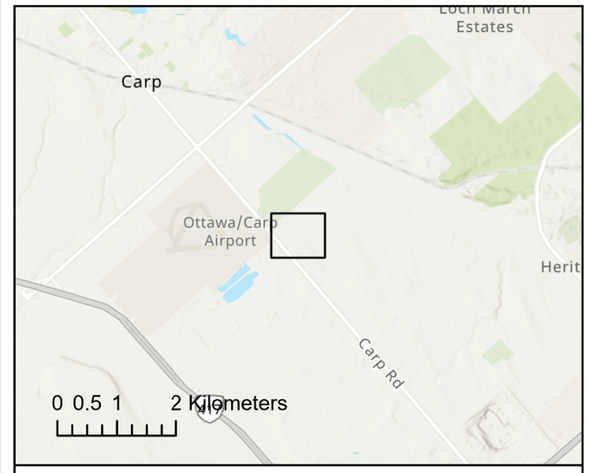
Figure: 9

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada



Legend

- Conceptual Well Location
- Lot Line
- Approximate Property Boundary
- Septic System (30m X 25m)
- 18m Buffer



Scale
1:3,000
40 20 0 40 80 120 160 m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive,
Ottawa, ON K2K 2A9
T: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client:	Project No.:
TLC Holdings LTD.	102151.001

Project
Hydrogeological Investigation & Terrain Analysis
3112 Carp Rd, Ottawa, ON

Drwn By:	Chkd By:	Conceptual Lot Development Plan
S.L.	A.P.	

Date: March 2026	Rev.	Figure: 10
© King's Printer for Ontario	0	

Coordinate System: NAD 1983 UTM Zone 18N
Service Layer Credits: Hybrid Reference Layer: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Google Earth: © OpenStreetMap (and) contributors, CC-BY-SA

APPENDIX A

Development Plan

DRAFT PLAN OF SUBDIVISION

PART OF LOTS 11 AND 12
CONCESSION 2
GEOGRAPHIC TOWNSHIP OF HUNTLEY
CITY OF OTTAWA

BLOCKS 1–3 and 6–14 for commercial/industrial use
BLOCK 4 for stormwater management
BLOCK 5 for other
STREET A – 26 metres wide

APPLICANT AND PROPERTY OWNER

T & L CARROLL HOLDINGS INC.
1380 HOWE ROAD
CARP, ON, K0A 1L0

I HEREBY AUTHORIZE THE PREPARATION AND SUBMISSION OF THIS PLAN TO THE COUNCIL OF THE CITY OF OTTAWA.

DATED ON NOVEMBER 25, 2025.

T & L CARROLL HOLDINGS INC.
I HAVE THE AUTHORITY TO BIND THIS CORPORATION

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AS SHOWN ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJOINING LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

NOVEMBER 25, 2025
DATE — JOHN GAUTHIER, ONTARIO LAND SURVEYOR

SUBJECT TO THE CONDITIONS, IF ANY, SET FORTH IN OUR LETTER DATED _____. THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT THIS ____ DAY OF _____, 20____

ADAM BROWN, MANAGER
DEVELOPMENT REVIEW–RURAL
PLANNING, DEVELOPMENT AND BUILDING SERVICES
DEPARTMENT, CITY OF OTTAWA

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 (17) OF THE PLANNING ACT

A. AS SHOWN ON DRAFT PLAN
B. AS SHOWN ON DRAFT PLAN
C. AS SHOWN ON DRAFT PLAN
D. AS DESCRIBED ON THE TITLE BLOCK
E. AS SHOWN ON DRAFT PLAN
F. AS SHOWN ON DRAFT PLAN
F.1 NOT APPLICABLE
G. AS SHOWN ON DRAFT PLAN
H. INDIVIDUAL PRIVATE WELLS
I. REFER TO SOILS REPORT
J. AS SHOWN ON DRAFT PLAN
K. INDIVIDUAL PRIVATE SEPTIC SYSTEMS
L. AS SHOWN ON DRAFT PLAN

SCHEDULE OF AREAS

LOT/BLOCK	AREA (Ha)	TYPE
BLOCK 1	1.00	COMMERCIAL/INDUSTRIAL USE
BLOCK 2	1.00	COMMERCIAL/INDUSTRIAL USE
BLOCK 3	1.00	COMMERCIAL/INDUSTRIAL USE
BLOCK 4	2.08	STORMWATER MANAGEMENT
BLOCK 5	0.33	OTHER
BLOCK 6	1.22	COMMERCIAL/INDUSTRIAL USE
BLOCK 7	1.20	COMMERCIAL/INDUSTRIAL USE
BLOCK 8	1.26	COMMERCIAL/INDUSTRIAL USE
BLOCK 9	3.83	COMMERCIAL/INDUSTRIAL USE
BLOCK 10	0.96	COMMERCIAL/INDUSTRIAL USE
BLOCK 11	1.14	COMMERCIAL/INDUSTRIAL USE
BLOCK 12	1.14	COMMERCIAL/INDUSTRIAL USE
BLOCK 13	1.15	COMMERCIAL/INDUSTRIAL USE
BLOCK 14	1.46	COMMERCIAL/INDUSTRIAL USE
TOTAL LOT/BLOCK AREA (Ha)		**18.78**

STREET	AREA (Ha)	LENGTH (m)
STREET A	2.47	918.97
TOTAL SUBDIVISION AREA (Ha)		**21.25**

LEGEND:

B	DENOTES	BELL UTILITY POLE
H	DENOTES	HYDRO UTILITY POLE
B&H	DENOTES	BELL & HYDRO UTILITY POLE
AN	DENOTES	ANCHOR
BP	DENOTES	BELL UTILITY PEDESTAL
OHW	DENOTES	OVERHEAD WIRES
BF	DENOTES	BOARD FENCE
PWF	DENOTES	POST & WIRE FENCE
PVC	DENOTES	POLYVINYL CHLORIDE (PLASTIC)
MW	DENOTES	MONITORING WELL
	DENOTES	TREE LINE
	DENOTES	SIGN

DISTANCES:

DISTANCES SHOWN ON THIS PLAN ARE GROUND DISTANCES AND CAN BE USED TO COMPUTE GRID DISTANCES BY MULTIPLYING BY A COMBINED SCALE FACTOR OF 0.999905.

BEARINGS:

BEARINGS ARE MTM GRID BEARINGS, DERIVED BY REAL TIME NETWORK GNSS OBSERVATIONS ON OBSERVED REFERENCE POINTS "A" AND "B" SHOWN HEREON, AND ARE REFERRED TO THE NAD83 (ORIGINAL) MTM ZONE 9 COORDINATE SYSTEM.

ELEVATIONS:

ELEVATIONS AND EXISTING TOPOGRAPHIC FEATURES SHOWN ON THIS PLAN WERE PROVIDED BY A SKETCH TO ILLUSTRATE TOPOGRAPHY BY MCINTOSH PERRY SURVEYING INC, FILE 23–1883.

HORIZONTAL DATUM :

HORIZONTAL DATUM IS NAD83 (ORIG) MTM ZONE 9 AND HAS BEEN DERIVED FROM REAL TIME NETWORK GNSS OBSERVATIONS.

VERTICAL DATUM :

VERTICAL DATUM IS CGVD28/78 DERIVED FROM REAL TIME NETWORK GNSS OBSERVATIONS REFERENCED TO THE CANADA HT_2 GEOID MODEL.

SCALE 1 : 750

0 15 30 45 60 75 Metres

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

REVISIONS

No.	DESCRIPTION	DATE	BY
1	REMOVED SEVERANCE ALREADY COMPLETED, REDUCED ROW TO 20M, ADDED NEW BLOCK	2025–02–06	MP
2	BLOCKS AND STREET REVISED	2025–11–24	MP
3	ROAD RADIUS UPDATED, BLOCKS REVISED	2025–12–08	MP
4	DAYLIGHTING TRIANGLE ON BLOCK 5	2026–01–09	MP

Callon Dietz INCORPORATED
ONTARIO LAND SURVEYORS
CARLETON PLACE LONDON NORTH BAY
info@callondietz.com callondietz.com

ISO 9001 REGISTERED

SURVEY BY: | DRAWN BY: MP | FILE No: 23–1833 | PLAN No:

APPENDIX B

Pre-Consultation Meeting Notes

July 11, 2023
Project Number: 230318

Ms. Erica C. Ogden-Fedak, MCIP, RPP
Planner, Development Review, Rural Services
Planning, Infrastructure & Economic Development Department
City Hall 4th floor, Mail Code 01-14
Email: Erica.Ogden-Fedak@ottawa.ca

Re: Summary of Pre-Submission Consultation (Hydrogeology) Meeting on July 4, 2023
11 Lot Subdivision at 3160 Carp Road
Standing Offer Agreement, No: RFSO 30820-91843-S01

Dear Ms. Ogden-Fedak:

The City of Ottawa (COO) retained BluMetric Environmental Inc. (BluMetric®) to conduct a hydrogeological pre-submission consultation for a proposed 11 Lot Subdivision at 3160 Carp Road. Gemtec provided a data package on June 15, 2023 and this was reviewed and discussed by COO and BluMetric prior to the pre-submission consultation meeting that was conducted on July 4, 2023. BluMetric was asked to provide a summary of the meeting. The following coverage of the meeting is organized according to topics covered and is not a sequential record of the discussions that occurred.

MEETING AND RESPONSIBILITIES

- The meeting was held from 10 am to approximately 11 am on July 4, 2023.
- Attendance:
  - Erica Ogden-Fedak (COO)
  - Tesssa Di Iorio (COO)
  - Travis Smith (COO)
  - Derek Kulyk (COO)
  - Andrius Paznekas (Gemtec)
  - Brent Redmond (Gemtec)
  - Adam O'Connor (Keeper)
  - Russell Chown (BluMetric)

- COO is responsible for pre-submission consultation for the severance of lot 1.
- BluMetric responsible for pre-submission consultation for the 11 lot subdivision.
- The applications for severance and subdivision are for commercial development.
- All lots are greater than 1 hectare.
- The commercial lots will be serviced by drilled water supply wells that extend into bedrock, and individual onsite wastewater treatments systems.

PRE-SUBMISSION HYDROGEOLOGY / DATA PACKAGE FEEDBACK

TEST WELL(S) / QUANTITY

- RC discussed suitability of test wells and future wells to provide sufficient yield for the intended development.
    - Higher yield normally required for commercial use.
    - RC noted that pumping tests conducted to date were at 18.9 L/min and may not be sufficient for some future uses. AP and BR commented that the yields should be sufficient.
    - RC noted that pumping tests should demonstrate future intended uses are supported. Further discussion included a request for a breakdown of intended uses and discussion of process water requirements and if they need to be limited (this may require a zoning amendment if listed uses cannot be supported). Quantity issues should be brought to the forefront. The report should indicate if quantity limitations exist.
    - After the meeting EOF provided a list of approved uses according to zoning and the list is included as Attachment A.
- RC noted that since some test well yields are relatively low an interference analysis will be required.
- AP indicated two further 8-hour pumping tests will be conducted targeting wells with low yield and/or quality issues.
- TDI indicated an additional test on the proposed severed lot is requested if one of the two pump tests is not already planned for the severed lot (i.e. the well with the worst yield and the well with the elevated H_2S) It is noted that one of the test wells is located on the proposed lot to be severed. Depending on the results of the pumping tests, additional wells may need to be tested if results indicate water quantity or quality issues.

GEOLOGY / TERRAIN

- Sandy soils occur over much of site with some lenses of clay in some areas.
- A COO memorandum (Carp Road corridor nitrate impact assessment recommendations) indicates overburden monitors are required. AP confirmed that there are four overburden monitoring wells. They have been sampled and analytical results show negligible nitrates.

- Long term monitoring wells (OB and BR) may be required. To be addressed in an assessment report if nitrate loading has potential to be an issue in the long term.

HYDROGEOLOGY

- Groundwater flow regime was discussed (RC suggested overburden groundwater flow appears to be to north (based on topography) and bedrock groundwater flow to northeast (relative to Ottawa River). AP and BR agreed with this interpretation.
- RC noted that a detailed coverage of surrounding land uses that could impact yield or could potentially contaminate is required. Further groundwater sampling should include any potential contaminants identified. The report should discuss mitigative measures associated with potentially contaminating sources (e.g. spill plans).
- RC indicated the site appears to be hydrogeologically sensitive due to highly permeable soils, and that where highly permeable soils are present, soil profiles and grain size analyses will be required to confirm soil texture and distribution, which will confirm if the site is considered hydrogeologically sensitive. AP indicated a geotechnical study will be available for review and will include grain size analyses.
- RC indicated well owner interviews/information regarding nearby wells in the vicinity of the site is required (yield, quantity, quality). Two wells have been sampled but the study should ensure that a reasonably representative sample of information from neighbouring properties is included.

GROUNDWATER QUALITY

- RC noted that the list of analytical testing parameters to date appears to be suitable (long list D-5-5 + metals). It was noted that VOCs are required and that contaminants indicated at upgradient properties should also be included.
- RC noted that analytical results for colour are elevated and that it may be helpful to include colour in the suite of field parameters.
- RC noted that field testing for residual chlorine must be supported (instrument used, MDL and calibration records).
- RC noted that analytical results for sulphide (as H_2S) are elevated and that concentrations increased between 3-hour and 6-hour samples at each test well. TDI suggested that chlorination of wells prior to retesting may help reduce sulphide reducing bacteria if present.
- RC noted that treatability limits must be considered. There is no treatability limit for sulphide so the study should address feasibility including financial/maintenance impacts of treatment to future homeowners.

- RC noted that analytical results for turbidity were elevated at all of the test wells and that extended pumping may be needed to reduce turbidity to acceptable levels. AP agreed that additional pumping my be required. Note that if additional pumping is required to decrease turbidity, then a recommendation should be included in the final set of recommendations indicating that additional pumping may be required for well development after new wells are drilled.

Septic Suitability

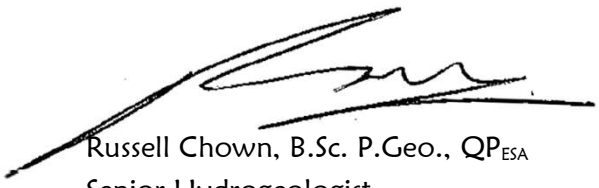
- RC requested that septic flow rates to be based on a conceptual breakdown of expected uses regarding occupancy.
- RC noted that since the site is hydrogeologically sensitive due to highly permeable soils, best management practices will be needed including wells located up-gradient from septic systems, increased casing lengths (as per existing test wells which have 12 m casing), and increased separation distances between wells and septic systems.
- RC mentioned that stormwater could potentially be used as part of the dilution calculation but must be accompanied by appropriate calculations and that this would have to be reviewed by a COO engineer. Note that this is identified in the Carp Road Corridor memorandum (2016).
- RC noted that tertiary/advanced treatment for nitrates (nutrient reduction technologies) may be needed. AP indicated that advanced treatment will likely be used.
- RC noted that a conceptual lot layout plan should be provided that shows constraints (hydrogeologically sensitive terrain, setbacks, etc.), including proposed septic system locations and the proposed water well locations at all of the lots.
- RC noted that a predictive nitrate impact assessment will be required, and that non-pervious areas should include reasonable estimates based on a table the provides a breakdown of types of impervious areas (e.g. roads, roofs, parking areas, etc.).
- TDI indicated that a 'water balance' with pre-development and post-development scenarios should be presented (note that this is a requirement because the site lies within the area in the Carp Road Corridor community design plan and is identified as moderate recharge zone). This led to a discussion with input from AP, TDI and DK regarding stormwater management and the need to demonstrate conceptually that recharge can be maintained. AO provided feedback regarding stormwater management (a communal pond is not anticipated / each lot will have its own stormwater management measures). It was mentioned that low impact development (LID) measures may be required. DK provided further clarification following the meeting including a copy of the pre-application consultation minutes (DK's email is included as Attachment B, and pre-application consultation minutes are included as Attachment C). It was also noted that the water balance presented in the HGTA report must be harmonized with the information presented in the stormwater management report.

General Comments

- RC noted that a hydrogeological assessment report should include a concise list of recommendations, which can be reproduced in a development agreement / site plan agreement (these recommendations will be confirmed at Site Plan Control).
- AP requested clarification regarding the need for a separate report for the single lot severance. TDI and EOF confirmed that a separate report will be needed.
- RC noted that pre-submission consultation will occur as a stepwise process to ensure that all issues and challenges are fully addressed.
- Next steps were discussed, and it was agreed that Gemtec will provide a detailed work plan for review before proceeding with additional investigation and testing. BluMetric will provide a written response following review of the work plan.

If you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
BluMetric Environmental Inc.



Russell Chown, B.Sc. P.Geo., QP_{ESA}
Senior Hydrogeologist

Encl.

Ref: COO Hydrog 3160 Carp Rd preconsult summ - 11jul23.docx

LIMITATIONS

The conclusions presented in the above captioned meeting summary letter represent our professional opinion, in light of the terms of reference, scope of work, and the limiting conditions noted herein.

The findings presented in this meeting summary letter are based on conditions reported by others at the specified dates and locations, the analysis of samples for the specified parameters, and information obtained for this hydrogeological assessment. Unless otherwise stated, the findings cannot be extended to previous or future site conditions, locations that were not investigated directly, or types of analysis not performed.

BluMetric makes no warranty as to the accuracy or completeness of the information provided by others, or of conclusions and recommendations predicated on the accuracy of that information. Nothing in this report is intended to constitute or provide a legal opinion.

This meeting summary letter describes the observations made by the BluMetric team at the time of the review and have been prepared solely for the use of the client. No other party may use or rely upon the above-captioned report or portion thereof without the express written consent of BluMetric. BluMetric will consent to any reasonable request to approve the use of this report by other parties as "Approved Users".

ATTACHMENT A

Zoning Uses

Russell Chown

From: Ogden-Fedak, Erica <Erica.Ogden-Fedak@ottawa.ca>
Sent: Tuesday, July 4, 2023 11:26 AM
To: Russell Chown
Subject: RE: 3160 Carp Road Technical Pre-Consultation, proposed commercial/industrial subdivision

Follow Up Flag: Follow up
Flag Status: Flagged

Good morning Russell,

Following up on our meeting this morning, please find below the list of uses permitted.

The subject site is zoned Rural Commercial subzone 9 (RC9). Below is a summary of the permitted use. Please refer to the Zoning By-law for a complete list of permitted uses, definitions and zoning provisions.

- amusement centre
- amusement park, a go-cart track is not permitted in an RC zone which abuts in whole or in part any VM, V1, V2 or V3 zone;
- animal care establishment
- animal hospital
- artist studio
- automobile rental establishment
- automobile dealership
- automobile service station, may not retail fuel
- bank machine, provided it is located in the same building or on the same lot as a permitted use
- campground
- car wash
- click and collect facility
- convenience store, provided it is located in the same building or on the same lot as a permitted use
- detached dwelling, limited to one in total (with dwelling unit) and must be accessory to a permitted use
- dwelling unit, limited to one in total (with detached dwelling) and must be accessory to a permitted use
- drive-through facility, provided it is located in the same building or on the same lot as a permitted use
- heavy equipment and vehicle sales, rental and servicing
- hotel
- light industrial
- office
- parking lot
- personal service business, provided it is located in the same building or on the same lot as a permitted use
- printing plant
- research and development centre
- retail food store, limited to a farmers' market
- retail store, limited to the sale of agricultural, construction, gardening or landscaping-related products, equipment or supplies; and to the sale of goods, products, equipment, supplies or services manufactured, processed, assembled, packaged or delivered by a permitted use, or the sale of previously prepared materials used in the manufacturing, processing, assembly, packaging or delivery of finished parts, finished products or services.
- service and repair shop

- storefront industry
- warehouse

Thank you,

Erica C. Ogden-Fedak **MCIP, RPP** (she/her/elle)
Planner II | Urbaniste II
Development Review, Rural Services | Examen des projets d'aménagement, Service ruraux
City of Ottawa | Ville d'Ottawa
Tel. | Tél. 613.580.2424 ext.|poste 26510 | erica.ogden-fedak@ottawa.ca

---

From: Brown, Adam <Adam.Brown@ottawa.ca>
Sent: June 28, 2023 3:57 PM
To: Russell Chown <rchown@blumetric.ca>; Di Iorio, Tessa <tessa.diiorio@ottawa.ca>; brent.redmond@gemtec.ca; Adam O'Connor <keeper.co.ltd@gmail.com>
Cc: Andrius Paznekas <andrius.paznekas@gemtec.ca>; Ogden-Fedak, Erica <Erica.Ogden-Fedak@ottawa.ca>
Subject: RE: 3160 Carp Road Technical Pre-Consultation, proposed commercial/industrial subdivision

Please include Erica (file lead) in the meeting as an optional.

I cannot attend at the time as I have another commitment but that's fine.

From: Russell Chown <rchown@blumetric.ca>
Sent: June 28, 2023 1:35 PM
To: Di Iorio, Tessa <tessa.diiorio@ottawa.ca>; brent.redmond@gemtec.ca; Adam O'Connor <keeper.co.ltd@gmail.com>; Brown, Adam <Adam.Brown@ottawa.ca>
Cc: Andrius Paznekas <andrius.paznekas@gemtec.ca>
Subject: RE: 3160 Carp Road Technical Pre-Consultation, proposed commercial/industrial subdivision

CAUTION: This email originated from an External Sender. Please do not click links or open attachments unless you recognize the source.

ATTENTION : Ce courriel provient d'un expéditeur externe. Ne cliquez sur aucun lien et n'ouvrez pas de pièce jointe, excepté si vous connaissez l'expéditeur.

Please advise regarding your availability for participation in a pre-consultation meeting

July 4 (10 am)

Regards
Russell

Russell Chown - Senior Hydrogeologist - (T) 877-487-8436 x362

From: Andrius Paznekas <andrius.paznekas@gemtec.ca>
Sent: Wednesday, June 28, 2023 1:30 PM
To: Russell Chown <rchown@blumetric.ca>; Di Iorio, Tessa <tessa.diiorio@ottawa.ca>
Cc: Adam O'Connor <keeper.co.ltd@gmail.com>; Brown, Adam <Adam.Brown@ottawa.ca>; Brent Redmond <brent.redmond@gemtec.ca>
Subject: Re: 3160 Carp Road Technical Pre-Consultation, proposed commercial/industrial subdivision

ATTACHMENT B

Stormwater Requirements

Russell Chown

From: Kulyk, Derek <derek.kulyk@ottawa.ca>
Sent: Tuesday, July 4, 2023 12:01 PM
To: Ogden-Fedak, Erica
Cc: Smith, Travis; Di Iorio, Tessa; Russell Chown; Whittaker, Damien; Andrius Paznekas
Subject: 3160 Carp Rd (PC2022-0214)
Attachments: 3160 Carp Rd (PC2022-0214) pre-application consultation Subdivision comments-DK-September 09, 2022.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Erica,
I re-attached the pre-application consultation notes that were provided previously for this site. Some references to the MVCA duties might be limited now and might have been transferred to the City responsibilities.

It states the SWM requirements that were previously provided and to follow up on the conversation of this meeting today, the Hydrogeological investigation should address the infiltration targets for the entire subdivision from the perspective of maintaining the water budget on site, to maintain the recharge, as the site is within a significant groundwater recharge area . If there are specific site conditions that might limit some areas due to thin soils or other conditions preventing adequate recharge, then it will need to address these areas and recommend how these conditions should be mitigated. The overall infiltration targets for the entire subdivision will need to be provided with recommendations how they can be achieved on the individual lot levels in the future, to maintain the overall water budget balance.
The targets for individual lots will need to specified prior to lot creation.

Below are the criteria stated during the pre-application consultation:

> A water budget will need to be developed for the proposal to maintain recharge, as the site is within significant groundwater recharge area. It should provide a 15% reduction in the difference from pre-development to post-development.
>
> The stormwater management report shall itemize concurrence with the content of the CRWSS and address all Subwatershed criteria pertaining to the SWM site control, such as but not limited to:
>
> a. Storage shall be the greater of Table 8.3.10 of the CRWSS and that required for 80% TSS removal
> b. Efforts are required to maintain low flow runoff in summer
> c. 104 mm/yr infiltration (p.196) – area identified as significant groundwater recharge area
> d. Runoff shall be provided to achieve cool water thermal regime (p. 159)
>
> The SWM report needs to reference soil hydrogeological and geotechnical conditions and its infiltration capacity clearly and what surface run-off water treatment measures are being applied to protect the highly vulnerable aquifer that was identified on the site.

Please let me know if you have questions pertaining to this matter.

Sincerely,
Derek Kulyk, P.Eng

Project Manager ▪ Gestionnaire de projet

Development Review, Rural Branch ▪ Direction de l'examen des projets d'aménagement, rurale
Planning, Real Estate and Economic Development Department ▪ Direction générale de la planification, des biens immobiliers et du développement économique
City of Ottawa | **ville d'Ottawa**
110 Laurier Ave. W. | 110, avenue Laurier Ouest, Ottawa ON K1P 1J1
Int. Mail Code | Code de Courrier Interne 01-14

'

This e-mail originates from the City of Ottawa e-mail system. Any distribution, use or copying of this e-mail or the information it contains by other than the intended recipient(s) is unauthorized. Thank you.

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.

'

ATTACHMENT C

Pre-Application Comments

Pre-Application Consultation Meeting Notes

Property Address: 3160 Carp Road
PC2022-0214
September 9, 2022, Microsoft Teams Meeting

Attendees:
Erica Ogden, Planner II, City of Ottawa
Sean Harrigan, Planner I, City of Ottawa
Stephan Kukkonen, Planner I, City of Ottawa
Derek Kulyk, Project Manager, City of Ottawa
Josiane Gervais, Transportation, City of Ottawa
Ann O'Connor, Urban Design, City of Ottawa
Adiva Saadat, Student Planner, City of Ottawa
Mercedes Liedtke, Environmental Planner, Mississippi Valley Conservation Authority
Claire Milloy, Hydrogeologist, Rideau Valley Conservation Authority

Bridgette Alchawa, McIntosh Perry
Adam O'Connor, Keeper Co. Ltd.
Alex Testa
Lois Carroll, TG Carroll Cartage Ltd.
Thomas Carroll, TG Carroll Cartage Ltd.

Regrets:
Anissa McAlpine, Parks Planner, City of Ottawa
Tessa Di Iorio, Hydrogeologist, City of Ottawa
Sami Rehman, Environmental Planner, City of Ottawa

Subject: 3160 Carp Road

Meeting notes:

Overview of Proposal

- The proposal includes the severance of one (1) commercial/industrial lot and a plan of subdivision for a commercial/industrial subdivision with eleven (11) lots.
- Undecided at this time which lot would be created through a severance application, likely considering Lot 1, 11 or 12, as shown on the concept plan provided.

Preliminary comments and questions from staff and agencies, including follow-up actions:

Planning

- Official Plan
  - The property is designated Rural Employment Area on Schedule A of the current City of Ottawa Official Plan
  - The Rural Employment area permits heavy and light industrial uses, transportation, warehouse and storage operations, uses that are noxious by virtue and new commercial uses that primarily provide services to employees of the rural business park or the travelling public.
  - Development will be subject to Site Plan Control and all new development must be supportable on individual well and septic systems.

- Carp Road Corridor Community Design Plan
  - The property is designated as Highway Commercial Area within the Carp Road Corridor Community Design Plan.
  - Highway commercial uses are generally oriented to attract and serve passing traffic and require direct access to arterial roads. Carp Road is an arterial road that provides easy access to Highway 417 and the Carp Airport.
  - The Carp Road Corridor CDP encourages industrial development primarily in industrial/business parks
  - The following Design Guidelines from Section 7.3 of the CDP apply to Industrial/Business Park/ Subdivisions:
    1. Limit access to Carp Road. Internal roads to the subdivision should provide access to Carp Road.
    2. Locate parking at the rear or side of buildings. Where this is not possible and parking is required at the front or side of the building a greater setback from the property line should be required to permit planting to mitigate the effects of the parking area (e.g. parking screened from view).
    3. Locate storage and service areas at the rear of buildings except on sites where the property backs onto Carp Road or the main entry road.
    4. Site buildings fronting on Carp Road to face, front and feature the road corridor (entry roads and all local roads).
    5. Preserve as many trees as possible on the site.
    6. Compensate for removal of existing trees by extensive planting in the open space corridor, entry features "gateways" and on-site landscape areas.
    7. Plant trees along the corridor - an informal mix of trees and shrubs is preferable, with more coniferous than deciduous species.
    8. Provide landscaping at the front of buildings.
    9. Use landscaping, decorative fences to screen unsightly uses.
    10. Create entry feature ("gateways") for new subdivisions/parks. This should include a sign and landscaping with the name of the development and the park occupants and enhanced lighting for visibility at night.
    11. Provide for turning lanes where warranted.
  - The proposed subdivision is adjacent to residential uses, the CDP includes the following policies related to appropriate transition between existing and future uses:
    1. Locate all unsightly and noise-generating elements, such as service lanes, loading zones, dumpsters and outdoor storage, away from adjacent residential properties;
    2. Separate existing residential and institutional areas which back onto "Carp Road Corridor Rural Employment Area" with a landscaped buffer, located on development lands, designed to mitigate unsightly and noise-generating elements. Construction and maintenance of the landscaped buffer may be required as a condition of subdivision/site plan approval;
    3. The buffer should be formed by a 6m wide, 1.5 to 2 metres high aesthetic berm, predominantly planted with evergreen trees that retain their lower limbs with age. The planting should create a continuous and dense visual screen; and
    4. Where the noise generated by future uses is of concern, the setbacks from residential uses should be increased to allow for densely landscaped buffers.
- New Official Plan
  - The property is designated Rural Industrial and Logistics on Schedule B9 of the Council adopted Official Plan, which is awaiting approval from the Ministry of Municipal Affairs and Housing.

- City Council has approved transition policies for the New Official Plan, which state that in the period between Council approval of the New Official Plan and the Minister's approval of the New Official Plan, City staff will apply whichever provision, as between the Current and New Official Plan, is more restrictive.
- The property is subject to the Area Specific Policies for the Carp Road Corridor which designate the lands Corridor Commercial Area on Schedule 8.A within Volume 2C of the New Official Plan
- Permitted uses include light industrial uses, automotive, recreational and heavy vehicle sales and service. Convenience commercial uses are not permitted.

- Zoning By-law
  - The property is zoned Rural Commercial subzone 9 (RC9), which permits a variety of commercial and industrial uses.
  - The provisions for lots zoned RC9 include:
    - Minimum lot area 4000 sq.m.
    - Minimum lot width 30 m
    - Maximum lot coverage 25%

- Plan of Subdivision Application - Erica Ogden, erica.ogden@ottawa.ca
  - The policies of the Carp Road Corridor CDP, discourages lots fronting on to Carp Road. The internal access road should be the access for the proposed lots.
  - Consideration for existing easements to the neighbouring property 3108 Carp Road for the existing access, as well as access to the landlocked agricultural parcel to the rear, which appears to be accessed through the subject property.
  - The property is within the Airport Area of Influence, see the engineering section below for additional required studies.
  - The site has been identified to have Archaeological Potential and will require an Archaeological Resources Assessment.
  - Many of the proposed uses within the Rural Commercial zone require Site Plan Control approval.
  - Appropriate buffering to any existing residential uses and the proposed new lots will be required.

- Severance Application – Sean Harrigan, sean.harrigan@ottawa.ca
  - The severance application must be reviewed independently from the subdivision application but must also have consideration for the future development.
  - Both the proposed severed and retained lots require appropriate frontages, lot sizes and servicing, regardless of the future subdivision application.
  - Lots 11 or 12, shown on the concept plan provided, likely would not be supported through a severance application as they are located behind existing lots and do not have frontage on to Carp Road.
  - Severing Lot 1 may not maintain the required lot frontage for the retained parcel. The lot frontage is not considered cumulative across the various access points. A minor variance application could be considered for the retained lands. It is the applicant's decision whether to pursue a lot configuration that is zoning complaint or to submit a minor variance application and this decision should be rationalized in accordance with applicable policies and consideration for future development potential. However, when determining an appropriate lot configuration (i.e. whether to leave 20m for the future laneway south of Lot 1 or 30+m such that it is zoning compliant, or any other lot configuration), please consider how much space is required for the future subdivision

lane for engineering and traffic requirements (i.e. will 20m be sufficient for industrial related traffic such as freight?).

- The retained and severed lot must be sufficient sized, primarily related to servicing requirements, to adequately accommodate the uses permitted within the RC9 zone, or other mechanisms must be considered in the interim prior to the plan of subdivision application. This is a requirement of the Official Plan and should be discussed in the Planning Rationale/Cover Letter and accounted for in the Hydrogeological Report which will be required as a condition of approval.
- A Planning Justification will be required with the initial severance application and should include an analysis of current permitted uses, and rationale that the severed and retained lots are sufficiently sized.
- Road widening, if required, will be required as a condition of approval for the severance application. A survey is required to confirm.
- Parkland dedication will be required for the severance, see the comments provided below.
- A Hydrogeological and Terrain Analysis will be required and must demonstrate that both the severed and retain can be serviced, see the comments provided below.
- A condition of approval may require a notice on title related to well water quality, if required.
- Consideration should be given to future access from the internal road of the subdivision to Lot 1, as the CDP discourages direct access from Carp Road. Easements across the retained lands and a 30 cm reserve along the Carp Road frontage of Lot 1 may be required.
- Existing access to the farmlands to the rear of the subject property must be considered, as the existing access is located within the area of Lot 1. There more than likely will be a condition of approval that requires a formal easement agreement for the farmlands. Where exactly the easement should be placed is unknown at this time, but it is suspected the best location is over the retained lands through the proposed future lane (potential 30cm reserve would prevent an easement over the severed lot)
- Please note that other conditions of approval not listed above may be requested for the severance applications. The exact list of conditions will be determined based on the final proposal and after a comprehensive review is completed for a formal application submission.

Urban Design - Ann O'Connor, Ann.OConnor@ottawa.ca

- For a Plan of Subdivision application alone, no Design Brief is required. If a Zoning By-law Amendment application is going to be applied for concurrently with the Plan of Subdivision, a Design Brief may be required. A Terms of Reference can be provided by Design staff if this is considered.
- As the design of the lots move forward, consider retaining as much of the tree canopy/wooded area identified on the perimeter of the site.
- All policies in the Carp Road Corridor Community Design Plan should be adhered to, where possible. In particular, consider:
  - For Lot 1, with frontage on Carp Road, note that:
    - Section 2.1 of the CDP identifies that the properties fronting on the Carp Road are most appropriate for highway commercial and industrial use
    - Section 7 addresses how to enhance the visual appearance of the corridor and maintain the rural landscape.
  - For the Lot 8 and Lot 7, with lot lines that abut residential lots, note that:
    - Section 8 addresses land use compatibility with residences.

- Schedules:
  - Schedule 1 – Land Use Designations identifies the subject site as “Highway Commercial Area”
  - Schedule 2 – Environmental Features identifies portions of the site as having “moderate recharge’

Engineering - Derek Kulyk, derek.kulyk@ottawa.ca

Severance

Groundwater and Water Service

Please see the Hydrogeological comments provided below. While confirming quantity and quality it is important to be aware that the site is situated within 220 m of Highland Park Cemetery to the north-east, within 30 m of Presbyterian Cemetery to the south and Mineral Extraction pits (sand and gravel) are approximately 500 m to the south and approximately 375 m to the south-west.

The site is within Mississippi Rideau Source Water Protection Area. The site has been identified to be within a significant groundwater recharge area and contains a highly vulnerable aquifer. The location is within the area covered by the Carp River Watershed/Subwatershed Study (CRWSS).

If the accepted report recommends specific mitigation measures or design requirements, the Owners shall enter into a Development Agreement with the City, at the expense of the Owners, which is to be registered on the title of the property, which includes those recommendations. In instances where the subject site has sensitive soils, the drilling of a well or the conveyance of a 30-centimetre reserve may be required and also for access to the lot from the proposed road, not driveway from Carp Road. Both the report and any required Development Agreement shall be prepared to the satisfaction of Development Review Manager of the Relevant Branch within Planning, Infrastructure and Economic Development Department, or his/her designate.

Sanitary Service

There are no municipal sanitary sewers adjacent the proposed expansion. An Impact Risk Assessment will be required (as part of Hydrogeological and Terrain Analysis). Please see the Hydrogeology comments below.

Stormwater

There are no municipal storm sewers adjacent the proposed lot and also road ROW ditches with downstream outlets were not identified. Consequently, Stormwater investigation (NOT a report) should be provided to the City, as there is a concern of surface run-off conveyance and legal outlet from the proposed lot.

Site Geotechnical Conditions

Please note that sensitive marine clays are anticipated in the area of the proposed severance and potentially thin soils. Also slope of the site is unknown (Slope Stability study might be required).

In the severance application, if the City identifies any adverse soils conditions such as sensitive marine clays, a notice on title will need to be registered that advises of the potential site specific detailed engineering solutions that may be required to allow for development:

“The City of Ottawa has identified that there are potential sensitive marine clay soils and thin soils within the area that may require site specific detailed geotechnical engineering solutions to allow for development, the City of Ottawa bears no responsibility, financial or otherwise, to provide solutions to the deficiency, such solutions being the sole responsibility of the homeowner.”

Carp Airport Proximity

The proposed land severance is direct proximity to Carp airport, 650 m from the end of runway 28, consequently and landing/taking off aircraft might generate excessive noise and vibration. The proposed severance is also directly adjacent to Carp Road (arterial road), which is also identified as a “full load truck route”.

Noise and Vibration Attenuation Study**,** as per City of Ottawa Environmental Noise Control Guidelines will be required to address these two sources (airport & Carp Road) of noise and vibration and potential impacts and mitigation to the future development proposal. The Owner might have to enter into an agreement with the City that requires the Owner to implement any noise control (and vibration if applicable) attenuation measures recommended in the approved study. The Noise Warning Clauses might need to be registered on title.

Transport Canada, Carp Airport Authority, Navigation Canada, or other aviation authorities, as required, need to be contacted regarding ponds and lighting or other specific considerations and limitations associated with proposed development in direct proximity to Carp Airport. The City Engineering needs to be copied on the communication (the findings resulting from the communication might need to be registered on title). Airport area zoning restrictions imposed by the Airport Vicinity Development Zone need to be considered, as per new OP section 10.2.2.11 (Schedule C14) and current OP, Section 4.8.6.

Easements/ROW

Easements and rights-of-ways must be shown on the plans and information on any existing easements or ROWs, must be provided with the application. 0.3 m reserve along Carp Road might be required (preferred access is from the road proposed as subdivision road not directly from Carp Road). There is a concern of access to the agricultural property to the north. It appears that access to that property is along the north-west side of the severed property. The proposed severance will remove access to the mentioned property. Solution must be presented to the City for review, prior to approval of the severance.

Roads

Carp Road in Rural Road Network is an Arterial Road and ROW protection of 30.0 m is required, as per new Official plan, Schedule C16 (15 m from the road centre line to the property limit).
It appears that the ROW width is sufficient and road widening will not be required.
Please refer to the City of Ottawa Private Approach By-Law (Private Approach (By-law No. 2003-447) | City of Ottawa) The driveway setback needs to be, as minimum 3.0 m from the property line, however, as the proposed severed parcel is part of the proposed commercial/industrial subdivision, access to the lot should be provided along its east property limit, which will become in the future the subdivision access road. 0.3 m reserve along Carp Road might be required. Please refer to Transportation Department comments for more information.

Subdivision

Topographic Plan of Survey

A topographic survey needs to identify all representative elevation points, currently existing features, including all property lines, bodies of water, vegetation, easements etc. It needs to provide a note that references the horizontal and vertical datums that were used and tied into to complete the project, including the local benchmarks. The survey should show the municipal road ROW which is identified as an arterial road with 30m ROW protection.

Groundwater and Water Service

It is understood that there are no municipal water pipes near the application. Please see the Hydrogeological comments provided below. While confirming quantity and quality it is important to be aware that the site is situated within 220 m of Highland Park Cemetery to the north-east, within 30 m of Presbyterian Cemetery to the south and Mineral Extraction pits (sand and gravel) are approximately 500 m to the south and approximately 375 m to the south-west. Proximity and potential impact of the aforementioned facilities should be analyzed.

The site is within Mississippi Rideau Source Water Protection Area. The site has been identified to be within a significant groundwater recharge area and contains a highly vulnerable aquifer. The location is within the area covered by the Carp River Watershed/Subwatershed Study (CRWSS).

The Consultant undertaking the hydrogeological and terrain study needs to refer for more details to Hydrogeological and Terrain Analysis Guidelines (March 2021)and should clearly demonstrate integration with other studies such as, but not limited to, Geotechnical Study, ESA, EIS, etc. Also, all surface features of interest or concern need to be addressed. There is an existing watercourse at the NE corner of the property – Fluvial Geomorphological report will be required.

If a SWM pond or similar stormwater management infrastructure is proposed, it will also need to be included in the Hydrogeological Report and Terrain Analysis.

It is the responsibility of the owner to ensure that adequate water supply for firefighting is provided for each lot by the FUS method and please note that a recently revised FUS exists.

As a condition of approval of plan of subdivision, the developer will be required to dedicate a monitoring well, at no cost, to the City.

Sanitary Service

There are no municipal sanitary sewers adjacent the proposed subdivision. Please see the comments below regarding hydrogeology. An Impact Risk Assessment will be required (as part of Hydrogeological and Terrain Analysis).

Minimum Septic Field Setback from property lines is 3 metres & 5 metres from buildings. Note: if the septic fields are raised beds then these separations distances increase (they increase by 2x the grade raise) – please see Ottawa Septic System Office guidelines for details.

Servicing Study (water/sanitary)
A Subdivision Servicing Study (and Plans) will need to be submitted to the City for review and it needs to demonstrate that all lots can be adequately serviced. It should comprehensively address the available water quality and quantity. It should identify the required projected water demand and the expected well capacities (sustainably to be in excess of demand). It should also address sanitary servicing needs of all individual lots.

The report needs to provide all pertinent calculations and justifications to support any claims made in the report. References to other relevant studies need to be made and clearly stated in order to adequately address the servicing needs and underlying ground conditions.

Proposed septic bed sizing needs to be provided, to demonstrate that each bed will be able to accommodate the generated flows and there is an adequate lot area to accommodate the proposed septic beds and water wells on each of the lots. Since there is a watercourse identified on site, required setbacks, as per City official plan need to be observed- they can be significant.

The study should also contain comprehensive rationale that will allow to conclude that the existing hydrogeological and geotechnical conditions were considered, in order to protect the groundwater, as per latest guidelines and legal requirements.

Fire-fighting considerations should also be included in the report to determine potential surface area requirements if water storage tanks need to be implemented in the future, for each lot. As per the clarification provided in Technical Bulletin ISTB-2021-03 the FUS fire-fighting methodology is to be used in Rural Areas in all cases.

All SWM systems need to be identified on the Servicing Plan (i.e. common SWM pond, multiple ponds, swales, ditches, CB's, underground pipes, etc.), as this will impact future space allocation for individual site designs and septic systems.

Storm Sewers
There are no municipal storm sewers adjacent the proposed subdivision and also road ROW ditches with downstream outlets were not identified. Consequently, the retained consultant will need to review the existing terrain and demonstrate that there is Legal and sufficient storm outlet from site for both release rate and volume and prepare a SWM Report and Plan, as per City of Ottawa Sewer Design Guidelines (Second edition, October 2012, plus bulletins) that will ensure that the post development surface run-off will not adversely affect the downstream drainage system, including culverts, point of proposed site storm sewer system outlet location and the adjacent properties, during construction and in the post-construction condition. SWM pond might be required.

Storm Water Management
SWM Report will be required, as per above-mentioned guidelines. LID is required as per the memo from the former MOECC (now MECP). Any existing stormwater runoff from adjacent site(s) that crosses the property must be accommodated by the proposed stormwater

management design. No adverse effect can be created to the surrounding properties. Since it is a commercial/industrial subdivision proposal, on-site SWM measures need to be applied to minimize impact to downstream storm control systems.

Any stormwater outlet to a watercourse will require treatment and, as such, if there are any new stormwater outlets proposed to the watercourse, as part of the SWM plan, or proposed stormwater systems servicing multiple lots, they will require a direct submission Environmental Compliance Approval (ECA) application to the Ministry of the Environment, Conservation and Parks (MECP). The turnaround time for a direct submission ECA from the MECP can be up to one year.

Please note: Once the development application has been submitted, a request can be made to the City to consider a Transfer of Review (ToR) ECA for SWM works (ponds, ditches, culverts, etc.) for a private property, instead of the direct submission ECA. This is subject to approval by the City and MECP. Note that the ECA requirements are currently in flux. It is recommended to check with the City when the development application is submitted to confirm the ECA process at that time.

Stormwater management quality criteria is provided by Mississippi Valley Conservation Authority below.

Note that oil/grit separators, if used, require Environmental Technology Verification (ETV) protocol for ECA approval.

Capacity of the downstream systems needs to be investigated in detail and concurrence with any existing Drainage Studies or Watershed/Subwatershed Studies needs to be demonstrated. All stormwater management determinations shall have supporting rationale.

The site is located within the area covered by the Carp River Watershed/Subwatershed Study, and it suggests methods promoting infiltration (following sufficient/satisfactory treatment). The Stormwater Management Report must address the applicable requirements of the Carp River Watershed/Subwatershed Study and if such pertains, Master Drainage Plan.

A water budget will need to be developed for the proposal to maintain recharge, as the site is within significant groundwater recharge area. It should provide a 15% reduction in the difference from pre-development to post-development.

The SWM report needs to reference soil hydrogeological and geotechnical conditions and its infiltration capacity clearly and what surface run-off water treatment measures are being applied to protect the highly vulnerable aquifer that was identified on the site.

The stormwater management quantity criteria for the development is that the 100-year post-development stormwater runoff must be controlled to the 2-year pre-development runoff, as per section 8.3.7.3 of the Ottawa Sewer Design Guidelines (SDG).

All stormwater management determinations shall have supporting rationale.

All SWM systems need to be identified on the SWM Plan (i.e. common SWM pond, multiple ponds, swales, ditches, CB's, underground pipes, etc.), to support the analysis and recommendations provided in the SWM Report. All these considerations need to be shown on the SWM Plan. Any SWM ponds will need a sediment drying area.

Geotechnical Investigation
A Geotechnical Investigation Report is required. Please note that sensitive marine clays are anticipated in the area of the proposed subdivision and, therefore, enhanced geotechnical investigation and exhaustive analysis will be necessary. Investigation of clays should be undertaken with vane shear testing, Atterberg limits testing (from a number of depths in each column), shrinkage, grain size, grade raise restriction, consolidation, compaction sensitivity, remolded strength and liquefaction analysis- amongst others. For geotechnical investigation, please refer to "Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa"

It should also include exhaustive infiltration/percolation testing for SWM & septic field design, as a highly vulnerable aquifer is present on the site. Extensive analysis and discussion is required to address LID requirements of the MECP bulletin and the Carp River subwatershed study (CRWSS). The area is within Mississippi-Rideau source water protection area and also within significant groundwater recharge area. Infiltration is required here but also might be of concern (septic systems)

The groundwater level is to be investigated and the level is to be derived from spring-time investigation (there are mineral extraction sites to the south, and their presence might need to be considered in the investigation). Water table level needs to be determined for the proposed design and foundation drainage need to be addressed. The above mentioned CRWSS concerns, and its recommendations need to be considered in the Geotechnical Report. In sensitive marine clays, trees in proximity to foundations can cause foundation damage. The requirements of the City's Tree Planting in Sensitive Marine Clay Soils – 2017 Guidelines should be contemplated.

Earthquake analysis and potential for seismic liquefaction analysis are also required to be undertaken and details provided in the report.

As current site grading is unknown, Slope stability Study may also be required, and potential "Hazard Lands" will need to be identified and safe setbacks are to be specified as per Section 4.8 of the Official Plan, in accordance with the "City Slope Stability Guidelines in the City of Ottawa (Original by Golder Associates, 2004; updated by City of Ottawa, 2012)".

Environmental Site Assessment (ESA).
A Phase 1 Environmental Site Assessment (ESA) is required, completed in accordance with Ontario Regulation (O.Reg.) 153/04.
A Phase 2 ESA may be required, depending on the outcome of the Phase 1 ESA.
A Record of Site Condition, if applicable, will be required as a condition of the Plan of Subdivision approval.

Noise Control Feasibility Study
A study will be required due to the potential of the proposed development to generate noise (Stationary Noise) and close proximity of the proposed commercial/industrial subdivision to the existing buildings nearby (offices/potentially residential)

Noise and Vibration Study
A study will be required, in order to address the noise and vibration generated by the Carp Airport activities, adjacent to the proposed development and also the noise and vibration component of the adjacent Carp Road (arterial road), which is also identified as a "full load truck route", and how, if required, the noise and vibration should be mitigated.

Carp Airport Proximity
Transport Canada, Carp Airport Authority, Navigation Canada, or other aviation authorities, as required, need to be contacted regarding ponds and lighting or other specific considerations and limitations associated with proposed development in direct proximity to Carp Airport. The City Engineering needs to be copied on the communication. Airport area zoning restrictions imposed by the Airport Vicinity Development Zone need to be considered, as per new OP section 10.2.2.11 (Schedule C14) and current OP, Section 4.8.6.

- Noise-sensitive development is not permitted within the 30 NEF/NEP contour lines at the Carp airport.
- Proposed development in the vicinity of Carp airport shall comply with current Transport Canada guidelines.
- Proposed development in the vicinity of Carp airport will comply with TP 312 Aerodrome Standards, and within runway approach surfaces will be subject to the overall building height provisions of the Federal Airport Zoning Regulations and Recommended Practices affecting building heights.
- Prior to Draft Plan of Subdivision approval, exterior lighting specifications need to be defined by a qualified Professional Engineer. Confirmation that the defined criteria comply with the requirements, set by the governing airport authority, will need to be presented to the City prior to the Draft Plan approval.

Easements/ROW
Easements and rights-of-ways must be shown on the plans and information on any existing easements or ROWs, must be provided with the application. There is a concern of access to the agricultural property to the north. It appears that access to that property is along the north-west side of proposed subdivision Lot #1, which is also considered presently as subject to severance. The proposed development will remove access to the mentioned property. Solution needs to be provided.

Roads
Carp Road in Rural Road Network is an Arterial Road and ROW protection of 30.0 m is required, as per new Official plan, Schedule C16 (15 m from the road centre line to the property limit).
Topographic survey needs to confirm the ROW width. If distance between property line and Carp Road centre line is not 15 m, road widening will be required.
Sight line triangles need to be added at the subdivision road intersections with Carp Rad.

As per the Safer Roads initiative (adopted by Council, late 2019), roads must be designed to limit vehicle speeds to 30 km/h (by design, not by signage). Please refer to Transportation Department comments for more information.

Energy conservation
Energy conservation is required to be demonstrated throughout design as per section 4.9 of the Official Plan (reduction of urban heat, renewable energy, mitigation of climate change impacts and others).

Permits and Approvals
The property is within the regulation limit of Mississippi Valley Conservation Authority.

Please contact the Mississippi Valley Conservation Authority (MVCA), amongst other federal and provincial departments/agencies, to identify all the necessary permits and approvals required to facilitate the development. Responsibility rests with the developer and their consultant for determining which approvals are needed and for obtaining all external agency approvals. The address shall be in good standing with all approval agencies. Copies of confirmation of correspondence will be required by the City of Ottawa from all approval agencies that a form of assent is given.
Please note that a stormwater program for multiple lots is understood to be the expanded type of Environmental Compliance Approval (ECA) application with the MECP; please speak with your engineering consultant to understand the impact this has on the application. Note that oil/grit separators require Environmental Technology Verification (ETV) protocol for ECA approval.

If required, an MECP ECA application is not submitted until after City of Ottawa Engineering is satisfied that components directly or indirectly aligned with the ECA process concur with standards, directives, and guidelines of the MECP. No construction shall commence until after a commence work notification is given by Development Review

Hydrogeology
General
Submissions are to be in accordance with the following.

- The City of Ottawa Hydrogeological and Terrain Analysis Guidelines (March, 2021)
- The Carp Road Corridor – Nitrate Impact Assessment Recommendations (City of Ottawa Memorandum, September 2016)
- Ontario's Procedures D-5-4 and D-5-5
- The City of Ottawa Official Plan Section 4.4
- Section 1.6.6.4 of the Provincial Policy Statement

Severance
The hydrogeological and terrain information required to support the proposed single lot severance will be reviewed by City of Ottawa hydrogeological geoscience and other staff. The required information is as follows.

- A hydrogeological and terrain analysis (HGTA) report is required to support the private servicing (well and septic).

- HGTA report must meet the requirement of the City's Hydrogeological and Terrain Analysis Guideline Guidelines (March, 2021); requirements related to severance applications are listed in Section 4.0. Also note that there are special considerations for the septic impact assessment for lots within the Carp Road Corridor (memo dated September 27, 2016), please contact the City planner or hydrogeologist if your hydrogeological consultant does not have a copy of the memo.
- Water quantity and quality: A well must be tested to support the water quantity and water quality. It is recommended that a well be installed onsite, which can be used as the future supply well, however the City Guidelines allow that a near-by technically representative well be used to support severance applications. Note that the supply well must be installed and tested to support an future site plan approval.
    - Support must be provided for the pump test rate; should use the maximum day rate. The rate should consider the actual use (if known), or potential uses permitted through zoning.
    - Must meet the water quality testing requirements outlined in the City Guidelines – i.e. sample for subdivision suite parameters, metals and VOCs. Also consider local existing and historic land use and determine if any additional parameters need to be included (i.e. cemetery, industries, etc.)
- A septic impact assessment is required, as per City Guidelines and the 2016 City memo related to special considerations within the Carp Road Corridor, which includes the use of advance septic treatment (up to 50% nitrate reduction with certified systems). For the severance application, if the use is unknown, then the assessment must be conducted using a proposed reasonable impermeable surface coverage and septic flow, which will be verified at Site Plan Control.
- Note that if the total septic flows for the site will be greater than 10,000 L/day, then an ECA from the MECP will be required for the septic system at Site Plan. If the septic flows are less than 10,000 L/day then a septic assessment is required to ensure that the septic does not impact the local aquifer; the required methodology for the assessment is outlined in the City Guidelines – refer to the predictive assessment for commercial/industrial developments.
- The HGTA report must include a water budget; since the site lies within an area identified as moderate recharge in the Carp Road Corridor CDP; the water budget should show how recharge will be maintained onsite (compared to pre-development conditions).
- The HGTA report should also outline potential onsite activities and risks to existing groundwater users and identify measures that should be implemented to protect the aquifer in the long-term, if needed, to be confirmed at Site Plan.
- The report recommendations section must include clear development recommendations which will be verified at Site Plan Approval, including:
    - Maximum permitted well yield, based on pump test results.
    - Well construction details (if supply well not installed onsite)
    - Maximum septic flow (or maximum employment), maximum impermeable surface and proposed septic system type (if advanced septic treatment is recommended) – based on septic impact assessment calculations
    - Infiltration targets to meet recharge requirements, based on the site-specific water budget
    - Mitigative measures recommended for protection of the aquifer
- At Site Plan Control, additional hydrogeological analyses may be considered if the proposed use exceeds the recommendations. Any additional analyses must meet the requirements of the HGTA Guidelines, to the satisfaction of the City.
- Technical consultation with the hydrogeological reviewer of the severance application is encouraged with the hydrogeological consultant prior to starting field work to help scope report

requirements. Please contact the City hydrogeologist, Tessa Di Iorio (Tessa.diiorio@ottawa.ca) to schedule a technical pre-consultation.

Subdivision

The hydrogeological and terrain information required to support the proposed 11 or 12 lot subdivision will be reviewed by the conservation authority's hydrogeological geoscientist on behalf of the City of Ottawa, as per a formal service agreement. In this way, conservation authority staff are acting on behalf of the City and are not referencing any conservation authority requirements.

High level considerations about the natural hydrogeological and terrain conditions that might impact the proposed subdivision servicing plan and / or scope of investigation include the following.

- The uppermost underlying aquifer is mapped as the Verulam Formation, which is generally considered to be only an inconsistent or marginal producer. Well yield and the acceptability of interference with existing and proposed wells will be especially important to demonstrate.
- There are known issues here and there along the Carp Road Corridor with elevated nitrate and problematic aesthetic parameters. There are also multiple land uses adjacent to the site that should trigger additional chemical analysis of all groundwater samples. The ESA and / or the equivalent work should dictate what additional chemical analyses are needed. If water quality considerations arise, consultation in advance of a formal application is recommended.
- Industrial and commercial development tends to create significant impervious areas, which conflict with the need for rainwater to be able to infiltrate into each lot to dilute septic effluent to acceptable standards. This is to be fully addressed in any submission.
- A water budget assessment will be required to support not only lot sizes, via the nitrate dilution calculations, but also to demonstrate that groundwater recharge is maintained as part of the stormwater management plan. These should be aligned.
- Service locations and design may not be sustainable if only the minimum regulatory requirements from the Wells Regulation and OBC are implemented. The studies that are undertaken to address municipal and provincial planning and development policies should identify what other measures are required to ensure sustainability. In some cases, service location should take precedence over building locations and special well design is needed.

The required investigation and report submission must be respectively supervised and authored by an experienced hydrogeological geoscientist or equivalent engineer. Full information about the required submission is detailed in the City's guideline, to which the link is provided above. In addition, an equivalent summary is provided above in the severance discussion. Note that the severance investigation can be designed to be relevant for and included in the subdivision investigation and submission.

Rather than re-summarizing those requirements then, the following is advised.

Given that there may be well yield and groundwater chemistry / quality issues that arise during the hydrogeological and terrain investigation, it is recommended that the hydrogeological work is phased, and that technical consultation occurs between phases. Technical consultation for the subdivision will be with the designated technical reviewer from the conservation authority. It is recommended that the work proceed as follows.

- A detailed background review and site reconnaissance should be undertaken prior to finalizing the work plan.
- The results of the hydrogeological and terrain work for the severance and the ESA should be used to refine the work plan for the subdivision and integrated into any submission for the subdivision.

- The results of water sample analysis from existing adjacent wells (for all relevant parameters) may be done prior to the main field program as to help gauge the likelihood of existing problems. Otherwise, sampling of adjacent existing water wells would be included in the main field program.
- A work plan should be established which is based on a detailed review of all available background data, rather than generically. It should provide the rationale for test-well and test-pit locations and design and list all methods. Some items that tend to pose issues are elaborated on next.
    - The representative terrain unit investigation should be aligned with any geotechnical work, but the hydrogeologist must be a full participant to all sediment and rock logging work. Further, sediment structure and not just texture and colour should be documented. Photographs are very useful.
    - The work plan should consider if there are existing constraints on service locations, which may dictate testing locations from,
        - non-hydrogeological considerations, such as setbacks from the creek, easements, roads etc.,
        - hydrogeological considerations, such as setbacks from existing services, sources of contamination, outcrops, etc.
    - The work plan should ensure that observation well data can be collected during aquifer tests. Some representative observation well data should be representative of typical separation distances between proposed wells and to existing services from the closest proposed well.
    - Continuous background water level data should be collected prior to and following all aquifer tests to eliminate uncertainties in well recovery datasets and aquifer parameter analysis and to document the baseline interference from existing groundwater users and natural groundwater level fluctuations.
    - Test well construction, purging, disinfection and lithological logging should be fully supervised and documented, and all additional chlorination episodes fully documented, as applicable.
    - Test well design must be representative of future water wells, as to suitably investigate groundwater quality and yield.
    - Well testing must be representative of the greatest water taking (rate and duration) which is permissible by existing zoning, so extended aquifer testing may be required.
    - Residual chlorine measurements must address the level of accuracy and precision needed to ascertain if a groundwater sample is free of chlorine to a level where it is not only undetectable but also non-disinfecting.
    - Sampling plans should be provided, which explain methods:
        - for how required field parameters will be measured, the equipment previously calibrated, the results of calibration and field testing documented to specific levels of accuracy, and what uncertainty is expected
        - Photos of samples and equipment readouts are very useful for considering colour, turbidity, chlorine residual, etc.
        - for filtering and preserving
        - for determining if hydrogen sulphide requires on-site measurement
        - for deciding if and how methane should be measured

- Results should be discussed with the technical reviewer if issues are encountered, prior to application submission.

Please note that following acceptance of the subdivision, each lot will be subject to Site Plan Control. Therefore, the final hydrogeological and terrain analysis, which is submitted with the subdivision application, should provide precise recommendations on a lot-by-lot basis related to the following:

- The types of land use included in the current zoning, which cannot be supported, if applicable.
- The maximum allowable impervious surface area and septic flows, as assessed via the D-5-4 procedure.
- The type of septic treatment that is to be used and that was assessed via the D-5-4 procedure considering the Carp Road Corridor memorandum (i.e., conventional vs. advanced treatment).
- The sustainable and safe water well design
- The maximum sustainable well yield (rate and duration)
- The most suitable service locations to minimize interference but preserve access

These recommendations will become the accepted limitations for private servicing on each lot and will be upheld for each lot at Site Plan Control. Nevertheless, there may be flexibility to amend these limitations if additional investigation is undertaken for the individual lot and that work indicates that a new more intensive private servicing plan is sustainable. The review of such an amended plan would be subject to City review and approval.

Please contact Claire Milloy for questions regarding the subdivision hydrogeological requirements. claire.milloy@rvca.ca

Transportation - Josiane Gervais, josiane.gervais@ottawa.ca

- Follow Traffic Impact Assessment Guidelines
  - Update Screening Form to indicate the anticipated amount of industrial/commercial development. This is required to determine what the impacts will be to Carp Road and should there be any roadway modifications required to support the subdivision.
  - Please submit the revised Screening Form at your earliest convenience to Josiane.gervais@ottawa.ca. The Screening Form will be reviewed to determine if a TIA is required.
  - Start this process asap.
  - The application will not be deemed complete until the submission of the draft step 1-4, including the functional draft RMA package (if applicable), draft functional plans (if applicable) and/or monitoring report (if applicable).
  - Request base mapping asap if RMA is required. Contact Engineering Services (https://ottawa.ca/en/city-hall/planning-and-development/engineering-services)
- Local roadways are to be designed for a 30km/hr operating speed.
- Local roads and collector roads in the rural area must have a 20m and 26m ROW, respectively.
- Geometric Road Design Drawings (GRDD) will be required with the first submission of underground infrastructure and grading drawings. These drawings should include such items as, but are not limited to:
  - Road signage and pavement markings;
  - Location of depressed curbs and tactile walking surface indicators (TWSI);
  - Traffic calming measures aimed at reducing vehicle speed and enhancing pedestrian safety. Measures may include either vertical or horizontal features, however such measures shall not interfere with stormwater management and overland flow routing. Traffic calming measures shall reference best management practices from the Canadian Guide to Neighbourhood Traffic Calming, published by the Transportation Association of Canada, and/or Ontario Traffic Manual, and/or the City of Ottawa's Traffic Calming Design Guidelines;

    - Intersection control measures at new internal intersections;
    - Consideration should be made to include mini roundabouts where feasible throughout the subdivision.
- ROW protection on Carp Road between March and Richardson Side is 30m even.

Environmental - Sami Rehman, Sami.Rehman@ottawa.ca

- It is assumed that lot 1 identified in the draft concept plan for TLC Holdings will be the proposed severance. If so, there are little environmental concern for the single severance. It has been identified as moderate recharge are and may require a groundwater impact assessment (Carp Rd Corridor CDP, Section 3, policy 3).
- For the proposed plan of subdivision, our data indicates a watercourse in the eastern corner of the property. As such, an Environmental Impact Study (EIS) will be required to determine the minimum watercourse setbacks (see OP 4.9). The EIS should also investigate potential significant habitat for threatened or endangered species on or adjacent to the subject property.
- The plan of subdivision will also require a Tree Conservation Report (TCR). This can be combined with the EIS to avoid duplications.
- Here are the links to the Environmental Impact Statement Guidelines and the Tree Conservation Report Guidelines.

Parks

- Severance for commercial or Industrial purposes: As a condition of severance, the General Manager shall require cash-in-lieu of parkland, as well as the fee for appraisal services. Commercial and Industrial uses are expected to convey parkland at a rate of 2 % of the gross land area.
- Industrial Subdivision: Upon subdivision registration, the General Manager shall require cash-in-lieu of parkland, as well as the fee for appraisal services. Commercial and Industrial uses are expected to convey parkland at a rate of 2 % of the gross land area.
- Please address parkland dedication in the planning rationale for each application.
- A property survey will be required to confirm the gross land area being developed with each application.
- Please note that Parks and Facilities Planning has recently undertaken a legislated replacement of the Parkland Dedication By-law, with the new by-law approved by City Council on August 31, 2022. To ensure you are aware of parkland dedication requirements for your proposed development, we encourage you to familiarize yourself with the staff report and By-Law that were approved by Council on August 31, 2022.
- Please contact the Parks and Faculties Planner anissa.mcalpine@ottawa.ca if you have any questions.

City Surveyor

- The determination of property boundaries, minimum setbacks and other regulatory constraints are a critical component of development. An Ontario Land Surveyor (O.L.S.) needs to be consulted at the outset of a project to ensure properties are properly defined and can be used as the geospatial framework for the development.
- Topographic details may also be required for a project and should be either carried out by the O.L.S. that has provided the Legal Survey or done in consultation with the O.L.S. to ensure that the project is integrated to the appropriate control network.

Questions regarding the above requirements can be directed to the City's Surveyor, Bill Harper, at Bill.Harper@ottawa.ca

Conservation Authority - Mercedes Liedtke mliedtke@mvc.on.ca

Severance (Lot 1, 11, or 12)

- The subject property is not regulated by MVCA under Ontario Regulation 153/06.
- If stormwater management is required, MVCA would review the proposal for water quantity and quality impacts on the receiving watercourse.

Subdivision:

- The watercourse on the property is regulated by the Mississippi Valley Conservation Authority (MVCA) under Ontario Regulation 153/06, *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.* Under Ontario Regulation 153/06, written permission is required from the MVCA prior to the initiation of development (which includes construction, site grading and the placement or removal of fill) within an area regulated by the Conservation Authority as well as straightening, changing, diverting or interfering in any way with the existing channel or the shoreline of a watercourse.
- MVCA recommends that a headwater drainage feature assessment be completed for the identified watercourse on proposed lot 7.
- A stormwater management report will be required with the subdivision submission:
    a. 80% TSS removal, or enhanced level of protection is recommended, but 70%, or normal level of protection is required as per the Carp River Watershed Subwatershed Study.
- The property is within the Carp River Watershed Subwatershed Study area, and was outlined in the Carp Road Corridor Community Design Plan which has an annual infiltration target outlined below. Existing infiltration rates on site should be assessed and maintained post development.
    a. Moderate groundwater recharge area 104 mm/year infiltration

Submission requirements and fees

- Severance
    - Planning Rationale/Cover Letter
    - Hydrogeological and Terrain analysis and report
    - Storm water investigation
        - brief analysis - please see comments above
    - Geotechnical Investigation and Slope Stability Report
        - might be required (please see comments above)
- Subdivision
    - Draft Plan of Subdivision
    - Planning Rationale
    - Archaeological Assessment
    - Private Servicing Plan
    - Preliminary Grading Plan
        - (Provisional Grading Plan can be submitted with application submission and then Grade Control and Drainage Plan as a condition of draft approval)
    - Drainage Plan (SWM Plan to be included)
    - Erosion and Sediment Control Plan
    - Lighting Plan
        - (proximity to Carp Airport – lighting constraints to be defined)
    - Hydrogeological and Terrain analysis and report
    - Baseline Well Water Quality Sampling report
    - Geotechnical Investigation and report
        - (The geotechnical consultant will need to provide full copies of any published and peer reviewed papers relied on, to determine results and conclusions; Earthquake analysis and potential for Seismic liquefaction analysis are also

required to be undertaken and details provided in the report; Slope Stability Study might also be required – grading dependent)
    - Subdivision Servicing Study and Report (Water & Sanitary Private servicing)
    - Storm Water Management Report
    - Noise Control Feasibility Study
        - (to control stationary noise produced by industrial component of the proposed subdivision)
    - Noise and Vibration Study (due to proximity to Carp airport and Carp Road)
    - Phase 1 Environmental Site Assessment (ESA)
    - Phase 2 Environmental Site Assessment (ESA)
        - if required based on outcome of Phase 1 (refer to Environmental Site Assessment comments above)
    - Fluvial Geomorphology Report
        - may be required (identified watercourse on site – NE corner)
    - Environmental Impact Study
    - Transportation Impact Assessment (depending on Screening Form)
- Additional information regarding fees related to planning applications can be found here.
- Guide to preparing City of Ottawa Studies and Plans
- To request City of Ottawa plan(s) or report information please contact the ISD Information Centre: Information Centre (informationcentre@ottawa.ca): (613) 580-2424 ext. 44455
- Plans are to be standard A1 size (594 mm x 841 mm) or Arch D size (609.6 mm x 914.4 mm) sheets, dimensioned in metric and utilizing an appropriate Metric scale (1:200, 1:250, 1:300, 1:400 or 1:500).
- All PDF submitted documents are to be unlocked and flattened.

Next steps

- You are encouraged to discuss the proposal with Councillor, community groups and neighbours.

BluMetric Environmental Inc.

1682 Woodward Drive
Ottawa, Ontario
Canada K2C 3R8
Tel: 613.839.3053
Fax: 613.839.5376
ottawa@blumetric.ca

4 Cataraqui Street
The Tower, The Woolen Mill
Kingston, Ontario
Canada K7K 1Z7
Tel: 613.531.2725
kingston@blumetric.ca

209 Frederick Street
Unit 3B
Kitchener, Ontario
Canada N2H 2M7
Tel: 519.742.6685
kitchener@blumetric.ca

825 Milner Avenue
Toronto, Ontario
Canada M1B 3C3
Tel: 877.487.8436
toronto@blumetric.ca

410 Falconbridge Road
Unit 6
Sudbury, Ontario
Canada P3A 4S4
Tel: 705.525.6075
sudbury@blumetric.ca

1046 Gorham Street
Thunder Bay, Ontario
Canada P7B 5X5
Tel: 807.707.4736
thunderbay@blumetric.ca

4-41 de Valcourt Street
Gatineau, Quebec
Canada J8T 8G9
Tel: 819.243.7555
gatineau@blumetric.ca

1500 du College Street
Suite 200
Saint-Laurent, Quebec
Canada H4L 5G6
Tel: 514.844.7199
montreal@blumetric.ca

4916 – 49th Street
Yellowknife, NT
Canada X1A 1P3
Tel: 867.873.3500
Fax: 867.873.3499
yellowknife@blumetric.ca

202b Strickland Street
Whitehorse, Yukon
Canada Y1A 2J8
Tel: 867.689.8465
whitehorse@blumetric.ca

www.blumetric.ca

APPENDIX C

MECP Water Well Record Summary

MECP Water Well Record Compilation
(3160 Carp Road- 500 m search radius)

Well ID	Completed	Depth (m)	Depth to Bedrock (m)	Static Water Level (m bgs)	Water Found (m bgs)	Casing Length (m bgs)	Recommended Pumping Rate (litres per minute)	Water Detail	Well Use
7049976	24-05-07	-	-	-	-	-	-	-	-
1503068	03-05-61	30.5	4.3	3	29.9	3.0	19.0	FR	DO
1503070	05-06-64	32	21.6	6.1	21.6, 32	6.1	19.0	FR	DO
1503123	05-12-59	37.8	3.7	4.9	37.2	3.0	26.5	FR	ST
1503125	05-05-62	38.7	1.8	4.9	38.1	7.0	19.0	FR	DO
1503126	03-09-64	32.9	3.7	7	21.6, 32.9	3.0	19.0	FR	DO
1503128	05-09-60	29.3	11.0	3.7	28.7	11.0	11.4	FR	PS
1511759	03-05-72	42.4	3.4	6.7	42.4	6.1	19.0	FR	DO
1511921	06-05-72	43	2.7	6.1	27.4, 42.1	6.7	19.0	FR	DO
1512197	06-12-72	57.3	14.3	3	24.4, 57	14.6	19.0	SU	IN
1512382	18-09-68	39.3	3.0	3	19.2, 39.3	6.1	-	FR	DO
1513273	18-04-73	79.2	9.8	4.6	78	10.7	19.0	SU	DO
1514247	08-07-74	18.9	9.1	7.6	13.4, 18.3	0.9	19.0	FR	DO
1514608	18-10-72	24.4	8.8	3	21.6	9.8	-	UK	DO
1517689	11-11-81	65.5	24.1	2.4	25.3, 56.4	25.6	15.2	FR	DO
1516579	27-06-78	19.5	12.8	6.1	18.3	13.7	19.0	FR	-
1516828	01-11-78	44.2	10.7	12.2	44.2	11.9	19.0	FR	DO
1517526	22-10-80	45.7	4.0	6.1	14.6, 44.2	6.4	19.0	UK	DO
1517781	30-09-81	90.8	4.6	6.1	9.1, 88.4	6.7	19.0	FR	DO
1517897	24-06-82	39	2.4	7.9	38.1	6.7	37.9	FR	DO
1519074	05-06-84	79.2	2.4	6.1	47.2, 76.2	6.7	19.0	SU	ST
1523034	03-11-88	48.8	5.8	4.6	27.4, 48.2	6.4	22.7	FR	DO
1523175	19-08-88	50.3	-	-	49.7	49.7	22.7	FR	DO
1524583	26-06-90	61	9.1	-	44.2, 57.9	10.1	-	FR	DO
1535787	20-09-05	27.4	-	5.9	22.4	7.9	-	-	MN
1536029	10-11-05	8.9	8.8	6.3	7.9	7.9	30.0	FR	CO
7035379	28-07-06	3.8	-	-	-	-	-	-	-
7193278	24-10-12	10.4	10.4	-	4.2	-	-	-	MO
7199876	20-03-13	48.8	6.2	4.9	42.7	10.5	26.5	UT	CO
7205575	13-06-13	78.6	2.3	3.2	48.8, 70.1	10.4	17.1	UT	DO
7205576	07-06-13	48.5	11.0	1.5	44.8	12.5	19.0	UT	DO
7205577	05-06-13	48.8	14.8	1.1	42.672	16.3	3.7	UT	DO
7257727	14-10-15	70.4	3.7	6.1	24.4, 64	6.1	37.9	UT	CO
7266948	20-06-16	22.9	6.1	2.7	9.1, 19.8	6.7	37.9	UT	DO

Project: 102151.001
Date: Dec 2023

MECP Water Well Record Compilation
(3160 Carp Road- 500 m search radius)

Well ID	Completed	Depth (m)	Depth to Bedrock (m)	Static Water Level (m bgs)	Water Found (m bgs)	Casing Length (m bgs)	Recommended Pumping Rate (litres per minute)	Water Detail	Well Use
7334825	06-03-19	61	8.2	4.1	58.8	12.8	11.4	UT	DO
7334826	07-03-19	61	7.0	2.9	56.4	11.6	19.0	UT	DO
7340319	19-06-19	61	7.6	1.4	16.2, 51.8	12.2	19.0	UT	DO
7340320	19-06-19	61	7.9	4.2	57.9	12.8	0.9	UT	DO
7347647	04-11-19	54.9	0.0	4.6	24.384	18.4	34.1	UT	DO

https://www.ontario.ca/page/map-well-records

"Well Use"

DO	Domestic
ST	Livestock
IR	Irrigation
IN	Industrial
CO	Commercial
MN	Municipal
PS	Public
AC	Cooling and A/C
NU	Not Used
OT	Other
TH	Test Hole
DE	Dewatering
MO	Monitoring
MT	Monitoring Test

"Water Detail"

FR	Fresh
SA	Salty
SU	Sulphur
MN	Mineral
UK	Unknown
GS	Gas
IR	Iron

GEMTEC
Consulting Engineers and Scientists

Project: 102151.001
Date: Dec 2023

APPENDIX D

Record of Test Pit and Borehole Sheets

RECORD OF BOREHOLE 19-1D

CLIENT: Novatech
PROJECT: Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 9 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface									Above ground protector
		Dark brown silty sand, with organic material (TOPSOIL)		0.20							
		Brown SILTY SAND		0.31	1	SS	533	5			
		Grey brown SILTY CLAY, some sand									
		Brown SILTY SAND, trace clay		0.61	2	SS	610	11			
1		Grey brown SILTY CLAY		0.91							
		Brown SILTY SAND, trace clay		1.04							
		Grey brown SILTY CLAY with silty sand seems		1.22	3	SS	610	10			
		Grey brown silty sand, some gravel, trace to some clay (GLACIAL TILL)		1.65							
2		Grey sandy silt / silty sand, some gravel, cobbles, and boulders (GLACIAL TILL)		1.83	4	SS	610	26			Bentonite
					5	SS	610	33			
3					6	SS	406	89			
					7	SS	200	65			
4					8	SS	100	68			Filter Sand
5					9	SS	279	59			50 mm diameter, 1.52 m length slotted PVC Pipe
					10	SS	483	43			
6					11	SS	381	50			
					12	SS	76	50			
7					13	SS	51	50			
8					14	SS	127	50			Slough
					15	SS	203	90			
9		Auger refusal on inferred bedrock End of borehole		9.17							
10											

GEO - BOREHOLE LOG 64819.03_BOREHOLE LOGS_GNT_V01_2019-07-10.GPJ GEMTEC 2018.GDT 21/8/19

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED:

RECORD OF BOREHOLE 19-1S

CLIENT: Novatech
PROJECT: Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 9 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, mm	SAMPLES: BLOWS/0.3m	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)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface							10 20 30 40 50 60 70 80 90		Above ground protector
		Soil conditions not logged									Bentonite
1											
2											Filter Sand
3				3.05							50 mm diameter, 1.52 m length slotted PVC Pipe
4											
5											
6											
7											
8											
9											
10											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED:

GEO - BOREHOLE LOG 64819.03_BOREHOLE LOGS_GNT_V01_2019-07-10.GPJ GEMTEC 2018.GDT 21/8/19

RECORD OF BOREHOLE 19-3D

CLIENT: Novatech
PROJECT: Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Borehole Location Plan, Figure 1

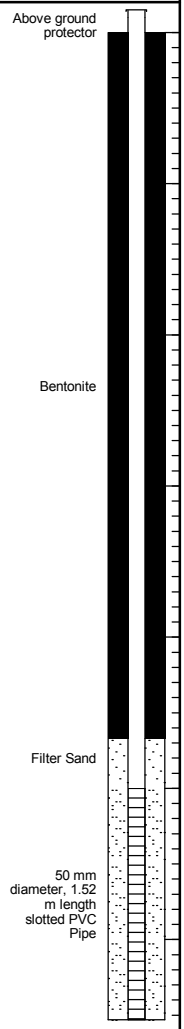
SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 10 2019

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						
		Dark brown silty sand, with organic material (TOPSOIL)		0.13	1	SS	330	16
		Grey brown sandy silt / silty sand, some gravel cobbles boulders (GLACIAL TILL)			2	SS	178	103
1					3	SS	229	85
2					4	SS	150	110
3					5	SS	610	58
					6	SS	381	84
4					7	SS	178	66
5					8	SS	310	92
6					9	SS	53	50
		Auger refusal on inferred bedrock End of borehole		6.53				
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



GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED:

GEO - BOREHOLE LOG 64819.03_BOREHOLE LOGS_GNT_V01_2019-07-10.GPJ GEMTEC 2018.GDT 21/8/19

RECORD OF BOREHOLE 19-3S

CLIENT: Novatech
PROJECT: Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 10 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	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)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface							10 20 30 40 50 60 70 80 90		Above ground protector
		Soil conditions not logged									Bentonite
3											Filter Sand
											50 mm diameter, 1.52 m length slotted PVC Pipe
				4.57							
10											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED:

GEO - BOREHOLE LOG 64819.03_BOREHOLE LOGS_GNT_V01_2019-07-10.GPJ GEMTEC 2018.GDT 21/8/19

RECORD OF BOREHOLE 19-4S

CLIENT: Novatech
PROJECT: Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Borehole Location Plan, Figure 1

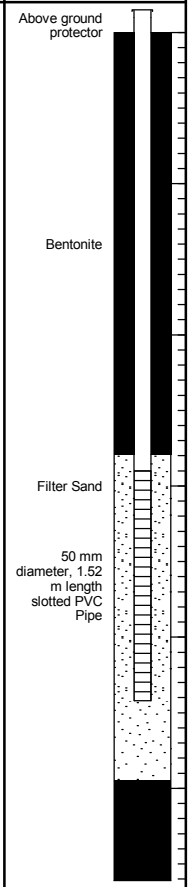
SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 10 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface						
		Dark brown silty sand, with organic material (TOPSOIL)		0.20	1	SS	406	9
		Reddish brown SILTY SAND, trace gravel		0.41				
1		Grey brown silty sand, some gravel, cobbles and boulders (GLACIAL TILL)			2	SS	254	8
					3	SS	330	43
2					4	SS	559	77
					5	SS	610	76
3								
		Grey brown silty sand / sandy silt, some gravel cobbles and boulders (GLACIAL TILL)		3.10	6	SS	381	92
					7	SS	406	83
4								
					8	SS	356	36
5								
		Auger refusal on boulders End of borehole		5.61				
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



GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED:

GEO - BOREHOLE LOG 64819.03_BOREHOLE LOGS_GNT_V01_2019-07-10.GPJ GEMTEC 2018.GDT 21/8/19

RECORD OF BOREHOLE 18-1

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m; DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m; SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED); WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface							10 20 30 40 50 60 70 80 90		
		Dark brown silty sand, with organic material (TOPSOIL)			1	GS					Test pit backfilled with excavated material
		Brown, fine to medium grained SAND, trace to some silt		0.23	2	GS					
1	Excavator CASE CX135 sr	Grey brown, fine to coarse grained SAND, trace silt, trace to some gravel, cobbles and boulders, some sandy silt pockets with depth (GLACIAL TILL)		0.91	3	GS					
2											
3					4	GS					
		End of Test Pit		3.05							No groundwater observed upon completion of test pit
4											
5											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-2

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-2

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface								Test pit backfilled with excavated material
		Dark brown silty sand, with organic material (TOPSOIL)								
		Brown SILTY SAND, some roots		0.18	1	GS				
1		Grey brown SILTY SAND		0.61	2	GS				
		Grey SANDY SILT / SILTY SAND, some gravel cobbles and boulders (GLACIAL TILL)		1.14	3	GS				
2					4	GS				
3		Practical shovel refusal on possible bedrock End of Test Pit		2.90						No groundwater observed upon completion of test pit
4										
5										

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-3

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-3

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0		Ground Surface						
	Excavator CASE CX135 sr	Dark brown silty sand, with organic material (TOPSOIL)						
		Grey brown SILTY SAND		0.15	1	GS		
		Grey brown SILTY CLAY (WEATHERED CRUST)		0.41	2	GS		
1		Grey brown, silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		0.94	3	GS		
2		Practical shovel refusal at 1.52 m on possible bedrock at two locations within test pit End of Test Pit		2.44				
3								
4								
5								

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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

Test pit backfilled with excavated material

No groundwater observed upon completion of test pit

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-4

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-4

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, mm	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface								
		Dark brown silty sand, with organic material (TOPSOIL)								Test pit backfilled with excavated material
		Grey brown SILTY CLAY (WEATHERED CRUST)		0.18	1	GS				
1		Grey brown silty sand, trace clay, some gravel, cobbles and boulders (GLACIAL TILL)		0.53	2	GS				
	Excavator CASE CX135 sr	Grey brown silty sand, trace clay, some gravel, cobbles and boulders, with pockets of grey SILTY CLAY on one side of test pit (GLACIAL TILL)		1.17	3	GS				
2					4	GS				
3		End of Test Pit		3.05						Groundwater seepage at 0.91 m below ground surface
4										
5										

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

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-5

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-5

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface							10 20 30 40 50 60 70 80 90		
		Dark brown silty sand, with organic material (TOPSOIL)									Test pit backfilled with excavated material
		Brown SILTY SAND		0.23							
1		Grey silty sand, some gravel, cobbles, and boulders (GLACIAL TILL)		0.97							
2											
3		End of Test Pit		3.05							No groundwater observed upon completion of test pit
4											
5											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-6

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-6

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface								Test pit backfilled with excavated material
		Dark brown silty sand, with organic material (TOPSOIL)								
		Brown SILTY SAND		0.36	1	GS				
		Grey brown SILTY CLAY (WEATHERED CRUST)		0.61	2	GS				
1		Grey silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		1.02	3	GS				
2										
3		Practical shovel refusal within Glacial Till End of Test Pit		2.90						No groundwater observed upon completion of test pit
4										
5										

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-7

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-7

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface							10 20 30 40 50 60 70 80 90		
		Dark brown silty sand, with organic material (TOPSOIL)									Test pit backfilled with excavated material
		Brown SILTY SAND		0.20							
1		Grey silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		0.76							
2											
3		End of Test Pit		3.05							No groundwater observed upon completion of test pit
4											
5											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-8

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-8

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, mm	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface								Test pit backfilled with excavated material
		Dark brown clayey silt, with organic material (TOPSOIL)								
		Grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		0.23						
1		Grey brown SILTY SAND, trace clay		1.70	1	GS				
2		Boulder encountered underlain by grey SILTY CLAY Note: Unable to determine depth of SILTY CLAY due to side wall shearing		1.98	2	GS				Groundwater seepage at 1.52 metres below ground surface
3		Test pit lost due to side wall shearing End of Test Pit		3.05						
4										
5										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-9

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-9

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface								
		Dark brown silty sand, with organic material (TOPSOIL)								Test pit backfilled with excavated material
		Grey brown SILTY SAND		0.20						
1		Grey brown silty sand, some gravel, cobbles, and boulders (GLACIAL TILL)		0.48						
2										
3		Practical shovel refusal within Glacial Till End of Test Pit		3.05						No groundwater observed upon completion of test pit
4										
5										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-10

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-10

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

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 (N), BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface							10 20 30 40 50 60 70 80 90		
		Dark brown silty sand, with organic material (TOPSOIL)									Test pit backfilled with excavated material
		Grey brown SILTY CLAY (WEATHERED CRUST)		0.15							
1		Grey brown silty sand, trace clay, some gravel, cobbles and boulders (GLACIAL TILL)		0.94							
2											
3		Practical shovel refusal within Glacial Till End of Test Pit		3.05							No groundwater observed upon completion of test pit
4											
5											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-11

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-11

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface									
		Dark brown clayey silt, with organic material (TOPSOIL)									Test pit backfilled with excavated material
				0.23							
1	Excavator CASE CX135 sr	Grey brown SILTY CLAY (WEATHERED CRUST)									
				1.32							
2		Grey silty sand, some gravel, cobbles and boulders (GLACIAL TILL)									
		Practical shovel refusal within Glacial Till		2.29							No groundwater observed upon completion of test pit
		End of Test Pit									
3											
4											
5											

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-12

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-12

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface									
		Dark brown silty sand, with organic material (TOPSOIL)									
		Brown SILTY SAND		0.23							
1		Grey brown, silty sand, some gravel cobbles and boulders (GLACIAL TILL)		0.76							Test pit backfilled with excavated material
2											
3		Practical shovel refusal within Glacial Till End of Test Pit		2.90							No groundwater observed upon completion of test pit
4											
5											

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-13

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-13

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
0		Ground Surface		
		Dark brown clayey silt, with organic material (TOPSOIL)		
		Grey brown SILTY SAND, some gravel and cobbles		0.31
1		Grey brown SILTY CLAY (WEATHERED CRUST)		1.14
				1.27
	Excavator CASE CX135 sr	Grey brown SILTY SAND		1.32
		Grey brown SILTY CLAY (WEATHERED CRUST)		
2				
		Grey silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		2.59
3		Practical shovel refusal within Glacial Till End of Test Pit		3.05
4				
5				

SAMPLES: NUMBER | TYPE | RECOVERY, mm | BLOWS/0.3m

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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

Test pit backfilled with excavated material

Groundwater seepage at 1.27 metres below ground surface

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-14

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-14

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Excavator CASE CX135 sr	Ground Surface								
		Dark brown silty sand, with organic material (TOPSOIL)			1	GS				Test pit backfilled with excavated material
		Brown SANDY SILT		0.23	2	GS				
1		Grey brown sandy silt, trace to some gravel, cobbles and boulders (GLACIAL TILL)		0.79	3	GS				
2		Practical shovel refusal on possible bedrock End of Test Pit		1.83						No groundwater observed upon completion of test pit
3										
4										
5										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), 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: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 18-15

CLIENT: Novatech
PROJECT: Industrial Subdivision Hydrogeological Investigation
JOB#: 64819.03
LOCATION: See Test Pit Location Plan, Figure 2

Correction: Record of Test Pit 18-15

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Nov 22 2018

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m; DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m; SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED); WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface							10 20 30 40 50 60 70 80 90		
		Dark brown clayey silt, with organic material (TOPSOIL)									Test pit backfilled with excavated material
		Grey brown SILTY CLAY, some sand (WEATHERED CRUST)		0.53							
1		Grey brown SILTY SAND		1.07							
2	Excavator CASE CX135 sr										
		Grey SILTY CLAY		2.57							
3											
		Grey silty clay, some gravel cobbles and boulders (GLACIAL TILL)		3.66							
4											Groundwater seepage at about 2.57 metres below ground surface
		Test pit lost due to side walls shearing End of Test Pit		4.27							
5											

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: A.P.

GEO - BOREHOLE LOG 64819.03_TEST PIT LOGS_GNT_V01_2018-11-26.GPJ GEMTEC 2018.GDT 10/12/18

RECORD OF BOREHOLE 23-01

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 18 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		115.75				
0	Power Auger / Hollow Stem Auger (210mm OD)	TOPSOIL		115.50				
		Loose, brown SILTY SAND, with rootlets		0.25	1	SS	405	7
				114.99				
		Grey brown SILTY SAND, trace to some clay		0.76				
1				114.79				
		Stiff to very stiff, grey brown SILTY CLAY, with sand seams (WEATHERED CRUST)		0.96	2	SS	535	7
				114.23				
		Compact to very dense, grey brown SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		1.52	3	SS	155	27
2					4	SS	430	26
3					5	SS	155	87
				111.94				
		Dense, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		3.81	6	SS	405	46
4				111.33				
		End of Borehole		4.42				
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

Auger Cuttings

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-03

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 18 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		112.76						
0	Power Auger / Hollow Stem Auger (210mm OD)	TOPSOIL		112.61						
		Very loose, grey brown SILTY SAND, trace to some clay		0.15	1	SS	380	WH		
				112.00						
1		Compact, grey brown SILTY SAND, some clay		0.76	2	SS	585	21		
				111.24						
		Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		1.52	3	SS	610	8		
2				110.48						Auger Cuttings
		Loose to compact, grey brown SILTY SAND to SANDY SILT, some gravel, with cobbles and boulders (GLACIAL TILL)		2.28	4	SS	380	8		
3					5	SS	535	20		
				109.11						
		End of Borehole		3.65						
4										
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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-04

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 18 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		110.49						
0	Power Auger / Hollow Stem Auger (210mm OD)	TOPSOIL		110.29						
		Loose, grey brown SILTY SAND, with rootlets		0.20	1	SS	510	4		
				109.73						
1		Loose to compact, grey brown SAND, some silt, with silty clay seams		0.76	2	SS	510	9		
					3	SS	460	12	MH	Auger Cuttings
2				108.21						
		Dense to very dense, grey brown SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		2.28	4	SS	405	51		
3					5	SS	430	57		
4					6	SS	205	49		
				106.07						
		End of Borehole		4.42						
5										
6										
7										
8										
9										
10										

SOIL PROFILE / 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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-06

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 20 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		110.29				
0	Power Auger / Hollow Stem Auger (210mm OD)	TOPSOIL		109.99	1	SS	355	5
		Grey brown SILTY SAND, trace clay, with rootlets		0.30				
				109.53				
1		Loose to very dense, grey brown SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		0.76	2	SS	560	6
2					3	SS	305	46
					4	SS	610	41
3					5	SS	305	50
4					6	SS	405	>50
5					7	SS	510	72
					8	SS	305	62
6					9	SS	480	36
7					10	SS	480	82
8					11	SS	330	77
					12	SS	330	59
9		End of Borehole Note: Auger refusal occured at 8.53 metres depth		101.30 8.99				
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: MH

PIEZOMETER OR STANDPIPE INSTALLATION: Auger Cuttings

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-07

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

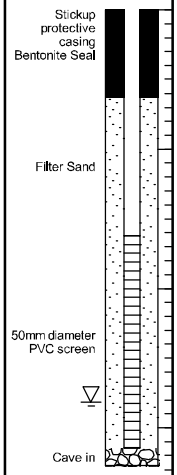
SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 20 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		112.82				
0	Power Auger / Hollow Stem Auger (210mm OD)	TOPSOIL		112.52	1	SS	355	1
		Brown SILTY SAND, with rootlets		0.30				
				112.06				
1		Loose, grey brown SILTY SAND, some gravel, trace clay		0.76	2	SS	405	7
				111.30				
		Dense, grey brown SILTY SAND, trace to some gravel, with cobbles and boulders (GLACIAL TILL)		1.52	3	SS	460	43
2					4	SS	330	>50
3					5	SS	50	> 50
				109.55				
		End of Borehole Auger Refusal		3.27				
4								
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)
23/04/27	2.82 ▽	110.0

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-08

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 18 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface		110.28						Auger Cuttings
		TOPSOIL		110.08						
		Brown SILTY SAND, trace clay, with rootlets		0.20	1	SS	430	7		
				109.52						
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.76	2	SS	610	5	MH	
2					3	SS	610	3		
		Very loose, grey SILT and SAND		2.13						
					4	SS	175	WH		
				107.39						
3		Very loose, grey sandy SILT and CLAY, with cobbles and boulders (GLACIAL TILL)		2.89						
					5	SS	380	WH	MH	
4				105.84						
		End of Borehole Auger Refusal		4.44						
5										
6										
7										
8										
9										
10										

SOIL PROFILE / 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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-10

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 19 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger; Hollow Stem Auger (210mm OD)	Ground Surface		114.14						
		TOPSOIL		113.99						
		Grey SAND and GRAVEL, with cobbles and boulders (GLACIAL TILL)		0.15	1	SS	205	17		
				113.38						
1		Loose, grey brown, SILTY SAND, trace gravel (GLACIAL TILL)		0.76	2	SS	405	4		
				112.62						
		Very dense, grey brown, SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		1.52	3	SS	75	>50		
2					4	SS	180	>50		
3					5	SS	0	>50		
4					6	SS	355	>50		
				109.90						
		End of Borehole Auger Refusal		4.24						
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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-11

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 18 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		111.49						
0		TOPSOIL		111.29						
	Power Auger / Hollow Stem Auger (210mm OD)	Loose to compact, grey brown SILTY SAND, trace to some clay		0.20	1	SS	510	11		
1					2	SS	510	11		
2					3	SS	610	5		Auger Cuttings
				109.21						
		Dense to very dense, grey brown SILTY SAND and GRAVEL, with cobbles and boulders (GLACIAL TILL)		2.28	4	SS	205	32		
3					5	SS	510	72		
4					6	SS	305	102		
				107.07						
		End of Borehole		4.42						
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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-13

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 19 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 (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface		111.69							
		TOPSOIL		111.41							
		Loose to compact, grey brown SILTY SAND, trace to some gravel		0.28	1	SS	405	4			
1					2	SS	330	10			
		Still to very stiff, grey brown SILTY CLAY, with silty sand seams (WEATHERED CRUST)		110.17 1.52	3	SS	610	2			
2											Auger Cuttings
		Very dense, grey SILTY SAND and GRAVEL, with cobbles and boulders (GLACIAL TILL)		109.41 2.28	4	SS	50	>50			
3					5	SS	405	100			
					6	SS	205	>50			
4		End of Borehole Spoon Refusal		107.63 4.06							
5											
6											
7											
8											
9											
10											

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-14

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 19 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		116.33						
0	Power Auger Hollow Stem Auger (210mm OD)	TOPSOIL		116.05						
		Loose, grey brown SILTY SAND		0.28	1	SS	50	6		
1					2	SS	380	7		Auger Cuttings
		Very dense, grey brown SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		114.96 1.37	3	SS	25	>50		
2					4	SS	180	>50		
		End of Borehole Auger Refusal		113.77 2.56						
3										
4										
5										
6										
7										
8										
9										
10										

SAMPLES

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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 23-15

CLIENT: TLC Holdings Ltd.
PROJECT: Geotechnical Investigation, Proposed Plan of Subdivision, 3112 Carp Road, Ottawa, Ontario
JOB#: 102151.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Apr 19 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		111.47						
0	Power Auger / Hollow Stem Auger (210mm OD)	TOPSOIL		111.27						
		Loose, brown SILTY SAND, with rootlets		0.20	1	SS	330	7		
				110.71						
1		Compact, grey brown SILTY SAND, trace clay		0.76	2	SS	460	11		
				109.95						
		Compact, brown SILTY SAND		1.52	3	SS	355	17		
2				109.19						
		Very loose, grey SANDY SILT		2.28	4	SS	560	1		Auger Cuttings
				108.42						
3		Grey brown SAND, some silt		3.05						
				108.12	5	SS	430	20		
		Grey brown SILTY CLAY with sand seams (WEATHERED CRUST)		3.35						
				107.66						
4		Dense to very dense, grey brown SILTY SAND and GRAVEL, trace clay, with cobbles and boulders (GLACIAL TILL)		3.81	6	SS	330	38		
					7	SS	230	>50		
5				106.44						
		End of Borehole Auger Refusal		5.03						
6										
7										
8										
9										
10										

SOIL PROFILE / 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

GEMTEC
Consulting Engineers and Scientists

LOGGED: CC
CHECKED: TM

GEO - BOREHOLE LOG 102151.001 BH LOGS 2023-04-24.GPJ GEMTEC 2018.GDT 3/20/26

RECORD OF BOREHOLE 24-1

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	SAMPLE DATA: TYPE	SAMPLE DATA: RECOVERY (mm)	SAMPLE DATA: BLOWS/0.3m	SAMPLE DATA: LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		114.70									
0	Direct Push	Topsoil		114.50									
		Brown silty sand with trace clay and some organics - Wet		0.20	1	SS	406		OC Pesticides, Metals	HEX: 40; IBL: 0	None		Native backfill
				113.94									
		End of borehole (No refusal)		0.76									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-2

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		114.20									
0	Direct Push	Topsoil		113.97									
		Brown silty sand with trace clay and some organics - Wet		0.23	1	SS	609		OC Pesticides, Metals	HEX: 15; IBL: 1	None		Native backfill
				113.44									
		End of borehole (No refusal)		0.76									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-3

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		112.34									
0	Direct Push	Topsoil		112.13									
		Brown silty sand with trace gravel and clay - Wet		0.21	1	SS	305		PHC F1-F4/BTEX, PAHs, M&Is	HEX: 10; IBL: 0	None		Native backfill
1					2	SS	305			HEX: 10; IBL: 0	None		
		End of borehole (No refusal)		110.82 1.52									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-4

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		110.56									
0	Direct Push	Topsoil		110.29									
		Brown silty sand with trace clay and some organics - Wet		0.27	1	SS	762		OC Pesticides, Metals	HEX: 5; IBL: 0	None		Native backfill
				109.80									
		End of borehole (No refusal)		0.76									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-5

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		110.79									
0	Direct Push	Topsoil		110.59									
		Brown silty sand with trace gravel and clay - Wet		0.20	1	SS	203			HEX: 5; IBL: 0	None		Native backfill
1					2	SS	406		PHC F1-F4/BTEX, PAHs, M&Is	HEX: 10; IBL: 2	None		
		End of borehole (No refusal)		109.27 1.52									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-6

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		113.67									
0	Direct Push	Topsoil		113.42									
		Brown silty sand with trace gravel and clay - Wet		0.25	1	SS	304			HEX: 45; IBL: 3	None		
1					2	SS	508		PHC F1-F4/BTEX, PAHs	HEX: 20; IBL: 2	None		Native backfill
		End of Borehole (No refusal)		112.15 1.52									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-7

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		114.32									
0	Direct Push	Topsoil		114.07									
		Brown silty sand with trace gravel and clay- Wet		0.25	1	SS	406		PHC F1-F4/BTEX, PAHs, M&Is	HEX: 10; IBL: 2	None		Native backfill
1					2	SS	305			HEX: 0; IBL: 3	None		
		End of Borehole (No refusal)		112.80 1.52									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-8

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		115.93									
0	Direct Push	Topsoil		115.72									
		Brown silty sand with trace gravel and clay - Wet		0.21	1	SS	406			HEX: 10; IBL: 1	None		
1					2	SS	406		PHC F1-F4/BTEX, PAHs	HEX: 10; IBL: 3	None		Native backfill
		End of Borehole (No refusal)		114.41 1.52									

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

RECORD OF BOREHOLE 24-9

CLIENT: T & L Carroll Holdings Inc.
PROJECT: Phase Two Environmental Site Assessment
JOB#: 102151.001
LOCATION: 3160 Carp Road, Ottawa, Ontario

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 14 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE DATA: NUMBER	TYPE	RECOVERY (mm)	BLOWS/0.3m	LABORATORY ANALYSES	COMBUSTIBLE VAPOUR CONCENTRATION (ppm)	ODOUR	TPH (mg/kg)	MONITORING WELL INSTALLATION AND NOTES
		Ground Surface		117.49									
0	Direct Push	Gravel		116.73	1	SS	406		PHC F1-F4/BTEX	HEX: 5; IBL: 2	None		Bentonite Seal
1		Brown silty sand with trace gravel and clay		0.76 / 115.97	2	SS	210			HEX: 35; IBL: 1	None		Filter Sand
2		Silty sand with some gravel, rocks - Wet		1.52	3	SS	430			HEX: 0 ; IBL: 1	None		51 mm diameter 3.05 metre long well screen
					4	SS	365			HEX: 5; IBL: 1	None		
3					5	SS	150			HEX: 5; IBL: 1	None		
		End of Borehole - Auger Refusal at Inferred Bedrock		114.14 / 3.35									

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEVATION (m)
Feb. 14/24	3.35 ▽	114.14
Feb. 23/24	3.35 ▼	114.14
Feb. 28/24	3.35 ▽	114.14

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.B.
CHECKED: M.K.

ENV - BOREHOLE LOG 102151.001_LOGS_2024-03-16.GPJ GEMTEC 2018.GDT 4/10/24

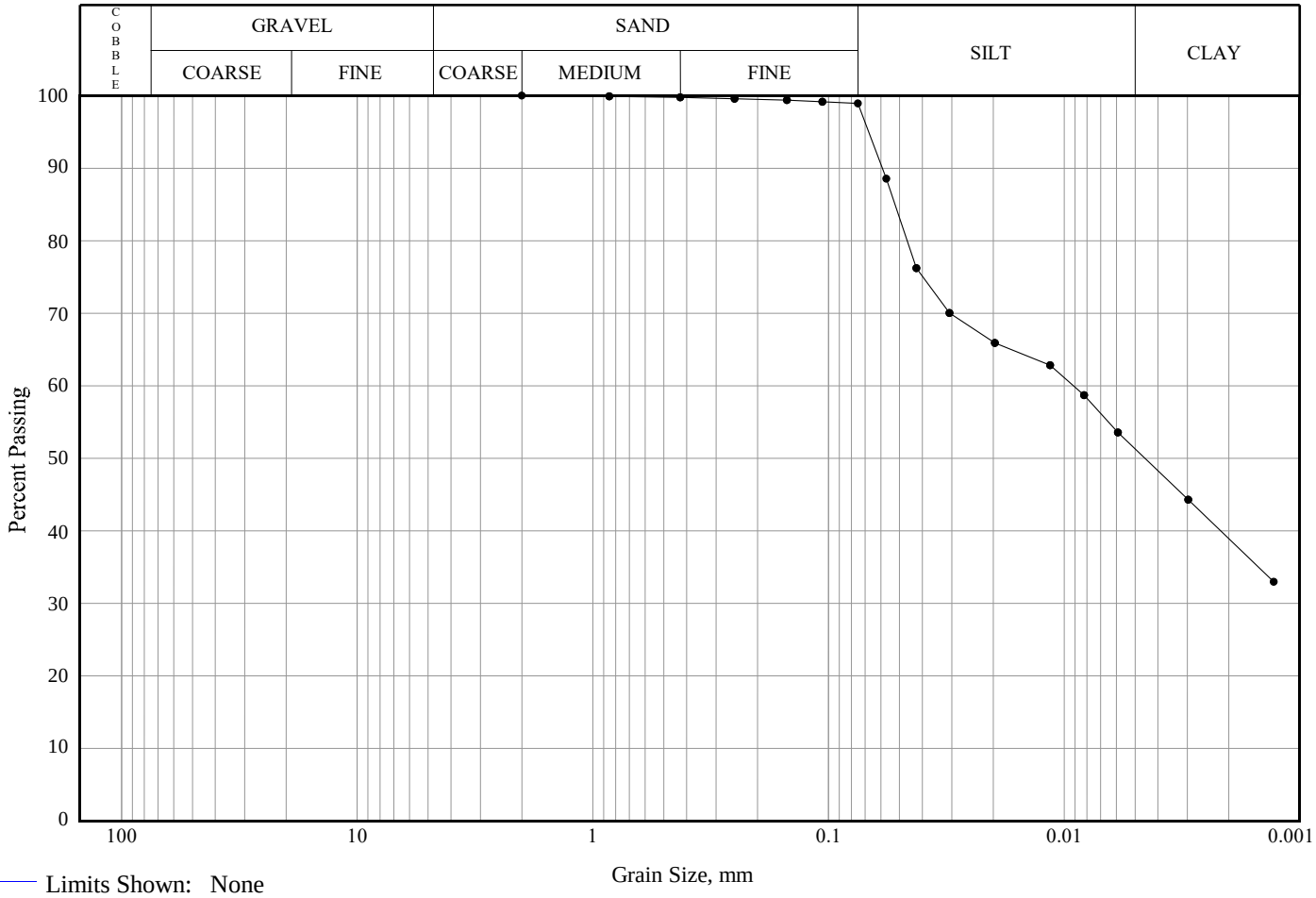
APPENDIX E

Soil Grain Size Analyses

GEMTEC
Consulting Engineers and Scientists

Client:	TLC Holdings Inc
Project:	Geotechnical Investigation and Environmental Impact St
Project #:	102151001

Soils Grading Chart (LS-702/ ASTM D-422)



Limits Shown: None

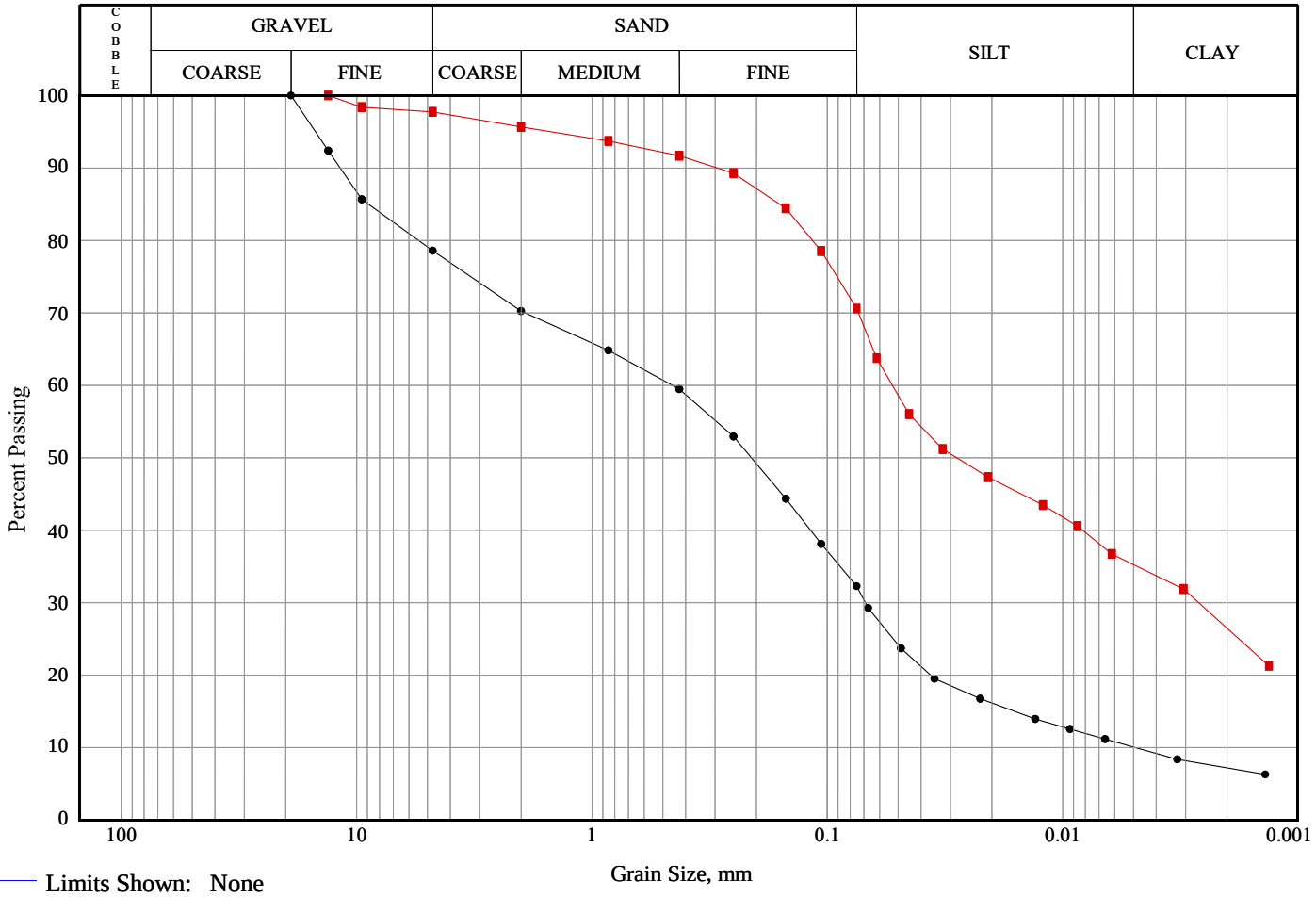
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	WEATHERED CRUST	23-08	02	0.76-1.37	0.0	1.1	47.6	51.3

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Clay and silt , trace sand	N/A	---	---	---	0.00	0.01	0.05	47.6

GEMTEC
Consulting Engineers and Scientists

Client:	TLC Holdings Inc
Project:	Geotechnical Investigation and Environmental Impact St
Project #:	102151001

Soils Grading Chart (LS-702/ ASTM D-422)



Limits Shown: None

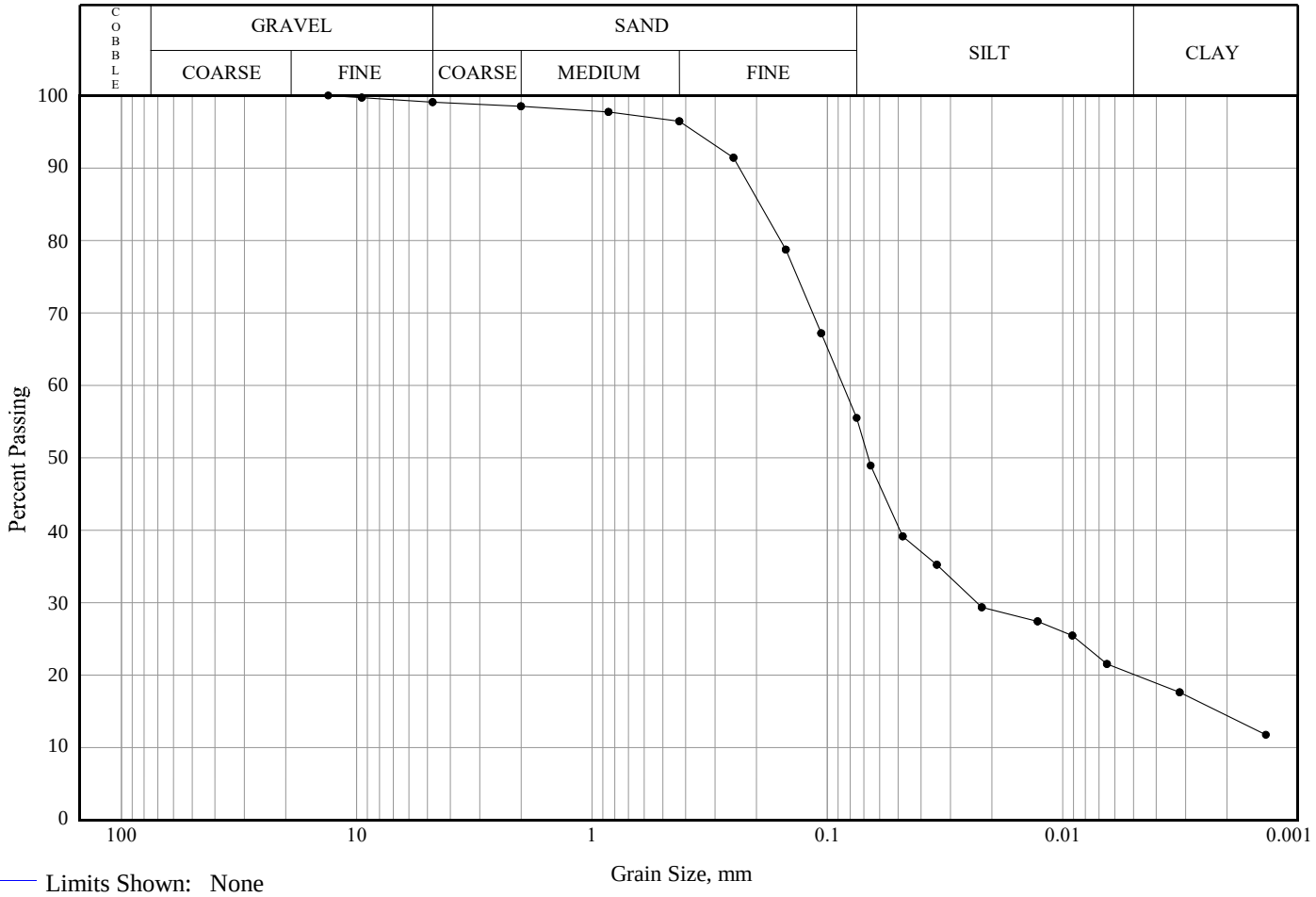
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●—	GLACIAL TILL	23-06	10B	7.01-7.47	21.4	46.3	22.2	10.1
■—	GLACIAL TILL	23-08	05	3.05-3.20	2.3	27.1	35.4	35.2

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
●—	Gravelly silty sand , some clay	N/A	0.00	0.02	0.07	0.21	0.46	8.91	22.2
■—	Sandy silt and clay , trace gravel	N/A	---	---	0.00	0.03	0.05	0.16	35.4

GEMTEC
Consulting Engineers and Scientists

Client:	TLC Holdings Inc
Project:	Geotechnical Investigation and Environmental Impact St
Project #:	102151001

Soils Grading Chart (LS-702/ ASTM D-422)



Limits Shown: None

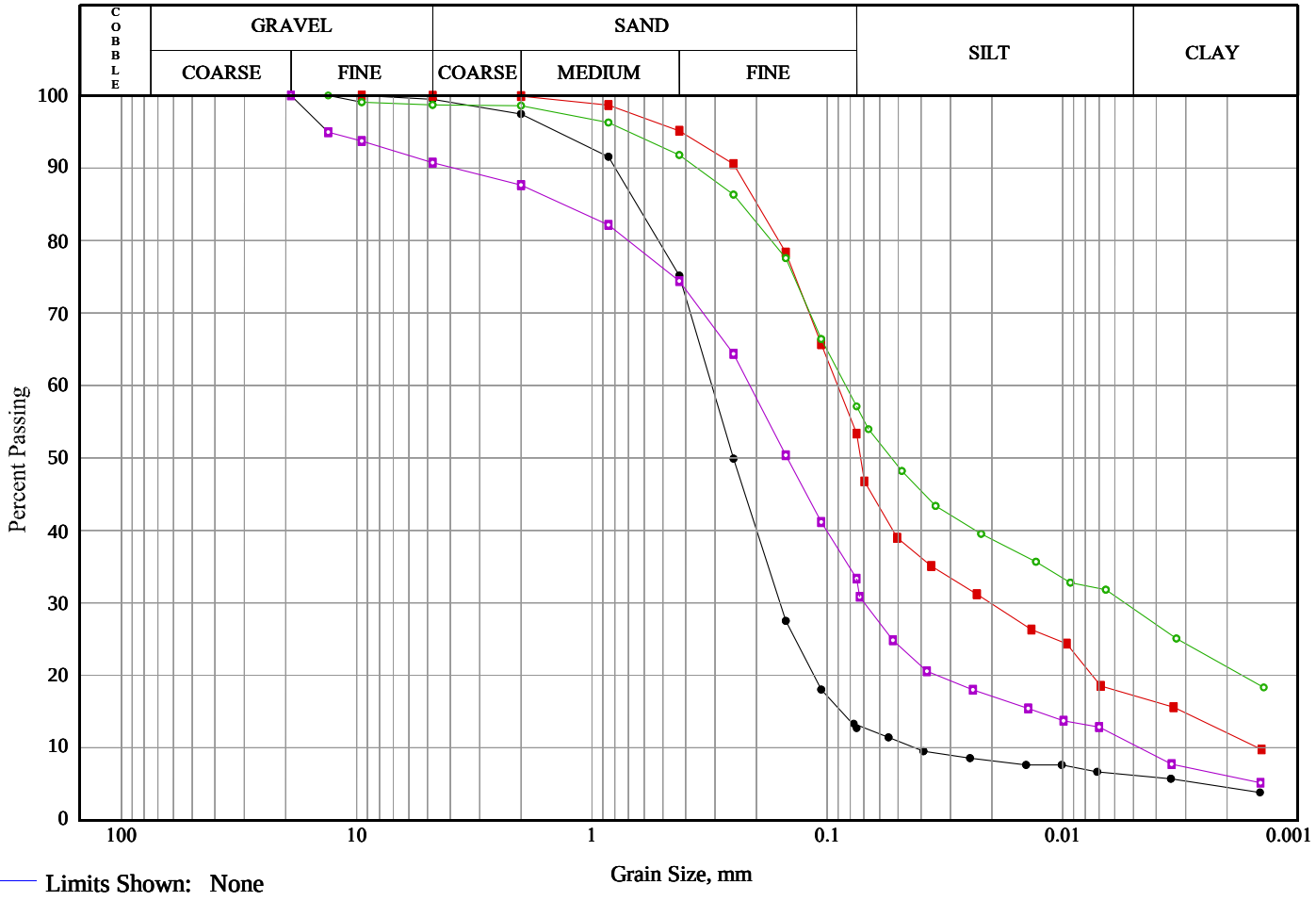
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	SAND and SILT	23-04	03	1.52-2.13	0.9	43.6	35.4	20.1

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Clayey sand and silt , trace gravel	N/A	---	0.00	0.02	0.07	0.09	0.19	35.4

GEMTEC
Consulting Engineers and Scientists

Client:	Novatech
Project:	(Client: Alan Gale Agencies Limited) Site: 3160 Carp Ro
Project #:	6481903

Soils Grading Chart



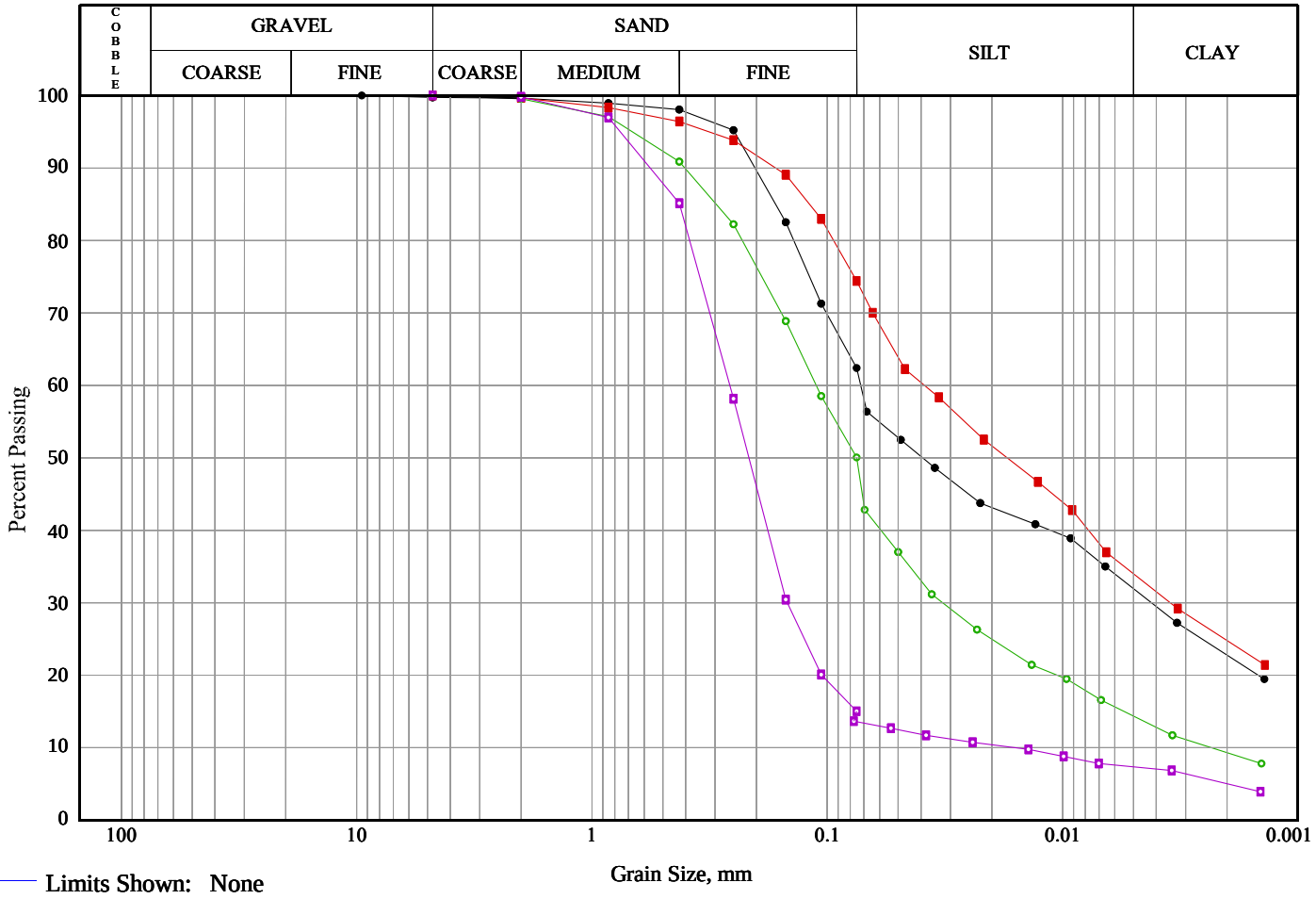
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
		18-1	2	0.23-0.85	0.5	86.8	6.5	6.2
		18-14	2	0.23-0.79	0.1	46.6	36.1	17.2
		18-3	2	0.41-0.94	1.3	41.6	27.9	29.2
		18-4	2	0.53-1.17	9.3	57.4	22.9	10.4

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
	Sand , trace gravel, trace silt, trace clay	N/A	0.04	0.09	0.16	0.25	0.31	0.64	6.5
	Sand and silt , some clay , trace gravel	N/A	0.00	0.00	0.02	0.07	0.09	0.20	36.1
	Silty clayey sand , trace gravel	N/A	---	---	0.01	0.05	0.08	0.23	27.9
	Silty sand , some clay , trace gravel	N/A	0.00	0.01	0.07	0.15	0.21	1.33	22.9

GEMTEC
Consulting Engineers and Scientists

Client:	Novatech
Project:	(Client: Alan Gale Agencies Limited) Site: 3160 Carp Ro
Project #:	6481903

Soils Grading Chart



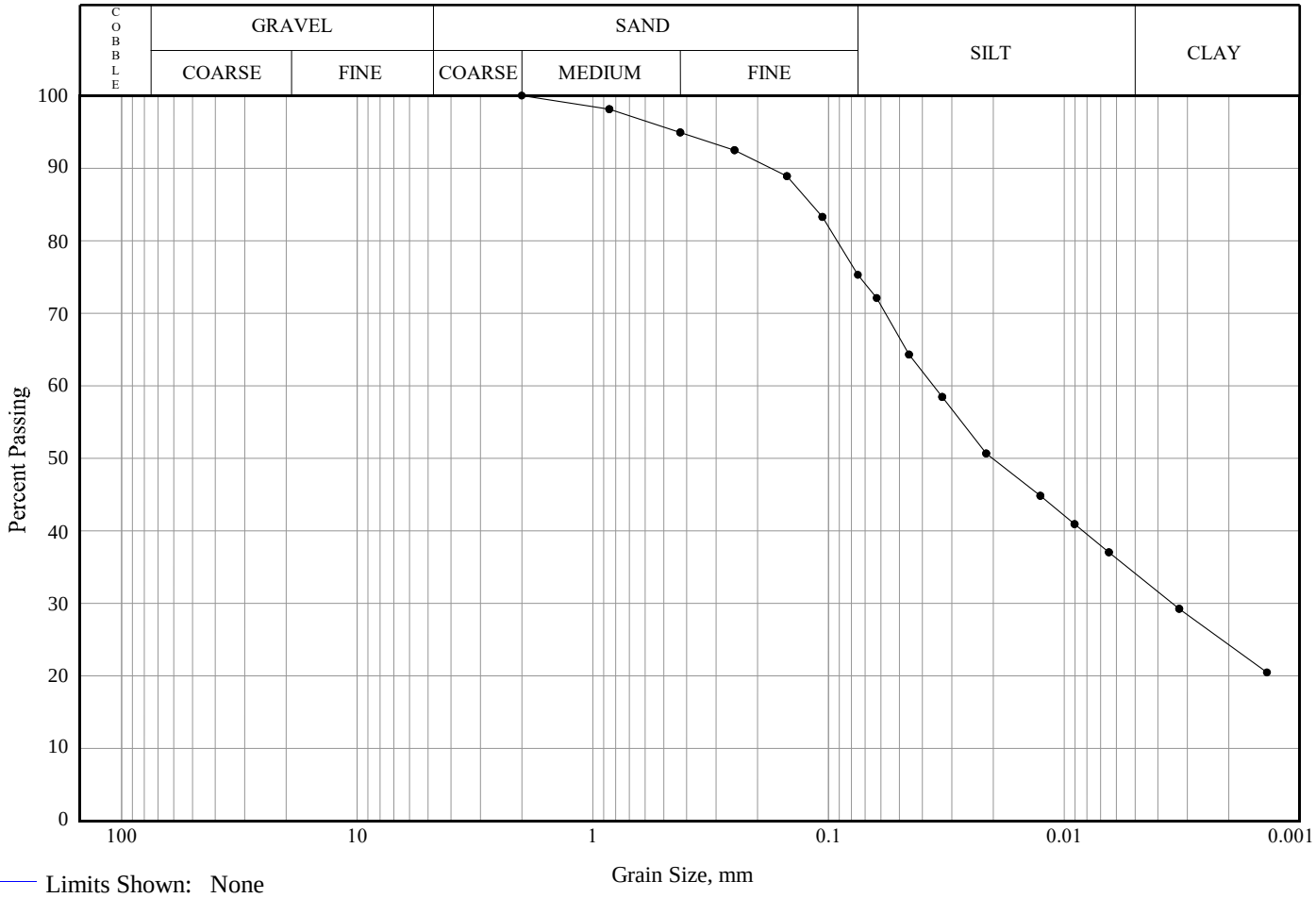
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
		18-8	2	2.2-2.45	0.3	37.4	30.4	31.9
		GP 18-10S	1	0.4-0.55	0.0	25.6	40.4	34.0
		GP 18-14S	1	0.3-0.45	0.0	50.0	35.7	14.3
		GP 18-1S	1	0.3-0.45	0.0	85.0	7.7	7.3

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
	Silty clayey sand , trace gravel	N/A	---	---	0.00	0.04	0.07	0.17	30.4
	Sandy clayey silt	N/A	---	---	0.00	0.02	0.04	0.12	40.4
	Sand and silt , some clay	N/A	0.00	0.01	0.03	0.07	0.11	0.30	35.7
	Sand , trace silt, trace clay	N/A	0.02	0.08	0.15	0.22	0.26	0.42	7.7

GEMTEC
Consulting Engineers and Scientists

Client:	Novatech
Project:	(Client: Alan Gale Agencies Limited) Site: 3160 Carp Ro
Project #:	6481903

Soils Grading Chart



Limits Shown: None

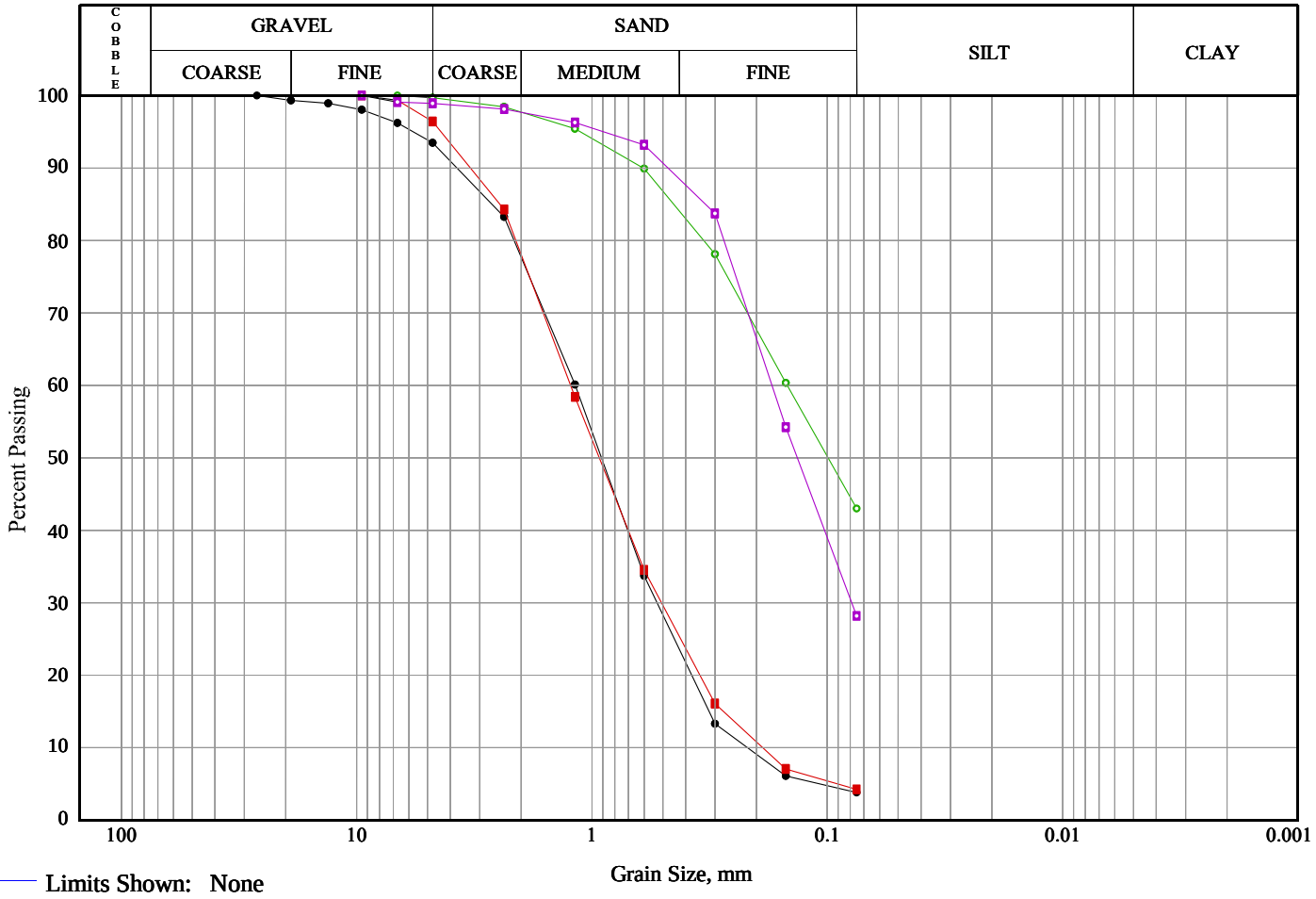
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—		GP 18-3S	1	0.5-0.6	0.0	24.7	41.2	34.1

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Sandy clayey silt	N/A	---	---	0.00	0.02	0.04	0.12	41.2

GEMTEC
Consulting Engineers and Scientists

Client:	Novatech
Project:	(Client: Alan Gale Agencies Limited) Site: 3160 Carp Ro
Project #:	6481903

Soils Grading Chart



Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
		18-1	3	0.91-1.25	6.5	89.7	3.8	
		GP 18-1D	1	1.0-1.15	3.6	92.2	4.2	
		GP 18-5S	1	0.25-0.40	0.3	56.7	43.0	
		GP 18-9S	1	0.25-0.40	1.1	70.7	28.2	

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
	Sand , trace gravel, trace silt	SP	0.22	0.32	0.53	0.91	1.18	2.66	---
	Sand , trace gravel, trace silt	SW	0.19	0.28	0.51	0.93	1.23	2.46	---
	Sand and silt , trace gravel	N/A	---	---	---	0.10	0.15	0.45	---
	Silty sand , trace gravel	N/A	---	---	0.08	0.13	0.17	0.33	---

APPENDIX F

Guelph Permeameter Infiltration Testing

Table E1: Comparison of infiltration rates based on field saturated hydraulic conductivity (using Guelph Permeameter) and soil texture / grain size analysis (lab testing). Refer to Figure 1 for infiltration test locations.

		Field Testing		Infiltration Rates[2] (mm/hr)		
Test ID	**Depth m bgs**	**Guelph Permeameter K_{fs} (cm/s)**	**Soil Class. (GSA)**	**Guelph Permeameter *K_{fs}**	**Soil Texture**	**Hazen Method *K_{fs}**
GP 18-1S	0.30 – 0.45	1.3×10^{-3}	4.0×10^{-4}	92	61.2	197
GP 18-1D	1.00 – 1.15	1.1×10^{-2}	3.6×10^{-2}	163	210	230
GP 18-3S	0.50 – 0.65	1.1×10^{-5}	-	26	-	-
GP 18-5S	0.25 – 0.40	5.0×10^{-5}	-	38	-	-
GP 18-9S	0.25 - 0.40	8.5×10^{-4}	-	82	-	-
GP 18-10S	0.40 - 0.55	1.1×10^{-5}	-	26	-	-
GP 18-14S	0.30 – 0.45	2.1×10^{-4}	5.3×10^{-6}	56	13.2	20

Notes:
1. Appendix C – Site Evaluation and Soil Testing Protocol for Stormwater Infiltration (Low Impact Development Stormwater Management Planning and Design Guide, Credit Valley Conservation Authority, Version 1.0, 2011)
2. The estimated infiltration rates do not include a safety factor and do not represent design infiltration rates.

Abbreviations:
K_{fs} = Field saturated hydraulic conductivity;
GSA = Grain Size Analysis, Hazen D_{10}; **Soil Texture** = US Maryland Stormwater Design Manual – Table D.13.1 Hydrologic Soil Properties Classified by Soil Texture (revised May 2009);
***K_{fs}** converted to infiltration rate based on K_{fs}-infiltration relationship found in OMMAH;
OMMAH = Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to Ontario Building Code 1997. SG-6 Percolation Times and Soil Descriptions, Toronto, Ontario

Guelph Permeameter

GP18-1S

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**

Enter water Head Height ("H" in cm): **5**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **1.2000**

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	1.200
Q	0.704
pi	3.142

α^* = **0.12** cm^{-1}

C = **0.803154**

Q = **0.7044**

K_{fs} = **1.28E-03** *cm/sec*
7.69E-02 *cm/min*
1.28E-05 *m/sec*
3.03E-02 *inch/min*
5.04E-04 *inch/sec*

Φ_m = **1.07E-02** cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter water Head Height ("H" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

α^* = **0** cm^{-1}

C = **0**

Q = **0**

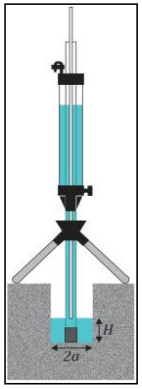
K_{fs} = **#DIV/0!** *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/ses*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

Φ_m = **#DIV/0!** cm^2/min

Average

K_{fs} = **#DIV/0!** *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/s*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

Φ_m = **#DIV/0!** cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):

Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^* = **0** cm^{-1}

α = **#DIV/0!**

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

Q_1 = **0**

Q_2 = **0**

Res Type:	0
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!
G-Denominator:	0

C_1 = **0**

C_2 = **0**

G_1 = **#DIV/0!**

G_2 = **#DIV/0!**

G_3 = **#DIV/0!**

G_4 = **#DIV/0!**

K_{fs} = **#DIV/0!** *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/sec*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

Φ_m = **#DIV/0!** cm^2/min

Θ_{fs} = cm^3/cm^3

Θ_i = cm^3/cm^3

Sorptivity **#DIV/0!** $(cm\ min^{-.5})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

GP18-1D

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22

Enter water Head Height ("H" in cm): 5

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 9.9000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	9.900
Q	5.811
pi	3.142

α^* = 0.12 cm^{-1}

C = 0.803154

Q = 5.8113

K_{fs} = 1.06E-02 cm/sec
6.34E-01 cm/min
1.06E-04 m/sec
2.50E-01 inch/min
4.16E-03 inch/sec

Φ_m = 8.81E-02 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter water Head Height ("H" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

α^* = 0 cm^{-1}

C = 0

Q = 0

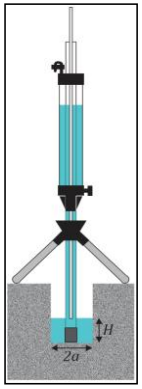
K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

Average

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):

Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^* = 0 cm^{-1}

α = #DIV/0!

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min): 18.0000

Q_1 = 0

Q_2 = 0

Res Type:	0
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!
G-Denominator:	0

C_1 = 0

C_2 = 0

G_1 = #DIV/0!

G_2 = #DIV/0!

G_3 = #DIV/0!

G_4 = #DIV/0!

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

Θ_{fs} = cm^3/cm^3

Θ_i = cm^3/cm^3

Sorptivity #DIV/0! $(cm\ min^{-.5})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_2^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Guelph Permeameter

GP18-3S

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.2900

Res Type	2.16
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	0.290
Q	0.01
pi	3.142

α^* = 0.12 cm^{-1}

C = 1.287543
Q = 0.01044

K_{fs} = 1.13E-05 cm/sec
6.79E-04 cm/min
1.13E-07 m/sec
2.67E-04 inch/min
4.45E-06 inch/sec

Φ_m = 9.43E-05 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

α^* = 0 cm^{-1}

C = 0
Q = 0

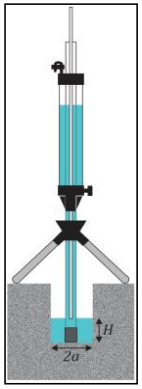
K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

Average

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir):
Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^* = 0 cm^{-1}

α = #DIV/0!

Steady State Rate of Water Level Change ("R1" in cm/min):
Steady State Rate of Water Level Change ("R2" in cm/min):

Q_1 = 0
Q_2 = 0

Res Type:	0
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!
G-Denominator:	0

C_1 = 0
C_2 = 0
G_1 = #DIV/0!
G_2 = #DIV/0!
G_3 = #DIV/0!
G_4 = #DIV/0!

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

Θ_{fs} = cm^3/cm^3

Θ_i = cm^3/cm^3

Sorptivity #DIV/0! $(cm\ min^{-.5})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

GP18-5S

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.7000

Res Type	2.16		
H	5		
a	3	α*=	0.12 cm^{-1}
H/a	1.667		
a*	0.12	C =	0.803154
C0.01	0.809	Q =	0.0252
C0.04	0.842		
C0.12	0.803	K_{fs} =	4.58E-05 cm/sec
C0.36	0.803		2.75E-03 cm/min
C	0.803		4.58E-07 m/sec
R	0.700		1.08E-03 inch/min
Q	0.025		1.80E-05 inch/sec
pi	3.142		
		Φ_m =	3.82E-04 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

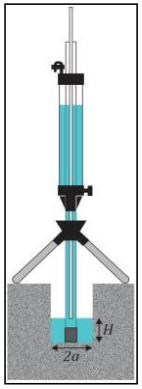
1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0		
H	0		
a	0	α*=	0 cm^{-1}
H/a	#DIV/0!		
a*	0	C =	0
C0.01	#DIV/0!	Q =	0
C0.04	#DIV/0!		
C0.12	#DIV/0!	K_{fs} =	#DIV/0! cm/sec
C0.36	#DIV/0!		#DIV/0! cm/min
C	0		#DIV/0! m/ses
R	0.000		#DIV/0! inch/min
Q	0		#DIV/0! inch/sec
pi	3.1415		
		Φ_m =	#DIV/0! cm^2/min

Average

K_{fs} =	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
Φ_m =	#DIV/0!	cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

		α*=	0 cm^{-1}
		α=	#DIV/0!
		Steady State Rate of Water Level Change ("R1" in cm/min):	
		Steady State Rate of Water Level Change ("R2" in cm/min):	
		Q_1 =	0
		Q_2 =	0
Res Type:	0		
H1/a:	#DIV/0!	C_1 =	0
H2/a:	#DIV/0!		
C1-0.01:	#DIV/0!	C_2 =	0
C2-0.01:	#DIV/0!		
C1-0.04:	#DIV/0!	G_1 =	#DIV/0!
C2-0.04:	#DIV/0!		
C1-0.12:	#DIV/0!	G_2 =	#DIV/0!
C2-0.12:	#DIV/0!		
C1-0.36:	#DIV/0!	G_3 =	#DIV/0!
C2-0.36:	#DIV/0!		
G-Denominator:	0	G_4 =	#DIV/0!
		K_{fs} =	#DIV/0! cm/sec
			#DIV/0! cm/min
			#DIV/0! m/sec
			#DIV/0! inch/min
			#DIV/0! inch/sec
		Φ_m =	#DIV/0! cm^2/min
		Θ_{fs} =	cm^3/cm^3
		Θ_i =	cm^3/cm^3
		Sorptivity	#DIV/0! (cm min$^{-½}$)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	α^*(cm^{-1})	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

GP18-9S

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22

Enter water Head Height ("H" in cm): 5

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.8000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	0.800
Q	0.47
pi	3.142

α^*= 0.12 cm^{-1}

C = 0.803154

Q = 0.4696

K_{fs} = 8.54E-04 cm/sec
5.12E-02 cm/min
8.54E-06 m/sec
2.02E-02 inch/min
3.36E-04 inch/sec

Φ_m = 7.12E-03 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter water Head Height ("H" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

α^*= 0 cm^{-1}

C = 0

Q = 0

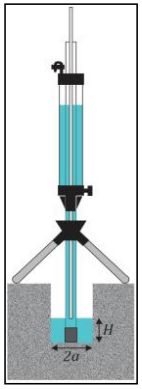
K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/ses
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

Average

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):

Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^*= 0 cm^{-1}

α= #DIV/0!

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

Q_1 = 0

Q_2 = 0

Res Type:	0
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!
G-Denominator:	0

C_1 = 0

C_2 = 0

G_1 = #DIV/0!

G_2 = #DIV/0!

G_3 = #DIV/0!

G_4 = #DIV/0!

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

θ_{fs} = cm^3/cm^3

θ_i = cm^3/cm^3

Sorptivity #DIV/0! $(cm\ min^{-.5})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

GP18-10S

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16
Enter water Head Height ("H" in cm): 15
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.4000

Res Type	2.16		
H	15		
a	3	α^*=	0.12 cm^{-1}
H/a	5		
a*	0.12	C =	1.666893
C0.01	1.518	Q =	0.0144
C0.04	1.629		
C0.12	1.667	K_{fs} =	1.07E-05 cm/sec
C0.36	1.667		6.41E-04 cm/min
C	1.667		1.07E-07 m/sec
R	0.400		2.52E-04 inch/min
Q	0.014		4.21E-06 inch/sec
pi	3.142		
		Φ_m =	8.91E-05 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

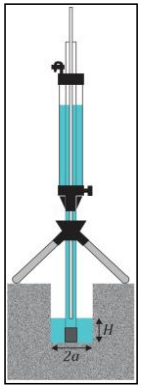
1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0		
H	0		
a	0	α^*=	0 cm^{-1}
H/a	#DIV/0!		
a*	0	C =	0
C0.01	#DIV/0!	Q =	0
C0.04	#DIV/0!		
C0.12	#DIV/0!	K_{fs} =	#DIV/0! cm/sec
C0.36	#DIV/0!		#DIV/0! cm/min
C	0		#DIV/0! m/ses
R	0.000		#DIV/0! inch/min
Q	0		#DIV/0! inch/sec
pi	3.1415		
		Φ_m =	#DIV/0! cm^2/min

Average

K_{fs} =	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
Φ_m =	#DIV/0!	cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

		α^*=	0 cm^{-1}
		α=	#DIV/0!
		Steady State Rate of Water Level Change ("R1" in cm/min):	
		Steady State Rate of Water Level Change ("R2" in cm/min):	18.0000
		Q_1 =	0
		Q_2 =	0
Res Type:	0		
H1/a:	#DIV/0!	C_1 =	0
H2/a:	#DIV/0!		
C1-0.01:	#DIV/0!	C_2 =	0
C2-0.01:	#DIV/0!		
C1-0.04:	#DIV/0!	G_1 =	#DIV/0!
C2-0.04:	#DIV/0!		
C1-0.12:	#DIV/0!	G_2 =	#DIV/0!
C2-0.12:	#DIV/0!		
C1-0.36:	#DIV/0!	G_3 =	#DIV/0!
C2-0.36:	#DIV/0!		
G-Denominator:	0	G_4 =	#DIV/0!
		K_{fs} =	#DIV/0! cm/sec
			#DIV/0! cm/min
			#DIV/0! m/sec
			#DIV/0! inch/min
			#DIV/0! inch/sec
		Φ_m =	#DIV/0! cm^2/min
		Θ_{fs} =	cm^3/cm^3
		Θ_i =	cm^3/cm^3
		Sorptivity	#DIV/0! $(cm\ min^{-.5})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

GP18-14S

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.2000

Res Type	35.22		
H	5		
a	3	α^*=	0.12 cm^{-1}
H/a	1.667		
a*	0.12	C =	0.803154
C0.01	0.809	Q =	0.1174
C0.04	0.842		
C0.12	0.803	K_{fs} =	2.14E-04 cm/sec
C0.36	0.803		1.28E-02 cm/min
C	0.803		2.14E-06 m/sec
R	0.200		5.04E-03 inch/min
Q	0.117		8.41E-05 inch/sec
pi	3.142		
		Φ_m =	1.78E-03 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

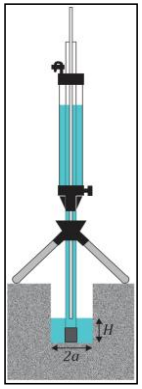
1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0		
H	0		
a	0	α^*=	0 cm^{-1}
H/a	#DIV/0!		
a*	0	C =	0
C0.01	#DIV/0!	Q =	0
C0.04	#DIV/0!		
C0.12	#DIV/0!	K_{fs} =	#DIV/0! cm/sec
C0.36	#DIV/0!		#DIV/0! cm/min
C	0		#DIV/0! m/ses
R	0.000		#DIV/0! inch/min
Q	0		#DIV/0! inch/sec
pi	3.1415		
		Φ_m =	#DIV/0! cm^2/min

Average

K_{fs} =	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
Φ_m =	#DIV/0!	cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

		α^*=	0 cm^{-1}
		α=	#DIV/0!
		Steady State Rate of Water Level Change ("R1" in cm/min):	
		Steady State Rate of Water Level Change ("R2" in cm/min):	
		Q_1 =	0
		Q_2 =	0
Res Type:	0		
H1/a:	#DIV/0!	C_1 =	0
H2/a:	#DIV/0!		
C1-0.01:	#DIV/0!	C_2 =	0
C2-0.01:	#DIV/0!		
C1-0.04:	#DIV/0!	G_1 =	#DIV/0!
C2-0.04:	#DIV/0!		
C1-0.12:	#DIV/0!	G_2 =	#DIV/0!
C2-0.12:	#DIV/0!		
C1-0.36:	#DIV/0!	G_3 =	#DIV/0!
C2-0.36:	#DIV/0!		
G-Denominator:	0	G_4 =	#DIV/0!
		K_{fs} =	#DIV/0! cm/sec
			#DIV/0! cm/min
			#DIV/0! m/sec
			#DIV/0! inch/min
			#DIV/0! inch/sec
		Φ_m =	#DIV/0! cm^2/min
		Θ_{fs} =	cm^3/cm^3
		Θ_i =	cm^3/cm^3
		Sorptivity	#DIV/0! $(cm\ min^{-.5})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

APPENDIX G

Laboratory Certificates of Analysis – Overburden Monitoring Wells

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 64819.03
Custody: 12003

Report Date: 3-Sep-2019
Order Date: 29-Aug-2019

Order #: 1935494

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

Paracel ID	Client ID
1935494-01	MW19-1D
1935494-02	MW19-3D

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 03-Sep-2019
Order Date: 29-Aug-2019
Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC	30-Aug-19	30-Aug-19

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 03-Sep-2019

Order Date: 29-Aug-2019

Project Description: 64819.03

	Client ID:	MW19-1D	MW19-3D	-	-
	Sample Date:	29-Aug-19 10:40	29-Aug-19 10:10	-	-
	Sample ID:	1935494-01	1935494-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Anions					
Nitrate as N	0.1 mg/L	<0.1	1.6	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 03-Sep-2019
Order Date: 29-Aug-2019
Project Description: 64819.03

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	1.62	0.1	mg/L	1.64			1.1	10	
Nitrite as N	ND	0.05	mg/L	ND				10	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	2.61	0.1	mg/L	1.64	97.3	79-120			
Nitrite as N	1.05	0.05	mg/L	ND	105	84-117			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 64819.03
Custody: 49226

Report Date: 11-Nov-2019
Order Date: 6-Nov-2019

Order #: 1945450

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

Paracel ID	Client ID
1945450-01	MW19-1D
1945450-02	MW19-3D

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 11-Nov-2019

Order Date: 6-Nov-2019

Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC	7-Nov-19	7-Nov-19

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 11-Nov-2019

Order Date: 6-Nov-2019

Project Description: 64819.03

	Client ID:	MW19-1D	MW19-3D	-	-
	Sample Date:	05-Nov-19 09:00	05-Nov-19 09:00	-	-
	Sample ID:	1945450-01	1945450-02	-	-
	MDL/Units	Water	Water	-	-
Anions					
Nitrate as N	0.1 mg/L	0.8	1.6	-	-
Nitrite as N	0.05 mg/L	0.05	<0.05	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 11-Nov-2019
Order Date: 6-Nov-2019
Project Description: 64819.03

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	ND	0.1	mg/L	ND				10	
Nitrite as N	ND	2.50	mg/L	ND				10	GEN04

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	1.10	0.1	mg/L	ND	110	79-120			
Nitrite as N	0.961	0.05	mg/L	ND	96.1	84-117			

Qualifier Notes:

QC Qualifiers :

GEN04 : Elevated detection limit because of dilution required due to the presence of high levels of non-target analytes.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

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: Brent Redmond

Client PO:
Project: 102151.001
Custody: 18295

Report Date: 19-Sep-2023
Order Date: 13-Sep-2023

Order #: 2337361

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

Paracel ID	Client ID
2337361-01	MW19-1D
2337361-02	MW19-3D
2337361-03	MW19-3S
2337361-04	MW23-7

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC	14-Sep-23	14-Sep-23

Certificate of Analysis

Report Date: 19-Sep-2023

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

Order Date: 13-Sep-2023

Client PO:

Project Description: 102151.001

	Client ID:	MW19-1D	MW19-3D	MW19-3S	MW23-7	-	-
	Sample Date:	13-Sep-23 10:00	13-Sep-23 11:30	13-Sep-23 13:30	13-Sep-23 14:35		
	Sample ID:	2337361-01	2337361-02	2337361-03	2337361-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Anions							
Nitrate as N	0.1 mg/L	0.5	1.6	1.6	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	<0.05	<0.05	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Nitrate as N	ND	0.1	mg/L					
Nitrite as N	ND	0.05	mg/L					

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	0.12	0.1	mg/L	0.13			3.1	20	
Nitrite as N	ND	0.05	mg/L	ND			NC	20	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	1.14	0.1	mg/L	0.13	101	77-126			
Nitrite as N	1.07	0.05	mg/L	ND	107	82-115			

Certificate of Analysis

Report Date: 19-Sep-2023

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

Order Date: 13-Sep-2023

Client PO:

Project Description: 102151.001

Qualifier Notes:

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

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

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

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

Client PO:
Project: 102151.001
Custody: 19887

Report Date: 13-Jun-2024
Order Date: 11-Jun-2024

Order #: 2424365

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

Paracel ID	Client ID
2424365-01	MW19-1D
2424365-02	MW19-3S
2424365-03	MW19-3D
2424365-04	MW23-07

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC	12-Jun-24	12-Jun-24

Certificate of Analysis

Report Date: 13-Jun-2024

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

Order Date: 11-Jun-2024

Client PO:

Project Description: 102151.001

	Client ID:	MW19-1D	MW19-3S	MW19-3D	MW23-07	-	-
	Sample Date:	11-Jun-24 11:25	11-Jun-24 12:30	11-Jun-24 13:10	11-Jun-24 13:45		
	Sample ID:	2424365-01	2424365-02	2424365-03	2424365-04		
	Matrix:	Ground Water	Ground Water	Ground Water	Ground Water		
	MDL/Units						
Anions							
Nitrate as N	0.1 mg/L	0.5	0.7	1.6	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	<0.05	<0.05	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Nitrate as N	ND	0.1	mg/L					
Nitrite as N	ND	0.05	mg/L					

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	ND	0.1	mg/L	ND			NC	20	
Nitrite as N	ND	0.05	mg/L	ND			NC	20	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Nitrate as N	1.11	0.1	mg/L	ND	111	77-126			
Nitrite as N	0.979	0.05	mg/L	ND	97.9	82-115			

Certificate of Analysis

Report Date: 13-Jun-2024

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

Order Date: 11-Jun-2024

Client PO:

Project Description: 102151.001

Qualifier Notes:

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

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

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

APPENDIX H

Nitrate Dilution Calculations

3112 Carp Road Nitrate Dilution Predictive Assessment

															40% Hard Surface					50% Hard Surface					60% Hard Surface				
Block	Land Use[1]	Water Holding Capacity (mm)	Hard Surface Percentage	Area (m^2)	Water Surplus (mm/yr)[2]	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m^3/yr)	Runoff Volume (m^3/yr)	Available Infiltration [1] (litres per day)	Maximum Septic Flow-Conventional[2] (litres per day)	Maximum Number of Users[3]	Maximum Septic Flow-Advanced[2] (litres per day)	Maximum Number of Users[3]	Available Infiltration [1] (litres per day)	Maximum Septic Flow-Conventional[2] (litres per day)	Maximum Number of Users[3]	Maximum Septic Flow-Advanced[2] (litres per day)	Maximum Number of Users[3]	Available Infiltration [1] (litres per day)	Maximum Septic Flow-Conventional[2] (litres per day)	Maximum Number of Users[3]	Maximum Septic Flow-Advanced[2] (litres per day)	Maximum Number of Users[3]
1	Urban Lawns	75	40%	10000	383	0.19	0.3	0.1	0.59	0.41	226	157	1356	2474	2229	743	10	2229	30	1857	619	8	1857	25	1486	495	7	1486	20
2	Urban Lawns	75 / 100	40%	10000	375	0.19	0.23	0.1	0.52	0.48	195	180	1170	2580	1923	641	9	1923	26	1603	534	7	1603	21	1282	427	6	1282	17
3	Urban Lawns	100	40%	10000	367	0.19	0.15	0.1	0.44	0.56	161	206	969	2701	1593	531	7	1593	21	1327	442	6	1327	18	1062	354	5	1062	14
6	Urban Lawns	100	40%	12200	367	0.19	0.15	0.1	0.44	0.56	161	206	1182	3295	1943	648	9	1943	26	1619	540	7	1619	22	1295	432	6	1295	17
7	Urban Lawns	100	40%	12000	367	0.19	0.15	0.1	0.44	0.56	161	206	1163	3241	1911	637	8	1911	25	1593	531	7	1593	21	1274	425	6	1274	17
8	Urban Lawns	100	40%	12600	367	0.19	0.15	0.1	0.44	0.56	161	206	1221	3403	2007	669	9	2007	27	1672	557	7	1672	22	1338	446	6	1338	18
9	Urban Lawns	75 / 100	40%	38300	375	0.19	0.23	0.1	0.52	0.48	195	180	4481	9881	7366	2455	33	7366	98	6139	2046	27	6139	82	4911	1637	22	4911	65
10	Urban Lawns	75	40%	9600	383	0.19	0.3	0.1	0.59	0.41	226	157	1302	2375	2140	713	10	2140	29	1783	594	8	1783	24	1426	475	6	1426	19
11	Urban Lawns	100	40%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	1105	3079	1816	605	8	1816	24	1513	504	7	1513	20	1210	403	5	1210	16
12	Urban Lawns	100	40%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	1105	3079	1816	605	8	1816	24	1513	504	7	1513	20	1210	403	5	1210	16
13	Urban Lawns	75 / 100	40%	11500	375	0.19	0.23	0.1	0.52	0.48	195	180	1346	2967	2212	737	10	2212	29	1843	614	8	1843	25	1475	492	7	1475	20
14	Urban Lawns	75	40%	14600	383	0.19	0.3	0.1	0.59	0.41	226	157	1979	3612	3254	1085	14	3254	43	2712	904	12	2712	36	2169	723	10	2169	29

Notes:
1. Available infiltration (litres per day) = Infiltration volume (m3/year) x (1000 litres/m3) / (365 days/year) x (1 - hard surface area) x Infiltration Factor
2. Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system. The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing a concentration of 20 mg/L of Nitrate in the effluent discharging from the tertiary treatment unit
3. Assumes 75 litres per day per person

Maximum Allowable Septic Flows (40% Hard Surface)
3112 Carp Road, Ottawa, ON

Lot	Available Infiltration [1] (litres per day)	Maximum Septic Flow-Conventional[2] (litres per day)	Maximum Number of Users[3]	Maximum Septic Flow-Advanced[2] (litres per day)	Maximum Number of Users[3]
Lot 1	2229	743	10	2229	30
Lot 2	1923	641	9	1923	26
Lot 3	1593	531	7	1593	21
Lot 6	1943	648	9	1943	26
Lot 7	1911	637	8	1911	25
Lot 8	2007	669	9	2007	27
Lot 9	7366	2455	33	7366	98
Lot 10	2140	713	10	2140	29
Lot 11	1816	605	8	1816	24
Lot 12	1816	605	8	1816	24
Lot 13	2212	737	10	2212	29
Lot 14	3254	1085	14	3254	43

Notes:

1. Available infiltration (litres per day) = Infiltration volume (m3/year) x (1000 litres/m3) / (365 days/year) x (1 - hard surface area) x Infiltration Factor. Assumes a hard surface coverage of 40%.
2. Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system. The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing a concentration of 20 mg/L of Nitrate in the effluent discharging from the tertiary treatment unit.
3. Assumes 75 litres per day per person.

Maximum Allowable Septic Flows (50% Hard Surface)
3112 Carp Road, Ottawa, ON

Lot	Available Infiltration [1] (litres per day)	Maximum Septic Flow-Conventional[2] (litres per day)	Maximum Number of Users[3]	Maximum Septic Flow-Advanced[2] (litres per day)	Maximum Number of Users[3]
Lot 1	1857	619	8	1857	25
Lot 2	1603	534	7	1603	21
Lot 3	1327	442	6	1327	18
Lot 6	1619	540	7	1619	22
Lot 7	1593	531	7	1593	21
Lot 8	1672	557	7	1672	22
Lot 9	6139	2046	27	6139	82
Lot 10	1783	594	8	1783	24
Lot 11	1513	504	7	1513	20
Lot 12	1513	504	7	1513	20
Lot 13	1843	614	8	1843	25
Lot 14	2712	904	12	2712	36

Notes:

1. Available infiltration (litres per day) = Infiltration volume (m3/year) x (1000 litres/m3) / (365 days/year) x (1 - hard surface area) x Infiltration Factor. Assumes a hard surface coverage of 50%.
2. Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system. The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing a concentration of 20 mg/L of Nitrate in the effluent discharging from the tertiary treatment unit.
3. Assumes 75 litres per day per person.

Maximum Allowable Septic Flows (60% Hard Surface)
3112 Carp Road, Ottawa, ON

Lot	Available Infiltration [1] (litres per day)	Maximum Septic Flow-Conventional[2] (litres per day)	Maximum Number of Users[3]	Maximum Septic Flow-Advanced[2] (litres per day)	Maximum Number of Users[3]
Lot 1	1486	495	7	1486	20
Lot 2	1282	427	6	1282	17
Lot 3	1062	354	5	1062	14
Lot 6	1295	432	6	1295	17
Lot 7	1274	425	6	1274	17
Lot 8	1338	446	6	1338	18
Lot 9	4911	1637	22	4911	65
Lot 10	1426	475	6	1426	19
Lot 11	1210	403	5	1210	16
Lot 12	1210	403	5	1210	16
Lot 13	1475	492	7	1475	20
Lot 14	2169	723	10	2169	29

Notes:

1. Available infiltration (litres per day) = Infiltration volume (m3/year) x (1000 litres/m3) / (365 days/year) x (1 - hard surface area) x Infiltration Factor. Assumes a hard surface coverage of 60%.
2. Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system. The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing a concentration of 20 mg/L of Nitrate in the effluent discharging from the tertiary treatment unit.
3. Assumes 75 litres per day per person.

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...150 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 90 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	35	58	147	297
28- 2	-8.1	52	15	26	1	1	0	38	68	149	349
31- 3	-2.2	61	29	77	7	7	0	97	24	150	410
30- 4	6.0	78	73	29	32	32	0	70	0	149	489
31- 5	13.3	77	77	0	82	82	0	14	0	131	566
30- 6	18.1	94	94	0	115	114	-1	8	0	103	661
31- 7	20.7	94	94	0	134	125	-9	5	0	67	756
31- 8	19.5	89	89	0	116	101	-16	1	0	55	846
30- 9	15.2	85	85	0	77	71	-6	2	0	67	932
31-10	8.4	88	86	1	37	37	0	11	0	106	88
30-11	1.6	76	58	12	11	11	0	32	6	133	164
31-12	-5.7	69	26	16	2	2	0	29	34	144	233
AVE	6.4 TTL	928	743	184	615	584	-32	342			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	12	59
28- 2	2.6	22	16	25	1	1	0	33	42	6	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	8	3	14	0	44	110
31- 7	1.3	51	51	0	9	20	22	23	0	50	138
31- 8	1.1	42	42	0	7	20	23	2	0	53	141
30- 9	1.5	35	35	0	8	12	12	11	0	53	136
31-10	1.5	33	34	4	7	7	0	24	2	43	33
30-11	2.0	28	25	10	4	4	0	37	14	24	48
31-12	3.2	26	20	17	2	2	0	31	29	13	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...200 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE.....120 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	29	58	194	297
28- 2	-8.1	52	15	26	1	1	0	37	68	198	349
31- 3	-2.2	61	29	77	7	7	0	96	24	200	410
30- 4	6.0	78	73	29	32	32	0	70	0	199	489
31- 5	13.3	77	77	0	82	82	0	14	0	181	566
30- 6	18.1	94	94	0	115	115	0	8	0	152	661
31- 7	20.7	94	94	0	134	130	-4	5	0	111	756
31- 8	19.5	89	89	0	116	106	-10	1	0	93	846
30- 9	15.2	85	85	0	77	73	-4	2	0	103	932
31-10	8.4	88	86	1	37	37	0	11	0	142	88
30-11	1.6	76	58	12	11	11	0	30	6	171	164
31-12	-5.7	69	26	16	2	2	0	24	34	186	233
AVE	6.4 TTL	928	743	184	615	597	-18	327			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	37	36	18	59
28- 2	2.6	22	16	25	1	1	0	32	42	11	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	8	0	14	0	46	110
31- 7	1.3	51	51	0	9	10	10	23	0	59	138
31- 8	1.1	42	42	0	7	17	19	2	0	64	141
30- 9	1.5	35	35	0	8	9	9	11	0	64	136
31-10	1.5	33	34	4	7	7	0	24	2	55	33
30-11	2.0	28	25	10	4	4	0	36	14	36	48
31-12	3.2	26	20	17	2	2	0	32	29	22	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY... 75 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 45 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	39	58	74	297
28- 2	-8.1	52	15	26	1	1	0	39	68	75	349
31- 3	-2.2	61	29	77	7	7	0	98	24	75	410
30- 4	6.0	78	73	29	32	32	0	70	0	74	489
31- 5	13.3	77	77	0	82	82	0	14	0	56	566
30- 6	18.1	94	94	0	115	105	-10	8	0	37	661
31- 7	20.7	94	94	0	134	107	-27	5	0	19	756
31- 8	19.5	89	89	0	116	88	-28	1	0	19	846
30- 9	15.2	85	85	0	77	70	-7	5	0	30	932
31-10	8.4	88	86	1	37	37	0	20	0	60	88
30-11	1.6	76	58	12	11	11	0	46	6	73	164
31-12	-5.7	69	26	16	2	2	0	38	34	74	233
AVE	6.4 TTL	928	743	184	615	543	-72	383			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	5	59
28- 2	2.6	22	16	25	1	1	0	32	42	0	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	10	1	22	0	25	101
30- 6	1.2	39	39	0	8	18	19	14	0	31	110
31- 7	1.3	51	51	0	9	32	35	23	0	26	138
31- 8	1.1	42	42	0	7	28	30	2	0	28	141
30- 9	1.5	35	35	0	8	13	14	14	0	30	136
31-10	1.5	33	34	4	7	7	0	27	2	19	33
30-11	2.0	28	25	10	4	4	0	31	14	7	48
31-12	3.2	26	20	17	2	2	0	28	29	3	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...100 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 60 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	38	58	99	297
28- 2	-8.1	52	15	26	1	1	0	39	68	100	349
31- 3	-2.2	61	29	77	7	7	0	98	24	100	410
30- 4	6.0	78	73	29	32	32	0	70	0	99	489
31- 5	13.3	77	77	0	82	82	0	14	0	81	566
30- 6	18.1	94	94	0	115	110	-5	8	0	57	661
31- 7	20.7	94	94	0	134	114	-20	5	0	32	756
31- 8	19.5	89	89	0	116	92	-24	1	0	28	846
30- 9	15.2	85	85	0	77	70	-7	3	0	41	932
31-10	8.4	88	86	1	37	37	0	16	0	75	88
30-11	1.6	76	58	12	11	11	0	38	6	96	164
31-12	-5.7	69	26	16	2	2	0	37	34	99	233
AVE	6.4 TTL	928	743	184	615	559	-56	367			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	7	59
28- 2	2.6	22	16	25	1	1	0	33	42	0	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	12	12	14	0	38	110
31- 7	1.3	51	51	0	9	30	33	23	0	35	138
31- 8	1.1	42	42	0	7	26	29	2	0	38	141
30- 9	1.5	35	35	0	8	13	14	12	0	39	136
31-10	1.5	33	34	4	7	7	0	27	2	28	33
30-11	2.0	28	25	10	4	4	0	35	14	12	48
31-12	3.2	26	20	17	2	2	0	30	29	5	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...125 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 75 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	37	58	123	297
28- 2	-8.1	52	15	26	1	1	0	39	68	125	349
31- 3	-2.2	61	29	77	7	7	0	98	24	125	410
30- 4	6.0	78	73	29	32	32	0	70	0	124	489
31- 5	13.3	77	77	0	82	82	0	14	0	106	566
30- 6	18.1	94	94	0	115	113	-2	8	0	79	661
31- 7	20.7	94	94	0	134	120	-14	5	0	48	756
31- 8	19.5	89	89	0	116	96	-20	1	0	40	846
30- 9	15.2	85	85	0	77	70	-7	2	0	52	932
31-10	8.4	88	86	1	37	37	0	13	0	90	88
30-11	1.6	76	58	12	11	11	0	34	6	115	164
31-12	-5.7	69	26	16	2	2	0	33	34	122	233
AVE	6.4 TTL	928	743	184	615	572	-43	354			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	9	59
28- 2	2.6	22	16	25	1	1	0	33	42	3	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	9	6	14	0	42	110
31- 7	1.3	51	51	0	9	26	29	23	0	44	138
31- 8	1.1	42	42	0	7	23	25	2	0	46	141
30- 9	1.5	35	35	0	8	13	14	11	0	46	136
31-10	1.5	33	34	4	7	7	0	25	2	36	33
30-11	2.0	28	25	10	4	4	0	37	14	18	48
31-12	3.2	26	20	17	2	2	0	30	29	9	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...250 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE.....150 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	26	58	240	297
28- 2	-8.1	52	15	26	1	1	0	34	68	247	349
31- 3	-2.2	61	29	77	7	7	0	95	24	250	410
30- 4	6.0	78	73	29	32	32	0	70	0	249	489
31- 5	13.3	77	77	0	82	82	0	14	0	231	566
30- 6	18.1	94	94	0	115	115	0	8	0	202	661
31- 7	20.7	94	94	0	134	133	-2	5	0	159	756
31- 8	19.5	89	89	0	116	110	-6	1	0	136	846
30- 9	15.2	85	85	0	77	74	-3	2	0	145	932
31-10	8.4	88	86	1	37	37	0	11	0	184	88
30-11	1.6	76	58	12	11	11	0	30	6	213	164
31-12	-5.7	69	26	16	2	2	0	24	34	229	233
AVE	6.4 TTL	928	743	184	615	605	-11	320			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	36	36	23	59
28- 2	2.6	22	16	25	1	1	0	32	42	14	65
31- 3	2.4	26	18	34	5	5	0	37	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	8	0	14	0	46	110
31- 7	1.3	51	51	0	9	8	4	23	0	63	138
31- 8	1.1	42	42	0	7	13	14	2	0	71	141
30- 9	1.5	35	35	0	8	8	6	11	0	72	136
31-10	1.5	33	34	4	7	7	0	24	2	63	33
30-11	2.0	28	25	10	4	4	0	36	14	45	48
31-12	3.2	26	20	17	2	2	0	32	29	29	53

Table 3.1: Hydrologic Cycle Component Values

	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

* *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

APPENDIX I

MECP Water Well Records – Test Wells

CERTIFICATE OF WELL COMPLIANCE

I (Jeremy Hanna) AIR ROCK DRILLING CO. LTD. - DO HEREBY CERTIFY

that I am licensed to drill water wells in the Province of Ontario, and that I have

supervised the drilling of the water well on the property of :

OWNER: ALAN GALE AGENCIES LIMITED

Location: #3160 CARP ROAD, CARP

LOT: Part 11 & 12 **CON:** 2 **PLAN #** RP-5R-7272 **S/L #** Parts 1 & 3

Ottawa-Carleton / Geographical Township of West Carleton

I CERTIFY FURTHER that, I am aware of the well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and City Standards.

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) as applicable and constructed in strict conformity with the standards required.

Signed this 18TH Day of JUNE, 2019

Jeremy Hanna (T3632) Air Rock Drilling Co. Ltd. (C-7681)

The Engineer on behalf of the Landowner set out above, Certifies that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg 903, ~~and~~ this report ~~and the Hydrogeological Report~~ with regards to casing length and grouting requirements.

Signed this 29 day of July 2019

A. C. HOULE
July 29/19

A. C. Houle, P. Eng.
Gemtec

(Engineer)

2019342
TW# 1 of 4
A260857

Shaping our future together
Ensemble, formons notre avenir

City of Ottawa
Client Service Centre

Ville d'Ottawa
Centre de service

Ontario — Ministry of the Environment and Climate Change

Tag#:A260857 (Print Below)
A260857

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☒ Imperial

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Alan Gale Agencies Limited		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1870 Sixth Line Road RR1	Dunrobin	ON	K0A 1T0	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 Carp Road	West Carleton	P/L 11 & 12	2

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa Carleton	Carp	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	421243	5019125	RP-5R-7272	Parts 1 & 3

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Clay			0'	8'
	Gravel		(Packed)	8'	26'
Grey	Limestone			26'	137'
Grey	Sandstone	w/ Grey	Limestone Mix	137'	190'
Grey	Sandstone	w/ Grey	Limestone Mix	190'	200'
	TEST WELL # 1 OF 4				

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
42'	32'	Neat cement	10.9
32'	0'	Bentonite slurry	12.6

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4"	Steel	.188"	+2'	42'
5 15/16"	Open Hole		42'	200'

Construction Record - Screen

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

Status of Well

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

Water Details

Water found at Depth (m/ft)	☐ Gas	Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify
190		

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	42'	9 3/4"
42'	200'	5 15/16"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify **Not tested**

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 190'

Pumping rate (l/min / GPM): 3

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 21.2'

If flowing give rate (l/min / GPM): X

Recommended pump depth (m/ft): 190'

Recommended pump rate (l/min / GPM): 3+

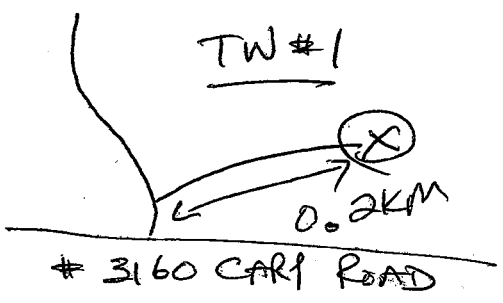
Well production (l/min / GPM): 3+

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	13.8'		21.2'
1	16	1	17
2	17.1	2	15.8
3	18	3	15.4
4	18.6	4	15.1
5	19.2	5	14.8
10	20.5	10	14.2
15	20.9	15	14
20	21	20	13.9
25	21.1	25	13.9
30	21.1	30	13.8
40	21.1	40	13.8
50	21.2	50	13.8
60	21.2'	60	13.8'

Map of Well Location

Please provide a map below following instructions on the back.



Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	7681

Business Address (Street Number/Name)	Municipality
6650 Franktown Road	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Hanna, Jeremy

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted (Y Y Y Y M M D D)
13632		2019 07 31

Comments: 1/2HP-5GPM Set @ 190 ft

Well owner's information package delivered	Date Package Delivered (Y Y Y Y M M D D)	Ministry Use Only
☒ Yes ☐ No	2019 06 19	Audit No. Z302284
	Date Work Completed (Y Y Y Y M M D D)	Received
	2019 06 19	

0506E (2014/11)

Ministry's Copy

© Queen's Printer for Ontario, 2014

CERTIFICATE OF WELL COMPLIANCE

Ottawa

I (Jeremy Hanna) AIR ROCK DRILLING CO. LTD. - DO HEREBY CERTIFY

that I am licensed to drill water wells in the Province of Ontario, and that I have

supervised the drilling of the water well on the property of :

OWNER: ALAN GALE AGENCIES LIMITED

Location: #3160 CARP ROAD, CARP

LOT: Part 11 & 12 **CON:** 2 **PLAN #** RP-5R-7272 **S/L #** Parts 1 & 3

Ottawa-Carleton / Geographical Township of West Carleton

I CERTIFY FURTHER that, I am aware of the well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and City Standards.

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) as applicable and constructed in strict conformity with the standards required.

Signed this 17TH Day of JUNE, 2019

Jeremy Hanna (T3632) Air Rock Drilling Co. Ltd. (C-7681)

The Engineer on behalf of the Landowner set out above, Certifies that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg 903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

Signed this 29 day of July 2019

LICENSED PROFESSIONAL ENGINEER A. C. HOULE PROVINCE OF ONTARIO July 29/19

A.C. Houle, P.Eng.
Gemtec

(Engineer)

2019343
TW# 2 OF 4
A260858

Ontario — Ministry of the Environment and Climate Change

Tag#: A260858 (Print Below)

A260858

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☒ Imperial

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Alan Gale Agencies Limited		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1870 Sixth Line Road RR1	Dunrobin	ON	K0A 1T0	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 Carp Road	West Carleton	PtL 11 & 12	2

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa Carleton	Carp	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	421451	5019245	RP-5R-7272	Parts 1 & 3

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Clay			0'	7'
	Gravel		(Packed)	7'	25'
Grey	Limestone			25'	53'
Grey	Limestone			53'	170'
Grey	Limestone			170'	175'
Grey	Sandstone	w/ Grey	Limestone	175'	200'
	TEST WELL # 2 OF 4				

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³)
40'	30'	Neat cement	10.9
30'	0'	Bentonite slurry	12.6

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4"	Steel	.188"	+2'	40'
5 15/16"	Open Hole		40'	200'

Status of Well

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

Construction Record - Screen

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

Water Details

Water found at Depth	Kind of Water	Hole Diameter Depth (m/ft) From	To	Diameter (cm/in)
53 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify			
170 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify	0'	40'	9 3/4"
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	40'	200'	5 15/16"

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify Not tested

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 190'

Pumping rate (l/min / GPM): 5

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 26.4'

If flowing give rate (l/min / GPM): X

Recommended pump depth (m/ft): 190'

Recommended pump rate (l/min / GPM): 5

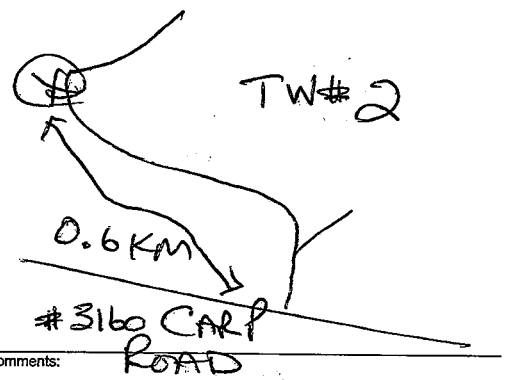
Well production (l/min / GPM): 5

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	4'6"		26.4'
1	8.3	1	19
2	10.9	2	16.5
3	12.5	3	14.7
4	14	4	13
5	15.3	5	11.7
10	19.6	10	7.6
15	21.9	15	6
20	23.3	20	4.8
25	24.2	25	4.6
30	24.8	30	4.6
40	25.5	40	4.6
50	26	50	4.6
60	26.4'	60	4'6"

Map of Well Location

Please provide a map below following instructions on the back.



Comments: 4/2HF-5GPM Set @ 190' Ft

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	7681

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
6859 Franktown Road	Richmond	ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
6138382170	Hanna, Jeremy	T3632		2019 07 31

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2019 07 14	2019 06 19

Ministry Use Only

Audit No. Z302285

Received

0506E (2014/11)

Ministry's Copy

© Queen's Printer for Ontario, 2014

CERTIFICATE OF WELL COMPLIANCE

Ottawa

I (Jeremy Hanna) AIR ROCK DRILLING CO. LTD. - DO HEREBY CERTIFY

that I am licensed to drill water wells in the Province of Ontario, and that I have

supervised the drilling of the water well on the property of :

OWNER: ALAN GALE AGENCIES LIMITED

Location: #3160 CARP ROAD. Carp

Part 11
LOT: 12 **CON:** 2 **PLAN #** RP-5R-7272 **S/L #** Parts 1+3

Ottawa-Carleton / Geographical Township of West Carleton

I CERTIFY FURTHER that, I am aware of the well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and City Standards.

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) as applicable and constructed in strict conformity with the standards required.

Signed this 7TH Day of MARCH, 2019

Jeremy Hanna (T3632) Air Rock Drilling Co. Ltd. (# 1119)

The Engineer on behalf of the Landowner set out above, Certifies that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg 903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

Signed this 13 day of May, 2019

LICENSED PROFESSIONAL ENGINEER
May 13/19
A. C. HOULE
A.C. Houle
PROVINCE OF ONTARIO

Test Well # 3/4
209070
A260960

A.C. Houle, P.Eng.
Gemtec

(Engineer)

Shaping our future together
Ensemble, formons notre avenir

City of Ottawa
Client Service Centre
8243 Victoria Street

Ville d'Ottawa
Centre de service
8243 rue Victoria

2001
International Year of Volunteers

Ontario — Ministry of the Environment and Climate Change

Tag#:A260960 (or Print Below)

A260960

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☐ Metric ☒ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Alan Gale Agencies Limited		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1870 Sixth Line Road.RR1	Dunrobin	ON	K0A 1T0	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 Carp Road	West Carleton	P/L 11+12	2

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa-Carleton	Carp	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	421648	5019008	RP-5R-7272	Parts 1 & 3

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Sand	+ Gravel	+ Boulders	0'	23'
Grey	Limestone			23'	185'
Grey	Limestone			185'	200'

TEST WELL #3 OF 4

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/cf)
38'	28'	Neat cement	9.36
28'	0'	Bentonite slurry	8.4

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4"	Steel	.188"	+2'	38'
6 1/8"	Open Hole		38'	200'

Status of Well

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

Construction Record - Screen

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

Water Details

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

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	38'	9 3/4"
38'	200'	6 1/8"

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality
6659 Franktown Road, RR#1	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Purcell, Shannon

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted (Y Y Y Y M M D D)
[redacted] T4033		2019 04 30

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify **Not tested**

If pumping discontinued, give reason: ☒

Pump intake set at (m/ft): 190

Pumping rate (l/min / GPM): 5

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 29.8"

If flowing give rate (l/min / GPM): X

Recommended pump depth (m/ft): 190'

Recommended pump rate (l/min / GPM): 5

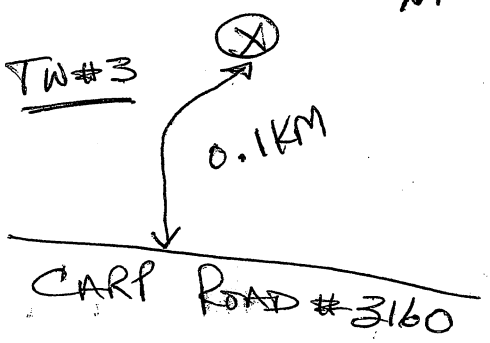
Well production (l/min / GPM): 5

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	91.5"		29.8"
1	16.5	1	23.6
2	18	2	21.4
3	19.1	3	20.4
4	20.1	4	19.4
5	20.9	5	18.7
10	23.8	10	16.5
15	25.4	15	15.3
20	26.5	20	14.5
25	27.3	25	14
30	27.9	30	13.7
40	28.7	40	13.1
50	29.3	50	12.5
60	29.8"	60	12'

Map of Well Location

Please provide a map below following instructions on the back.



Comments: 1/2 HP - 7 GPM SET @ 190 FEET

Well owner's information package delivered	Date Package Delivered (Y Y Y Y M M D D)	Ministry Use Only
☒ Yes ☐ No	2019 03 20	Audit No. Z302436
	Date Work Completed: 2019 03 07	Received

0506E (2014/11) Ministry's Copy

© Queen's Printer for Ontario, 2014

CERTIFICATE OF WELL COMPLIANCE

Ottawa

I (Jeremy Hanna) AIR ROCK DRILLING CO. LTD. - DO HEREBY CERTIFY

that I am licensed to drill water wells in the Province of Ontario, and that I have

supervised the drilling of the water well on the property of :

OWNER: ALAN GALE AGENCIES LIMITED

Location: #3160 CARP ROAD, Carp

Part 11
LOT: 12 **CON:** 2 **PLAN #** RP-5R-7272 **S/L #** Parts 1+3

Ottawa-Carleton / Geographical Township of West Carleton

I CERTIFY FURTHER that, I am aware of the well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and City Standards.

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) as applicable and constructed in strict conformity with the standards required.

Signed this 6TH Day of MARCH, 2019

Jeremy Hanna (T3632) Air Rock Drilling Co. Ltd. (# 1119)

The Engineer on behalf of the Landowner set out above, Certifies that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg 903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

Signed this 13 day of May, 2019

PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO — May 13/19 — A. C. HOULE' — A.C. Houle

Test well # 4/4
209069
A260961

A.C. Houle, P.Eng.
Gemtec

(Engineer)

Shaping our future together
Ensemble, formons notre avenir

City of Ottawa
Client Service Centre
8763 Victoria Street

Ville d'Ottawa
Centre de service
8763, rue Victoria

2001 International Year of Volunteers Année internationale

Ontario — Ministry of the Environment and Climate Change

Tag#:A260961 (Print Below)

A260961

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☐ Metric ☒ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Alan Gale Agencies Limited		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1870 Sixth Line Road RR1	Dunrobin	ON	K0A 1T0	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3160 Carp Road	West Carleton	P/L 11 & 12	2

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa-Carleton	Carp	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	421446	5018944	RP-5R-7272	Parts 1 & 3

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Sand	& Stones		0'	15'
	Sand	& Gravel		15'	27'
Grey	Limestone			27'	187'
Grey	Sandstone	w/ Grey Limestone	Mix	187'	200'

TEST WELL #4 OF #4

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
42'	32'	Neat cement	10.92 [redacted]
32'	0'	Bentonite slurry	16.8

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4"	Steel	.188"	+2'	42'
6 1/8"	Open Hole		42'	200'

Status of Well

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

Construction Record - Screen

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

Water Details

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

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	42'	9 3/4"
42'	200'	6 1/8"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify Not tested

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 190

Pumping rate (l/min / GPM): 3

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 63.2'

If flowing give rate (l/min / GPM): X

Recommended pump depth (m/ft): 190'

Recommended pump rate (l/min / GPM): 3

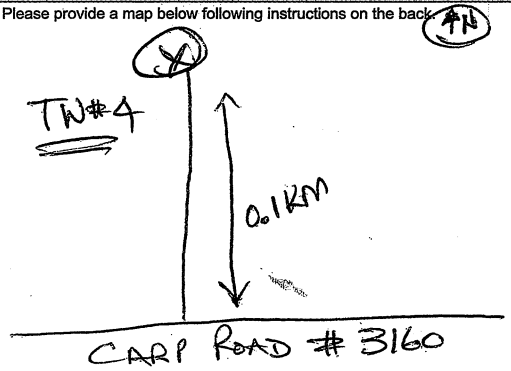
Well production (l/min / GPM): 3

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	13.5"		63.2'
1	20.3	1	52.3
2	23	2	50.6
3	25.2	3	48.4
4	27.1	4	46.3
5	28.5	5	44.4
10	36.6	10	35.7
15	42.7	15	30.6
20	40.4	20	25.1
25	49.8	25	21.3
30	54.5	30	17.5
40	57.8	40	13.5
50	60.7	50	13.5
60	63.2"	60	13.5"

Map of Well Location

Please provide a map below following instructions on the back. #4



Comments:

1/2 HP - 5 GPM SET @ 190 FEET

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality
6659 Franktown Road, RR#1	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Purcell, Shannon

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
[redacted] T4033		2019 04 30 (Y Y Y Y M M D D)

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2019 05 08	2019 03 06

Ministry Use Only

Audit No. Z302437

Received

0506E (2014/11) — Ministry's Copy

© Queen's Printer for Ontario, 2014

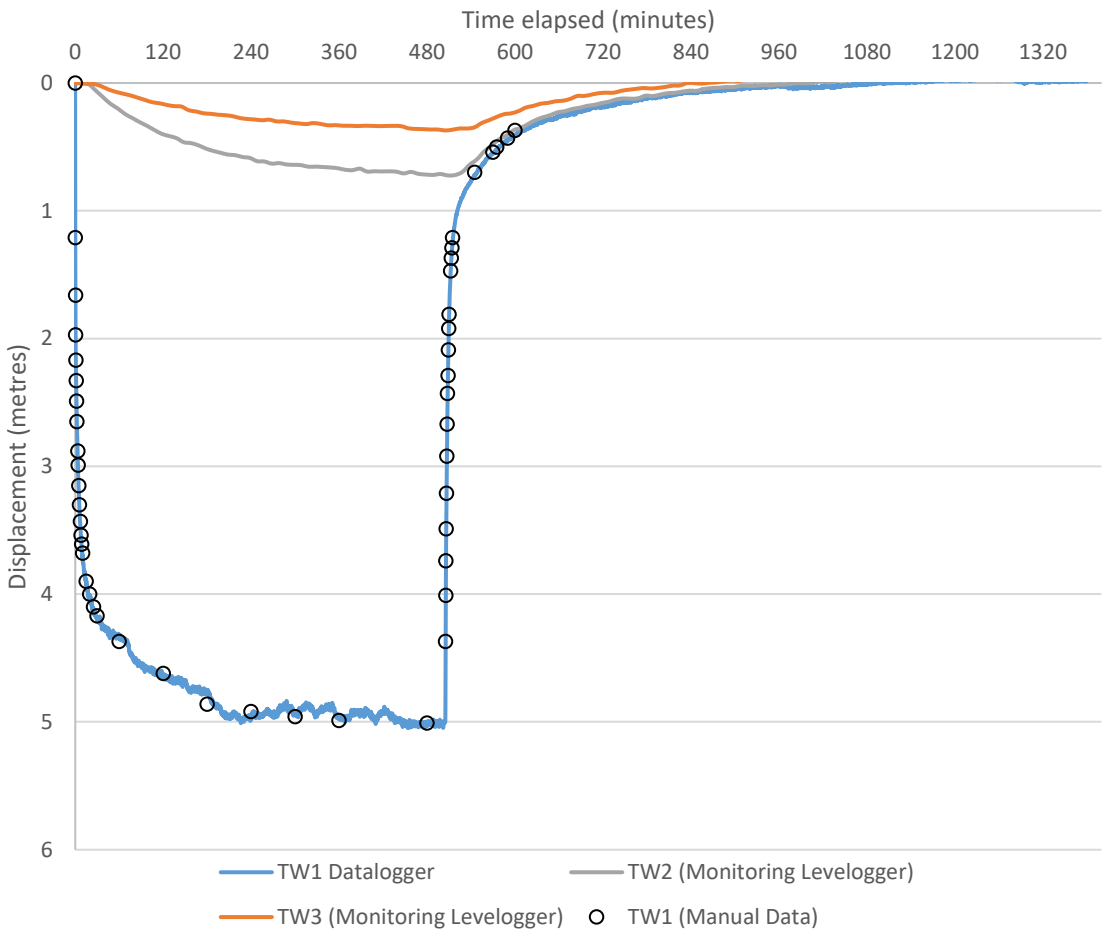
APPENDIX J

Pumping Test Analysis and Water Level Monitoring

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW1	P-Test Date: September 7, 2023
Analysis Performed by: SE	Method: N/A	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW1): Drawdown and Recovery



Water Levels TW1

Static : 4.1 m below ground surface

TOC = 0.66 m above ground surface

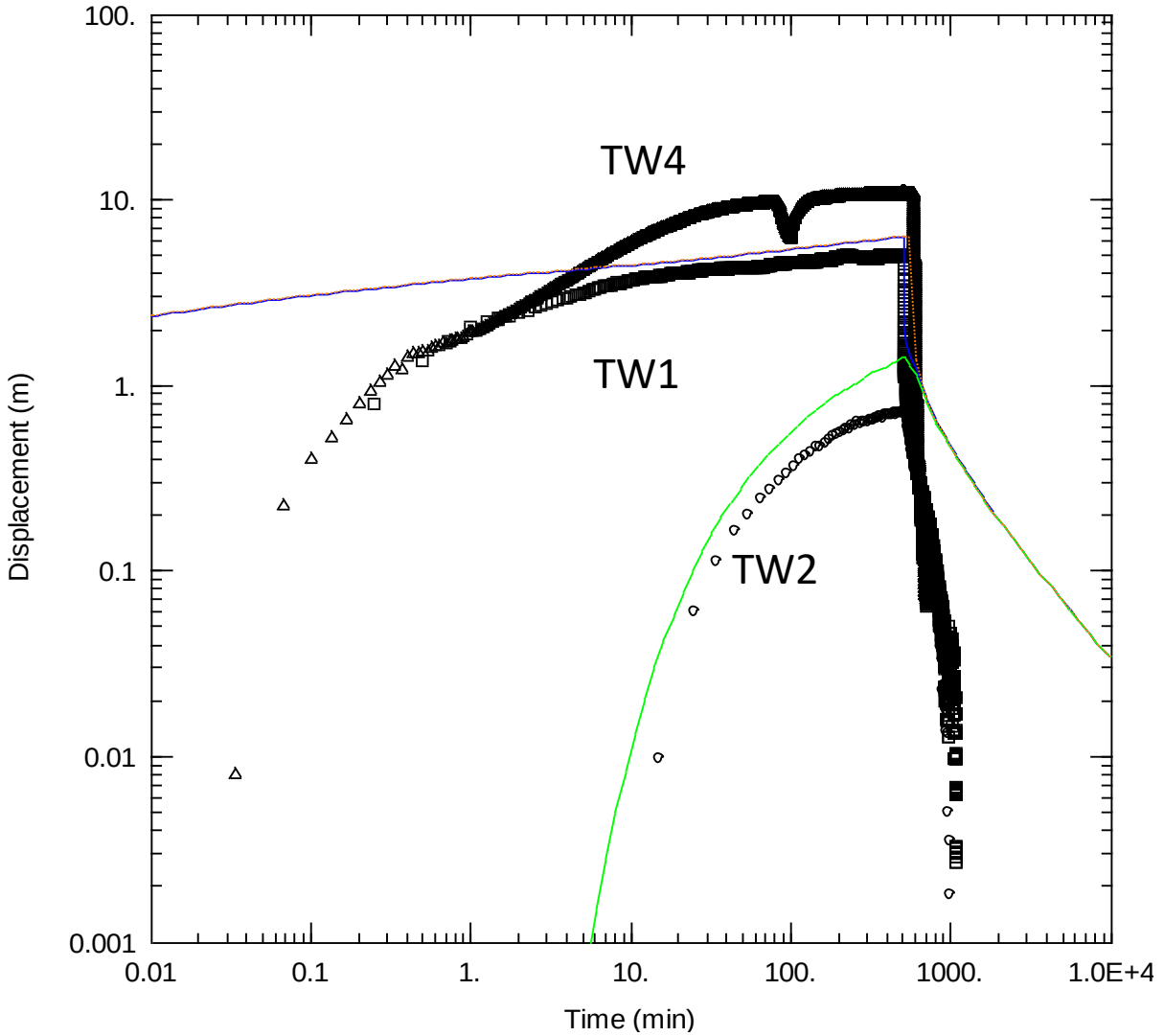
End of pump test (8-hours): 9.3 m below ground surface

Following recovery (24-hour): 4.1 m below ground surface

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW1	P-Test Date: September 7, 2023
Analysis Performed by: SE	Method: Pap. – Cooper Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW1): Papadopulos – Cooper (Confined Aquifer)



Estimated Transmissivity: 8 m^2/day or 9 x $10^{-5} m^2/s$

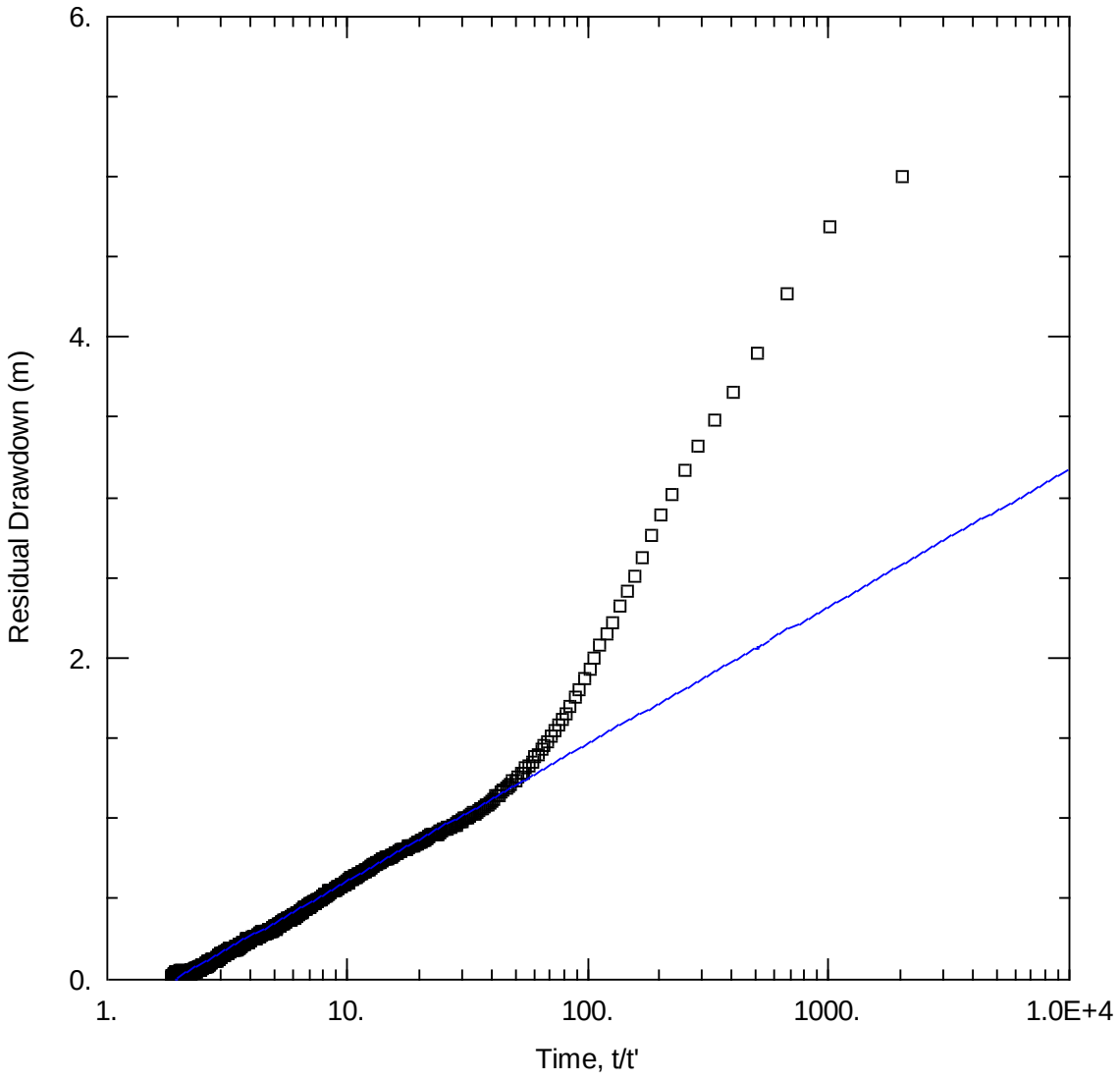
Estimated Hydraulic Conductivity (based on transmissivity): 2 x 10^{-6} m/s

Estimated Storage Coefficient: 7x10^{-6}

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW1	P-Test Date: September 7, 2023
Analysis Performed by: SE	Method: Theis Recovery Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW1): Theis Recovery (Confined Aquifer)



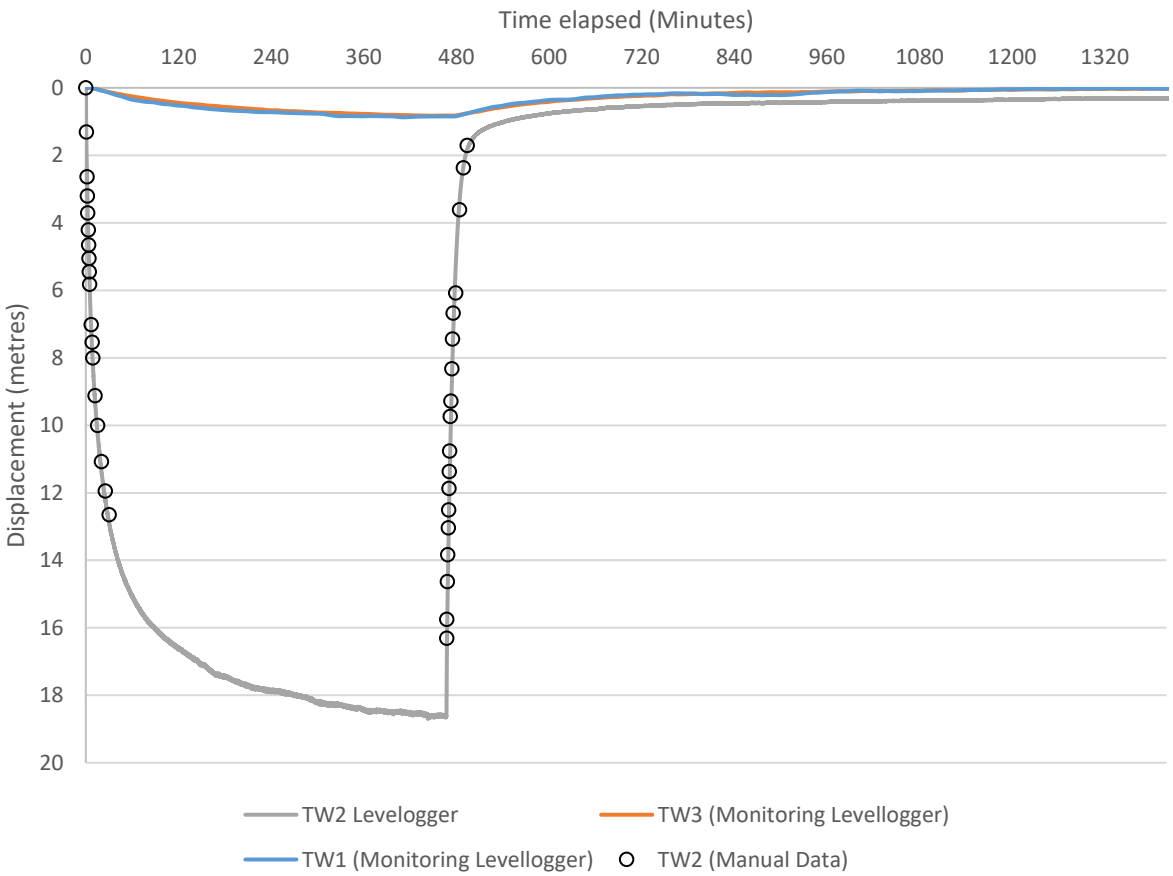
Estimated Transmissivity: 7 m^2/day or 8 x 10^{-5} m^2/s

Estimated Hydraulic Conductivity (based on transmissivity): 1 x 10^{-6} ms

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW2	P-Test Date: September 19, 2023
Analysis Performed by: SE	Method: N/A	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW2): Drawdown and Recovery

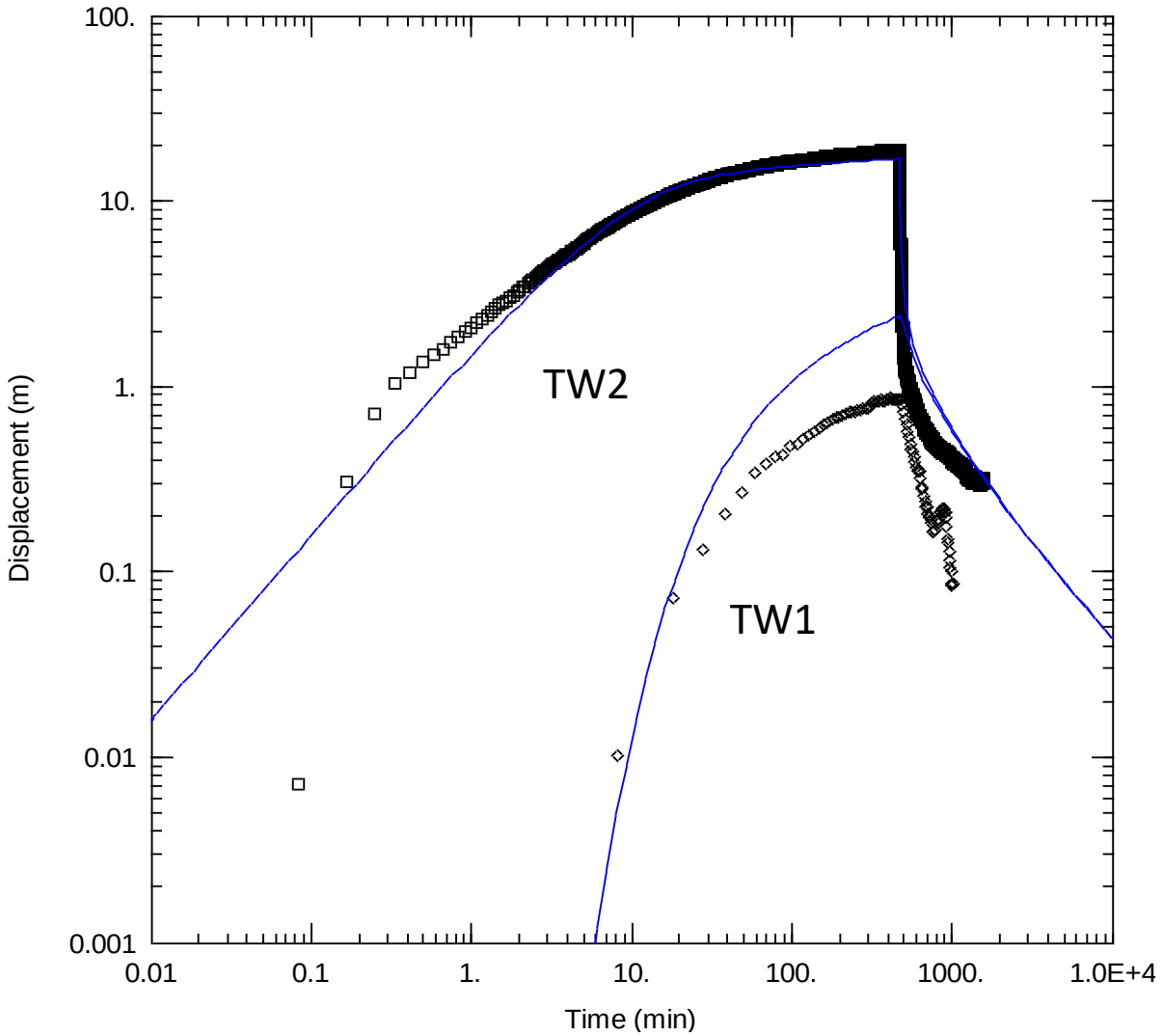


Water Levels TW2
Static : 1.70 m below ground surface
TOC = 0.29 m above ground surface
End of pump test (8-hours): 20.3 m below ground surface
Following recovery (24-hour): 2.0 m below ground surface

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW2	P-Test Date: September 19, 2023
Analysis Performed by: SE	Method: Pap. – Coop Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW2): Papadopulos – Cooper (Confined Aquifer)

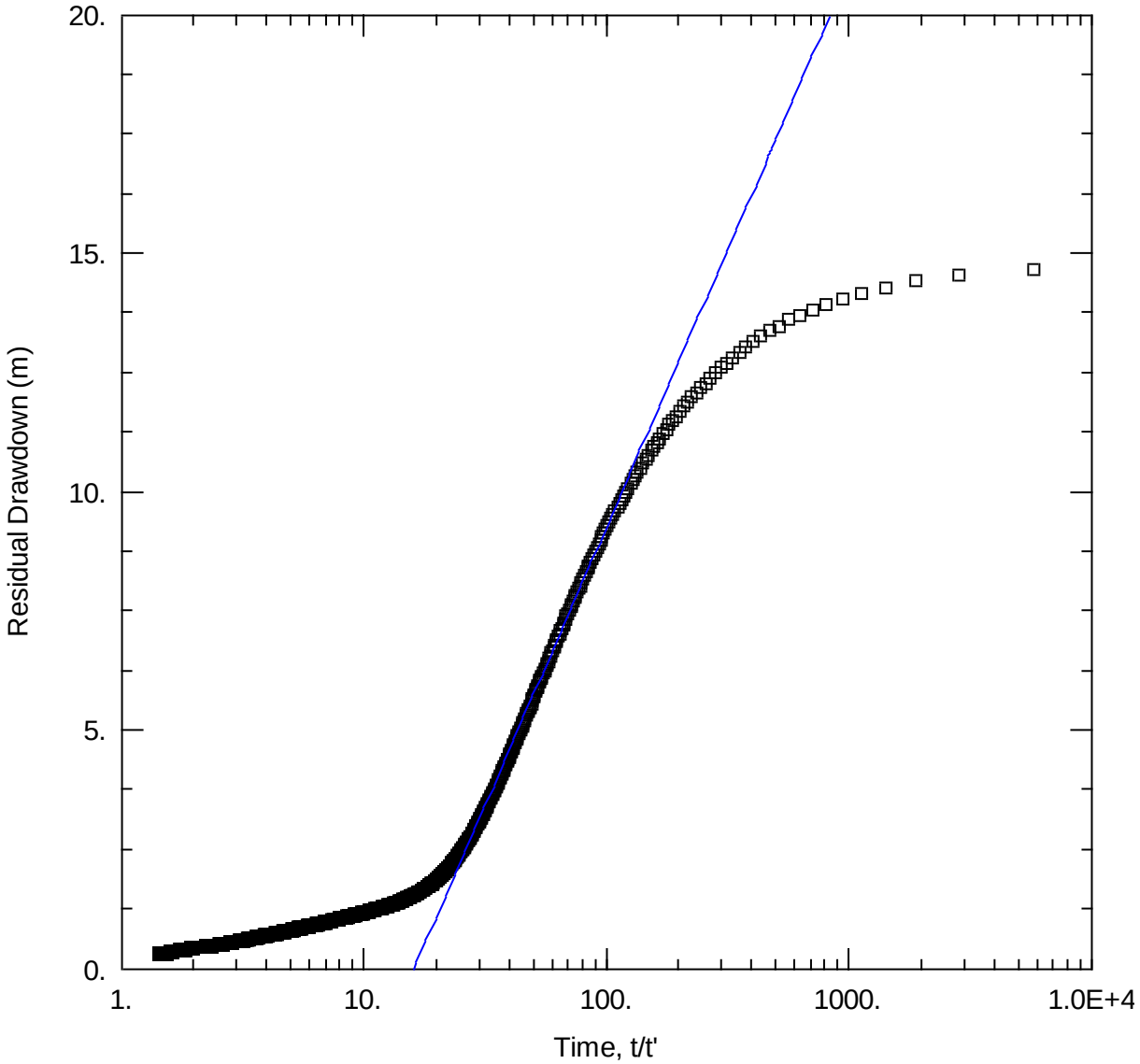


Estimated Transmissivity: 4 m^2/day or 5 x 10^{-5} m^2/s
Estimated Hydraulic Conductivity (based on transmissivity): 9 x 10^{-7} m/s
Storage Coefficient: 3x10^{-6} (model does not fit observation well curve)

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW2	P-Test Date: September 19, 2023
Analysis Performed by: SE	Method: Theis Recovery Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW2): Theis Recovery (Confined Aquifer)



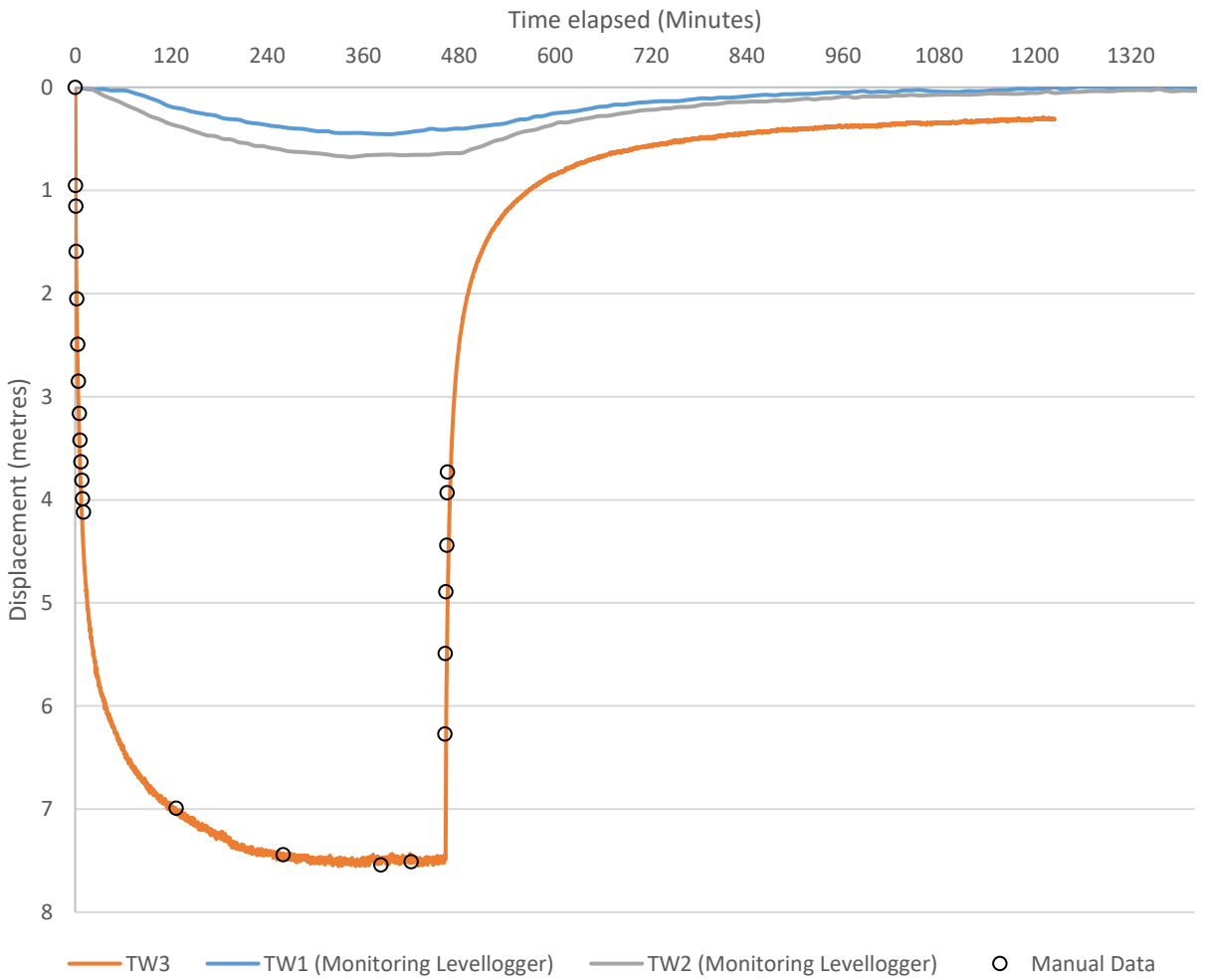
Estimated Transmissivity: 0.7 m^2/day or 8 x 10^{-6} m^2/s

Estimated Hydraulic Conductivity (based on transmissivity): 1 x 10^{-7} m/s

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW3	P-Test Date: September 06, 2023
Analysis Performed by: SE	Method: N/A	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW3): Drawdown and Recovery



Water Levels TW3

Static : 4.1 m below ground surface

TOC = 0.8 m above ground surface

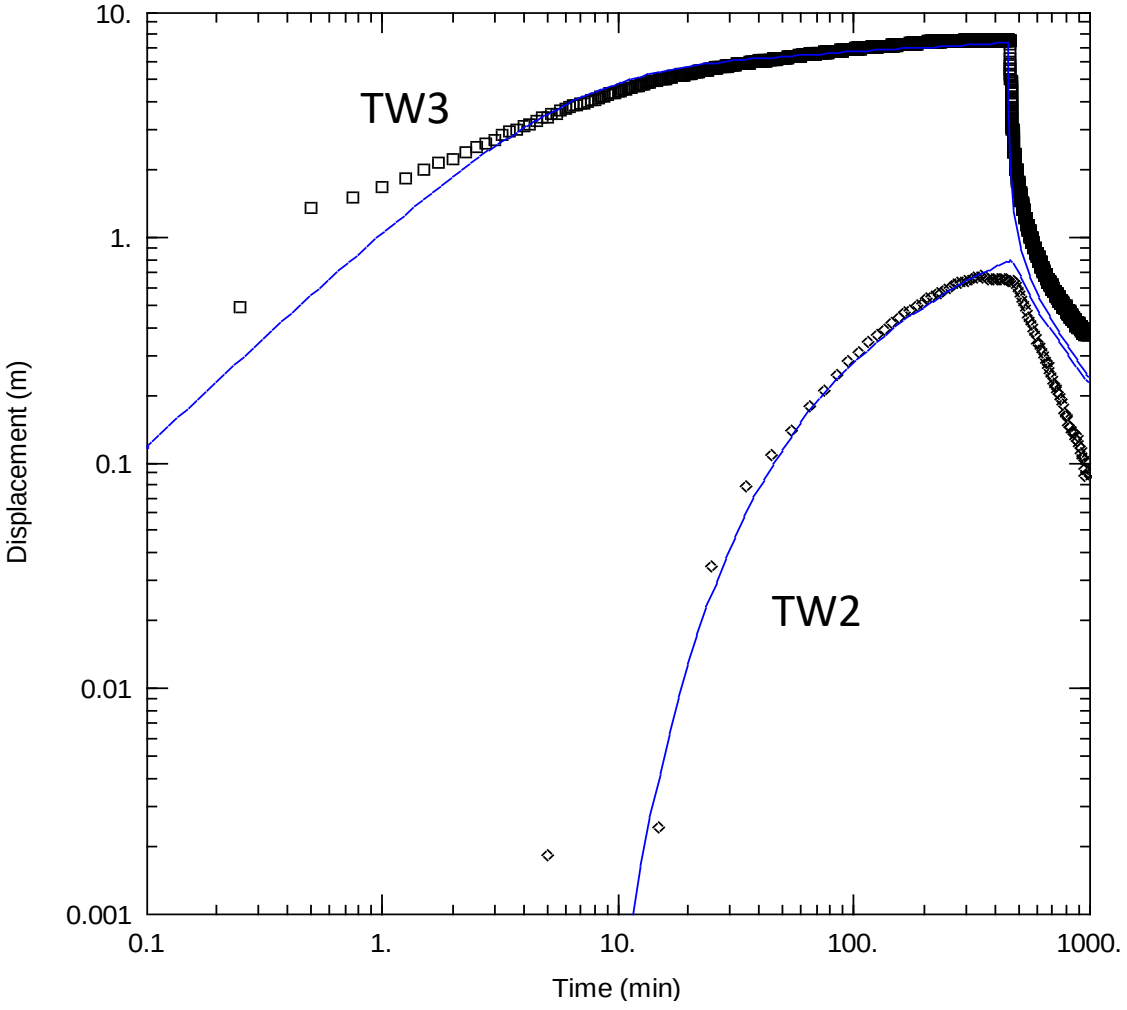
End of pump test (9-hour): 11.6 m below ground surface

Following recovery (24-hour): 4.4 m below ground surface

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW3	P-Test Date: September 06, 2023
Analysis Performed by: SE	Method: Pap. – Coop Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW3): Papadopulos – Cooper (Confined Aquifer)

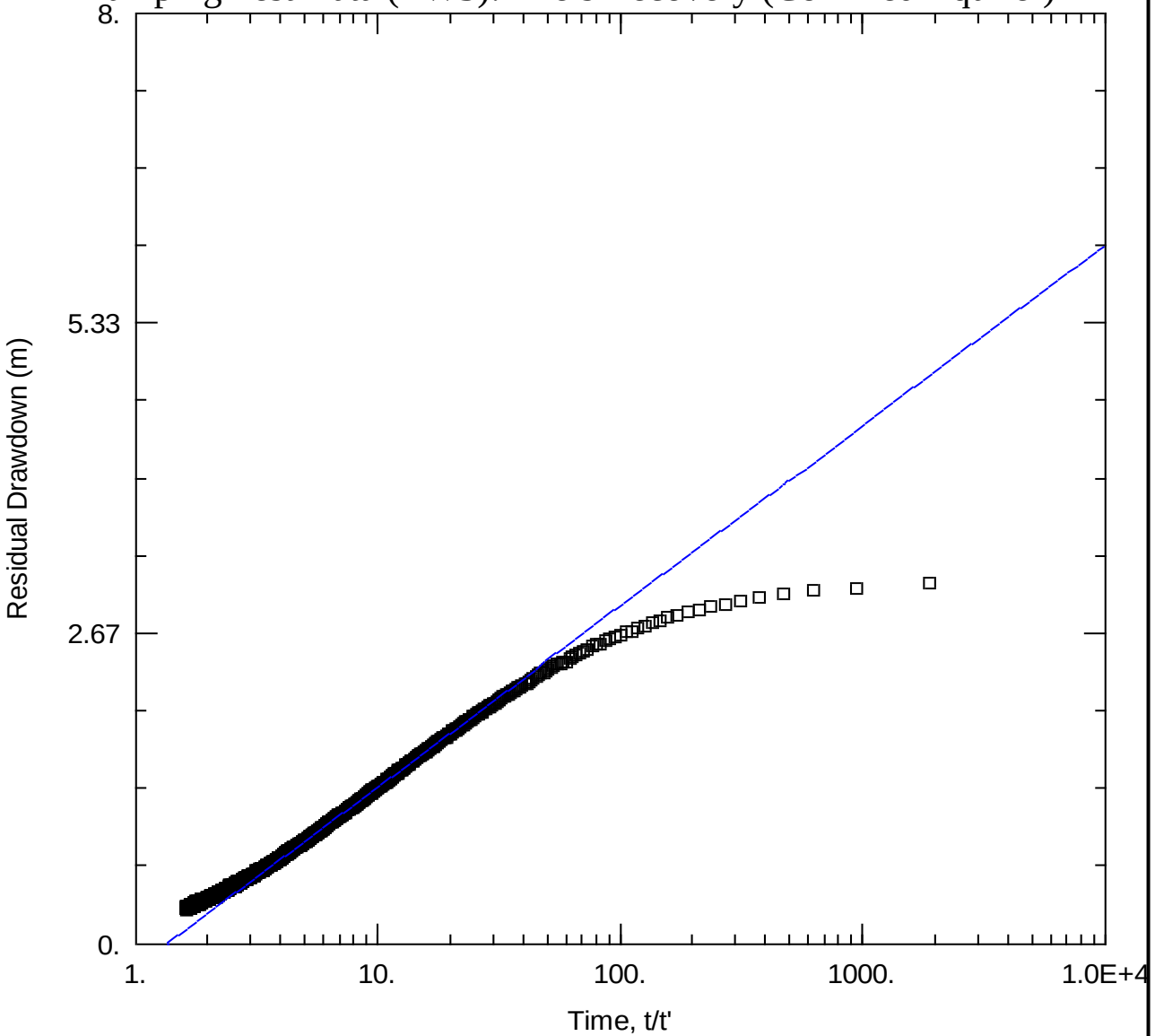


Estimated Transmissivity: 6 m^2/day or 7 x 10^{-5} m^2/s
Estimated Hydraulic Conductivity (based on transmissivity): 1 x 10^{-6} m/s
Storage Coefficient: 7x10^{-6}

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW3	P-Test Date: September 06, 2023
Analysis Performed by: SE	Method: Theis Recovery Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW3): Theis Recovery (Confined Aquifer)



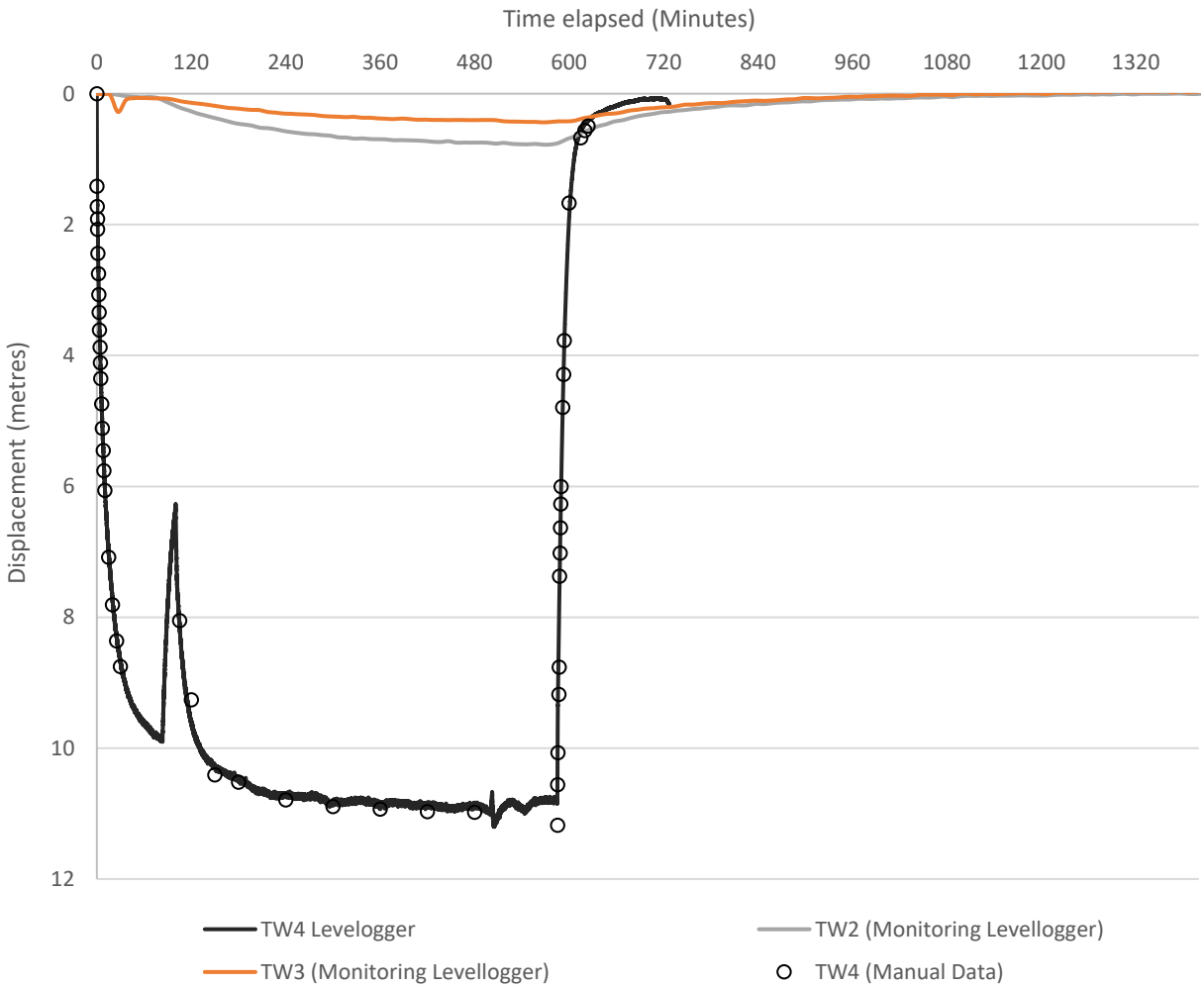
Estimated Transmissivity: 3.6 m^2/day or 4 x 10^{-5} m^2/s

Estimated Hydraulic Conductivity (based on transmissivity): 7 x 10^{-7} m/s

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW4	P-Test Date: September 07, 2023
Analysis Performed by: SE	Method: N/A	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW4): Drawdown and Recovery



Water Levels TW3

Static : 5.3 m below ground surface

TOC = 0.24 m above ground surface

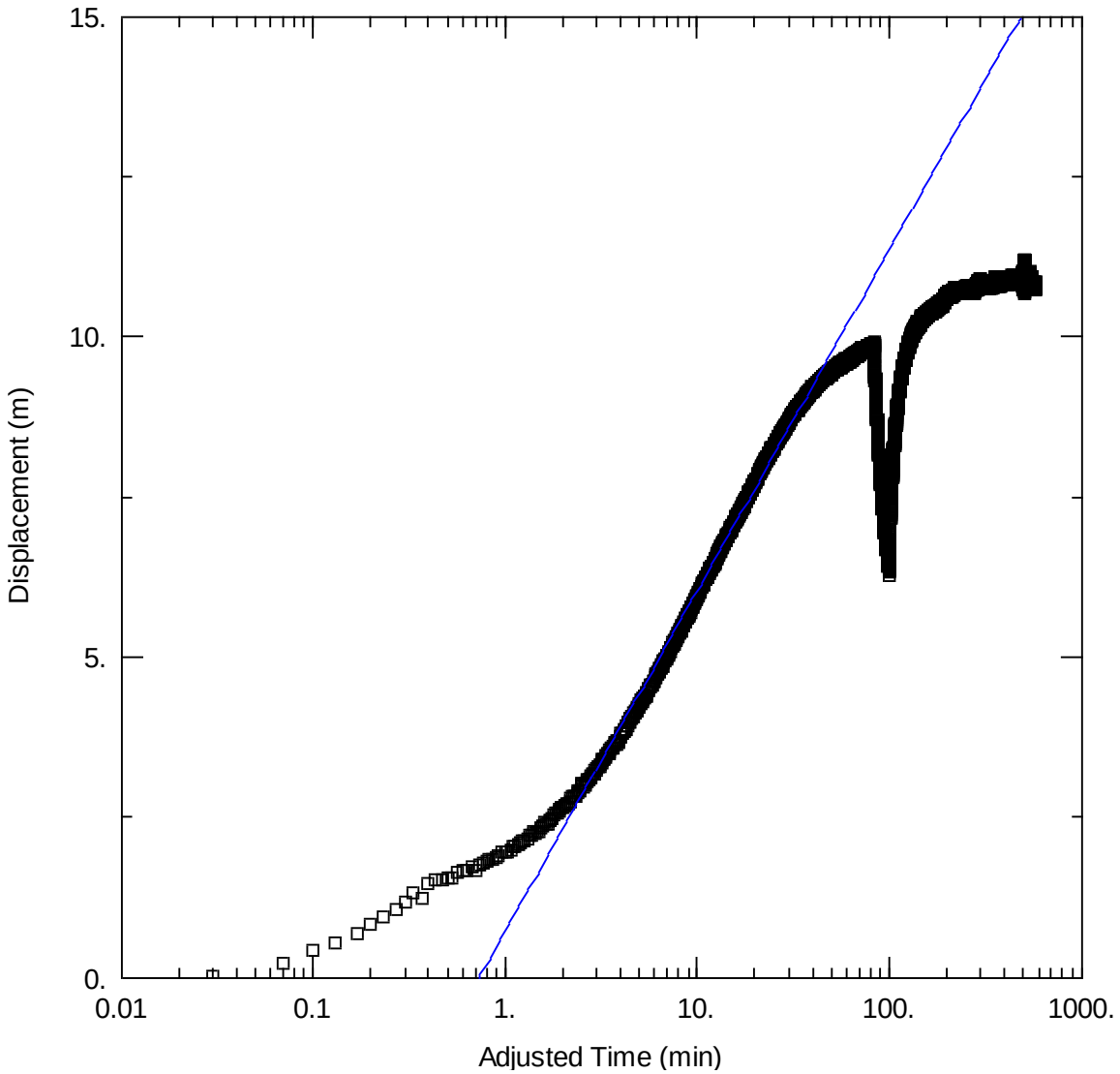
End of pump test (10-hour): 16.4 m below ground surface

Following recovery (2-hour): 5.5 m below ground surface

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW4	P-Test Date: September 07, 2023
Analysis Performed by: SE	Method: Cooper-Jacob	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW4): Cooper-Jacob (Confined Aquifer)



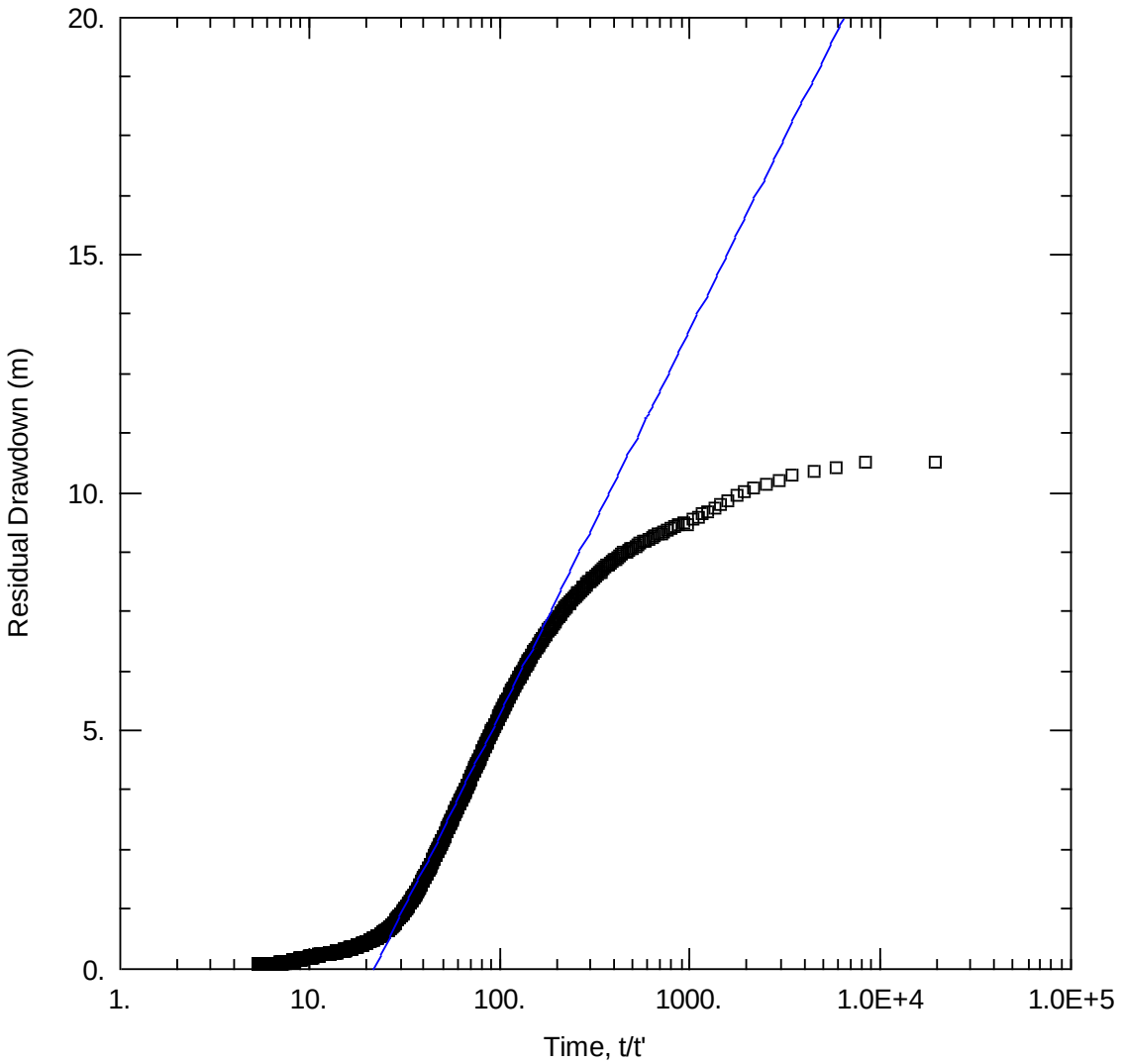
Estimated Transmissivity: 1 m^2/day or 1 x 10^{-5} m^2/s

Estimated Hydraulic Conductivity (based on transmissivity): 2 x 10^{-7} m/s

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW4	P-Test Date: September 07, 2023
Analysis Performed by: SE	Method: Theis Recovery Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW4): Theis Recovery (Confined Aquifer)

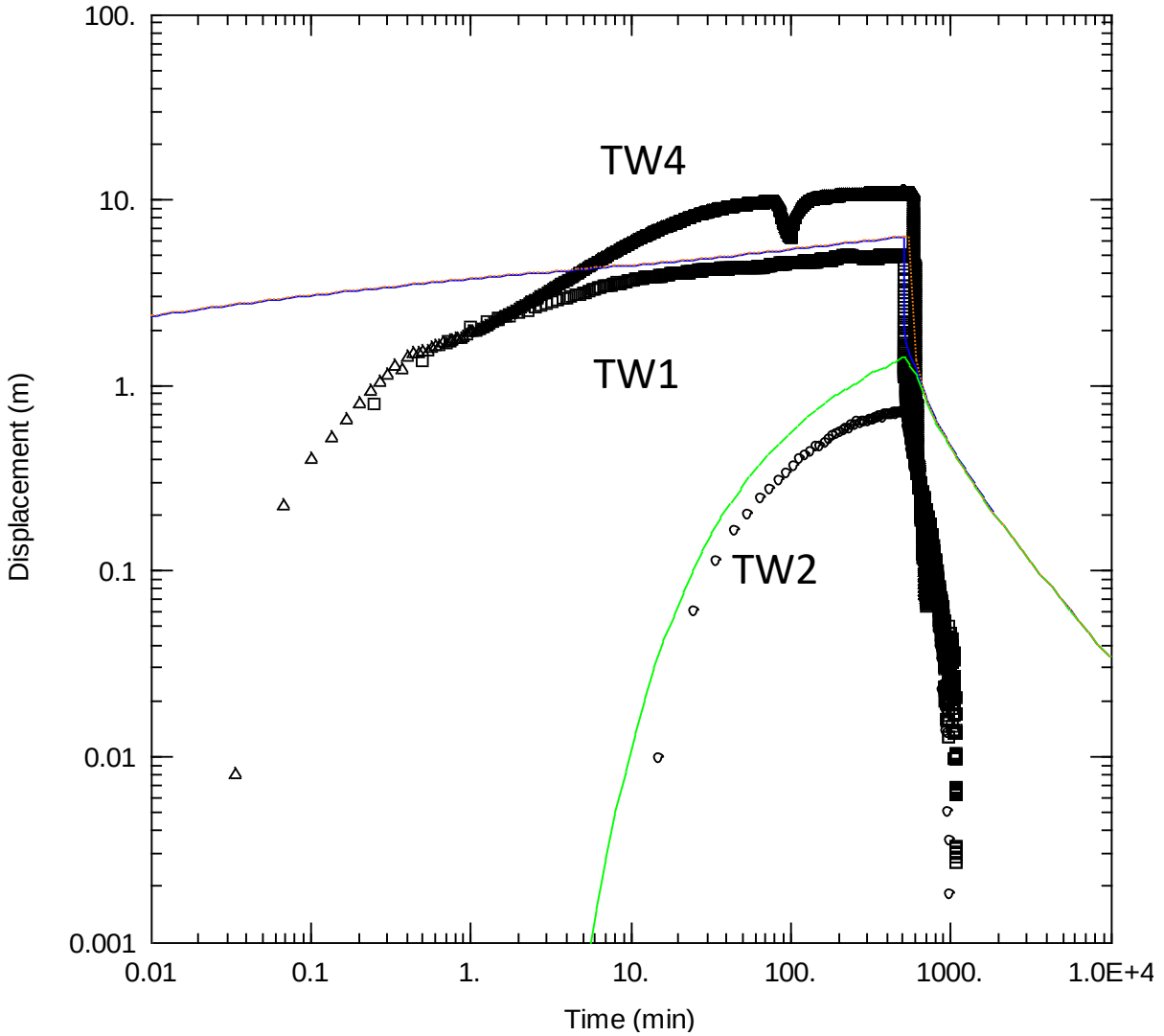


Estimated Transmissivity: 0.7 m^2/day or 8 x 10^{-6} m^2/s
Estimated Hydraulic Conductivity (based on transmissivity): 2 x 10^{-7} m/s

GEMTEC Consulting Engineers and Scientists	Pumping Test Compilation Report
	Project: Hydrogeological Investigation
	Project Number: 102151.001
	Client: TLC Holdings

Location: 3160 Carp Road, Ottawa, Ontario		
Test Conducted by: SM	Pumping Well: TW1	P-Test Date: September 7, 2023
Analysis Performed by: SE	Method: Pap. – Cooper Method	Discharge: Constant 21 L/min
Duration: 8 hours		

Pumping Test Data (TW4): Papadopulos – Cooper (Confined Aquifer)



Estimated Transmissivity: 8 m^2/day or 9 x $10^{-5} m^2/s$

Estimated Hydraulic Conductivity (based on transmissivity): 2 x 10^{-6} m/s

Estimated Storage Coefficient: 7x10^{-6}

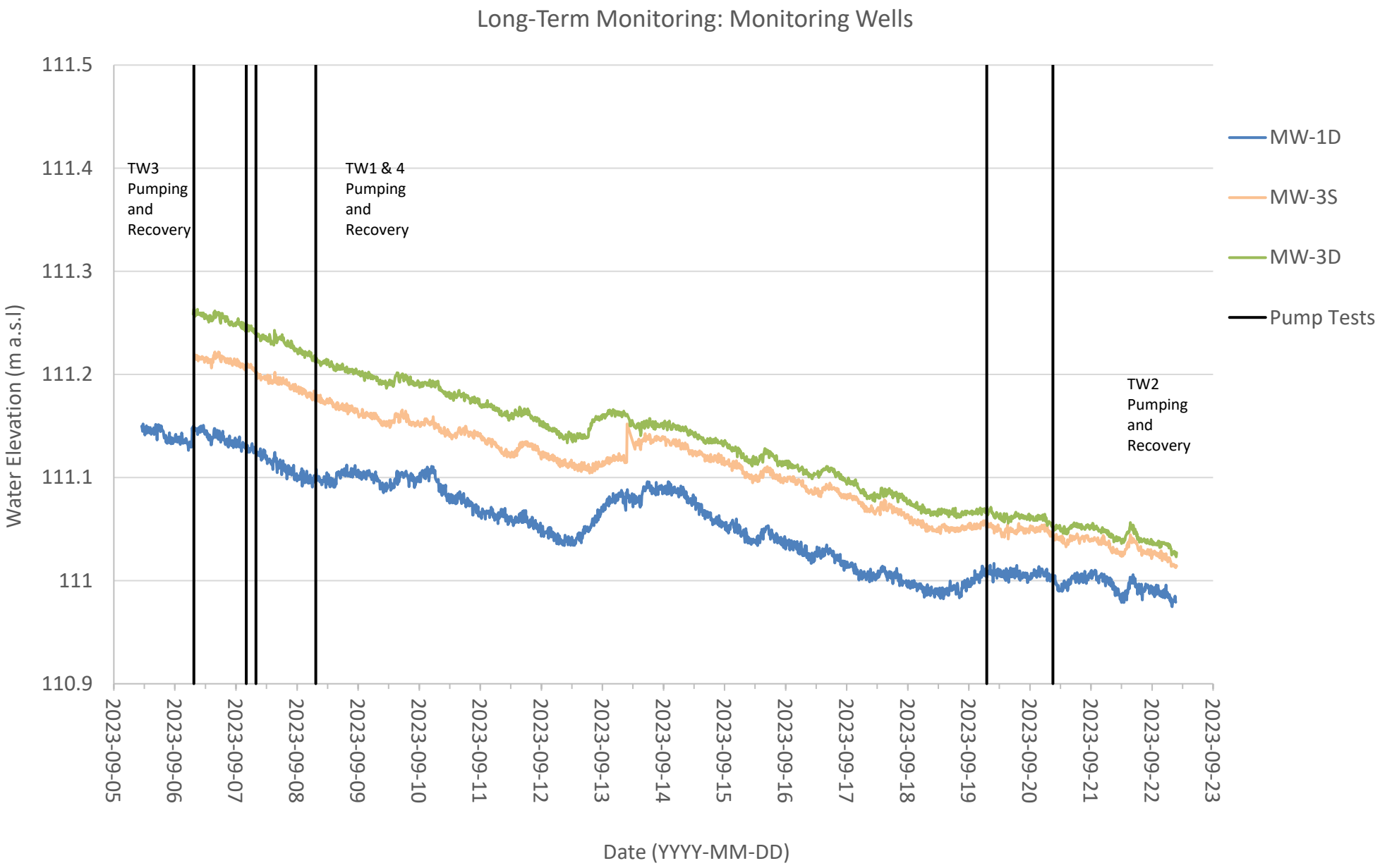
GEMTEC
Consulting Engineers and Scientists

Monitoring Well Observation Data

Project: Hydrogeological Investigation, 3160 Carp Road, Ottawa, Ontario

Project Number: 102151.001

Client: TLC Holdings Inc.



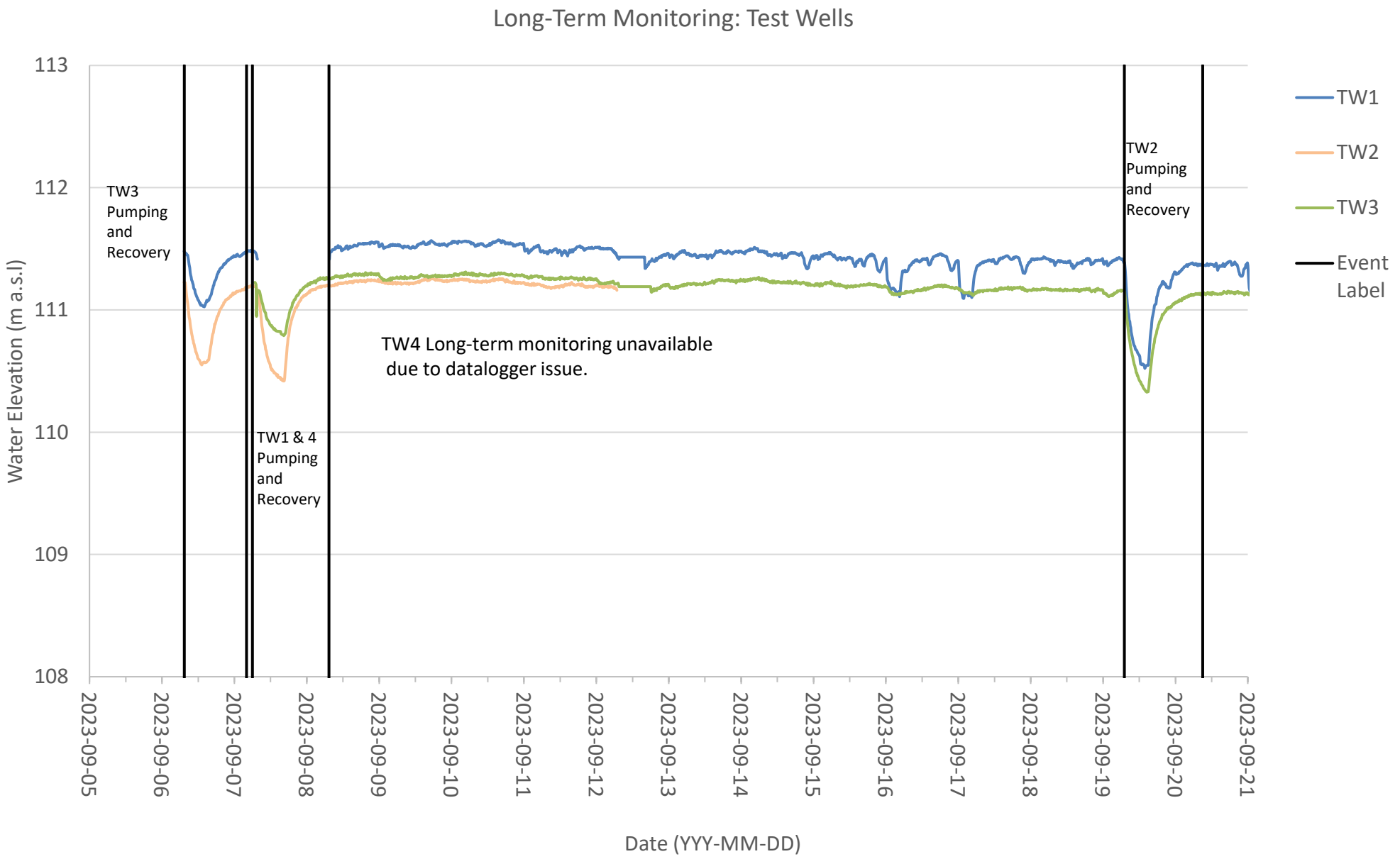
GEMTEC
Consulting Engineers and Scientists

Monitoring Well Observation Data

Project: Hydrogeological Investigation, 3160 Carp Road, Ottawa, Ontario

Project Number: 102151.001

Client: TLC Holdings Inc.



APPENDIX K

Test Well Water Quality Summary

Summary of Test Well Field Water Quality Measurements

Test Well ID	Time Since Initiaion of Pump (hrs)	Temp (°C)	pH	Electrical Conductivity (µS/cm)	Total Dissolved Solids (ppm)	Turbidity (NTU)	Colour (ACU[1])	Colour (ACU[2])	Free Chlorine (mg/L)	Total Chlorine (mg/L)
TW1	4	14	7.96	746	468	4.13	<5	-	<0.02	<0.02
	8	15	8.47	700	455	0	<5	-	<0.02	<0.02
TW2	8	11.5	8.31	528	265	2.02	<5	-	<0.02	<0.02
TW3	8	15.91	7.99	661	423	1.9	<5	-	<0.02	<0.02
TW4	4	13.66	8.21	773	486	3.9	<5	-	<0.02	<0.02
	8	16.42	8.33	726	461	0	<5	-	<0.02	<0.02

NOTES:

1. ACU = Actual Colour Units
2. Field filtered using 0.45 micron filter

Summary of Test Well Labratory Water Quality Measurements

Parameter	Units	TW1 8hr 2336376-03 09/07/2023 05:00 PM	TW1 8hr (Filtered) 2336376-04 09/07/2023 05:00 PM	TW1 3hr 1932395-01 08/08/2019 11:15 PM	TW1 6hr 1932395-02 08/08/2019 14:15 PM	TW2 8hr 2338190-01 09/19/2023 03:45 PM	TW2 3hr 1933220-01 08/12/2019 11:00 PM	TW2 6hr 1933220-02 08/12/2019 14:00 PM	TW3-8hr 2336243-01 09/06/2023 04:30 PM	TW3 3hr 19324002-01 08/7/2019 11:00 PM	TW3 6hr 19324002-02 08/7/2019 14:00 PM	TW4 8hr 2336376-01 09/07/2023 04:15 PM	TW4 8hr (Filtered) 2336376-02 09/07/2023 04:15 PM	TW4 3hr 1932194-01 08/06/2019 11:00 PM	TW4 6hr 1932194-02 08/06/2019 11:00 PM	Ontario Drinking Water Standard	Type of Standard[1,2,3]
Microbiological Parameters																	
E. Coli	CFU/100mL	ND (1)	-	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	-	ND (1)	ND (1)	0	MAC
Total Coliforms	CFU/100mL	ND (1)	-	ND (1)	ND (1)	1	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	-	ND (1)	ND (1)	-	-
Fecal Coliforms	CFU/100mL	ND (1)	-	ND (1)	ND (1)	ND (1)	1	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	-	ND (1)	ND (1)	0	MAC
Heterotrophic Plate Count	CFU/mL	10	-	270	120	110	240	50	40	-	-	ND (10)	-	40	40	-	-
General Inorganics																	
Alkalinity, total	mg/L	222	-	214	212	189	182	184	203	209	210	204	-	227	226	30-500	OG
Ammonia as N	mg/L	0.10	-	0.13	0.11	0.16	0.19	0.24	0.24	0.24	0.23	0.09	-	0.09	0.11		
Dissolved Organic Carbon	mg/L	0.7	-	1.1	0.6	ND (0.5)	0.6	0.7	0.8	1.2	1.4	0.8	-	1.1	1	10	MAC
Colour	TCU	ND (2)	-	**80**	2	ND (2)	**7**	ND(2)	ND (2)	**25**	5	ND (2)	-	**6**	**7**	5	AO
Colour, apparent	ACU	10	-	-	-	13	-	-	9	-	-	3	-	-	-	-	AO
Conductivity	uS/cm	758	-	723	706	628	603	611	730	670	699	788	-	645	643	-	OG
Hardness	mg/L	**283**	-	**306**	**292**	**209**	**219**	**215**	**176**	**189**	**172**	**339**	-	309	305	80-100	OG
pH	pH Units	8.1	-	8	8	8.2	8	8	8.3	8.2	8.2	8.2	-	7.8	7.8	6.5-8.5	-
Phenolics	mg/L	ND (0.001)	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	-	ND (0.001)	ND (0.001)	-	-
Total Dissolved Solids	mg/L	438	-	442	394	322	322	324	400	346	354	470	-	364	382	500	AO
Sulphide	mg/L	**0.18**	-	**0.16**	**0.24**	**0.22**	**1.74**	**2.02**	**0.77**	**0.77**	**1.09**	**0.13**	-	0.05	0.08	0.05	AO
Tannin & Lignin	mg/L	ND (0.1)	-	0.1	ND (0.1)	0.2	0.1	0.1	ND (0.1)	0.2	0.1	ND (0.1)	-	ND (0.1)	ND (0.1)	-	-
Total Kjeldahl Nitrogen	mg/L	0.1	-	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.1	-	ND (0.1)	0.1	-	-
Organic Nitrogen		0	-	0.07	0.09	0.04	0	0.1	0.06	0.1	0.1	0.01	-	0	0	0.15	OG
Turbidity	NTU	1.4	-	0.1	0.1	2.3	3.9	10.2	1.4	18.4	5.2	0.4	-	1.8	1	5	AO
Anions				92.2	20.2												
Chloride	mg/L	80	-	72	71	63	63	63	79	55	63	93	-	44	43	250	AO
Fluoride	mg/L	0.2	-	0.2	0.3	0.5	0.8	0.8	0.4	0.4	0.5	0.1	-	0.2	0.2	1.5	MAC
Nitrate as N	mg/L	ND (0.1)	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.1)	ND (0.1)	10[4]	MAC
Nitrite as N	mg/L	ND (0.05)	-	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	-	ND (0.05)	ND (0.05)	1.0[4]	MAC
Sulphate	mg/L	51	-	54	52	34	30	29	46	54	52	58	-	71	69	500	AO
Metals																	
Mercury	mg/L	ND (0.0001)	ND (0.0001)	-	-	-	-	-	-	-	-	ND (0.0001)	ND (0.0001)	-	-	0.001	
Aluminum	mg/L	0.043	0.001	-	-	-	-	-	-	-	-	0.007	ND (0.001)	-	-	0.1	OG
Antimony	mg/L	ND (0.0005)	ND (0.0005)	-	-	-	-	-	-	-	-	ND (0.0005)	ND (0.0005)	-	-	0.006	MAC
Arsenic	mg/L	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-	ND (0.001)	ND (0.001)	-	-	0.025	MAC
Barium	mg/L	0.114	0.115	-	-	-	-	-	-	-	-	0.205	0.204	-	-	1	MAC
Beryllium	mg/L	ND (0.0005)	ND (0.0005)	-	-	-	-	-	-	-	-	ND (0.0005)	ND (0.0005)	-	-	-	-
Boron	mg/L	0.08	0.08	-	-	-	-	-	-	-	-	0.04	0.05	-	-	5	MAC
Cadmium	mg/L	ND (0.0001)	ND (0.0001)	-	-	-	-	-	-	-	-	ND (0.0001)	ND (0.0001)	-	-	0.005	MAC
Calcium	mg/L	70.0	70.4	74.2	70.7	50.8	53.3	52.3	42	48.3	44.1	91.4	91.9	83.2	81.6	-	-
Chromium	mg/L	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-	ND (0.001)	ND (0.001)	-	-	0.05	MAC
Cobalt	mg/L	ND (0.0005)	ND (0.0005)	-	-	-	-	-	-	-	-	ND (0.0005)	ND (0.0005)	-	-	-	-
Copper	mg/L	ND (0.0005)	ND (0.0005)	-	-	-	-	-	-	-	-	ND (0.0005)	ND (0.0005)	-	-	1	AO
Iron	mg/L	ND (0.1)	ND (0.1)	2	0.7	ND(0.1)	0.2	0.6	0.1	0.5	0.2	ND (0.1)	ND (0.1)	0.2	0.1	0.3	AO
Lead	mg/L	ND (0.0001)	ND (0.0001)	-	-	-	-	-	-	-	-	ND (0.0001)	ND (0.0001)	-	-	0.01	MAC
Magnesium	mg/L	26.2	25.7	29.2	28.2	19.8	20.9	20.4	17.2	16.6	15	26.9	26.1	24.6	24.6	-	-
Manganese	mg/L	ND (0.005)	ND (0.005)	0.032	0.013	ND(0.005)	ND (0.005)	0.006	ND(0.005)	0.007	ND (0.005)	0.006	0.006	0.007	0.006	0.05	AO
Molybdenum	mg/L	0.0012	0.0011	-	-	-	-	-	-	-	-	0.0020	0.0020	-	-	-	-
Nickel	mg/L	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-	ND (0.001)	ND (0.001)	-	-	-	-
Potassium	mg/L	4.7	4.8	6.1	5.9	6.1	6.3	6.4	5.7	5.7	6	4.1	4.2	3.4	3.8	-	-
Selenium	mg/L	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-	ND (0.001)	ND (0.001)	-	-	0.01	MAC
Silver	mg/L	ND (0.0001)	ND (0.0001)	-	-	-	-	-	-	-	-	ND (0.0001)	ND (0.0001)	-	-	-	-
Sodium	mg/L	43.0	42.7	41.4	42.8	51.2	48.4	49.9	87.6	85.1	95.8	24.3	24.1	18.1	19.4	200 (20)(5)	AO
Strontium	mg/L	1.96	1.93	-	-	-	-	-	-	-	-	2.93	2.92	-	-	-	-
Thallium	mg/L	ND (0.001)	ND (0.001)	-	-	-	-	-	-	-	-	ND (0.001)	ND (0.001)	-	-	-	-
Uranium	mg/L	0.0001	0.0001	-	-	-	-	-	-	-	-	0.0007	0.0006	-	-	0.02	MAC
Vanadium	mg/L	ND (0.0005)	ND (0.0005)	-	-	-	-	-	-	-	-	ND (0.0005)	ND (0.0005)	-	-	-	-
Zinc	mg/L	ND (0.005)	ND (0.005)	-	-	-	-	-	-	-	-	ND (0.005)	ND (0.005)	-	-	5	AO
Volatiles																	
Acetone	ug/L	ND (5.0)	-	-	-	-	-	-	-	-	-	ND (5.0)	-	-	-	-	-
Benzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.001 mg/L (1 ug/L)	MAC
Bromodichloromethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Bromoform	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-

Summary of Test Well Labratory Water Quality Measurements

Parameter	Units	TW1 8hr 2336376-03 09/07/2023 05:00 PM	TW1 8hr (Filtered) 2336376-04 09/07/2023 05:00 PM	TW1 3hr 1932395-01 08/08/2019 11:15 PM	TW1 6hr 1932395-02 08/08/2019 14:15 PM	TW2 8hr 2338190-01 09/19/2023 03:45 PM	TW2 3hr 1933220-01 08/12/2019 11:00 PM	TW2 6hr 1933220-02 08/12/2019 14:00 PM	TW3-8hr 2336243-01 09/06/2023 04:30 PM	TW3 3hr 19324002-01 08/7/2019 11:00 PM	TW3 6hr 19324002-02 08/7/2019 14:00 PM	TW4 8hr 2336376-01 09/07/2023 04:15 PM	TW4 8hr (Filtered) 2336376-02 09/07/2023 04:15 PM	TW4 3hr 1932194-01 08/06/2019 11:00 PM	TW4 6hr 1932194-02 08/06/2019 11:00 PM	Ontario Drinking Water Standard	Type of Standard[1,2,3]
Bromomethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Carbon Tetrachloride	ug/L	ND (0.2)	-	-	-	-	-	-	-	-	-	ND (0.2)	-	-	-	0.002 mg/L (2 ug/L)	MAC
Chlorobenzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.08 mg/L (80 ug/L)	MAC
Chloroethane	ug/L	ND (1.0)	-	-	-	-	-	-	-	-	-	ND (1.0)	-	-	-	-	-
Chloroform	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Chloromethane	ug/L	ND (3.0)	-	-	-	-	-	-	-	-	-	ND (3.0)	-	-	-	-	-
Dibromochloromethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Dichlorodifluoromethane	ug/L	ND (1.0)	-	-	-	-	-	-	-	-	-	ND (1.0)	-	-	-	-	-
hylene dibromide (dibromoethane, 1,:	ug/L	ND (0.2)	-	-	-	-	-	-	-	-	-	ND (0.2)	-	-	-	-	-
1,2-Dichlorobenzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.2 mg/L (200 ug/L)	MAC
1,3-Dichlorobenzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,4-Dichlorobenzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.005 mg/L (5 ug/L)	MAC
1,1-Dichloroethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,2-Dichloroethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.005 mg/L (5 ug/L)	MAC
1,1-Dichloroethylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.014 mg/L (14 ug/L)	MAC
cis-1,2-Dichloroethylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
trans-1,2-Dichloroethylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,2-Dichloroethylene, total	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,2-Dichloropropane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
cis-1,3-Dichloropropylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
trans-1,3-Dichloropropylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,3-Dichloropropene, total	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Ethylbenzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	0.8	-	-	-	0.14 mg/L (140 ug/L)	MAC
Hexane	ug/L	ND (1.0)	-	-	-	-	-	-	-	-	-	ND (1.0)	-	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND (5.0)	-	-	-	-	-	-	-	-	-	ND (5.0)	-	-	-	-	-
Methyl Butyl Ketone (2-Hexanone)	ug/L	ND (10.0)	-	-	-	-	-	-	-	-	-	ND (10.0)	-	-	-	-	-
Methyl Isobutyl Ketone	ug/L	ND (5.0)	-	-	-	-	-	-	-	-	-	ND (5.0)	-	-	-	-	-
Methyl tert-butyl ether	ug/L	ND (2.0)	-	-	-	-	-	-	-	-	-	ND (2.0)	-	-	-	-	-
Methylene Chloride	ug/L	ND (5.0)	-	-	-	-	-	-	-	-	-	ND (5.0)	-	-	-	0.05 mg/L (50 ug/L)	MAC
Styrene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,1,1,2-Tetrachloroethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,1,2,2-Tetrachloroethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Tetrachloroethylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.01 mg/L (10 ug/L)	MAC
Toluene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.06 mg/L (60 ug/L)	MAC
1,1,1-Trichloroethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
1,1,2-Trichloroethane	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	-	-
Trichloroethylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.005 mg/L (5 ug/L)	MAC
Trichlorofluoromethane	ug/L	ND (1.0)	-	-	-	-	-	-	-	-	-	ND (1.0)	-	-	-	-	-
1,3,5-Trimethylbenzene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	1.4	-	-	-	-	-
Vinyl Chloride	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	ND (0.5)	-	-	-	0.001 mg/L (1 ug/L)	MAC
m/p-Xylene	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	3.9	-	-	-	-	-
o-Xylene		ND (0.5)	-	-	-	-	-	-	-	-	-	1.3	-	-	-	-	-
Xylenes, total	ug/L	ND (0.5)	-	-	-	-	-	-	-	-	-	5.2	-	-	-	0.09 mg/L (90 ug/L)	MAC
Hydrocarbons	mg/L																
F1 PHCs (C6-C10)	mg/L	ND (25)	-	-	-	-	-	-	-	-	-	ND (25)	-	-	-	-	-
F2 PHCs (C10-C16)	mg/L	ND (0.1)	-	-	-	-	-	-	-	-	-	ND (0.1)	-	-	-	-	-
F3 PHCs (C16-C34)		ND (0.1)	-	-	-	-	-	-	-	-	-	ND (0.1)	-	-	-	-	-
F4 PHCs (C34-C50)		ND (0.1)	-	-	-	-	-	-	-	-	-	ND (0.1)	-	-	-	-	-

NOTES:

1. MAC = Maximum Acceptable Concentration;
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. The total of Nitrate and Nitrite should not exceed 10 mg/litre.
5. The aesthetic objective for sodium is 200 mg/litre. The local medical officer of health should be notified when the sodium concentration exceeds 20 mg/litre for persons on sodium restricted diets.
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH_3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided
8. Values listed in Table 3 in MOE Procedure D-5-5 Technical Guideline for Private Wells: Water Supply Assessment, August 1996
9. 'ND' = No concentration detected above method detection limit
10. Health Canada (2019) MAC for strontium
11. Health Canada (2019) MAC for manganese

CERTIFICATE OF CALIBRATION

The HORIBA Instrument listed below has been inspected and calibrated following the Manufacturer's specifications and methods.

Instrument Model: **HORIBA U-52** *Serial Number:* **YT1VMG4N** *Calibration Date:* **August 30, 2023**

2-POINT pH	CONDUCTIVITY	TURBIDITY	DISSOLVED OXYGEN	OXIDIZATION-REDUCTION POTENTIAL	TEMPERATURE
4.00 pH, 7.00 pH	4.49mS/cm ZERO CHECKED	0 & 100 NTU	8.42 mg/L @ 24 DegC SODIUM SULFITE ZERO	240mV	Fisher Scientific s/n 210412377
AutoCal 4.00 pH Solution LOT # 3GE0924	AutoCal Solution LOT # 3GE0924	AutoCal Solution LOT# 3GE0924	Oakton Zero Solution LOT # 767903	Hanna ORP LOT # 8803	
Expiry Date: May 1, 2024	Expiry Date: May 1, 2024	Expiry Date: May 1, 2024	Expiry Date: December 1, 2023	Expiry Date: March 1, 2025	
pH 7.00 LOT # 2GK014	@25 DegC LOT # 2GK364	Turb. 100 NTU LOT # A1196			
Expiry Date: November 1, 2024	Expiry Date: November 1, 2023	Expiry Date: February 28, 2024			

The calibration standard used is considered to be a certified standard and is traceable to the National Institute of Standards and Technology (NIST). Certificate of Analysis is available upon request.

The instrument indicated above is now certified to be operating within the Manufacturer's specifications. This does not eliminate the requirement for regular maintenance and pre-use sensor response checks in order to ensure continued complete and accurate operating condition.

Certified By: Jeff Loney

Maxim **Environmental and Safety Inc.**

sales@maximenvironmental.com
www.maximenvironmental.com

Head Office:
9 - 170 Ambassador Dr., Mississauga, ON L5T 2H9
(905)670-1304 | Toll Free (888)285-2324

Ottawa Office:
9 - 148 Colonnade Rd., Ottawa, ON K2E 7R4
(613)224-4747 | Toll Free (888)285-2324

APPENDIX L

Laboratory Certificates of Analysis – Test Wells and Private Wells

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: Brent Redmond

Client PO:
Project: 102151.001
Custody: 18294

Report Date: 26-Sep-2023
Order Date: 19-Sep-2023

Order #: 2338190

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

Paracel ID	Client ID
2338190-01	TW2 8hr

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	21-Sep-23	21-Sep-23
Ammonia, as N	EPA 351.2 - Auto Colour	21-Sep-23	21-Sep-23
Anions	EPA 300.1 - IC	21-Sep-23	21-Sep-23
Colour	SM2120 - Spectrophotometric	20-Sep-23	21-Sep-23
Colour, apparent	SM2120 - Spectrophotometric	20-Sep-23	21-Sep-23
Conductivity	EPA 9050A- probe @25 °C	21-Sep-23	21-Sep-23
Dissolved Organic Carbon	MOE 3247B - Combustion IR	20-Sep-23	21-Sep-23
E. coli	MOE E3407	20-Sep-23	20-Sep-23
Fecal Coliform	SM 9222D	20-Sep-23	20-Sep-23
Heterotrophic Plate Count	SM 9215C	20-Sep-23	20-Sep-23
Metals, ICP-MS	EPA 200.8 - ICP-MS	21-Sep-23	21-Sep-23
pH	EPA 150.1 - pH probe @25 °C	21-Sep-23	21-Sep-23
Phenolics	EPA 420.2 - Auto Colour, 4AAP	20-Sep-23	20-Sep-23
Hardness	Hardness as CaCO3	21-Sep-23	21-Sep-23
Sulphide	SM 4500SE - Colourimetric	25-Sep-23	26-Sep-23
Tannin/Lignin	SM 5550B - Colourimetric	21-Sep-23	21-Sep-23
Total Coliform	MOE E3407	20-Sep-23	20-Sep-23
Total Dissolved Solids	SM 2540C - gravimetric, filtration	21-Sep-23	23-Sep-23
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	21-Sep-23	22-Sep-23
Turbidity	SM 2130B - Turbidity meter	20-Sep-23	21-Sep-23

PARACEL LABORATORIES LTD.

Order #: 2338190

Certificate of Analysis

Report Date: 26-Sep-2023

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

Order Date: 19-Sep-2023

Client PO:

Project Description: 102151.001

	Client ID:	TW2 8hr	-	-	-	-	-
	Sample Date:	19-Sep-23 15:45	-	-	-		
	Sample ID:	2338190-01	-	-	-		
	Matrix:	Drinking Water	-	-	-		
	MDL/Units						
Microbiological Parameters							
E. coli	1 CFU/100mL	ND	-	-	-	-	-
Total Coliforms	1 CFU/100mL	1	-	-	-	-	-
Fecal Coliforms	1 CFU/100mL	ND	-	-	-	-	-
Heterotrophic Plate Count	10 CFU/mL	110	-	-	-	-	-
General Inorganics							
Alkalinity, total	5 mg/L	189	-	-	-	-	-
Ammonia as N	0.01 mg/L	0.16	-	-	-	-	-
Dissolved Organic Carbon	0.5 mg/L	<0.5	-	-	-	-	-
Colour, apparent	2 ACU	13	-	-	-	-	-
Colour	2 TCU	<2	-	-	-	-	-
Conductivity	5 uS/cm	628	-	-	-	-	-
Hardness	mg/L	209	-	-	-	-	-
pH	0.1 pH Units	8.2	-	-	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-	-	-
Total Dissolved Solids	10 mg/L	322	-	-	-	-	-
Sulphide	0.02 mg/L	0.22	-	-	-	-	-
Tannin & Lignin	0.1 mg/L	0.2	-	-	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.2	-	-	-	-	-
Turbidity	0.1 NTU	2.3	-	-	-	-	-
Anions							
Chloride	1 mg/L	63	-	-	-	-	-
Fluoride	0.1 mg/L	0.5	-	-	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-	-	-
Sulphate	1 mg/L	34	-	-	-	-	-

	Client ID:	TW2 8hr	-	-	-		
	Sample Date:	19-Sep-23 15:45	-	-	-	-	-
	Sample ID:	2338190-01	-	-	-		
	Matrix:	Drinking Water	-	-	-		
	MDL/Units						
Metals							
Calcium	0.1 mg/L	50.8	-	-	-	-	-
Iron	0.1 mg/L	<0.1	-	-	-	-	-
Magnesium	0.2 mg/L	19.8	-	-	-	-	-
Manganese	0.005 mg/L	<0.005	-	-	-	-	-
Potassium	0.1 mg/L	6.1	-	-	-	-	-
Sodium	0.2 mg/L	51.2	-	-	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	1	mg/L					
Fluoride	ND	0.1	mg/L					
Nitrate as N	ND	0.1	mg/L					
Nitrite as N	ND	0.05	mg/L					
Sulphate	ND	1	mg/L					
General Inorganics								
Alkalinity, total	ND	5	mg/L					
Ammonia as N	ND	0.01	mg/L					
Dissolved Organic Carbon	ND	0.5	mg/L					
Colour	ND	2	TCU					
Colour, apparent	ND	2	ACU					
Conductivity	ND	5	uS/cm					
Total Dissolved Solids	ND	10	mg/L					
Sulphide	ND	0.02	mg/L					
Tannin & Lignin	ND	0.1	mg/L					
Total Kjeldahl Nitrogen	ND	0.1	mg/L					
Turbidity	ND	0.1	NTU					
Metals								
Calcium	ND	0.1	mg/L					
Iron	ND	0.1	mg/L					
Magnesium	ND	0.2	mg/L					
Manganese	ND	0.005	mg/L					
Potassium	ND	0.1	mg/L					
Sodium	ND	0.2	mg/L					
Microbiological Parameters								
E. coli	ND	1	CFU/100mL					
Total Coliforms	ND	1	CFU/100mL					
Fecal Coliforms	ND	1	CFU/100mL					
Heterotrophic Plate Count	ND	10	CFU/mL					

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	5.67	1	mg/L	5.64			0.6	20	
Fluoride	0.59	0.1	mg/L	0.59			0.4	20	
Nitrate as N	0.43	0.1	mg/L	0.43			0.9	20	
Nitrite as N	ND	0.05	mg/L	ND			NC	20	
Sulphate	25.4	1	mg/L	25.2			0.5	10	
General Inorganics									
Alkalinity, total	163	5	mg/L	165			0.8	14	
Ammonia as N	0.346	0.01	mg/L	0.350			1.2	17.7	
Dissolved Organic Carbon	1.2	0.5	mg/L	1.4			14.4	37	
Colour	ND	2	TCU	ND			NC	12	
Colour, apparent	13	2	ACU	13			0.0	12	
Conductivity	331	5	uS/cm	338			2.1	5	
pH	8.8	0.1	pH Units	8.8			0.1	3.3	
Total Dissolved Solids	86.0	10	mg/L	88.0			2.3	10	
Sulphide	0.07	0.02	mg/L	0.06			4.5	10	
Tannin & Lignin	0.3	0.1	mg/L	0.3			6.7	11	
Total Kjeldahl Nitrogen	0.43	0.1	mg/L	0.44			3.4	16	
Turbidity	ND	0.1	NTU	ND			NC	10	
Metals									
Calcium	34.8	0.1	mg/L	34.7			0.4	20	
Iron	ND	0.1	mg/L	ND			NC	20	
Magnesium	9.1	0.2	mg/L	9.2			0.9	20	
Manganese	ND	0.005	mg/L	ND			NC	20	
Potassium	1.7	0.1	mg/L	1.6			1.5	20	
Sodium	13.8	0.2	mg/L	14.0			1.7	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100mL	ND			NC	30	
Fecal Coliforms	ND	1	CFU/100mL	ND			NC	30	
Heterotrophic Plate Count	60	10	CFU/mL	110			59.0	30	BAC04

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	15.6	1	mg/L	5.64	99.2	70-124			
Fluoride	1.43	0.1	mg/L	0.59	83.8	70-130			
Nitrate as N	1.51	0.1	mg/L	0.43	108	77-126			
Nitrite as N	1.01	0.05	mg/L	ND	101	82-115			
Sulphate	34.4	1	mg/L	25.2	91.6	74-126			
General Inorganics									
Ammonia as N	1.30	0.01	mg/L	0.350	94.6	81-124			
Dissolved Organic Carbon	11.7	0.5	mg/L	1.2	105	60-133			
Total Dissolved Solids	92.0	10	mg/L	ND	92.0	75-125			
Sulphide	0.56	0.02	mg/L	0.06	99.8	79-115			
Tannin & Lignin	1.4	0.1	mg/L	0.3	104	71-113			
Total Kjeldahl Nitrogen	1.46	0.1	mg/L	0.44	102	81-126			
Metals									
Calcium	41300	0.1	mg/L	34700	66.5	80-120			QM-07
Iron	2350	0.1	mg/L	20.2	93.1	80-120			
Magnesium	17900	0.2	mg/L	9190	87.5	80-120			
Manganese	51.6	0.005	mg/L	3.81	95.5	80-120			
Potassium	11700	0.1	mg/L	1640	100	80-120			
Sodium	21900	0.2	mg/L	14000	78.8	80-120			QM-07

Qualifier Notes:

Sample Qualifiers :

QC Qualifiers:

BAC04	Duplicate QC data falls within method prescribed 95% confidence limits.
QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

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

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

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: Brent Redmond

Client PO: 3160 Carp
Project: 102151.001
Custody: 19013

Report Date: 15-Sep-2023
Order Date: 8-Sep-2023

Revised Report

Order #: 2336376

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

Paracel ID	Client ID
2336376-01	TW4 8hr
2336376-02	TW4 8hr (Filtered)
2336376-03	TW1 8hr
2336376-04	TW1 8hr (Filtered)

Approved By:



Dale Robertson, BSc
Laboratory Director

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	11-Sep-23	11-Sep-23
Ammonia, as N	EPA 351.2 - Auto Colour	13-Sep-23	13-Sep-23
Anions	EPA 300.1 - IC	12-Sep-23	12-Sep-23
Colour	SM2120 - Spectrophotometric	9-Sep-23	9-Sep-23
Colour, apparent	SM2120 - Spectrophotometric	9-Sep-23	9-Sep-23
Conductivity	EPA 9050A- probe @25 °C	11-Sep-23	11-Sep-23
Dissolved Organic Carbon	MOE 3247B - Combustion IR	11-Sep-23	12-Sep-23
E. coli	MOE E3407	8-Sep-23	8-Sep-23
Fecal Coliform	SM 9222D	8-Sep-23	8-Sep-23
Heterotrophic Plate Count	SM 9215C	9-Sep-23	9-Sep-23
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	11-Sep-23	11-Sep-23
Metals, ICP-MS	EPA 200.8 - ICP-MS	8-Sep-23	8-Sep-23
pH	EPA 150.1 - pH probe @25 °C	11-Sep-23	11-Sep-23
PHC F1	CWS Tier 1 - P&T GC-FID	8-Sep-23	8-Sep-23
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	11-Sep-23	12-Sep-23
Phenolics	EPA 420.2 - Auto Colour, 4AAP	8-Sep-23	8-Sep-23
Hardness	Hardness as CaCO3	8-Sep-23	8-Sep-23
Sulphide	SM 4500SE - Colourimetric	12-Sep-23	12-Sep-23
Tannin/Lignin	SM 5550B - Colourimetric	11-Sep-23	11-Sep-23
Total Coliform	MOE E3407	8-Sep-23	8-Sep-23
Total Dissolved Solids	SM 2540C - gravimetric, filtration	11-Sep-23	12-Sep-23
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	11-Sep-23	14-Sep-23
Turbidity	SM 2130B - Turbidity meter	9-Sep-23	9-Sep-23
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	8-Sep-23	8-Sep-23

PARACEL LABORATORIES LTD.

Order #: 2336376

Certificate of Analysis

Report Date: 15-Sep-2023

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

Order Date: 8-Sep-2023

Client PO: 3160 Carp

Project Description: 102151.001

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Microbiological Parameters							
E. coli	1 CFU/100mL	ND	-	ND	-	-	-
Total Coliforms	1 CFU/100mL	ND	-	ND	-	-	-
Fecal Coliforms	1 CFU/100mL	ND	-	ND	-	-	-
Heterotrophic Plate Count	10 CFU/mL	<10	-	10	-	-	-
General Inorganics							
Alkalinity, total	5 mg/L	204	-	222	-	-	-
Ammonia as N	0.01 mg/L	0.09	-	0.10	-	-	-
Dissolved Organic Carbon	0.5 mg/L	0.8	-	0.7	-	-	-
Colour, apparent	2 ACU	3	-	10	-	-	-
Colour	2 TCU	<2	-	<2	-	-	-
Conductivity	5 uS/cm	788	-	758	-	-	-
Hardness	mg/L	339	-	283	-	-	-
pH	0.1 pH Units	8.2	-	8.1	-	-	-
Phenolics	0.001 mg/L	<0.001	-	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	470	-	438	-	-	-
Sulphide	0.02 mg/L	0.13	-	0.18	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	-	0.1	-	-	-
Turbidity	0.1 NTU	0.4	-	1.4	-	-	-
Anions							
Chloride	1 mg/L	93	-	80	-	-	-
Fluoride	0.1 mg/L	0.1	-	0.2	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	<0.05	-	-	-
Sulphate	1 mg/L	58	-	51	-	-	-

Certificate of Analysis

Report Date: 15-Sep-2023

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

Order Date: 8-Sep-2023

Client PO: **3160 Carp**

Project Description: **102151.001**

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Metals							
Mercury	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Aluminum	0.001 mg/L	0.007	<0.001	0.043	0.001	-	-
Antimony	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Barium	0.001 mg/L	0.205	0.204	0.114	0.115	-	-
Beryllium	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Boron	0.01 mg/L	0.04	0.05	0.08	0.08	-	-
Cadmium	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Calcium	0.1 mg/L	91.4	91.9	70.0	70.4	-	-
Chromium	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Iron	0.1 mg/L	<0.1	<0.1	<0.1	<0.1	-	-
Lead	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Magnesium	0.2 mg/L	26.9	26.1	26.2	25.7	-	-
Manganese	0.005 mg/L	0.006	0.006	<0.005	<0.005	-	-
Molybdenum	0.0005 mg/L	0.0020	0.0020	0.0012	0.0011	-	-
Nickel	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Potassium	0.1 mg/L	4.1	4.2	4.7	4.8	-	-
Selenium	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Silver	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Sodium	0.2 mg/L	24.3	24.1	43.0	42.7	-	-
Strontium	0.01 mg/L	2.93	2.92	1.96	1.93	-	-
Thallium	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Uranium	0.0001 mg/L	0.0007	0.0006	0.0001	0.0001	-	-

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Metals							
Vanadium	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Zinc	0.005 mg/L	<0.005	<0.005	<0.005	<0.005	-	-
Volatiles							
Acetone	0.005 mg/L	<0.0050	-	<0.0050	-	-	-
Benzene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Bromodichloromethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Bromoform	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Bromomethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Carbon Tetrachloride	0.0002 mg/L	<0.0002	-	<0.0002	-	-	-
Chlorobenzene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Chloroethane	0.001 mg/L	<0.0010	-	<0.0010	-	-	-
Chloroform	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Dibromochloromethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Dichlorodifluoromethane	0.001 mg/L	<0.0010	-	<0.0010	-	-	-
1,2-Dibromoethane	0.0002 mg/L	<0.0002	-	<0.0002	-	-	-
1,2-Dichlorobenzene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,3-Dichlorobenzene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,4-Dichlorobenzene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,1-Dichloroethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,2-Dichloroethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,1-Dichloroethylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
cis-1,2-Dichloroethylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
trans-1,2-Dichloroethylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,2-Dichloroethylene, total	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,2-Dichloropropane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Volatiles							
cis-1,3-Dichloropropylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
trans-1,3-Dichloropropylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,3-Dichloropropene, total	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Ethylbenzene	0.0005 mg/L	0.0008	-	<0.0005	-	-	-
Hexane	0.001 mg/L	<0.0010	-	<0.0010	-	-	-
Methyl Ethyl Ketone (2-Butanone)	0.005 mg/L	<0.0050	-	<0.0050	-	-	-
Methyl Isobutyl Ketone	0.005 mg/L	<0.0050	-	<0.0050	-	-	-
Methyl tert-butyl ether	0.002 mg/L	<0.0020	-	<0.0020	-	-	-
Methylene Chloride	0.005 mg/L	<0.0050	-	<0.0050	-	-	-
Styrene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,1,1,2-Tetrachloroethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,1,2,2-Tetrachloroethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Tetrachloroethylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Toluene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,1,1-Trichloroethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
1,1,2-Trichloroethane	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Trichloroethylene	0.0005 mg/L	<0.0005	-	<0.0005	-	-	-
Trichlorofluoromethane	0.001 mg/L	<0.0010	-	<0.0010	-	-	-
Vinyl chloride	0.0002 mg/L	<0.0002	-	<0.0002	-	-	-
m,p-Xylenes	0.0005 mg/L	0.0039	-	<0.0005	-	-	-
o-Xylene	0.0005 mg/L	0.0013	-	<0.0005	-	-	-
Xylenes, total	0.0005 mg/L	0.0052	-	<0.0005	-	-	-
Toluene-d8	Surrogate	94.7%	-	97.0%	-	-	-
4-Bromofluorobenzene	Surrogate	106%	-	112%	-	-	-
Dibromofluoromethane	Surrogate	105%	-	102%	-	-	-

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Hydrocarbons							
F1 PHCs (C6-C10)	0.025 mg/L	<0.0250	-	<0.0250	-	-	-
F2 PHCs (C10-C16)	0.1 mg/L	<0.1	-	<0.1	-	-	-
F3 PHCs (C16-C34)	0.1 mg/L	<0.1	-	<0.1	-	-	-
F4 PHCs (C34-C50)	0.1 mg/L	<0.1	-	<0.1	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	1	mg/L					
Fluoride	ND	0.1	mg/L					
Nitrate as N	ND	0.1	mg/L					
Nitrite as N	ND	0.05	mg/L					
Sulphate	ND	1	mg/L					
General Inorganics								
Alkalinity, total	ND	5	mg/L					
Ammonia as N	ND	0.01	mg/L					
Dissolved Organic Carbon	ND	0.5	mg/L					
Colour	ND	2	TCU					
Colour, apparent	ND	2	ACU					
Conductivity	ND	5	uS/cm					
Phenolics	ND	0.001	mg/L					
Total Dissolved Solids	ND	10	mg/L					
Sulphide	ND	0.02	mg/L					
Tannin & Lignin	ND	0.1	mg/L					
Total Kjeldahl Nitrogen	ND	0.1	mg/L					
Turbidity	ND	0.1	NTU					
Hydrocarbons								
F2 PHCs (C10-C16) - PAHs	0.0		mg/L					
F3 PHCs (C16-C34) - PAHs	0.0		mg/L					
F1 PHCs (C6-C10)	ND	0.0250	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								
Mercury	ND	0.0001	mg/L					
Aluminum	ND	0.001	mg/L					
Antimony	ND	0.0005	mg/L					
Arsenic	ND	0.001	mg/L					
Barium	ND	0.001	mg/L					
Beryllium	ND	0.0005	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Boron	ND	0.01	mg/L					
Cadmium	ND	0.0001	mg/L					
Calcium	ND	0.1	mg/L					
Chromium	ND	0.001	mg/L					
Cobalt	ND	0.0005	mg/L					
Copper	ND	0.0005	mg/L					
Iron	ND	0.1	mg/L					
Lead	ND	0.0001	mg/L					
Magnesium	ND	0.2	mg/L					
Manganese	ND	0.005	mg/L					
Molybdenum	ND	0.0005	mg/L					
Nickel	ND	0.001	mg/L					
Potassium	ND	0.1	mg/L					
Selenium	ND	0.001	mg/L					
Silver	ND	0.0001	mg/L					
Sodium	ND	0.2	mg/L					
Strontium	ND	0.01	mg/L					
Thallium	ND	0.001	mg/L					
Uranium	ND	0.0001	mg/L					
Vanadium	ND	0.0005	mg/L					
Zinc	ND	0.005	mg/L					
Microbiological Parameters								
E. coli	ND	1	CFU/100mL					
Total Coliforms	ND	1	CFU/100mL					
Fecal Coliforms	ND	1	CFU/100mL					
Heterotrophic Plate Count	ND	10	CFU/mL					
Volatiles								
Acetone	ND	0.0050	mg/L					
Benzene	ND	0.0005	mg/L					
Bromodichloromethane	ND	0.0005	mg/L					
Bromoform	ND	0.0005	mg/L					
Bromomethane	ND	0.0005	mg/L					
Carbon Tetrachloride	ND	0.0002	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Chlorobenzene	ND	0.0005	mg/L					
Chloroethane	ND	0.0010	mg/L					
Chloroform	ND	0.0005	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 Isobutyl Ketone	ND	0.0050	mg/L					
Methyl tert-butyl ether	ND	0.0020	mg/L					
Methylene Chloride	ND	0.0050	mg/L					
Styrene	ND	0.0005	mg/L					
1,1,1,2-Tetrachloroethane	ND	0.0005	mg/L					
1,1,2,2-Tetrachloroethane	ND	0.0005	mg/L					
Tetrachloroethylene	ND	0.0005	mg/L					
Toluene	ND	0.0005	mg/L					
1,1,1-Trichloroethane	ND	0.0005	mg/L					
1,1,2-Trichloroethane	ND	0.0005	mg/L					
Trichloroethylene	ND	0.0005	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Trichlorofluoromethane	ND	0.0010	mg/L					
Vinyl chloride	ND	0.0002	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	*0.0848*		*%*	*106*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0855*		*%*	*107*	*50-140*			
Surrogate: Toluene-d8	*0.0771*		*%*	*96.3*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	79.0	1	mg/L	79.7			1.0	20	
Fluoride	0.16	0.1	mg/L	0.15			5.1	20	
Nitrate as N	ND	0.1	mg/L	ND			NC	20	
Nitrite as N	ND	0.05	mg/L	ND			NC	20	
Sulphate	50.7	1	mg/L	50.8			0.2	20	
General Inorganics									
Alkalinity, total	205	5	mg/L	204			0.2	14	
Ammonia as N	0.236	0.01	mg/L	0.229			2.8	17.7	
Dissolved Organic Carbon	0.7	0.5	mg/L	0.8			17.0	37	
Colour	ND	2	TCU	ND			NC	12	
Colour, apparent	3	2	ACU	3			0.0	12	
Conductivity	775	5	uS/cm	788			1.6	5	
pH	8.1	0.1	pH Units	8.2			0.5	3.3	
Phenolics	ND	0.001	mg/L	ND			NC	10	
Total Dissolved Solids	416	10	mg/L	438			5.2	10	
Sulphide	0.13	0.02	mg/L	0.13			1.5	10	
Tannin & Lignin	ND	0.1	mg/L	ND			NC	11	
Total Kjeldahl Nitrogen	0.11	0.1	mg/L	0.13			15.5	16	
Turbidity	ND	0.1	NTU	ND			NC	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	0.0250	mg/L	ND			NC	30	
Metals									
Mercury	ND	0.0001	mg/L	ND			NC	20	
Aluminum	0.046	0.001	mg/L	0.045			2.0	20	
Antimony	ND	0.0005	mg/L	ND			NC	20	
Arsenic	ND	0.001	mg/L	ND			NC	20	
Barium	0.013	0.001	mg/L	0.012			2.5	20	
Beryllium	ND	0.0005	mg/L	ND			NC	20	
Boron	ND	0.01	mg/L	ND			NC	20	
Cadmium	0.0001	0.0001	mg/L	ND			NC	20	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Calcium	7.8	0.1	mg/L	7.9			1.0	20	
Chromium	ND	0.001	mg/L	ND			NC	20	
Cobalt	ND	0.0005	mg/L	ND			NC	20	
Copper	0.0050	0.0005	mg/L	0.0050			0.4	20	
Iron	ND	0.1	mg/L	ND			NC	20	
Lead	0.0001	0.0001	mg/L	0.0001			13.5	20	
Magnesium	2.0	0.2	mg/L	2.0			0.3	20	
Manganese	ND	0.005	mg/L	ND			NC	20	
Molybdenum	ND	0.0005	mg/L	ND			NC	20	
Nickel	ND	0.001	mg/L	ND			NC	20	
Potassium	0.7	0.1	mg/L	0.7			0.1	20	
Selenium	ND	0.001	mg/L	ND			NC	20	
Silver	ND	0.0001	mg/L	0.0002			NC	20	
Sodium	16.4	0.2	mg/L	16.3			0.5	20	
Thallium	ND	0.001	mg/L	ND			NC	20	
Uranium	ND	0.0001	mg/L	ND			NC	20	
Vanadium	ND	0.0005	mg/L	ND			NC	20	
Zinc	ND	0.005	mg/L	ND			NC	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100mL	ND			NC	30	
Fecal Coliforms	ND	1	CFU/100mL	ND			NC	30	
Heterotrophic Plate Count	ND	10	CFU/mL	ND			NC	30	
Volatiles									
Acetone	0.0050	0.0050	mg/L	ND			NC	30	
Benzene	ND	0.0005	mg/L	ND			NC	30	
Bromodichloromethane	0.0038	0.0005	mg/L	0.0041			7.9	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	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroethane	ND	0.0010	mg/L	ND			NC	30	
Chloroform	0.0565	0.0005	mg/L	0.0543			3.9	30	
Dibromochloromethane	ND	0.0005	mg/L	ND			NC	30	
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 Isobutyl Ketone	ND	0.0050	mg/L	ND			NC	30	
Methyl tert-butyl ether	ND	0.0020	mg/L	ND			NC	30	
Methylene Chloride	ND	0.0050	mg/L	ND			NC	30	
Styrene	ND	0.0005	mg/L	ND			NC	30	
1,1,1,2-Tetrachloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1,2,2-Tetrachloroethane	ND	0.0005	mg/L	ND			NC	30	
Tetrachloroethylene	ND	0.0005	mg/L	ND			NC	30	
Toluene	ND	0.0005	mg/L	ND			NC	30	
1,1,1-Trichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1,2-Trichloroethane	ND	0.0005	mg/L	ND			NC	30	
Trichloroethylene	ND	0.0005	mg/L	ND			NC	30	
Trichlorofluoromethane	ND	0.0010	mg/L	ND			NC	30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Vinyl chloride	ND	0.0002	mg/L	ND			NC	30	
m,p-Xylenes	ND	0.0005	mg/L	ND			NC	30	
o-Xylene	ND	0.0005	mg/L	ND			NC	30	
Surrogate: 4-Bromofluorobenzene	*0.0967*		*%*		*121*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0863*		*%*		*108*	*50-140*			
Surrogate: Toluene-d8	*0.0770*		*%*		*96.2*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	89.2	1	mg/L	79.7	95.1	70-124			
Fluoride	1.15	0.1	mg/L	0.15	99.5	70-130			
Nitrate as N	1.07	0.1	mg/L	ND	107	77-126			
Nitrite as N	0.912	0.05	mg/L	ND	91.2	82-115			
Sulphate	59.2	1	mg/L	50.8	84.4	70-130			
General Inorganics									
Ammonia as N	1.30	0.01	mg/L	0.229	107	81-124			
Dissolved Organic Carbon	9.2	0.5	mg/L	0.8	83.9	60-133			
Phenolics	0.028	0.001	mg/L	ND	110	67-133			
Total Dissolved Solids	104	10	mg/L	ND	104	75-125			
Sulphide	0.64	0.02	mg/L	0.13	100	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	95.2	71-113			
Total Kjeldahl Nitrogen	1.12	0.1	mg/L	0.13	98.6	81-126			
Hydrocarbons									
F1 PHCs (C6-C10)	1.93	0.0250	mg/L	ND	96.7	85-115			
F2 PHCs (C10-C16)	1.3	0.1	mg/L	ND	83.8	60-140			
F3 PHCs (C16-C34)	4.0	0.1	mg/L	ND	101	60-140			
F4 PHCs (C34-C50)	2.6	0.1	mg/L	ND	105	60-140			
Metals									
Mercury	0.0025	0.0001	mg/L	ND	82.5	70-130			
Aluminum	89.8	0.001	mg/L	44.9	89.7	80-120			
Antimony	44.2	0.0005	mg/L	0.207	88.1	80-120			
Arsenic	51.4	0.001	mg/L	0.475	102	80-120			
Barium	58.1	0.001	mg/L	12.3	91.7	80-120			
Beryllium	52.4	0.0005	mg/L	0.0628	105	80-120			
Boron	50.9	0.01	mg/L	5.27	91.3	80-120			
Cadmium	47.0	0.0001	mg/L	0.0994	93.7	80-120			
Calcium	16900	0.1	mg/L	7880	90.0	80-120			
Chromium	52.0	0.001	mg/L	0.301	103	80-120			
Cobalt	49.5	0.0005	mg/L	0.104	98.8	80-120			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Copper	52.7	0.0005	mg/L	4.99	95.4	80-120			
Iron	2290	0.1	mg/L	12.2	91.3	80-120			
Lead	46.2	0.0001	mg/L	0.109	92.2	80-120			
Magnesium	11400	0.2	mg/L	1950	94.4	80-120			
Manganese	52.8	0.005	mg/L	2.53	101	80-120			
Molybdenum	46.6	0.0005	mg/L	0.347	92.5	80-120			
Nickel	49.6	0.001	mg/L	0.500	98.1	80-120			
Potassium	10400	0.1	mg/L	706	97.0	80-120			
Selenium	47.7	0.001	mg/L	0.198	95.0	80-120			
Silver	48.7	0.0001	mg/L	0.244	96.8	80-120			
Sodium	25200	0.2	mg/L	16300	88.3	80-120			
Thallium	48.0	0.001	mg/L	0.097	95.7	80-120			
Uranium	49.9	0.0001	mg/L	0.0951	99.6	80-120			
Vanadium	52.0	0.0005	mg/L	0.322	103	80-120			
Zinc	50.3	0.005	mg/L	2.29	96.1	80-120			
Volatiles									
Acetone	0.107	0.0050	mg/L	ND	107	50-140			
Benzene	0.0377	0.0005	mg/L	ND	94.3	60-130			
Bromodichloromethane	0.0387	0.0005	mg/L	ND	96.7	60-130			
Bromoform	0.0448	0.0005	mg/L	ND	112	60-130			
Bromomethane	0.0449	0.0005	mg/L	ND	112	50-140			
Carbon Tetrachloride	0.0372	0.0002	mg/L	ND	93.1	60-130			
Chlorobenzene	0.0484	0.0005	mg/L	ND	121	60-130			
Chloroethane	0.0383	0.0010	mg/L	ND	95.8	50-140			
Chloroform	0.0396	0.0005	mg/L	ND	99.0	60-130			
Dibromochloromethane	0.0486	0.0005	mg/L	ND	122	60-130			
Dichlorodifluoromethane	0.0405	0.0010	mg/L	ND	101	50-140			
1,2-Dibromoethane	0.0437	0.0002	mg/L	ND	109	60-130			
1,2-Dichlorobenzene	0.0455	0.0005	mg/L	ND	114	60-130			
1,3-Dichlorobenzene	0.0501	0.0005	mg/L	ND	125	60-130			
1,4-Dichlorobenzene	0.0471	0.0005	mg/L	ND	118	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1-Dichloroethane	0.0354	0.0005	mg/L	ND	88.4	60-130			
1,2-Dichloroethane	0.0358	0.0005	mg/L	ND	89.5	60-130			
1,1-Dichloroethylene	0.0447	0.0005	mg/L	ND	112	60-130			
cis-1,2-Dichloroethylene	0.0436	0.0005	mg/L	ND	109	60-130			
trans-1,2-Dichloroethylene	0.0434	0.0005	mg/L	ND	109	60-130			
1,2-Dichloropropane	0.0320	0.0005	mg/L	ND	80.1	60-130			
cis-1,3-Dichloropropylene	0.0350	0.0005	mg/L	ND	87.4	60-130			
trans-1,3-Dichloropropylene	0.0360	0.0005	mg/L	ND	89.9	60-130			
Ethylbenzene	0.0493	0.0005	mg/L	ND	123	60-130			
Hexane	0.0402	0.0010	mg/L	ND	100	60-130			
Methyl Ethyl Ketone (2-Butanone)	0.0940	0.0050	mg/L	ND	94.0	50-140			
Methyl Isobutyl Ketone	0.0865	0.0050	mg/L	ND	86.5	50-140			
Methyl tert-butyl ether	0.0937	0.0020	mg/L	ND	93.7	50-140			
Methylene Chloride	0.0437	0.0050	mg/L	ND	109	60-130			
Styrene	0.0433	0.0005	mg/L	ND	108	60-130			
1,1,1,2-Tetrachloroethane	0.0479	0.0005	mg/L	ND	120	60-130			
1,1,2,2-Tetrachloroethane	0.0333	0.0005	mg/L	ND	83.2	60-130			
Tetrachloroethylene	0.0458	0.0005	mg/L	ND	115	60-130			
Toluene	0.0380	0.0005	mg/L	ND	95.0	60-130			
1,1,1-Trichloroethane	0.0395	0.0005	mg/L	ND	98.8	60-130			
1,1,2-Trichloroethane	0.0376	0.0005	mg/L	ND	94.1	60-130			
Trichloroethylene	0.0508	0.0005	mg/L	ND	127	60-130			
Trichlorofluoromethane	0.0392	0.0010	mg/L	ND	98.0	60-130			
Vinyl chloride	0.0460	0.0002	mg/L	ND	115	50-140			
m,p-Xylenes	0.0835	0.0005	mg/L	ND	104	60-130			
o-Xylene	0.0440	0.0005	mg/L	ND	110	60-130			
Surrogate: 4-Bromofluorobenzene	*0.0847*		*%*		*106*	*50-140*			
Surrogate: Dibromofluoromethane	*0.0847*		*%*		*106*	*50-140*			
Surrogate: Toluene-d8	*0.0787*		*%*		*98.4*	*50-140*			

Qualifier Notes:

Sample Qualifiers :

Sample Data Revisions:

None

Work Order Revisions / Comments:

Revision 1 - This report includes updated units and parameters for VOCs

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.

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

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: Brent Redmond

Client PO: 3160 Carp
Project: 102151.001
Custody: 19013

Report Date: 14-Sep-2023
Order Date: 8-Sep-2023

Order #: 2336376

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

Paracel ID	Client ID
2336376-01	TW4 8hr
2336376-02	TW4 8hr (Filtered)
2336376-03	TW1 8hr
2336376-04	TW1 8hr (Filtered)

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	11-Sep-23	11-Sep-23
Ammonia, as N	EPA 351.2 - Auto Colour	13-Sep-23	13-Sep-23
Anions	EPA 300.1 - IC	12-Sep-23	12-Sep-23
Colour	SM2120 - Spectrophotometric	9-Sep-23	9-Sep-23
Colour, apparent	SM2120 - Spectrophotometric	9-Sep-23	9-Sep-23
Conductivity	EPA 9050A- probe @25 °C	11-Sep-23	11-Sep-23
Dissolved Organic Carbon	MOE 3247B - Combustion IR	11-Sep-23	12-Sep-23
E. coli	MOE E3407	8-Sep-23	8-Sep-23
Fecal Coliform	SM 9222D	8-Sep-23	8-Sep-23
Heterotrophic Plate Count	SM 9215C	9-Sep-23	9-Sep-23
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	11-Sep-23	11-Sep-23
Metals, ICP-MS	EPA 200.8 - ICP-MS	8-Sep-23	8-Sep-23
pH	EPA 150.1 - pH probe @25 °C	11-Sep-23	11-Sep-23
PHC F1	CWS Tier 1 - P&T GC-FID	8-Sep-23	8-Sep-23
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	11-Sep-23	12-Sep-23
Phenolics	EPA 420.2 - Auto Colour, 4AAP	8-Sep-23	8-Sep-23
Hardness	Hardness as CaCO3	8-Sep-23	8-Sep-23
Sulphide	SM 4500SE - Colourimetric	12-Sep-23	12-Sep-23
Tannin/Lignin	SM 5550B - Colourimetric	11-Sep-23	11-Sep-23
Total Coliform	MOE E3407	8-Sep-23	8-Sep-23
Total Dissolved Solids	SM 2540C - gravimetric, filtration	11-Sep-23	12-Sep-23
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	11-Sep-23	14-Sep-23
Turbidity	SM 2130B - Turbidity meter	9-Sep-23	9-Sep-23
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	8-Sep-23	8-Sep-23

PARACEL LABORATORIES LTD.

Order #: 2336376

Certificate of Analysis

Report Date: 14-Sep-2023

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

Order Date: 8-Sep-2023

Client PO: 3160 Carp

Project Description: 102151.001

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Microbiological Parameters							
E. coli	1 CFU/100mL	ND	-	ND	-	-	-
Total Coliforms	1 CFU/100mL	ND	-	ND	-	-	-
Fecal Coliforms	1 CFU/100mL	ND	-	ND	-	-	-
Heterotrophic Plate Count	10 CFU/mL	<10	-	10	-	-	-
General Inorganics							
Alkalinity, total	5 mg/L	204	-	222	-	-	-
Ammonia as N	0.01 mg/L	0.09	-	0.10	-	-	-
Dissolved Organic Carbon	0.5 mg/L	0.8	-	0.7	-	-	-
Colour, apparent	2 ACU	3	-	10	-	-	-
Colour	2 TCU	<2	-	<2	-	-	-
Conductivity	5 uS/cm	788	-	758	-	-	-
Hardness	mg/L	339	-	283	-	-	-
pH	0.1 pH Units	8.2	-	8.1	-	-	-
Phenolics	0.001 mg/L	<0.001	-	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	470	-	438	-	-	-
Sulphide	0.02 mg/L	0.13	-	0.18	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	-	0.1	-	-	-
Turbidity	0.1 NTU	0.4	-	1.4	-	-	-
Anions							
Chloride	1 mg/L	93	-	80	-	-	-
Fluoride	0.1 mg/L	0.1	-	0.2	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	<0.05	-	-	-
Sulphate	1 mg/L	58	-	51	-	-	-

Certificate of Analysis

Report Date: 14-Sep-2023

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

Order Date: 8-Sep-2023

Client PO: 3160 Carp

Project Description: 102151.001

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Metals							
Mercury	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Aluminum	0.001 mg/L	0.007	<0.001	0.043	0.001	-	-
Antimony	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Barium	0.001 mg/L	0.205	0.204	0.114	0.115	-	-
Beryllium	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Boron	0.01 mg/L	0.04	0.05	0.08	0.08	-	-
Cadmium	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Calcium	0.1 mg/L	91.4	91.9	70.0	70.4	-	-
Chromium	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Iron	0.1 mg/L	<0.1	<0.1	<0.1	<0.1	-	-
Lead	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Magnesium	0.2 mg/L	26.9	26.1	26.2	25.7	-	-
Manganese	0.005 mg/L	0.006	0.006	<0.005	<0.005	-	-
Molybdenum	0.0005 mg/L	0.0020	0.0020	0.0012	0.0011	-	-
Nickel	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Potassium	0.1 mg/L	4.1	4.2	4.7	4.8	-	-
Selenium	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Silver	0.0001 mg/L	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Sodium	0.2 mg/L	24.3	24.1	43.0	42.7	-	-
Strontium	0.01 mg/L	2.93	2.92	1.96	1.93	-	-
Thallium	0.001 mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Uranium	0.0001 mg/L	0.0007	0.0006	0.0001	0.0001	-	-

Certificate of Analysis

Report Date: 14-Sep-2023

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

Order Date: 8-Sep-2023

Client PO: 3160 Carp

Project Description: 102151.001

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Metals							
Vanadium	0.0005 mg/L	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Zinc	0.005 mg/L	<0.005	<0.005	<0.005	<0.005	-	-
Volatiles							
Acetone	5 ug/L	<5.0	-	<5.0	-	-	-
Benzene	0.5 ug/L	<0.5	-	<0.5	-	-	-
Bromodichloromethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
Bromoform	0.5 ug/L	<0.5	-	<0.5	-	-	-
Bromomethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	-	<0.2	-	-	-
Chlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	-	-
Chloroethane	1 ug/L	<1.0	-	<1.0	-	-	-
Chloroform	0.5 ug/L	<0.5	-	<0.5	-	-	-
Chloromethane	3 ug/L	<3.0	-	<3.0	-	-	-
Dibromochloromethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
Dichlorodifluoromethane	1 ug/L	<1.0	-	<1.0	-	-	-
1,2-Dibromoethane	0.2 ug/L	<0.2	-	<0.2	-	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,2-Dichloroethylene, total	0.5 ug/L	<0.5	-	<0.5	-	-	-

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Volatiles							
1,2-Dichloropropane	0.5 ug/L	<0.5	-	<0.5	-	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	-	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	0.8	-	<0.5	-	-	-
Hexane	1 ug/L	<1.0	-	<1.0	-	-	-
Methyl Ethyl Ketone (2-Butanone)	5 ug/L	<5.0	-	<5.0	-	-	-
Methyl Butyl Ketone (2-Hexanone)	10 ug/L	<10.0	-	<10.0	-	-	-
Methyl Isobutyl Ketone	5 ug/L	<5.0	-	<5.0	-	-	-
Methyl tert-butyl ether	2 ug/L	<2.0	-	<2.0	-	-	-
Methylene Chloride	5 ug/L	<5.0	-	<5.0	-	-	-
Styrene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	-	<0.5	-	-	-
Trichloroethylene	0.5 ug/L	<0.5	-	<0.5	-	-	-
Trichlorofluoromethane	1 ug/L	<1.0	-	<1.0	-	-	-
1,3,5-Trimethylbenzene	0.5 ug/L	1.4	-	<0.5	-	-	-
Vinyl chloride	0.5 ug/L	<0.5	-	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	3.9	-	<0.5	-	-	-
o-Xylene	0.5 ug/L	1.3	-	<0.5	-	-	-
Xylenes, total	0.5 ug/L	5.2	-	<0.5	-	-	-

	Client ID:	TW4 8hr	TW4 8hr (Filtered)	TW1 8hr	TW1 8hr (Filtered)	-	-
	Sample Date:	07-Sep-23 16:15	07-Sep-23 16:15	07-Sep-23 17:00	07-Sep-23 17:00		
	Sample ID:	2336376-01	2336376-02	2336376-03	2336376-04		
	Matrix:	Drinking Water	Drinking Water	Drinking Water	Drinking Water		
	MDL/Units						
Volatiles							
4-Bromofluorobenzene	Surrogate	118%	-	124%	-	-	-
Dibromofluoromethane	Surrogate	105%	-	102%	-	-	-
Toluene-d8	Surrogate	94.7%	-	97.0%	-	-	-
Hydrocarbons							
F1 PHCs (C6-C10)	25 ug/L	<25	-	<25	-	-	-
F2 PHCs (C10-C16)	0.1 mg/L	<0.1	-	<0.1	-	-	-
F3 PHCs (C16-C34)	0.1 mg/L	<0.1	-	<0.1	-	-	-
F4 PHCs (C34-C50)	0.1 mg/L	<0.1	-	<0.1	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	1	mg/L					
Fluoride	ND	0.1	mg/L					
Nitrate as N	ND	0.1	mg/L					
Nitrite as N	ND	0.05	mg/L					
Sulphate	ND	1	mg/L					
General Inorganics								
Alkalinity, total	ND	5	mg/L					
Ammonia as N	ND	0.01	mg/L					
Dissolved Organic Carbon	ND	0.5	mg/L					
Colour	ND	2	TCU					
Colour, apparent	ND	2	ACU					
Conductivity	ND	5	uS/cm					
Phenolics	ND	0.001	mg/L					
Total Dissolved Solids	ND	10	mg/L					
Sulphide	ND	0.02	mg/L					
Tannin & Lignin	ND	0.1	mg/L					
Total Kjeldahl Nitrogen	ND	0.1	mg/L					
Turbidity	ND	0.1	NTU					
Hydrocarbons								
F2 PHCs (C10-C16) - PAHs	0.0		mg/L					
F3 PHCs (C16-C34) - PAHs	0.0		mg/L					
F1 PHCs (C6-C10)	ND	25	ug/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								
Mercury	ND	0.0001	mg/L					
Aluminum	ND	0.001	mg/L					
Antimony	ND	0.0005	mg/L					
Arsenic	ND	0.001	mg/L					
Barium	ND	0.001	mg/L					
Beryllium	ND	0.0005	mg/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Boron	ND	0.01	mg/L					
Cadmium	ND	0.0001	mg/L					
Calcium	ND	0.1	mg/L					
Chromium	ND	0.001	mg/L					
Cobalt	ND	0.0005	mg/L					
Copper	ND	0.0005	mg/L					
Iron	ND	0.1	mg/L					
Lead	ND	0.0001	mg/L					
Magnesium	ND	0.2	mg/L					
Manganese	ND	0.005	mg/L					
Molybdenum	ND	0.0005	mg/L					
Nickel	ND	0.001	mg/L					
Potassium	ND	0.1	mg/L					
Selenium	ND	0.001	mg/L					
Silver	ND	0.0001	mg/L					
Sodium	ND	0.2	mg/L					
Strontium	ND	0.01	mg/L					
Thallium	ND	0.001	mg/L					
Uranium	ND	0.0001	mg/L					
Vanadium	ND	0.0005	mg/L					
Zinc	ND	0.005	mg/L					
Microbiological Parameters								
E. coli	ND	1	CFU/100mL					
Total Coliforms	ND	1	CFU/100mL					
Fecal Coliforms	ND	1	CFU/100mL					
Heterotrophic Plate Count	ND	10	CFU/mL					
Volatiles								
Acetone	ND	5.0	ug/L					
Benzene	ND	0.5	ug/L					
Bromodichloromethane	ND	0.5	ug/L					
Bromoform	ND	0.5	ug/L					
Bromomethane	ND	0.5	ug/L					
Carbon Tetrachloride	ND	0.2	ug/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Chlorobenzene	ND	0.5	ug/L					
Chloroethane	ND	1.0	ug/L					
Chloroform	ND	0.5	ug/L					
Chloromethane	ND	3.0	ug/L					
Dibromochloromethane	ND	0.5	ug/L					
Dichlorodifluoromethane	ND	1.0	ug/L					
1,2-Dibromoethane	ND	0.2	ug/L					
1,2-Dichlorobenzene	ND	0.5	ug/L					
1,3-Dichlorobenzene	ND	0.5	ug/L					
1,4-Dichlorobenzene	ND	0.5	ug/L					
1,1-Dichloroethane	ND	0.5	ug/L					
1,2-Dichloroethane	ND	0.5	ug/L					
1,1-Dichloroethylene	ND	0.5	ug/L					
cis-1,2-Dichloroethylene	ND	0.5	ug/L					
trans-1,2-Dichloroethylene	ND	0.5	ug/L					
1,2-Dichloroethylene, total	ND	0.5	ug/L					
1,2-Dichloropropane	ND	0.5	ug/L					
cis-1,3-Dichloropropylene	ND	0.5	ug/L					
trans-1,3-Dichloropropylene	ND	0.5	ug/L					
1,3-Dichloropropene, total	ND	0.5	ug/L					
Ethylbenzene	ND	0.5	ug/L					
Hexane	ND	1.0	ug/L					
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L					
Methyl Butyl Ketone (2-Hexanone)	ND	10.0	ug/L					
Methyl Isobutyl Ketone	ND	5.0	ug/L					
Methyl tert-butyl ether	ND	2.0	ug/L					
Methylene Chloride	ND	5.0	ug/L					
Styrene	ND	0.5	ug/L					
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L					
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L					
Tetrachloroethylene	ND	0.5	ug/L					
Toluene	ND	0.5	ug/L					
1,1,1-Trichloroethane	ND	0.5	ug/L					

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,2-Trichloroethane	ND	0.5	ug/L					
Trichloroethylene	ND	0.5	ug/L					
Trichlorofluoromethane	ND	1.0	ug/L					
1,3,5-Trimethylbenzene	ND	0.5	ug/L					
Vinyl chloride	ND	0.5	ug/L					
m,p-Xylenes	ND	0.5	ug/L					
o-Xylene	ND	0.5	ug/L					
Xylenes, total	ND	0.5	ug/L					
Surrogate: 4-Bromofluorobenzene	*92.2*		*%*	*115*	*50-140*			
Surrogate: Dibromofluoromethane	*76.6*		*%*	*95.8*	*50-140*			
Surrogate: Toluene-d8	*77.5*		*%*	*96.9*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	79.0	1	mg/L	79.7			1.0	20	
Fluoride	0.16	0.1	mg/L	0.15			5.1	20	
Nitrate as N	ND	0.1	mg/L	ND			NC	20	
Nitrite as N	ND	0.05	mg/L	ND			NC	20	
Sulphate	50.7	1	mg/L	50.8			0.2	20	
General Inorganics									
Alkalinity, total	205	5	mg/L	204			0.2	14	
Ammonia as N	0.236	0.01	mg/L	0.229			2.8	17.7	
Dissolved Organic Carbon	0.7	0.5	mg/L	0.8			17.0	37	
Colour	ND	2	TCU	ND			NC	12	
Colour, apparent	3	2	ACU	3			0.0	12	
Conductivity	775	5	uS/cm	788			1.6	5	
pH	8.1	0.1	pH Units	8.2			0.5	3.3	
Phenolics	ND	0.001	mg/L	ND			NC	10	
Total Dissolved Solids	416	10	mg/L	438			5.2	10	
Sulphide	0.13	0.02	mg/L	0.13			1.5	10	
Tannin & Lignin	ND	0.1	mg/L	ND			NC	11	
Total Kjeldahl Nitrogen	0.11	0.1	mg/L	0.13			15.5	16	
Turbidity	ND	0.1	NTU	ND			NC	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND			NC	30	
Metals									
Mercury	ND	0.0001	mg/L	ND			NC	20	
Aluminum	0.046	0.001	mg/L	0.045			2.0	20	
Antimony	ND	0.0005	mg/L	ND			NC	20	
Arsenic	ND	0.001	mg/L	ND			NC	20	
Barium	0.013	0.001	mg/L	0.012			2.5	20	
Beryllium	ND	0.0005	mg/L	ND			NC	20	
Boron	ND	0.01	mg/L	ND			NC	20	
Cadmium	0.0001	0.0001	mg/L	ND			NC	20	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Calcium	7.8	0.1	mg/L	7.9			1.0	20	
Chromium	ND	0.001	mg/L	ND			NC	20	
Cobalt	ND	0.0005	mg/L	ND			NC	20	
Copper	0.0050	0.0005	mg/L	0.0050			0.4	20	
Iron	ND	0.1	mg/L	ND			NC	20	
Lead	0.0001	0.0001	mg/L	0.0001			13.5	20	
Magnesium	2.0	0.2	mg/L	2.0			0.3	20	
Manganese	ND	0.005	mg/L	ND			NC	20	
Molybdenum	ND	0.0005	mg/L	ND			NC	20	
Nickel	ND	0.001	mg/L	ND			NC	20	
Potassium	0.7	0.1	mg/L	0.7			0.1	20	
Selenium	ND	0.001	mg/L	ND			NC	20	
Silver	ND	0.0001	mg/L	0.0002			NC	20	
Sodium	16.4	0.2	mg/L	16.3			0.5	20	
Thallium	ND	0.001	mg/L	ND			NC	20	
Uranium	ND	0.0001	mg/L	ND			NC	20	
Vanadium	ND	0.0005	mg/L	ND			NC	20	
Zinc	ND	0.005	mg/L	ND			NC	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100mL	ND			NC	30	
Fecal Coliforms	ND	1	CFU/100mL	ND			NC	30	
Heterotrophic Plate Count	ND	10	CFU/mL	ND			NC	30	
Volatiles									
Acetone	ND	5.0	ug/L	ND			NC	30	
Benzene	ND	0.5	ug/L	ND			NC	30	
Bromodichloromethane	ND	0.5	ug/L	ND			NC	30	
Bromoform	ND	0.5	ug/L	ND			NC	30	
Bromomethane	ND	0.5	ug/L	ND			NC	30	
Carbon Tetrachloride	ND	0.2	ug/L	ND			NC	30	
Chlorobenzene	ND	0.5	ug/L	ND			NC	30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroethane	ND	1.0	ug/L	ND			NC	30	
Chloroform	ND	0.5	ug/L	ND			NC	30	
Chloromethane	ND	3.0	ug/L	ND			NC	30	
Dibromochloromethane	ND	0.5	ug/L	ND			NC	30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND			NC	30	
1,2-Dibromoethane	ND	0.2	ug/L	ND			NC	30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND			NC	30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND			NC	30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND			NC	30	
1,1-Dichloroethane	ND	0.5	ug/L	ND			NC	30	
1,2-Dichloroethane	ND	0.5	ug/L	ND			NC	30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND			NC	30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND			NC	30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND			NC	30	
1,2-Dichloropropane	ND	0.5	ug/L	ND			NC	30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND			NC	30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND			NC	30	
Ethylbenzene	ND	0.5	ug/L	ND			NC	30	
Hexane	ND	1.0	ug/L	ND			NC	30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND			NC	30	
Methyl Butyl Ketone (2-Hexanone)	ND	10.0	ug/L	ND			NC	30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND			NC	30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND			NC	30	
Methylene Chloride	ND	5.0	ug/L	ND			NC	30	
Styrene	ND	0.5	ug/L	ND			NC	30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND			NC	30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND			NC	30	
Tetrachloroethylene	ND	0.5	ug/L	ND			NC	30	
Toluene	ND	0.5	ug/L	ND			NC	30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND			NC	30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND			NC	30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Trichloroethylene	ND	0.5	ug/L	ND			NC	30	
Trichlorofluoromethane	ND	1.0	ug/L	ND			NC	30	
1,3,5-Trimethylbenzene	ND	0.5	ug/L	ND			NC	30	
Vinyl chloride	ND	0.5	ug/L	ND			NC	30	
m,p-Xylenes	ND	0.5	ug/L	ND			NC	30	
o-Xylene	ND	0.5	ug/L	ND			NC	30	
Surrogate: 4-Bromofluorobenzene	*89.4*		*%*		*112*	*50-140*			
Surrogate: Dibromofluoromethane	*86.4*		*%*		*108*	*50-140*			
Surrogate: Toluene-d8	*77.1*		*%*		*96.4*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	89.2	1	mg/L	79.7	95.1	70-124			
Fluoride	1.15	0.1	mg/L	0.15	99.5	70-130			
Nitrate as N	1.07	0.1	mg/L	ND	107	77-126			
Nitrite as N	0.912	0.05	mg/L	ND	91.2	82-115			
Sulphate	59.2	1	mg/L	50.8	84.4	70-130			
General Inorganics									
Ammonia as N	1.30	0.01	mg/L	0.229	107	81-124			
Dissolved Organic Carbon	9.2	0.5	mg/L	0.8	83.9	60-133			
Phenolics	0.028	0.001	mg/L	ND	110	67-133			
Total Dissolved Solids	104	10	mg/L	ND	104	75-125			
Sulphide	0.64	0.02	mg/L	0.13	100	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	95.2	71-113			
Total Kjeldahl Nitrogen	1.12	0.1	mg/L	0.13	98.6	81-126			
Hydrocarbons									
F1 PHCs (C6-C10)	1860	25	ug/L	ND	108	85-115			
F2 PHCs (C10-C16)	1.3	0.1	mg/L	ND	83.8	60-140			
F3 PHCs (C16-C34)	4.0	0.1	mg/L	ND	101	60-140			
F4 PHCs (C34-C50)	2.6	0.1	mg/L	ND	105	60-140			
Metals									
Mercury	0.0025	0.0001	mg/L	ND	82.5	70-130			
Aluminum	89.8	0.001	mg/L	44.9	89.7	80-120			
Antimony	44.2	0.0005	mg/L	0.207	88.1	80-120			
Arsenic	51.4	0.001	mg/L	0.475	102	80-120			
Barium	58.1	0.001	mg/L	12.3	91.7	80-120			
Beryllium	52.4	0.0005	mg/L	0.0628	105	80-120			
Boron	50.9	0.01	mg/L	5.27	91.3	80-120			
Cadmium	47.0	0.0001	mg/L	0.0994	93.7	80-120			
Calcium	16900	0.1	mg/L	7880	90.0	80-120			
Chromium	52.0	0.001	mg/L	0.301	103	80-120			
Cobalt	49.5	0.0005	mg/L	0.104	98.8	80-120			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Copper	52.7	0.0005	mg/L	4.99	95.4	80-120			
Iron	2290	0.1	mg/L	12.2	91.3	80-120			
Lead	46.2	0.0001	mg/L	0.109	92.2	80-120			
Magnesium	11400	0.2	mg/L	1950	94.4	80-120			
Manganese	52.8	0.005	mg/L	2.53	101	80-120			
Molybdenum	46.6	0.0005	mg/L	0.347	92.5	80-120			
Nickel	49.6	0.001	mg/L	0.500	98.1	80-120			
Potassium	10400	0.1	mg/L	706	97.0	80-120			
Selenium	47.7	0.001	mg/L	0.198	95.0	80-120			
Silver	48.7	0.0001	mg/L	0.244	96.8	80-120			
Sodium	25200	0.2	mg/L	16300	88.3	80-120			
Thallium	48.0	0.001	mg/L	0.097	95.7	80-120			
Uranium	49.9	0.0001	mg/L	0.0951	99.6	80-120			
Vanadium	52.0	0.0005	mg/L	0.322	103	80-120			
Zinc	50.3	0.005	mg/L	2.29	96.1	80-120			
Volatiles									
Acetone	72.0	5.0	ug/L	ND	72.0	50-140			
Benzene	31.2	0.5	ug/L	ND	78.0	60-130			
Bromodichloromethane	30.6	0.5	ug/L	ND	76.5	60-130			
Bromoform	40.9	0.5	ug/L	ND	102	60-130			
Bromomethane	40.2	0.5	ug/L	ND	100	50-140			
Carbon Tetrachloride	31.0	0.2	ug/L	ND	77.4	60-130			
Chlorobenzene	35.4	0.5	ug/L	ND	88.5	60-130			
Chloroethane	32.5	1.0	ug/L	ND	81.2	50-140			
Chloroform	31.6	0.5	ug/L	ND	79.1	60-130			
Chloromethane	41.4	3.0	ug/L	ND	103	50-140			
Dibromochloromethane	39.5	0.5	ug/L	ND	98.8	60-130			
Dichlorodifluoromethane	33.4	1.0	ug/L	ND	83.6	50-140			
1,2-Dibromoethane	36.3	0.2	ug/L	ND	90.7	60-130			
1,2-Dichlorobenzene	39.6	0.5	ug/L	ND	98.9	60-130			
1,3-Dichlorobenzene	38.0	0.5	ug/L	ND	95.0	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,4-Dichlorobenzene	39.1	0.5	ug/L	ND	97.8	60-130			
1,1-Dichloroethane	35.7	0.5	ug/L	ND	89.2	60-130			
1,2-Dichloroethane	44.3	0.5	ug/L	ND	111	60-130			
1,1-Dichloroethylene	37.5	0.5	ug/L	ND	93.8	60-130			
cis-1,2-Dichloroethylene	35.4	0.5	ug/L	ND	88.6	60-130			
trans-1,2-Dichloroethylene	35.9	0.5	ug/L	ND	89.8	60-130			
1,2-Dichloropropane	36.5	0.5	ug/L	ND	91.3	60-130			
cis-1,3-Dichloropropylene	32.4	0.5	ug/L	ND	81.0	60-130			
trans-1,3-Dichloropropylene	33.8	0.5	ug/L	ND	84.6	60-130			
Ethylbenzene	32.6	0.5	ug/L	ND	81.5	60-130			
Hexane	48.4	1.0	ug/L	ND	121	60-130			
Methyl Ethyl Ketone (2-Butanone)	74.1	5.0	ug/L	ND	74.1	50-140			
Methyl Butyl Ketone (2-Hexanone)	72.0	10.0	ug/L	ND	72.0	50-140			
Methyl Isobutyl Ketone	65.3	5.0	ug/L	ND	65.3	50-140			
Methyl tert-butyl ether	74.8	2.0	ug/L	ND	74.8	50-140			
Methylene Chloride	36.9	5.0	ug/L	ND	92.2	60-130			
Styrene	33.8	0.5	ug/L	ND	84.4	60-130			
1,1,1,2-Tetrachloroethane	35.4	0.5	ug/L	ND	88.5	60-130			
1,1,2,2-Tetrachloroethane	33.2	0.5	ug/L	ND	83.1	60-130			
Tetrachloroethylene	43.1	0.5	ug/L	ND	108	60-130			
Toluene	34.8	0.5	ug/L	ND	87.1	60-130			
1,1,1-Trichloroethane	33.0	0.5	ug/L	ND	82.4	60-130			
1,1,2-Trichloroethane	30.2	0.5	ug/L	ND	75.5	60-130			
Trichloroethylene	31.8	0.5	ug/L	ND	79.6	60-130			
Trichlorofluoromethane	36.2	1.0	ug/L	ND	90.4	60-130			
1,3,5-Trimethylbenzene	35.8	0.5	ug/L	ND	89.6	60-130			
Vinyl chloride	38.3	0.5	ug/L	ND	95.7	50-140			
m,p-Xylenes	73.3	0.5	ug/L	ND	91.7	60-130			
o-Xylene	31.2	0.5	ug/L	ND	78.1	60-130			
Surrogate: 4-Bromofluorobenzene	*82.6*		*%*		*103*	*50-140*			
Surrogate: Dibromofluoromethane	*81.7*		*%*		*102*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Toluene-d8	*87.0*		*%*		*109*	*50-140*			

Certificate of Analysis

Report Date: 14-Sep-2023

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

Order Date: 8-Sep-2023

Client PO: 3160 Carp

Project Description: 102151.001

Qualifier Notes:

Sample Qualifiers :

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

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

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

CCME PHC additional information:

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

- F1 range corrected for BTEX.

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

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

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

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

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

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: Brent Redmond

Client PO:
Project: 102151.001
Custody: 17258

Report Date: 12-Sep-2023
Order Date: 6-Sep-2023

Order #: 2336243

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

Paracel ID	Client ID
2336243-01	TW3-8hr

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	8-Sep-23	8-Sep-23
Ammonia, as N	EPA 351.2 - Auto Colour	8-Sep-23	8-Sep-23
Anions	EPA 300.1 - IC	7-Sep-23	7-Sep-23
Colour	SM2120 - Spectrophotometric	7-Sep-23	7-Sep-23
Colour, apparent	SM2120 - Spectrophotometric	7-Sep-23	7-Sep-23
Conductivity	EPA 9050A- probe @25 °C	8-Sep-23	8-Sep-23
Dissolved Organic Carbon	MOE 3247B - Combustion IR	11-Sep-23	12-Sep-23
E. coli	MOE E3407	7-Sep-23	7-Sep-23
Fecal Coliform	SM 9222D	7-Sep-23	7-Sep-23
Heterotrophic Plate Count	SM 9215C	7-Sep-23	7-Sep-23
Metals, ICP-MS	EPA 200.8 - ICP-MS	8-Sep-23	8-Sep-23
pH	EPA 150.1 - pH probe @25 °C	8-Sep-23	8-Sep-23
Phenolics	EPA 420.2 - Auto Colour, 4AAP	8-Sep-23	8-Sep-23
Hardness	Hardness as CaCO3	8-Sep-23	8-Sep-23
Sulphide	SM 4500SE - Colourimetric	7-Sep-23	7-Sep-23
Tannin/Lignin	SM 5550B - Colourimetric	11-Sep-23	11-Sep-23
Total Coliform	MOE E3407	7-Sep-23	7-Sep-23
Total Dissolved Solids	SM 2540C - gravimetric, filtration	11-Sep-23	12-Sep-23
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	8-Sep-23	8-Sep-23
Turbidity	SM 2130B - Turbidity meter	7-Sep-23	7-Sep-23

PARACEL LABORATORIES LTD.

Order #: 2336243

Certificate of Analysis

Report Date: 12-Sep-2023

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

Order Date: 6-Sep-2023

Client PO:

Project Description: 102151.001

	Client ID:	TW3-8hr	-	-	-		
	Sample Date:	06-Sep-23 16:30	-	-	-	-	-
	Sample ID:	2336243-01	-	-	-		
	Matrix:	Drinking Water	-	-	-		
	MDL/Units						
Microbiological Parameters							
E. coli	1 CFU/100mL	ND [1]	-	-	-	-	-
Total Coliforms	1 CFU/100mL	ND [1]	-	-	-	-	-
Fecal Coliforms	1 CFU/100mL	ND	-	-	-	-	-
Heterotrophic Plate Count	10 CFU/mL	40	-	-	-	-	-
General Inorganics							
Alkalinity, total	5 mg/L	203	-	-	-	-	-
Ammonia as N	0.01 mg/L	0.24	-	-	-	-	-
Dissolved Organic Carbon	0.5 mg/L	0.8	-	-	-	-	-
Colour, apparent	2 ACU	9	-	-	-	-	-
Colour	2 TCU	<2	-	-	-	-	-
Conductivity	5 uS/cm	730	-	-	-	-	-
Hardness	mg/L	176	-	-	-	-	-
pH	0.1 pH Units	8.3	-	-	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-	-	-
Total Dissolved Solids	10 mg/L	400	-	-	-	-	-
Sulphide	0.02 mg/L	0.77	-	-	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.3	-	-	-	-	-
Turbidity	0.1 NTU	1.4	-	-	-	-	-
Anions							
Chloride	1 mg/L	79	-	-	-	-	-
Fluoride	0.1 mg/L	0.4	-	-	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-	-	-
Sulphate	1 mg/L	46	-	-	-	-	-

	Client ID:	TW3-8hr	-	-	-		
	Sample Date:	06-Sep-23 16:30	-	-	-	-	-
	Sample ID:	2336243-01	-	-	-		
	Matrix:	Drinking Water	-	-	-		
	MDL/Units						
Metals							
Calcium	0.1 mg/L	42.0	-	-	-	-	-
Iron	0.1 mg/L	0.1	-	-	-	-	-
Magnesium	0.2 mg/L	17.2	-	-	-	-	-
Manganese	0.005 mg/L	<0.005	-	-	-	-	-
Potassium	0.1 mg/L	5.7	-	-	-	-	-
Sodium	0.2 mg/L	87.6	-	-	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	1	mg/L					
Fluoride	ND	0.1	mg/L					
Nitrate as N	ND	0.1	mg/L					
Nitrite as N	ND	0.05	mg/L					
Sulphate	ND	1	mg/L					
General Inorganics								
Alkalinity, total	ND	5	mg/L					
Ammonia as N	ND	0.01	mg/L					
Dissolved Organic Carbon	ND	0.5	mg/L					
Colour	ND	2	TCU					
Colour, apparent	ND	2	ACU					
Conductivity	ND	5	uS/cm					
Phenolics	ND	0.001	mg/L					
Total Dissolved Solids	ND	10	mg/L					
Sulphide	ND	0.02	mg/L					
Tannin & Lignin	ND	0.1	mg/L					
Total Kjeldahl Nitrogen	ND	0.1	mg/L					
Turbidity	ND	0.1	NTU					
Metals								
Calcium	ND	0.1	mg/L					
Iron	ND	0.1	mg/L					
Magnesium	ND	0.2	mg/L					
Manganese	ND	0.005	mg/L					
Potassium	ND	0.1	mg/L					
Sodium	ND	0.2	mg/L					
Microbiological Parameters								
E. coli	ND	1	CFU/100mL					
Total Coliforms	ND	1	CFU/100mL					
Fecal Coliforms	ND	1	CFU/100mL					
Heterotrophic Plate Count	ND	10	CFU/mL					

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	78.9	1	mg/L	78.6			0.4	20	
Fluoride	0.46	0.1	mg/L	0.41			12.2	20	
Nitrate as N	ND	0.1	mg/L	ND			NC	20	
Nitrite as N	ND	0.05	mg/L	ND			NC	20	
Sulphate	45.5	1	mg/L	45.8			0.7	20	
General Inorganics									
Alkalinity, total	203	5	mg/L	203			0.2	14	
Ammonia as N	0.240	0.01	mg/L	0.242			0.8	17.7	
Dissolved Organic Carbon	0.7	0.5	mg/L	0.8			17.0	37	
Colour	ND	2	TCU	ND			NC	12	
Colour, apparent	9	2	ACU	9			0.0	12	
Conductivity	721	5	uS/cm	730			1.2	5	
Phenolics	ND	0.001	mg/L	ND			NC	10	
Total Dissolved Solids	416	10	mg/L	438			5.2	10	
Sulphide	0.77	0.02	mg/L	0.77			0.4	10	
Tannin & Lignin	ND	0.1	mg/L	ND			NC	11	
Total Kjeldahl Nitrogen	0.27	0.1	mg/L	0.28			1.2	16	
Turbidity	1.4	0.1	NTU	1.4			0.0	10	
Metals									
Calcium	7.8	0.1	mg/L	7.9			1.0	20	
Iron	ND	0.1	mg/L	ND			NC	20	
Magnesium	2.0	0.2	mg/L	2.0			0.3	20	
Manganese	ND	0.005	mg/L	ND			NC	20	
Potassium	0.7	0.1	mg/L	0.7			0.1	20	
Sodium	16.4	0.2	mg/L	16.3			0.5	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100mL	ND			NC	30	
Fecal Coliforms	ND	1	CFU/100mL	ND			NC	30	
Heterotrophic Plate Count	ND	10	CFU/mL	40			NC	30	BAC04

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	86.7	1	mg/L	78.6	81.2	70-124			
Fluoride	1.37	0.1	mg/L	0.41	96.1	70-130			
Nitrate as N	1.08	0.1	mg/L	ND	108	77-126			
Nitrite as N	0.944	0.05	mg/L	ND	94.4	82-115			
Sulphate	54.1	1	mg/L	45.8	82.9	70-130			
General Inorganics									
Ammonia as N	1.23	0.01	mg/L	0.242	98.8	81-124			
Dissolved Organic Carbon	9.2	0.5	mg/L	0.8	83.9	60-133			
Phenolics	0.028	0.001	mg/L	ND	110	67-133			
Total Dissolved Solids	104	10	mg/L	ND	104	75-125			
Sulphide	0.51	0.02	mg/L	ND	102	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	95.2	71-113			
Total Kjeldahl Nitrogen	1.19	0.1	mg/L	0.28	91.3	81-126			
Metals									
Calcium	16900	0.1	mg/L	7880	90.0	80-120			
Iron	2290	0.1	mg/L	12.2	91.3	80-120			
Magnesium	11400	0.2	mg/L	1950	94.4	80-120			
Manganese	52.8	0.005	mg/L	2.53	101	80-120			
Potassium	10400	0.1	mg/L	706	97.0	80-120			
Sodium	25200	0.2	mg/L	16300	88.3	80-120			

Qualifier Notes:

Sample Qualifiers :

1: Greater than 200 CFU of background colonies present. This may interfere with target growth and ability of the analyst to count E. coli & Total Coliform. The target colonies may be under-represented.

QC Qualifiers:

BAC04 Duplicate QC data falls within method prescribed 95% confidence limits.

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

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

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 64819.03
Custody: 10402

Report Date: 20-Aug-2019
Order Date: 13-Aug-2019

Order #: 1933220

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

Paracel ID	Client ID
1933220-01	TW19-2 GW1
1933220-02	TW19-2 GW2

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 20-Aug-2019

Order Date: 13-Aug-2019

Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	14-Aug-19	14-Aug-19
Ammonia, as N	EPA 351.2 - Auto Colour	14-Aug-19	14-Aug-19
Anions	EPA 300.1 - IC	14-Aug-19	14-Aug-19
Chromium, hexavalent - water	MOE E3056 - colourimetric	14-Aug-19	14-Aug-19
Colour	SM2120 - Spectrophotometric	14-Aug-19	14-Aug-19
Conductivity	EPA 9050A- probe @25 °C	14-Aug-19	14-Aug-19
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	16-Aug-19	16-Aug-19
E. coli	MOE E3407	14-Aug-19	14-Aug-19
Fecal Coliform	SM 9222D	14-Aug-19	14-Aug-19
Heterotrophic Plate Count	SM 9215C	14-Aug-19	14-Aug-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	15-Aug-19	16-Aug-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	16-Aug-19	20-Aug-19
pH	EPA 150.1 - pH probe @25 °C	14-Aug-19	14-Aug-19
Phenolics	EPA 420.2 - Auto Colour, 4AAP	14-Aug-19	14-Aug-19
Subdivision Package	Hardness as CaCO3	16-Aug-19	20-Aug-19
Sulphide	SM 4500SE - Colourimetric	17-Aug-19	17-Aug-19
Tannin/Lignin	SM 5550B - Colourimetric	14-Aug-19	14-Aug-19
Total Coliform	MOE E3407	14-Aug-19	14-Aug-19
Total Dissolved Solids	SM 2540C - gravimetric, filtration	13-Aug-19	15-Aug-19
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	14-Aug-19	15-Aug-19
Turbidity	SM 2130B - Turbidity meter	14-Aug-19	14-Aug-19

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 20-Aug-2019

Order Date: 13-Aug-2019

Project Description: 64819.03

	Client ID:	TW19-2 GW1	TW19-2 GW2	-	-
	Sample Date:	12-Aug-19 11:00	12-Aug-19 14:00	-	-
	Sample ID:	1933220-01	1933220-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [1]	ND [1]	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	1 [1]	ND [1]	-	-
Heterotrophic Plate Count	10 CFU/mL	240	50	-	-
General Inorganics					
Alkalinity, total	5 mg/L	182	184	-	-
Ammonia as N	0.01 mg/L	0.19	0.24	-	-
Dissolved Organic Carbon	0.5 mg/L	0.6	0.7	-	-
Colour	2 TCU	7	<2	-	-
Conductivity	5 uS/cm	603	611	-	-
Hardness	mg/L	219	215	-	-
pH	0.1 pH Units	8.0	8.0	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	322	324	-	-
Sulphide	0.02 mg/L	1.74	2.02	-	-
Tannin & Lignin	0.1 mg/L	0.1	0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.2	0.3	-	-
Turbidity	0.1 NTU	3.9	10.2	-	-
Anions					
Chloride	1 mg/L	63	63	-	-
Fluoride	0.1 mg/L	0.8	0.8	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	30	29	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Aluminum	0.001 mg/L	-	0.020	-	-
Antimony	0.0005 mg/L	-	<0.0005	-	-
Arsenic	0.001 mg/L	-	<0.001	-	-
Barium	0.001 mg/L	-	0.195	-	-
Beryllium	0.0005 mg/L	-	<0.0005	-	-
Boron	0.01 mg/L	-	0.16	-	-
Cadmium	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	53.3	52.3	-	-
Chromium	0.001 mg/L	-	<0.001	-	-

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 20-Aug-2019

Order Date: 13-Aug-2019

Project Description: 64819.03

	Client ID:	TW19-2 GW1	TW19-2 GW2	-	-
	Sample Date:	12-Aug-19 11:00	12-Aug-19 14:00	-	-
	Sample ID:	1933220-01	1933220-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Chromium (VI)	0.010 mg/L	-	<0.010	-	-
Cobalt	0.0005 mg/L	-	<0.0005	-	-
Copper	0.0005 mg/L	-	0.0010	-	-
Iron	0.1 mg/L	0.2	0.6	-	-
Lead	0.0001 mg/L	-	<0.0001	-	-
Magnesium	0.2 mg/L	20.9	20.4	-	-
Manganese	0.005 mg/L	<0.005	0.006	-	-
Molybdenum	0.0005 mg/L	-	0.0011	-	-
Nickel	0.001 mg/L	-	<0.001	-	-
Potassium	0.1 mg/L	6.3	6.4	-	-
Selenium	0.001 mg/L	-	<0.001	-	-
Silver	0.0001 mg/L	-	<0.0001	-	-
Sodium	0.2 mg/L	48.4	49.9	-	-
Strontium	0.01 mg/L	-	2.20	-	-
Thallium	0.001 mg/L	-	<0.001	-	-
Tin	0.01 mg/L	-	<0.01	-	-
Titanium	0.005 mg/L	-	<0.005	-	-
Tungsten	0.01 mg/L	-	<0.01	-	-
Uranium	0.0001 mg/L	-	<0.0001	-	-
Vanadium	0.0005 mg/L	-	<0.0005	-	-
Zinc	0.005 mg/L	-	<0.005	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Beryllium	ND	0.0005	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Chromium	ND	0.001	mg/L						
Cobalt	ND	0.0005	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Molybdenum	ND	0.0005	mg/L						
Nickel	ND	0.001	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Silver	ND	0.0001	mg/L						
Sodium	ND	0.2	mg/L						
Strontium	ND	0.01	mg/L						
Thallium	ND	0.001	mg/L						
Tin	ND	0.01	mg/L						
Titanium	ND	0.005	mg/L						
Uranium	ND	0.0001	mg/L						
Vanadium	ND	0.0005	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	5.63	1	mg/L	5.67			0.7	10	
Fluoride	0.91	0.1	mg/L	0.90			1.8	10	
Nitrate as N	0.14	0.1	mg/L	0.14			0.4	10	
Nitrite as N	ND	0.05	mg/L	ND			0.0	10	
Sulphate	24.0	1	mg/L	24.1			0.7	10	
General Inorganics									
Alkalinity, total	32.0	5	mg/L	31.4			1.8	14	
Ammonia as N	ND	0.01	mg/L	0.010			0.0	17.7	
Dissolved Organic Carbon	ND	0.5	mg/L	ND			0.0	37	
Colour	6	2	TCU	7			15.4	12	QR-01
Conductivity	144	5	uS/cm	143			1.2	5	
pH	9.1	0.1	pH Units	9.0			0.3	3.3	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	102	10	mg/L	98.0			4.0	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	0.1	0.1	mg/L	0.1			9.4	11	
Total Kjeldahl Nitrogen	0.45	0.1	mg/L	0.40			12.1	16	
Turbidity	1.5	0.1	NTU	1.4			2.7	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Aluminum	0.011	0.001	mg/L	0.012			7.1	20	
Antimony	0.0007	0.0005	mg/L	0.0006			15.0	20	
Arsenic	0.079	0.001	mg/L	0.078			1.5	20	
Barium	ND	0.001	mg/L	ND			0.0	20	
Beryllium	ND	0.0005	mg/L	ND			0.0	20	
Boron	0.05	0.01	mg/L	0.06			1.3	20	
Cadmium	ND	0.0001	mg/L	ND			0.0	20	
Calcium	0.2	0.1	mg/L	0.2			27.1	20	QR-01
Chromium (VI)	ND	0.010	mg/L	ND			0.0	20	
Chromium	ND	0.001	mg/L	ND			0.0	20	
Cobalt	ND	0.0005	mg/L	ND			0.0	20	
Copper	0.0028	0.0005	mg/L	0.0024			17.0	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Lead	0.0008	0.0001	mg/L	0.0008			3.0	20	
Magnesium	ND	0.2	mg/L	ND			0.0	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Molybdenum	0.0368	0.0005	mg/L	0.0361			1.9	20	
Nickel	ND	0.001	mg/L	ND			0.0	20	
Potassium	0.4	0.1	mg/L	0.4			1.1	20	
Selenium	ND	0.001	mg/L	ND			0.0	20	
Silver	ND	0.0001	mg/L	ND			0.0	20	
Sodium	83.6	0.2	mg/L	83.1			0.7	20	
Thallium	ND	0.001	mg/L	ND			0.0	20	
Tin	ND	0.01	mg/L	ND			0.0	20	
Titanium	0.010	0.005	mg/L	0.010			0.7	50	
Uranium	0.0003	0.0001	mg/L	0.0003			1.5	20	
Vanadium	ND	0.0005	mg/L	ND			0.0	20	
Zinc	0.006	0.005	mg/L	ND			0.0	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	BAC14
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	1	1	CFU/100 mL	1			0.0	30	BAC14
Heterotrophic Plate Count	210	10	CFU/mL	240			13.0	30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	15.1	1	mg/L	5.67	94.3	77-123			
Fluoride	1.96	0.1	mg/L	0.90	107	79-121			
Nitrate as N	1.23	0.1	mg/L	0.14	109	79-120			
Nitrite as N	0.899	0.05	mg/L	ND	89.9	84-117			
Sulphate	33.5	1	mg/L	24.1	93.6	74-126			
General Inorganics									
Ammonia as N	0.265	0.01	mg/L	0.010	102	81-124			
Dissolved Organic Carbon	9.8	0.5	mg/L	ND	98.4	60-133			
Phenolics	0.021	0.001	mg/L	ND	84.1	69-132			
Total Dissolved Solids	106	10	mg/L		106	75-125			
Sulphide	0.50	0.02	mg/L	ND	99.6	79-115			
Tannin & Lignin	1.2	0.1	mg/L	0.1	112	71-113			
Total Kjeldahl Nitrogen	2.30	0.1	mg/L	0.40	95.3	81-126			
Metals									
Mercury	0.0025	0.0001	mg/L	ND	84.5	70-130			
Aluminum	57.7		ug/L	11.7	92.0	80-120			
Antimony	43.2		ug/L	0.625	85.1	80-120			
Arsenic	127		ug/L	78.0	98.3	80-120			
Barium	48.9		ug/L	0.111	97.6	80-120			
Beryllium	51.3		ug/L	0.0435	103	80-120			
Boron	97.0		ug/L	55.0	84.0	80-120			
Cadmium	46.7		ug/L	0.0366	93.3	80-120			
Calcium	10300		ug/L	178	101	80-120			
Chromium (VI)	0.166	0.010	mg/L	ND	83.0	70-130			
Chromium	53.4		ug/L	0.145	107	80-120			
Cobalt	48.0		ug/L	0.0301	95.9	80-120			
Copper	52.5		ug/L	2.37	100	80-120			
Iron	2340		ug/L	8.4	93.1	80-120			
Lead	44.8		ug/L	0.755	88.2	80-120			
Magnesium	9400		ug/L	13.3	93.8	80-120			
Manganese	51.7		ug/L	0.265	103	80-120			
Molybdenum	81.7		ug/L	36.1	91.1	80-120			
Nickel	50.0		ug/L	0.241	99.5	80-120			
Potassium	9930		ug/L	351	95.8	80-120			
Selenium	46.5		ug/L	0.110	92.8	80-120			
Silver	40.8		ug/L	0.0424	81.5	80-120			
Sodium	23500		ug/L	15300	82.1	80-120			
Thallium	44.6		ug/L	0.034	89.2	80-120			
Tin	49.5		ug/L	0.73	97.5	80-120			
Titanium	52.9		ug/L		106	70-130			
Uranium	48.4		ug/L	0.300	96.3	80-120			
Vanadium	53.4		ug/L	0.0384	107	80-120			
Zinc	51.4		ug/L	2.77	97.3	80-120			

Qualifier Notes:

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

BAC14 : A2C - Background counts greater than 200

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 64819.03
Custody: 9345

Report Date: 14-Aug-2019
Order Date: 8-Aug-2019

Order #: 1932395

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

Paracel ID	Client ID
1932395-01	TW19-1 GW-1
1932395-02	TW19-1 GW-2

Approved By:

Dale Robertson, BSc
Laboratory Director

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	9-Aug-19	9-Aug-19
Ammonia, as N	EPA 351.2 - Auto Colour	12-Aug-19	12-Aug-19
Anions	EPA 300.1 - IC	9-Aug-19	9-Aug-19
Chromium, hexavalent - water	MOE E3056 - colourimetric	9-Aug-19	9-Aug-19
Colour	SM2120 - Spectrophotometric	9-Aug-19	9-Aug-19
Conductivity	EPA 9050A- probe @25 °C	9-Aug-19	9-Aug-19
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	9-Aug-19	9-Aug-19
E. coli	MOE E3407	8-Aug-19	8-Aug-19
Fecal Coliform	SM 9222D	8-Aug-19	8-Aug-19
Heterotrophic Plate Count	SM 9215C	8-Aug-19	8-Aug-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	12-Aug-19	12-Aug-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	13-Aug-19	14-Aug-19
pH	EPA 150.1 - pH probe @25 °C	9-Aug-19	9-Aug-19
Phenolics	EPA 420.2 - Auto Colour, 4AAP	12-Aug-19	12-Aug-19
Subdivision Package	Hardness as CaCO3	13-Aug-19	14-Aug-19
Sulphide	SM 4500SE - Colourimetric	10-Aug-19	10-Aug-19
Tannin/Lignin	SM 5550B - Colourimetric	9-Aug-19	9-Aug-19
Total Coliform	MOE E3407	8-Aug-19	8-Aug-19
Total Dissolved Solids	SM 2540C - gravimetric, filtration	12-Aug-19	13-Aug-19
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	9-Aug-19	12-Aug-19
Turbidity	SM 2130B - Turbidity meter	9-Aug-19	9-Aug-19

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 14-Aug-2019

Order Date: 8-Aug-2019

Project Description: 64819.03

	Client ID:	TW19-1 GW-1	TW19-1 GW-2	-	-
	Sample Date:	08-Aug-19 11:15	08-Aug-19 14:15	-	-
	Sample ID:	1932395-01	1932395-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [1]	ND [1]	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND [1]	ND [1]	-	-
Heterotrophic Plate Count	10 CFU/mL	270	120	-	-
General Inorganics					
Alkalinity, total	5 mg/L	214	212	-	-
Ammonia as N	0.01 mg/L	0.13	0.11	-	-
Dissolved Organic Carbon	0.5 mg/L	1.1	0.6	-	-
Colour	2 TCU	80	2	-	-
Conductivity	5 uS/cm	723	706	-	-
Hardness	mg/L	306	292	-	-
pH	0.1 pH Units	8.0	8.0	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	442	394	-	-
Sulphide	0.02 mg/L	0.16	0.24	-	-
Tannin & Lignin	0.1 mg/L	0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.2	0.2	-	-
Turbidity	0.1 NTU	92.2	20.2	-	-
Anions					
Chloride	1 mg/L	72	71	-	-
Fluoride	0.1 mg/L	0.2	0.3	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	54	52	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	74.2	70.7	-	-
Chromium (VI)	0.010 mg/L	-	<0.010	-	-
Iron	0.1 mg/L	2.0	0.7	-	-
Magnesium	0.2 mg/L	29.2	28.2	-	-
Manganese	0.005 mg/L	0.032	0.013	-	-
Potassium	0.1 mg/L	6.1	5.9	-	-
Sodium	0.2 mg/L	41.4	42.8	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Iron	ND	0.1	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Sodium	ND	0.2	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	5.49	1	mg/L	5.46			0.6	10	
Fluoride	0.65	0.1	mg/L	0.62			5.3	10	
Nitrate as N	0.14	0.1	mg/L	0.14			3.7	10	
Nitrite as N	ND	0.05	mg/L	ND			0.0	10	
Sulphate	24.7	1	mg/L	24.5			1.0	10	
General Inorganics									
Alkalinity, total	89.1	5	mg/L	84.8			4.9	14	
Ammonia as N	0.261	0.01	mg/L	0.265			1.7	17.7	
Dissolved Organic Carbon	0.8	0.5	mg/L	1.1			27.6	37	
Colour	6	2	TCU	5			18.2	12	QR-01
Conductivity	360	5	uS/cm	331			8.5	5	QR-05
Phenolics	0.005	0.001	mg/L	0.006			11.0	10	QR-01
Total Dissolved Solids	68.0	10	mg/L	70.0			2.9	10	
Sulphide	0.05	0.02	mg/L	0.05			4.0	10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	ND	0.1	mg/L	ND				16	
Turbidity	96.2	0.1	NTU	92.2			4.3	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Calcium	7.7	0.1	mg/L	7.8			1.6	20	
Chromium (VI)	ND	0.010	mg/L	ND			0.0	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Magnesium	1.9	0.2	mg/L	1.9			1.7	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Potassium	0.7	0.1	mg/L	0.7			3.5	20	
Sodium	13.5	0.2	mg/L	13.9			2.7	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	
Heterotrophic Plate Count	210	10	CFU/mL	270			25.0	30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	15.2	1	mg/L	5.46	97.1	77-123			
Fluoride	1.53	0.1	mg/L	0.62	91.3	79-121			
Nitrate as N	1.24	0.1	mg/L	0.14	110	79-120			
Nitrite as N	0.863	0.05	mg/L	ND	86.3	84-117			
Sulphate	34.2	1	mg/L	24.5	97.3	74-126			
General Inorganics									
Ammonia as N	0.564	0.01	mg/L	0.265	119	81-124			
Dissolved Organic Carbon	10.8	0.5	mg/L	1.1	97.5	60-133			
Phenolics	0.026	0.001	mg/L	0.006	79.9	69-132			
Total Dissolved Solids	98.0	10	mg/L		98.0	75-125			
Sulphide	0.54	0.02	mg/L	0.05	99.2	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	104	71-113			
Total Kjeldahl Nitrogen	1.94	0.1	mg/L	ND	96.8	81-126			
Metals									
Mercury	0.0031	0.0001	mg/L	ND	104	70-130			
Calcium	16700		ug/L	7830	89.0	80-120			
Chromium (VI)	0.152	0.010	mg/L	ND	76.0	70-130			
Iron	2320		ug/L	5.0	92.7	80-120			
Magnesium	11400		ug/L	1880	95.1	80-120			
Manganese	50.1		ug/L	1.44	97.3	80-120			
Potassium	10400		ug/L	682	97.3	80-120			
Sodium	22700		ug/L	13900	88.3	80-120			

Qualifier Notes:

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

QR-05 : Duplicate RPDs higher than normally accepted. Remaining batch QA\QC was acceptable. May be sample effect.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 64819.03
Custody: 12001

Report Date: 14-Aug-2019
Order Date: 8-Aug-2019

Order #: 1932402

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

Paracel ID	Client ID
1932402-01	TW19-3 GW1
1932402-02	TW19-3 GW2

Approved By:

Dale Robertson, BSc
Laboratory Director

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 14-Aug-2019
Order Date: 8-Aug-2019
Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	9-Aug-19	9-Aug-19
Ammonia, as N	EPA 351.2 - Auto Colour	12-Aug-19	12-Aug-19
Anions	EPA 300.1 - IC	9-Aug-19	9-Aug-19
Chromium, hexavalent - water	MOE E3056 - colourimetric	9-Aug-19	9-Aug-19
Colour	SM2120 - Spectrophotometric	9-Aug-19	9-Aug-19
Conductivity	EPA 9050A- probe @25 °C	9-Aug-19	9-Aug-19
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	9-Aug-19	9-Aug-19
E. coli	MOE E3407	9-Aug-19	9-Aug-19
Fecal Coliform	SM 9222D	9-Aug-19	9-Aug-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	12-Aug-19	12-Aug-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	13-Aug-19	14-Aug-19
pH	EPA 150.1 - pH probe @25 °C	9-Aug-19	9-Aug-19
Phenolics	EPA 420.2 - Auto Colour, 4AAP	12-Aug-19	12-Aug-19
Subdivision Package	Hardness as CaCO3	13-Aug-19	14-Aug-19
Sulphide	SM 4500SE - Colourimetric	10-Aug-19	10-Aug-19
Tannin/Lignin	SM 5550B - Colourimetric	9-Aug-19	9-Aug-19
Total Coliform	MOE E3407	9-Aug-19	9-Aug-19
Total Dissolved Solids	SM 2540C - gravimetric, filtration	12-Aug-19	13-Aug-19
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	9-Aug-19	12-Aug-19
Turbidity	SM 2130B - Turbidity meter	9-Aug-19	9-Aug-19

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 14-Aug-2019

Order Date: 8-Aug-2019

Project Description: 64819.03

	Client ID:	TW19-3 GW1	TW19-3 GW2	-	-
	Sample Date:	07-Aug-19 11:00	07-Aug-19 14:00	-	-
	Sample ID:	1932402-01	1932402-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [1]	ND [1]	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND [1]	ND [1]	-	-
General Inorganics					
Alkalinity, total	5 mg/L	209	210	-	-
Ammonia as N	0.01 mg/L	0.24	0.23	-	-
Dissolved Organic Carbon	0.5 mg/L	1.2	1.4	-	-
Colour	2 TCU	25	5	-	-
Conductivity	5 uS/cm	670	699	-	-
Hardness	mg/L	189	172	-	-
pH	0.1 pH Units	8.2	8.2	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	346	354	-	-
Sulphide	0.02 mg/L	0.77	1.09	-	-
Tannin & Lignin	0.1 mg/L	0.2	0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.3	0.3	-	-
Turbidity	0.1 NTU	18.4	5.2	-	-
Anions					
Chloride	1 mg/L	55	63	-	-
Fluoride	0.1 mg/L	0.4	0.5	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	54	52	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	48.3	44.1	-	-
Chromium (VI)	0.010 mg/L	-	<0.010	-	-
Iron	0.1 mg/L	0.5	0.2	-	-
Magnesium	0.2 mg/L	16.6	15.0	-	-
Manganese	0.005 mg/L	0.007	<0.005	-	-
Potassium	0.1 mg/L	5.7	6.0	-	-
Sodium	0.2 mg/L	85.1	95.8	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Iron	ND	0.1	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Sodium	ND	0.2	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	5.49	1	mg/L	5.46			0.6	10	
Fluoride	0.65	0.1	mg/L	0.62			5.3	10	
Nitrate as N	0.14	0.1	mg/L	0.14			3.7	10	
Nitrite as N	ND	0.05	mg/L	ND			0.0	10	
Sulphate	24.7	1	mg/L	24.5			1.0	10	
General Inorganics									
Alkalinity, total	89.1	5	mg/L	84.8			4.9	14	
Ammonia as N	0.261	0.01	mg/L	0.265			1.7	17.7	
Dissolved Organic Carbon	0.8	0.5	mg/L	1.1			27.6	37	
Colour	6	2	TCU	5			18.2	12	QR-01
Conductivity	360	5	uS/cm	331			8.5	5	QR-05
Phenolics	0.005	0.001	mg/L	0.006			11.0	10	QR-01
Total Dissolved Solids	68.0	10	mg/L	70.0			2.9	10	
Sulphide	0.05	0.02	mg/L	0.05			4.0	10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	ND	0.1	mg/L	ND				16	
Turbidity	96.2	0.1	NTU	92.2			4.3	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Calcium	7.7	0.1	mg/L	7.8			1.6	20	
Chromium (VI)	ND	0.010	mg/L	ND			0.0	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Magnesium	1.9	0.2	mg/L	1.9			1.7	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Potassium	0.7	0.1	mg/L	0.7			3.5	20	
Sodium	13.5	0.2	mg/L	13.9			2.7	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	15.2	1	mg/L	5.46	97.1	77-123			
Fluoride	1.53	0.1	mg/L	0.62	91.3	79-121			
Nitrate as N	1.24	0.1	mg/L	0.14	110	79-120			
Nitrite as N	0.863	0.05	mg/L	ND	86.3	84-117			
Sulphate	34.2	1	mg/L	24.5	97.3	74-126			
General Inorganics									
Ammonia as N	0.564	0.01	mg/L	0.265	119	81-124			
Dissolved Organic Carbon	10.8	0.5	mg/L	1.1	97.5	60-133			
Phenolics	0.026	0.001	mg/L	0.006	79.9	69-132			
Total Dissolved Solids	98.0	10	mg/L		98.0	75-125			
Sulphide	0.54	0.02	mg/L	0.05	99.2	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	104	71-113			
Total Kjeldahl Nitrogen	1.94	0.1	mg/L	ND	96.8	81-126			
Metals									
Mercury	0.0031	0.0001	mg/L	ND	104	70-130			
Calcium	16700		ug/L	7830	89.0	80-120			
Chromium (VI)	0.152	0.010	mg/L	ND	76.0	70-130			
Iron	2320		ug/L	5.0	92.7	80-120			
Magnesium	11400		ug/L	1880	95.1	80-120			
Manganese	50.1		ug/L	1.44	97.3	80-120			
Potassium	10400		ug/L	682	97.3	80-120			
Sodium	22700		ug/L	13900	88.3	80-120			

Qualifier Notes:

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

QR-05 : Duplicate RPDs higher than normally accepted. Remaining batch QA\QC was acceptable. May be sample effect.

Sample Data Revisions

None

Work Order Revisions / Comments:

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.

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 64819.03
Custody: 12110

Report Date: 13-Aug-2019
Order Date: 7-Aug-2019

Order #: 1932194

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

Paracel ID	Client ID
1932194-01	TW19-4 GW1
1932194-02	TW19-4 GW2

Approved By:

Dale Robertson, BSc
Laboratory Director

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 13-Aug-2019

Order Date: 7-Aug-2019

Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	8-Aug-19	8-Aug-19
Ammonia, as N	EPA 351.2 - Auto Colour	8-Aug-19	8-Aug-19
Anions	EPA 300.1 - IC	7-Aug-19	7-Aug-19
Chromium, hexavalent - water	MOE E3056 - colourimetric	9-Aug-19	9-Aug-19
Colour	SM2120 - Spectrophotometric	8-Aug-19	8-Aug-19
Conductivity	EPA 9050A- probe @25 °C	8-Aug-19	8-Aug-19
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	8-Aug-19	8-Aug-19
E. coli	MOE E3407	7-Aug-19	7-Aug-19
Fecal Coliform	SM 9222D	7-Aug-19	7-Aug-19
Heterotrophic Plate Count	SM 9215C	7-Aug-19	7-Aug-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	12-Aug-19	12-Aug-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	13-Aug-19	13-Aug-19
pH	EPA 150.1 - pH probe @25 °C	8-Aug-19	8-Aug-19
Phenolics	EPA 420.2 - Auto Colour, 4AAP	8-Aug-19	8-Aug-19
Subdivision Package	Hardness as CaCO3	13-Aug-19	13-Aug-19
Sulphide	SM 4500SE - Colourimetric	10-Aug-19	10-Aug-19
Tannin/Lignin	SM 5550B - Colourimetric	8-Aug-19	8-Aug-19
Total Coliform	MOE E3407	7-Aug-19	7-Aug-19
Total Dissolved Solids	SM 2540C - gravimetric, filtration	8-Aug-19	9-Aug-19
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	8-Aug-19	9-Aug-19
Turbidity	SM 2130B - Turbidity meter	8-Aug-19	8-Aug-19

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 13-Aug-2019

Order Date: 7-Aug-2019

Project Description: 64819.03

	Client ID:	TW19-4 GW1	TW19-4 GW2	-	-
	Sample Date:	06-Aug-19 11:00	06-Aug-19 14:00	-	-
	Sample ID:	1932194-01	1932194-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND [1]	ND [1]	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND [1]	ND [1]	-	-
Heterotrophic Plate Count	10 CFU/mL	40	40	-	-
General Inorganics					
Alkalinity, total	5 mg/L	227	226	-	-
Ammonia as N	0.01 mg/L	0.09	0.11	-	-
Dissolved Organic Carbon	0.5 mg/L	1.1	1.0	-	-
Colour	2 TCU	6	7	-	-
Conductivity	5 uS/cm	645	643	-	-
Hardness	mg/L	309	305	-	-
pH	0.1 pH Units	7.8	7.8	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	364	382	-	-
Sulphide	0.02 mg/L	0.05	0.08	-	-
Tannin & Lignin	0.1 mg/L	<0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	<0.1	0.1	-	-
Turbidity	0.1 NTU	1.8	1.0	-	-
Anions					
Chloride	1 mg/L	44	43	-	-
Fluoride	0.1 mg/L	0.2	0.2	-	-
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	71	69	-	-
Metals					
Mercury	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	83.2	81.6	-	-
Chromium (VI)	0.010 mg/L	-	<0.010	-	-
Iron	0.1 mg/L	0.2	0.1	-	-
Magnesium	0.2 mg/L	24.6	24.6	-	-
Manganese	0.005 mg/L	0.007	0.006	-	-
Potassium	0.1 mg/L	3.4	3.8	-	-
Sodium	0.2 mg/L	18.1	19.4	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Iron	ND	0.1	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Sodium	ND	0.2	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	25.5	1	mg/L	25.5			0.1	10	
Fluoride	ND	0.1	mg/L	ND				10	
Nitrate as N	0.21	0.1	mg/L	0.21			0.1	10	
Nitrite as N	ND	0.05	mg/L	ND				10	
Sulphate	23.4	1	mg/L	23.4			0.2	10	
General Inorganics									
Alkalinity, total	321	5	mg/L	321			0.0	14	
Ammonia as N	0.248	0.01	mg/L	0.247			0.5	17.7	
Dissolved Organic Carbon	1.6	0.5	mg/L	1.1			36.7	37	
Colour	5	2	TCU	6			18.2	12	QR-01
Conductivity	581	5	uS/cm	584			0.5	5	
pH	8.0	0.1	pH Units	8.0			0.0	3.3	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	336	10	mg/L	348			3.5	10	
Sulphide	0.05	0.02	mg/L	0.05			4.0	10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	ND	0.1	mg/L	ND			0.0	16	
Turbidity	1.9	0.1	NTU	1.8			5.5	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			0.0	20	
Calcium	7.7	0.1	mg/L	7.7			0.1	20	
Chromium (VI)	ND	0.010	mg/L	ND			0.0	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Magnesium	2.1	0.2	mg/L	2.0			5.6	20	
Manganese	0.019	0.005	mg/L	0.006			101.0	20	QR-01
Potassium	0.6	0.1	mg/L	0.6			7.7	20	
Sodium	15.5	0.2	mg/L	15.2			1.8	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	BAC14
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	BAC14
Heterotrophic Plate Count	40	10	CFU/mL	40			0.0	30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	34.3	1	mg/L	25.5	87.7	77-123			
Fluoride	1.18	0.1	mg/L	ND	118	79-121			
Nitrate as N	1.22	0.1	mg/L	0.21	102	79-120			
Nitrite as N	0.895	0.05	mg/L	ND	89.5	84-117			
Sulphate	32.3	1	mg/L	23.4	88.8	74-126			
General Inorganics									
Ammonia as N	0.567	0.01	mg/L	0.247	128	81-124			QM-07
Dissolved Organic Carbon	10.9	0.5	mg/L	1.1	98.3	60-133			
Phenolics	0.022	0.001	mg/L	ND	87.9	69-132			
Total Dissolved Solids	94.0	10	mg/L		94.0	75-125			
Sulphide	0.54	0.02	mg/L	0.05	99.2	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	101	71-113			
Total Kjeldahl Nitrogen	1.89	0.1	mg/L	ND	94.3	81-126			
Metals									
Mercury	0.0031	0.0001	mg/L	ND	104	70-130			
Calcium	16500		ug/L	9780	67.0	80-120			QM-07
Chromium (VI)	0.152	0.010	mg/L	ND	76.0	70-130			
Iron	2270		ug/L	5.0	90.8	80-120			
Magnesium	10800		ug/L	1950	88.2	80-120			
Manganese	51.3		ug/L	6.39	89.8	80-120			
Potassium	9450		ug/L	594	88.6	80-120			
Sodium	22500		ug/L	15200	73.1	80-120			QM-07

Qualifier Notes:

Login Qualifiers :

Container(s) - Broken/cracked cap - phenols
Applies to samples: TW19-4 GW2

Sample Qualifiers :

1 : A2C - Background counts greater than 200

QC Qualifiers :

BAC14 : A2C - Background counts greater than 200

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-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

PARACEL LABORATORIES LTD.
TRUSTED. RESPONSIVE. RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Nicole Soucy

Client PO:
Project: 64819.03
Custody: 6783

Report Date: 26-Nov-2018
Order Date: 20-Nov-2018

Order #: 1847208

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

Paracel ID	Client ID
1847208-01	PW2

Approved By:



Dale Robertson, BSc
Laboratory Director

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 26-Nov-2018
Order Date: 20-Nov-2018
Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	21-Nov-18	21-Nov-18
Ammonia, as N	EPA 351.2 - Auto Colour	23-Nov-18	23-Nov-18
Anions	EPA 300.1 - IC	21-Nov-18	21-Nov-18
Colour	SM2120 - Spectrophotometric	22-Nov-18	22-Nov-18
Conductivity	EPA 9050A- probe @25 °C	21-Nov-18	21-Nov-18
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	26-Nov-18	26-Nov-18
E. coli	MOE E3407	20-Nov-18	20-Nov-18
Fecal Coliform	SM 9222D	20-Nov-18	20-Nov-18
Heterotrophic Plate Count	SM 9215C	20-Nov-18	20-Nov-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	21-Nov-18	21-Nov-18
pH	EPA 150.1 - pH probe @25 °C	21-Nov-18	21-Nov-18
Phenolics	EPA 420.2 - Auto Colour, 4AAP	23-Nov-18	23-Nov-18
Subdivision Package	Hardness as CaCO3	21-Nov-18	21-Nov-18
Sulphide	SM 4500SE - Colourimetric	26-Nov-18	26-Nov-18
Tannin/Lignin	SM 5550B - Colourimetric	21-Nov-18	21-Nov-18
Total Coliform	MOE E3407	20-Nov-18	20-Nov-18
Total Dissolved Solids	SM 2540C - gravimetric, filtration	21-Nov-18	22-Nov-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	21-Nov-18	21-Nov-18
Turbidity	SM 2130B - Turbidity meter	21-Nov-18	21-Nov-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 26-Nov-2018

Order Date: 20-Nov-2018

Project Description: 64819.03

	Client ID:	PW2	-	-	-
	Sample Date:	11/20/2018 11:47	-	-	-
	Sample ID:	1847208-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND	-	-	-
Fecal Coliforms	1 CFU/100 mL	ND	-	-	-
Total Coliforms	1 CFU/100 mL	1	-	-	-
Heterotrophic Plate Count	10 CFU/mL	<10	-	-	-
General Inorganics					
Alkalinity, total	5 mg/L	234	-	-	-
Ammonia as N	0.01 mg/L	0.03	-	-	-
Dissolved Organic Carbon	0.5 mg/L	2.9	-	-	-
Colour	2 TCU	<2	-	-	-
Conductivity	5 uS/cm	661	-	-	-
Hardness	mg/L	270	-	-	-
pH	0.1 pH Units	7.7	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	374	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	<0.1	-	-	-
Turbidity	0.1 NTU	0.1	-	-	-
Anions					
Chloride	1 mg/L	43	-	-	-
Fluoride	0.1 mg/L	0.1	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	78	-	-	-
Metals					
Calcium	0.1 mg/L	76.6	-	-	-
Iron	0.1 mg/L	<0.1	-	-	-
Magnesium	0.2 mg/L	19.1	-	-	-
Manganese	0.005 mg/L	0.010	-	-	-
Potassium	0.1 mg/L	3.4	-	-	-
Sodium	0.2 mg/L	13.5	-	-	-

Certificate of Analysis
Client: GEMTEC Consulting Engineers and Scientists Limited
Client PO:

Report Date: 26-Nov-2018
Order Date: 20-Nov-2018
Project Description: 64819.03

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Calcium	ND	0.1	mg/L						
Iron	ND	0.1	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Sodium	ND	0.2	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	47.1	1	mg/L	47.2			0.2	10	
Fluoride	ND	0.1	mg/L	ND				10	
Nitrate as N	0.75	0.1	mg/L	0.75			0.2	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	6.67	1	mg/L	6.72			0.7	10	
General Inorganics									
Alkalinity, total	46.1	5	mg/L	42.9			7.2	14	
Ammonia as N	1.29	0.04	mg/L	1.31			1.5	17.7	
Dissolved Organic Carbon	1.5	0.5	mg/L	2.9			66.4	37	QR-01
Colour	ND	2	TCU	ND			0.0	12	
Conductivity	265	5	uS/cm	255			3.9	11	
pH	6.4	0.1	pH Units	6.4			0.2	10	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	140	10	mg/L	140			0.0	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.36	0.1	mg/L	0.36			0.1	10	
Turbidity	0.1	0.1	NTU	0.1			0.0	10	
Metals									
Calcium	20.3	0.1	mg/L	19.9			2.0	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Magnesium	2.0	0.2	mg/L	2.0			0.0	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Potassium	1.3	0.1	mg/L	1.3			0.3	20	
Sodium	18.5	0.2	mg/L	18.5			0.2	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	1			0.0	30	
Heterotrophic Plate Count	ND	10	CFU/mL	ND				30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	55.3	1	mg/L	47.2	81.4	78-112			
Fluoride	1.06	0.1	mg/L	ND	106	73-113			
Nitrate as N	1.70	0.1	mg/L	0.75	95.3	81-112			
Nitrite as N	0.974	0.05	mg/L	ND	97.4	76-107			
Sulphate	17.7	1	mg/L	6.72	110	75-111			
General Inorganics									
Ammonia as N	0.240	0.01	mg/L		96.2	81-124			
Dissolved Organic Carbon	11.1	0.5	mg/L	2.9	81.8	60-133			
Phenolics	ND	0.001	mg/L	ND		69-132			
Total Dissolved Solids	94.0	10	mg/L		94.0	75-125			
Sulphide	0.51	0.02	mg/L	ND	103	79-115			
Tannin & Lignin	1.1	0.1	mg/L	ND	105	71-113			
Total Kjeldahl Nitrogen	2.52	0.1	mg/L	0.36	108	81-126			
Metals									
Calcium	20600		ug/L	19900	67.5	80-120			QM-07
Iron	904		ug/L	10.2	89.4	80-120			
Magnesium	2780		ug/L	2030	75.1	80-120			QM-07
Manganese	51.1		ug/L	3.33	95.5	80-120			
Potassium	2030		ug/L	1260	77.0	80-120			QM-07
Sodium	850		ug/L		85.0	80-120			

Qualifier Notes:

Sample Qualifiers :

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-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

PARACEL LABORATORIES LTD.
TRUSTED. RESPONSIVE. RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Nicole Soucy

Client PO:
Project: 64819.03
Custody: 8335

Report Date: 14-Nov-2018
Order Date: 8-Nov-2018

Order #: 1845594

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

Paracel ID	Client ID
1845594-01	PW1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 14-Nov-2018

Order Date: 8-Nov-2018

Project Description: 64819.03

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	12-Nov-18	12-Nov-18
Ammonia, as N	EPA 351.2 - Auto Colour	12-Nov-18	12-Nov-18
Anions	EPA 300.1 - IC	12-Nov-18	12-Nov-18
Colour	SM2120 - Spectrophotometric	9-Nov-18	9-Nov-18
Conductivity	EPA 9050A- probe @25 °C	12-Nov-18	12-Nov-18
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	12-Nov-18	12-Nov-18
E. coli	MOE E3407	9-Nov-18	10-Nov-18
Fecal Coliform	SM 9222D	9-Nov-18	10-Nov-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	14-Nov-18	14-Nov-18
pH	EPA 150.1 - pH probe @25 °C	12-Nov-18	12-Nov-18
Phenolics	EPA 420.2 - Auto Colour, 4AAP	12-Nov-18	12-Nov-18
Subdivision Package	Hardness as CaCO3	14-Nov-18	14-Nov-18
Sulphide	SM 4500SE - Colourimetric	13-Nov-18	13-Nov-18
Tannin/Lignin	SM 5550B - Colourimetric	12-Nov-18	12-Nov-18
Total Coliform	MOE E3407	9-Nov-18	10-Nov-18
Total Dissolved Solids	SM 2540C - gravimetric, filtration	12-Nov-18	13-Nov-18
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	12-Nov-18	12-Nov-18
Turbidity	SM 2130B - Turbidity meter	9-Nov-18	9-Nov-18

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 14-Nov-2018

Order Date: 8-Nov-2018

Project Description: 64819.03

	Client ID:	PW1	-	-	-
	Sample Date:	11/08/2018 15:00	-	-	-
	Sample ID:	1845594-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Microbiological Parameters					
E. coli	1 CFU/100 mL	ND	-	-	-
Fecal Coliforms	1 CFU/100 mL	ND	-	-	-
Total Coliforms	1 CFU/100 mL	ND	-	-	-
General Inorganics					
Alkalinity, total	5 mg/L	211	-	-	-
Ammonia as N	0.01 mg/L	0.05	-	-	-
Dissolved Organic Carbon	0.5 mg/L	3.9	-	-	-
Colour	2 TCU	<2	-	-	-
Conductivity	5 uS/cm	834	-	-	-
Hardness	mg/L	288	-	-	-
pH	0.1 pH Units	7.8	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	486	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	<0.1	-	-	-
Turbidity	0.1 NTU	0.6	-	-	-
Anions					
Chloride	1 mg/L	121	-	-	-
Fluoride	0.1 mg/L	0.2	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	66	-	-	-
Metals					
Calcium	0.1 mg/L	73.6	-	-	-
Iron	0.1 mg/L	<0.1	-	-	-
Magnesium	0.2 mg/L	25.2	-	-	-
Manganese	0.005 mg/L	0.007	-	-	-
Potassium	0.1 mg/L	6.3	-	-	-
Sodium	0.2 mg/L	51.2	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Calcium	ND	0.1	mg/L						
Iron	ND	0.1	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Sodium	ND	0.2	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	13.9	1	mg/L	14.8			6.2	10	
Fluoride	ND	0.1	mg/L	ND				10	
Nitrate as N	0.24	0.1	mg/L	0.23			3.8	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	4.25	1	mg/L	4.46			4.7	10	
General Inorganics									
Alkalinity, total	208	5	mg/L	211			1.3	14	
Ammonia as N	0.117	0.01	mg/L	0.120			3.1	17.7	
Dissolved Organic Carbon	0.8	0.5	mg/L	0.8			0.0	37	
Colour	ND	2	TCU	ND			0.0	12	
Conductivity	815	5	uS/cm	834			2.3	11	
pH	7.8	0.1	pH Units	7.8			0.3	10	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	172	10	mg/L	164			4.8	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.20	0.1	mg/L	0.15			31.2	10	QR-01
Turbidity	0.4	0.1	NTU	0.4			7.6	10	
Metals									
Calcium	73.5	0.1	mg/L	73.6			0.1	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Magnesium	25.2	0.2	mg/L	25.2			0.1	20	
Manganese	0.007	0.005	mg/L	0.007			1.7	20	
Potassium	6.2	0.1	mg/L	6.3			1.3	20	
Sodium	51.1	0.2	mg/L	51.2			0.2	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Fecal Coliforms	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	23.6	1	mg/L	14.8	87.4	78-112			
Fluoride	1.00	0.1	mg/L	ND	99.7	73-113			
Nitrate as N	1.29	0.1	mg/L	0.23	106	81-112			
Nitrite as N	0.901	0.05	mg/L	ND	90.1	76-117			
Sulphate	15.3	1	mg/L	4.46	108	75-111			
General Inorganics									
Ammonia as N	0.395	0.01	mg/L	0.120	110	81-124			
Dissolved Organic Carbon	10.2	0.5	mg/L	0.8	93.8	60-133			
Phenolics	0.020	0.001	mg/L	ND	79.1	69-132			
Total Dissolved Solids	98.0	10	mg/L		98.0	75-125			
Sulphide	0.46	0.02	mg/L	ND	91.2	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	95.7	71-113			
Total Kjeldahl Nitrogen	2.20	0.1	mg/L	0.15	102	81-126			
Metals									
Iron	999		ug/L	76.6	92.3	80-120			
Manganese	62.0		ug/L	6.68	111	80-120			
Potassium	7130		ug/L	6260	87.6	80-120			

Qualifier Notes:

Sample Qualifiers :

QC Qualifiers :

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

APPENDIX M

Water Balance Calculations

Water Balance - 3112 Carp Road

Pre-Development Conditions

Block	Land Use[1]	Water Holding Capacity (mm) [3]	Hard Surface Percentage	Area (m^2)	Water Surplus (mm/yr)[2]	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m^3/yr)	Runoff Volume (m^3/yr)
1	Pasture and Shrubs	150	0%	10000	342	0.19	0.3	0.1	0.59	0.41	202	140	2018	1402
2	Pasture and Shrubs	150 / 250	0%	10000	331	0.19	0.23	0.1	0.52	0.48	172	159	1721	1589
3	Pasture and Shrubs	250	0%	10000	320	0.19	0.15	0.1	0.44	0.56	141	179	1408	1792
4	Pasture and Shrubs	250	0%	20800	320	0.19	0.15	0.1	0.44	0.56	141	179	2929	3727
5	Pasture and Shrubs	250	0%	33000	320	0.19	0.15	0.1	0.44	0.56	141	179	4646	5914
6	Pasture and Shrubs	250	0%	12200	320	0.19	0.15	0.1	0.44	0.56	141	179	1718	2186
7	Pasture and Shrubs	250	0%	12000	320	0.19	0.15	0.1	0.44	0.56	141	179	1690	2150
8	Pasture and Shrubs	250	0%	12600	320	0.19	0.15	0.1	0.44	0.56	141	179	1774	2258
9	Pasture and Shrubs	150 / 250	0%	38300	331	0.19	0.23	0.1	0.52	0.48	172	159	6592	6085
10	Pasture and Shrubs	150	0%	9600	342	0.19	0.3	0.1	0.59	0.41	202	140	1937	1346
11	Pasture and Shrubs	250	0%	11400	320	0.19	0.15	0.1	0.44	0.56	141	179	1605	2043
12	Pasture and Shrubs	250	0%	11400	320	0.19	0.15	0.1	0.44	0.56	141	179	1605	2043
13	Pasture and Shrubs	150 / 250	0%	11500	331	0.19	0.23	0.1	0.52	0.48	172	159	1979	1827
14	Pasture and Shrubs	150	0%	14600	342	0.19	0.3	0.1	0.59	0.41	202	140	2946	2047
Street A	Pasture and Shrubs	150 / 250	0%	24700	331	0.19	0.3	0.1	0.59	0.41	195	136	4824	3352

Post-Development Conditions: Blocks 4, 5 and Street A

Block	Land Use[1]	Water Holding Capacity (mm) [3]	Hard Surface Percentage	Area (m^2)	Water Surplus (mm/yr)[2]	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m^3/yr)	Runoff Volume (m^3/yr)
4	SWMP - Urban Lawns	100	20%	20800	367	0.19	0.15	0.1	0.44	0.56	161	206	2687	4947
5	Pasture and Shrubs	250	0%	33000	320	0.19	0.15	0.1	0.44	0.56	141	179	4646	5914
Street A	Road and ROW - Urban Lawns	75 / 100	50%	24700	375	0.19	0.3	0.1	0.59	0.41	221	154	2732	6530

Post-Development Conditions: Scenario 1 - 40% Hard Surface

Block	Land Use[1]	Water Holding Capacity (mm) [3]	Hard Surface Percentage	Area (m^2)	Water Surplus (mm/yr)[2]	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m^3/yr)	Runoff Volume (m^3/yr)
1	Urban Lawns	75	40%	10000	383	0.19	0.3	0.1	0.59	0.41	226	157	1356	2474
2	Urban Lawns	75 / 100	40%	10000	375	0.19	0.23	0.1	0.52	0.48	195	180	1170	2580
3	Urban Lawns	100	40%	10000	367	0.19	0.15	0.1	0.44	0.56	161	206	969	2701
6	Urban Lawns	100	40%	12200	367	0.19	0.15	0.1	0.44	0.56	161	206	1182	3295
7	Urban Lawns	100	40%	12000	367	0.19	0.15	0.1	0.44	0.56	161	206	1163	3241
8	Urban Lawns	100	40%	12600	367	0.19	0.15	0.1	0.44	0.56	161	206	1221	3403
9	Urban Lawns	75 / 100	40%	38300	375	0.19	0.23	0.1	0.52	0.48	195	180	4481	9881
10	Urban Lawns	75	40%	9600	383	0.19	0.3	0.1	0.59	0.41	226	157	1302	2375
11	Urban Lawns	100	40%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	1105	3079
12	Urban Lawns	100	40%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	1105	3079
13	Urban Lawns	75 / 100	40%	11500	375	0.19	0.23	0.1	0.52	0.48	195	180	1346	2967
14	Urban Lawns	75	40%	14600	383	0.19	0.3	0.1	0.59	0.41	226	157	1979	3612

Post-Development Conditions: Scenario 2 - 50% Hard Surface

Block	Land Use[1]	Water Holding Capacity (mm) [3]	Hard Surface Percentage	Area (m^2)	Water Surplus (mm/yr)[2]	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m^3/yr)	Runoff Volume (m^3/yr)
1	Urban Lawns	75	50%	10000	383	0.19	0.3	0.1	0.59	0.41	226	157	1130	2700
2	Urban Lawns	75 / 100	50%	10000	375	0.19	0.23	0.1	0.52	0.48	195	180	975	2775
3	Urban Lawns	100	50%	10000	367	0.19	0.15	0.1	0.44	0.56	161	206	807	2863
6	Urban Lawns	100	50%	12200	367	0.19	0.15	0.1	0.44	0.56	161	206	985	3492
7	Urban Lawns	100	50%	12000	367	0.19	0.15	0.1	0.44	0.56	161	206	969	3435
8	Urban Lawns	100	50%	12600	367	0.19	0.15	0.1	0.44	0.56	161	206	1017	3607
9	Urban Lawns	75 / 100	50%	38300	375	0.19	0.23	0.1	0.52	0.48	195	180	3734	10628
10	Urban Lawns	75	50%	9600	383	0.19	0.3	0.1	0.59	0.41	226	157	1085	2592
11	Urban Lawns	100	50%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	920	3263
12	Urban Lawns	100	50%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	920	3263
13	Urban Lawns	75 / 100	50%	11500	375	0.19	0.23	0.1	0.52	0.48	195	180	1121	3191
14	Urban Lawns	75	50%	14600	383	0.19	0.3	0.1	0.59	0.41	226	157	1650	3942

Post-Development Conditions: Scenario 3 - 60% Hard Surface

Block	Land Use[1]	Water Holding Capacity (mm) [3]	Hard Surface Percentage	Area (m^2)	Water Surplus (mm/yr)[2]	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m^3/yr)	Runoff Volume (m^3/yr)
1	Urban Lawns	75	60%	10000	383	0.19	0.3	0.1	0.59	0.41	226	157	904	2926
2	Urban Lawns	75 / 100	60%	10000	375	0.19	0.23	0.1	0.52	0.48	195	180	780	2970
3	Urban Lawns	100	60%	10000	367	0.19	0.15	0.1	0.44	0.56	161	206	646	3024
6	Urban Lawns	100	60%	12200	367	0.19	0.15	0.1	0.44	0.56	161	206	788	3689
7	Urban Lawns	100	60%	12000	367	0.19	0.15	0.1	0.44	0.56	161	206	775	3629
8	Urban Lawns	100	60%	12600	367	0.19	0.15	0.1	0.44	0.56	161	206	814	3810
9	Urban Lawns	75 / 100	60%	38300	375	0.19	0.23	0.1	0.52	0.48	195	180	2987	11375
10	Urban Lawns	75	60%	9600	383	0.19	0.3	0.1	0.59	0.41	226	157	868	2809
11	Urban Lawns	100	60%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	736	3447
12	Urban Lawns	100	60%	11400	367	0.19	0.15	0.1	0.44	0.56	161	206	736	3447
13	Urban Lawns	75 / 100	60%	11500	375	0.19	0.23	0.1	0.52	0.48	195	180	897	3416
14	Urban Lawns	75	60%	14600	383	0.19	0.3	0.1	0.59	0.41	226	157	1320	4272

Notes:
1. Table 3.1 MOE SWMP Planning and Design Manual (2003)
2. Surplus data from Environment Canada Water Budget Means for Carleton&Appleton 1985-2020.

GEMTEC
Consulting Engineers and Scientists

Water Balance Summary - 3112Carp Road

Lot	Pre-Development Infiltration Volume (m^3/yr)	Pre-Development Infiltration (mm/yr)	Post-Development Infiltration (Volume m^3/year)							
			Hard Surface[1,2,3]	Water Blance Target (mm/year)[(4)]	40% Hard Surface	40% Water Balance Target (mm/year)[(4)]	50% Hard Surface	50% Water Balance Target (mm/year)[(4)]	60% Hard Surface	60% Water Balance Target (mm/year)[(4)]
1	2018	202	-	-	1356	60	1130	98	904	135
2	1721	172	-	-	1170	49	975	81	780	114
3	1408	141	-	-	969	38	807	65	646	92
4	2929	141	2732[(1)]	-12	-	-	-	-	-	-
5	4646	141	4646[(2)]	0	-	-	-	-	-	-
6	1718	141	-	-	1182	38	985	65	788	92
7	1690	141	-	-	1163	38	969	65	775	92
8	1774	141	-	-	1221	38	1017	65	814	92
9	6592	172	-	-	4481	49	3734	81	2987	114
10	1937	202	-	-	1302	60	1085	98	868	135
11	1605	141	-	-	1105	38	920	65	736	92
12	1605	141	-	-	1105	38	920	65	736	92
13	1979	172	-	-	1346	49	1121	81	897	114
14	2946	202	-	-	1979	60	2732	98	1320	135
Street A	4824	195	2779[(3)]	92	-	-	-	-	-	-

Notes:

1. Block 4 SWMP assumes 20% hard surface coverage for future access roads.
2. Block 5 assumes 0% hard surface
3. Street A assumes 50% hard surfaced area (12.5m of the 25m right of way)
4. Water balance targets assume 85% of groundwater recharge (pre-to-post development) is maintained.

Water Balance Summary - 3112 Carp Road

Lot	Pre-Development Infiltration Volume (m^3/yr)	Reduction in Infiltration (Volume / %)			
		Post-Development (Hard Surface[1])	Post-Development 40% Hard Surface	Post-Development 50% Hard Surface	Post-Development 60% Hard Surface
1	2052	-	34%	45%	56%
2	1754	-	33%	44%	56%
3	1440	-	33%	44%	55%
4	2995	8%	-	-	-
5	4752	0%	-	-	-
6	1757	-	33%	44%	55%
7	1728	-	33%	44%	55%
8	1814	-	33%	44%	55%
9	6719	-	33%	44%	56%
10	1970	-	34%	45%	56%
11	1642	-	33%	44%	55%
12	1642	-	33%	44%	55%
13	2017	-	33%	44%	56%
14	2996	-	34%	45%	56%
Street A	4905	43%	-	-	-

Notes.

1. Lot 4 hard surface 20%, lot 5 hard surface 0% and Street A hard surface 50%.

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...150 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 90 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	35	58	147	297
28- 2	-8.1	52	15	26	1	1	0	38	68	149	349
31- 3	-2.2	61	29	77	7	7	0	97	24	150	410
30- 4	6.0	78	73	29	32	32	0	70	0	149	489
31- 5	13.3	77	77	0	82	82	0	14	0	131	566
30- 6	18.1	94	94	0	115	114	-1	8	0	103	661
31- 7	20.7	94	94	0	134	125	-9	5	0	67	756
31- 8	19.5	89	89	0	116	101	-16	1	0	55	846
30- 9	15.2	85	85	0	77	71	-6	2	0	67	932
31-10	8.4	88	86	1	37	37	0	11	0	106	88
30-11	1.6	76	58	12	11	11	0	32	6	133	164
31-12	-5.7	69	26	16	2	2	0	29	34	144	233
AVE	6.4 TTL	928	743	184	615	584	-32	342			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	12	59
28- 2	2.6	22	16	25	1	1	0	33	42	6	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	8	3	14	0	44	110
31- 7	1.3	51	51	0	9	20	22	23	0	50	138
31- 8	1.1	42	42	0	7	20	23	2	0	53	141
30- 9	1.5	35	35	0	8	12	12	11	0	53	136
31-10	1.5	33	34	4	7	7	0	24	2	43	33
30-11	2.0	28	25	10	4	4	0	37	14	24	48
31-12	3.2	26	20	17	2	2	0	31	29	13	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...200 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE.....120 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	29	58	194	297
28- 2	-8.1	52	15	26	1	1	0	37	68	198	349
31- 3	-2.2	61	29	77	7	7	0	96	24	200	410
30- 4	6.0	78	73	29	32	32	0	70	0	199	489
31- 5	13.3	77	77	0	82	82	0	14	0	181	566
30- 6	18.1	94	94	0	115	115	0	8	0	152	661
31- 7	20.7	94	94	0	134	130	-4	5	0	111	756
31- 8	19.5	89	89	0	116	106	-10	1	0	93	846
30- 9	15.2	85	85	0	77	73	-4	2	0	103	932
31-10	8.4	88	86	1	37	37	0	11	0	142	88
30-11	1.6	76	58	12	11	11	0	30	6	171	164
31-12	-5.7	69	26	16	2	2	0	24	34	186	233
AVE	6.4 TTL	928	743	184	615	597	-18	327			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	37	36	18	59
28- 2	2.6	22	16	25	1	1	0	32	42	11	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	8	0	14	0	46	110
31- 7	1.3	51	51	0	9	10	10	23	0	59	138
31- 8	1.1	42	42	0	7	17	19	2	0	64	141
30- 9	1.5	35	35	0	8	9	9	11	0	64	136
31-10	1.5	33	34	4	7	7	0	24	2	55	33
30-11	2.0	28	25	10	4	4	0	36	14	36	48
31-12	3.2	26	20	17	2	2	0	32	29	22	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY... 75 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 45 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	39	58	74	297
28- 2	-8.1	52	15	26	1	1	0	39	68	75	349
31- 3	-2.2	61	29	77	7	7	0	98	24	75	410
30- 4	6.0	78	73	29	32	32	0	70	0	74	489
31- 5	13.3	77	77	0	82	82	0	14	0	56	566
30- 6	18.1	94	94	0	115	105	-10	8	0	37	661
31- 7	20.7	94	94	0	134	107	-27	5	0	19	756
31- 8	19.5	89	89	0	116	88	-28	1	0	19	846
30- 9	15.2	85	85	0	77	70	-7	5	0	30	932
31-10	8.4	88	86	1	37	37	0	20	0	60	88
30-11	1.6	76	58	12	11	11	0	46	6	73	164
31-12	-5.7	69	26	16	2	2	0	38	34	74	233
AVE	6.4 TTL	928	743	184	615	543	-72	383			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	5	59
28- 2	2.6	22	16	25	1	1	0	32	42	0	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	10	1	22	0	25	101
30- 6	1.2	39	39	0	8	18	19	14	0	31	110
31- 7	1.3	51	51	0	9	32	35	23	0	26	138
31- 8	1.1	42	42	0	7	28	30	2	0	28	141
30- 9	1.5	35	35	0	8	13	14	14	0	30	136
31-10	1.5	33	34	4	7	7	0	27	2	19	33
30-11	2.0	28	25	10	4	4	0	31	14	7	48
31-12	3.2	26	20	17	2	2	0	28	29	3	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...100 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 60 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	38	58	99	297
28- 2	-8.1	52	15	26	1	1	0	39	68	100	349
31- 3	-2.2	61	29	77	7	7	0	98	24	100	410
30- 4	6.0	78	73	29	32	32	0	70	0	99	489
31- 5	13.3	77	77	0	82	82	0	14	0	81	566
30- 6	18.1	94	94	0	115	110	-5	8	0	57	661
31- 7	20.7	94	94	0	134	114	-20	5	0	32	756
31- 8	19.5	89	89	0	116	92	-24	1	0	28	846
30- 9	15.2	85	85	0	77	70	-7	3	0	41	932
31-10	8.4	88	86	1	37	37	0	16	0	75	88
30-11	1.6	76	58	12	11	11	0	38	6	96	164
31-12	-5.7	69	26	16	2	2	0	37	34	99	233
AVE	6.4 TTL	928	743	184	615	559	-56	367			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	7	59
28- 2	2.6	22	16	25	1	1	0	33	42	0	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	12	12	14	0	38	110
31- 7	1.3	51	51	0	9	30	33	23	0	35	138
31- 8	1.1	42	42	0	7	26	29	2	0	38	141
30- 9	1.5	35	35	0	8	13	14	12	0	39	136
31-10	1.5	33	34	4	7	7	0	27	2	28	33
30-11	2.0	28	25	10	4	4	0	35	14	12	48
31-12	3.2	26	20	17	2	2	0	30	29	5	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...125 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE..... 75 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	37	58	123	297
28- 2	-8.1	52	15	26	1	1	0	39	68	125	349
31- 3	-2.2	61	29	77	7	7	0	98	24	125	410
30- 4	6.0	78	73	29	32	32	0	70	0	124	489
31- 5	13.3	77	77	0	82	82	0	14	0	106	566
30- 6	18.1	94	94	0	115	113	-2	8	0	79	661
31- 7	20.7	94	94	0	134	120	-14	5	0	48	756
31- 8	19.5	89	89	0	116	96	-20	1	0	40	846
30- 9	15.2	85	85	0	77	70	-7	2	0	52	932
31-10	8.4	88	86	1	37	37	0	13	0	90	88
30-11	1.6	76	58	12	11	11	0	34	6	115	164
31-12	-5.7	69	26	16	2	2	0	33	34	122	233
AVE	6.4 TTL	928	743	184	615	572	-43	354			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	39	36	9	59
28- 2	2.6	22	16	25	1	1	0	33	42	3	65
31- 3	2.4	26	18	34	5	5	0	36	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	9	6	14	0	42	110
31- 7	1.3	51	51	0	9	26	29	23	0	44	138
31- 8	1.1	42	42	0	7	23	25	2	0	46	141
30- 9	1.5	35	35	0	8	13	14	11	0	46	136
31-10	1.5	33	34	4	7	7	0	25	2	36	33
30-11	2.0	28	25	10	4	4	0	37	14	18	48
31-12	3.2	26	20	17	2	2	0	30	29	9	53

CarletonPlace+Appleton WATER BUDGET MEANS FOR THE PERIOD 1985-2020 DC20492

LAT.... 45.18 WATER HOLDING CAPACITY...250 MM HEAT INDEX... 36.83
LONG... 76.12 LOWER ZONE.....150 MM A..... 1.082

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-9.4	64	17	23	1	1	0	26	58	240	297
28- 2	-8.1	52	15	26	1	1	0	34	68	247	349
31- 3	-2.2	61	29	77	7	7	0	95	24	250	410
30- 4	6.0	78	73	29	32	32	0	70	0	249	489
31- 5	13.3	77	77	0	82	82	0	14	0	231	566
30- 6	18.1	94	94	0	115	115	0	8	0	202	661
31- 7	20.7	94	94	0	134	133	-2	5	0	159	756
31- 8	19.5	89	89	0	116	110	-6	1	0	136	846
30- 9	15.2	85	85	0	77	74	-3	2	0	145	932
31-10	8.4	88	86	1	37	37	0	11	0	184	88
30-11	1.6	76	58	12	11	11	0	30	6	213	164
31-12	-5.7	69	26	16	2	2	0	24	34	229	233
AVE	6.4 TTL	928	743	184	615	605	-11	320			

CarletonPlace+Appleton STANDARD DEVIATIONS FOR THE PERIOD 1985-2020 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	3.0	28	20	22	1	1	0	36	36	23	59
28- 2	2.6	22	16	25	1	1	0	32	42	14	65
31- 3	2.4	26	18	34	5	5	0	37	46	0	72
30- 4	1.6	41	40	47	8	8	0	59	0	5	92
31- 5	1.6	37	37	0	11	11	0	22	0	26	101
30- 6	1.2	39	39	0	8	8	0	14	0	46	110
31- 7	1.3	51	51	0	9	8	4	23	0	63	138
31- 8	1.1	42	42	0	7	13	14	2	0	71	141
30- 9	1.5	35	35	0	8	8	6	11	0	72	136
31-10	1.5	33	34	4	7	7	0	24	2	63	33
30-11	2.0	28	25	10	4	4	0	36	14	45	48
31-12	3.2	26	20	17	2	2	0	32	29	29	53

Table 3.1: Hydrologic Cycle Component Values

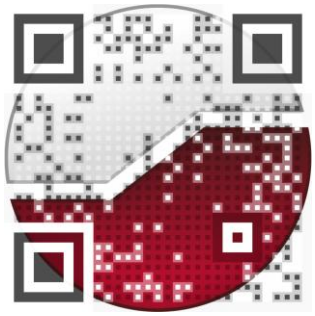
	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

* *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

experience • knowledge • integrity



civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité