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Hydrogeological Assessment & Terrain Analysis
Proposed Commercial/Industrial Subdivision
3119 Carp Road, Township of Huntley
Ottawa, Ontario

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Submitted to:

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1.0 INTRODUCTION

Gemtec Consulting Engineers and Scientists Limited (GEMTEC), formerly Houle Chevrier Engineering Ltd. (HCEL), was retained by Mr. Greg LeBlanc to conduct a hydrogeological investigation and terrain evaluation at the site of a proposed commercial/industrial subdivision located at 3119 Carp Road in Ottawa, Ontario.

1.1 Proposed Development Details

The proposed development (hereafter referred to as 'the subject site') will be comprised of a 14.20 hectare (35.09 acre) commercial/industrial subdivision located on Concession 3 in the Township of Huntley, at 3119 Carp Road (refer to Site Location Plan, Figure 1). The subject site is currently vacant and portions of it have been previously used for agricultural purposes.

The proposed commercial/industrial development will consist of a maximum of twelve (12) lots serviced with on-site septic disposal systems and water supply wells. The proposed lots will be serviced by an internal roadway system and are to have a minimum lot size of approximately 0.7 hectares (1.7 acres) with an average lot size of 1.0 hectares (2.5 acres). It is understood that if a prospective buyer has large space requirements, then they could purchase two (2) lots as a single large lot. The proposed lot layout, showing the maximum of twelve (12) lots, is shown on the Site Plan, Figure 2 and on the Private Servicing Plan prepared by Novatech Engineering Consultants Ltd. (see Appendix A).

1.2 Objectives

The objectives of this investigation are to demonstrate that:

- The terrain at the site is suitable to attenuate the effluent from on-site wastewater treatment systems such that down gradient land is not impacted in excess of provincial standards;
- The onsite groundwater available from test wells of specified construction will meet the Ontario Drinking Water Standards (ODWS) Standards, Objectives and Guidelines and/or provincial treatability limits for aesthetic/operational parameters;
- The quantity of onsite groundwater available from test wells of specified construction will be able to provide enough water for the proposed development use on an on-going basis and not interfere with the use of well water on adjacent properties; and,
- Demonstrate that the policies of the Carp Road Corridor Community Design Plan, the City of Ottawa Carp Road Corridor-Nitrate Impact Assessment Recommendations and the City of Ottawa zoning provisions are met.

Following a review of available background information and analysis of the results of the field investigation, conclusions and recommendations for the proposed development of the subject site are provided.

2.0 REVIEW OF BACKGROUND INFORMATION

2.1 Available Background Reports

A number of available background reports were reviewed as part of the revised investigation:

- "Mineral Aggregate Assessment, 3119 Carp Road, Ottawa, Ontario" prepared by Paterson Group Inc. and dated March 7, 2014 (Report: PH2450-REP.01). This report is referred to herein as the 'MAA Report'.
- "3119 Carp Road, West Carleton, Environmental Impact Statement and Tree Conservation Report" prepared by Muncaster Environmental Planning Inc. and dated July 18, 2013. This report is referred to herein as the "EIS Report".
- "3119 Carp Road Plan of Subdivision, Ottawa, Ontario, Servicing Options and Stormwater Management Report" prepared by Robinson Land Development and dated September 2014 (Project No: 13084). This report is referred to herein as the "SWM Report".
- "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 the "CDP Report".
- "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 the "Groundwater Study Report".
- "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 the "MVSPR Report".
- "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 the "ARIP 191 Report".
- "Carp Road Corridor – Nitrate Impact Assessment Recommendations" dated September 27, 2016.

2.1.1 Mineral Aggregate Assessment Report

The Mineral Aggregate Assessment (MAA) Report prepared by Paterson Group Inc. was reviewed for relevant information to the development of the subject site:

- The purpose of the MAA Study was to ascertain the quantity and quality of the aggregate materials present beneath the site.
- A review of Ontario Geologic Survey (OGS) mapping indicates that the site is underlain by coarse textured glaciofluvial deposits consisting of sand and silt. Surficial bedrock was noted in the mapping. The subject site is reported to overlay

the Verulam Formation of the Ottawa Group, a Middle Ordovician bedrock. The Verulam Formation is one of the youngest of the Ottawa Group of limestones and overlays the Bobcaygeon Formation. The Verulam Formation consists of interbedded bioclastic to very fine grained limestone and grey-green calcareous shale.

- Seven (7) test pits were advanced across the subject site on February 7, 2014 to supplement the existing subsurface information available from eighteen (18) test pits previously completed by Houle Chevrier Engineering Ltd. It is understood that draft test pit location maps, draft soil profile and data sheets, and draft overburden thickness interpretation maps by Houle Chevrier Engineering Ltd. were made available to Paterson Group by the property owner.

- The MAA report provides a discussion on the subsurface soil profile across the subject site:

- Topsoil was encountered at ground surface at all test hole locations generally ranging from between 0.05 to 0.3 metres;

- A transitional layer consisting of sand with varying amounts of silt is present beneath the topsoil layer across most of the subject site. This silty sand to sandy silt layer is underlain directly by shallow bedrock or by a fine to medium grained sand. The thickness of the transitional layer generally ranges from 0.6 to 1.3 metres in thickness. Grain size distribution testing carried out on this stratum did not meet OPSS Granular 'B' Type I aggregate gradation envelope.

- Below the transition layer of silty sand, resides a fine sand to medium grained sand. The stratum has a thickness of 1.0 to 2.7 metres. The fine to medium grained sand met OPSS Granular 'B' Type I aggregate gradation envelope requirements but was noted to be below the overburden groundwater table.

- Groundwater was encountered in four (4) of the seven (7) test pits and the remaining three (3) test pits encountered bedrock within 1.5 metres of ground surface.

- Bedrock surface observations noted that the visual characteristics of the bedrock surface were consistent with the Verulam Formation and published bedrock mapping. Where encountered, the bedrock was noted to be smooth and competent with no obvious signs of weathering.

- Sea shells were noted within the silty sand deposit in test pit 2.

- The conclusions of the MAA report state that:

- the portion of the subject site licensed for aggregate extraction was characterized by shallow bedrock and that the existing soil overlying the bedrock did not meet OPSS Granular 'B' Type I gradation requirements;

- the remaining aggregate outside the existing licensed area met OPSS Granular 'B' Type I gradation requirements but exists in extremely limited quantity. In addition, the overburden groundwater table was elevated throughout the central portion of the site and the usable material was noted to be below the water table; and,

- the maximum thickness of the potential aggregate deposit in this area is less than 3 metres.

It is noted that the MAA Report states that, based on a review of available Ontario Geological Survey (OGS) mapping, the subject site is underlain by coarse textured glaciofluvial deposits. However, based on an email from Paterson Group Inc. dated August 13, 2015, it was clarified that OGS surficial geology mapping indicates that the subject site is underlain by coarse textured glaciomarine deposits.

Copies of the seven (7) test pit logs advanced on the subject site by Paterson Group Inc. are provided in Appendix B. A site plan from the MAA Report indicating the locations of the test pits is also provided in Appendix B.

2.1.2 EIS and Tree Conservation Report

The EIS report prepared by Muncaster Environmental Planning Inc. was reviewed for relevant information pertaining to the development of the subject site:

- The site is a combination of cultural meadows and woodlands and young and intermediate-aged forests, with deciduous hedgerows adjacent to some of the fields.
- The topography of the site is generally level and well drained sandy soils dominate the area (Schut and Wilson, 1987).
- An existing access road connects Carp Road to the site and continues west through the site to the former extraction areas west of the site.
- No channels with potential aquatic habitat or wetland habitat were observed on or adjacent to the site outside of the former excavation areas to the west of the site.
- Based on available aerial photography mapping provided in the report, the pre-development site condition is approximately 50 percent tree covered.
- A recommended tree preservation plan is provided which identifies areas of the site where retention of existing trees is recommended, particularly on the western boundary of the subject site.

2.1.3 Storm Water Management Report

The SWM report prepared by Robinson Land Development was reviewed for relevant information pertaining to the development of the subject site. The SWM Report recommends the following measures for mitigating the post development storm water runoff from the roadways:

- Maintain pre-development drainage area boundaries as much as possible.
- Control post-development flow to meet pre-development levels.
- The excess stormwater for the 5-year and 100-year storm events for proposed roadways to be stored in the proposed road side ditches.

- Quality control measures for the roadway drainage to be provided by vegetation within the proposed roadside ditches.

- These recommendations would need to be addressed (with supporting calculations) as part of the detailed design work at the detailed design stage.

The SWM report indicates that the post development runoff is restricted to the pre-development design event for up to and including the 100 year design event. The SWM report provides a statement of opinion that that the increase in flows from the proposed roadways will contribute negligibly to the overall flow and therefore would not require any on-site quantity mitigating measures. However, if necessary (at the detailed design stage), the proposed roadway ditches can be designed with the following additions in order to achieve on-site runoff storage in the post development scenario:

- increased bottom width; and/or,

- reduced side slopes; and/or,

- rock check dams within the ditch itself.

The SWM report indicates that individual lots will need to provide on-site quantity control storage of stormwater up to and including the 100 year design event as per the current City of Ottawa Sewer Design Guidelines. The site plan process would ensure that each lot development follows this recommendation for their design.

The SWM report provides a statement of opinion that the stormwater generated by the proposed roadway achieves a sufficient quality by incorporating the following measures:

- vegetation within the ditches themselves; and,

- shallow slopes within the ditches (due to outlet and tributary drainage constraints) to promote infiltration through the soil.

2.1.4 Community Design Plan Report

The CDP report prepared by the City of Ottawa was reviewed for relevant information pertaining to the development of the subject site:

- 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 subject 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 of the CDP Report indicates that the subject 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 resource 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.

2.1.5 Groundwater Study Report

The Groundwater Study Report prepared by the Dillon Consulting Ltd. was reviewed for relevant information pertaining to the development of the subject site. The following recommendations were presented:

- 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 following information from the report is considered relevant to this investigation:

- The Groundwater Study Report was completed using information from the following resources:

- 1:50,000 scale overburden and bedrock geology maps by Geological Survey of Canada and 1:10,000 scale Ontario Base Maps from the Ministry of Natural Resources;

- MECP Water Well Records;

- Other previous studies (please refer to the Groundwater Study Report for specific sources); and,

- Geographic Information System (GIS) Database sources from: City of Ottawa, Renfrew County, Ministry of Northern Development. In addition, GIS data from a Regional Groundwater Study (Golder et al, 2003) was modified to a scale suitable for analysis (1:25,000).

    - The Surficial Geology & Aquifer Location (Figure 3) map of the Groundwater Study Report indicates that:

- The subject site has nearshore sediments of the Champlain Sea consisting of fine to medium sand.

- The lands immediately adjacent to the eastern boundary of the subject site have nearshore sediments of the Champlain Sea consisting of gravel and sand.

- The closest glaciofluvial deposits of sand and gravel to the subject site are mapped to the south of Richardson Side Road (which is greater than 3.5 kilometres from the closest boundary of the subject 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 (Figure 4) map of the Groundwater Study Report indicates that:

- The subject site is mapped as Paleozoic bedrock consisting of limestone and shale of the Verulam Formation.

- The closest MOE 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 (Figure 5) map of the Groundwater Study Report indicates that groundwater flow in the region of the site is expected to flow to the north (or to the northeast from the subject's site 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 (Figure 6) map of the Groundwater Study Report indicates that groundwater infiltration is high for the sand and gravel deposits of the subject 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 Recharge/Discharge Areas (Figure 7) map of the Groundwater Study Report indicates that the vertical groundwater gradient is subject site as being a recharge zone with the majority of the site identified as having a strong downward vertical groundwater gradient. The southeastern corner of the subject site is mapped as having a weak downward vertical groundwater gradient. 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 (Figure 8) map of the Groundwater Study Report indicates that the subject site (as is much of the Carp Road Development Corridor) is located in a high vulnerability aquifer 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.

2.1.6 Mississippi Valley Source Protection Region Report

The MVSPR Report prepared by Mississippi Valley Conservation and Rideau Valley Conservation Authority was reviewed for relevant information pertaining to the development of the subject site:

- Figure 5-1d (Mississippi-Rideau Source Protection Region - Highly Vulnerable Aquifers (HVA's) map indicates that the subject site is located 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 5-6c indicates that the closest corner of the subject site is located about 750 metres to the south of the outermost boundary of the Carp Wellhead Protection Area (Zone D: 25 year travel time). In addition, the closest corner of the subject site to the Carp Communal well is approximately 3 kilometres.

2.1.7 ARIP 191 Report

The ARIP 191 Report prepared by Ontario Geological Survey was reviewed for relevant information to the development of the subject site:

- The subject site is shown on Map 1 (Appendix B) as being located in a sand and gravel deposit of tertiary significance;

- The adjacent land to the southwest of the subject 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;

- The existing sand pit located about 900 metres southwest of the closest boundary of the subject site on the west side of William Mooney Road is completed in a glaciomarine plain deposit and is predominately a source of sand;

- The aggregate available from the existing and former sand pits to the southwest of the subject site is reported to have less than 5 percent gravel.

2.1.8 Carp Road Corridor Nitrate Impact Assessment Recommendations

The City of Ottawa memorandum entitled "Carp Road Corridor – Nitrate Impact Assessment Recommendations" dated September 27, 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 are able to 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.

2.2 Land Use

The subject site is currently vacant undeveloped land and portions of the site are/were previously used for agricultural purposes. There are currently three (3) bedrock test wells located on the subject site.

Land use in the vicinity of the site consists of vacant undeveloped land, agricultural land, rural residential land use, and commercial / light industrial (Carp Airport and gravel pits). Specific land uses near the subject site boundaries are documented in Table 2.1.

Table 2.1 - Summary of Land Use in Study Area

Subject Site Boundary	Existing Land Use
Southwest	• Combination of former gravel pits (now open water ponds) and undeveloped rural land along with some heavily treed areas; followed by, • An existing sand pit is located approximately 900 metres to the southwest of the site on the far side of William Mooney Road.
Northwest	• Access road to McGee Pit followed by Carp Airfields.
Northeast	• Cemetery, private residence and church followed by Carp Road. • Mixed land use, including rural residential, agricultural and commercial (e.g. general contractor, landscape supply company) along Carp Road.

Subject Site Boundary	Existing Land Use
Southeast	• Mixed land use, including: rural residential, commercial and agriculture land along Carp Road.

The impact on groundwater quality from existing and/or historical land use of the subject site and adjacent properties was addressed by conducting additional groundwater samples for laboratory analysis. Specific land uses addressed include the Carp Airport, the adjacent cemetery, general light industrial use along Carp Road, and historical and nearby aggregate extraction operations.

No land use was identified on and/or in the vicinity of the subject site which is expected to adversely impact the available quantity of groundwater for the proposed development.

2.3 Topography

Topographic mapping data which was provided to us indicates that elevations range from about 110 to 117 metres above sea level. Overall, the property is relatively flat with a regional slope downwards in a northeasterly direction towards the Carp River. The topographic high point of the property is the southwest corner of the property.

2.4 Drainage

There are no surface water features on the subject site, however, two ponds (former gravel pits) are located just west of the site. There is a possible swale (observed to be dry) centrally located on the western portion of the subject site.

Overall, the drainage of the subject site is assumed to be influenced by the natural topography of the site and is anticipated to be generally to the north towards the Carp River (or northeast from the subject site perspective). Roadside drainage ditches have been constructed along the northwest boundary of the site.

Ontario Base Mapping indicates that there are no wetland features on the subject site. This is consistent with field observations of the subject site.

2.5 Geology Mapping

Surficial, bedrock and karst geology maps available from OGSEarth geoscience program (Ontario Ministry of Northern Development and Mines) were reviewed for geological information to support the hydrogeological conceptual model.

The OGSEarth surficial geology map indicates that the overburden on the subject site is indicated to be coarse textured glaciomarine deposits composed of sand, gravel and minor amounts of silt and clay. The surficial geology of the northwest corner of the subject site is indicated to be

Paleozoic bedrock suggesting possible shallow bedrock conditions. It is noted that the Carp Road Development Corridor is primarily located within zones of coarse textured glaciomarine deposits and glacial till.

The OGSEarth surficial geology map indicates that the closest glaciofluvial deposit is located approximately 4.2 kilometres to the southeast of the subject site near the intersection of Carp Road and Highway 417. It is noted that the Carp Road Landfill and an existing limestone bedrock quarry are prominently situated within the mapped area of the glaciofluvial deposits.

The OGSEarth bedrock geology map is indicated to be Paleozoic bedrock consisting of limestone and shale from the Verulam Formation of the Simcoe Group.

The OGSEarth karst geology map indicates that the closest boundary of the subject site to any potential or inferred karst bedrock features is greater than 1.6 kilometres. The closest known karst bedrock feature is approximately 11 kilometres to the north of the subject site.

2.6 Ontario Ministry of Environment Water Well Records

The MECP Water Well Records for a 1.0 kilometre radius surrounding the centre of the subject site were obtained to determine the characteristics of existing private wells in the vicinity of the subject site. A total of sixty seven (67) well records were obtained and these records are provided in Appendix C along with a map showing the locations of well records in the vicinity of the subject site. Six (6) well records were for wells completed in the overburden; all of the remaining well records were for drilled wells completed in the bedrock.

Table 2.2 provides a summary of the well characteristics for the remaining sixty seven (67) water well records for depth to water found, static water levels, depth to bedrock and total well depth.

Table 2.2 - Summary of Water Well Records Search Results

Parameter	10th Percentile	90th Percentile	Average / Geometric Mean
Depth Water Found (m)	18.3	68.6	39.8 / 32.8
Static Water Level (m)	1.9	7.9	5.4 / 4.6
Depth to Bedrock (m)	1.2	35.3	10.8 / 5.5
Total Well Depth (m)	24.3	74.4	48.6 / 43.8

The MECP Water Well Records for a 1.0 kilometre radius around the subject site indicate that water in existing private wells was encountered at shallower depths compared to that of the onsite

test wells (i.e. geometric average of 32.8 metres below ground surface for the offsite private well records and geometric average of 53.5 metres below ground surface for the onsite test wells). This indicates that the majority of nearby private wells likely utilize more a shallow water bearing zone than the onsite test wells.

The MECP Water Well Records indicate that the existing private wells have shallower well completion depths than the onsite test wells (i.e. geometric average of 43.8 metres below ground surface for the offsite private well records and geometric average of 57.1 metres below ground surface for the onsite test wells). Again, this supports the assumption that nearby shallow wells utilize a shallower water bearing zone than the onsite test wells. This could be due to the longer well casing length (10 metres minimum) selected for the test wells at this site. Somewhat longer casings would cut off shallow aquifer zones.

The depth to bedrock in existing private wells is slightly less that the depth to bedrock of the onsite test wells (i.e. geometric average of 5.5 metres below ground surface for the offsite well records and geometric average of 7.2 metres below ground surface for the onsite test wells).

A review of the overburden material noted on the well logs was carried out to provide additional information on regional subsurface geology. The overburden material noted in the well logs ranges from sand and gravel deposits to deposits of grey silty clay and varies significantly from well log to well log. Well records were classified as having insufficient information to characterize overburden deposits, overburden deposits with some or all soils listed as low permeability (clays, silts, tills, and hardpan) and overburden deposits characterized as having relatively high permeability soils (sand and gravel) and/or shallow bedrock. The results of the enumeration indicates that 9 percent (6 of 67) well records contain insufficient information to characterize the overburden, 60 percent (40 of 67) well records reference one or more formations characterized as low permeability and 31 percent (21 of 67) well records were characterized as being completed in formations of relatively high permeability soils and/or shallow rock.

3.0 TERRAIN EVALUATION

3.1 Field Procedure

Test pits were advanced by HCEL from June 17 to 20, 2011. Eighteen (18) test pits, numbered 11-1 to 11-18, were advanced at the site. The field work was supervised throughout by a member of our engineering staff, who directed the excavating operations and logged the test pits. The locations of the test pits are shown on the Site Plan, Figure 2.

The test pits were advanced using an excavator to depths ranging from about 0.3 to 3.2 metres below ground surface. The subsurface conditions encountered in the test pits were identified by visual and tactile examination of the materials exposed on the sides and bottom of the test pits and from the excavated materials. Groundwater levels were measured in five (5) temporary piezometers installed in the test pits. The test pits were backfilled with the excavated materials

and tamped with the bucket of the excavator during backfilling. Soil and groundwater conditions encountered during test pitting are described in the Record of Test Pit sheets provided in Appendix D.

Selected samples of the overburden deposits were returned to our office for further testing. Grain size distribution testing was carried out on six (6) soil samples. The results of the grain size distribution testing are presented in Appendix D following the Records of Test Pit sheets.

A plan showing the interpreted overburden thickness is provided in the Interpreted Overburden Thickness Plan, Figure 3. Please note that the areas identified are approximate only and are based on the information collected from the test pits. Therefore, areas outside the locations of the test pits may differ in overburden thickness than indicated on Figure 3.

3.2 Soil and Groundwater Conditions

3.2.1 General

Soil and groundwater conditions encountered during test pitting are described in the Record of Test Pit sheets provided in Appendix D. The test pit logs indicate the subsurface conditions at the specific test pit locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and may have been interpreted. Subsurface conditions at other than the test pit locations may vary from the conditions encountered in the test pits. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgment and HCEL does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

An overview of the subsurface conditions, interpreted from the Records of Test Pits, is presented below.

3.2.2 Topsoil

Topsoil was encountered at ground surface in all of the eighteen (18) test pits. The topsoil consists of dark brown silty clay to silty sand with organic material. The topsoil ranges from about 0.1 to 0.2 metres in thickness and has an average thickness of about 0.1 metres.

3.2.3 Silty Clay to Silt

Deposits of silty clay to clayey silt with trace sand were encountered in test pits 11-1, 11-2, 11-4, 14, 11-15, 11-16, 11-17 and 11-18. The silty clay deposit was encountered underlying the topsoil in test pit 11-1 but was encountered overlain by a sand or silty sand deposit at the other test pit locations. Trace to some small gravel was encountered throughout the site

3.2.4 Silty Sand to Sand

Deposits of brown and grey sand (fine to coarse) and silty sand with some to trace clay and gravel were encountered in all of test pits except for test pits 11-1 and 11-7. The silty sand / sand deposits were encountered directly beneath the topsoil. The silty sand / sand deposits at test pit 4 was noted to contain clay seams and cobbles with increasing depth. At some test pit locations, the silty sand / sand deposits occur above and below the silty clay deposits. Trace sea shells were encountered within the silty sand deposits in seven (7) test pits across the subject site.

3.2.5 Bedrock

Six (6) the test pits were terminated either on inferred smooth surface bedrock (as determined by practical refusal of the excavator) and/or practical refusal on boulders. Observed bedrock conditions in the shallower test pits indicate that the surface of the bedrock was smooth and no obvious fractures were observed.

An interpreted overburden thickness plan (refer to Figure 3), was created based on the depth to bedrock/refusal encountered in the HCEL test pits, MAA Report test pits and the MECP Water Well Records for the onsite test wells. The interpreted overburden thickness map indicates that some localized areas of thin overburden (less than 0.5 metres to bedrock) are present across Lots 8 and 9 along the western boundary of the subject site. The overburden thickness increases to depths of more than 3 metres towards the central and eastern portions of the subject site.

Based on the MECP Water Well Records for test wells TW1 and TW2, the depth to bedrock across the eastern portion of the subject site ranges from about 11 to 14 metres below ground surface.

3.2.6 Groundwater Conditions

Groundwater was observed to enter all of the test pits at depths generally ranging from 1 to 2 metres below ground surface. Water levels were measured in five (5) shallow piezometers using an electronic water level meter on June 30, 2011. Water levels ranged from 0.37 to 2.05 metres below the ground surface, averaging 1.1 metres below the ground surface.

Since no significant overburden aquifer was encountered on the western portion of the subject site in the vicinity of Lots 8 and 9, it is our opinion that the bedrock surface is the receiving aquifer for septic system effluent on Lots 8 and 9. For the remainder of the subject site, the receiving aquifer for septic system effluent is the overburden aquifer. No significant amounts of groundwater were noted in the overburden during the test well drilling.

The flow of groundwater in the overburden is expected to be heavily influenced by the shallow bedrock topography on the western portion of the subject site. Groundwater flow direction estimates indicate that the groundwater flow is to the north refer to Groundwater Flow Direction Plan, Figure 4.

It should be noted that the groundwater levels could vary during wet periods of the year, after periods of heavy precipitation and snow melt or during the dry summer months. Groundwater flow directions may also change due to changing groundwater levels and/or development activities on and off the subject site.

Background nitrate concentrations in the overburden were measured in water samples collected from test pits 11-4, 11-12 and 11-5. The nitrate concentrations were 0.86, 0.28 and <0.10 mg/L respectively. The highest overburden nitrate concentration of 0.86 mg/L was measured in test pit 11-4, which is located in the easternmost corner of the subject site. Adjacent land use surrounding the easternmost corner of the subject site is all agricultural land. It is expected that the low nitrate concentration detected at this location is due to adjacent land use impacts. The source of the trace nitrate concentration measured in test pit 11-12 is possibly a result of historical use of the site as a cow pasture.

3.2.7 Grainsize and Hydrometer Testing

Soil samples from the terrain analysis were selected for grain size and hydrometer testing. The results of the grain size and hydrometer testing are presented following the Record of Test Pit sheets in Appendix E. The soil sample ID's, along with accompanying classification based on the results of the grain size and hydrometer testing, are summarized in Table 3.1:

Table 3.1 - Summary of Grain Size and Hydrometer Testing

Test Pit	Sample No.	Description
11-3	1	Sand, trace silt and some gravel
11-4	4	Silty sand, some clay
11-6	2	Sand, some silt
11-13	2	Sand, some silt, trace gravel
11-14	2	Sandy silt with clay
11-15	3	Silty clay and fine sand

4.0 HYDROGEOLOGICAL CONCEPTUAL MODEL

4.1 Background Information

Based on the results of the review of available background reports, MECP Water Well Records, land use observations and selected geology maps, the overburden geology on and around the subject site is characterized by glaciomarine sediments consisting of sand and gravel with minor amounts of silt and clay. The sediments are expected to range in thickness from less than 1 to more than 15 metres in depth, with the overburden thickness generally increasing from west to

east across the subject site. The bedrock geology is characterized by limestone and shale bedrock of the Verulam formation.

The technical hydrogeological review memorandum by the MVCA states that the background information for this area indicates that the subject site is underlain by a regionally extensive sand aquifer and that an esker is located very close to or on the site. The MVCA considers the gravel core and other coarser sandy material associated with an esker to be hydrogeologically sensitive material that should be protected from contamination and in which clean groundwater recharge should be maintained/enhanced. Based on a review of available background information, HCEL is unable to identify any information source indicating the presence of a gravel core and/or coarser sandy material associated with an esker.

4.2 Site Specific Geology

The western portion of the subject site is characterized by limestone and shale bedrock of the Verulam formation at depths from about 0.3 to 2.3 metres below ground surface. The shallow overburden soils on the western portion of the site are generally characterized by deposits of sand and silty sand with varying amounts of clay and gravel.

The central and eastern portions of the subject site are characterized by limestone and shale bedrock of the Verulam formation at depths from about 2 to more than 15 metres below ground surface. The overburden soils on the western portion of the site are generally characterized by deposits of sand and gravel, fine to medium sand and silty sand to sandy silt; all of which may contain varying amounts of clay and gravel.

Sea shells were noted to be present in six (6) of the test pits advanced on the central and eastern portions of the subject site as part of this investigation. One (1) of the test pits reported in the MAA Report by Paterson Group Inc. indicated the presence of sea shells. The presence of sea shells within the overburden soils is consistent with available background information which indicates that the site is characterized by glaciomarine deposits.

It is noted that the site-specific investigations encountered fine grained material such as silty sand and silty clay across portions of the subject site. The presence of finer grained materials on the subject site is somewhat consistent with available background information, which indicates minor amounts of silt and clay can be expected within coarse textured deposits. Some localized areas of fine and/or coarser grained materials may be encountered across portions of the subject site; however, based on the observed variability of the test pits and test wells completed on the subject site, these areas are not continuous and are not representative of the overall hydrogeological setting.

4.3 Hydrogeological Conceptual Model

The framework for the hydrogeological conceptual model was developed based on our analysis and interpretation of the available background information and the site-specific subsurface investigations carried out at the subject site. Due to the regional nature of the information available in background information sources, the site-specific subsurface investigation information was given a higher weight in characterizing the site geology.

The framework for the hydrogeological conceptual model for the subject site is summarized in Table 4.1.

Table 4.1 Framework of Hydrogeological Conceptual Model

Stratigraphic Unit	Generalized Composition	Thickness (m)
Western Overburden	• Topsoil; • Sand, silty sand and silt.	0.3 to 2.3
Central and Eastern Overburden	• Topsoil; • Sand, Sand and gravel, silty sand, sandy silt, all with varying amounts of clay, gravel and/or cobbles.	2 to 15
Bedrock	• Limestone and shale of the Verulam formation.	Unknown

It is our assessment that the hydrogeological conceptual model is consistent with available background information and the results of the field investigation on the subject site. A Hydrogeological Cross Section (refer to Figure 5) was prepared based on our interpretation of the above noted hydrogeological conceptual model. The alignment of the cross section (Section A-A') line is provided on the Site Plan in Figure 2.

Based on the reported depths to water found in the onsite test wells, the proposed water supply aquifer is between 25 and 75 metres below the surface of the bedrock.

5.0 GROUNDWATER IMPACT ASSESSMENT

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

5.1 Sewage Disposal Systems

It is understood that the use of advanced treatment technologies, capable of producing Level IV treatment, as provided in Section 8.6.2.2.(1) of the Ontario Building Code, as well as reducing the concentration of nitrate within the treated septic effluent, are being proposed for the development. Treated effluent meeting the above noted criteria may be dispersed to a number of types of Class IV leaching beds including conventional trench beds, filter media beds, Type A and B beds, and shallow buried trench beds. The selection of the type Class IV leaching bed will likely be determined based on available area, as some of the bed options require a smaller area than others and some have a lessened required vertical separation distance between the disposal bed and low permeability soils, bedrock, or the seasonally high groundwater table.

The City of Ottawa memorandum entitled “Carp Road Corridor – Nitrate Impact Assessment Recommendations” dated September 27, 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 assuming the use of advanced treatment technologies that are capable of achieving a 50% or greater reduction in nitrogen concentration in the treated effluent prior to disposal to the ground surface. In this case, the modified minimum concentration of nitrate used in the nitrate attenuation assessment can therefore 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 on the subject 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 the OBC requirements.

5.2 Background Nitrate Concentrations

The majority of the subject site is underlain by coarse grained soils, consisting of sand, silty sand, and sandy silt. Based on the test well logs, the maximum overburden thickness on the northeastern portion of the site is approximately 15 metres. The southern portion of the site is underlain by thin soils, 0.3 to 2.3 metres in thickness, underlain by limestone bedrock. The receiving aquifer is considered to be a combination of the overburden sands and limestone bedrock. The background nitrate concentrations in the overburden, based on water samples collected from shallow test pits and the limestone bedrock, are compiled in Tables 4.2 and 4.3 below.

Table 4.2 – Background Nitrate (Overburden)

	Nitrate Concentrations (mg/L)		
	TP11-4	TP11-12	TP11-15
June 2011	0.86 mg/L	0.28 mg/L	<0.10 mg/L
Average Background	0.41		

Table 4.3 - Background Nitrate (Bedrock)

	Nitrate Concentrations (mg/L)				
	TW1	TW2	TW3	PW1	PW2
June 2013 (P-Tests)	3hr: <0.1 6hr: <0.1	3hr: 2.78 6hr: <0.1	3hr: 0.67 6hr: 0.46	-	-
June 2013 (private well sampling)	-	-	-	<0.1	9.57
June 2015 (Supplemental Pumping)	-	1.7	-	-	-
Average Background	0.75[1]				

Notes: 1. Average background nitrate concentration does not include PW2. The private well is not considered to be technically representative.

It is noted that the level of nitrate in private well PW2 was elevated at a concentration of about 9.6 mg/L and close to the maximum acceptable concentration for nitrates provided in the ODWS. A water well record was not available for PW2 and the completion details (well casing, completion depth, overburden or bedrock well) are unknown. It is noted that the building serviced by this well was likely an old farmhouse and the well may have been installed without proper well construction and grouting methods. The well may be exhibiting impacts from the onsite septic system or adjacent agricultural land use due to its construction.

The shallow groundwater flow direction, based on test well and background mapping data, is generally to the north, which suggests that PW2 is cross gradient of the subject site. None of the

test wells on the subject site, the other private well, or overburden groundwater samples showed nitrate concentrations in this range and it is our opinion that the nitrate level in this private well is not representative of the receiving aquifer proposed for the subject site.

The nitrate concentrations in test wells TW2 and TW3 decreased throughout the pumping tests conducted in June 2013. Variable nitrate concentrations were observed in TW2, which decreased from 2.78 mg/L to <0.1 mg/L throughout the June 2013 pumping test and following supplemental pumping and sampling of TW2 in June 2015, the nitrate concentring was measured to be 1.7 mg/L. The variability in background nitrates may be related to past agricultural activities, current agricultural lands located adjacent to the site, septic system effluent from adjacent residential and commercial properties and/or due to seasonal variability.

Given the receiving aquifer is anticipated to be a combination of the overburden and bedrock aquifer, an estimate of the background nitrate concentrations on-site are calculated to be 0.75 mg/L (refer to Table 4.3).

5.3 Groundwater Impacts

The potential risk to groundwater resources on and off the subject site was assessed in accordance with Ministry of Environment Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment. To evaluate the groundwater impacts, the Three-Step Assessment Process outlining in MECP D-5-4 was followed.

Based on the minimum lot size of 0.81 hectares and the hydrogeologically sensitive terrain, the subject site does not meet Step 1 – lot size consideration or Step 2 – isolation of MECP D-5-4. Where it cannot be demonstrated that the effluent is hydrogeologically isolated from the water supply aquifer and the proposed lot sizes are less than 1.0 hectares, the risk of individual on-site septic systems will be assessed using nitrate-nitrogen contaminant loading. The predictive assessment for industrial/commercial developments (section 5.6.3 of D-5-4) only applies to developments which have an average daily flow of less than 4,500 litres per day. The maximum allowable concentration of nitrate in the groundwater at the boundaries of the subject property is 10 milligrams per litre as per the Ministry of the Environment and Climate Change's guideline D-5-4, dated August 1996.

The septic flow for the commercial lots is based on information provided in Guideline D-5-4, Section 5.6.3 and the Carp Road Corridor Nitrate Impact Assessment Recommendations memo dated September 27, 2016.

The nitrate concentration at the site boundaries was calculated using the following information:

- Commercial Lots 1-12 (refer to Private Servicing Plan in Appendix A).
- Ministry of the Environment, Conservation and Parks guideline D-5-4, dated August 1996. Section 5.6.3 of D-5-4 was implemented into our assessment;

- An allowance for 40 percent hard surface area on the commercial lots;
- An average background nitrate concentration of 0.75 mg/L;
- The hydrologic factors used to estimate infiltration, such as topography, soil and cover are based on the Ministry of Environment (MOE) Stormwater Management Planning and Design Manual Section 3.0 (MOE, 2003) and the Ministry of the Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (MOEE, 1995);
  - Topography: 0.2 (rolling land, average slope 2.8m to 3.8m/km).
  - Cover Factor: 0.1 (cultivated lands) and 0.2 (woodland).
  - Soil Factor: 0.1 (tight impervious clay), 0.2 (medium combo clay and loam), and 0.4 (open sandy loam).
- The water holding capacity (WHC) for soils is based on the Ministry of Environment (MOE) Stormwater Management Planning and Design Manual Section 3.0 (MOE, 2003);
  - Urban lawns/shallow rooted crops: fine sands (WHC 50mm), fine sandy loam (WHC 75mm), silt loam (WHC 125mm).
  - Pasture and shrubs: fine sandy loam (WHC 150 mm).
- An annual water surplus obtained from Environment Canada, Ottawa International Airport (1939-2013).
  - WHC 50 mm is 0.402 m/year, WHC 75 mm is 0.378 m/year, WHC 125mm is 0.341 m/year, WHC 150 mm is 0.328 mm/year and WHC of 300 mm is 0.328 mm/year.
  - Environment Canada datasheets provided in Appendix F.
- The use of advanced treatment technologies in the construction of the septic systems at each commercial lot, capable of reducing the concentration of nitrate in the treated effluent to 20 mg/L or less.

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 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 lot-specific hydrologic factors, soil water holding capacities and water surplus is compiled in Table F1 in Appendix F. Based on the site-specific terrain units and a maximum 40% hard surface area, the maximum septic flow for each commercial lot, using conventional septic systems (no

advanced treatment technologies) is provided in Table 5.1 below. The maximum septic flow, utilizing septic systems with advanced treatment technologies is provided in Table 5.2.

Table 5.1 - Allowable Sewage Flow per Commercial Lot (Conventional Septic Systems)

Block	Area (m^2)	Infiltration Factor	Precipitation Surplus (m^3/year)	Available Infiltration[1] (litres per day)	Maximum Septic Flow[2] (litres per day)
1	8089.6	0.70	3252	3742	1123
2	8090.9	0.50	2759	2268	680
3	8090.9	0.50	2759	2268	680
4	8165.4	0.60	3087	3044	913
5	8153.0	0.70	3277	3771	1131
6	8158.0	0.70	3280	3774	1132
7	8279.3	0.80	2716	3571	1071
8	8639.3	0.80	2834	3727	1118
9	8206.6	0.80	2692	3540	1062
10	21815.7	0.70	7156	8234	2470
11	15487.1	0.60	5854	5774	1732
12	13535.4	0.70	5441	6261	1878

1. Available infiltration based on 40% hard surface areas.
2. Maximum septic flow incorporates the average background nitrate concentration calculated to be 0.75 mg/L (refer to section 5.2).

Table 5.2 - Allowable Sewage Flow per Commercial Lot (Septic Systems with Advanced Treatment Technologies)

Block	Area (m^2)	Infiltration Factor	Precipitation Surplus (m^3/year)	Available Infiltration[1] (litres per day)	Maximum Septic Flow[2] (litres per day)
1	8089.6	0.70	3252	3742	3218
2	8090.9	0.50	2759	2268	1950
3	8090.9	0.50	2759	2268	1950
4	8165.4	0.60	3087	3044	2618
5	8153.0	0.70	3277	3771	3243
6	8158.0	0.70	3280	3774	3245
7	8279.3	0.80	2716	3571	3071
8	8639.3	0.80	2834	3727	3205
9	8206.6	0.80	2692	3540	3044
10	21815.7	0.70	7156	8234	7081
11	15487.1	0.60	5854	5774	4966
12	13535.4	0.70	5441	6261	5385

1. Available infiltration based on 40% hard surface areas.
2. Maximum septic flow incorporates the average background nitrate concentration calculated to be 0.75 mg/L (refer to section 5.2).

As part of the predictive assessment, the maximum number of users was calculated, based on the calculated maximum allowable septic flow. It is noted that the maximum septic flow is limited to 4,500 litres per day, as outlined in Procedure D-5-4 section 5.6.3. As per the Carp Road Corridor memorandum, the maximum number of users is calculated assuming 75 litres per person per day. The calculations and assumptions are provided in Table F1, Appendix F.

The findings presented in this report are based on the assumption that the proposed Daily Design Sanitary Sewage Flow (DDSSF) will be produced 7 days a week. Dependant on the nature of the business that may occupy the lots, it may be possible to increase the allowable DDSSF if, for example, if a business was to operate on 5 days of a typical week and a balancing of the dispersal of effluent were to be applied over 7 days.

If, during the site plan approval process, 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 based on the development proposal. If the proposed septic system design flow exceeds 4,500 litres per day, supplemental investigation will be required in accordance with MOEE Guideline B-7 guidelines for large subsurface sewage disposal systems. The impact assessment should take into account the soil conditions, topography, vegetation cover, impermeable areas, stormwater management design and best management practices, etc. This may include additional subsurface investigation activities, site specific infiltration tests, additional grain size distribution testing, etc. If the site-specific lot conditions and site plan design demonstrate that additional septic flow can be accommodated on a lot by way of a detailed groundwater impact assessment, then the preliminary septic flow recommendation for that lot should be amended accordingly.

6.0 GROUNDWATER QUALITY ASSESSMENT

A groundwater supply investigation was carried out in accordance with the MECP August 1996 document “Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment”, to determine the quantity and quality of groundwater available for water supply. The results of the groundwater supply investigation are summarized in the following sections.

6.1 Test Well Construction

The MECP Procedure D-5-5 document indicates that a minimum of three (3) test wells are required for sites up to 15 hectares. Three (3) new test wells (Test Wells TW1 to TW3) were drilled by Saunders Well Drilling under Well Contractor License No. 4879. The wells were completed between June 5 and 13, 2013. Copies of the MECP Water Well Records and the Certificates of Well Compliance (Well Grouting Inspections) are provided in Appendix G.

The locations of the test wells are shown on Figure 2. The locations of the new test wells were chosen to provide maximum coverage of the site. The geographical references for the test wells are provided in the respective MECP Water Well Records.

Well grouting inspections were carried out by HCEL staff during the sealing of the well casings in the test wells. HCEL staff were not present for the remainder of the drilling of test wells. The test wells were constructed using a nominal 159 millimetre inside diameter steel casing. Based on the well records provided by the well driller, all of the test wells were completed with steel well

casings installed a minimum of 10.7 metres (34 feet) below the ground surface. The construction details of the test wells are summarized in Table 6.1.

Table 6.1 - Summary of Test Well Construction Details

Test Well	Depth to Bedrock (m BGS)	Depth of Well Casing (m BGS)	Depth Water Found (m BGS)	Total Well Depth (m BGS)
TW1	14.8	16.3	42.7	48.8
TW2	11.0	12.5	44.8	48.5
TW3	2.3	10.7	48.8 / 70.1	78.6

It should be noted that efforts were made to limit the total well depth to less than 61 metres (200 feet) due to concerns with highly mineralized water at deep depths in the area. Test well TW1 was hydrofractured by the well driller to increase the well yield for the purposes of the hydrogeological investigation. Test well TW2 did not require any activity to increase the flow rate of the well. Test well TW3 was initially completed to a depth of approximately 50 metres and hydrofractured; however, the well driller determined that the well yield was insufficient for inclusion in the hydrogeological investigation. The test well was subsequently deepened to 78.6 metres below ground surface and the lower portion (newly drilled/deepened section) was also hydrofractured to obtain the necessary well yield for the hydrogeological investigation.

6.2 Pumping Tests Field Procedure

The pumping tests for the onsite test wells were conducted between June 18 and 20, 2013. A six (6) hour duration constant discharge rate pumping test was conducted in each test well. 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. Due to the test well casings being sealed a minimum of 1.5 metres into bedrock, this is considered to be sufficient to ensure that artificial recharge of the test well does not occur.

Additional pumping was carried out on test wells TW1 and TW2 on August 19, 2013 and July 22, 2013, respectively, to collect additional water samples due to bacteriological exceedances of the ODWS.

Test wells TW1 and TW2 were subjected to further testing and pumping on June 1 and 2, 2015, respectively. Both test wells were pumped for greater than six (6) hours at a flow rate of approximately 20 litres per minute and water samples were collected at the end of the pumping.

6.2.1 Water Level Measurements

During the pumping tests, water level measurements were taken at regular intervals in the well being pumped using an electric water level tape. After the pump was shut off, water level data were collected until a minimum of 90 percent of the drawdown in water level had recovered in the test wells TW1 and TW2. During the recovery of well TW3 the water level tape got stuck around the pump TW3 and only 61 percent of the recovered was captured for that well; however, the well was later confirmed to have recovered to 99 percent by 8:00 am the following day (when the pump was removed and the water level meter retrieved). For the supplemental pumping of test wells TW1 and TW2 in June of 2015, recovery of the test wells ranged from 98 to 100 percent by 1 hour after pumping was completed.

The water level measurements for the drawdown and recovery data for the pumping tests are provided in Appendix H. The drawdown data contained in Appendix H were measured with reference to the top of the well casings.

Water level measurements were also taken from other onsite test wells (observation wells) during the pumping of each test well to determine potential interference effects between the test wells. Water level measurements taken in the observation wells are provided in Appendix I.

6.2.2 Flow Rate Measurements

The flow rate of the pump discharge hose was measured at regular intervals throughout the pumping test to ensure that the flow rate of the pumping test was maintained at a constant flow rate. The discharge nozzle of the pump hose was outfitted with a critical flow nozzle which ensures that the flow rate of the pump is restricted to the critical flow nozzle calibration rate. A summary of the flow rates from the initial pumping tests conducted in 2013 is provided in Table 6.2:

Table 6.2 - Pump Test Flow Rates - June 2013

Time (min)	Flow Rate (Litres per Minute)		
	TW1	TW2	TW3
5	19	30	23
30	19	30	23
60	19	30	23
120	-	30	-

Time (min)	Flow Rate (Litres per Minute)		
	TW1	TW2	TW3
180	19	30	-
240	19	30	-
300	19	30	23
360	19	30	-

Additional pumping was carried out in June of 2015 for test wells TW1 and TW2. The flow rates were determined by the licensed well driller contracted to carry out the additional pumping. The well driller reported to us that a constant flow rate of about 19 litres per minute was maintained throughout the pumping.

Please note that the discharge rate on the drawdown data and graph sheets for the pumping tests are listed as variable because the recovery period, where the discharge rate is zero, is included in the same data set as the drawdown data. However, the actual discharge rate during the pumping of the test wells was at a constant rate.

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 Table 1 in Appendix J. The field equipment used during the pumping test is calibrated monthly by HCEL and the details of field equipment are provided in Table 6.3:

Table 6.3 - Field Equipment Overview

Field Parameters	Manufacturer	Model No.
Total Chlorine	Hach	CN-60
pH, temperature, TDS and Conductivity	Hanna	HI 98129

Field Parameters	Manufacturer	Model No.
Turbidity	Hanna	HI 98703

Groundwater 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. The groundwater samples were subsequently submitted to Exova Canada Inc. (Exova) in Ottawa, Ontario for chemical, physical and bacteriological analyses as listed in the MECP guideline titled “Technical Guideline for Private Wells: Water Supply Assessment”, dated August 1996 and other supplemental parameters, as required.

Laboratory samples collected in 2015 were submitted to Paracel Laboratories Ltd. Groundwater samples were collected in laboratory supplied bottles and prepared/preserved in the field using in accordance with the industry standard sampling, handling and preservation procedures required by the laboratory.

The analytical laboratory analysis carried out on the groundwater samples is summarized in Table 6.4:

Table 6.4 - Summary of Laboratory Analysis Samples

Test Well	Date	Laboratory Analysis Parameters
TW1	June 18, 2013	• Subdivision Package (3 hour) • Subdivision Package (6 hour)
	July 22, 2013	• Bacti-5 Retest 1 • Bacti-5 Retest 2
	June 1, 2015	• General Inorganics • Petroleum Hydrocarbons F1 to F4 • Glycol • Volatile Organic Compounds • Metals including mercury
TW2	June 19, 2013	• Subdivision Package (3 hour) • Subdivision Package (6 hour)
	August 19, 2013	• Bacti-5 Retest 1 • Bacti-5 Retest 2 • Turbidity
	June 2, 2015	• General Inorganics • Petroleum Hydrocarbons F1 to F4 • Glycol • Volatile Organic Compounds • Metals including mercury
TW3	June 20, 2013	• Subdivision Package (3 hour) • Subdivision Package (6 hour) • Herbicides and Pesticides (6 hour) • Petroleum Hydrocarbons F1 to F4 (6 hour) • Volatile Organic Compounds (6 hour)

The results of the laboratory analyses are summarized in Table 2 in Appendix J. The laboratory Certificates of Analysis for the test well sample results are provided in Appendix K. The results the supplemental testing carried out on test wells are provided in Tables 3A to 3C in Appendix J. The laboratory Certificate of Analysis for the supplementary sampling is provided in Appendix L.

6.2.4 Chlorination and Retesting

Chlorination and retesting of test wells TW1 and TW2 was carried out between August 19, 2013 and June 19, 2013, to address low levels of total coliform bacteria encountered in samples obtained during the initial pumping tests.

The water wells were chlorinated and pumped by licensed well technicians from Saunders Well Drilling (Well Contractor License No. 4879) for approximately six (6) hours. Upon confirmation from Saunders Drilling that the well had been chlorinated and had been continuously pumped throughout the day, HCEL staff sampled the pump discharge water.

Field testing of total chlorine at the time of retesting was carried out prior to water sample collection to confirm the absence of chlorine at the time of bacteriological sampling (refer to Tables 4A and 4B). The total chlorine sampling procedure to document the absence of chlorine in the discharge water is:

- Upon arrival, the discharge water from the pump is observed and the absence of chlorine odour is confirmed;
- The discharge water is tested for total chlorine. If chlorine is detected, then Air Rock is informed to continue pumping and HCEL staff leaves the site.
- If no total chlorine is detected, then the test well is allowed to pump for another fifteen (15) minutes.
- The discharge water is tested a second time for total chlorine. If chlorine is detected, then Air Rock is informed to continue pumping and HCEL staff leaves the site.
- If no total chlorine is detected, then the first bacteriological retest sample is collected and the test well is allowed to pump for another fifteen minutes.
- The discharge water is tested for a third time for total chlorine. If chlorine is detected, then Air Rock is informed to continue pumping, HCEL staff leaves the site and the first bacteriological retest sample is discarded.
- If no total chlorine is detected, then the second bacteriological retest sample is collected and the pump is shut off.

The groundwater retest 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. The groundwater samples were subsequently submitted to Exova laboratory in Ottawa, Ontario. The results of the retesting laboratory analysis are summarized in Tables 4A and 4B in Appendix J for test wells TW1 and TW2, respectively. The laboratory Certificates of Analysis for the resting test well samples are provided Appendix L.

The results of the re-sampling of test well TW1 indicated that total coliform bacteria concentrations had been reduced to 0 ct/100 mL in both of the retest samples. In addition, the concentrations of E. coli., faecal streptococcus and faecal coliform bacteria were non-detectable.

Low concentrations of Heterotrophic Plate Count (HPC) bacteria and a single isolated faecal streptococcus bacteria were detected in the first retest sample of test well TW3; however, both types of bacteria were determined to be non-detectable in the second retest sample for TW3. The occurrence of the single isolated faecal streptococcus bacteria in one sample is not considered to be representative of the water supply aquifer and does not exceed any health related limits of the ODWS.

6.3 Test Well Water Quality

The results of the chemical, physical and bacteriological analyses on the water samples from the test wells is provided in Appendices K and L and summarized in Tables 2, 3A, 3B, 3C, 4A and 4B in Appendix J.

6.3.1 Maximum Acceptable Concentration Exceedances

The proposed water supply aquifer, based on water samples collected from the onsite test wells, does not contain any maximum acceptable concentration exceedances of the Ontario Drinking Water Standards (ODWS). It is noted that initial bacteriological sampling conducted in test wells TW1 and TW2 indicated an exceedance of the ODWS for total coliform bacteria; however, this was addressed with remedial chlorination and retesting of groundwater samples. Based on the absence of health-related exceedances for chemical parameters and the results of the bacteriological retesting of test wells TW1 and TW2, the water from the proposed water supply aquifer is safe for consumption.

6.3.1.1 Bacteriological Parameters

Elevated levels (10 to 60 counts per 100 mL) of total coliform bacteria were detected in both the three (3) and six (6) hour water samples for test well TW1. Low levels (3 counts per 100 mL) of total coliform bacteria were detected in the three (3) and six (6) hour water samples for test well TW2.

The results of the re-sampling of test well TW1 indicated that total coliform bacteria concentrations had been reduced to 0 ct/100 mL in both of the retest samples. In addition, the concentrations of E. coli., faecal streptococcus and faecal coliform bacteria were non-detectable.

Low concentrations of Heterotrophic Plate Count (HPC) bacteria and a single isolated faecal streptococcus bacteria were detected in the first retest sample of test well TW3; however, both types of bacteria were determined to be non-detectable in the second retest sample for TW3. The occurrence of the single isolated faecal streptococcus bacteria in the one sample is not

considered to be representative of the water supply aquifer and does not exceed any health-related limits of the ODWS.

Based on discussions with the well driller, it is understood that the test wells were not chlorinated following construction of the test wells. As the test wells were not chlorinated following construction, it is our opinion that the resulting concentrations of total coliform bacteria were a result of the well construction activities and are not representative of groundwater quality available at the subject site. Well construction recommendations have been updated to recommend well chlorination following construction for future wells to eliminate bacteria within newly constructed wells.

The results of the bacteriological analysis of the test well water samples indicate that the water samples met all the standards of the ODWS for bacteriological parameters (based on three (3) and six (6) hour water samples from test well TW3 and subsequent retesting of test wells TW1 and TW2 following chlorination and pumping).

6.3.1.2 Other Health Related Parameters

Other than total coliform bacteria (discussed in Section 6.3.1.1), no maximum acceptable concentration limits of the ODWS were exceeded in the three (3) and six (6) hour water samples and/or supplemental water samples collected from the onsite test wells.

No maximum acceptable concentration limits of the ODWS were exceeded in the heavy metal samples from the test wells TW1 and TW2. No detectable concentrations of herbicide and pesticide parameters were detected in the samples from test well TW3. No detectable concentrations of petroleum hydrocarbons and/or volatile organic compounds were detected in the water samples from the onsite test wells. No semi-volatile glycol parameters were detected in the supplemental water samples collected from test wells TW1 and TW2.

The level of sodium in the three (3) and six (6) hour water samples from test well TW1 exceeded the ODWS warning level of 20 mg/L for persons on sodium restricted diets; however, the sodium concentration was below the aesthetic objective of the ODWS. The sodium concentration was below the ODWS warning level for all samples collected from test wells TW2 and TW3.

It should be noted that the Exova Laboratory Certificates of Analysis indicates that turbidity has a health-related maximum acceptable concentration of 1 NTU; however, this value is only applicable for water undergoing disinfection processes. Based on the absence of bacteria in the water supply aquifer, disinfection is not required for future drinking water wells on the subject site. Therefore, for the purposes of this investigation, the aesthetic objective of 5 NTU for turbidity will be used.

6.3.2 Operational Guideline Exceedances

Operational related exceedances of the Ontario Drinking Water Standards (ODWS) were detected for hardness (all test well samples) and organic nitrogen (test well TW3 six (6) hour sample). These exceedances are discussed in the following sections:

6.3.2.1 Hardness

The concentrations of hardness in water samples obtained from all three (3) test wells ranged from 184 to 263 mg/L as $CaCO_3$, which exceed 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. The MECP Procedure D-5-5 document states that water having a hardness value more than 300 mg/L is considered "very hard". The Ontario Ministry of the Environment 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 Procedure D-5-5.

The concentrations of hardness in all the test wells are below the reported threshold of 500 mg/L as CaCO3 as specified in the Technical Support Document for the ODWS. The concentration of hardness observed in 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.

6.3.2.2 Organic Nitrogen

The operational guideline (OG) for organic nitrogen was exceeded in the six (6) hour water sample collected from TW3. The concentration was 0.18 mg/L, compared to an operational guideline value of 0.15 mg/L. Organic nitrogen is calculated as the difference between the total kjeldahl nitrogen and the ammonia nitrogen. Organic nitrogen compounds may react with chlorine and severely reduce its disinfectant power. Taste and odour problems are common with organic nitrogen levels greater than 0.15 mg/L.

6.3.3 Aesthetic Objective Exceedances

Aesthetic objective exceedances of the Ontario Drinking Water Standards (ODWS) were iron (TW1 supplemental sample and TW2 3 hour sample), turbidity (TW1 and TW2 3 hour sample only) and hydrogen sulphide (TW1 and TW2. These exceedances are discussed in the following sections:

6.3.3.1 Iron

The iron concentration was 0.58 mg/L in water sample (3 hour sample only) collected from test well TW2 and was 0.36 mg/L in the supplemental sample from TW1. The iron concentration in these samples was above the aesthetic objective of 0.30 mg/L listed by the ODWS.

The MECP Procedure D-5-5 document indicates that iron concentrations up to 5.0 mg/L are considered treatable by conventional water softeners. The iron concentrations in the test wells are well below the treatable limit for water softeners provided by MECP Procedure D-5-5 and are not of concern.

6.3.3.2 Turbidity

The laboratory Certificates of Analysis indicate that the levels of turbidity in samples from test well TW1 (both the 3 and 6 hour samples) and the three (3) hour sample from TW2 exceeded the ODWS aesthetic objective. The six (6) hour water sample from test well TW2 was equal to the aesthetic objective of the ODWS and is considered to be acceptable.

Following corrective actions carried out on test well TW1 (to address bacteriological exceedances), a supplemental water sample was collected from test well TW1 on August 19, 2013 and submitted to Exova laboratory for turbidity analysis. The result of the turbidity analysis on the supplemental water sample collected from TW1 was 0.7 NTU (refer to the laboratory Certificate of Analysis is presented in Appendix L). In addition, supplemental water sampling conducted on test well TW1 in June 2015 met the ODWS aesthetic objective for turbidity (refer to laboratory Certificate of Analysis in Appendix L). Based on the August 19, 2013 and June 1, 2015 supplemental water samples from TW1, the turbidity is considered to be acceptable.

The levels of turbidity measured in the field during the pumping tests (refer to Table 1) for these test wells was noted to decrease significantly during the six (6) pump test and levels will likely further decline with well use. It is noted that the field testing of turbidity for test well TW2 at six (6) hours showed an increase in turbidity after six (6) hours of pumping (refer to Table 1). However, this was not correlated with an increase in turbidity in the laboratory results for the six (6) hour water sample. The discrepancy between the field reading and the laboratory level for turbidity is unknown; however, it is our opinion that the turbidity measured by the laboratory is representative of the groundwater quality from the test well (based on the decreasing trend in turbidity concentrations in the field and laboratory results). In addition, supplemental water sampling conducted on test well TW2 in June 2015 met the ODWS aesthetic objective for turbidity (refer to laboratory Certificate of Analysis in Appendix L). Based on the June 2, 2015 supplemental water sample from TW2, the turbidity is considered to be acceptable

Based on the laboratory certificates of analysis for initial samples from test well TW3 and the results of supplemental samples collected from test wells TW1 and TW2, the level of turbidity in all of the test wells meets the ODWS aesthetic objective.

6.3.3.3 Hydrogen Sulphide

The concentration of hydrogen sulphide in test wells TW1 and TW2 exceeded the Ontario Drinking Water Standards (ODWS) aesthetic objective of 0.05 mg/L. The concentration of hydrogen sulphide in test well TW1 ranged from 0.23 to 0.75 mg/L and both samples from TW2 contained a hydrogen sulphide concentration of 0.11 mg/L.

Elevated concentrations of hydrogen sulphide are typically characterized by an unpleasant odour (rotten egg smell) and, when in present in association with iron, can produce black stains on laundered items and black deposits on pipes and fixtures. The Ministry of Environment, Conservation and Parks (MECP) document entitled "Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines" indicates that low levels of hydrogen sulphide can be removed effectively from most well water by aeration. Hydrogen sulphide can also be effectively treated through the use of activated charcoal filters, chlorination, manganese greensand filters and other forms of oxidizing treatment. An unofficial addendum to Procedure 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. Based on the observed levels of hydrogen sulphide in TW1 and TW2, it is our opinion that the measured concentrations on the subject site are reasonably treatable.

6.4 Offsite Wells Water Quality

Water samples were collected from two (2) nearby private wells located on private lots to characterize groundwater quality at established wells in the vicinity of the subject site. The water samples were collected September 11, 2013. The locations of the private wells are not provided in this report to respect participant's privacy; however, the all of the offsite private properties sampled in the study were located within 200 metres of the boundary of the subject site. The addresses of the private lots are maintained on file at HCEL's office. The results of the private well sampling were provided to each of the well owners separately by means of a letter.

The private well 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. The private well samples were subsequently submitted to Exova laboratory in Ottawa, Ontario for analysis chemical, physical and bacteriological analyses as listed in the MECP guideline titled "Technical Guideline for Private Wells: Water Supply Assessment", dated August 1996.

Water samples were collected directly from the pressure tank or an untreated sample point (as determined by the well owner) after purging the water system at full flow for a period of about 10 to 15 minutes. When contacting well owners for collection of a water sample, it was requested that we be provided access to an untreated sample point.

The total chlorine levels of the groundwater were measured in the field and are summarized in Table 5A in Appendix J. The results of the private well laboratory analyses are summarized in Table 5B in Appendix J and the laboratory Certificates of Analysis are provided in Appendix M.

Interviews were conducted with well owners at the time of sampling for the private wells to obtain information regarding the well construction and the well owner's perception of water quality and water quantity.

None of the private well samples contained any health-related exceedances of the ODWS. Operational guideline exceedances for hardness were noted for both of the private wells. The aesthetic objective for total dissolved solids was exceeded in private well PW2. No other exceedances of the ODWS were noted for the private wells.

It is noted that the level of nitrate in private well PW2 was elevated at a concentration of about 9.6 mg/L and close to the maximum acceptable concentration for nitrates provided in the ODWS. A water well record was not available for PW2 and the completion details (well casing, completion depth, overburden or bedrock well) are unknown. It is noted that the building serviced by this well was likely an old farmhouse and the well may have been installed without proper well construction and grouting methods. The well may be exhibiting impacts from the onsite septic system or adjacent agricultural land use due to its construction. None of the test wells on the subject site or the other private well showed nitrate concentrations in this range and it is our opinion that the nitrate level in this private well is not representative of the water supply aquifer proposed for the subject site.

Interviews regarding well construction details and the well owner's perception of the quality and quantity of well water were carried out during collection of the water samples. The results of the interviews are summarized in Table 6.5.

Table 6.5 - Summary of Well Owner Interview Comments

Private Well ID	Well Owner Comments
PW1	• Well was drilled on May 22, 1985 by Valley Drilling Ltd. and is 38.1 metres in depth; • Occasional sulphur smell; • No water treatment; • No water quantity issues reported; • No septic system problems were reported.
PW2	• No information about the well; • Water is not used for drinking (bottled water is provided by building owner); • Brown color when tap hasn't been used in a while; • No water treatment; • No water quantity issues were reported; • No septic system problems were reported.

Based on the results of the interviews carried out with the building occupants (private well users), the wells were reported to have no issues with respect to water quantity. Reported water quality issues were limited to occasional sulphur smell (one private well) and brown water colour when not used for an extended period (one private well). Based on the results of the water sampling for offsite private wells, the water quality in the vicinity of the subject site is considered to be good and no significant exceedances of the ODWS were identified.

6.4.1 Comparison between Onsite Test Wells and Offsite Private Wells

Table 6.6 provides a list of all aesthetic objective (AO) and operational guideline (OG) exceedances for both the onsite test wells and the offsite private wells sampled during the course of this investigation.

Table 6.6 - Comparison of Test Well and Private Well Exceedances

Onsite Test Wells	Offsite Private Wells
Hardness	Hardness
Turbidity	-
Hydrogen Sulphide	-
Iron	-
Organic Nitrogen	-
-	Total Dissolved Solids

Both the onsite test wells and the offsite private wells had exceedances for hardness. The onsite test wells encountered exceedances for turbidity, hydrogen sulphide (test wells), iron (one test well only) and organic nitrogen (one test well only). The offsite private wells encountered exceedances of total dissolved solids (one private well only).

Based on the onsite and offsite water sample results and interviews with adjacent homeowners, water quality on the site appears to be from a different water bearing zone than offsite private well PW2, as evidenced by the elevated TDS and nitrate levels in the well. However, the occurrences of aesthetic objective and operational guideline exceedances may vary from well to well.

7.0 GROUNDWATER QUANTITY ANALYSIS

7.1 Pump Test Analysis Overview

The drawdown and recovery water level data from the three (3) initial pumping tests conducted in June 2013 on the onsite test wells TW1, TW2 and TW3 are provided in Appendix H. The details of the pumping tests carried out on the test wells are provided in Table 7.1. All depths provided are in metres below ground surface (m BGS).

Table 7.1 - Initial Pumping Tests Details - June 2013

Parameter	TW1	TW2	TW3
Duration (minutes)	360	360	360
Flow Rate (litres per minute)	18.9	30.3	22.7

Parameter	TW1	TW2	TW3
Static Water Level (m BGS)	3.77	1.66	2.03
Well Depth (m BGS)	48.8	48.5	78.6
Available Drawdown (m)	42.0	43.8	73.6
Observed Drawdown at End of Pumping (m)	38.4	6.5	14.8
Percent Drawdown Utilized (%)	91 %	15 %	20 %
Percent Recovery (18 hour)	100 %	> 98 %	100 %

As per MECP Procedure D-5-5, each of the test wells was pumped at a flow rate equal to or greater than the anticipated flow rate for 6 hours. The daily design sanitary sewage flow (DDSSF) is anticipated to be the same as the water demand and based on the maximum septic flows calculated for each of the 12 lots (refer to Table F1 in Appendix F). The average septic flow, assuming tertiary treatment septic systems, is calculated to be 3,581 litres per day. It is noted that where the maximum DDSSF was greater than 4,500 litres per day, the impact assessment was completed assuming a maximum DDSSF of 4,500 litres per day (MECP D-5-4, section 5.6.3).

The minimum pumping rate for the test wells was 18.9 litres per minute for a period of six hours. The minimum total volume of groundwater pumped was approximately 6,804 litres, which is 1.5 times the maximum septic flow of 4,500 litres per day. A typical commercial or industrial property is not anticipated to have a peak demand period, as compared to residential properties, and would be expected to be relatively uniform over an eight-hour work day. Therefore, the minimum flow rate of 18.9 litres per minute is considered to be equal to or greater than the anticipated flow rate.

The maximum drawdown observed at the end of pumping was 38.4 metres in test well TW1 which is equivalent to approximately 91 percent of the available drawdown in the test well. The drawdown utilized in the remaining test wells ranged from 15 to 20 percent. Based on these results, all of the onsite test wells are capable of supplying water at a rate greater than 18.9 litres per minute for a period greater than six (6) hours.

Additional pumping was conducted on test wells TW1 and TW2 in 2015 for the collection of additional groundwater samples. The wells were pumped for approximately six (6) hours at a reported flow rate of about 20 litres per minute by the well driller retained to carry out the pumping.

Water level measurements were taken by an electronic data logger during the pumping test. The drawdown and recovery water level data from the two (2) supplemental pumping tests conducted in June 2015 on the onsite test wells TW1 and TW2 is provided in Appendix H. The details of the 2015 supplemental pumping tests are provided in Table 7.2. All depths provided are in metres below ground surface (m BGS).

Table 7.2 - Supplemental Pumping Tests Details - June 2015

Parameter	TW1	TW2
Duration (minutes)	379	386
Flow Rate (litres per minute)	20	20
Static Water Level (m BGS)	1.94	2.49
Well Depth (m BGS)	48.8	78.6
Available Drawdown (m)	43.9	73.1
Observed Drawdown at End of Pumping (m)	3.47	3.30
Percent Drawdown Utilized (%)	8 %	5 %
Percent Recovery (1 hour)	98 %	100 %

The maximum drawdown observed in TW1 at the end of pumping in 2015 was significantly less than observed in the well at the end of pumping in 2013. The flow rates of the pumping tests for TW1 in 2013 and 2015 were similar and ranged from about 19 to 20 litres per minute. The apparent increase in well yield for test well TW1 is attributed to additional well development activities in the hydrofractured wells as a result of chlorination and additional pumping due to bacteriological exceedances in 2013. The additional pumping resulted in further development of the test well, which increased well yields.

Similarly, the maximum drawdown observed in TW2 at the end of pumping in 2015 was less than observed in the well at the end of pumping in 2013; although it is noted that TW2 was pumped at about 2/3 of the 2013 test rate in 2015.

The revised percent drawdown utilized for the onsite test wells ranges from 5 to 20 percent (based on 2015 pumping test for test well TW1, the 2013 and 2015 pumping tests for TW2 and the 2013 pumping test for TW3).

Based on these results, all of the onsite test wells are capable of supplying water at a rate greater than 19.2 litres per minute for a period greater than six (6) hours. All of the onsite test wells have been demonstrated to provide more than 6,700 litres over the course of a six-hour period during the pumping tests. It is noted that this flow is significantly larger than the average maximum septic flow recommendations for the 12 lots, which is 3,581 litres per day and the maximum septic flows of 4,500 litres per day.

7.2 Transmissivity Analysis

The drawdown and recovery data were interpreted and analyzed using the Aquifer Test software program from Waterloo Hydrogeologic Inc. The results of the analysis are provided in Appendix N.

Based on a review of the drawdown and recovery datasets, the Hantush-Jacob (1955) method of analysis for leaky or recharge aquifers was applied to the drawdown data of the pumping tests. The Theis & Jacob Recovery (1935) method was applied to the recovery data of the pumping tests. It is our opinion that the application of these analysis methods is appropriate based on the hydrogeological conceptual model.

The transmissivity and specific capacity of the test wells were determined from the aforementioned pumping tests conducted in the onsite test wells in 2013 and 2015. The results of the analysis are summarized in Table 7.3:

Table 7.3 - Summary of Transmissivity and Specific Capacity Estimates

Test Well and Date of Pump Test	Drawdown Data Transmissivity[1] (m^2/day)	Leakage Factor (m)[1]	Recovery Data Transmissivity[2] (m^2/day)	Specific Capacity (Litres per minute per metre)
TW1 (June 18, 2013)	0.17	0.39	0.24	0.5
TW2 (June 19, 2013)	1.7	0.31	2.6	4.7
TW3 (June 20, 2013)	0.49	0.27	0.83	1.5
TW1 (June 1, 2015)	3.9	1.54	2.4	5.8
TW2 (June 2, 2015)	2.1	0.82	1.5	6.1
Geometric Mean	**1.03**	**0.53**	**1.13**	**2.6**

Notes: 1. Hantush-Jacob (1955) method of analysis
2. Theis Recovery (1935) method of analysis

The unified parameter values were calculated from the geometric mean of the specific capacity and transmissivity values of the above noted pumping tests. Based on the unified parameter calculations, the specific capacity of the bedrock water supply aquifer at the subject site is 2.6 litres per minute per metre and the transmissivity is about 1.1 m^2/day.

7.3 Hydraulic Interference Effects

During the pumping of the onsite test wells, water level measurements were generally taken at one (1) hour intervals in the two (2) test wells that were not being pumped (observation wells). The water level measurements in observation wells, the radial distances between the pumping and observation wells and the pumping rates are provided in Appendix I.

The results of the water level measurements made at the bedrock observation wells during the pumping tests indicate that the drawdown in the observation wells was zero or levels slightly increased; the maximum increase was -0.02 metres (rise in water level). The radial distances between the observation wells and the pumping wells ranged from about 218 metres to 430 metres.

Based on the absence of any hydraulic interference effects during the pumping of the test wells on the other onsite test wells, any potential interference with on-site or off-site water wells is expected to be acceptable.

7.4 Computer Model Simulations

A well interference simulation was developed using Aqtesolv version 4.5. The well simulation output is provided on Figure N1 in Appendix N for discussion purposes. A discussion of the simulation and the parameters used in its development are provided in the following sections.

No estimates of the storativity are available, however typical values for confined aquifers range from 5 x 10^{-5} to 5 x 10^{-3} (Todd, 1980).

7.4.1.1 Scenario 1 (Figure N1 - Appendix N)

Scenario 1 is provided to illustrate the maximum drawdown using the unified aquifer parameters identified in Table 7.3. The following parameter values were utilized in the model:

- Number of pumping wells =12 wells;
- Individual well pumping rate = 19.2 litres per minute;
- Duration of pumping = 480 minutes;
  - Pumping at a rate of 19.2 L/min for 480 minutes equals 9,216 litres per day.
- Analysis model = Theis (1935)
  - Both the Hantush-Jacob (1955) and Theis Recovery (1935) models were used to estimate aquifer transmissivity. The Theis (1935) model was selected for the simulation

as it provides a simpler solution which is less dependant upon calibrated variables such as the leakage factor within the Hantush-Jacob (1955) model.

- Aquifer thickness = 41 metres;
  - Based on TW1 in 2015 minus a 3 metre sump; provides a conservative aquifer thickness.
- Aquifer transmissivity = 1.1 m^2/day (geometric mean); and,
  - Considered to be a conservative estimate as it includes the lower transmissivity estimates from the 2013 pumping tests, which when re-analyzed in the 2015 pumping tests found higher transmissivity estimates.
- Storativity coefficient = 5 x 10^{-4} (average storativity estimate for confined aquifers; Todd, 1980).

The results of Scenario 1 simulation indicate that the maximum drawdown is approximately 25 metres and is localized to the pumping wells. The drawdown at the individual lot boundaries (assumes the test well is located in the centre of the individual lot) and the subject site boundary are less than 4.0 and 2.0 metres respectively. Furthermore, it is noted that the drawdown decreases to less than 1.0 metre at a distance of approximately 80 metres from the pumping wells.

Based on the minimum available drawdown of 42.0 metres, the drawdown of approximately 25.0 metres in the pumping wells is considered to be acceptable. Furthermore, the geometric mean total well depth of wells within 500 metres is 43.8 metres and potential interference effects of up to 2.0 metres is not considered to be significant. Based on the results of the well interference simulation, the interference between on-site drinking water wells and off-site water wells is considered to be negligible.

During the actual on-site pumping tests, no drawdown was observed in the observation test wells, which is consistent with the computer model simulations. Furthermore, it is noted that the test wells were pumped at rates of 18.9 to 30 litres per minute and withdrew between 6,800 to 10,800 litres during the respective 6-hour pumping tests, which is significantly greater than the anticipated 4,500 litres per day water demand.

7.5 Long Term Well Yields

The British Columbia Ministry of the Environment (2012) estimates the long-term well yield by first determining the well's specific capacity after 100 days of pumping (theoretical drawdown without recharge). The assessment was carried out using the following data:

- Time (t) - 100 days;
- Pumping Rate (Q) – 27.65 m^3/day (based on average flow of 19.2 litres per minute);
- Transmissivity (T) - 1.1 m^2/day (based on Table 7.3 Unified Parameter);
- Distance (r) - 0.076 metres (based on radius of open hole test well);
- Storativity (S) – 5 x 10^{-4} (based on an estimate of storativity from Todd, 1980); and,

- Available Drawdown (D) - 41 metres (based on TW1 minus a 3 metre sump for the pump).

First, the drawdown in the aquifer after 100 days of pumping is calculated using the Modified Nonequilibrium Equation (Groundwater and Wells 2nd Ed., Discoll, 1986):

$$s = \frac{0.183 \cdot Q}{T} \cdot Log \frac{2.25 \cdot T \cdot t}{r^2 \cdot S}$$

The specific capacity after 100 days (SC) is calculated using the pumping flow rate (Q) and estimated drawdown after 100 days (S):

$$SC = \frac{Q}{s}$$

The safe well yield (Q_{safe}) can then be estimated by multiplying the specific capacity after 100 days of pumping (SC) by the maximum available drawdown (D) by a safety factor of 0.7:

$$Q_{safe} = 0.7 \times SC_{100} \times D_{available}$$

Using this approach, the safe well yield was calculated for the average scenario based on unified transmissivity values. The safe well yield was calculated to be approximately 21.7 litres per minute of continuous pumping for 100 days and is greater than the average flow rate anticipated for the proposed industrial/commercial properties.

Based on these results, it is our opinion that the long-term safe well yield of the onsite test wells and future wells constructed in accordance with the well construction recommendations is greater than the demand of the proposed development. That is, no concerns with long term sustainability of the proposed water supply aquifer were identified.

8.0 CONCLUSIONS

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

- The site geology consists of coarse grained glaciomarine deposits overlying the proposed bedrock water supply aquifer.
- The overburden of the subject site is characterized by shallow bedrock conditions on the western portion of the subject site (Lots 8 and 9) with the overburden depth increasing in an easterly direction. The surficial soils are characterized by sand, sand and gravel and silty sand with varying amounts of clay, gravel and cobbles;
- The nitrate dilution predictive assessment for industrial/commercial developments meets MECP Procedure D-5-4 guidelines.
    - With the use of best management practices and the recommended protective measures, the impact to the receiving aquifer is considered to be acceptable.
- The test well construction is typical of future water supply wells in the development.

- The water quality determined in the course of this investigation is representative of the long-term water quality which future lot owners are likely to obtain from their wells constructed in accordance with the well construction recommendations.
- The water quality available from drilled wells on the subject site is safe for consumption based on the absence of health-related exceedances of the ODWS.
- The quality of the groundwater meets the Ministry of the Environment, Conservation and Parks Regulations, Standards, Guidelines and Objectives with the exception of hardness, organic nitrogen, iron and hydrogen sulphide.
  - The levels of hardness and iron are considered to be reasonably treatable using a conventional water softener.
  - The level of organic nitrogen is an operational parameter intended for use in waters requiring chlorination for disinfection purposes. As there are no disinfection requirements for the subject site, this operational exceedance is not of concern.
  - An unofficial addendum to Procedure 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 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.

9.0 RECOMMENDATIONS

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

9.1 General Recommendations

- The accepted hydrogeological report entitled “Hydrogeological Assessment and Terrain Analysis, Proposed Commercial/Industrial Subdivision, 3119 Carp Road, Township of Huntley, Ottawa, Ontario”, GEMTEC, (January 29, 2020) shall be made available to lot purchasers as a guide to development;
- The recommended maximum number of lots for the subject site is 12 privately serviced lots, as identified in the Private Servicing Plan (Appendix A);
- The subdivision agreement should include the following statement: “The Owner acknowledges and agrees to provide a dedicated monitoring well, at no cost to the City, and to which the City will have unlimited access by way of a permanent easement or dedication, to monitor groundwater conditions. The required easement shall be provided to the satisfaction of the City Solicitor and the General Manager, Planning, Infrastructure and Economic Development.”

- A water budget should be completed as part of the Site Plan Application. Groundwater recharge should be maintained following development of the subdivision.
  - Disclaimer: Groundwater infiltration estimates for pre-development conditions should be obtained using in-situ methods (e.g. grain size analyses, Guelph Permeameter, Ring Infiltrometer testing, etc.). Infiltration rates used in the nitrate dilution estimates should not solely be relied upon to assess terrain unit infiltration rates.
- Measures should be put in place to protect the groundwater aquifer, including:
  - 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.
  - It is recommended that low impact development measures be utilized to maintain groundwater recharge post-development.

9.2 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 10.7 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 1.5 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 subject site. The well grouting certification inspection should be conducted under the supervision of a professional engineer or professional geoscientist;

- Hydrofracturing of two (2) onsite test wells was required to demonstrate the minimum pumping requirements of MECP Procedure 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; and,
- The test wells completed for this study were completed at depths ranging from 49 to 79 metres below ground surface. Future drinking water wells completed on the subject site at depths outside of this range may encounter different hydrogeological conditions and the quality and quantity of water available from drilled wells may differ than that presented in this study.

9.3 Septic System Recommendations

- The proposed lots are recommended to be serviced by septic sewage disposal systems that incorporate advanced treatment technologies, capable of achieving a minimum of 50% reduction in nitrogen, and that are approved under the Ontario Building Code. 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 the authorized agents of the manufacturer of the advanced treatment systems for the service life of the system;
- In areas where shallow soils (i.e. less than 2.0 metres) or exposed bedrock are present, it is recommended that a minimum of 150 millimetre thick clay seal be placed between the bedrock and base of the proposed leaching bed;
    - For example, lots 6, 7, 8, 9 and 10 (refer to Private Servicing Plan, Appendix A).
- In view of the percolation time of the native soils and the depth to bedrock, 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; and,
- Preliminary septic flow recommendations have been assigned to each proposed lot for both systems not using and using advanced treatment system, and are provided in Table 8.1 below (refer to Lot Development Plan in Appendix A for lot locations and Table F1 in Appendix F for additional septic flow information).

Table 8.1 – Septic flow recommendations

Lot # [1]	NO ADVANCED TREATMENT [2] Maximum Septic Flow (L/day)	Maximum Number of Users [3]	ADVANCDED TREATMENT Maximum Septic Flow [4] (L/day)	Maximum Number of Users
1	1,123	15	3,218	43
2	680	9	1,950	26
3	680	9	1,950	26
4	913	12	2,618	35
5	1,131	15	3,243	43
6	1,132	15	3,245	43
7	1,071	14	3,071	41
8	1,118	15	3,205	43
9	1,062	14	3,044	41
10	2,470	33	4,500	60
11	1,732	23	4,500	60
12	1,878	25	4,500	60

Notes.

1. Lot numbers and location based on Private Servicing Plan provided in Appendix A.
2. Maximum allowable flows based on the use of septic systems without advanced treatment, 40% hard surface areas and incorporating background nitrate concentration of 0.75 mg/L.
3. Maximum number of users based on Carp Road Corridor memo, dated September 27, 2016 indicating 75 litres per day per user.
4. Maximum allowable flows based on the use of advanced treatment septic systems and 40% hard surface area. It is noted that the maximum septic flow is limited to 4,500 litres per day based on the MECP Procedure D-5-4 predicative assessment.

- If during the site plan approval process, 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.
  - Additional analysis for septic flows exceeding 4,500 litres per day are recommended to conform with MECP Guideline B-7 for large subsurface sewage disposal systems.

- 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.

9.4 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;

- The following water quality parameters may not meet the ODWS operational guidelines in drinking water wells completed at the subject site:
  - Hardness – Hardness levels in the onsite test wells were greater than the operational guideline for hardness and can be expected in future wells drilled at the property.

  - Organic nitrogen – Organic nitrogen levels in onsite test wells encountered a single exceedance of the operational guideline for organic nitrogen and may be possible in future wells drilled at the property. Taste and odour problems are common with organic nitrogen levels greater than the operational guideline. In addition, organic nitrogen levels in exceedance of the operational guideline can react with chlorine disinfection systems and severely reduce its disinfection power.

- The following water quality parameters may not meet the ODWS aesthetic objectives in drinking water wells completed at the subject site:

  - Iron – Iron concentrations in some of the water samples from onsite test wells exceeded the ODWS aesthetic objective for iron and may be encountered in future wells drilled at the property. Excessive levels of iron may impart a brownish colour to laundered goods, plumbing fixtures and the water itself; it may also produce a bitter, astringent taste in water and beverages; and the precipitation of iron can promote the growth of iron bacteria in water distribution systems. Any iron exceedances can be effectively treated with the use of conventional water softener (up to 5 mg/L), oxidation with filtration through proprietary media (up to 10 mg/L) or chlorination followed by sand or multimedia filtration (up to 10 mg/L).

  - Sulphide – Sulphide levels in two (2) of the onsite test wells exceeded the ODWS 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.

- The maximum proposed water demand should not exceed 6,800 litres per day, which is approximately 50% greater than maximum DDSSF, unless additional pumping tests and well interference modelling is carried out.

10.0 LIMITATIONS OF REPORT

This report was prepared for Mr. Greg LeBlanc and is intended for the exclusive use of Mr. Greg LeBlanc. This report may not be relied upon by any other person or entity without the express written consent of GEMTEC and Mr. Greg LeBlanc Nothing in this report is intended to provide a legal opinion.

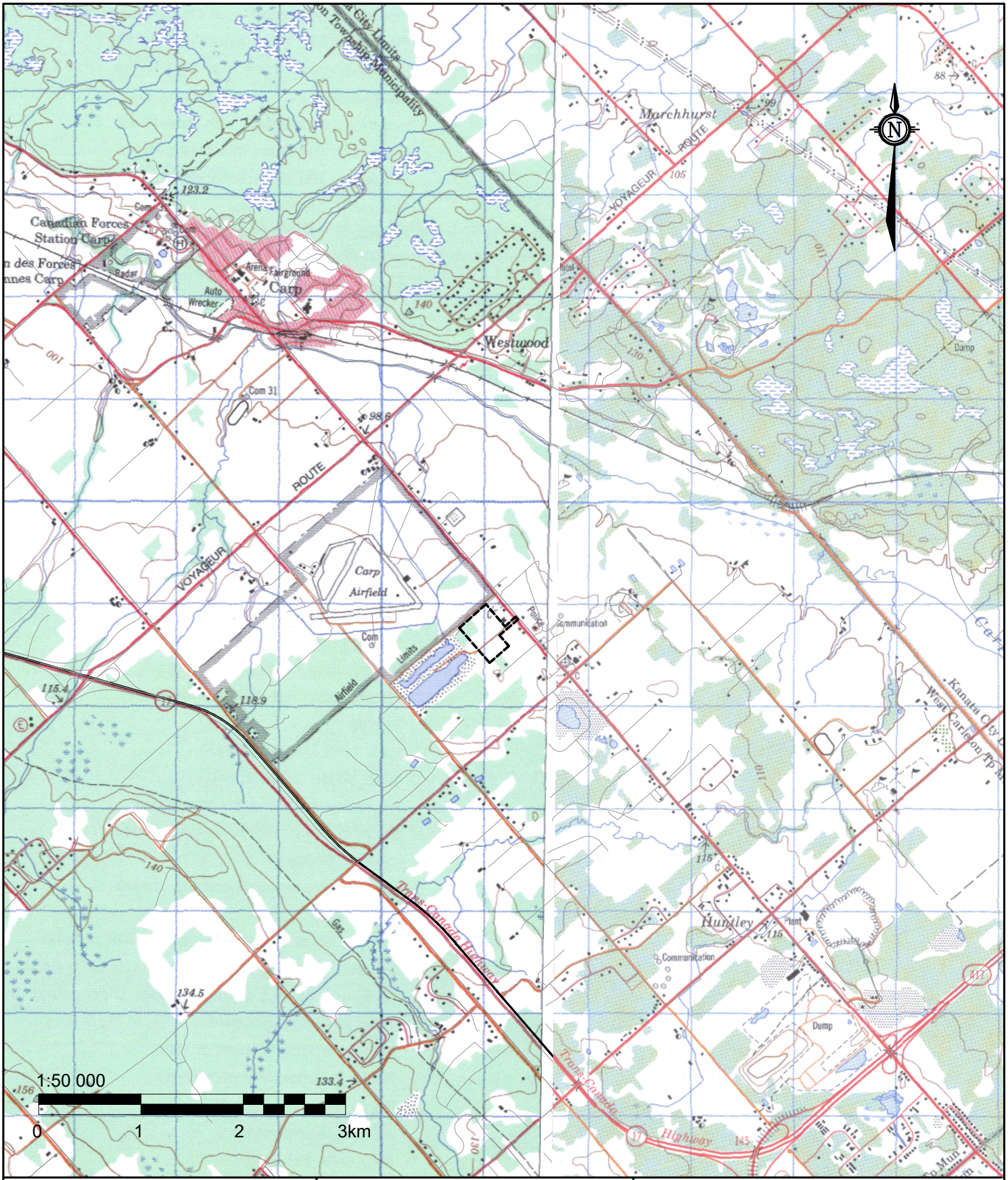
The investigation undertaken by GEMTEC with respect to this report and any conclusions or recommendations made in this report reflect the best judgments of GEMTEC based on the site conditions observed during the investigations undertaken at the date(s) identified in the report and on the information available at the time the report was prepared. This report has been prepared for the application noted and it is based, in part, on visual observations made at the site, subsurface investigations at discrete locations and depths and laboratory analyses of specific chemical parameters and material during a specific time interval, all as described in the report. Unless otherwise stated, the findings contained in this report cannot be extrapolated or extended to previous or future site conditions, portions of the site that were unavailable for direct investigation, subsurface locations on the site that were not investigated directly, or chemical parameters, materials or analysis which were not addressed.

Should new information become available during future work, including excavations, borings or other studies, GEMTEC should be requested to review the information and, if necessary, re-assess the conclusions presented herein.

We trust that this report is sufficient for your requirements. If you have any questions concerning this information or if we can be of further assistance to you on this project, please call.

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

Shaun Pelkey, M.Sc.E., P.Eng.
Principal, Environmental Engineer



GEMTEC
Consulting Engineers and Scientists

32 Steacie Drive, Ottawa, ON K2K 2A9
T: (613) 836-1422 | www.gemtec.ca | ottawa@gemtec.ca

Project	Drawing
HYROGEOLOGICAL INVESTIGATION/ TERRAIN EVALUATION 3119 CARP ROAD OTTAWA, ONTARIO	KEY PLAN

Drwn By	Chkd By	Date	Project No.	Revision No.	
P.C.	A.P.	FEBRUARY 2019	62471.01	0	**FIGURE 1**

P:\0. Files\62400\62471.01\Drafting\1.Drawing\62471.01_FG1_V00_2017-08-04.dwg, KEY PLAN, 2/6/2019 9:20:09 AM

LEGEND

- TP 11-1 — APPROXIMATE TEST PIT LOCATION IN PLAN (current investigation by GEMTEC)
- TP 1 — APPROXIMATE TEST PIT LOCATION IN PLAN (previous investigation by Paterson Group)
- TW 1 99.99 — TEST WELL LOCATION IN PLAN (current investigation by GEMTEC)
  - GROUND SURFACE ELEVATION IN METRES GEODETIC DATUM
- PW 1 — APPROXIMATE PRIVATE WELL LOCATION IN PLAN (current investigation by GEMTEC)
- A — A' — CROSS SECTION LOCATION

Scale 1:3000

0 100 200m

GEMTEC
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Ottawa, ON K2K 2A9
Tel: (613) 836-1422
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Drawing: SITE PLAN

Client: STOREYWORKS DEVELOPMENTS INC.

Project: 62471.01

HYDROGEOLOGICAL INVESTIGATION/TERRAIN EVALUATION
3119 CARP ROAD
OTTAWA, ONTARIO

Drwn by: P.C.

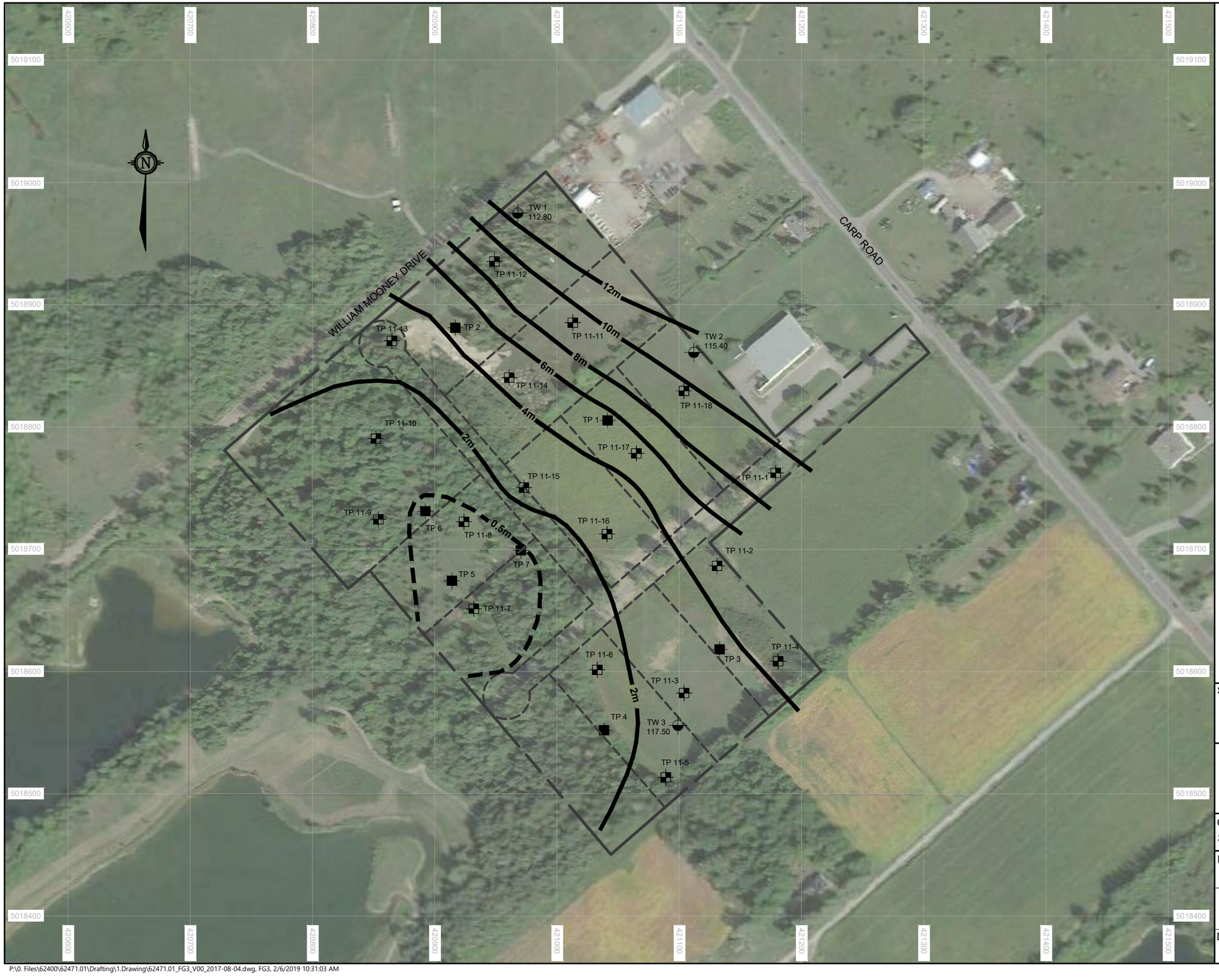
Chkd by: A.P.

Date: JANUARY 2020

Rev.: 0

FIGURE 2

P:\0. Files\62400\62471.01\2019 Update\Drafting\62471.01_FG02-06_2019-02-06.dwg, FIGURE 2, 20/01/22 1:25:30 PM



LEGEND

TP11-1

TP 1 — APPROXIMATE TEST PIT LOCATION
(previous investigation by Paterson Group)

TW 1
99.99 — APPROXIMATE TEST WELL LOCATION
(current investigation by Houle Chevrier Engineering Ltd.)

GROUND SURFACE ELEVATION IN METRES
GEODETIC DATUM

2m — INTERPRETED OVERBURDEN THICKNESS (METRES)
BASED ON REFUSAL DEPTH IN TEST PITS AND
TEST WELL LOGS

IMAGE SOURCE: GOOGLE EARTH PRO 2017, UTM83 ZONE 18T

Scale 1:3000

0 100 200m

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS
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Client	Project
STOREYWORKS DEVELOPMENT INC.	62471.01

Location	
3119 CARP ROAD CARP, ONTARIO	

Drwn by	Chkd by	
P.C.	A.P.	SITE PLAN

Date	Rev.	
FEBRUARY 2019	0	**FIGURE 3**

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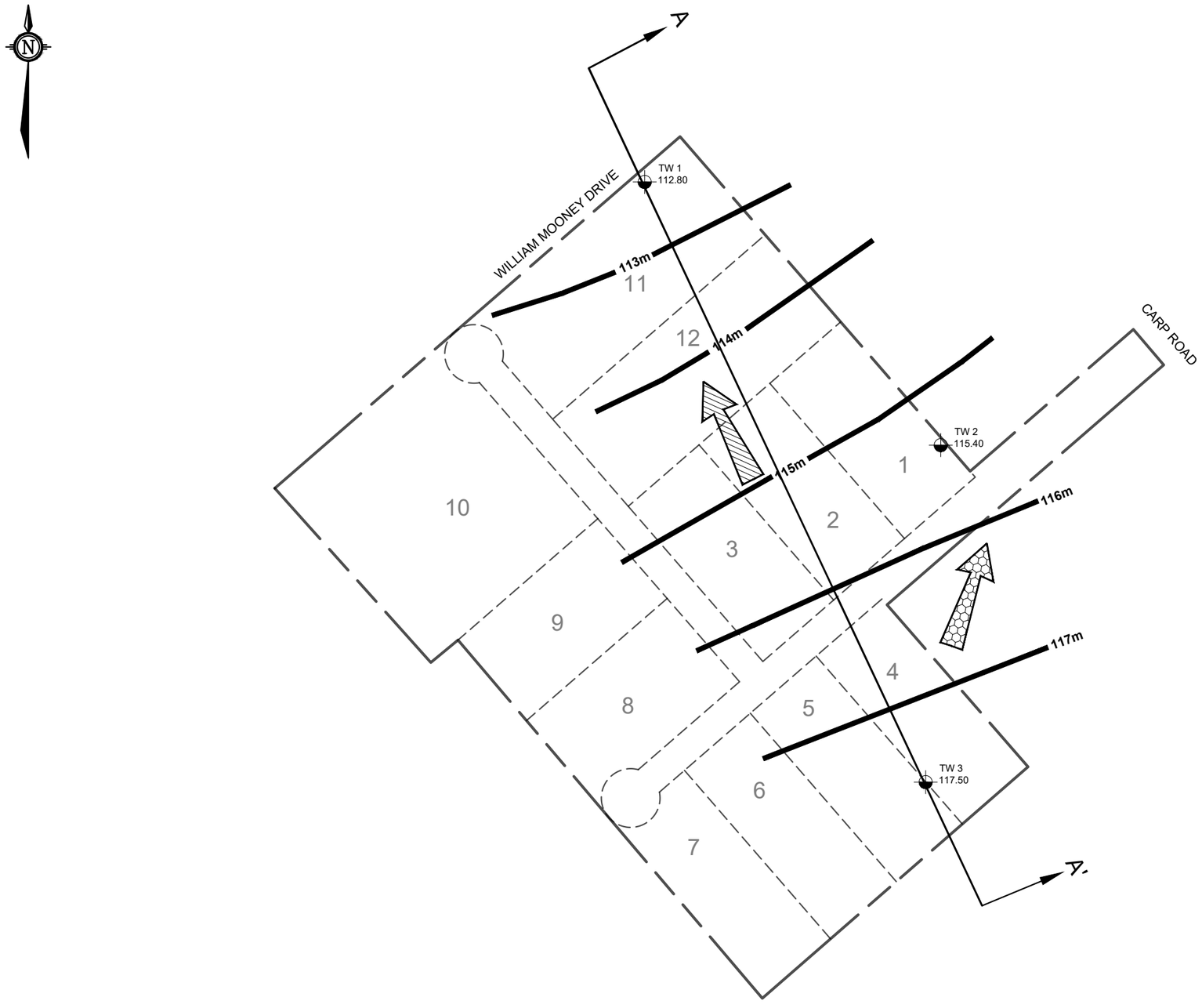

LEGEND

TW 1
99.99 APPROXIMATE TEST WELL LOCATION IN PLAN
(previous investigation by Houle Chevrier Engineering Ltd., 2011)

GROUND SURFACE ELEVATION IN METRES
GEODETIC DATUM

APPROXIMATE BEDROCK GROUNDWATER FLOW DIRECTION

APPROXIMATE OVERBURDEN GROUNDWATER FLOW DIRECTION

114m APPROXIMATE GROUNDWATER FLOW CONTOURS

Scale 1:3000

0 100 200m

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Drawing
GROUNDWATER FLOW DIRECTION PLAN

Client
STOREYWORKS DEVELOPMENTS INC.

Project
62471.01

HYDROGEOLOGICAL INVESTIGATION/TERRAIN EVALUATION
3119 CARP ROAD
OTTAWA, ONTARIO

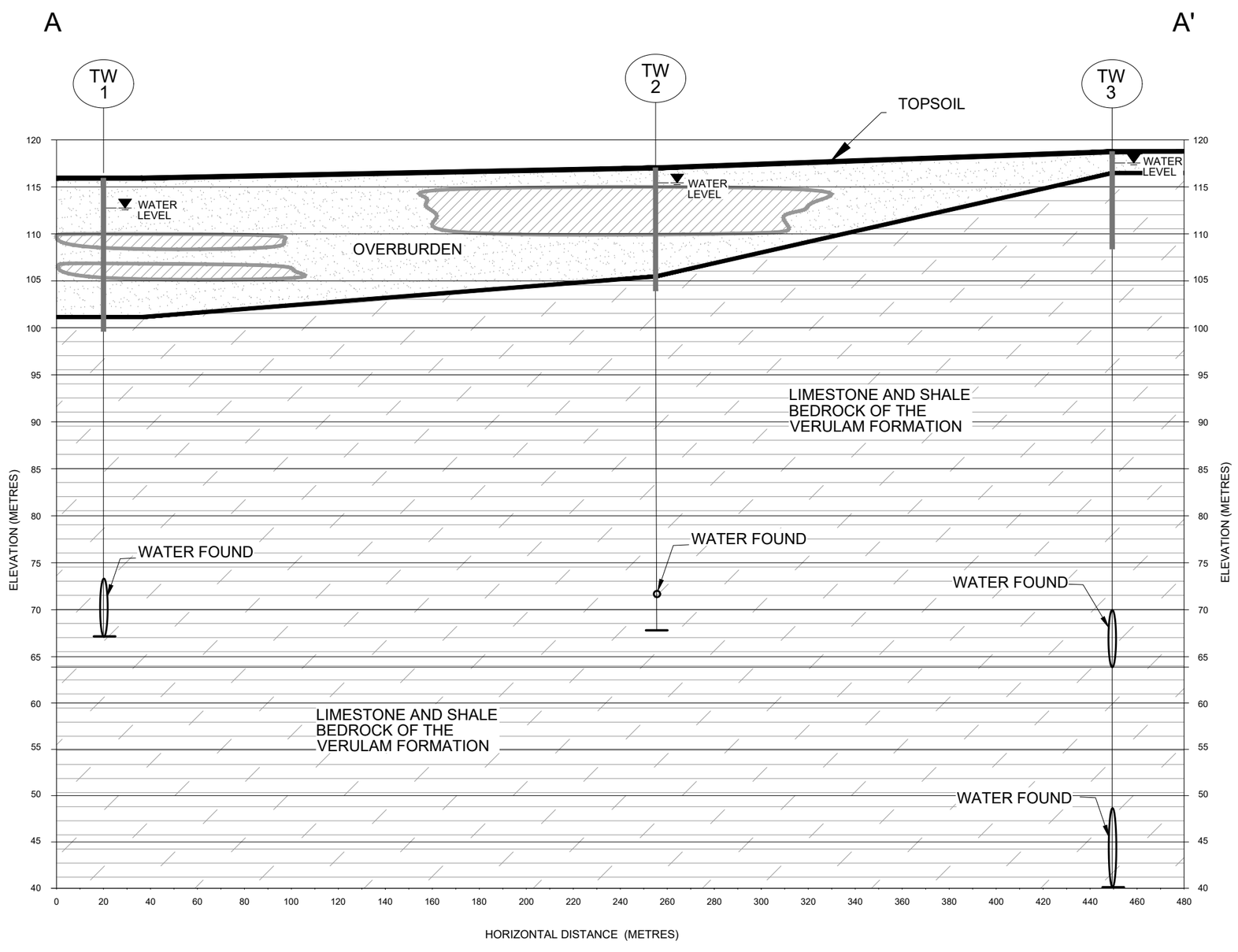
Drwn by
P.C.

Chkd by
A.P.

Date
FEBRUARY 2019

Rev.
0

FIGURE 4



LEGEND

GENERALIZED OVERBURDEN COMPOSITION CONSISTING:

SAND, SAND AND GRAVEL, SILTY SAND, SANDY SILT ALL WITH VARYING AMOUNTS OF CLAY AND GRAVEL AND/OR COBBLES

CLAY

LIMESTONE BEDROCK

TW1 TEST WELL LOCATION

GROUNDWATER LEVEL (JUNE 18-30, 2013)

Horizontal Scale	Vertical Scale
1 : 2000	1 : 500

GEMTEC
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Drawing
INTERPRETED SUBSURFACE CROSS SECTION

Client
STOREYWORKS DEVELOPMENT INC.

Project		
62471.01		HYROGEOLOGICAL INVESTIGATION/ TERRAIN EVALUATION 3119 CARP ROAD OTTAWA, ONTARIO
Drwn by: P.C.	Chkd by: A.P.	
Date: FEBRUARY 2019	Rev.: 0	**FIGURE 5**

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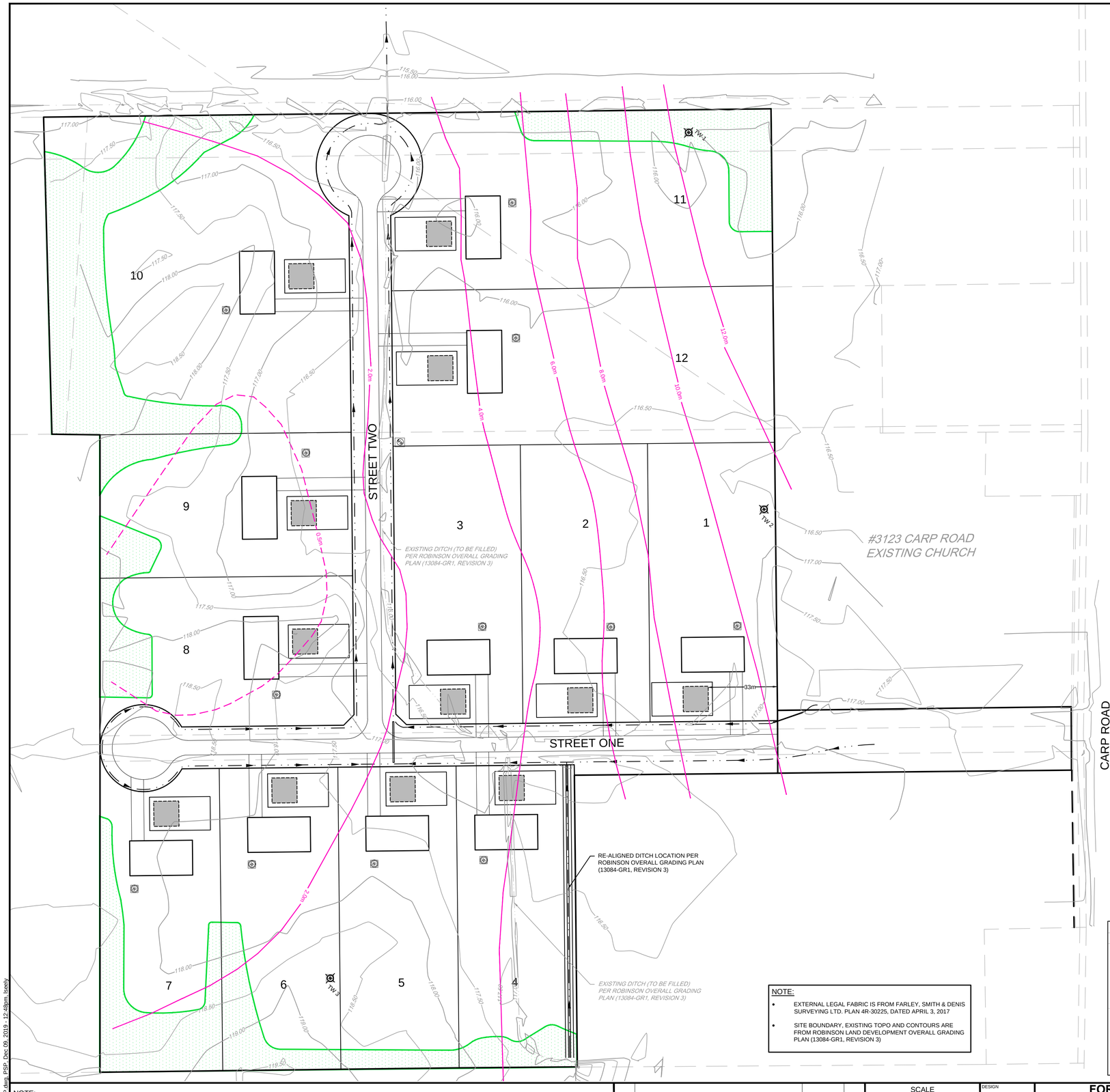
APPENDIX A

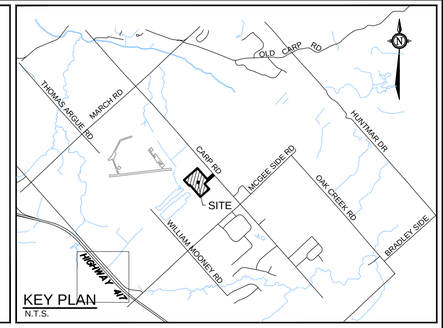
Private Servicing Plan



NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOTE:
- EXTERNAL LEGAL FABRIC IS FROM FARLEY, SMITH & DENIS SURVEYING LTD. PLAN 4R-30225, DATED APRIL 3, 2017
- SITE BOUNDARY, EXISTING TOPO AND CONTOURS ARE FROM ROBINSON LAND DEVELOPMENT OVERALL GRADING PLAN (13084-GR1, REVISION 3)

NORTH



KEY PLAN
N.T.S.

LEGEND

- PROPOSED BUILDING FOOTPRINT (500m²/ 5382ft²)
- PROPOSED TYPE A BED (RAISED BED, 2300 L/day)
- PROPOSED WELL LOCATION
- PROPOSED MONITORING WELL LOCATION
- TW 1 — APPROXIMATE TEST WELL LOCATION (GPS) (HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS PREPARED BY GEMTECH, DATED FEBRUARY 8, 2019)
- 2.0m — INTERPRETED OVERBURDEN THICKNESS BASED ON REFUSAL DEPTH IN TEST PITS AND TEST WELL LOGS (HYDROGEOLOGICAL ASSESSMENT AND TERRAIN ANALYSIS PREPARED BY GEMTECH, DATED FEBRUARY 8, 2019)
- LIMIT OF TREE RETENTION AREAS PER ENVIRONMENTAL IMPACT STATEMENT AND TREE CONSERVATION REPORT PREPARED BY MUNCASTER ENVIRONMENTAL PLANNING INC., DATED JULY 18, 2013

LOT DEVELOPMENT NOTES:

1. BUILDING FOOTPRINTS, SEPTIC SYSTEM ENVELOPES (2,300L/day) AND WELL LOCATIONS ARE CONCEPTUAL ONLY AND ARE TO BE FINALIZED AT THE TIME OF APPLICATION FOR BUILDING PERMIT AND SEPTIC SYSTEM PERMIT.
2. BUILDING SETBACKS REQUIRED ARE AS PER CITY OF OTTAWA ZONING BY-LAW RC9 (SEE TABLE BELOW).
3. SEPTIC SYSTEM SETBACKS REQUIRED PER ONTARIO BUILDING CODE:

   RAISED TYPE A BED
   STONE/TILE TO DRILLED WELL - 16.8m
   STONE/TILE TO DUG WELL - 31.8
   STONE/TILE TO PROPERTY LINE - 4.8m
   STONE/TILE TO STRUCTURE - 6.8m
   STONE/TILE TO WATERCOURSE - N/A
   TANK TO WELL - 15.0m
   TANK TO STRUCTURE - 1.5m
4. THE USE OF TERTIARY SEPTIC SYSTEMS IS ACCEPTABLE UNDER THE BUILDING CODE. TERTIARY TREATMENT, REDUCING NITRATES BY A MINIMUM OF 50%, IS REQUIRED FOR THIS DEVELOPMENT AND IS ALLOWED PER THE CITY OF OTTAWA CARP ROAD CORRIDOR - NITRATE IMPACT ASSESSMENT RECOMMENDATIONS (SEPTEMBER 27, 2016). A MAINTENANCE AGREEMENT WILL BE REQUIRED.
5. WELL SHALL BE LOCATED OUTSIDE OF THE OUTCROP (AREA WITH LESS THAN 0.5m OVERBURDEN).
6. IN AREAS OF THIN SOILS (LESS THAN 2.0m OVERBURDEN), A MINIMUM 150mm CLAY SEAL MUST BE PROVIDED IN THE ENTIRE SEWAGE ENVELOPE AREA, INCLUDING THE MANTLE. LOTS REQUIRING A CLAY SEAL WILL BE DETERMINED DURING THE APPLICATION PROCESS FOR THE SEWAGE SYSTEM PERMIT.
7. TEST WELLS LOCATED ON LOTS 1, 6 AND 11 MAY BE USED FOR DOMESTIC USE. TEST WELLS THAT ARE NOT USED ARE TO BE ABANDONED IN ACCORDANCE WITH MOECC O.REG 903.
8. WELL CASINGS SHOULD BE EXTENDED AT LEAST 12.2m (40ft CASING) BELOW THE 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, ALL WELL CASINGS SHOULD BE COMPLETED A MINIMUM OF 1.5m INTO SOUND, COMPETENT BEDROCK.

RC9 Zoning Provisions

I	II	III	IV	V	VI		VII	VIII	IX	X	XI
ZONING MECHANISMS	**Minimum Lot Area (m2)**	**Minimum Lot Width (m)**	**Minimum Front Yard Setback (m)**	**Minimum Rear Yard Setback (m)**	**Minimum Interior Side Yard Setback (m)**		**Minimum Corner Side Yard Setback (m)**	**Maximum Height (m) -Principal Building**	**Maximum Lot Coverage (%)**	**Landscaping of Yards**	**Outdoor Storage**
					Abutting a residential zone	All other zones					
RC9	4000	30	10	10	4.5	3	6	11	25	required front and corner side yards to be landscaped, except for driveways crossing the front or corner side yard leading to a parking area	outdoor storage permitted in interior side and rear yard only; must be screened and concealed from view from abutting streets and from abutting non-commercial or non-industrial zones

No.	REVISION	DATE	BY
2.	ISSUED FOR COORDINATION	DEC 9/19	LKC
1.	ISSUED FOR COORDINATION	SEP 25/19	LKC

SCALE 1:1000 (1:1000, 0 10 20 30 40)

DESIGN LAB
CHECKED SMG
DRAWN LKC
CHECKED LAB
APPROVED SMG

FOR REVIEW ONLY

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
CITY OF OTTAWA
3119 CARP ROAD

DRAWING NAME
PRIVATE SERVICING PLAN

PROJECT No. 116103-6
REV REV # 2
DRAWING No. 116103-PSP

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PLAN1.DWG - 841mmx594mm

APPENDIX B

External References (Figures, Maps and Soil Profile Sheets)

LEGEND:

- APPROXIMATE TEST PIT LOCATION BY PATERSON (CURRENT STUDY)
- APPROXIMATE TEST PIT LOCATION BY OTHERS
- **G6** LOCATION OF NUMBERED GRAB SAMPLE

BASE PLAN AND TEST HOLE LOCATIONS BY OTHERS FROM HOULE CHEVRIER ENGINEERING LTD. PROJECT No. 11-037 FIGURE 2

Date	Description	Rev.

Client:

MR. GREG LEBLANC

Consultant:

patersongroup
consulting engineers

Project:

MINERAL AGGREGATE ASSESSMENT

3119 CARP ROAD
OTTAWA(CARP), ONTARIO

Drawing:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Seal:
Date: 02/2014	
Drawn by: BA	
Checked by: RAP	
File: PH2450	

Drawing No.: **PH2450-1**

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patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. **PH2450**

HOLE NO. **TP 1**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR						0		20 40 60 80	
TOPSOIL 0.30									
Brown **SANDY SILT** 0.91		G	1			1			
Light grey-brown medium **FINE SAND** 2.90		G	2			2			▽
Grey **CLAYEY SILT** 4.27		G	3			3			
End of Test Pit						4			
(GWL @ 2.4m depth)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. **PH2450**

HOLE NO. **TP 2**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR									
TOPSOIL 0.23						0			
Brown **SAND**, some silt 0.91		G	4			1			
Light brown **SILTY SAND,** with some shells 1.52		G	5			2			
Light brown to grey-brown **SAND**		G	6			3			
4.27						4			
End of Test Pit (GWL @ 1.7m depth)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa) scale: 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. PH2450

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR									
TOPSOIL 0.15						0			
Brown **SAND**, some silt 0.91		G	7			1			
Light brown medium to coarse **SAND**, some gravel 1.68		G	8			2			▽
Light brown **SAND** 4.27		G	9			3			
End of Test Pit (GWL @ 2.1m depth)						4			

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. **PH2450**

HOLE NO. **TP 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR						0		20 40 60 80	
TOPSOIL 0.30									
Brown **SILTY SAND** to **FINE SAND**		G	10			1			▽
1.52									
End of Test Pit Practical refusal to excavation on inferred bedrock at 1.52m depth (GWL @ 1.4m depth)									

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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

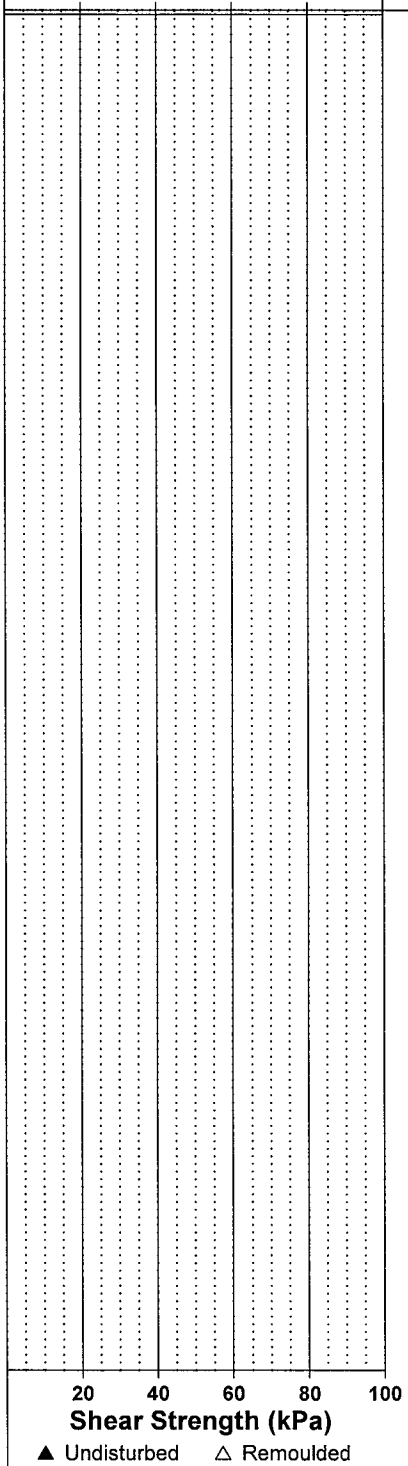
REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. **PH2450**

HOLE NO. **TP 5**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR						0			
TOPSOIL 0.05									
SILTY SAND with gravel and cobbles 0.20									
End of Test Pit									
Practical refusal to excavation on inferred bedrock at 0.20m depth									



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

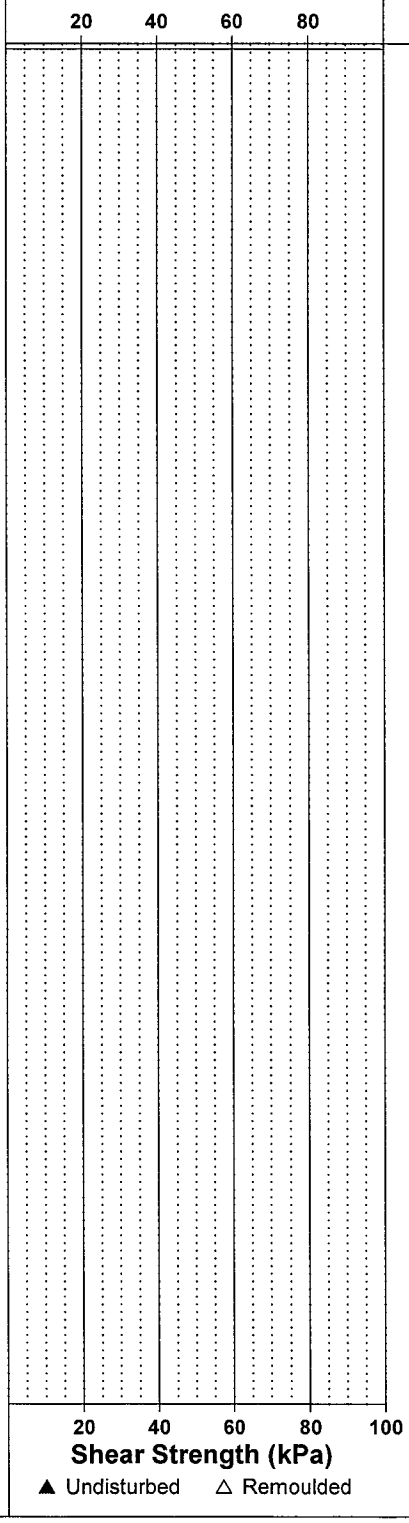
REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. **PH2450**

HOLE NO. **TP 6**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR						0			
TOPSOIL 0.10									
SILTY SAND with gravel and cobbles 0.25									
End of Test Pit									
Practical refusal to excavation on inferred bedrock at 0.25m depth									



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Mineral Aggregate Assessment
3119 Carp Road
Ottawa, Ontario

DATUM

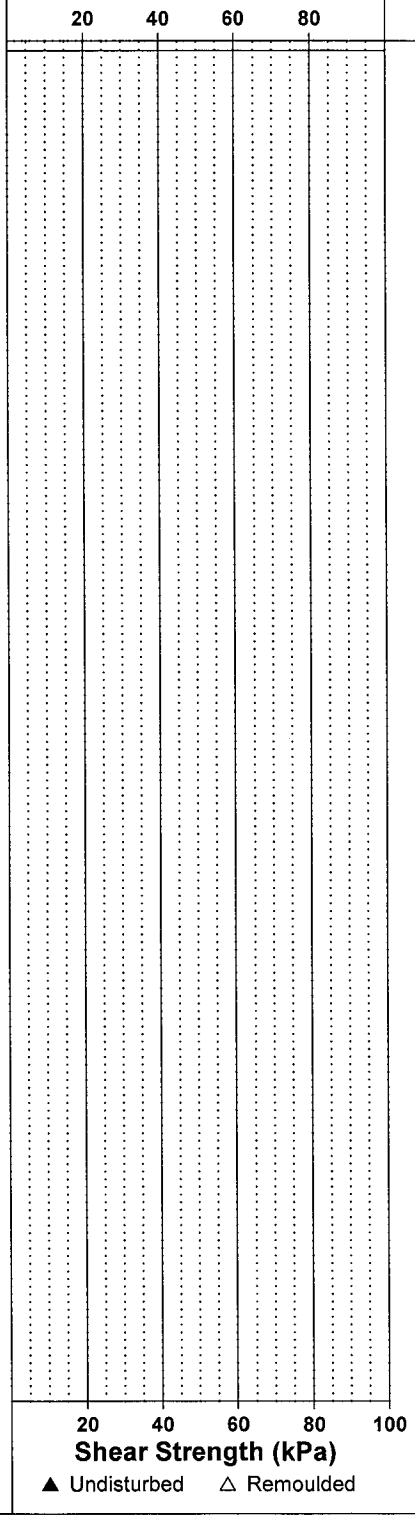
REMARKS

BORINGS BY Backhoe DATE February 7, 2014

FILE NO. **PH2450**

HOLE NO. **TP 7**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
BASEMENT FLOOR						0			
TOPSOIL 0.20									
SILTY SAND, some clay 0.45		G	11						
End of Test Pit									
Practical refusal to excavation on inferred bedrock at 0.45m depth									



Aggregate Resources Inventory Paper 191

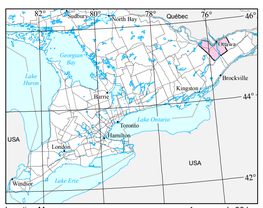
MAP 1

Sand and Gravel Resources for the City of Ottawa

Scale 1:100 000

2000 m 0 2 4 km

NTS References: 31 B/13; F/1, 8, 9; G/3, 4, 5, 6, 11, 12



Location Map 1 cm equals 80 km

SAND AND GRAVEL RESOURCES

- Selected Sand and Gravel Resource Area, primary significance; deposit number (*see* Table 3)
- Sand and gravel deposits that have been substantially extracted in the past, but where limited resources may still be available
- Selected sand and gravel resource area, secondary significance
- Sand and gravel deposit, tertiary significance
- Other surficial deposits or exposed bedrock

SYMBOLS

- Licenced property boundary; property number (*see* Table 2)
- Unlicenced sand or gravel pit (i.e., abandoned pit or wayside pit operating on demand under authority of a permit); property number (*see* Table 2)
- Borehole location; identification number (*see* Table 7)
- Sample site; identification number (*see* Table 9)
- Geological and aggregate thickness boundary of sand and gravel deposits
- Buried geological and aggregate thickness boundary of sand and gravel deposits

SOURCES OF INFORMATION

Base map information derived from National Topographic System (NTS) maps, Natural Resources Canada, scale 1:50 000, and from the Ontario Land Information Warehouse, Land Information Ontario, Ministry of Natural Resources, Ontario, scale 1:50 000, with modifications by staff of the Ministry of Northern Development and Mines.
Projection: North American Datum 1983 (NAD83), Zone 18.

Aggregate suitability data from the Ministry of Transportation, Ontario. Selected drilled water well data from the Ministry of the Environment, Ontario. Additional borehole date from the Ontario Geological Survey, Ministry of Northern Development and Mines.

Geology based on
Bélanger, J.R., Moore, A. and Prégent, A. 1997a, 1997b, 1997c
Bélanger, J.R., Moore, A., Prégent, A. and Richard, H. 1995a, 1995b, 1995c, 1995d
Ontario Geological Survey 2010
St. Onge, D.A. 1997

Additional geology by V.L. Lee, 2012. Compilation by V.L. Lee. Drafting by S.A. Evers. This map is published with the permission of the Director, Ontario Geological Survey.

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Lee, V.L. 2013. Aggregate resources inventory for the City of Ottawa, southern Ontario; Ontario Geological Survey, Aggregate Resources Inventory Paper 191, Map 1–Sand and Gravel Resources, scale 1:100 000.

[/]

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Cemeteries: Environmental Pollution and Groundwater Contamination

By Ian Langtree

Agriculture, industry and landfills are commonly believed to be the major anthropogenic sources of environmental contamination, however, little attention has been given to cemeteries as possible sources of pollution and groundwater contamination.

There are about 109,000 cemeteries in the United States that are recognized by the U.S. Geological Survey. Regardless of how many people are interred at each of these cemeteries - anywhere from one at the smallest private cemeteries to more than 260,000 at Arlington National Cemetery in Virginia.

Every year, 22,500 cemeteries across the United States bury approximately:

- 14,000 tons of steel vaults.
- 90,272 tons of steel caskets.
- 2,700 tons of copper and bronze caskets.
- 1,636,000 tons of reinforced concrete vaults.
- 30 million board feet (70,000 m3) of hardwood caskets.
- 827,060 US gallons (3,130 m3) of embalming fluid, which usually includes formaldehyde.

Coffins

Toxic chemicals from coffins that may be released into groundwater include varnishes, sealers and preservatives and metal handles and ornaments used on wooden coffins. The burial of coffins can pose an environmental and health hazard since the metals that are used in coffin-making can corrode or degrade into harmful toxins. These can leach into the surrounding soils and groundwater. Casket manufacturers are listed on the EPA's top 50 hazardous waste generators list due to chemicals such as methyl and xylene used in the protective finish sprayed on the caskets exterior (a casket that will be buried or burned).

Black and white picture of headstones in a cemetery

Wood preservatives and paints used in coffin construction contain minerals include copper naphthalene and ammoniac or chromated copper arsenate (CCA), as well as ammonium copper quaternary (ACQ) and copper boron azole (CBA). Prior to the 1940s, lead compounds were commonly used as coloring agents in paints. These toxic metals such as manganese, nickel, copper and vanadium were also identified in old paint samples. Currently, many paints still contain lead [/artman/publish/lead.shtml] , mercury, cadmium, and chromium. Arsenic [/fitness/nutrition/foodsecurity/well-arsenic.php] is used as a pigment, a wood preservative and as an anti-fouling ingredient while barium is used as a pigment and a corrosion inhibitor.

Metals are also used for the handles and other ornaments that are attached to the outside of a coffin. The fasteners and coffin ornaments also contain minerals such as zinc and zinc or copper-alloys, silver or bronze. Often these items are spray painted, vacmetalized, electroplated or a combination of these processes to enhance their aesthetic value.

Formaldehyde

The primary purpose of embalming is to delay decomposition long enough to allow the body to be viewed. Today, the main ingredient in embalming fluid is formaldehyde. The World Health Organization, and The U.S. Environmental Protection Agency, classify formaldehyde as a hazardous waste being a human carcinogen [/health/cancer/carcinogen-list.php] .

The funeral industry legally buries over three gallons of formaldehyde-based formalin embalming solution every time it inters an embalmed body. As the vast majority of casketed burials involve embalmed bodies, funeral directors oversee the burial of some three to five million gallons of formaldehyde into cemetery grounds every year - (www.utne.com/environment/arsenic-contamination-ze0z1306zpit.aspx?PageId=3)

When formaldehyde is used for embalming, it breaks down, and the chemicals released into the ground after burial and ensuing decomposition are inert. The problems with the use of formaldehyde and its constituent components in natural burial are the exposure of mortuary workers to it and the destruction of the decomposer microbes necessary for breakdown of the body in the soil. However, formaldehyde is only moderately persistent, its half-life is just two to 20 days in water, unlike arsenic, which, as a basic element, pretty much lasts forever.

Mercury

Another element of concern is mercury from dental fillings [/artman/publish/mercury-toxicity.shtml] (which, in some cases, can be composed of as much as 50 percent mercury), pacemakers, esophageal tubes, and a host of other medical products, which can leach into groundwater once the body has decayed.

Other Chemicals

Numerous toxic pesticides, fertilizers, and weed killers used to keep graveyards green and neat.

Green Burials

Billy Campbell, a rural doctor and a pioneer of the green burial movement in the USA, is reported to have opened the first modern green cemetery in North America at the Ramsey Creek Preserve in South Carolina in 1998. A green burial is a cremation alternative, and a viable alternative to "traditional" burial practices in the United States. A green burial, or natural burial, ensures the burial site remains as natural as possible in all respects. Interment of bodies is done in a bio-degradable casket, shroud, or blanket. No embalming fluid, no concrete vaults. Natural burials were long the default, and many Americans continue to rely on natural burial practices. Conservation burial uses an old practice to promote rural conservation and urban open space. More than returning nutrients to the land, the great potential for conservation burial is to conserve land, create open space, and restore natural habitats.

Embalming, expensive sealed caskets and burial vaults are not required by law. Though traditional memorial parks may require them, a green cemetery or memorial nature preserve does not. The simplicity of a green burial is in tune with nature and need not be expensive.

Resources and Citations

- *Arsenic and Old Graves*
  https://eponline.com/articles/2006/09/01/arsenic-and-old-graves.aspx
- *Til Death Do We Pollute, and Beyond: The Potential Pollution of Cemeteries and Crematoriums*
  https://archive.org/stream/tilDeathDoWePolluteAndBeyondThePotentialPollutionOfCemeteriesAnd/TillDeathDoWePollute_djvu.txt
- *Mineral Contamination from Cemetery Soils*
  www.ncbi.nlm.nih.gov/pmc/articles/PMC3315260/
- *Cemeteries, Burials & The Water Environment*
  www.doeni.gov.uk/niea/cemeteryguidance.pdf
- *Landscapes of the Dead: An Argument for Conservation Burial*
  ced.berkeley.edu/bpj/2012/09/landscapes-of-the-dead-an-argument-for-conservation-burial/
- *Concerns: Embalming and Cemetery Pollution*
  villagememorial.blogspot.ca/2015/05/pollution-from-embalming-and-cemeteries.html
- *Groundwater near cemeteries*
  www.wspgroup.com/en/WSP-UK/Who-we-are/Newsroom/features/Groundwater-near-cemeteries/
- *Arsenic Contamination in Graveyards: How the Dead Are Hurting the Environment*
  www.utne.com/environment/arsenic-contamination-ze0z1306zpit.aspx
- *Issues to Consider in Preparing for Disposition of Decedents*
  www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/comm-sanitation/burial-and-cremation.html
- *Natural burial*
  https://en.wikipedia.org/wiki/Natural_burial

APPENDIX C

Water Well Records Search

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 01(011)	18 421530 5018621[W]	1982/06 3504	06	FR 0125	026 / 120 020 / 0:30	DO		1517897 () BLUE CLAY 0008 BLCK GRNT 0128
HUNTLEY TOWNSHIP CON 02(010)	18 421930 5018421[W]	1980/10 3644	06	FR 0080	025 / 080 004 / 1:0	DO		1517377 () GREY CLAY STNS 0012 GREY LMSN SHLY 0084
HUNTLEY TOWNSHIP CON 02(010)	18 421951 5018122[W]	1960/03 4832	04 04	FR 0178	020 / 021 005 / 0:30	DO		1503064 () CLAY LOAM 0004 GREY LMSN 0180
HUNTLEY TOWNSHIP CON 02(010)	18 421891 5018222[W]	1962/04 4825	04 04	FR 0120	016 / 018 006 / 1:0	DO		1503065 () CLAY 0002 LMSN 0120
HUNTLEY TOWNSHIP CON 02(011)	18 421781 5018487[W]	1964/06 4806	06 06	FR 0105 FR 0071	020 / 090 008 / 1:0	DO		1503070 () LOAM 0004 GREY LMSN 0105
HUNTLEY TOWNSHIP CON 02(011)	18 421766 5018362[W]	1962/05 4825	04 04	FR 0125	020 / 055 006 / 1:30	DO		1503069 () PRDR 0070 LMSN 0130
HUNTLEY TOWNSHIP CON 02(011)	18 421721 5018422[W]	1961/05 4833	04 04	FR 0098	010 / 020 005 / 0:30	DO		1503068 () CLAY LOAM 0014 GREY LMSN 0100
HUNTLEY TOWNSHIP CON 02(011)	18 421921 5018437[W]	2007/08 1119	00	0340 0485	019 / 115 006 / 1:0	DO		7050820 (Z60149) A049703 SAND GRVL 0014 GREY LMSN 0500
HUNTLEY TOWNSHIP CON 02(011)	18 421830 5018321[W]	1977/08 1365	06 06	FR 0041	007 / 030 020 / 2:0	DO		1516282 () BRWN CSND BLDR 0021 WHIT SNDS CGRD 0050
HUNTLEY TOWNSHIP CON 02(011)	18 421726 5018881[W]	1988/11 3142	06 06	UK 0158 FR 0090	015 / 140 007 / 1:30	DO		1523034 (44875) BRWN SAND BLDR PCKD 0019 GREY LMSN HARD 0090 GREY LMSN SHLE PORS 0160
HUNTLEY TOWNSHIP CON 02(011)	18 421630 5018521[W]	1984/06 1558	06 06	SU 0155 SU 0250	020 / 060 015 / 1:0	ST		1519074 () BRWN SAND PCKD 0004 GREY SAND GRVL PCKD 0008 GREY LMSN SOFT 0012 GREY LMSN MGRD 0260
HUNTLEY TOWNSHIP CON 02(011)	18 421930 5018521[W]	1981/09 1558	06 06	SU 0290 FR 0030	020 / 125 005 / 1:0	DO		1517781 () BRWN SAND BLDR 0015 GREY LMSN 0250 BLCK LMSN 0298
HUNTLEY TOWNSHIP CON 02(011)	18 421630 5018521[W]	1980/10 1558	06 06	UK 0048 UK 0145	020 / 040 010 / 1:0	DO		1517526 () BRWN SAND STNS FILL 0004 BRWN CLAY BLDR SNDY 0013 GREY LMSN SOFT 0150
HUNTLEY TOWNSHIP CON 02(011)	18 421731 5018522[W]	1978/06 3644	06	FR 0060	020 / 050 006 / 1:0			1516579 () GREY HPAN GRVL 0010 GREY SHLE GRVL 0042 GREY LMSN 0064
HUNTLEY TOWNSHIP CON 02(011)	18 421943 5018748[W]	1974/07 1558	06 06	FR 0044 FR 0060	025 / 040 030 / 1:0	DO		1514247 () BRWN CLAY SAND PCKD 0006 GREY HPAN BLDR HPAN 0030 GREY LMSN FCRD 0033 GREY LMSN 0062
HUNTLEY TOWNSHIP CON 02(011)	18 421671 5018532[W]	1968/09 4806	06 06	FR 0063 FR 0129	010 / 129 006 / 1:0	DO		1512382 () SHLE 0010 GREY LMSN 0129

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 02(011)	18 421631 5018548[W]	1972/05 1558	06 06	FR 0090 FR 0138	020 / 075 007 / 1:0	DO		1511921 () BRWN SAND FILL 0003 BRWN SAND STNS 0009 GREY LMSN 0141
HUNTLEY TOWNSHIP CON 02(011)	18 421631 5018542[W]	1972/05 3644	05	FR 0139	022 / 070 005 / 1:0	DO		1511759 () GREY CLAY GRVL 0011 GREY LMSN 0139
HUNTLEY TOWNSHIP CON 02(011)	18 421851 5018392[W]	1969/07 4806	06	FR 0073 FR 0121	021 / 080 010 / 1:0	DO		1510511 () GREY SHLE 0009 GREY LMSN 0121
HUNTLEY TOWNSHIP CON 02(012)	18 421096 5018982[W]	2005/11 6574	40 35	FR 0026	021 / 021 022 / 1:0	CO	26 2	1536029 (Z28740) A035191 BRWN SAND 0016 GREY CLAY 0026 GREY GRVL 0029 GREY LMSN 0029
HUNTLEY TOWNSHIP CON 02(012)	18 421715 5019458[L]	1988/08 5222	06	FR 0163	/ 075 025 / 2:0	DO		1523175 (39009) BRWN CLAY SNDY PCKD 0018 GREY CLAY PCKD 0050 GREY CLAY SILT 0115 GREY SILT CLAY LYRD 0155 BRWN SAND GRVL CGVL 0165
HUNTLEY TOWNSHIP CON 02(012)	18 421715 5019458[L]	 5222	06 06	SU 0190 FR 0145	/ 006 / 2:0	DO		1524583 (84304) BRWN SAND SLTY PCKD 0005 BRWN SAND PCKD 0015 GREY HPAN BLDR PCKD 0027 GREY SILT 0030 GREY LMSN HARD 0200
HUNTLEY TOWNSHIP CON 02(013)	18 420631 5019702[W]	1967/09 1503	05 05	SU 0198	050 / 058 010 / 1:0	DO		1503071 () CLAY 0110 MSND 0135 LMSN 0200
HUNTLEY TOWNSHIP CON 02(014)	18 420601 5019762[W]	1969/06 1802	06	SU 0165	032 / 165 025 / 1:0	IN IR		1510130 () BRWN MSND 0006 GREY MSND CLAY 0035 GREY CLAY 0100 GREY MSND 0112 GREY MSND GRVL 0131 GREY LMSN 0200
HUNTLEY TOWNSHIP CON 03(010)	18 421900 5017952[W]	2010/02 1119	06 06	0152 0186	012 / 056 020 / 1:0	DO		7141758 (Z108236) A093679 SAND GRVL BLDR 0017 GREY LMSN 0135 GREY LMSN SNDS 0160 GREY LMSN 0200
HUNTLEY TOWNSHIP CON 03(010)	18 421567 5017859[W]	2009/10 1119	06 06	0231	016 / 099 015 / 1:0	DO		7132598 (Z102713) A089342 SAND GRVL BLDR 0052 GREY LMSN 0240
HUNTLEY TOWNSHIP CON 03(010)	18 421530 5018021[W]	1984/09 3142	06 06	FR 0069	004 / 015 040 / 4:0	DO		1519233 () RED SAND PCKD 0006 BRWN SAND PCKD 0018 GREY SAND CLAY LOOS 0052 GREY SAND GRVL STNS 0063 GREY LMSN 0070
HUNTLEY TOWNSHIP CON 03(010)	18 421807 5018216[W]	1972/10 1558	06 06	FR 0124	025 / 075 010 / 1:0	DO		1512118 () GREY GRVL SAND 0015 GREY LMSN 0125
HUNTLEY TOWNSHIP CON 03(010)	18 421624 5018051[W]	2006/02 1558	06	0118 0060		DO		1536296 (Z39257) A035418 BRWN LOAM STNS PCKD 0004 BRWN SNDS 0023 GREY SNDS STNS 0044 GREY LMSN 0123
HUNTLEY TOWNSHIP CON 03(010)	18 421668 5017988[W]	2009/03 1558	06	0140	015 / 015 012 / 2:0	DO		7123248 (Z095326) A076799 BRWN LOAM ROCK FCRD 0004 BRWN CLAY PCKD 0014 BRWN SAND WBRG 0022 GREY TILL PCKD 0032 GREY LMSN MGRD 0140
HUNTLEY TOWNSHIP CON 03(010)	18 421755 5018048[W]	2009/10 1558	06	0110 0161	016 / 020 012 / 2:0	DO		7139851 (Z101735) A076883 BRWN HPAN BLDR 0008 GREY LMSN LYRD SOFT 0020 GREY LMSN MGRD 0162

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 03(011)	18 421371 5018322[W]	1959/12 4833	04 04	FR 0122	016 / 030 007 / 0:30	ST DO		1503123 () CLAY LOAM 0012 GREY LMSN 0124
HUNTLEY TOWNSHIP CON 03(011)	18 421419 5018710[W]	1972/10 3503	06 06	UK 0071	010 / 016 020 / 0:30	DO		1514608 () GREY SAND STNS 0029 GREY SHLE SAND 0080
HUNTLEY TOWNSHIP CON 03(011)	18 421431 5018662[W]	1962/05 4825	04 04	FR 0125	016 / 035 006 / 1:0	DO		1503125 () CLAY 0006 LMSN 0127
HUNTLEY TOWNSHIP CON 03(011)	18 421741 5018272[W]	1961/09 4833	04 04	FR 0100	020 / 025 005 / 0:30	ST DO		1503124 () CLAY LOAM 0007 GREY LMSN 0101
HUNTLEY TOWNSHIP CON 03(011)	18 421631 5018442[W]	1964/09 4806	06 06	FR 0108 FR 0071	023 / 090 006 / 1:0	DO		1503126 () SHLE 0012 GREY LMSN 0108
HUNTLEY TOWNSHIP CON 03(011)	18 421691 5018272[W]	1966/03 4824	04 04	FR 0080	015 / 050 003 / 1:0	DO		1503127 () GRVL 0010 LMSN 0081
HUNTLEY TOWNSHIP CON 03(011)	18 421581 5018292[W]	1969/05 4847	04 04	FR 0060	016 / 028 005 / 0:30	DO		1510221 () LOAM MSND 0008 GREY LMSN 0111
HUNTLEY TOWNSHIP CON 03(011)	18 420854 5018003[W]	 5222	06 06	FR 0085 FR 0190	013 / 190 003 / 6:0	DO CO		1524588 (84306) BRWN LOAM PCKD 0001 BRWN CLAY SNDY PCKD 0003 GREY LMSN HARD 0200
HUNTLEY TOWNSHIP CON 03(011)	18 421532 5018171[W]	 5222	06 06	FR 0030	010 / 030 006 / 6:0	CO	30 3	1524587 (84307) BRWN LOAM PCKD 0001 BRWN CLAY PCKD 0005 BRWN CLAY SNDY FSND 0012 BRWN MSND 0023 BRWN SAND SILT MGRD 0028 BRWN MSND 0037
HUNTLEY TOWNSHIP CON 03(011)	18 421089 5018090[L]	1983/09 3644	06 06	FR 0075	025 / 060 020 / 1:0	DO		1518611 () GREY CLAY 0006 GREY SNDS 0080
HUNTLEY TOWNSHIP CON 03(012)	18 421151 5018922[W]	1960/09 4833	04 04	FR 0094	012 / 014 003 / 0:30	PS		1503128 () CLAY LOAM 0036 GREY LMSN 0096
HUNTLEY TOWNSHIP CON 03(012)	18 420234 5018316[W]	1975/04 2801	05	FR 0003	003 / 008 010 / 4:0	PS	10 5	1514738 () RED SAND DRTY LOOS 0003 CSND FSND GRVL 0015 GREY CLAY SOFT 0022
HUNTLEY TOWNSHIP CON 03(012)	18 420185 5018212[W]	1975/04 2801						1514737 () RED SAND DRTY LOOS 0003 GREY CSND FSND LOOS 0011 GREY SAND SILT CLAY 0024 GREY CLAY SOFT 0061
HUNTLEY TOWNSHIP CON 03(012)	18 420686 5018556[L]	1985/05 1558	06 05	SU 0220	030 / 125 005 / 1:0	DO		1519713 () BRWN SAND 0005 GREY SAND GRVL WBRG 0023 GREY CLAY 0089 GREY LMSN 0225
HUNTLEY TOWNSHIP CON 03(012)	18 420152 5018314[W]	2005/06 6574	06	0148	019 / 051 001 / 1:0			1536026 (Z28727) A029175 BRWN SAND SILT PCKD 0027 BLUE CLAY WBRG 0086 GREY SAND GRVL DNSE 0090 GREY LMSN 0325

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP CON 03(012)	18 421126 5018996[W]	1972/12 1558	06 06	SU 0080 SU 0187	010 / 050 015 / 2:0	IN		1512197 () BRWN GRVL SAND PCKD 0003 BRWN SAND PCKD 0018 GREY SAND PCKD 0032 GREY CLAY LOOS 0042 GREY SAND GRVL STNS 0047 BLCK LMSN 0188
HUNTLEY TOWNSHIP CON 03(012)	18 420686 5018556[L]	1986/10 5222	06 06	FR 0023	007 / 023 006 / 3:0	DO	23 3	1521050 (02025) BRWN FSND LOOS 0017 BRWN SAND CGVL 0026 GREY CLAY PCKD 0026
HUNTLEY TOWNSHIP CON 03(012)	18 421227 5018949[W]	1973/04 1836	06	SU 0256	015 / 100 008 / 1:0	DO		1513273 () YLLW SAND 0020 HPAN 0032 GREY LMSN 0260
HUNTLEY TOWNSHIP CON 03(012)	18 420489 5018547[W]	1975/04 2801	05	FR 0003	003 / 011 060 / 1:0			1514739 () RED SAND DRTY LOOS 0002 BRWN SAND LOOS 0018 SAND FGVL LOOS 0023 GREY FSND SILT CLAY 0025 GREY CLAY SOFT 0038
HUNTLEY TOWNSHIP CON 03(013)	18 420831 5019422[W]	1978/11 1558	06 06	FR 0145	040 / 055 025 / 1:0	DO		1516828 () BRWN CLAY BLDR 0021 GREY HPAN BLDR PCKD 0035 GREY LMSN SOFT 0145
HUNTLEY TOWNSHIP CON 03(013)	18 420813 5019053[W]	2005/09 6574	06 06	0090	019 / 035 / :0	MN PS	86 4	1535787 (Z28731) A029180 BLCK LOAM 0001 BRWN SAND 0015 BRWN SAND 0022 GREY GRVL 0027 GREY SILT 0035 GREY CLAY HARD 0048 BLUE CLAY WBRG 0072 GREY CLAY HARD 0082 GREY GRVL PCKD 0090
HUNTLEY TOWNSHIP CON 03(013)	18 420701 5019542[W]	1958/06 4832	05 04 03 03	SU 0183	028 / 045 003 / 3:0	DO		1503129 () PRDR 0140 HPAN 0152 LMSN 0187
HUNTLEY TOWNSHIP CON 03(013)	18 420436 5019162[W]	1975/02 1558	06 06	SU 0167	018 / 030 020 / 2:0	DO		1514573 () BRWN SAND SILT PCKD 0030 BLUE CLAY LOOS 0115 GREY SAND CLAY PCKD 0123 BLCK LMSN 0175
HUNTLEY TOWNSHIP CON 03(013)	18 420291 5019026[L]	1985/09 3142	06	FR 0024	006 / 015 020 / 1:0	DO		1520137 () GREY CLAY SAND PCKD 0020 GREY GRVL LOOS 0025
HUNTLEY TOWNSHIP CON 03(013)	18 420424 5019205[W]	2004/09 1119	02 06 02			NU	133 10 2 11	1535240 (Z19014) A018872 CLAY 0127 GREY LMSN 0144
HUNTLEY TOWNSHIP CON 03(013)	18 420930 5019321[W]	1981/11 4006	06 06	FR 0083 FR 0185	008 / 200 004 / 1:0	DO		1517689 () GREY CLAY PCKD 0015 GREY SILT STNS PCKD 0057 GREY SAND CMTD 0061 GREY TILL STNS PCKD 0079 GREY GRNT MGRD 0215
HUNTLEY TOWNSHIP CON 03(014)	18 420155 5019475[W]	2004/09 1119	06 02 02			NU	119 10 2 9	1535239 (Z19016) A018880 CLAY 0114 GREY LMSN 0129
HUNTLEY TOWNSHIP CON 03(015)	18 419327 5019365[W]	2009/06 1844						7127229 (M04486) A074638 BRWN LOAM 0000 GREY CSND GRVL 0006 GREY ROCK SAND GRVL 0008 GREY SAND GRVL ROCK 0009 GREY SILT CLAY SAND 0012

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HUNTLEY TOWNSHIP 02(012)	18 421372 5018928[W]	2007/05 6907						7049976 (Z50987) A017504
HUNTLEY TOWNSHIP 03(010)	18 421718 5018158[W]	2010/07 1558	06	0230	021 / 024 010 / 2:0	DO		7151500 (Z115581) A102298 BRWN LOAM 0002 BRWN SHLE SOFT 0018 GREY LMSN LYRD SOFT 0231
HUNTLEY TOWNSHIP ()	18 420944 5019366[W]	2006/07 7241	02				5 8	7035379 (Z51855) A046053 BRWN LOAM LOOS 0004 BRWN SAND SILT 0012 GREY CLAY SILT WBRG 0013
HUNTLEY TOWNSHIP ()	18 421630 5018027[W]	2010/10 1558						7156095 (Z115626) A102342
HUNTLEY TOWNSHIP ()	18 420326 5019172[W]	2006/07 1844	02				0 12	1536752 (Z50484) A045182 BRWN SAND FILL FGRD 0003 GREY SAND WBRG 0008 GREY SAND SLTY WBRG 0012
HUNTLEY TOWNSHIP ()	18 420301 5019145[W]	2008/07 1844						7120701 (M04547) A045182
OTTAWA CITY ()	18 420263 5019179[W]	2009/06 1844						7127228 (M04487)
RUSSELL TOWNSHIP CON 04(022)	18 420609 5018335[W]	2005/08 1414	06	FR 0072	025 / 034 004 / 1:0	DO		5606152 (Z27954) A021433 RED SHLE 0078

Notes:
1. UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
2. Date Work Completed
3. Well Contractor Licence Number
4. Casing diameter in inches
5. Unit of Depth in Feet
6. See Table 4 for Meaning of Code
7. STAT LVL: Static Water Level in Feet ; PUMP LVL: Water Level After Pumping in Feet
8. Pump Test Rate in GPM, Pump Test Duration in Hour : Minutes
9. See Table 3 for Meaning of Code
10. Screen Depth and Length in feet
11. See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	…	Code	Description	…	Code	Description	…	Code	Description	…	Code	Description
BLDR	BOULDERS		FCRD	FRACTURED		IRFM	IRON FORMATION		PORS	POROUS		SOFT	SOFT
BSLT	BASALT		FGRD	FINE-GRAINED		LIMY	LIMY		PRDG	PREVIOUSLY DUG		SPST	SOAPSTONE
CGRD	COARSE-GRAINED		FGVL	FINE GRAVEL		LMSN	LIMESTONE		PRDR	PREV. DRILLED		STKY	STICKY
CGVL	COARSE GRAVEL		FILL	FILL		LOAM	TOPSOIL		QRTZ	QUARTZITE		STNS	STONES
CHRT	CHERT		FLDS	FELDSPAR		LOOS	LOOSE		QSND	QUICKSAND		STNY	STONEY
CLAY	CLAY		FLNT	FLINT		LTCL	LIGHT-COLOURED		QTZ	QUARTZ		THIK	THICK
CLN	CLEAN		FOSS	FOSILIFEROUS		LYRD	LAYERED		ROCK	ROCK		THIN	THIN
CLYY	CLAYEY		FSND	FINE SAND		MARL	MARL		SAND	SAND		TILL	TILL
CMTD	CEMENTED		GNIS	GNEISS		MGRD	MEDIUM-GRAINED		SHLE	SHALE		UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE		GRNT	GRANITE		MGVL	MEDIUM GRAVEL		SHLY	SHALY		VERY	VERY
CRYS	CRYSTALLINE		GRSN	GREENSTONE		MRBL	MARBLE		SHRP	SHARP		WBRG	WATER-BEARING
CSND	COARSE SAND		GRVL	GRAVEL		MSND	MEDIUM SAND		SHST	SCHIST		WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED		GRWK	GREYWACKE		MUCK	MUCK		SILT	SILT		WTHD	WEATHERED
DLMT	DOLOMITE		GVLY	GRAVELLY		OBDN	OVERBURDEN		SLTE	SLATE			
DNSE	DENSE		GYPS	GYPSUM		PCKD	PACKED		SLTY	SILTY			
DRTY	DIRTY		HARD	HARD		PEAT	PEAT		SNDS	SANDSTONE			
DRY	DRY		HPAN	HARDPAN		PGVL	PEA GRAVEL		SNDY	SANDY			

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Water Use

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

4. Water Detail

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

APPENDIX D

Record of Test Pit Sheets

PROJECT: 11-037

RECORD OF TEST PIT 11-1

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL, trace roots							Backfilled with excavated material
	Grey SILTY CLAY, occasional sand pocket (weathered crust)		0.15	1				
1								20 mm diameter, 0.61 metres long slotted well screen
	Grey SILTY CLAY, trace gravel		1.52					
2	End of test pit		1.96					Groundwater conditions observed at 0.37 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-2

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown fine to medium SILTY SAND		0.25					
	Brown SILTY CLAY (weathered crust)		0.55					
1								
	End of test pit		1.68					
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-3

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.08					
	Dark brown fine to coarse SAND, trace silt, some gravel, trace boulders becoming lighter by 0.56 metres depth			1				
1								
2								
	End of test pit		2.59					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-4

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Brown fine SILTY SAND, trace organic material		0.18	1				
	Grey brown SANDY SILT with clay		0.51	2				
1	Grey SANDY SILT and CLAY		0.66	3				
2	Grey, fine SILTY SAND, some clay with intervals of 0.15 metres silty clay seams, cobbles and trace boulders with depth		1.68	4				
3	End of test pit		3.20					
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-5

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Brown silty sand, trace organic material (TOPSOIL)							Backfilled with excavated material
			0.20					
1	Brown fine to medium SAND, some gravel and cobbles							
2								20 mm diameter, 0.61 metres long slotted well screen
	End of test pit Refusal on inferred smooth surfaced bedrock		2.44					Groundwater conditions observed at 2.05 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-6

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Dark brown SILTY SAND, trace organic material		0.05					
	Reddish brown fine SAND, trace organic material and silt		0.23	1				
	Grey fine SAND, some silt		0.69	2				
1								
	Test pit terminated on smooth surfaced bedrock		1.75					
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-7

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Brown silty sand, TOPSOIL							
	Test pit terminated on smooth surfaced bedrock		0.25					
1								
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-8

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	Dark brown TOPSOIL							
	Brown fine SAND		0.20					
	Test pit terminated on smooth surfaced bedrock		0.36					
1								
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-9

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) — Natural. V - +, Remoulded. V - ⊕ (20, 40, 60, 80)	WATER CONTENT (PERCENT) — Wp, W, Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.05					
	Brown SILTY SAND, trace organic material, small rootlets		0.20					
1	Brown SILTY SAND, some gravel, cobbles and boulders							
	Test pit terminated on smooth surfaced bedrock		1.37					
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-10

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 20, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.08					
	Brown SILTY SAND, trace organic material		0.25					
1	Grey brown SILTY SAND, some gravel, cobbles and boulders							Backfilled with excavated material; 20 mm diameter, 0.61 metres long slotted well screen
	End of test pit Refusal on inferred bedrock or boulder		1.47					Groundwater conditions observed at 1.33 metres below ground surface on June 30, 2011.
2								
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-11

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) — Natural. V - +, Remoulded. V - ⊕ (20, 40, 60, 80)	WATER CONTENT (PERCENT) — Wp, W, Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.08					
	Dark brown SILTY SAND, trace small rootlets		0.30					
	Reddish brown fine to medium SAND		0.77					
1	Brown grey fine to medium SAND		1.00					
	Grey SILTY SAND, trace gravel and shells		1.70					
2	Grey SILTY SAND, some clay, some gravel and shells		2.30					
	Grey SAND		2.70					
3	End of test pit							
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

RECORD OF TEST PIT 11-12

PROJECT: 11-037

LOCATION: See Test Pit Location Plan, Figure 2

DATE OF EXCAVATION: June 17, 2011

SHEET 1 OF 1

DATUM:

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) (Natural. V - +, Remoulded. V - ⊕) 20 40 60 80	WATER CONTENT (PERCENT) Wp W Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL							
	Reddish brown fine SILTY SAND with trace organic material turning brown grey by 0.3 metres depth		0.09	1				Backfilled with excavated material
1	Grey fine SILTY SAND to SANDY SILT, trace shells and gravel		0.75	2				
	Brown grey fine to medium SAND		1.40	3				20 mm diameter, 0.61 metres long well screen
2	End of test pit		2.20					Groundwater conditions observed at 1.38 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-13

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.10	1				
	Reddish brown fine to medium SAND, trace silt and organic material		0.40					
	Brown fine to medium SAND, some silt, trace gravel			2				
1	Brown fine to medium SAND, trace silt		1.00	3				
	Grey SAND, occasional shells with depth		1.20					
2								
	End of test pit		2.59					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

RECORD OF TEST PIT 11-14

PROJECT: 11-037

LOCATION: See Test Pit Location Plan, Figure 2

DATE OF EXCAVATION: June 17, 2011

SHEET 1 OF 1

DATUM:

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.08					
	Reddish brown fine to medium SAND, trace silt			1				
	Grey brown fine to medium SAND		0.48					
1	Grey brown SILTY SAND with some clay		0.82	2				
	Grey SILTY SAND, some shells		1.43					
	Grey brown fine to coarse SAND, trace silt		1.77	3				
2	End of test pit		2.80					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-15

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							Backfilled with excavated material
	TOPSOIL							
	Brown grey fine SAND		0.15					
	Brown SILTY SAND, trace clay		0.53	1				
1	Grey SILTY SAND		1.09	2				
	Grey SILTY SAND, trace shells		1.35					
2	Grey SILTY CLAY and fine sand		1.91	3				20 mm diameter, 0.61 metres long slotted well screen
	Grey fine SAND, some silt		2.44	4				
	End of test pit		2.74					Groundwater conditions observed at 0.45 metres below ground surface on June 30, 2011.
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-16

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.10					
	Dark brown to brown fine to medium SAND			1				
	Grey brown fine to medium SAND		0.81					
1	Brown grey SILTY CLAY (weathered crust)		1.04	2				
2	Grey SILTY CLAY, trace rounded gravel, trace shells		1.93					
	End of test pit		2.44					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-17

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ (20 40 60 80)	WATER CONTENT (PERCENT) Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.10					
	Dark brown SILTY SAND, trace organic material		0.24					
	Reddish brown fine to medium SAND becoming grey brown by 0.48 metres depth		0.86					
1	Brown grey SILTY SAND, some clay seams grey with shells by 1.83 metres depth		1.83					
2	Grey medium SAND		2.44					
	Grey SILTY CLAY		2.97					
3	End of test pit							
4								

DEPTH SCALE
1 to 20

Houle Chevrier Engineering

LOGGED: M.L.
CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

PROJECT: 11-037

RECORD OF TEST PIT 11-18

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM:

DATE OF EXCAVATION: June 17, 2011

TYPE OF EXCAVATOR: Backhoe

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) — Natural. V - +, Remoulded. V - ⊕ (20, 40, 60, 80)	WATER CONTENT (PERCENT) — Wp, W, Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface							
	TOPSOIL		0.09					
	Dark brown SILTY SAND, trace rootlets		0.23					
	Brown fine to medium SAND, trace silt			1				
1	Brown fine to medium SAND		0.91	2				
	becoming grey by 1.09 metres depth							
2								
	Grey SILTY CLAY		2.29					
	End of test pit		2.59					
3								
4								

DEPTH SCALE

1 to 20

Houle Chevrier Engineering

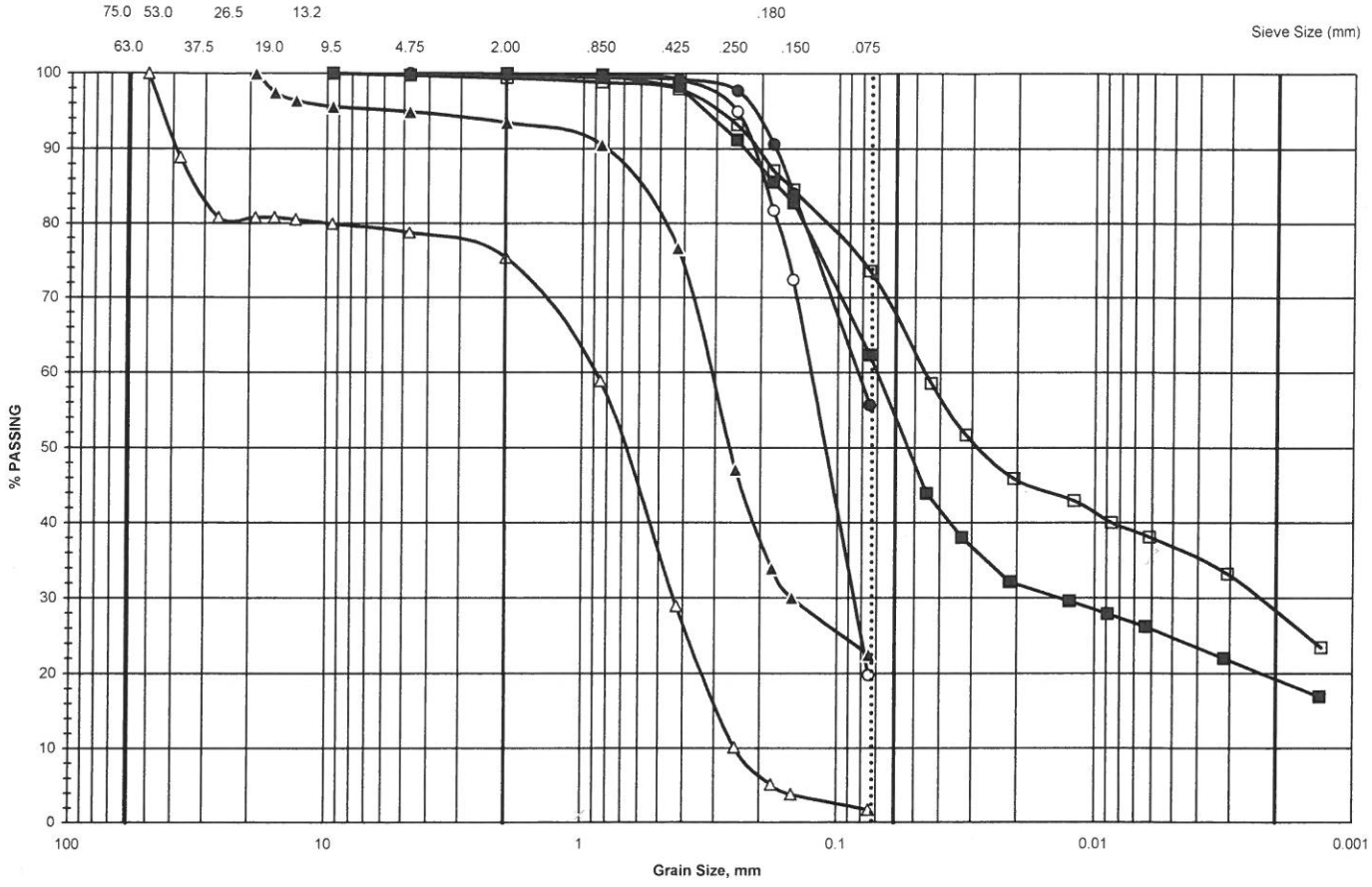
LOGGED: M.L.

CHECKED:

TESTPIT LOG PRE 2015 GINT 11-037 TP 1-18.GPJ HOULE CHEVRIER FEB 9 2011.GDT 23/7/15

GRAIN SIZE ANALYSIS

FIGURE



	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
	GRAVEL			SAND			SILT			
Modified M.I.T. Classification										

Test Pit	Sample	Depth (m)	Legend
11-3	1	0.61 - 0.91	△
11-4	4	2.44 - 3.05	■
11-6	2	0.91 - 1.22	○
11-13	2	0.50 0.70	▲
11-14	2	0.95 - 1.25	□
11-15	3	1.98 - 2.44	●

Houle Chevrier Engineering

Date: July 2011
Project : 11-037

APPENDIX E

Carp Road Corridor - Nitrate Impact Assessment Recommendations

MEMO / NOTE DE SERVICE

To / Destinataire	Adam Brown, Manager DRS Rural	File/N° de fichier:
From / Expéditeur	Jeff McEwen, Program Manager DRS Rural	
Subject / Objet	Carp Road Corridor – Nitrate Impact Assessment Recommendations	Date: 27 September 2016

This memo is intended to provide developers and their consultants with guidance in the application of the MOECC D-5-4 guidelines within the Carp Road Corridor. Many of the undeveloped sections of the Carp Road Corridor are currently zoned: 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 above zoning stipulates that *"It should be noted that lots serviced by private services may require lot sizes larger than that necessary to meet zone provisions in order to accommodate the servicing systems capable of handling the increased levels of water consumption and sewage generation that may be associated with these uses.*"

Typically the minimum lot size is determined at the draft plan of subdivision stage, and then the zoning is applied that matches the draft plan approval. In the Carp Road Corridor the zoning reflects the land uses proposed in the Carp Road Corridor Community Design Plan (CDP). As such, the Plan of Subdivision applications are implementing the CDP, with the zoning already in place.

The evaluation of Hydrogeological and Terrain Analysis for official plan amendments, zoning bylaw amendments and subdivision applications is currently reviewed, as per a memorandum of understanding with the City of Ottawa, by the local conservation authorities. Recently, during the course of a technical review for a subdivision application and in respect to several pre-consultations for development along the Carp Road Corridor, it has become apparent that there are significant challenges for proposed development along the corridor to meet both the intended zoning and the provincial D-series guidance.

The Mississippi Conservation Authority has provided the below advice to clarify the acceptable scope for nitrate attenuation assessments undertaken in support of Carp Road Corridor subdivision and severance applications. This advice only applies to the development under the 2004 Carp Road Corridor Community Design Plan.

Procedure D-5-4 Considerations

It is understood that the City of Ottawa maintains that Section 5.6.3 of MOECC Procedure D-5-4 should be addressed for all privately serviced industrial / commercial development along the Carp Road Corridor, to determine the available infiltration; maximum allowable flow; and maximum number of users. This is found to be in keeping with the zoning provision cited above.

Available Infiltration

The available infiltration, as per the MOECC's advice is estimated from amongst several other factors, impermeable areas. MVCA recommends that the proponent use the zoning provisions as a starting point for determination of lot size and impervious areas in their calculations.

MVCA further recommends that the City also allow accommodation of the advice in the following sections of the D-5-4 guidelines:

1) *"Storm water management facilities may also contribute to infiltration. However, they may also detract from infiltration by directing water away from the tile bed areas. These facilities should be considered as part of determination of available infiltration"* (Annotation to Section 5.6.2 b iv in 'Hydrogeological Technical Information Requirements for Land Development Applications')

   Clean storm water infiltration measures should therefore be accounted for in the estimation of 'available infiltration', in consideration of the following points.

   a) Most of the terrain along the Carp Road corridor is sandy and therefore suitable for clean storm water infiltration.

      i) Measured representative infiltration rates would need to be obtained to characterize the local variability in infiltration rates. Infiltration rates would need to be determined at the soil horizon on which the effluent disposal bed would lie.

      ii) It is understood that the City prefers the use of a Double-Ring Infiltrometer (DRI) or the Guelph Permeameter to assess infiltrative capacity.

   b) Clean storm water infiltrate volumes should be determined by the applicant's storm water engineer, to the satisfaction of the City of Ottawa's storm water engineer.

      i) Where natural features (i.e. streams and wetlands) are further than 120 meters down gradient of the subdivision property, clean storm water infiltration should be accounted as monthly or annual average amounts for the subdivision as a whole.

ii) Where natural features are within 120 meters down gradient of the subdivision boundary or severed lot boundary, clean storm water infiltration should be accounted as monthly or seasonal average amounts for specific natural feature catchments.

c) The proponent should demonstrate that the additional infiltrate will dilute septic system effluent by the time it reaches the down gradient property boundary.

i) The property boundary should be considered to be the subdivision boundary or lot boundary for severances.

ii) For subdivision applications, the down gradient property boundary should be determined from hydraulic gradients in the receiving groundwater that are measured on-site.

iii) For severance applications, the down gradient property boundary can be estimated from the groundwater study that was completed in support of the CDP. (Dillon 2004)

d) However, the proponent will have to demonstrate that the proposed infiltration will occur indefinitely.

Maximum Allowable Flow and Number of Users

In addition, MVCA recommends that the City also consider allowing proponents to undertake the nitrate attenuation assessment as a modified predictive assessment for residential development (Section 5.6.2) in which the following points would be accounted for. This would also meet the overall intentions of Procedure D-5-4.

4) The maximum allowable flow for each lot /block would be determined by the proponent as that which corresponds to a maximum number of users (rather than 1000 L/day, as per Section 5.6.2 and rather than a calculated number based on Section 5.6.3).

a) The Ottawa Septic System Office (OSSO) has indicated that the use of 75 L/day per employee is suitable.

5) Section 3.0 in Procedure D-5-4 says that "*This guideline may not apply to non-standard individual on-site systems which are specifically designed to reduce nitrate loadings. It should be emphasized that MOEE encourages the development of new technologies for the treatment of domestic sewage waste.*"

There are now available on the market nitrogen reduction treatment systems, certified by third body organizations (such as CAN/BQN 3680-600 or NSF 245), that achieve a minimum of 50% reduction in nitrogen. As a result, they could be incorporated into the private servicing plan for the corridor. Since they disperse better quality effluent, these effluent treatment levels could be used to estimate a

(modified) minimum concentration of nitrate (as nitrogen) that could be used in the nitrate attenuation assessment, in consideration of the following points.

a) In the opinion of the OSSO, the above nitrate reduction systems designed, installed and inspected according to the OBC are safer for ground water protection than conventional systems.

b) Nitrate loading should be calculated in consultation with the OSSO.

c) In addition, the OSSO requires ground elevation surveys to confirm the existing high groundwater table elevation, so that the proper vertical separation distances can be established during septic system installation even after grade changes occur on-site.

d) Further, the proponent should provide for mechanisms to reasonably ensure that the intended nitrate loading will be maintained indefinitely. Towards this end, it is understood that:

    i) Certified nitrate reduction treatment units require a maintenance agreement between the owner and maintenance provider. The Ottawa Septic Office currently maintains enforcement of these agreements.

    ii) The owner/consultants should contact the OSSO regarding additional fees for the monitoring and reporting requirements of the above treatment systems

    iii) In addition, the City should include draft plan conditions that require the commendations of the nitrate attenuation assessment in the subdivision agreement such that future site plan control applications would also require nitrate reduction systems.

Other Considerations

6) All privately serviced subdivisions in the City of Ottawa require provision of a monitoring well. For development within the Carp Road Corridor, these monitoring wells could be purpose-built to monitor both the receiving groundwater quality and the groundwater supply levels and quality.

7) High Recharge Areas identified as an Environmental Feature in Schedule 2 of the Carp Road Corridor CDP require the below consideration.
    a) Hydrogeological assessments in support of development applications, where private septic systems are proposed, require an assessment of nitrate impact. Consideration should also be given to the designation of a High Recharge Area in the CDP; this may include an additional assessment of pre- and post- water budget to determine the change in recharge and potential impact to the regional hydrogeological system. Additional infiltration measures to maintain recharge within the high recharge areas may be recommended to maintain recharge.

APPENDIX F

Nitrate Dilution Calculations and Water Surplus Data Sheets

TABLE F1: Daily Design Sanitary Sewer Flow (DDSSF) Calculations

Lot	Width	Depth	Area m^2	Soil Cover [2]	Surplus [3]	Topo Factor	Soil Factor	Cover Factor	Infiltration Factor [4]	Precipitation Surplus (m^3/year)	Scenario No. 1 (40% hard surface and use of conventional setpci systems)[1] Available infiltration (litres per day)	Maximum septic flow (litres per day)	Maximum septic flow (litres per day) - Incorporating Background Nitrate [5]	Maximum number of users [6]
1	60.76	133.14	8089.6	Sand	402	0.20	0.40	0.10	0.70	3252	3742	1247	1123	15
2	60.77	133.14	8090.9	Silty Sand to Silty Clay	341	0.20	0.20	0.10	0.50	2759	2268	756	680	9
3	60.77	133.14	8090.9	Sand to Silty Clay	341	0.20	0.20	0.10	0.50	2759	2268	756	680	9
4	56.50	144.52	8165.4	Silty Sand	378	0.20	0.30	0.10	0.60	3087	3044	1015	913	12
5	56.50	144.30	8153.0	Sand	402	0.20	0.40	0.10	0.70	3277	3771	1257	1131	15
6	56.50	144.39	8158.0	Sand	402	0.20	0.40	0.10	0.70	3280	3774	1258	1132	15
7	57.30	144.49	8279.3	Sand	328	0.20	0.40	0.20	0.80	2716	3571	1190	1071	14
8	71.50	120.83	8639.3	Sand overlying bedrock	328	0.20	0.40	0.20	0.80	2834	3727	1242	1118	15
9	68.32	120.12	8206.6	Sand overlying bedrock	328	0.20	0.40	0.20	0.80	2692	3540	1180	1062	14
10	152.44	143.11	21815.7	Silty Sand	328	0.20	0.30	0.20	0.70	7156	8234	2745	2470	33
11	84.94	182.33	15487.1	Silty Sand	378	0.20	0.30	0.10	0.60	5854	5774	1925	1732	23
12	74.24	182.32	13535.4	Sand	402	0.20	0.40	0.10	0.70	5441	6261	2087	1878	25

Notes:

1 Scenario No. 1 values are calculated under the following:
- a) A total of 40% hard surface from which runoff is not available for infiltration
- b) Incorporates a value of 40 mg/L nitrate in the discharged effluent from a conventional septic system

2 Soil cover information obtained from on-site test pits

3 Water surplus obtained from Environment Canada Water Surplus Datasets (Ottawa International Airport (1939-2013)

4 Infiltration factor obtained from "MOEE Hydrogeological Technical Requirements for Land Development Applications" dated April 1995

5 Maximum septic flow calculated incorporating the average background nitrate concentration of 0.75 mg/L, based on MECP D-5-4 equation (40mg/L x Flow) / (Flow + Infiltration) = 10mg/L - Background

6 Maximum number of users based on Carp Road Corridor Memo, dated Setpemebr 27, 2016 of 75 litres per employee per day

Lot	Width	Depth	Area m^2	Soil Cover [2]	Surplus [3]	Topo Factor	Soil Factor	Cover Factor	Infiltration Factor [4]	Precipitation Surplus (m^3/year)	Scenario No. 2 (40% hard surface and use of tertiary treatment)[1] Available infiltration (litres per day)	Maximum septic flow (litres per day)	Maximum septic flow (litres per day) - Incorporating Background Nitrate [5]	Maximum number of users [6]
1	60.76	133.14	8089.6	Sand	402	0.20	0.40	0.10	0.70	3252	3742	3742	3218	43
2	60.77	133.14	8090.9	Silty Sand to Silty Clay	341	0.20	0.20	0.10	0.50	2759	2268	2268	1950	26
3	60.77	133.14	8090.9	Sand to Silty Clay	341	0.20	0.20	0.10	0.50	2759	2268	2268	1950	26
4	56.50	144.52	8165.4	Silty Sand	378	0.20	0.30	0.10	0.60	3087	3044	3044	2618	35
5	56.50	144.30	8153.0	Sand	402	0.20	0.40	0.10	0.70	3277	3771	3771	3243	43
6	56.50	144.39	8158.0	Sand	402	0.20	0.40	0.10	0.70	3280	3774	3774	3245	43
7	57.30	144.49	8279.3	Sand	328	0.20	0.40	0.20	0.80	2716	3571	3571	3071	41
8	71.50	120.83	8639.3	Sand overlying bedrock	328	0.20	0.40	0.20	0.80	2834	3727	3727	3205	43
9	68.32	120.12	8206.6	Sand overlying bedrock	328	0.20	0.40	0.20	0.80	2692	3540	3540	3044	41
10	152.44	143.11	21815.7	Silty Sand	328	0.20	0.30	0.20	0.70	7156	8234	8234	7081	94
11	84.94	182.33	15487.1	Silty Sand	378	0.20	0.30	0.10	0.60	5854	5774	5774	4966	66
12	74.24	182.32	13535.4	Sand	402	0.20	0.40	0.10	0.70	5441	6261	6261	5385	72

Notes:

1 Scenario No. 2 values are calculated under the following:
- a) Carried out in accordance with Section 5.6.3 of the MOECC Procedure D-5-4 & the "Carp Road Corridor - Nitrate Impact Assessment Recommendations" dated September 27, 2016
- b) Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system
- c) The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing 20 mg/L of Nitrate in the effluent discharging from tertiary treatment
- d) A total of 40% hard surface from which runoff is not available for infiltration

2 Soil cover information obtained from on-site test pits

3 Water surplus obtained from Environment Canada Water Surplus Datasets (Ottawa International Airport (1939-2013)

4 Infiltration factor obtained from "MOEE Hydrogeological Technical Requirements for Land Development Applications" dated April 1995

5 Maximum septic flow calculated incorporating the average background nitrate concentration of 0.75 mg/L, based on MECP D-5-4 equation (20mg/L x Flow) / (Flow + Infiltration) = 10mg/L - Background

6 Maximum number of users based on Carp Road Corridor Memo, dated Setpemebr 27, 2016 of 75 litres per employee per day

Ottawa Intl A WATER BUDGET MEANS FOR THE PERIOD 1939-2013 DC20492

LAT.... 45.32 WATER HOLDING CAPACITY... 50 MM HEAT INDEX... 36.57
LONG... 75.67 LOWER ZONE..... 30 MM A..... 1.078

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-10.7	62	11	14	0	0	0	25	85	50	296
28- 2	-9.0	55	10	16	1	1	0	25	115	50	352
31- 3	-2.7	66	31	79	6	6	0	104	71	50	418
30- 4	5.7	71	67	76	32	32	0	111	0	50	489
31- 5	13.0	76	76	0	80	79	-1	14	0	33	566
30- 6	18.3	84	84	0	116	98	-19	5	0	15	649
31- 7	20.9	86	86	0	136	93	-42	2	0	5	735
31- 8	19.6	83	83	0	117	80	-37	1	0	7	818
30- 9	14.7	84	84	0	75	65	-10	7	0	19	902
31-10	8.2	75	75	0	37	36	-1	22	0	37	76
30-11	1.3	78	60	8	10	10	0	47	10	48	154
31-12	-7.1	81	27	15	1	1	0	39	49	50	234
AVE	6.0 TTL	901	694	208	611	501	-110	402			

Ottawa Intl A STANDARD DEVIATIONS FOR THE PERIOD 1939-2013 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	2.9	26	15	18	1	1	0	29	45	0	59
28- 2	2.5	27	14	25	1	1	0	35	60	0	63
31- 3	2.6	28	22	50	5	5	0	57	90	0	70
30- 4	1.8	31	32	91	9	9	0	91	3	2	78
31- 5	1.9	32	32	3	12	11	5	23	0	19	90
30- 6	1.2	39	39	0	8	25	26	17	0	19	101
31- 7	1.1	40	40	0	8	31	32	11	0	14	104
31- 8	1.3	38	38	0	8	29	32	5	0	15	117
30- 9	1.4	40	40	0	8	16	16	19	0	21	124
31-10	1.5	36	36	1	7	7	2	26	0	19	36
30-11	1.7	27	27	8	4	4	0	29	13	6	45
31-12	2.9	30	23	14	1	1	0	30	35	0	56

Ottawa Intl A WATER BUDGET MEANS FOR THE PERIOD 1939-2013 DC20492

LAT.... 45.32 WATER HOLDING CAPACITY... 75 MM HEAT INDEX... 36.57
LONG... 75.67 LOWER ZONE..... 45 MM A..... 1.078

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-10.7	62	11	14	0	0	0	24	85	74	296
28- 2	-9.0	55	10	16	1	1	0	25	115	74	352
31- 3	-2.7	66	31	79	6	6	0	104	71	75	418
30- 4	5.7	71	67	76	32	32	0	111	0	75	489
31- 5	13.0	76	76	0	80	80	0	14	0	57	566
30- 6	18.3	84	84	0	116	107	-9	5	0	29	649
31- 7	20.9	86	86	0	136	103	-33	2	0	10	735
31- 8	19.6	83	83	0	117	82	-35	1	0	10	818
30- 9	14.7	84	84	0	75	65	-10	4	0	25	902
31-10	8.2	75	75	0	37	36	-1	14	0	51	76
30-11	1.3	78	60	8	10	10	0	38	10	70	154
31-12	-7.1	81	27	15	1	1	0	36	49	74	234
AVE	6.0 TTL	901	694	208	611	523	-88	378			

Ottawa Intl A STANDARD DEVIATIONS FOR THE PERIOD 1939-2013 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	2.9	26	15	18	1	1	0	29	45	3	59
28- 2	2.5	27	14	25	1	1	0	35	60	3	63
31- 3	2.6	28	22	50	5	5	0	56	90	0	70
30- 4	1.8	31	32	91	9	9	0	91	3	2	78
31- 5	1.9	32	32	3	12	12	0	23	0	22	90
30- 6	1.2	39	39	0	8	18	18	17	0	29	101
31- 7	1.1	40	40	0	8	31	32	10	0	21	104
31- 8	1.3	38	38	0	8	29	31	4	0	21	117
30- 9	1.4	40	40	0	8	16	16	15	0	29	124
31-10	1.5	36	36	1	7	7	2	22	0	28	36
30-11	1.7	27	27	8	4	4	0	33	13	12	45
31-12	2.9	30	23	14	1	1	0	31	35	4	56

Ottawa Intl A WATER BUDGET MEANS FOR THE PERIOD 1939-2013 DC20492

LAT.... 45.32 WATER HOLDING CAPACITY...125 MM HEAT INDEX... 36.57
LONG... 75.67 LOWER ZONE..... 75 MM A..... 1.078

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-10.7	62	11	14	0	0	0	22	85	120	296
28- 2	-9.0	55	10	16	1	1	0	24	115	121	352
31- 3	-2.7	66	31	79	6	6	0	101	71	125	418
30- 4	5.7	71	67	76	32	32	0	110	0	125	489
31- 5	13.0	76	76	0	80	80	0	14	0	107	566
30- 6	18.3	84	84	0	116	115	-1	5	0	71	649
31- 7	20.9	86	86	0	136	121	-15	2	0	33	735
31- 8	19.6	83	83	0	117	91	-26	1	0	25	818
30- 9	14.7	84	84	0	75	66	-9	3	0	40	902
31-10	8.2	75	75	0	37	36	-1	7	0	72	76
30-11	1.3	78	60	8	10	10	0	24	10	106	154
31-12	-7.1	81	27	15	1	1	0	28	49	118	234
AVE	6.0 TTL	901	694	208	611	559	-52	341			

Ottawa Intl A STANDARD DEVIATIONS FOR THE PERIOD 1939-2013 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	2.9	26	15	18	1	1	0	29	45	14	59
28- 2	2.5	27	14	25	1	1	0	35	60	13	63
31- 3	2.6	28	22	50	5	5	0	55	90	3	70
30- 4	1.8	31	32	91	9	9	0	90	3	2	78
31- 5	1.9	32	32	3	12	12	0	23	0	22	90
30- 6	1.2	39	39	0	8	9	4	17	0	39	101
31- 7	1.1	40	40	0	8	23	25	10	0	36	104
31- 8	1.3	38	38	0	8	26	28	4	0	35	117
30- 9	1.4	40	40	0	8	15	14	13	0	42	124
31-10	1.5	36	36	1	7	6	2	18	0	42	36
30-11	1.7	27	27	8	4	4	0	31	13	27	45
31-12	2.9	30	23	14	1	1	0	29	35	16	56

Ottawa Intl Airport WATER BUDGET MEANS FOR THE PERIOD 1939-2013 DC20492

LAT.... 45.32 WATER HOLDING CAPACITY...150 MM HEAT INDEX... 36.57
LONG... 75.67 LOWER ZONE..... 90 MM A..... 1.078

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	-10.7	62	11	14	0	0	0	21	85	142	296
28- 2	-9.0	55	10	16	1	1	0	23	115	144	352
31- 3	-2.7	66	31	79	6	6	0	99	71	149	418
30- 4	5.7	71	67	76	32	32	0	110	0	150	489
31- 5	13.0	76	76	0	80	80	0	14	0	132	566
30- 6	18.3	84	84	0	116	116	0	5	0	95	649
31- 7	20.9	86	86	0	136	126	-9	2	0	52	735
31- 8	19.6	83	83	0	117	97	-21	1	0	38	818
30- 9	14.7	84	84	0	75	67	-8	2	0	52	902
31-10	8.2	75	75	0	37	36	-1	7	0	85	76
30-11	1.3	78	60	8	10	10	0	20	10	123	154
31-12	-7.1	81	27	15	1	1	0	24	49	139	234
AVE	6.0 TTL	901	694	208	611	572	-39	328			

Ottawa Intl Airport STANDARD DEVIATIONS FOR THE PERIOD 1939-2013 DC20492

DATE	TEMP (C)	PCPN	RAIN	MELT	PE	AE	DEF	SURP	SNOW	SOIL	ACC P
31- 1	2.9	26	15	18	1	1	0	29	45	19	59
28- 2	2.5	27	14	25	1	1	0	34	60	17	63
31- 3	2.6	28	22	50	5	5	0	55	90	5	70
30- 4	1.8	31	32	91	9	9	0	90	3	2	78
31- 5	1.9	32	32	3	12	12	0	23	0	22	90
30- 6	1.2	39	39	0	8	8	1	17	0	41	101
31- 7	1.1	40	40	0	8	19	20	10	0	42	104
31- 8	1.3	38	38	0	8	23	24	4	0	42	117
30- 9	1.4	40	40	0	8	13	13	13	0	48	124
31-10	1.5	36	36	1	7	7	2	18	0	47	36
30-11	1.7	27	27	8	4	4	0	29	13	34	45
31-12	2.9	30	23	14	1	1	0	29	35	22	56

REPORT OF ANALYSIS

Client: **Houle Chevrier Engineering**
180 Wescar Lane, R.R. #2

Carp, ON
K0A 1L0

Attention: **Mr. James McEwen**

Report Number: 1113436
Date: 2011-06-24
Date Submitted: 2011-06-22

Project: 11-037

P.O. Number:

Chain of Custody Number: **142176**

Matrix: Water

			LAB ID:	890055	890056	890057			**GUIDELINE**	
			Sample Date:	2011-06-04	2011-06-15	2011-06-15				
			Sample ID:	TP11-4 GW-1	TP11-12 GW-1	TP11-15 GW-1				
PARAMETER	**UNITS**	**MRL**							**TYPE**	**LIMIT**	**UNITS**
N-NO3 (Nitrate)	mg/L	0.1	0.86	0.28	<0.10					

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

Methods references and/or additional QA/QC information available on request.

APPENDIX G

Onsite Test Well Water Well Records and Certificates of Well Compliance

CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS **DO HEREBY CERTIFY** that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of GREGORY LEBLANC (Name of Landowner), located at 3119 CARP RD. (Legal Description, Lot / Plan No.) in the City of Ottawa. TEST WELL #3

WELL TAG# A138239

I CERTIFY FURTHER that, I am aware of 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 Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 22nd day of JULY, 2013.

Troy Saunders / SAUNDERS WELL DRILLING

Well Driller / Company

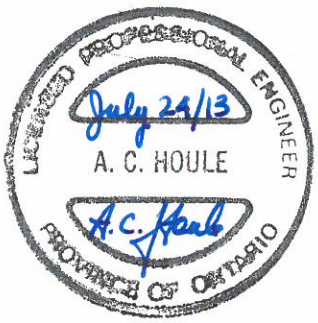
The Engineer on behalf of the landowner set out above **CERTIFIES** that he/she has inspected the well and it was constructed in accordance with the specifications in 0.Reg.903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

SIGNED this 24 day of July, 2013.

A. C. Houle, P. Eng.

Engineer

Houle Chevrier Engineering Ltd.



Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A138239

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	LEBLANC		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1963 OLD CARP RD	OTTAWA	ONT	K0A 1L0	613 720 1903

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3119 CARP RD	FORMERLY HUNTLEY	12	3

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA CARELTON	CARP	Ontario	K0A 1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	421095	5018561		

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
RED	SAND			0	7½
GREY	LIMESTONE		FRACTURED	7½	9
GREY	LIMESTONE			9	258

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	24	BENTONITE SLURRY	.256
24	34	CEMENT GROUT	.150

Method of Construction

☐ Cable Tool ☒ Rotary (Conventional) ☐ Rotary (Reverse) MUD ☐ Boring ☒ Air percussion ☐ Other, specify ____

☐ Diamond ☐ Jetting ☐ Driving ☐ Digging

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	To
6¼	STEEL	.188	0	34
6	OPEN HOLE		34	258

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	To

Water Details

Water found at Depth	Kind of Water	
160-180 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify HYDROFRAC	
230-258 (m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify HYDROFRAC	
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify ____	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
34	258	6"

Results of Well Yield Testing

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

If pumping discontinued, give reason: ____

Pump intake set at (m/ft): 230

Pumping rate (l/min / GPM): 5

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 71.45

If flowing give rate (l/min / GPM): ____

Recommended pump depth (m/ft): 248

Recommended pump rate (l/min / GPM): 4.5

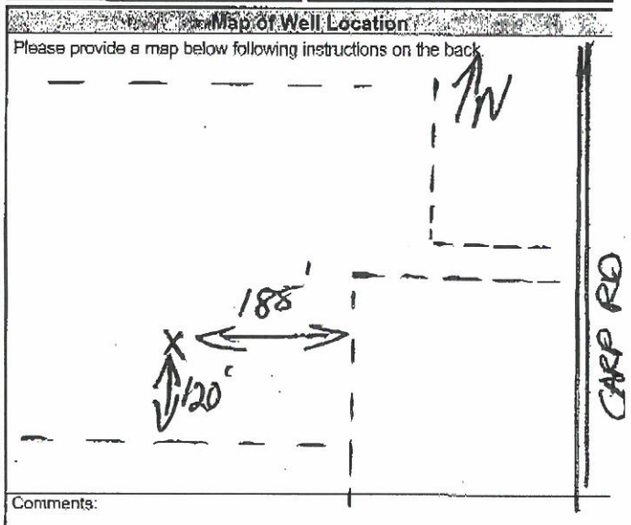
Well production (l/min / GPM): 4.5

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	10.58		
1	14.30	1	67.34
2	17.80	2	64.40
3	21.79	3	61.87
4	24.36	4	58.98
5	27.04	5	56.10
10	36.48	10	48.30
15	42.34	15	41.61
20	47.24	20	35.84
25	51.61	25	31.17
30	55.39	30	26.84
40	61.62	40	20.53
50	66.42	50	16.58
60	71.45	60	13.65

Map of Well Location

Please provide a map below following instructions on the back.



Comments: ____

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A 1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
613 623 5848	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
1517	Troy Saunders	2013 06 13

Well owner's information package delivered: ☒ Yes ☐ No

Date Package Delivered: 2013 06 13

Date Work Completed: 2013 06 13

Ministry Use Only

Audit No. Z158244

Received

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Ministry's Copy

CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS **DO HEREBY CERTIFY** that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of GREGORY LEBLANC (Name of Landowner), located at 3119 CARP RD (Legal Description, Lot / Plan No.) in the City of Ottawa. TEST WELL #1 160' DEEP
WELL TAG # A138240

I CERTIFY FURTHER that, I am aware of 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 Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 22nd day of JULY, 2013.

Troy Saunders / SAUNDERS WELL DRILLING LTD.
Well Driller / Company

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 0.Reg.903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

SIGNED this 24 day of July, 2013.

A. C. Houle, P.Eng.
Engineer

Houle Chevrier Engineering Ltd.

LICENSED PROFESSIONAL ENGINEER
July 24/13
A. C. HOULE
A. C. Houle
PROVINCE OF ONTARIO

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Be*: A138240

Well Record

Regulation 903 Ontario Water Resources Act

Page _____ of _____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	LEBLANC		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1963 OLD CARP RD	OTTAWA	ONT	K0A1L0	6137201986

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3119 CARP RD	FORMERLY HUNTLEY	12	3

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA CARLETON	CARP	Ontario	K0A1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	420964	5018977		

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
RED	SAND			0	5
BROWN	SAND	[redacted]		5	14
GREY	SAND		OCCASIONAL LAYERS OF GREY CLAY	14	48½
GREY	LIMESTONE			48½	160

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	38½	BENTONITE SLURRY	.768
38½	48½	CEMENT GROUT	.150

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	STEEL	.188	0+2	53½
6	OPENHOLE		53½	160

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	
140-160 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify HYDRO FRACTURED	
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
53½	160	6

Results of Well Yield Testing

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

If pumping discontinued, give reason: —

Pump intake set at (m/ft): 150

Pumping rate (l/min / GPM): 12

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 42.48

If flowing give rate (l/min / GPM): —

Recommended pump depth (m/ft): 150

Recommended pump rate (l/min / GPM): 12

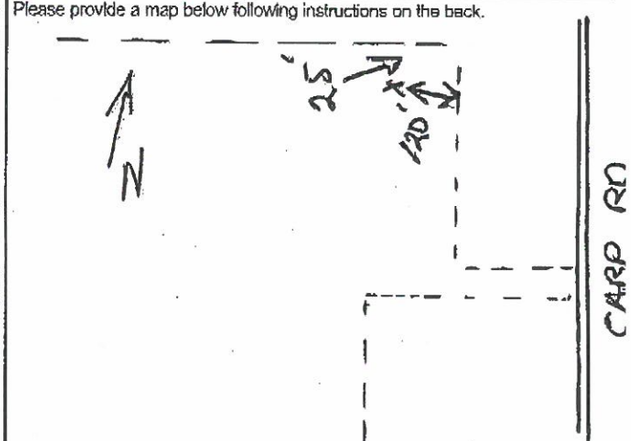
Well production (l/min / GPM): 12+

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		3.66		
1		11.60	1	32.48
2		15.68	2	26.41
3		18.93	3	21.75
4		21.64	4	17.77
5		24.07	5	14.59
10		31.64	10	7.24
15		36.29	15	6.08
20		38.56	20	4.99
25		39.93	25	4.69
30		40.95	30	4.50
40		41.88	40	4.39
50		42.30	50	4.22
60		42.48	60	4.09

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6136235648	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
11517	Troy Saunders	2013/06/05

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2013/06/05	2013/06/05

Ministry Use Only

Audit No. Z 158243

Received

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Ministry's Copy

CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS **DO HEREBY CERTIFY** that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of GREGORY LEBLANC (Name of Landowner), located at 3119 CARP RD (Legal Description, Lot / Plan No.) in the City of Ottawa. TEST WELL #2

WELL TAG# A138241

I CERTIFY FURTHER that, I am aware of 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 Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 22nd day of JULY, 2013.

Troy Saunders / SAUNDERS WELL DRILLING LTD

Well Driller / Company

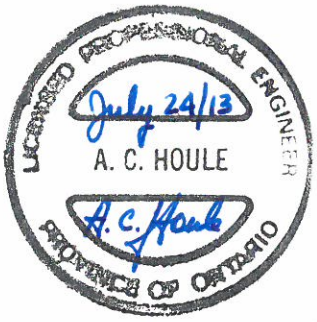
The Engineer on behalf of the landowner set out above **CERTIFIES** that he/she has inspected the well and it was constructed in accordance with the specifications in 0.Reg.903, this report and the Hydrogeological Report with regards to casing length and grouting requirements.

SIGNED this 24 day of July, 2013.

A. C. Houle, P.Eng.

Engineer

Houle Chevrier Engineering Ltd.



Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A 138241

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
GREGORY	LEBLANC		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
1963 OLD CARP RD	OTTAWA	ONT.	K0A 1L0	613 720 1963

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
3119 CARP RD	FORMERLY HUNTLEY	12	3

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA CARLETON	CARP	Ontario	K0A 1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	421108	5018864		

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
RED	SAND			0	6½
GREY	CLAY			6½	25½
GREY+RED	SAND	GRAVEL+STONES		25½	36
GREY	LIMESTONE			36	159

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0	31	BENTONITE SLURRY	.256
31	41	CEMENT GROUT	.150

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Well Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	STEEL	.188	0 +2	41
6	OPEN HOLE		41	159

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
147	☐	☐ Fresh ☒ Untested	
	☐	☐ Fresh ☐ Untested	
	☐	☐ Fresh ☐ Untested	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
41	159	6

Results of Well Yield Testing

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

If pumping discontinued, give reason: —

Pump intake set at (m/ft): 155

Pumping rate (l/min / GPM): 6

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 57.18

If flowing give rate (l/min / GPM): —

Recommended pump depth (m/ft): 150

Recommended pump rate (l/min / GPM): 5

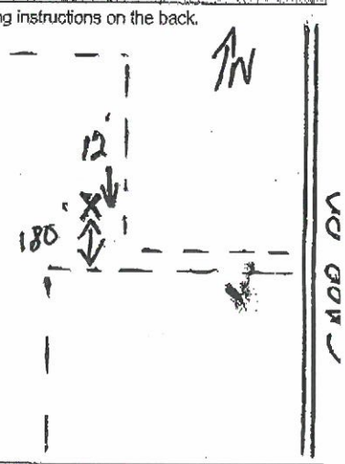
Well production (l/min / GPM): 7

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		5.0		
1	1	8.45	1	50.39
2	2	10.81	2	46.62
3	3	12.96	3	43.64
4	4	15.77	4	41.02
5	5	17.69	5	38.30
10	10	25.03	10	26.78
15	15	31.85	15	18.13
20	20	36.87	20	11.94
25	25	41.13	25	8.15
30	30	44.86	30	6.43
40	40	50.18	40	5.18
50	50	54.19	50	5.0
60	60	57.18	60	5.0

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Water Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A 1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6136235648	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
7517	Troy Saunders	2013 07 02

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2013 06 07	2013 06 07

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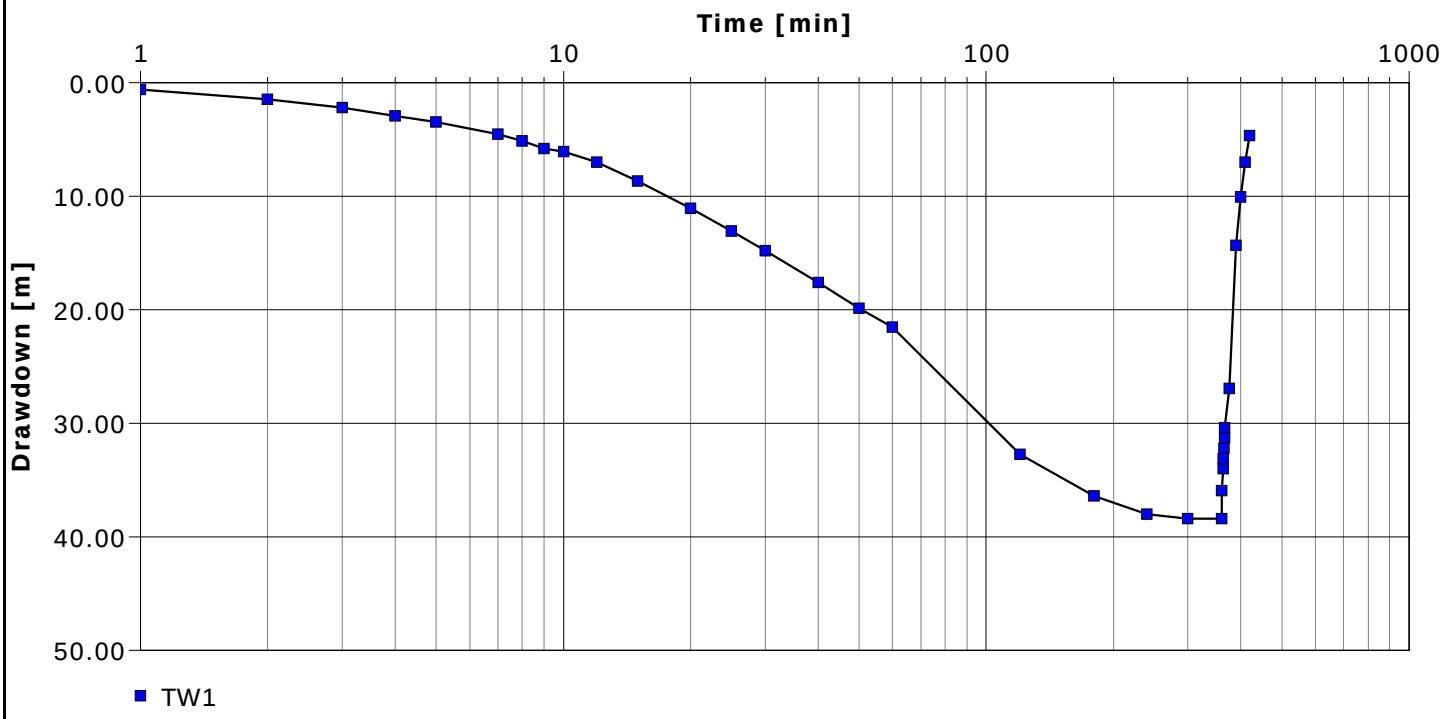
APPENDIX H

Pumping Test Drawdown and Recovery Data

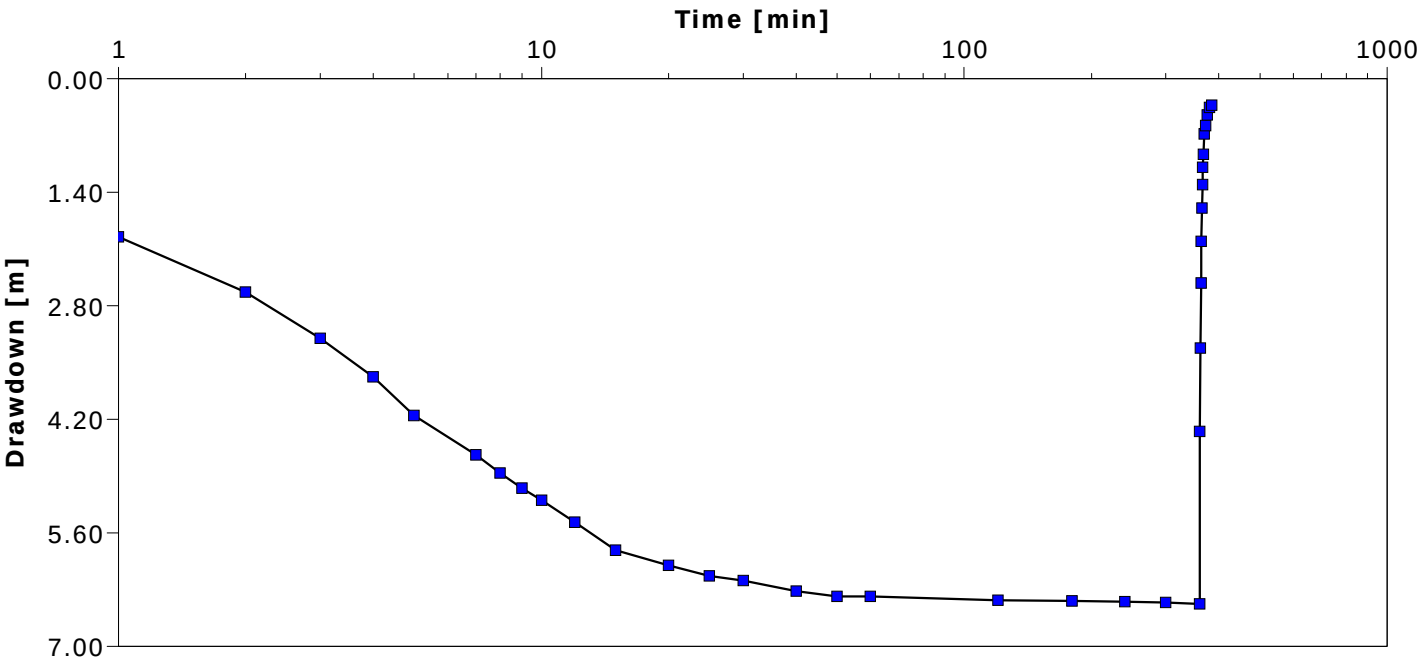
GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: TW1	Pumping Well: TW1
Test Conducted by: HCE Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Drawdown and recovery data	Analysis Date: 9/28/2013
Aquifer Thickness:	Discharge: variable, average rate 5 [U.S. gal/min]	



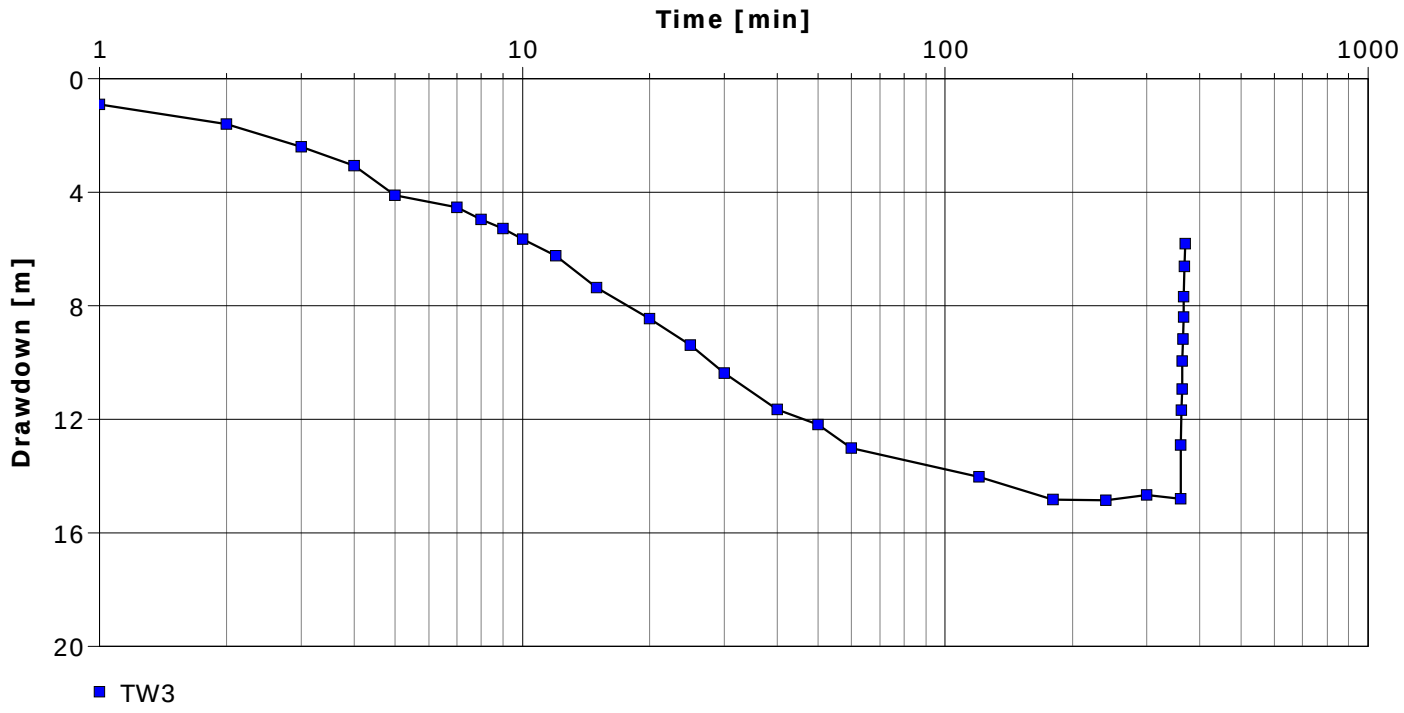
GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: TW2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Drawdown and recovery	Analysis Date: 9/28/2013
Aquifer Thickness:	Discharge: variable, average rate 8 [U.S. gal/min]	



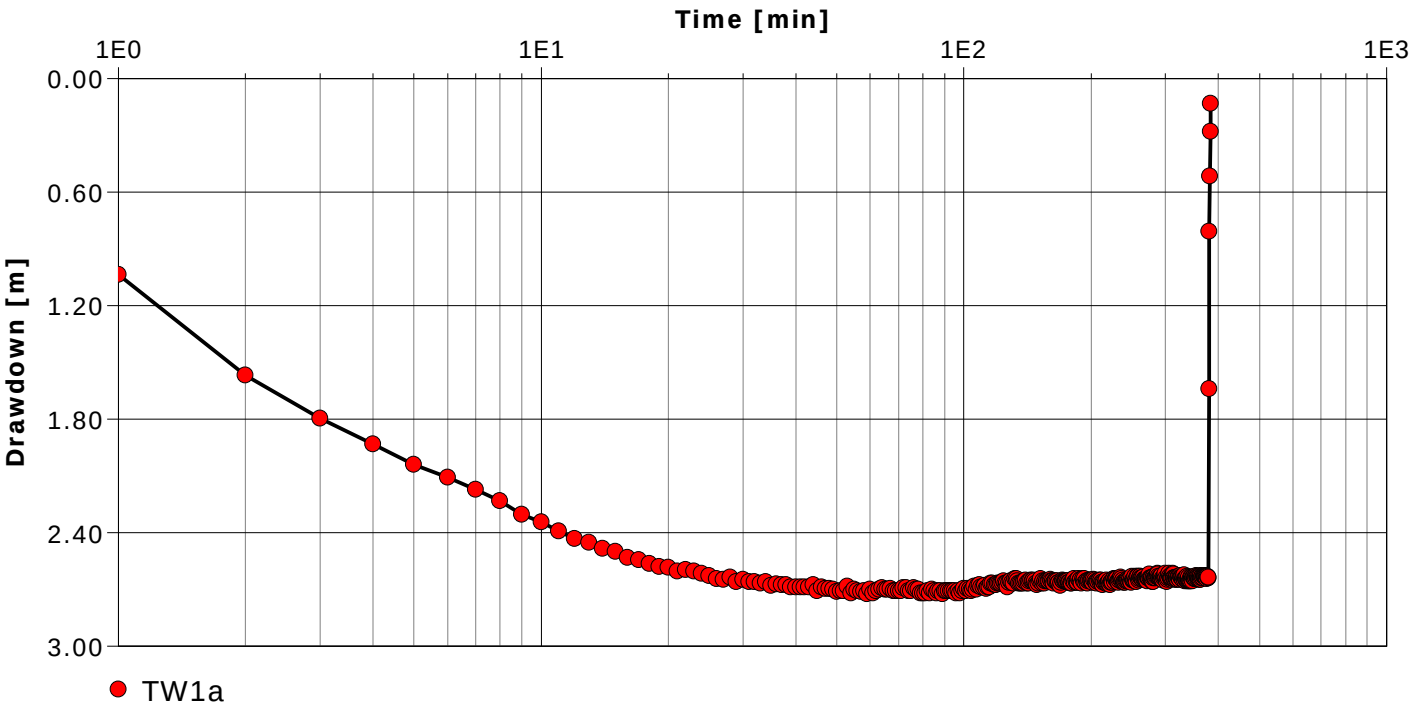
GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number:
	Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: TW3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Drawdown and recovery	Analysis Date: 9/28/2013
Aquifer Thickness:	Discharge: variable, average rate 6 [U.S. gal/min]	



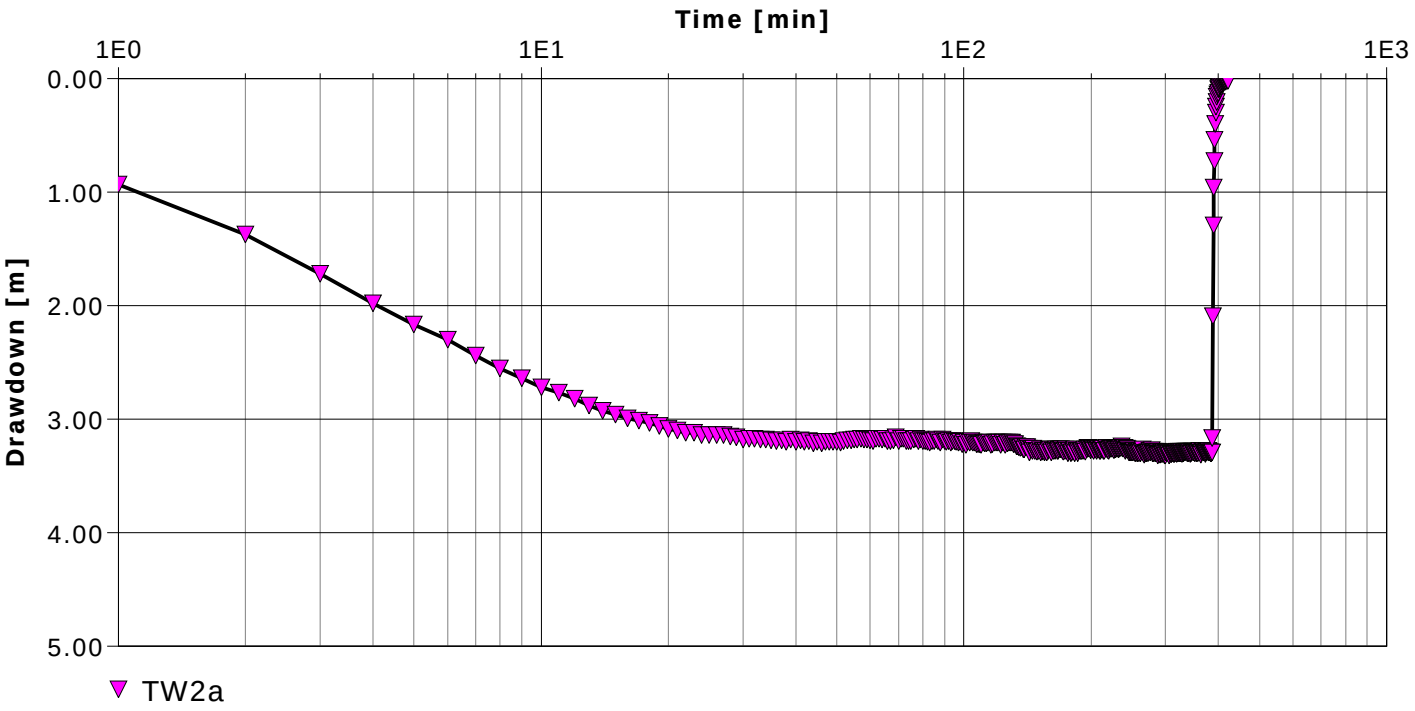
Contact Info Address Company Name City, State/Province	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number: 11-037
	Client: Mr. Greg Leblanc

Location: Ottawa, Ontario	Pumping Test: TW1 2015 Pump Test - Drawdown	Pumping Well: TW1
Test Conducted by: BW		Test Date: 15/06/01
Analysis Performed by:	TW1 Hantush	Analysis Date: 15/07/22
Aquifer Thickness:	Discharge: variable, average rate 0.02 [m³/min]	



Contact Info Address Company Name City, State/Province	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number: 11-037
	Client: Mr. Greg Leblanc

Location: Ottawa, Ontario	Pumping Test: TW2 2015 Pump Test - Drawdown	Pumping Well: TW2
Test Conducted by: BW		Test Date: 15/06/02
Analysis Performed by:	TW2 Theis	Analysis Date: 15/07/22
Aquifer Thickness:	Discharge: variable, average rate 0.02 [m³/min]	



APPENDIX I

Observation Well Water Level Measurements

Radial Distances Between Wells

Pumping Well	Approximate Distance to Observation Well (m)		
	TW1	TW2	TW3
TW1	-	255	430
TW2	255	-	218
TW3	430	218	-

Pumping Interference Effects

Pumping of TW1 @ 18.9 L/min

Time (hours)	Water Level in Observation Wells (m TOC)	
	TW2	TW3
0 (Static Water Level)	1.66	2.00
1	1.66	2.00
2	1.66	2.00
3	1.66	1.99
4	1.65	1.99
5	1.65	1.99
6	1.65	1.99
Maximum Observed Drawdown	- 0.01 (rise in water level)	- 0.01 (rise in water level)

Pumping of TW2 @ 18.9 L/min

Time (hours)	Water Level in Observation Wells (m TOC)	
	TW1	TW3
0 (Static Water Level)	3.75	2.00
1	3.74	1.98
2	3.74	1.98
3	3.74	1.97
4	3.74	1.97
5	3.74	1.98
6	3.74	1.98
Maximum Observed Drawdown	- 0.01 (rise in water level)	- 0.02 (rise in water level)

Pumping of TW3 @ 18.9 L/min

Time (hours)	Water Level in Observation Wells (m TOC)	
	TW1	TW2
0 (Static Water Level)	3.75	1.65
1	3.75	1.64
2	3.75	1.64
3	3.75	1.64
4	3.75	1.64
5	3.75	1.63
6	3.75	1.63
Maximum Observed Drawdown	0.00	- 0.02 (rise in water level)

APPENDIX J

Water Quality Summary Tables

TABLE 1
SUMMARY OF FIELD PARAMETER MEASUREMENTS
ONSITE TEST WELLS PUMPING TESTS

Test Well	Date	Time Since Start of Pumping (hrs:min)	Temperature (°C)	Conductivity (µS/cm)	Total Dissolved Solids (ppm)	pH	Turbidity (NTU)	Total Chlorine (mg/L)
TW1	18-Jun-13	1:00	12.8	615	302	7.88	41.63	0.0
		2:00	11.5	586	307	8.03	108.00	0.0
		3:00	11.0	615	298	8.05	27.31	0.0
		4:00	10.3	586	290	7.97	12.39	0.0
		5:00	10.4	588	307	7.88	11.49	0.0
		6:00	11.1	589	302	7.87	8.91	0.0
TW2	19-Jun-13	1:00	10.7	502	247	7.50	46.37	0.0
		2:00	10.5	477	236	7.77	26.61	0.0
		3:00	11.7	482	240	7.54	17.77	0.0
		4:00	11.9	485	250	7.80	10.88	0.0
		5:00	11.8	493	241	7.79	5.87	0.0
		6:00	11.1	472	234	7.81	14.41	0.0
TW3	20-Jun-13	1:00	10.4	508	256	7.46	14.1	0.0
		2:00	11.9	517	257	7.63	3.5	0.0
		3:00	12.5	517	257	7.70	3.5	0.0
		4:00	12.1	510	255	7.85	3.6	0.0
		5:00	12.1	520	251	7.80	3.6	0.0
		6:00	12.3	507	261	7.84	2.8	0.0

TABLE 2
SUMMARY OF ANALYTICAL RESULTS
ONSITE TEST WELLS PUMPING TESTS

Parameter	Units	TW1 - 3Hr	TW1 - 6Hr	TW2 - 3Hr	TW2 - 6Hr	Ontario Drinking Water Standard	Type of Standard
Total Coliforms	ct/100mL	**60**	**10**	**3**	**3**	0	MAC [1]
Escherichia Coli	ct/100mL	0	0	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	216	193	15	23	-	-
Faecal Coliforms	ct/100mL	0	0	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	0	0	-	-
Alkalinity as CaCO3	mg/L	250	247	191	189	30-500	OG [2]
Calcium (Ca)	mg/L	39	41	65	63	-	-
Chloride (Cl)	mg/L	34	35	32	32	250	AO [3]
Colour	TCU	2	<2	2	<2	5	AO
Conductivity	uS/cm	678	686	554	553	-	-
Dissolved Organic Carbon (DOC)	mg/L	1.5	1.5	1.1	1.2	5	AO
Fluoride (F)	mg/L	1.05	0.99	0.23	0.24	1.5	MAC
Iron (Fe)	mg/L	0.19	0.08	**0.58**	0.24	0.3	AO
Hardness as CaCO3	mg/L	**184**	**193**	**261**	**256**	80-100	OG
Ion Balance		1.04	1.03	0.95	0.97	-	-
Potassium (K)	mg/L	5	5	3	3	-	-
Magnesium (Mg)	mg/L	21	22	24	24	-	-
Manganese (Mn)	mg/L	<0.01	<0.01	0.01	<0.01	0.05	AO
Sodium (Na)	mg/L	85	80	13	13	200 [4]	AO
Ammonia (N-NH3)	mg/L	0.3	0.32	0.08	0.09	-	-
Nitrite (N-NO2)	mg/L	<0.10	<0.10	<0.10	<0.10	0.1 [5]	MAC
Nitrate (N-NO3)	mg/L	<0.10	<0.10	2.78	<0.10	10 [5]	MAC
pH		8.19	8.16	8.09	8.06	6.5-8.5	OG
Phenols	mg/L	<0.001	<0.001	<0.001	<0.001	-	-
Sulphide (S2-)	mg/L	**0.23**	**0.75**	**0.11**	**0.11**	0.05	AO
Sulphate (SO4)	mg/L	60	61	60	60	500	AO
Tannin & Lignin	mg/L	<0.1	0.3	0.2	0.2	-	-
Total Dissolved Solids (TDS)	mg/L	441	446	360	359	500	AO
Total Kjeldahl Nitrogen (TKN)	mg/L	0.40	0.42	0.17	<0.10	-	-
Turbidity	NTU	**12.2**	**5.9**	**15.5**	5	5	AO
Organic Nitrogen [6]	mg/L	0.10	0.1	0.09	0.01	0.15	OG

NOTES:
1. MAC = Maximum Acceptable Concentration
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. 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.
5. The total of Nitrate and Nitrite should not exceed 10 mg/litre
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided in the ODWS guideline.

TABLE 2
SUMMARY OF ANALYTICAL RESULTS
ONSITE TEST WELLS PUMPING TESTS

Parameter	Units	TW3-3Hr	TW3-6Hr	-	-	Ontario Drinking Water Standard	Type of Standard
Total Coliforms	ct/100mL	0	0	-	-	0	MAC (1)
Escherichia Coli	ct/100mL	0	0	-	-	0	MAC
Heterotrophic Plate Count	ct/1mL	2	6	-	-	-	-
Faecal Coliforms	ct/100mL	0	0	-	-	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-	-	-
Alkalinity as CaCO3	mg/L	184	183	-	-	30-500	OG (2)
Calcium (Ca)	mg/L	74	73	-	-	-	-
Chloride (Cl)	mg/L	46	48	-	-	250	AO (3)
Colour	TCU	2	<2	-	-	5	AO
Conductivity	uS/cm	591	589	-	-	-	-
Dissolved Organic Carbon (DOC)	mg/L	1.2	1.2	-	-	5	AO
Fluoride (F)	mg/L	0.1	0.1	-	-	1.5	MAC
Iron (Fe)	mg/L	0.18	0.26	-	-	0.3	AO
Hardness as CaCO3	mg/L	**263**	**261**	-	-	80-100	OG
Ion Balance		0.91	0.91	-	-	-	-
Potassium (K)	mg/L	2	2	-	-	-	-
Magnesium (Mg)	mg/L	19	19	-	-	-	-
Manganese (Mn)	mg/L	<0.01	<0.01	-	-	0.05	AO
Sodium (Na)	mg/L	10	11	-	-	200 (4)	AO
Ammonia (N-NH3)	mg/L	<0.02	0.06	-	-	-	-
Nitrite (N-NO2)	mg/L	<0.10	<0.10	-	-	0.1 (5)	MAC
Nitrate (N-NO3)	mg/L	0.67	0.46	-	-	10 (5)	MAC
pH		7.94	7.95	-	-	6.5-8.5	OG
Phenols	mg/L	<0.001	<0.001	-	-	-	-
Sulphide (S2-)	mg/L	<0.01	<0.01	-	-	0.05	AO
Sulphate (SO4)	mg/L	61	59	-	-	500	AO
Tannin & Lignin	mg/L	0.2	0.1	-	-	-	-
Total Dissolved Solids (TDS)	mg/L	384	383	-	-	500	AO
Total Kjeldahl Nitrogen (TKN)	mg/L	0.17	0.24	-	-	-	-
Turbidity	NTU	2.8	2.7	-	-	5	AO
Organic Nitrogen (6)	mg/L	0.15	**0.18**	-	-	0.15	OG

NOTES:
1. MAC = Maximum Acceptable Concentration
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. 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.
5. The total of Nitrate and Nitrite should not exceed 10 mg/litre
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided in the ODWS guideline.

TABLE 3A
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
ONSITE TEST WELL TW1 - JUNE 1, 2015

Parameter	Units	MDL	Ontario Drinking Water Standards, Objecives and Guidelines	Test Well TW1
General Inorganics				
Alkalinity, total	mg/L	5	500 mg/L	201
Colour	TCU	2	5 TCU	ND (2)
Hardness	mg/L	1.0		288
pH	pH Units	0.1		8.0
Total Dissolved Solids	mg/L	10	500 mg/L	332
Turbidity	NTU	0.1	5 NTU	4.9
Anions				
Chloride	mg/L	1	250 mg/L	32
Fluoride	mg/L	0.1	1.5 mg/L	0.1
Nitrate as N	mg/L	0.1	10 mg/L	ND (0.1)
Nitrite as N	mg/L	0.05	1 mg/L	ND (0.05)
Sulphate	mg/L	1	500 mg/L	64
Metals				
Mercury	ug/L	0.1	0.001 mg/L (1 ug/L)	ND (0.1)
Aluminum	ug/L	1	0.1 mg/L (100 ug/L)	13
Antimony	ug/L	0.5	0.006 mg/L (6 ug/L)	ND (0.5)
Arsenic	ug/L	1	0.025 mg/L (25 ug/L)	ND (1)
Barium	ug/L	1	1 mg/L (1000 ug/L)	104
Boron	ug/L	10	5 mg/L (5000 ug/L)	37
Cadmium	ug/L	0.1	0.005 mg/L (5 ug/L)	ND (0.1)
Calcium	ug/L	100		73300
Chromium	ug/L	1	0.05 mg/L (50 ug/L)	3
Copper	ug/L	0.5	1 mg/L (1000 ug/L)	ND (0.5)
Iron	ug/L	100	0.3 mg/L (300 ug/L)	**358**
Lead	ug/L	0.1	0.01 mg/L (10 ug/L)	ND (0.1)
Magnesium	ug/L	200		25600
Manganese	ug/L	5	0.05 mg/L (50 ug/L)	8
Selenium	ug/L	1	0.01 mg/L (10 ug/L)	ND (1)
Sodium	ug/L	200	200 mg/L (200000 ug/L)	11900
Uranium	ug/L	0.1	0.02 mg/L (20 ug/L)	3.0
Zinc	ug/L	5	5 mg/L (5000 ug/L)	ND (5)
Volatiles				
Acetone	ug/L	5.0		ND (5.0)
Benzene	ug/L	0.5	0.005 mg/L (5 ug/L)	ND (0.5)
Bromodichloromethane	ug/L	0.5		ND (0.5)

TABLE 3A
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
ONSITE TEST WELL TW1 - JUNE 1, 2015

Parameter	Units	MDL	Ontario Drinking Water Standards, Objecives and Guidelines	Test Well TW1
Bromoform	ug/L	0.5		ND (0.5)
Bromomethane	ug/L	0.5		ND (0.5)
Carbon Tetrachloride	ug/L	0.2	0.005 mg/L (5 ug/L)	ND (0.2)
Chlorobenzene	ug/L	0.5	0.08 mg/L (80 ug/L)	ND (0.5)
Chloroethane	ug/L	1.0		ND (1.0)
Chloroform	ug/L	0.5		ND (0.5)
Chloromethane	ug/L	3.0		ND (3.0)
Dibromochloromethane	ug/L	0.5		ND (0.5)
Dichlorodifluoromethane	ug/L	1.0		ND (1.0)
1,2-Dibromoethane	ug/L	0.2		ND (0.2)
1,2-Dichlorobenzene	ug/L	0.5	0.2 mg/L (200 ug/L)	ND (0.5)
1,3-Dichlorobenzene	ug/L	0.5		ND (0.5)
1,4-Dichlorobenzene	ug/L	0.5	0.005 mg/L (5 ug/L)	ND (0.5)
1,1-Dichloroethane	ug/L	0.5		ND (0.5)
1,2-Dichloroethane	ug/L	0.5		ND (0.5)
1,1-Dichloroethylene	ug/L	0.5	0.014 mg/L (14 ug/L)	ND (0.5)
cis-1,2-Dichloroethylene	ug/L	0.5		ND (0.5)
trans-1,2-Dichloroethylene	ug/L	0.5		ND (0.5)
1,2-Dichloroethylene, total	ug/L	0.5		ND (0.5)
1,2-Dichloropropane	ug/L	0.5		ND (0.5)
cis-1,3-Dichloropropylene	ug/L	0.5		ND (0.5)
trans-1,3-Dichloropropylene	ug/L	0.5		ND (0.5)
1,3-Dichloropropene, total	ug/L	0.5		ND (0.5)
Ethylbenzene	ug/L	0.5	0.0024 mg/L (2.4 ug/L)	ND (0.5)
Hexane	ug/L	1.0		ND (1.0)
Methyl Ethyl Ketone (2-Butanone)	ug/L	5.0		ND (5.0)
Methyl Butyl Ketone (2-Hexanone)	ug/L	10.0		ND (10.0)
Methyl Isobutyl Ketone	ug/L	5.0		ND (5.0)
Methyl tert-butyl ether	ug/L	2.0		ND (2.0)
Methylene Chloride	ug/L	5.0	0.05 mg/L (50 ug/L)	ND (5.0)
Styrene	ug/L	0.5		ND (0.5)
1,1,1,2-Tetrachloroethane	ug/L	0.5		ND (0.5)
1,1,2,2-Tetrachloroethane	ug/L	0.5		ND (0.5)
Tetrachloroethylene	ug/L	0.5	0.03 mg/L (30 ug/L)	ND (0.5)

TABLE 3A
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
ONSITE TEST WELL TW1 - JUNE 1, 2015

Parameter	Units	MDL	Ontario Drinking Water Standards, Objecives and Guidelines	Test Well TW1
Toluene	ug/L	0.5	0.024 mg/L (24 ug/L)	ND (0.5)
1,1,1-Trichloroethane	ug/L	0.5		ND (0.5)
1,1,2-Trichloroethane	ug/L	0.5		ND (0.5)
Trichloroethylene	ug/L	0.5	0.005 mg/L (5 ug/L)	ND (0.5)
Trichlorofluoromethane	ug/L	1.0		ND (1.0)
1,3,5-Trimethylbenzene	ug/L	0.5		ND (0.5)
Vinyl Chloride	ug/L	0.5	0.002 mg/L (2 ug/L)	ND (0.5)
m/p-Xylene	ug/L	0.5		ND (0.5)
o-Xylene	ug/L	0.5		ND (0.5)
Xylenes, total	ug/L	0.5	0.3 mg/L (300 ug/L)	ND (0.5)
Hydrocarbons				
F1 PHCs (C6-C10)	ug/L	25		ND (25)
F2 PHCs (C10-C16)	ug/L	100		ND (100)
F3 PHCs (C16-C34)	ug/L	100		ND (100)
F4 PHCs (C34-C50)	ug/L	100		ND (100)
TPH (diesel)	mg/L	0.1		ND (0.1)
Semi-Volatiles				
Ethylene glycol	mg/L	2		ND (2)
Diethylene glycol	mg/L	2		ND (2)
Propylene glycol	mg/L	2		ND (2)
Triethylene glycol	mg/L	2		ND (2)
Trimethylene glycol	mg/L	2		ND (2)

TABLE 3B
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
TEST WELL TW2 - JUNE 2, 2015

Parameter	Units	MDL	Ontario Drinking Water Standards, Objecives and Guidelines	Test Well TW2
General Inorganics				
Alkalinity, total	mg/L	5	500 mg/L	199
Colour	TCU	2	5 TCU	2
Hardness	mg/L	1.0		316
pH	pH Units	0.1		7.6
Total Dissolved Solids	mg/L	10	500 mg/L	384
Turbidity	NTU	0.1	5 NTU	2.4
Anions				
Chloride	mg/L	1	250 mg/L	40
Fluoride	mg/L	0.1	1.5 mg/L	ND (0.1)
Nitrate as N	mg/L	0.1	10 mg/L	1.7
Nitrite as N	mg/L	0.05	1 mg/L	0.17
Sulphate	mg/L	1	500 mg/L	67
Metals				
Mercury	ug/L	0.1	0.001 mg/L (1 ug/L)	ND (0.1)
Aluminum	ug/L	1	0.1 mg/L (100 ug/L)	ND (1)
Antimony	ug/L	0.5	0.006 mg/L (6 ug/L)	ND (0.5)
Arsenic	ug/L	1	0.025 mg/L (25 ug/L)	ND (1)
Barium	ug/L	1	1 mg/L (1000 ug/L)	179
Boron	ug/L	10	5 mg/L (5000 ug/L)	18
Cadmium	ug/L	0.1	0.005 mg/L (5 ug/L)	ND (0.1)
Calcium	ug/L	100		95500
Chromium	ug/L	1	0.05 mg/L (50 ug/L)	ND (1)
Copper	ug/L	0.5	1 mg/L (1000 ug/L)	ND (0.5)
Iron	ug/L	100	0.3 mg/L (300 ug/L)	150
Lead	ug/L	0.1	0.01 mg/L (10 ug/L)	ND (0.1)
Magnesium	ug/L	200		18800
Manganese	ug/L	5	0.05 mg/L (50 ug/L)	7
Selenium	ug/L	1	0.01 mg/L (10 ug/L)	ND (1)
Sodium	ug/L	200	200 mg/L (200000 ug/L)	9950
Uranium	ug/L	0.1	0.02 mg/L (20 ug/L)	5.3
Zinc	ug/L	5	5 mg/L (5000 ug/L)	ND (5)
Volatiles				
Acetone	ug/L	5.0		ND (5.0)
Benzene	ug/L	0.5	0.005 mg/L (5 ug/L)	ND (0.5)
Bromodichloromethane	ug/L	0.5		ND (0.5)

TABLE 3B
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
TEST WELL TW2 - JUNE 2, 2015

Parameter	Units	MDL	Ontario Drinking Water Standards, Objecives and Guidelines	Test Well TW2
Bromoform	ug/L	0.5		ND (0.5)
Bromomethane	ug/L	0.5		ND (0.5)
Carbon Tetrachloride	ug/L	0.2	0.005 mg/L (5 ug/L)	ND (0.2)
Chlorobenzene	ug/L	0.5	0.08 mg/L (80 ug/L)	ND (0.5)
Chloroethane	ug/L	1.0		ND (1.0)
Chloroform	ug/L	0.5		ND (0.5)
Chloromethane	ug/L	3.0		ND (3.0)
Dibromochloromethane	ug/L	0.5		ND (0.5)
Dichlorodifluoromethane	ug/L	1.0		ND (1.0)
1,2-Dibromoethane	ug/L	0.2		ND (0.2)
1,2-Dichlorobenzene	ug/L	0.5	0.2 mg/L (200 ug/L)	ND (0.5)
1,3-Dichlorobenzene	ug/L	0.5		ND (0.5)
1,4-Dichlorobenzene	ug/L	0.5	0.005 mg/L (5 ug/L)	ND (0.5)
1,1-Dichloroethane	ug/L	0.5		ND (0.5)
1,2-Dichloroethane	ug/L	0.5		ND (0.5)
1,1-Dichloroethylene	ug/L	0.5	0.014 mg/L (14 ug/L)	ND (0.5)
cis-1,2-Dichloroethylene	ug/L	0.5		ND (0.5)
trans-1,2-Dichloroethylene	ug/L	0.5		ND (0.5)
1,2-Dichloroethylene, total	ug/L	0.5		ND (0.5)
1,2-Dichloropropane	ug/L	0.5		ND (0.5)
cis-1,3-Dichloropropylene	ug/L	0.5		ND (0.5)
trans-1,3-Dichloropropylene	ug/L	0.5		ND (0.5)
1,3-Dichloropropene, total	ug/L	0.5		ND (0.5)
Ethylbenzene	ug/L	0.5	0.0024 mg/L (2.4 ug/L)	ND (0.5)
Hexane	ug/L	1.0		ND (1.0)
Methyl Ethyl Ketone (2-Butanone)	ug/L	5.0		ND (5.0)
Methyl Butyl Ketone (2-Hexanone)	ug/L	10.0		ND (10.0)
Methyl Isobutyl Ketone	ug/L	5.0		ND (5.0)
Methyl tert-butyl ether	ug/L	2.0		ND (2.0)
Methylene Chloride	ug/L	5.0	0.05 mg/L (50 ug/L)	ND (5.0)
Styrene	ug/L	0.5		ND (0.5)
1,1,1,2-Tetrachloroethane	ug/L	0.5		ND (0.5)
1,1,2,2-Tetrachloroethane	ug/L	0.5		ND (0.5)
Tetrachloroethylene	ug/L	0.5	0.03 mg/L (30 ug/L)	ND (0.5)

TABLE 3B
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
TEST WELL TW2 - JUNE 2, 2015

Parameter	Units	MDL	Ontario Drinking Water Standards, Objecives and Guidelines	Test Well TW2
Toluene	ug/L	0.5	0.024 mg/L (24 ug/L)	ND (0.5)
1,1,1-Trichloroethane	ug/L	0.5		ND (0.5)
1,1,2-Trichloroethane	ug/L	0.5		ND (0.5)
Trichloroethylene	ug/L	0.5	0.005 mg/L (5 ug/L)	ND (0.5)
Trichlorofluoromethane	ug/L	1.0		ND (1.0)
1,3,5-Trimethylbenzene	ug/L	0.5		ND (0.5)
Vinyl Chloride	ug/L	0.5	0.002 mg/L (2 ug/L)	ND (0.5)
m/p-Xylene	ug/L	0.5		ND (0.5)
o-Xylene	ug/L	0.5		ND (0.5)
Xylenes, total	ug/L	0.5	0.3 mg/L (300 ug/L)	ND (0.5)
Hydrocarbons				
F1 PHCs (C6-C10)	ug/L	25		ND (25)
F2 PHCs (C10-C16)	ug/L	100		ND (100)
F3 PHCs (C16-C34)	ug/L	100		ND (100)
F4 PHCs (C34-C50)	ug/L	100		ND (100)
TPH (diesel)	mg/L	0.1		ND (0.1)
Semi-Volatiles				
Ethylene glycol	mg/L	2		ND (2)
Diethylene glycol	mg/L	2		ND (2)
Propylene glycol	mg/L	2		ND (2)
Triethylene glycol	mg/L	2		ND (2)
Trimethylene glycol	mg/L	2		ND (2)

TABLE 3C
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
TEST WELL TW3 - JUJE 20, 2013

Parameter	Units	MDL	TW3-6HR
1,1,1,2-tetrachloroethane	ug/L	0.5	<0.5
1,1,1-trichloroethane	ug/L	0.4	<0.4
1,1,2,2-tetrachloroethane	ug/L	0.5	<0.5
1,1,2-trichloroethane	ug/L	0.4	<0.4
1,1-dichloroethane	ug/L	0.4	<0.4
1,1-dichloroethylene	ug/L	0.5	<0.5
1,2-dibromoethane	ug/L	0.2	<0.2
1,2-dichlorobenzene	ug/L	0.4	<0.4
1,2-dichloroethane	ug/L	0.2	<0.2
1,2-dichloropropane	ug/L	0.5	<0.5
1,3,5-trimethylbenzene	ug/L	0.3	<0.3
1,3-dichlorobenzene	ug/L	0.4	<0.4
1,4-dichlorobenzene	ug/L	0.4	<0.4
Alachlor	ug/L	1	<1.0
Atrazine	ug/L	1	<1.0
Azinphos-methyl	ug/L	2	<2
Bendiocarb	ug/L	2	<2
Benzene	ug/L	0.5	<0.5
Bromodichloromethane	ug/L	0.3	<0.3
Bromoform	ug/L	0.4	<0.4
Bromomethane	ug/L	0.5	<0.5
c-1,2-Dichloroethylene	ug/L	0.4	<0.4
c-1,3-Dichloropropylene	ug/L	0.2	<0.2
Carbaryl	ug/L	5	<5
Carbofuran	ug/L	5	<5
Carbon Tetrachloride	ug/L	0.2	<0.2
Chloroethane	ug/L	0.2	<0.2
Chloroform	ug/L	0.5	<0.5
Chloromethane	ug/L	0.2	<0.2
Chlorpyrifos	ug/L	1	<1
Cyanazine	ug/L	1	<1
De-ethylated atrazine	ug/L	1	<1.0
Diazinon	ug/L	1	<1
Dibromochloromethane	ug/L	0.3	<0.3
Dichlorodifluoromethane	ug/L	0.5	<0.5
Dichloromethane	ug/L	4	<4.0
Diclofop-methyl	ug/L	1	<1.0

TABLE 3C
SUMMARY OF HISTORICAL AND ADJACENT LAND USE TESTING
TEST WELL TW3 - JUJE 20, 2013

Parameter	Units	MDL	TW3-6HR
Dimethoate	ug/L	2.5	<2.5
Ethylbenzene	ug/L	0.5	<0.5
F1 (C6-C10)	mg/L	0.1	<0.1
F2 (C10-C16)	mg/L	0.1	<0.1
F3 (C16-C34)	mg/L	0.2	<0.2
F4 (C34-C50)	mg/L	0.2	<0.2
m/p-xylene	ug/L	0.5	<0.5
Malathion	ug/L	5	<5
Metolachlor	ug/L	1	<1.0
Metribuzin	ug/L	5	<5
Monochlorobenzene	ug/L	0.2	<0.2
o-xylene	ug/L	0.5	<0.5
Parathion	ug/L	1	<1
Phorate	ug/L	1	<1.0
Prometryne	ug/L	1	<1.0
Simazine	ug/L	1	<1
Styrene	ug/L	0.5	<0.5
t-1,2-Dichloroethylene	ug/L	0.4	<0.4
t-1,3-Dichloropropylene	ug/L	0.2	<0.2
Temephos	ug/L	10	<10
Terbufos	ug/L	1	<1.0
Tetrachloroethylene	ug/L	0.3	<0.3
Toluene	ug/L	0.5	<0.5
Triallate	ug/L	1	<1
Trichloroethylene	ug/L	0.3	<0.3
Trichlorofluoromethane	ug/L	0.5	<0.5
Trifluralin	ug/L	1	<1.0
Vinyl Chloride	ug/L	0.2	<0.2
Xylene; total	ug/L	1	<1.0

TABLE 4A
SUMMARY OF RETESTING RESULTS
TEST WELL TW1 - AUGUST 19, 2013

Parameter	Units	TW1-R1	TW1-R2	Ontario Drinking Water Standard	Type of Standard
Total Chlorine (field test)	mg/L	0.0	0.0	-	-
Turbidity (field test)	NTU	-	0.70	-	-
Total Coliforms	ct/100mL	0	0	0	MAC [(1)]
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	4	7	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-

NOTES:
1. MAC = Maximum Acceptable Concentration
2. '-' signifies no value provided in the ODWS guideline.

TABLE 4B
SUMMARY OF RETESTING RESULTS
TEST WELL TW2 - JULY 22, 2013

Parameter	Units	TW2-R1	TW2-R2	Ontario Drinking Water Standard	Type of Standard
Total Chlorine (field test)	mg/L	0.0	0.0	-	-
Total Coliforms	ct/100mL	0	0	0	MAC (1)
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	2	0	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	1	0	-	-

NOTES:
1. MAC = Maximum Acceptable Concentration
2. '-' signifies no value provided in the ODWS guideline.

TABLE 5A
SUMMARY OF FIELD PARAMETER MEASUREMENTS
OFFSITE PRIVATE WELLS

Private Well	Total Chlorine (mg/L)
PW1	0.0
PW2	0.0

TABLE 5B
SUMMARY OF ANALYTICAL RESULTS
PRIVATE WELLS

Parameter	Units	PW1	PW2	Ontario Drinking Water Standard	Type of Standard
Total Coliforms	ct/100mL	0	0	0	MAC [1]
Escherichia Coli	ct/100mL	0	0	0	MAC
Heterotrophic Plate Count	ct/1mL	0	0	-	-
Faecal Coliforms	ct/100mL	0	0	-	-
Faecal Streptococcus	ct/100mL	0	0	-	-
Alkalinity as CaCO3	mg/L	156	227	30-500	OG [2]
Calcium (Ca)	mg/L	73	75	-	-
Chloride (Cl)	mg/L	44	127	250	AO [3]
Colour	TCU	2	2	5	AO
Conductivity	uS/cm	521	996	-	-
Dissolved Organic Carbon (DOC)	mg/L	1.1	1.9	5	AO
Fluoride (F)	mg/L	<0.10	<0.10	1.5	MAC
Iron (Fe)	mg/L	0.21	0.03	0.3	AO
Hardness as CaCO3	mg/L	**252**	**220**	80-100	OG
Ion Balance		1.08	1.05	-	-
Potassium (K)	mg/L	2	1	-	-
Magnesium (Mg)	mg/L	17	8	-	-
Manganese (Mn)	mg/L	0.02	<0.01	0.05	AO
Sodium (Na)	mg/L	16	131	200 [4]	AO
Ammonia (N-NH3)	mg/L	0.05	0.05	-	-
Nitrite (N-NO2)	mg/L	<0.10	<0.10	0.1 [5]	MAC
Nitrate (N-NO3)	mg/L	<0.10	9.57	10 [5]	MAC
pH		7.82	7.75	6.5-8.5	OG
Phenols	mg/L	<0.001	<0.001	-	-
Sulphide (S2-)	mg/L	<0.01	<0.01	0.05	AO
Sulphate (SO4)	mg/L	48	39	500	AO
Tannin & Lignin	mg/L	<0.1	<0.1	-	-
Total Dissolved Solids (TDS)	mg/L	339	**647**	500	AO
Total Kjeldahl Nitrogen (TKN)	mg/L	<0.10	<0.10	-	-
Turbidity	NTU	2.7	0.2	5	AO
Organic Nitrogen [6]	mg/L	0.05	0.05	0.15	OG

NOTES:
1. MAC = Maximum Acceptable Concentration
2. OG = Operational Guideline
3. AO = Aesthetic Objective
4. 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.
5. The total of Nitrate and Nitrite should not exceed 10 mg/litre
6. Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3 and should not exceed 0.15 mg/litre.
7. '-' signifies no value provided in the ODWS guideline.

APPENDIX K

Test Well Sampling – Laboratory Certificates of Analysis

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311934
Date Submitted: 2013-06-18
Date Reported: 2013-06-21
Project: 11-037
COC #: 152382

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Jennifer Mitchell
Laboratory Supervisor, Microbiology

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs(for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311934
Date Submitted: 2013-06-18
Date Reported: 2013-06-21
Project: 11-037
COC #: 152382

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1034388 Water 2013-06-18 TW1 - 3Hr	1034389 Water 2013-06-18 TW1 - 6Hr
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			216	193
	Total Coliforms	0	ct/100mL	MAC-0		60*	10*

Guideline = ODWSOG *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Lorna Wilson
Laboratory Supervisor, Inorganics

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1034386 Water 2013-06-18 TW1 - 3Hr	1034387 Water 2013-06-18 TW1 - 6Hr
Calculations	Hardness as CaCO3	1	mg/L	OG-100		184*	193*
	Ion Balance	0.01				1.04	1.03
	TDS (COND - CALC)	1	mg/L	AO-500		441	446
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500		250	247
	Cl	1	mg/L	AO-250		34	35
	Colour	2	TCU	AO-5		2	<2
	Conductivity	5	uS/cm			678	686
	DOC	0.5	mg/L	AO-5		1.5	1.5
	F	0.10	mg/L	MAC-1.5		1.05	0.99
	N-NO2	0.10	mg/L	MAC-1.0		<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0		<0.10	<0.10
	pH	1.00		6.5-8.5		8.19	8.16
	S2-	0.01	mg/L	AO-0.05		0.23*	0.75*
	SO4	3	mg/L	AO-500		60	61
	Turbidity	0.1	NTU	MAC-1.0		12.2*	5.9*
Metals	Ca	1	mg/L			39	41
	Fe	0.03	mg/L	AO-0.3		0.19	0.08
	K	1	mg/L			5	5
	Mg	1	mg/L			21	22
	Mn	0.01	mg/L	AO-0.05		<0.01	<0.01
	Na	2	mg/L	AO-200		85	80
Nutrients	N-NH3	0.02	mg/L			0.30	0.32
	Phenols	0.001	mg/L			<0.001	<0.001
	Tannin & Lignin	0.1	mg/L			<0.1	0.3
	Total Kjeldahl Nitrogen	0.10	mg/L			0.40	0.42

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
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MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Houle Chevrier Engineering
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Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 0 **Analysis Date** 2013-06-21 **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 252705 **Analysis Date** 2013-06-19 **Method** C SM4500-NH3D			
N-NH3	<0.02 mg/L	98	85-115
Run No 252709 **Analysis Date** 2013-06-19 **Method** C SM2120C			
Colour	<2 TCU	95	90-110
Run No 252719 **Analysis Date** 2013-06-19 **Method** C SM2130B			
Turbidity	<0.1 NTU	107	73-127
Run No 252755 **Analysis Date** 2013-06-19 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	120	80-120
N-NO3	<0.10 mg/L	83	80-120
Run No 252768 **Analysis Date** 2013-06-19 **Method** M SM3120B-3500C			
Ca	<1 mg/L	108	80-120

Guideline = ODWSOG *** = Guideline Exceedence**
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Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

QC Summary

Analyte	Blank	QC % Rec	QC Limits
K	<1 mg/L	108	80-120
Mg	<1 mg/L	102	80-120
Na	<2 mg/L	107	80-120
Run No 252769 **Analysis Date** 2013-06-19 **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	104	
Run No 252780 **Analysis Date** 2013-06-20 **Method** C SM5550B			
Tannin & Lignin	<0.1 mg/L	100	80-120
Run No 252784 **Analysis Date** 2013-06-20 **Method** SM 4110C			
Cl	<1 mg/L	99	90-110
SO4	<3 mg/L	105	90-110
Run No 252789 **Analysis Date** 2013-06-19 **Method** SM 2320B			
Alkalinity as CaCO3	<5 mg/L	97	95-105
Conductivity	<5 uS/cm	100	95-105
F	<0.10 mg/L	101	90-110
pH	5.77	100	90-110
Run No 252870 **Analysis Date** 2013-06-21 **Method** C SM4500-Norg-C			
Total Kjeldahl Nitrogen	<0.10 mg/L	105	77-123

Guideline = ODWSOG *** = Guideline Exceedence**
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MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Report Number: 1311933
Date Submitted: 2013-06-18
Date Reported: 2013-06-24
Project: 11-037
COC #: 152382

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 252878 **Analysis Date** 2013-06-21 **Method** C SM5530D			
Phenols	<0.001 mg/L	106	73-127
Run No 252923 **Analysis Date** 2013-06-21 **Method** EPA 200.8			
Fe	<0.03 mg/L	111	88-112
Mn	<0.01 mg/L	102	91-109
Run No 252933 **Analysis Date** 2013-06-21 **Method** C SM5310C			
DOC	<0.5 mg/L	98	84-116

Guideline = ODWSOG *** = Guideline Exceedence**
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EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
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K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312115
Date Submitted: 2013-06-19
Date Reported: 2013-06-21
Project: 11-037
COC #: 37670

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Jennifer Mitchell
Laboratory Supervisor, Microbiology

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312115
Date Submitted: 2013-06-19
Date Reported: 2013-06-21
Project: 11-037
COC #: 37670

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1034818 Water 2013-06-19 TW2 - 3Hr	1034819 Water 2013-06-19 TW2 - 6Hr
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			15	23
	Total Coliforms	0	ct/100mL	MAC-0		3*	3*

Guideline = ODWSOG *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Lorna Wilson
Laboratory Supervisor, Inorganics

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.	
					1034957 Water 2013-06-19 TW2-3hr	1034958 Water 2013-06-19 TW2-6hr
Calculations	Hardness as CaCO3	1	mg/L	OG-100	261*	256*
	Ion Balance	0.01			0.95	0.97
	TDS (COND - CALC)	1	mg/L	AO-500	360	359
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500	191	189
	Cl	1	mg/L	AO-250	32	32
	Colour	2	TCU	AO-5	2	<2
	Conductivity	5	uS/cm		554	553
	DOC	0.5	mg/L	AO-5	1.1	1.2
	F	0.10	mg/L	MAC-1.5	0.23	0.24
	N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0	2.78	<0.10
	pH	1.00		6.5-8.5	8.09	8.06
	S2-	0.01	mg/L	AO-0.05	0.11*	0.11*
	SO4	3	mg/L	AO-500	60	60
	Turbidity	0.1	NTU	MAC-1.0	15.5*	5.0*
Metals	Ca	1	mg/L		65	63
	Fe	0.03	mg/L	AO-0.3	0.58*	0.24
	K	1	mg/L		3	3
	Mg	1	mg/L		24	24
	Mn	0.01	mg/L	AO-0.05	0.01	<0.01
	Na	2	mg/L	AO-200	13	13
Nutrients	N-NH3	0.02	mg/L		0.08	0.09
	Phenols	0.001	mg/L		<0.001	<0.001
	Tannin & Lignin	0.1	mg/L		0.2	0.2
	Total Kjeldahl Nitrogen	0.10	mg/L		0.17	<0.10

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 0 **Analysis Date** 2013-06-26 **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 252780 **Analysis Date** 2013-06-20 **Method** C SM5550B			
Tannin & Lignin	<0.1 mg/L	100	80-120
Run No 252830 **Analysis Date** 2013-06-20 **Method** C SM2130B			
Turbidity	<0.1 NTU	107	73-127
Run No 252873 **Analysis Date** 2013-06-21 **Method** C SM2120C			
Colour	<2 TCU	100	90-110
Run No 252874 **Analysis Date** 2013-06-21 **Method** C SM4500-NH3D			
N-NH3	<0.02 mg/L	101	85-115
Run No 252915 **Analysis Date** 2013-06-21 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	110	80-120
N-NO3	<0.10 mg/L	92	80-120

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 252923 **Analysis Date** 2013-06-21 **Method** EPA 200.8			
Fe	<0.03 mg/L	111	88-112
Mn	<0.01 mg/L	102	91-109
Run No 252966 **Analysis Date** 2013-06-21 **Method** SM 4110C			
Cl	<1 mg/L	100	90-110
SO4	<3 mg/L	108	90-110
Run No 252976 **Analysis Date** 2013-06-21 **Method** SM 2320B			
Alkalinity as CaCO3	<5 mg/L	99	95-105
Conductivity	<5 uS/cm	101	95-105
F	<0.10 mg/L	100	90-110
pH	5.92	100	90-110
Run No 253037 **Analysis Date** 2013-06-25 **Method** C SM4500-Norg-C			
Total Kjeldahl Nitrogen	<0.10 mg/L	98	77-123
Run No 253111 **Analysis Date** 2013-06-25 **Method** M SM3120B-3500C			
Ca	<1 mg/L	100	80-120
K	<1 mg/L	111	80-120
Mg	<1 mg/L	96	80-120

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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312144
Date Submitted: 2013-06-19
Date Reported: 2013-06-26
Project: 11-037
COC #: 37670

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Na	<2 mg/L	106	80-120
Run No 253133 **Analysis Date** 2013-06-25 **Method** C SM5310C			
DOC	<0.5 mg/L	97	84-116
Run No 253151 **Analysis Date** 2013-06-26 **Method** C SM5530D			
Phenols	<0.001 mg/L	125	73-127
Run No 253199 **Analysis Date** 2013-06-26 **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	104	

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EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312314
Date Submitted: 2013-06-21
Date Reported: 2013-06-24
Project: 11-037
COC #: 37746

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Dragana Dzeletovic
Microbiology Laboratory Team Lead

EXOVA OTTAWA

Certificate of Analysis

Exova

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312314
Date Submitted: 2013-06-21
Date Reported: 2013-06-24
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035339 Water 2013-06-20 TW3-3hr	1035340 Water 2013-06-20 TW3-6hr
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			2	6
	Total Coliforms	0	ct/100mL	MAC-0		0	0

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EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number:	1312344
Date Submitted:	2013-06-21
Date Reported:	2013-06-28
Project:	11-037
COC #:	37746

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Diana Cameron
Team Leader, Inorganics

APPROVAL: _____

Charlie (Long) Qu
Laboratory Supervisor, Organics

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.					
Calculations	Hardness as CaCO3	1	mg/L	OG-100	263*	261*
	Ion Balance	0.01			0.91	0.91
	TDS (COND - CALC)	1	mg/L	AO-500	384	383
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500	184	183
	Cl	1	mg/L	AO-250	46	48
	Colour	2	TCU	AO-5	2	<2
	Conductivity	5	uS/cm		591	589
	DOC	0.5	mg/L	AO-5	1.2	1.2
	F	0.10	mg/L	MAC-1.5	0.10	0.10
	N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0	0.67	0.46
	pH	1.00		6.5-8.5	7.94	7.95
	S2-	0.01	mg/L	AO-0.05	<0.01	<0.01
	SO4	3	mg/L	AO-500	61	59
	Turbidity	0.1	NTU	MAC-1.0	2.8*	2.7*
Herbicide/Pesticide	Alachlor	1.0	ug/L	IMAC-5		<1.0
	Atrazine	1.0	ug/L			<1.0
	Azinphos-methyl	2	ug/L	MAC-20		<2
	Bendiocarb	2	ug/L	MAC-40		<2
	Carbaryl	5	ug/L	MAC-90		<5
	Carbofuran	5	ug/L	MAC-90		<5
	Chlorpyrifos	1	ug/L	MAC-90		<1
	Cyanazine	1	ug/L	IMAC-10		<1
	De-ethylated atrazine	1.0	ug/L			<1.0
	Diazinon	1	ug/L	MAC-20		<1
	Diclofop-methyl	1.0	ug/L	MAC-9		<1.0

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Certificate of Analysis

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Carp, ON
K0A 1L0
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Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
Herbicide/Pesticide	Dimethoate	2.5	ug/L	IMAC-20			<2.5
	Malathion	5	ug/L	MAC-190			<5
	Metolachlor	1.0	ug/L	IMAC-50			<1.0
	Metribuzin	5	ug/L	MAC-80			<5
	Parathion	1	ug/L	MAC-50			<1
	Phorate	1.0	ug/L	IMAC-2			<1.0
	Prometryne	1.0	ug/L	IMAC-1			<1.0
	Simazine	1	ug/L	IMAC-10			<1
	Temephos	10	ug/L	IMAC-280			<10
	Terbufos	1.0	ug/L	IMAC-1			<1.0
	Triallate	1	ug/L	MAC-230			<1
	Trifluralin	1.0	ug/L	IMAC-45			<1.0
Hydrocarbons	F1 (C6-C10)	0.1	mg/L				<0.1
	F2 (C10-C16)	0.1	mg/L				<0.1
	F3 (C16-C34)	0.2	mg/L				<0.2
	F4 (C34-C50)	0.2	mg/L				<0.2
Metals	Ca	1	mg/L			74	73
	Fe	0.03	mg/L	AO-0.3		0.18	0.26
	K	1	mg/L			2	2
	Mg	1	mg/L			19	19
	Mn	0.01	mg/L	AO-0.05		<0.01	<0.01
	Na	2	mg/L	AO-200		10	11
Nutrients	N-NH3	0.02	mg/L			<0.02	0.06
	Phenols	0.001	mg/L			<0.001	<0.001
	Tannin & Lignin	0.1	mg/L			0.2	0.1
	Total Kjeldahl Nitrogen	0.10	mg/L			0.17	0.24

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
VOCs	1,1,1,2-tetrachloroethane	0.5	ug/L				<0.5
	1,1,1-trichloroethane	0.4	ug/L				<0.4
	1,1,2,2-tetrachloroethane	0.5	ug/L				<0.5
	1,1,2-trichloroethane	0.4	ug/L				<0.4
	1,1-dichloroethane	0.4	ug/L				<0.4
	1,1-dichloroethylene	0.5	ug/L	MAC-14			<0.5
	1,2-dibromoethane	0.2	ug/L				<0.2
	1,2-dichlorobenzene	0.4	ug/L	MAC-200			<0.4
	1,2-dichloroethane	0.2	ug/L	IMAC-5			<0.2
	1,2-dichloroethane-d4	1	%				102
	1,2-dichloropropane	0.5	ug/L				<0.5
	1,3,5-trimethylbenzene	0.3	ug/L				<0.3
	1,3-dichlorobenzene	0.4	ug/L				<0.4
	1,4-dichlorobenzene	0.4	ug/L	MAC-5			<0.4
	4-bromofluorobenzene	1	%				100
	Benzene	0.5	ug/L	MAC-5			<0.5
	Bromodichloromethane	0.3	ug/L				<0.3
	Bromoform	0.4	ug/L				<0.4
	Bromomethane	0.5	ug/L				<0.5
	c-1,2-Dichloroethylene	0.4	ug/L				<0.4
	c-1,3-Dichloropropylene	0.2	ug/L				<0.2
	Carbon Tetrachloride	0.2	ug/L	MAC-5			<0.2
	Chloroethane	0.2	ug/L				<0.2
	Chloroform	0.5	ug/L				<0.5
	Chloromethane	0.2	ug/L				<0.2
	Dibromochloromethane	0.3	ug/L				<0.3

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Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
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Invoice to: Houle Chevrier Engineering

Report Number: 1312344
Date Submitted: 2013-06-21
Date Reported: 2013-06-28
Project: 11-037
COC #: 37746

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1035414 Water 2013-06-20 TW3-3Hr	1035415 Water 2013-06-20 TW3-6Hr
VOCs	Dichlorodifluoromethane	0.5	ug/L				<0.5
	Dichloromethane	4.0	ug/L	MAC-50			<4.0
	Ethylbenzene	0.5	ug/L	AO-2.4			<0.5
	m/p-xylene	0.5	ug/L				<0.5
	Monochlorobenzene	0.2	ug/L	MAC-80			<0.2
	o-xylene	0.5	ug/L				<0.5
	Styrene	0.5	ug/L				<0.5
	t-1,2-Dichloroethylene	0.4	ug/L				<0.4
	t-1,3-Dichloropropylene	0.2	ug/L				<0.2
	Tetrachloroethylene	0.3	ug/L	MAC-30			<0.3
	Toluene	0.5	ug/L	AO-24			<0.5
	Toluene-d8	1	%				103
	Trichloroethylene	0.3	ug/L	MAC-5			<0.3
	Trichlorofluoromethane	0.5	ug/L				<0.5
	Vinyl Chloride	0.2	ug/L	MAC-2			<0.2
	Xylene; total	1.0	ug/L	AO-300			<1.0

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APPENDIX L

Test Well Supplemental Sampling – Laboratory Certificates of Analysis

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e: paracel@paracellabs.com
www.paracellabs.com

Certificate of Analysis

Houle Chevrier
32 Steacie Drive
Kanata, ON K2K 2A9
Attn: James McEwen

Phone: (613) 836-1422
Fax: (613) 836-9731

Client PO:
Project: 11-037
Custody: 23631

Report Date: 8-Jun-2015
Order Date: 2-Jun-2015
Order #: 1523122

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

Paracel ID	Client ID
1523122-01	TW-1

Approved By: Mark Foto

Mark Foto, M.Sc. For Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

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	2-Jun-15	3-Jun-15
Anions	EPA 300.1 - IC	2-Jun-15	3-Jun-15
Colour	SM2120 - Spectrophotometric	2-Jun-15	2-Jun-15
Glycols	EPA 8015C - GC-FID	3-Jun-15	3-Jun-15
Hardness	Hardness as CaCO3	2-Jun-15	4-Jun-15
Mercury by CVAA	EPA 245.1 - Cold Vapour AA	5-Jun-15	5-Jun-15
Metals, ICP-MS	EPA 200.8 - ICP-MS	2-Jun-15	2-Jun-15
pH	EPA 150.1 - pH probe @25 °C	2-Jun-15	3-Jun-15
PHC F1	CWS Tier 1 - P&T GC-FID	2-Jun-15	3-Jun-15
PHC F2 - F4	CWS Tier 1 - GC-FID, extraction	3-Jun-15	3-Jun-15
Total Dissolved Solids	SM 2540C - gravimetric, filtration	2-Jun-15	4-Jun-15
TPH (diesel)	E3420 - GC-FID, extraction	3-Jun-15	3-Jun-15
Turbidity	SM 2130B - Turbidity meter	2-Jun-15	2-Jun-15
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	2-Jun-15	3-Jun-15

PARACEL LABORATORIES LTD.

Order #: 1523122

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO:

Project Description: 11-037

	Client ID:	TW-1	-	-	-
	Sample Date:	01-Jun-15	-	-	-
	Sample ID:	1523122-01	-	-	-
	MDL/Units	Water	-	-	-
General Inorganics					
Alkalinity, total	5 mg/L	201	-	-	-
Colour	2 TCU	<2	-	-	-
Hardness	1.0 mg/L	288	-	-	-
pH	0.1 pH Units	8.0	-	-	-
Total Dissolved Solids	10 mg/L	332	-	-	-
Turbidity	0.1 NTU	4.9	-	-	-
Anions					
Chloride	1 mg/L	32	-	-	-
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	64	-	-	-
Metals					
Mercury	0.1 ug/L	<0.1	-	-	-
Aluminum	1 ug/L	13	-	-	-
Antimony	0.5 ug/L	<0.5	-	-	-
Arsenic	1 ug/L	<1	-	-	-
Barium	1 ug/L	104	-	-	-
Boron	10 ug/L	37	-	-	-
Cadmium	0.1 ug/L	<0.1	-	-	-
Calcium	100 ug/L	73300	-	-	-
Chromium	1 ug/L	3	-	-	-
Copper	0.5 ug/L	<0.5	-	-	-
Iron	100 ug/L	358	-	-	-
Lead	0.1 ug/L	<0.1	-	-	-
Magnesium	200 ug/L	25600	-	-	-
Manganese	5 ug/L	8	-	-	-
Selenium	1 ug/L	<1	-	-	-
Sodium	200 ug/L	11900	-	-	-
Uranium	0.1 ug/L	3.0	-	-	-
Zinc	5 ug/L	<5	-	-	-
Volatiles					
Acetone	5.0 ug/L	<5.0	-	-	-

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO:

Project Description: 11-037

	Client ID:	TW-1	-	-	-
	Sample Date:	01-Jun-15	-	-	-
	Sample ID:	1523122-01	-	-	-
	MDL/Units	Water	-	-	-
Benzene	0.5 ug/L	<0.5	-	-	-
Bromodichloromethane	0.5 ug/L	<0.5	-	-	-
Bromoform	0.5 ug/L	<0.5	-	-	-
Bromomethane	0.5 ug/L	<0.5	-	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	-	-	-
Chlorobenzene	0.5 ug/L	<0.5	-	-	-
Chloroethane	1.0 ug/L	<1.0	-	-	-
Chloroform	0.5 ug/L	<0.5	-	-	-
Chloromethane	3.0 ug/L	<3.0	-	-	-
Dibromochloromethane	0.5 ug/L	<0.5	-	-	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	-	-	-
1,2-Dibromoethane	0.2 ug/L	<0.2	-	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethylene, total	0.5 ug/L	<0.5	-	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	-	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	-	-	-
Hexane	1.0 ug/L	<1.0	-	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	-	-	-
Methyl Butyl Ketone (2-Hexanone)	10.0 ug/L	<10.0	-	-	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	-	-	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	-	-	-
Methylene Chloride	5.0 ug/L	<5.0	-	-	-
Styrene	0.5 ug/L	<0.5	-	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO:

Project Description: 11-037

	Client ID:	TW-1	-	-	-
	Sample Date:	01-Jun-15	-	-	-
	Sample ID:	1523122-01	-	-	-
	MDL/Units	Water	-	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	-	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	-	-	-
Trichloroethylene	0.5 ug/L	<0.5	-	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	-	-	-
1,3,5-Trimethylbenzene	0.5 ug/L	<0.5	-	-	-
Vinyl chloride	0.5 ug/L	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	-	-	-
Xylenes, total	0.5 ug/L	<0.5	-	-	-
4-Bromofluorobenzene	Surrogate	109%	-	-	-
Dibromofluoromethane	Surrogate	117%	-	-	-
Toluene-d8	Surrogate	109%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	-	-	-
F2 PHCs (C10-C16)	100 ug/L	<100	-	-	-
F3 PHCs (C16-C34)	100 ug/L	<100	-	-	-
F4 PHCs (C34-C50)	100 ug/L	<100	-	-	-
TPH (diesel)	0.1 mg/L	<0.1	-	-	-
Semi-Volatiles					
Ethylene glycol	2 mg/L	<2	-	-	-
Diethylene glycol	2 mg/L	<2	-	-	-
Propylene glycol	2 mg/L	<2	-	-	-
Triethylene glycol	2 mg/L	<2	-	-	-
Trimethylene glycol	2 mg/L	<2	-	-	-

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

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						
Colour	ND	2	TCU						
Total Dissolved Solids	ND	10	mg/L						
Turbidity	ND	0.1	NTU						
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
TPH (diesel)	ND	0.1	mg/L						
Metals									
Mercury	ND	0.1	ug/L						
Aluminum	ND	1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Calcium	ND	100	ug/L						
Chromium	ND	1	ug/L						
Copper	ND	0.5	ug/L						
Iron	ND	100	ug/L						
Lead	ND	0.1	ug/L						
Magnesium	ND	200	ug/L						
Manganese	ND	5	ug/L						
Selenium	ND	1	ug/L						
Sodium	ND	200	ug/L						
Uranium	ND	0.1	ug/L						
Zinc	ND	5	ug/L						
Semi-Volatiles									
Ethylene glycol	ND	2	mg/L						
Diethylene glycol	ND	2	mg/L						
Propylene glycol	ND	2	mg/L						
Triethylene glycol	ND	2	mg/L						
Trimethylene glycol	ND	2	mg/L						
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						
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						

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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						
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	*34.7*		*ug/L*		*108*	*50-140*			
Surrogate: Dibromofluoromethane	*32.5*		*ug/L*		*102*	*50-140*			
Surrogate: Toluene-d8	*35.6*		*ug/L*		*111*	*50-140*			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	110	1	mg/L	110			0.2	10	
Fluoride	1.18	0.1	mg/L	1.17			0.4	10	
Nitrate as N	5.81	0.1	mg/L	5.84			0.6	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	153	1	mg/L	154			0.6	10	
General Inorganics									
Alkalinity, total	353	5	mg/L	354			0.2	14	
Colour	ND	2	TCU	ND				12	
pH	8.0	0.1	pH Units	8.0			0.1	10	
Total Dissolved Solids	316	10	mg/L	332			4.9	10	
Turbidity	4.8	0.1	NTU	4.9			1.2	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Metals									
Mercury	ND	0.1	ug/L	ND			0.0	20	
Aluminum	66.5	1	ug/L	68.6			3.1	20	
Antimony	2.93	0.5	ug/L	3.01			2.6	20	
Arsenic	5.5	1	ug/L	5.5			0.3	20	
Barium	13.6	1	ug/L	13.7			0.5	20	
Boron	491	10	ug/L	527			7.0	20	
Cadmium	0.21	0.1	ug/L	ND			0.0	20	
Calcium	75600	1000	ug/L	71700			5.3	20	
Chromium	7.1	1	ug/L	2.9			84.1	20	QR-01
Copper	4.21	0.5	ug/L	4.41			4.6	20	
Iron	ND	100	ug/L	101			0.0	20	
Lead	0.11	0.1	ug/L	0.10			9.5	20	
Magnesium	25500	200	ug/L	25600			0.4	20	
Manganese	115	5	ug/L	117			1.8	20	
Selenium	4.6	1	ug/L	4.5			4.0	20	
Sodium	12900	200	ug/L	12800			0.9	20	
Uranium	10.7	0.1	ug/L	10.9			1.4	20	
Zinc	9	5	ug/L	9			2.1	20	
Semi-Volatiles									
Ethylene glycol	ND	2	mg/L	ND				50	
Diethylene glycol	ND	2	mg/L	ND				50	
Propylene glycol	ND	2	mg/L	ND				50	
Triethylene glycol	ND	2	mg/L	ND				50	
Trimethylene glycol	ND	2	mg/L	ND				50	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroethane	ND	1.0	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Chloromethane	ND	3.0	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dibromoethane	ND	0.2	ug/L	ND				30	

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Butyl Ketone (2-Hexanone)	ND	10.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
1,3,5-Trimethylbenzene	ND	0.5	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*36.1*		*ug/L*	*ND*	*113*	*50-140*			
Surrogate: Dibromofluoromethane	*33.3*		*ug/L*	*ND*	*104*	*50-140*			
Surrogate: Toluene-d8	*37.1*		*ug/L*	*ND*	*116*	*50-140*			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	9.64	1	mg/L	ND	96.4	78-112			
Fluoride	1.92	0.1	mg/L	1.17	74.6	73-113			
Nitrate as N	6.66	0.1	mg/L	5.84	82.1	81-112			
Nitrite as N	1.06	0.05	mg/L	ND	106	76-117			
Sulphate	10.6	1	mg/L	ND	106	75-111			
General Inorganics									
Total Dissolved Solids	80.0	10	mg/L	ND	80.0	75-125			
Hydrocarbons									
F1 PHCs (C6-C10)	1840	25	ug/L	ND	92.0	68-117			
F2 PHCs (C10-C16)	1780	100	ug/L	ND	99.0	60-140			
F3 PHCs (C16-C34)	4230	100	ug/L	ND	114	60-140			
F4 PHCs (C34-C50)	2680	100	ug/L	ND	108	60-140			
TPH (diesel)	4.36	0.1	mg/L	ND	109	46-135			
Metals									
Mercury	3.71	0.1	ug/L	ND	124	78-137			
Aluminum	45.9		ug/L	2.5	86.9	80-120			
Antimony	49.8		ug/L	3.01	93.7	80-120			
Arsenic	59.2		ug/L	5.5	107	80-120			
Barium	63.4		ug/L	13.7	99.4	80-120			
Boron	69		ug/L	29	79.0	80-120			QS-02
Cadmium	43.9		ug/L	ND	87.8	80-120			
Calcium	987		ug/L	ND	98.7	80-120			
Chromium	52.3		ug/L	2.9	98.8	80-120			
Copper	47.7		ug/L	4.41	86.7	80-120			
Iron	816		ug/L	101	71.5	80-120			QS-02
Lead	45.9		ug/L	0.10	91.7	80-120			
Magnesium	1140		ug/L	ND	114	80-120			
Manganese	54.6		ug/L	ND	109	80-120			
Selenium	60.8		ug/L	4.5	113	80-120			
Sodium	1130		ug/L	ND	113	80-120			
Uranium	50.2		ug/L	10.9	78.6	80-120			
Zinc	49		ug/L	9	80.7	80-120			
Semi-Volatiles									
Ethylene glycol	21	2	mg/L	ND	104	50-150			
Diethylene glycol	15	2	mg/L	ND	74.2	50-150			
Propylene glycol	23	2	mg/L	ND	115	50-150			
Triethylene glycol	7	2	mg/L	ND	33.7	50-150			QS-02
Trimethylene glycol	24	2	mg/L	ND	120	50-150			
Volatiles									
Acetone	88.7	5.0	ug/L	ND	88.7	50-140			
Benzene	27.4	0.5	ug/L	ND	68.6	50-140			
Bromodichloromethane	30.4	0.5	ug/L	ND	76.0	50-140			
Bromoform	39.0	0.5	ug/L	ND	97.5	50-140			
Bromomethane	16.3	0.5	ug/L	ND	40.8	50-140			
Carbon Tetrachloride	24.7	0.2	ug/L	ND	61.7	50-140			
Chlorobenzene	41.7	0.5	ug/L	ND	104	50-140			
Chloroethane	31.8	1.0	ug/L	ND	79.5	50-140			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroform	31.9	0.5	ug/L	ND	79.8	50-140			
Chloromethane	27.8	3.0	ug/L	ND	69.5	50-140			
Dibromochloromethane	42.0	0.5	ug/L	ND	105	50-140			
Dichlorodifluoromethane	32.2	1.0	ug/L	ND	80.6	50-140			
1,2-Dibromoethane	44.4	0.2	ug/L	ND	111	50-140			
1,2-Dichlorobenzene	38.6	0.5	ug/L	ND	96.4	50-140			
1,3-Dichlorobenzene	40.2	0.5	ug/L	ND	101	50-140			
1,4-Dichlorobenzene	38.9	0.5	ug/L	ND	97.4	50-140			
1,1-Dichloroethane	30.7	0.5	ug/L	ND	76.8	50-140			
1,2-Dichloroethane	31.5	0.5	ug/L	ND	78.7	50-140			
1,1-Dichloroethylene	37.5	0.5	ug/L	ND	93.7	50-140			
cis-1,2-Dichloroethylene	28.7	0.5	ug/L	ND	71.7	50-140			
trans-1,2-Dichloroethylene	29.7	0.5	ug/L	ND	74.2	50-140			
1,2-Dichloropropane	28.9	0.5	ug/L	ND	72.3	50-140			
cis-1,3-Dichloropropylene	33.2	0.5	ug/L	ND	83.1	50-140			
trans-1,3-Dichloropropylene	33.8	0.5	ug/L	ND	84.5	50-140			
Ethylbenzene	36.2	0.5	ug/L	ND	90.4	50-140			
Hexane	22.4	1.0	ug/L	ND	55.9	50-140			
Methyl Ethyl Ketone (2-Butanone)	91.0	5.0	ug/L	ND	91.0	50-140			
Methyl Butyl Ketone (2-Hexanone)	112	10.0	ug/L	ND	112	50-140			
Methyl Isobutyl Ketone	77.6	5.0	ug/L	ND	77.6	50-140			
Methyl tert-butyl ether	81.2	2.0	ug/L	ND	81.2	50-140			
Methylene Chloride	26.8	5.0	ug/L	ND	67.1	50-140			
Styrene	36.9	0.5	ug/L	ND	92.4	50-140			
1,1,1,2-Tetrachloroethane	40.7	0.5	ug/L	ND	102	50-140			
1,1,2,2-Tetrachloroethane	51.8	0.5	ug/L	ND	130	50-140			
Tetrachloroethylene	47.5	0.5	ug/L	ND	119	50-140			
Toluene	41.4	0.5	ug/L	ND	104	50-140			
1,1,1-Trichloroethane	30.8	0.5	ug/L	ND	77.0	50-140			
1,1,2-Trichloroethane	31.5	0.5	ug/L	ND	78.7	50-140			
Trichloroethylene	25.8	0.5	ug/L	ND	64.6	50-140			
Trichlorofluoromethane	26.2	1.0	ug/L	ND	65.5	50-140			
1,3,5-Trimethylbenzene	32.0	0.5	ug/L	ND	80.1	50-140			
Vinyl chloride	29.8	0.5	ug/L	ND	74.6	50-140			
m,p-Xylenes	80.8	0.5	ug/L	ND	101	50-140			
o-Xylene	39.3	0.5	ug/L	ND	98.2	50-140			
Surrogate: 4-Bromofluorobenzene	*22.1*		*ug/L*		*69.1*	*50-140*			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Qualifier Notes:

QC Qualifiers :

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

QS-02 : Spike level outside of control limits. Analysis batch accepted based on other QC included in the batch.

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.

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.

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Chain of Custody
(Lab Use Only)
№ 23631

Page ___ of ___

Client Name: Houle Chevrier Engineering Limited	Project Reference: 11-037	TAT: [✓] Regular [ ] 3 Day
Contact Name: James McEwen	Quote #	[ ] 2 Day [ ] 1 Day
Address: 32 Steacie Drive, Ottawa, ON, K2K 2A9	PO #	Date Required:
Telephone: (613) 836-1422	Email Address: jmcewen@hceng.ca	

Criteria: [ ] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [ ] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: _____ [✓] Other: OWS

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

Required Analyses

Paracel Order Number: 1523122

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHC (F2-F4) TPH (Diesel)	Glycol	VOCs/BTEX PHC (F1)	Gen Chem	Mercury	Metals					
1	TW-1	H_2O		7	June 1/15		✓	✓	✓	✓	✓	✓					
2																	
3																	
4																	
5																	
6																	
7	June 2, 15																
8	Gen Chem = fluoride, nitrate, nitrite, Alkalinity, chloride,																
9	colour, hardness, ph, sulphate, TDS, turbidity																
10	per James OB																

Comments: Client will confirm analysis and guideline.

Method of Delivery: Walk in

Relinquished By (Sign):	Received by Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Brett Webster	Date/Time: June 1 15 3:50	Date/Time: JUN 02, 2015 09:37	Date/Time: June 2 1:00
Date/Time: June 1/2015 3:50	Temperature: ____ °C	Temperature: 4.9 °C	pH Verified [ ] By:

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Certificate of Analysis

Houle Chevrier
32 Steacie Drive
Kanata, ON K2K 2A9
Attn: James McEwen

Phone: (613) 836-1422
Fax: (613) 836-9731

Client PO:
Project: 11-037
Custody: 23632

Report Date: 8-Jun-2015
Order Date: 2-Jun-2015
Order #: 1523158

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

Paracel ID	Client ID
1523158-01	TW-2

Approved By: Mark Foto

Mark Foto, M.Sc. For Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

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	2-Jun-15	3-Jun-15
Anions	EPA 300.1 - IC	4-Jun-15	4-Jun-15
Colour	SM2120 - Spectrophotometric	3-Jun-15	3-Jun-15
Glycols	EPA 8015C - GC-FID	3-Jun-15	3-Jun-15
Hardness	Hardness as CaCO3	2-Jun-15	4-Jun-15
Mercury by CVAA	EPA 245.1 - Cold Vapour AA	5-Jun-15	5-Jun-15
Metals, ICP-MS	EPA 200.8 - ICP-MS	2-Jun-15	3-Jun-15
pH	EPA 150.1 - pH probe @25 °C	2-Jun-15	3-Jun-15
PHC F1	CWS Tier 1 - P&T GC-FID	2-Jun-15	3-Jun-15
PHC F2 - F4	CWS Tier 1 - GC-FID, extraction	3-Jun-15	3-Jun-15
Total Dissolved Solids	SM 2540C - gravimetric, filtration	2-Jun-15	4-Jun-15
TPH (diesel)	E3420 - GC-FID, extraction	3-Jun-15	3-Jun-15
Turbidity	SM 2130B - Turbidity meter	3-Jun-15	3-Jun-15
VOCs by P&T GC-MS	EPA 624 - P&T GC-MS	2-Jun-15	3-Jun-15

PARACEL LABORATORIES LTD.

Order #: 1523158

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO:

Project Description: 11-037

	Client ID:	TW-2	-	-	-
	Sample Date:	02-Jun-15	-	-	-
	Sample ID:	1523158-01	-	-	-
	MDL/Units	Water	-	-	-
General Inorganics					
Alkalinity, total	5 mg/L	199	-	-	-
Colour	2 TCU	2	-	-	-
Hardness	1.0 mg/L	316	-	-	-
pH	0.1 pH Units	7.6	-	-	-
Total Dissolved Solids	10 mg/L	384	-	-	-
Turbidity	0.1 NTU	2.4	-	-	-
Anions					
Chloride	1 mg/L	40	-	-	-
Fluoride	0.1 mg/L	<0.1	-	-	-
Nitrate as N	0.1 mg/L	1.7	-	-	-
Nitrite as N	0.05 mg/L	0.17	-	-	-
Sulphate	1 mg/L	67	-	-	-
Metals					
Mercury	0.1 ug/L	<0.1	-	-	-
Aluminum	1 ug/L	<1	-	-	-
Antimony	0.5 ug/L	<0.5	-	-	-
Arsenic	1 ug/L	<1	-	-	-
Barium	1 ug/L	179	-	-	-
Boron	10 ug/L	18	-	-	-
Cadmium	0.1 ug/L	<0.1	-	-	-
Calcium	100 ug/L	95500	-	-	-
Chromium	1 ug/L	<1	-	-	-
Copper	0.5 ug/L	<0.5	-	-	-
Iron	100 ug/L	150	-	-	-
Lead	0.1 ug/L	<0.1	-	-	-
Magnesium	200 ug/L	18800	-	-	-
Manganese	5 ug/L	7	-	-	-
Selenium	1 ug/L	<1	-	-	-
Sodium	200 ug/L	9950	-	-	-
Uranium	0.1 ug/L	5.3	-	-	-
Zinc	5 ug/L	<5	-	-	-
Volatiles					
Acetone	5.0 ug/L	<5.0	-	-	-

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO:

Project Description: 11-037

	Client ID:	TW-2	-	-	-
	Sample Date:	02-Jun-15	-	-	-
	Sample ID:	1523158-01	-	-	-
	MDL/Units	Water	-	-	-
Benzene	0.5 ug/L	<0.5	-	-	-
Bromodichloromethane	0.5 ug/L	<0.5	-	-	-
Bromoform	0.5 ug/L	<0.5	-	-	-
Bromomethane	0.5 ug/L	<0.5	-	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	-	-	-
Chlorobenzene	0.5 ug/L	<0.5	-	-	-
Chloroethane	1.0 ug/L	<1.0	-	-	-
Chloroform	0.5 ug/L	<0.5	-	-	-
Chloromethane	3.0 ug/L	<3.0	-	-	-
Dibromochloromethane	0.5 ug/L	<0.5	-	-	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	-	-	-
1,2-Dibromoethane	0.2 ug/L	<0.2	-	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethylene, total	0.5 ug/L	<0.5	-	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	-	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	-	-	-
Hexane	1.0 ug/L	<1.0	-	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	-	-	-
Methyl Butyl Ketone (2-Hexanone)	10.0 ug/L	<10.0	-	-	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	-	-	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	-	-	-
Methylene Chloride	5.0 ug/L	<5.0	-	-	-
Styrene	0.5 ug/L	<0.5	-	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO:

Project Description: 11-037

	Client ID:	TW-2	-	-	-
	Sample Date:	02-Jun-15	-	-	-
	Sample ID:	1523158-01	-	-	-
	MDL/Units	Water	-	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	-	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	-	-	-
Trichloroethylene	0.5 ug/L	<0.5	-	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	-	-	-
1,3,5-Trimethylbenzene	0.5 ug/L	<0.5	-	-	-
Vinyl chloride	0.5 ug/L	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	-	-	-
Xylenes, total	0.5 ug/L	<0.5	-	-	-
4-Bromofluorobenzene	Surrogate	110%	-	-	-
Dibromofluoromethane	Surrogate	117%	-	-	-
Toluene-d8	Surrogate	108%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	-	-	-
F2 PHCs (C10-C16)	100 ug/L	<100	-	-	-
F3 PHCs (C16-C34)	100 ug/L	<100	-	-	-
F4 PHCs (C34-C50)	100 ug/L	<100	-	-	-
TPH (diesel)	0.1 mg/L	<0.1	-	-	-
Semi-Volatiles					
Ethylene glycol	2 mg/L	<2	-	-	-
Diethylene glycol	2 mg/L	<2	-	-	-
Propylene glycol	2 mg/L	<2	-	-	-
Triethylene glycol	2 mg/L	<2	-	-	-
Trimethylene glycol	2 mg/L	<2	-	-	-

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

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						
Colour	ND	2	TCU						
Total Dissolved Solids	ND	10	mg/L						
Turbidity	ND	0.1	NTU						
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
TPH (diesel)	ND	0.1	mg/L						
Metals									
Mercury	ND	0.1	ug/L						
Aluminum	ND	1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Calcium	ND	100	ug/L						
Chromium	ND	1	ug/L						
Copper	ND	0.5	ug/L						
Iron	ND	100	ug/L						
Lead	ND	0.1	ug/L						
Magnesium	ND	200	ug/L						
Manganese	ND	5	ug/L						
Selenium	ND	1	ug/L						
Sodium	ND	200	ug/L						
Uranium	ND	0.1	ug/L						
Zinc	ND	5	ug/L						
Semi-Volatiles									
Ethylene glycol	ND	2	mg/L						
Diethylene glycol	ND	2	mg/L						
Propylene glycol	ND	2	mg/L						
Triethylene glycol	ND	2	mg/L						
Trimethylene glycol	ND	2	mg/L						
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						
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						

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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						
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	*34.7*		*ug/L*		*108*	*50-140*			
Surrogate: Dibromofluoromethane	*32.5*		*ug/L*		*102*	*50-140*			
Surrogate: Toluene-d8	*35.6*		*ug/L*		*111*	*50-140*			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	39.7	1	mg/L	39.5			0.5	10	
Fluoride	ND	0.1	mg/L	ND			0.0	10	
Nitrate as N	1.70	0.1	mg/L	1.70			0.4	20	
Nitrite as N	ND	0.05	mg/L	ND				20	
Sulphate	67.4	1	mg/L	67.3			0.2	10	
General Inorganics									
Alkalinity, total	353	5	mg/L	354			0.2	14	
Colour	2	2	TCU	2			0.0	12	
pH	8.0	0.1	pH Units	8.0			0.1	10	
Total Dissolved Solids	316	10	mg/L	332			4.9	10	
Turbidity	2.3	0.1	NTU	2.4			1.7	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Metals									
Mercury	ND	0.1	ug/L	ND			0.0	20	
Aluminum	ND	1	ug/L	ND				20	
Antimony	ND	0.5	ug/L	ND			0.0	20	
Arsenic	ND	1	ug/L	ND			0.0	20	
Barium	172	1	ug/L	179			3.8	20	
Boron	15	10	ug/L	18			17.4	20	
Cadmium	ND	0.1	ug/L	ND			0.0	20	
Calcium	75600	100	ug/L	95500			23.2	20	
Chromium	ND	1	ug/L	ND			0.0	20	
Copper	ND	0.5	ug/L	ND				20	
Iron	140	100	ug/L	150			6.8	20	
Lead	ND	0.1	ug/L	ND			0.0	20	
Magnesium	19000	200	ug/L	18800			0.8	20	
Manganese	7.4	5	ug/L	7.4			0.5	20	
Selenium	ND	1	ug/L	ND			0.0	20	
Sodium	9940	200	ug/L	9950			0.1	20	
Uranium	5.3	0.1	ug/L	5.3			1.3	20	
Zinc	ND	5	ug/L	ND			0.0	20	
Semi-Volatiles									
Ethylene glycol	ND	2	mg/L	ND				50	
Diethylene glycol	ND	2	mg/L	ND				50	
Propylene glycol	ND	2	mg/L	ND				50	
Triethylene glycol	ND	2	mg/L	ND				50	
Trimethylene glycol	ND	2	mg/L	ND				50	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroethane	ND	1.0	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Chloromethane	ND	3.0	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dibromoethane	ND	0.2	ug/L	ND				30	

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Butyl Ketone (2-Hexanone)	ND	10.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
1,3,5-Trimethylbenzene	ND	0.5	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*36.1*		*ug/L*	*ND*	*113*	*50-140*			
Surrogate: Dibromofluoromethane	*33.3*		*ug/L*	*ND*	*104*	*50-140*			
Surrogate: Toluene-d8	*37.1*		*ug/L*	*ND*	*116*	*50-140*			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	48.7	1	mg/L	39.5	91.3	78-112			
Fluoride	0.92	0.1	mg/L	ND	92.5	73-113			
Nitrate as N	2.62	0.1	mg/L	1.70	91.0	81-112			
Nitrite as N	1.18	0.05	mg/L	0.166	101	76-117			
Sulphate	75.3	1	mg/L	67.3	80.0	75-111			
General Inorganics									
Total Dissolved Solids	80.0	10	mg/L	ND	80.0	75-125			
Hydrocarbons									
F1 PHCs (C6-C10)	1840	25	ug/L	ND	92.0	68-117			
F2 PHCs (C10-C16)	1780	100	ug/L	ND	99.0	60-140			
F3 PHCs (C16-C34)	4230	100	ug/L	ND	114	60-140			
F4 PHCs (C34-C50)	2680	100	ug/L	ND	108	60-140			
TPH (diesel)	4.36	0.1	mg/L	ND	109	46-135			
Metals									
Mercury	3.71	0.1	ug/L	ND	124	78-137			
Aluminum	48.2		ug/L	ND	96.3	80-120			
Antimony	46.8		ug/L	0.08	93.4	80-120			
Arsenic	48.1		ug/L	0.07	96.0	80-120			
Barium	214		ug/L	179	70.6	80-120			QM-4X
Boron	59		ug/L	18	80.8	80-120			
Cadmium	45.6		ug/L	0.002	91.1	80-120			
Calcium	880		ug/L	ND	88.0	80-120			
Chromium	46.0		ug/L	0.08	91.7	80-120			
Copper	39.5		ug/L	ND	79.0	80-120			QM-07
Iron	1040		ug/L	150	89.0	80-120			
Lead	46.5		ug/L	0.03	93.0	80-120			
Magnesium	884		ug/L	ND	88.4	80-120			
Manganese	52.3		ug/L	7.4	89.9	80-120			
Selenium	45.8		ug/L	0.1	91.4	80-120			
Sodium	931		ug/L	ND	93.1	80-120			
Uranium	55.7		ug/L	5.3	101	80-120			
Zinc	46		ug/L	2	88.9	80-120			
Semi-Volatiles									
Ethylene glycol	21	2	mg/L	ND	104	50-150			
Diethylene glycol	15	2	mg/L	ND	74.2	50-150			
Propylene glycol	23	2	mg/L	ND	115	50-150			
Triethylene glycol	7	2	mg/L	ND	33.7	50-150			QS-02
Trimethylene glycol	24	2	mg/L	ND	120	50-150			
Volatiles									
Acetone	88.7	5.0	ug/L	ND	88.7	50-140			
Benzene	27.4	0.5	ug/L	ND	68.6	50-140			
Bromodichloromethane	30.4	0.5	ug/L	ND	76.0	50-140			
Bromoform	39.0	0.5	ug/L	ND	97.5	50-140			
Bromomethane	16.3	0.5	ug/L	ND	40.8	50-140			
Carbon Tetrachloride	24.7	0.2	ug/L	ND	61.7	50-140			
Chlorobenzene	41.7	0.5	ug/L	ND	104	50-140			
Chloroethane	31.8	1.0	ug/L	ND	79.5	50-140			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroform	31.9	0.5	ug/L	ND	79.8	50-140			
Chloromethane	27.8	3.0	ug/L	ND	69.5	50-140			
Dibromochloromethane	42.0	0.5	ug/L	ND	105	50-140			
Dichlorodifluoromethane	32.2	1.0	ug/L	ND	80.6	50-140			
1,2-Dibromoethane	44.4	0.2	ug/L	ND	111	50-140			
1,2-Dichlorobenzene	38.6	0.5	ug/L	ND	96.4	50-140			
1,3-Dichlorobenzene	40.2	0.5	ug/L	ND	101	50-140			
1,4-Dichlorobenzene	38.9	0.5	ug/L	ND	97.4	50-140			
1,1-Dichloroethane	30.7	0.5	ug/L	ND	76.8	50-140			
1,2-Dichloroethane	31.5	0.5	ug/L	ND	78.7	50-140			
1,1-Dichloroethylene	37.5	0.5	ug/L	ND	93.7	50-140			
cis-1,2-Dichloroethylene	28.7	0.5	ug/L	ND	71.7	50-140			
trans-1,2-Dichloroethylene	29.7	0.5	ug/L	ND	74.2	50-140			
1,2-Dichloropropane	28.9	0.5	ug/L	ND	72.3	50-140			
cis-1,3-Dichloropropylene	33.2	0.5	ug/L	ND	83.1	50-140			
trans-1,3-Dichloropropylene	33.8	0.5	ug/L	ND	84.5	50-140			
Ethylbenzene	36.2	0.5	ug/L	ND	90.4	50-140			
Hexane	22.4	1.0	ug/L	ND	55.9	50-140			
Methyl Ethyl Ketone (2-Butanone)	91.0	5.0	ug/L	ND	91.0	50-140			
Methyl Butyl Ketone (2-Hexanone)	112	10.0	ug/L	ND	112	50-140			
Methyl Isobutyl Ketone	77.6	5.0	ug/L	ND	77.6	50-140			
Methyl tert-butyl ether	81.2	2.0	ug/L	ND	81.2	50-140			
Methylene Chloride	26.8	5.0	ug/L	ND	67.1	50-140			
Styrene	36.9	0.5	ug/L	ND	92.4	50-140			
1,1,1,2-Tetrachloroethane	40.7	0.5	ug/L	ND	102	50-140			
1,1,2,2-Tetrachloroethane	51.8	0.5	ug/L	ND	130	50-140			
Tetrachloroethylene	47.5	0.5	ug/L	ND	119	50-140			
Toluene	41.4	0.5	ug/L	ND	104	50-140			
1,1,1-Trichloroethane	30.8	0.5	ug/L	ND	77.0	50-140			
1,1,2-Trichloroethane	31.5	0.5	ug/L	ND	78.7	50-140			
Trichloroethylene	25.8	0.5	ug/L	ND	64.6	50-140			
Trichlorofluoromethane	26.2	1.0	ug/L	ND	65.5	50-140			
1,3,5-Trimethylbenzene	32.0	0.5	ug/L	ND	80.1	50-140			
Vinyl chloride	29.8	0.5	ug/L	ND	74.6	50-140			
m,p-Xylenes	80.8	0.5	ug/L	ND	101	50-140			
o-Xylene	39.3	0.5	ug/L	ND	98.2	50-140			
Surrogate: 4-Bromofluorobenzene	*22.1*		*ug/L*		*69.1*	*50-140*			

Certificate of Analysis

Report Date: 08-Jun-2015
Order Date:2-Jun-2015

Client: **Houle Chevrier**
Client PO: Project Description: 11-037

Qualifier Notes:

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.

QM-4X : The spike recovery was outside of QC acceptance limits due to elevated analyte concentration.

QS-02 : Spike level outside of control limits. Analysis batch accepted based on other QC included in the batch.

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.

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.

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Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
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www.paracellabs.com

Chain of Custody
(Lab Use Only)
No. 23632

Page ___ of ___

Client Name: HOULE CHEVRIER ENGINEERING LTD	Project Reference: 11-037	TAT: [X] Regular [ ] 3 Day
Contact Name: James McEwen	Quote #	[ ] 2 Day [ ] 1 Day
Address: 32 Steacie Dr, Ottawa, ON, K2K 2A9	PO #	Date Required:
Telephone: (613) 836-1422	Email Address: jmcewen@hceng.ca	

Criteria: [ ] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [ ] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: _____ [X] Other: ODWS

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

Paracel Order Number: 1523158

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Glycol	VOCs/BTEX/PHC (F1-F4) Diesel	PHC (F2-F4)	Gen Chem (Subdivision Reg)	Metals	Mercury					
1	TW-2	H2O		7	June 2/15		X	X	X	X	X	X					
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Comments: Same as previous order.

Method of Delivery: Walk-in

Relinquished By (Sign): Brett Webster	Received by Driver/Depot: SUNEEPORN DOKMAI	Received at Lab:	Verified By:
Relinquished By (Print): Brett Webster	Date/Time: JUN 02, 2015 05:25	Date/Time: June 2/15	Date/Time: June 2/15 5:35
Date/Time: June 2/2015 3:50	Temperature: 14.6 °C	Temperature: 12.6 °C 3:48	pH Verified [ ] By:

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317890
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Revised Report - Sample ID changed as per client request.

APPROVAL: _____

Craig Thompson
Project Manager

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317890
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1051186 Water 2013-08-19 TW1-R1	1051187 Water 2013-08-19 TW1-R2
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			4	7
	Total Coliforms	0	ct/100mL	MAC-0		0	0

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317896
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Revised Report - Sample ID changed as per client request.

APPROVAL: _____

Craig Thompson
Project Manager

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317896
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

				Lab I.D.	1051196
				Sample Matrix	Water
				Sample Type	
				Sampling Date	2013-08-19
				Sample I.D.	TW1 - R2
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
General Chemistry	Turbidity	0.1	NTU	MAC-1.0	0.7

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1317896
Date Submitted: 2013-08-19
Date Reported: 2013-08-22
Project: 11-037
COC #: 160506

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 256307 **Analysis Date** 2000-00-13 **Method** C SM2130B			
Turbidity	<0.1 NTU	107	73-127

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1315482
Date Submitted: 2013-07-22
Date Reported: 2013-07-25
Project: 11-037
COC #: 160501

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Revised Report - Sample ID changed as per client request.

APPROVAL: _____

Craig Thompson
Project Manager

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1315482
Date Submitted: 2013-07-22
Date Reported: 2013-07-25
Project: 11-037
COC #: 160501

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.	
					1044356 Water 2013-07-22 TW2-R1	1044357 Water 2013-07-22 TW2-R2
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0	0	0
	Faecal Coliforms	0	ct/100mL		0	0
	Faecal Streptococcus	0	ct/100mL		1	0
	Heterotrophic Plate Count	0	ct/1mL		2	0
	Total Coliforms	0	ct/100mL	MAC-0	0	0

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

APPENDIX M

Private Well Sampling – Laboratory Certificates of Analysis

Report to: Mr. Greg LeBlanc
Project: 62471.01 (January 29, 2020)

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1319998
Date Submitted: 2013-09-11
Date Reported: 2013-09-16
Project: 11-037
COC #: 160507

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Krista Quantrill
Laboratory Supervisor, Microbiology

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1319998
Date Submitted: 2013-09-11
Date Reported: 2013-09-16
Project: 11-037
COC #: 160507

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1057265 Water 2013-09-11 PW 1	1057266 Water 2013-09-11 PW 2
Microbiology	Escherichia Coli	0	ct/100mL	MAC-0		0	0
	Faecal Coliforms	0	ct/100mL			0	0
	Faecal Streptococcus	0	ct/100mL			0	0
	Heterotrophic Plate Count	0	ct/1mL			0	0
	Total Coliforms	0	ct/100mL	MAC-0		0	0

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

EXOVA OTTAWA

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1320010
Date Submitted: 2013-09-11
Date Reported: 2013-09-17
Project: 11-037
COC #: 160507

Dear James McEwen:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Lorna Wilson
Laboratory Supervisor, Inorganics

Certificate of Analysis

Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
Carp, ON
K0A 1L0
Attention: Mr. James McEwen
PO#:
Invoice to: Houle Chevrier Engineering

Report Number: 1320010
Date Submitted: 2013-09-11
Date Reported: 2013-09-17
Project: 11-037
COC #: 160507

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.	
					1057281 Water 2013-09-11 PW 1	1057282 Water 2013-09-11 PW 2
Calculations	Hardness as CaCO3	1	mg/L	OG-100	252*	220*
	Ion Balance	0.01			1.08	1.05
	TDS (COND - CALC)	1	mg/L	AO-500	339	647*
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG-500	156	227
	Cl	1	mg/L	AO-250	44	127
	Colour	2	TCU	AO-5	2	2
	Conductivity	5	uS/cm		521	996
	DOC	0.5	mg/L	AO-5	1.1	1.9
	F	0.10	mg/L	MAC-1.5	<0.10	<0.10
	N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
	N-NO3	0.10	mg/L	MAC-10.0	<0.10	9.57
	pH	1.00		6.5-8.5	7.82	7.75
	S2-	0.01	mg/L	AO-0.05	<0.01	<0.01
	SO4	3	mg/L	AO-500	48	39
	Turbidity	0.1	NTU	MAC-1.0	2.7*	0.2
Metals	Ca	1	mg/L		73	75
	Fe	0.03	mg/L	AO-0.3	0.21	0.03
	K	1	mg/L		2	1
	Mg	1	mg/L		17	8
	Mn	0.01	mg/L	AO-0.05	0.02	<0.01
	Na	2	mg/L	AO-200	16	131
Nutrients	N-NH3	0.02	mg/L		0.05	0.05
	Phenols	0.001	mg/L		<0.001	<0.001
	Tannin & Lignin	0.1	mg/L		<0.1	<0.1
	Total Kjeldahl Nitrogen	0.10	mg/L		<0.10	<0.10

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Houle Chevrier Engineering
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QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 0 **Analysis Date** 2013-09-16 **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 257516 **Analysis Date** 2013-09-12 **Method** C SM4500-NH3D			
N-NH3	<0.02 mg/L	95	85-115
Run No 257596 **Analysis Date** 2013-09-13 **Method** C SM2120C			
Colour	<2 TCU	105	90-110
Run No 257598 **Analysis Date** 2013-09-13 **Method** C SM5530D			
Phenols	<0.001 mg/L	92	73-127
Run No 257599 **Analysis Date** 2013-09-13 **Method** C SM4500-Norg-C			
Total Kjeldahl Nitrogen	<0.10 mg/L	102	77-123
Run No 257603 **Analysis Date** 2013-09-13 **Method** C SM2130B			
Turbidity	<0.1 NTU	100	73-127
Run No 257604 **Analysis Date** 2013-09-13 **Method** C SM5550B			

Guideline = ODWSOG *** = Guideline Exceedence**
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Client: Houle Chevrier Engineering
180 Wescar Lane, R.R. #2
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Report Number: 1320010
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Project: 11-037
COC #: 160507

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Tannin & Lignin	<0.1 mg/L	96	80-120
Run No 257629 **Analysis Date** 2013-09-13 **Method** EPA 200.8			
Fe	<0.03 mg/L	110	88-112
Mn	<0.01 mg/L	103	91-109
Run No 257638 **Analysis Date** 2013-09-13 **Method** M SM3120B-3500C			
Ca	<1 mg/L	100	80-120
K	<1 mg/L	105	80-120
Mg	<1 mg/L	100	80-120
Na	<2 mg/L	110	80-120
Run No 257656 **Analysis Date** 2013-09-13 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	103	80-120
N-NO3	<0.10 mg/L	95	80-120
Run No 257670 **Analysis Date** 2013-09-13 **Method** SM 2320B			
Alkalinity as CaCO3	<5 mg/L	101	95-105
Conductivity	<5 uS/cm	99	95-105
F	<0.10 mg/L	103	90-110
pH	5.82	100	90-110

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
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MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 257676 **Analysis Date** 2013-09-13 **Method** SM 4110C			
Cl	<1 mg/L	101	90-110
SO4	<3 mg/L	105	90-110
Run No 257683 **Analysis Date** 2013-09-16 **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	107	
Run No 257685 **Analysis Date** 2013-09-16 **Method** C SM4500-NO3-F			
N-NO2	<0.10 mg/L	107	80-120
N-NO3	<0.10 mg/L	97	80-120
Run No 257702 **Analysis Date** 2013-09-16 **Method** C SM5310C			
DOC	<0.5 mg/L	102	84-116

Guideline = ODWSOG *** = Guideline Exceedence**
** = Analysis completed at Mississauga, Ontario.
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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

APPENDIX N

Transmissivity Analysis Estimates and Interference Analysis

GEMTEC
Consulting Engineers and Geoscientists
191 Doak Road
Fredericton, NB, Canada

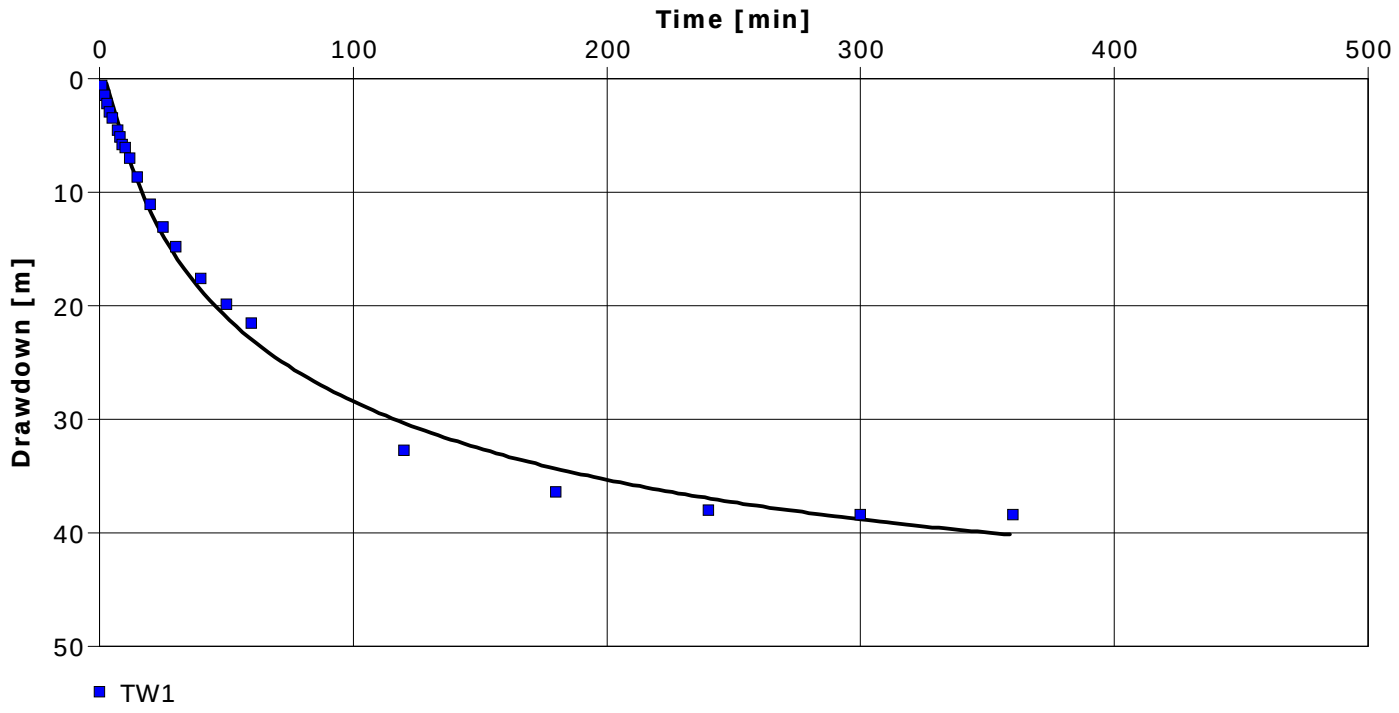
Pumping Test Analysis Report K

Project: Hydrogeological Investigation

Number:

Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 1	Pumping Well: TW1
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Hantush Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 5 [U.S. gal/min]	

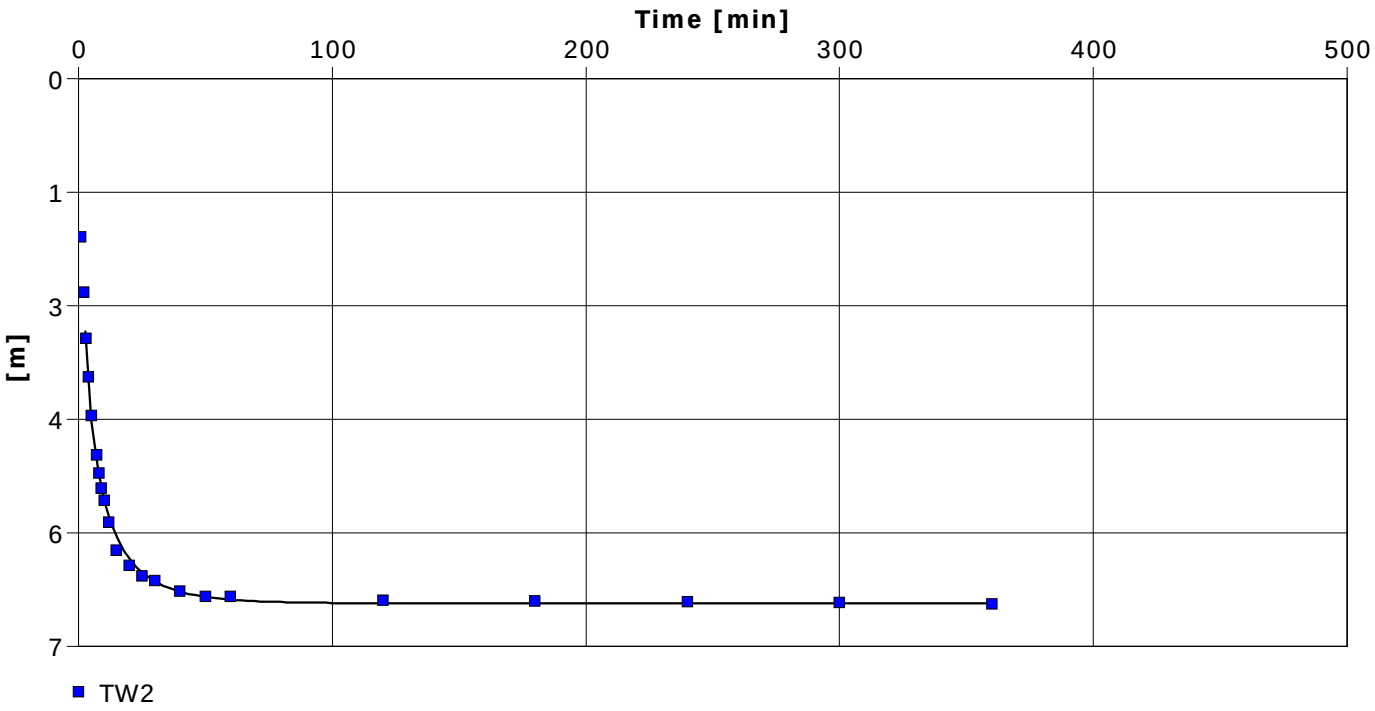


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW1	1.66×10^{-1}		1.30×10^{3}	3.87×10^{-1}		

GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**	K
	Project: Hydrogeological Investigation	
	Number:	
	Client: Mr. Greg LeBlanc	

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Hantush Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 8 [U.S. gal/min]	



Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW2	1.68×10^{0}		8.42×10^{1}	3.14×10^{-1}		

GEMTEC
Consulting Engineers and Geoscientists
191 Doak Road
Fredericton, NB, Canada

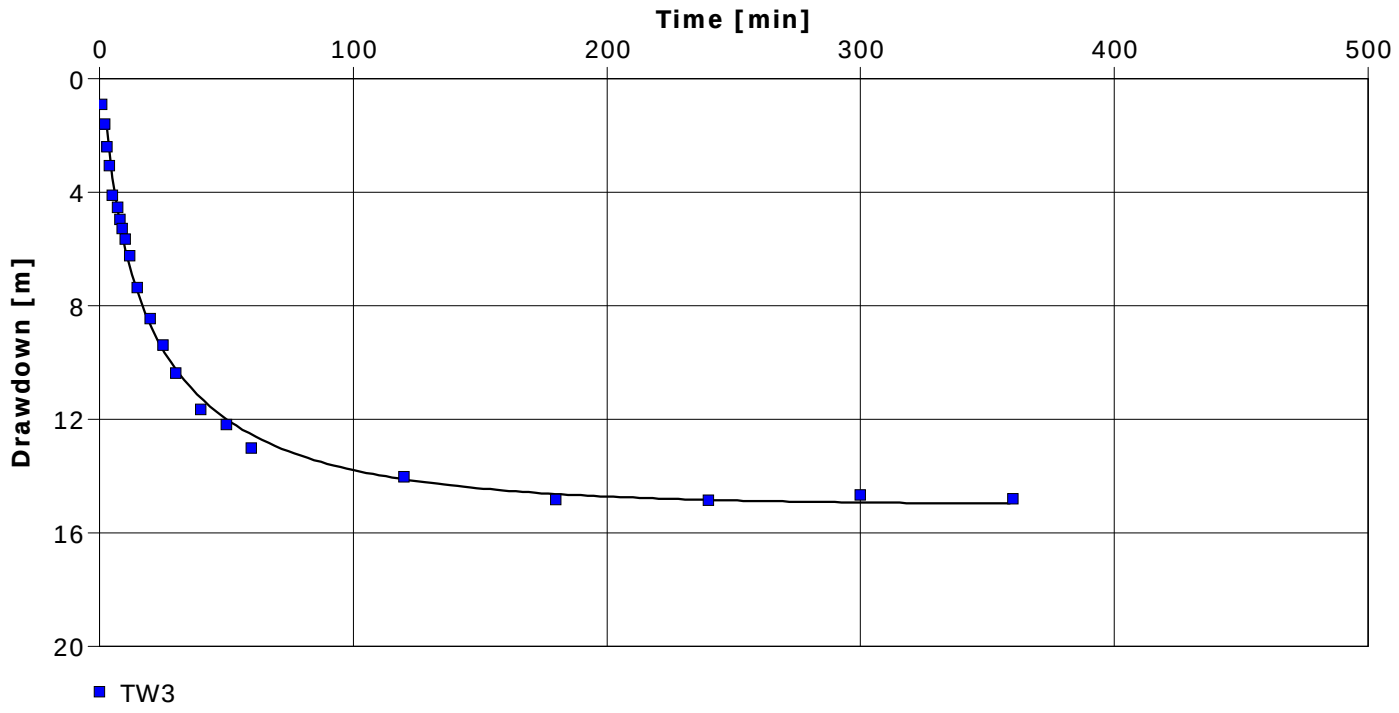
Pumping Test Analysis Report K

Project: Hydrogeological Investigation

Number:

Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Test Well 3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Hantush Analysis	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge Rate: 6 [U.S. gal/min]	

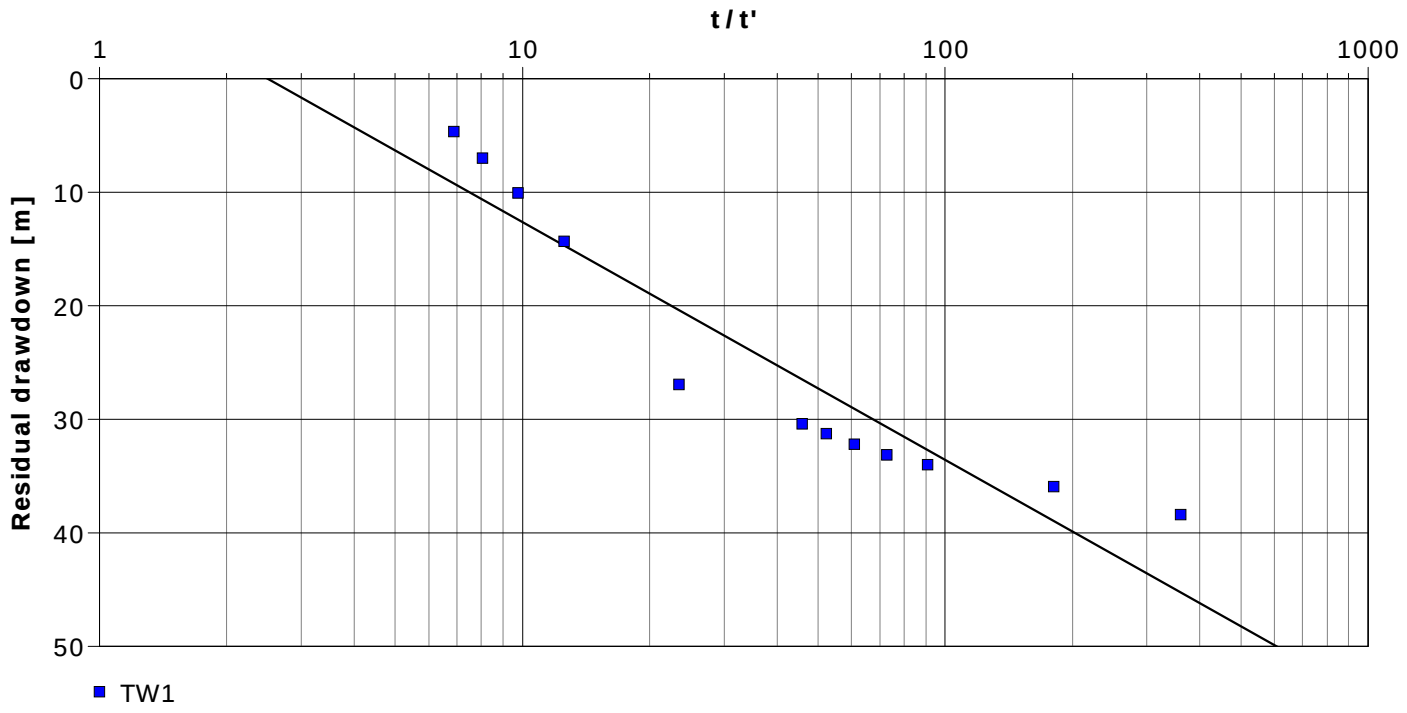


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW3	4.91×10^{-1}		2.08×10^{2}	2.66×10^{-1}		

GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**	K
	Project: Hydrogeological Investigation	
	Number:	
	Client: Mr. Greg LeBlanc	

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Recovery Test Well 1	Pumping Well: TW1
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/18/2013
Analysis Performed by: BK	Theis Recovery	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge: variable, average rate 5 [U.S. gal/min]	

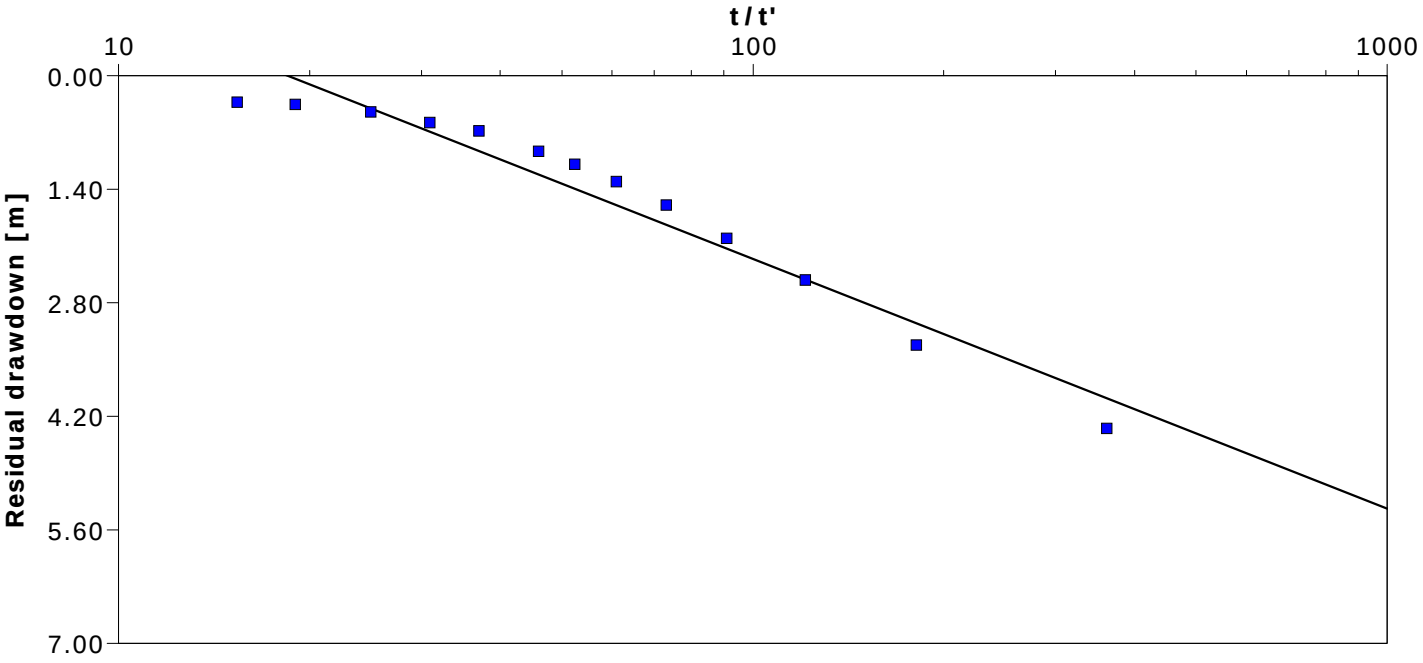


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW1	2.38×10^{-1}		

GEMTEC **Consulting Engineers and Geoscientists** **191 Doak Road** **Fredericton, NB, Canada**	**Pumping Test Analysis Report**	K
	Project: Hydrogeological Investigation	
	Number:	
	Client: Mr. Greg LeBlanc	

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Recovery Test Well 2	Pumping Well: TW2
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/19/2013
Analysis Performed by: BK	Theis Recovery	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge: variable, average rate 8 [U.S. gal/min]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW2	2.59×10^{0}		

GEMTEC
Consulting Engineers and Geoscientists
191 Doak Road
Fredericton, NB, Canada

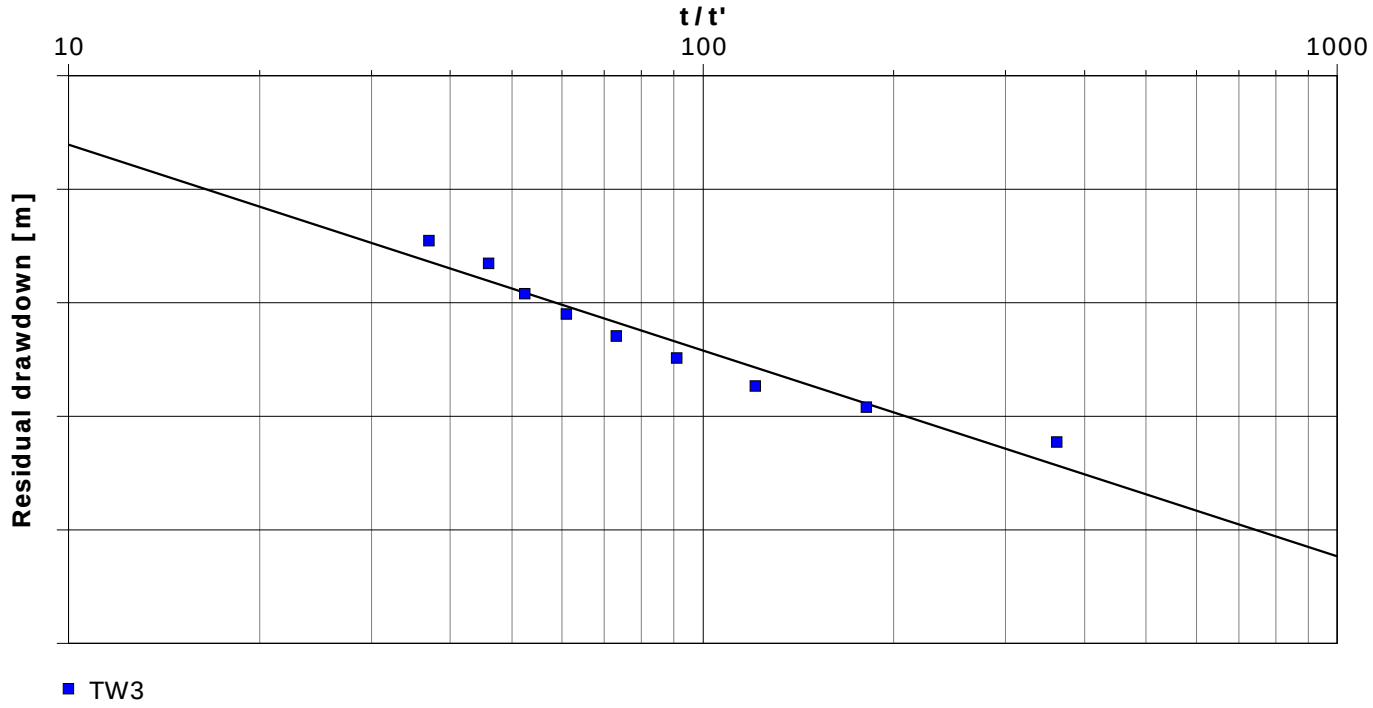
Pumping Test Analysis Report K

Project: Hydrogeological Investigation

Number:

Client: Mr. Greg LeBlanc

Location: Carp Rd., Ottawa, Ontario	Pumping Test: Recovery Test Well 3	Pumping Well: TW3
Test Conducted by: Houle Chevrier Engineering Ltd.		Test Date: 6/20/2013
Analysis Performed by: BK	Theis Recovery	Analysis Date: 9/27/2013
Aquifer Thickness:	Discharge: variable, average rate 6 [U.S. gal/min]	

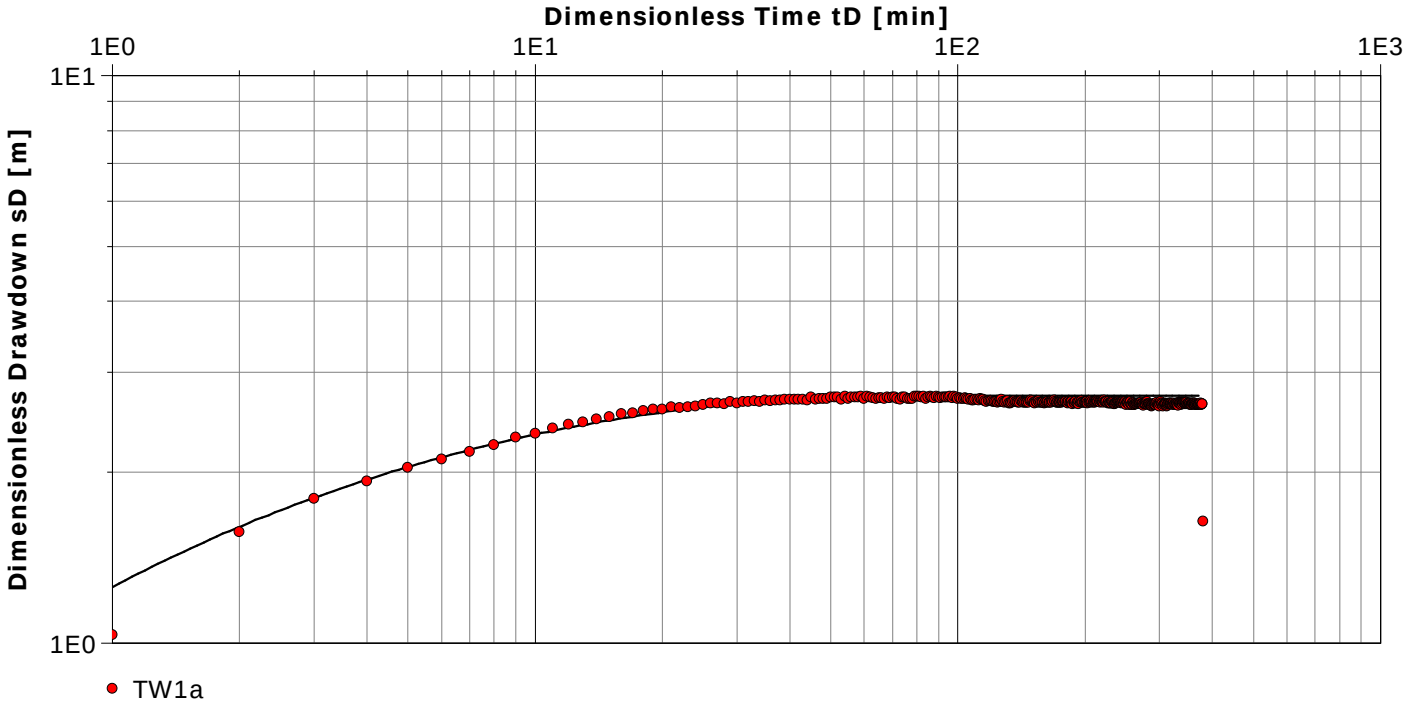


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW3	8.25×10^{-1}		

Contact Info Address Company Name City, State/Province	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number: 11-037
	Client: Mr. Greg Leblanc

Location: Ottawa, Ontario	Pumping Test: TW1 2015 Pump Test - Drawdown	Pumping Well: TW1
Test Conducted by: BW		Test Date: 15/06/01
Analysis Performed by:	TW1 Hantush	Analysis Date: 15/07/22
Aquifer Thickness:	Discharge: variable, average rate 0.02 [m³/min]	

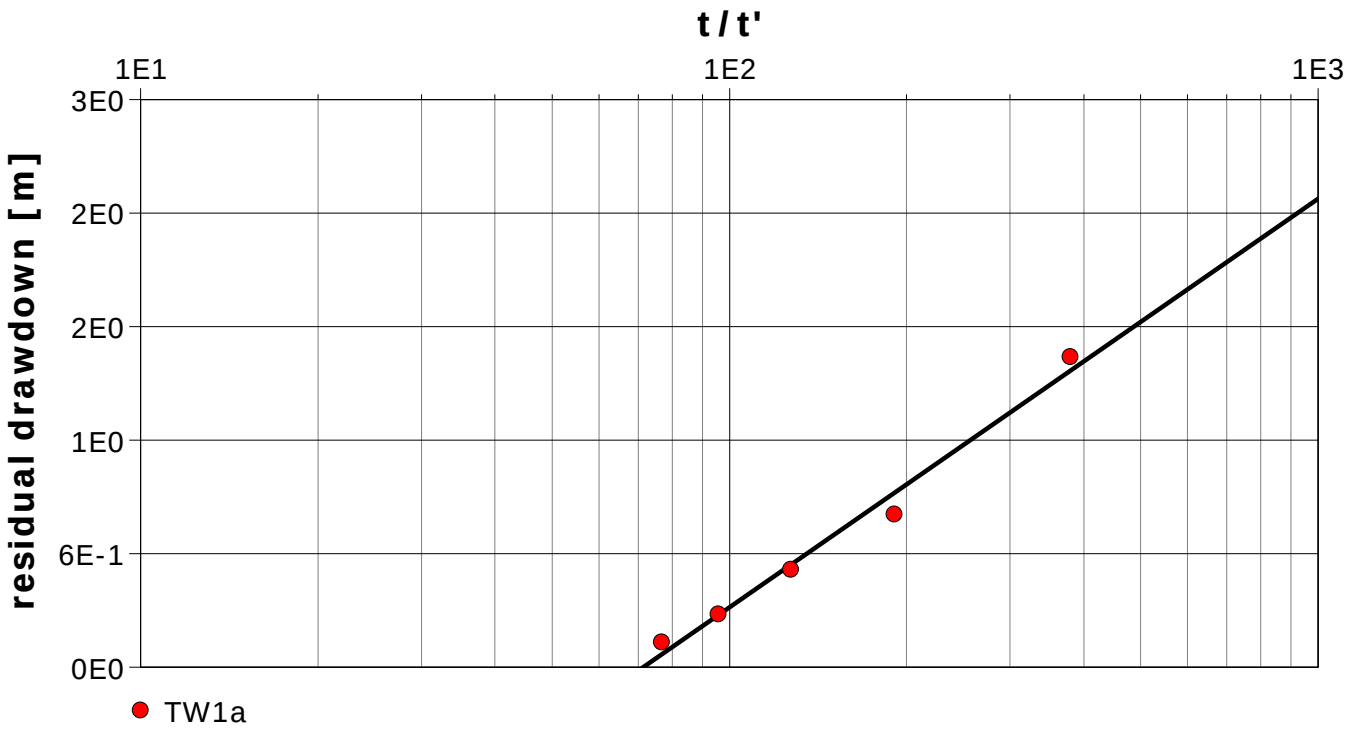


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW1a	3.90×10^{0}	2.92×10^{-2}	8.70×10^{2}	1.54×10^{0}	0.15	

Contact Info **Address** **Company Name** **City, State/Province**	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number: 11-037
	Client: Mr. Greg Leblanc

Location: Ottawa, Ontario	Pumping Test: TW1 2015 Pump Test - Drawdown	Pumping Well: TW1
Test Conducted by: BW		Test Date: 15/06/01
Analysis Performed by: JM	TW1 Theis Rec	Analysis Date: 15/07/22
Aquifer Thickness:	Discharge: variable, average rate 0.02 [m³/min]	

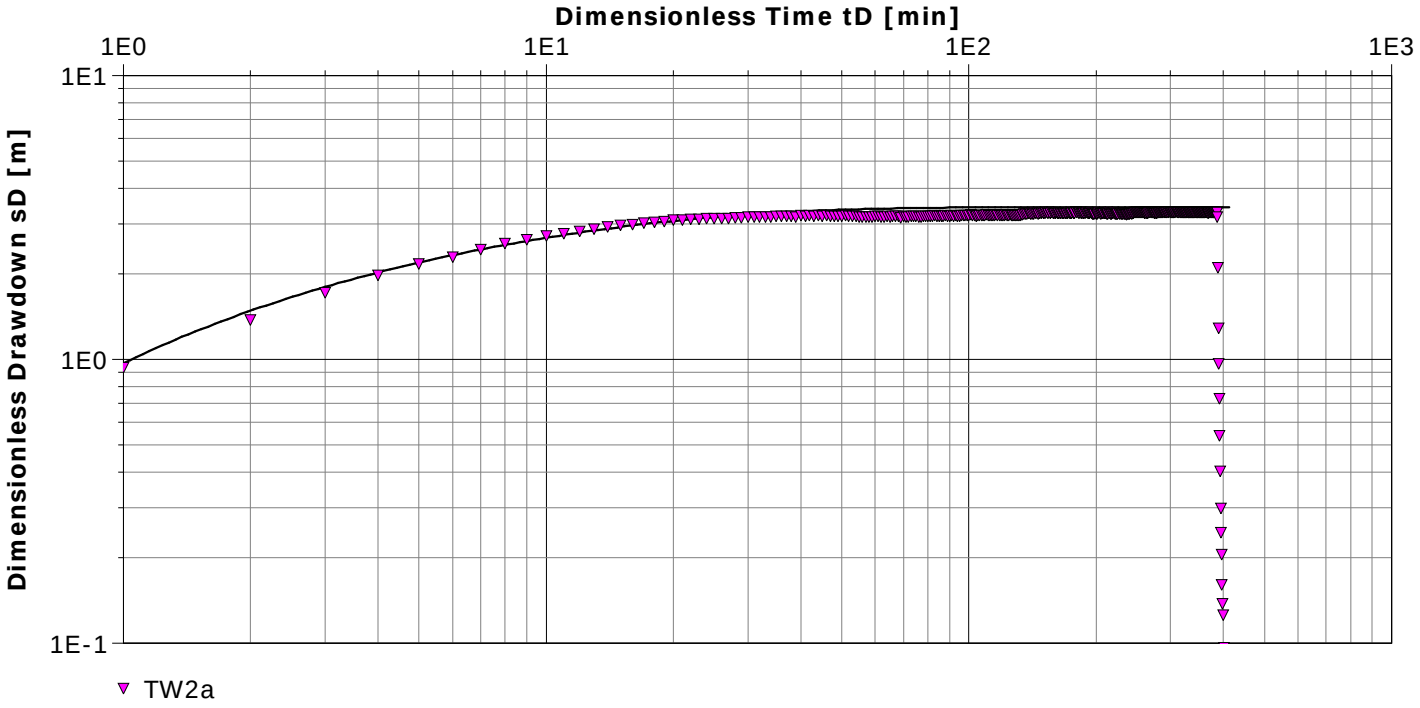


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW1a	2.44×10^{0}	0.15	

Contact Info Address Company Name City, State/Province	**Pumping Test Analysis Report**
	Project: Hydrogeological Investigation
	Number: 11-037
	Client: Mr. Greg Leblanc

Location: Ottawa, Ontario	Pumping Test: TW2 2015 Pump Test - Drawdown	Pumping Well: TW2
Test Conducted by: BW		Test Date: 15/06/02
Analysis Performed by:	New analysis 3	Analysis Date: 15/07/22
Aquifer Thickness:	Discharge: variable, average rate 0.02 [m³/min]	

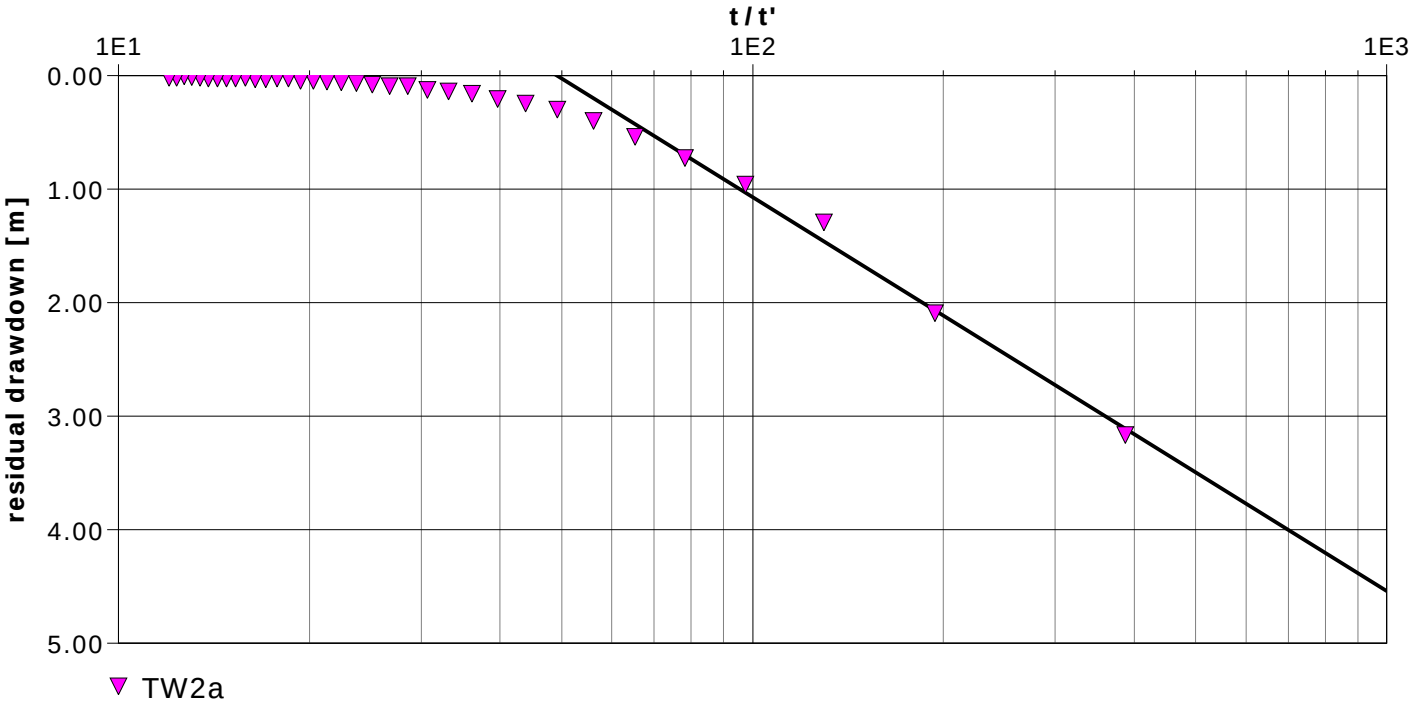


Calculation using Hantush

Observation Well	Transmissivity [m²/d]	Storage coefficient	Hydr. resistance [min]	Leakage factor [m]	Radial Distance to PW [m]	
TW2a	2.10×10^{0}	6.43×10^{-2}	4.59×10^{2}	8.18×10^{-1}	0.15	

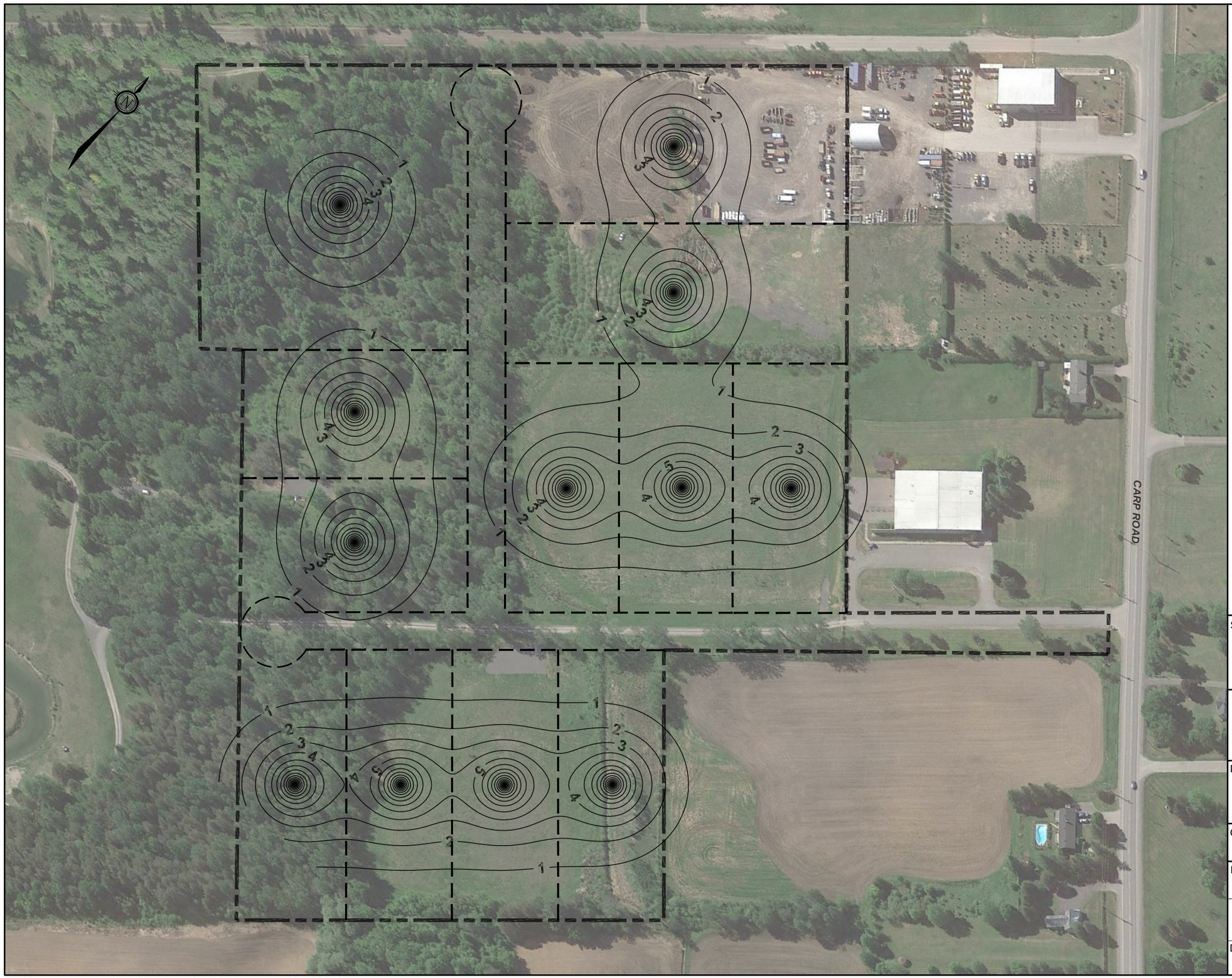
	Contact Info **Address** **Company Name** **City, State/Province**	**Pumping Test Analysis Report**
		Project: Hydrogeological Investigation
		Number: 11-037
		Client: Mr. Greg Leblanc

Location: Ottawa, Ontario	Pumping Test: TW2 2015 Pump Test - Drawdown	Pumping Well: TW2
Test Conducted by: BW		Test Date: 15/06/02
Analysis Performed by:	Analysis TW2 Rec	Analysis Date: 15/07/22
Aquifer Thickness:	Discharge: variable, average rate 0.02 [m³/min]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]	
TW2a	1.52×10^{0}	0.15	



LEGEND

SUBJECT SITE

4 CONTOURS, IN 1 METRE INTERVALS

Scale 1:2000

0 40 80 120m

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

Drawing: WELL INTERFERENCE SIMULATION 1

Client: STOREYWORKS DEVELOPMENT INC.

Project: 62471.01

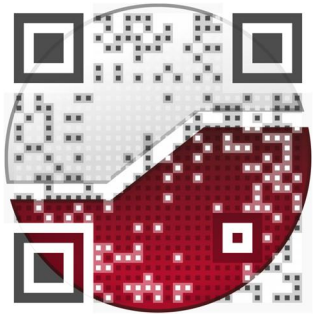
HYDROGEOLOGICAL ASSESSMENT & TERRAIN ANALYSIS
3119 CARP ROAD
OTTAWA, ONTARIO

Drwn by: P.C. | Chkd by: A.P.

Date: JANUARY 2020 | Rev.: 0

FIGURE N1

experience • knowledge • integrity



civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité