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Geotechnical Engineering

Environmental Engineering

Hydrogeology

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Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Residential Development
Highway 7 at Highway 15, Carleton Place
Ottawa, Ontario

Prepared For

Novatech Engineering Consultants Ltd.

May 1, 2020

Report PG5212-1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Novatech Engineering Consultants Ltd. to conduct a geotechnical investigation for the subject site to be located at Highway 7 at Highway 15, Carleton Place, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

❑ determine the subsurface soil and groundwater conditions based on available subsoil information and test pit investigation.

❑ to provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as they are understood at the time of writing this report.

2.0 Proposed Project

Based on available design plans, it is understood that the proposed development will consist of medium density residential dwellings with basement or slab-on-grade construction, attached garages, associated driveways, local roadways and landscaped areas. It is also understood that the development will include a park area as well as a school. It is further anticipated that the site will be municipally serviced by future water, sanitary and storm services, with a stormwater management pond planned within the northernmost corner of the subject site.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was carried out on January 9, 2020. A total of 15 test pits were excavated to a maximum depth of 3.8 m below existing grade. It should be noted that previous investigations were conducted by this firm within the subject property in 2012 consisting of a total of 11 test pits excavated to a maximum depth of 2.2 m below existing grade. The test holes were distributed in a manner to provide general coverage of the subject site, with a specific focus on the Northern section of the parcel for storm water management planning. The approximate locations of the test holes are shown on Drawing PG5212-1 - Test Hole Location Plan included in Appendix 2.

The test pits were excavated using a rubber tired backhoe. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The test hole procedure consisted of excavating to the required depths at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples from the test pits from the current investigation were recovered from the side walls of the open excavation and all soil samples were initially classified on site. All samples were transported to our laboratory for further examination and classification. The depths at which the grab samples were recovered from the test holes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

Undrained shear strength testing, using a hand held vane apparatus, was carried out at regular intervals of depth in cohesive soils.

The subsurface conditions observed at the test pits were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Open hole groundwater infiltration levels were observed at the time of excavation at each test pit location. Our observations are presented in the Soil Profile and Test Data sheets in Appendix 1.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The location of the test pits and ground surface elevation at each test hole location was recovered in the field by Paterson personnel. The ground surface elevation at each test hole location was referenced to a geodetic datum. The location and ground surface elevation at each test hole location is presented on Drawing PG5212-1 - Test Hole Location Plan attached to Appendix 1.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the samples. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently occupied by agricultural lands with areas of trees and brush over Steward Lands (RSSR), while Laing/Mutuura Lands are being occupied primarily by trees and dense brush. The ground surface across Stewart Lands is relatively flat, with high points in the southeast and southwest corners sloping North. For Laing/Mutuura Lands a high point just south of the centre of the site was noted sloping downward in all directions at varying slopes (see Drawing PG5212-1 - Test Hole Location Plan in Appendix 1). The site is bordered on the Southeast by rural residential properties, and the Northwest by a vacant forested area (to eventually be Riddell Street just beyond the site boundary). There currently exists two fill piles west of the North corner of the site, at the site boundary, where there also exists an area of dense trees (approximately 3200 sq m). Ditches were noted running Northeast along Highway 15 to the South as well as McNeely Ave to the North at the site boundaries. Directly across McNeely Avenue to the Northwest exists a residential development area.

4.2 Subsurface Profile

Overburden

RSSR or Stewart Lands

The subsoil profile encountered at the test hole locations consist primarily of topsoil overlaying hard to very stiff silty clay (TP 4-20, TP 7-20, TP 12). A layer of glacial till was encountered in most pits, underlaying the silty clay layer (TP 2-20, TP 3-20, TP 5-20, TP 15-20). The glacial till consist of silty sand with gravel, cobbles and boulders within a silty clay soil matrix. In areas of shallow bedrock, growth over bedrock or a thin layer of topsoil was encountered (TP 1-20, TP 6-20, TP13, TP14). Test pit TP 19 near the south corner of the site from the 2012 investigation revealed a layer of silty sand underlaying the topsoil layer and extending down to the bedrock. All test pits in this area were terminated due to practical refusal on inferred bedrock surface refusal was encounter from surface to 3.8 m deep. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profiles encountered at each test hole location.

Laing/Mutuura Lands

The subsoil profile encountered at the test hole locations consist primarily of till-like topsoil layer (TP 10-20, TP 12-20, TP 14-20, TP 23, TP 24, TP 25) or topsoil overlaying a silty sand with gravel or glacial till (TP 8-20, TP 9-20, TP 11-20, TP 13-20, TP 20, TP 21, TP 22). All test pits in this area were terminated due to practical refusal on inferred bedrock surface, ranging from depths of 0.22 metres to 1.20 metres from surface. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the subject site is underlain by sandstone and dolomite bedrock of the March Formation extending through most of the subject site. The drift thickness varies between 0 to 1 metres for most of the site, with areas of 2 to 5 metres thickness along the Northeast site boundary.

4.3 Groundwater

Groundwater levels (GWL) were measured in the test pits upon completion of the field program. The results are summarized in Table 1.

Table 1 - Summary of Groundwater Level Readings

Test Pit Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Level (m)	Recording Date
PG5212 - Highway 7 at Highway 15, Carleton Place				
TP 2-20	130.48	2.40	128.08	January 9, 2020
TP 3-20	131.29	1.45	129.84	January 9, 2020
TP 5-20	130.00	2.40	127.60	January 9, 2020
TP 11-20	135.80	0.80	135.00	January 9, 2020
TP 15-20	132.23	1.10	131.13	January 9, 2020
PG2793 - Highway 7 at Highway 15, Carleton Place				
TP 12	130.15	1.80	128.35	October 22, 2012
TP 19	135.41	1.00	134.41	October 22, 2012

The remaining test pits were dry upon completion. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction. Most shallow test holes were observed to be dry upon completion of the sampling program. The deeper test holes were noted to have minor infiltration through the test pit walls. Based on the moisture levels and colouring of the recovered soil samples, and our experience with the local area, the long-term groundwater table is expected at depths between 4 to 5 m below ground surface. The recorded groundwater levels are noted on the applicable Soil Profile and Test Data sheet presented in Appendix 1.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is expected that the proposed residential dwellings will be founded over conventional shallow footings placed on an undisturbed, very stiff silty clay, compact silty sand, compact glacial till, engineered fill and/or surface-sounded bedrock bearing surface.

Due to the presence of a silty clay deposit, a permissible grade raise restriction is required for the subject site.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Preparation

Stripping Depth

Topsoil, and any deleterious fill, such as those containing organic materials, should be stripped from under any buildings and other settlement sensitive structures. Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities. Disturbance of the subgrade may result in having to sub-excavate the disturbed material and the placement of additional suitable fill material.

Existing foundation walls and other construction debris should be entirely removed from within the building perimeter. Under paved areas, existing construction remnants such as foundation walls should be excavated to a minimum of 1 metre below final grade.

Bedrock Removal

It is expected that line-drilling in conjunction with hoe-ramming or controlled blasting may be required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed.

A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm per second during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Excavation side slopes in sound bedrock can be carried out using almost vertical side walls. A minimum 1 m horizontal ledge, should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing or to provide a stable base for the overburden shoring system. However, should the entire area be required to accommodate the parking garage, drilled piles into the weathered portion of the bedrock can be used to support the upper levels of the excavation and can be placed at the property boundary.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels as much as possible should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipments could be a source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of the shoring system using soldier piles or sheet piling will require the use of this equipment. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). It should be noted that these guidelines are for today's construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II material. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the buildings should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If excavated stiff brown silty clay, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved, the silty clay, under dry conditions, should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

In-filling the existing ditches should be completed in a stepped fashion within the lateral support of the proposed buildings. The fill should consist of clean imported granular fill, such as OPSS Granular A or Granular B Type II material. The steps should have a minimum horizontal length of 1.5 m and minimum vertical height of 0.5 m and should be compacted using suitable compaction equipment to a minimum 98% of the material's SPMDD. All backfilling and compaction efforts should be reviewed and approved by Paterson personnel at the time of construction.

5.3 Foundation Design

Shallow Foundation

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, very stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit state (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit state (ULS) of **225 kPa**.

Footings placed on an undisturbed, compact glacial till bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa**.

Footings placed on an undisturbed, compact silty sand bearing surface can be designed using a bearing resistance value at SLS of **100 kPa** and a factored bearing resistance value at ULS of **175 kPa**.

Footings placed over an approved engineered fill bearing surface over an undisturbed, very stiff silty clay or compact silty sand bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa.**

Footings placed over an approved engineered fill bearing surface over a clean, surface sounded bedrock bearing surface can be designed using a factored bearing resistance value at ULS of **1,000 kPa** using a geotechnical factor of 0.5**.**

Footings designed using the above noted bearing resistance values at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

Footings bearing on a clean, surface sounded bedrock and designed using the above noted bearing resistance values will be subjected to negligible post-construction total and differential settlements. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near or surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Permissible Grade Raise

A **permissible grade raise restriction of 2.0 m** is recommended for areas where building foundations are founded over a silty clay deposit. Areas affected by a permissible grade raise restriction due to the presence of a silty clay deposit are indicated in Drawing PG5212-2 - Permissible Grade Raise Areas in Appendix 2. Footings bearing on a compact glacial till, silty sand and/or bedrock bearing surface will not subjected to permissible grade raise restrictions.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff silty clay above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1H:6V passing through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock should be provided with a lateral support zone of 1.5H:1V.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for foundations considered for the subject site. A higher seismic site class such as Class A or B may be applicable for foundations located within the eastern portion of the subject site where shallow bedrock was encountered. However, the higher site class would have to be confirmed by site specific shear wave velocity testing. The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest version of the Ontario Building Code (OBC) 2012 for a full discussion of the earthquake design requirements.

5.5 Basement Slab / Slab on Grade Construction

With the removal of all topsoil and deleterious fill from within the footprint of the proposed buildings, the native soil surface or approved fill will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

For structures with slab-on-grade construction, the upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone.

5.6 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of driveways, local residential streets and roadways with bus traffic. It should be noted that for residential driveways and car only parking areas, an Ontario Traffic Category A is applicable. For local roadways and roadways with bus traffic, an Ontario Traffic Category B and Category D should be used for design purposes, respectively.

Table 2 - Recommended Pavement Structure - Driveways/Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either approved fill, in situ soil or OPSS Granular B Type I or Type II material placed over in situ soil or approved fill	

Table 3 - Recommended Pavement Structure - Local Residential Roadways

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either approved fill, in situ soil or OPSS Granular B Type I or Type II material placed over in situ soil or approved fill	

Table 4 - Recommended Pavement Structure - Roadways with Bus Traffic

Thickness mm	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
550	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil or OPSS Granular B Type I or Type II material placed over in situ soil or approved fill	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways and local roadways and PG 64-34 asphalt cement should be used for roadways with bus traffic. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Where silty clay is anticipated at subgrade level, consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a composite drainage system, such as Delta Drain 6000 or an approved equivalent. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavations to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

At least 150 mm of OPSS Granular A should be used for bedding for sewer and water pipes when placed on soil subgrade. However, the bedding thickness should be increased to 300 mm for areas over a bedrock subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe).

The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 99% of the material’s SPMDD.

Based on the soil profile encountered, the subgrade for the services will be placed in both bedrock and overburden soils. It is recommended that the subgrade medium be inspected in the field to determine how steeply the bedrock surface, where encountered, drops off. A transition should be provided where the bedrock slopes more than 3H:1V. At these locations, the bedrock should be excavated and replaced with addition bedding materials to provide a 3H:1V (or flatter) transition from the bedrock subgrade towards the soil subgrade. This treatment reduced the propensity for bending stress to occur in the service pipes.

Generally, it should be possible to re-use the moist, not wet, silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. The wet silty clay should be given a sufficient drying period to decrease its moisture content to an acceptable level to make compaction possible prior to being re-used.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

A temporary Ministry of the Environment and Climate Change (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the chloride content, pH and resistivity indicate the presence of a non-aggressive to slightly aggressive environment for exposed ferrous metals at this site.

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that a materials testing and observation services program including the following aspects be performed by the geotechnical consultant.

☐ Grading plan review from a geotechnical perspective, once the final grading plan is available.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the concrete and fill materials used.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to determine the level of compaction achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should also be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole logs are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Novatech Engineering Consultants Ltd. or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Joey R. Villeneuve, M.A.Sc.,P.Eng

Faisal I. Abou-Seido, P.Eng.

Report Distribution:

❏ Novatech Engineering Consultants Ltd.
❏ Paterson Group

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

FILE NO. PG5212

REMARKS

HOLE NO. TP 1-20

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.10	■					0	129.60		
End of Test Pit TP terminated on bedrock surface at 0.10m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

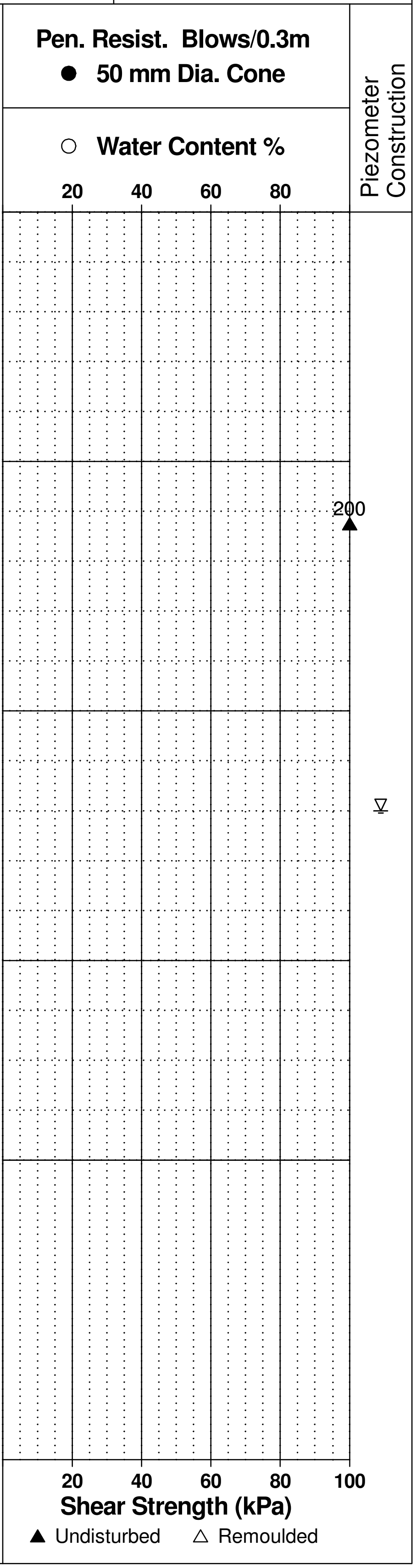
BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP 2-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	130.48
TOPSOIL		G	1				
0.30							
Hard, brown **SILTY CLAY**		G	2			1	129.48
1.70							
GLACIAL TILL: Brown silty clay with gravel, cobbles and boulders		G	3			2	128.48
		G	4			3	127.48
3.80							
End of Test Pit TP terminated on inferred bedrock surface at 3.80m depth (Groundwater infiltration at 2.4m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

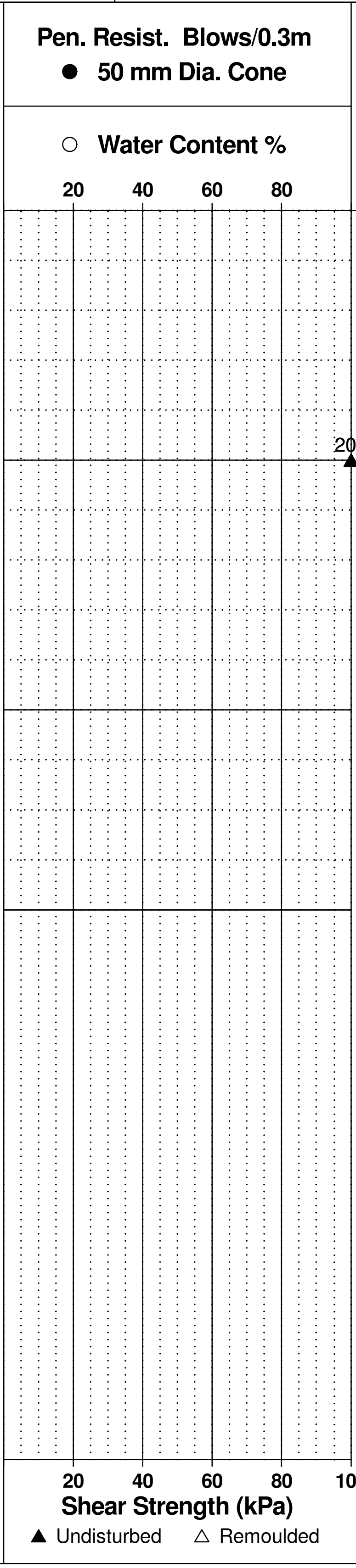
HOLE NO. TP 3-20

SOIL DESCRIPTION GROUND SURFACE	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
TOPSOIL 0.40	■	G	1			0	131.29	
Hard, brown **SILTY CLAY** 1.30	▨	G	2			1	130.29	
GLACIAL TILL: Grey-brown silty clay with gravel, cobbles and boulders 2.80	^	G	3			2	129.29	∇

End of Test Pit

TP terminated on inferred bedrock surface at 2.80m depth

(Groundwater infiltration at 1.45m depth)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

FILE NO. PG5212

REMARKS

HOLE NO. TP 4-20

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.20	■	G	1			0	130.88		
Very stiff, brown **SILTY CLAY,** trace organics 0.50	▨	G	2						
End of Test Pit TP terminated on inferred bedrock surface at 0.50m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
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DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

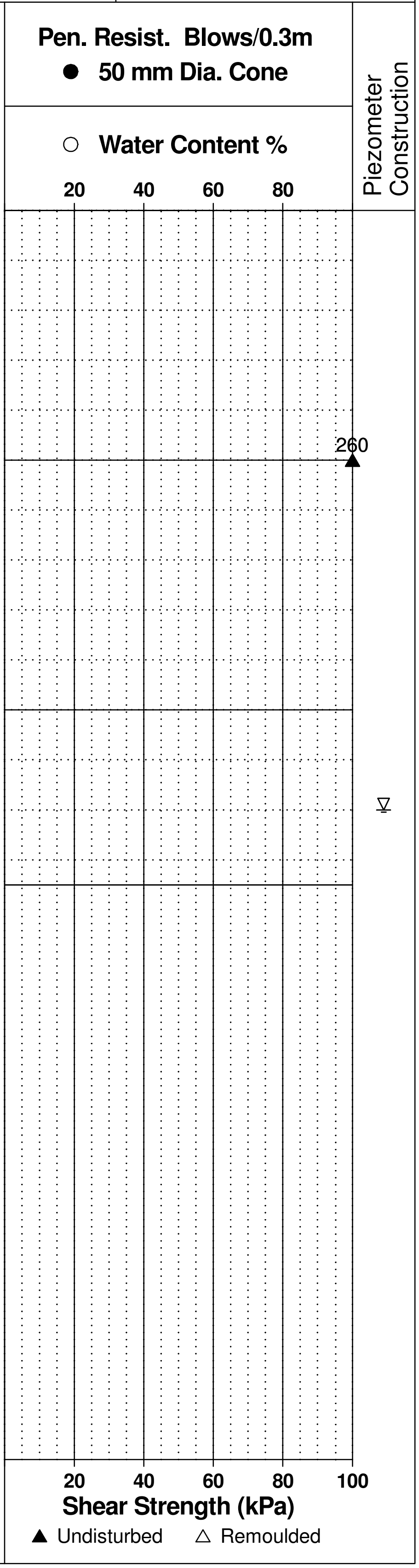
HOLE NO. TP 5-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	130.00
TOPSOIL		G	1				
0.48							
Hard, brown **SILTY CLAY**		G	2			1	129.00
1.40							
GLACIAL TILL: Brown silty clay with gravel, cobbles and boulders		G	3			2	128.00
2.70							

End of Test Pit

TP terminated on inferred bedrock surface at 2.70m depth

(Groundwater infiltration at 2.4m depth)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP 6-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	132.34		
TOPSOIL 0.25	■	G	1						
End of Test Pit TP terminated on inferred bedrock surface at 0.25m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. **PG5212**

HOLE NO. **TP 7-20**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	131.26		
TOPSOIL 0.30	■	G	1						
Very stiff, brown **SILTY CLAY,** trace sand 0.50	▨	G	2						
End of Test Pit TP terminated on inferred bedrock surface at 0.50m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

FILE NO. PG5212

REMARKS

HOLE NO. TP 8-20

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	136.66		
TOPSOIL 0.30		G	1						
GLACIAL TILL: Brown silty clay with gravel, cobbles and boulders 0.85		G	2						
End of Test Pit TP terminated on inferred bedrock surface at 0.85m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP 9-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20 40 60 80	
GROUND SURFACE						0	140.07		
Loose to compact, brown **SILTY SAND** with gravel, cobbles and boulders, some clay		G	1						
0.80									
End of Test Pit TP terminated on inferred bedrock surface at 0.80m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP10-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
						0	136.14		
TOPSOIL	■	G	1						
0.40									
End of Test Pit TP terminated on inferred bedrock surface at 0.40m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP11-20

SOIL DESCRIPTION	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
GROUND SURFACE					0	135.80		
TOPSOIL 0.30	G	1						
Brown **SILTY SAND** with clay, trace gravel 0.95	G	2						∇
End of Test Pit TP terminated on inferred bedrock surface at 0.95m depth (Groundwater infiltration at 0.8m depth)								

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP12-20

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 % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	135.22		
TOPSOIL 0.35	■	G	1						
End of Test Pit TP terminated on inferred bedrock surface at 0.35m depth (TP dry upon completion)									

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
Carleton Place, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP13-20

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	137.22		
TOPSOIL 0.40	■								
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders 1.20	^	G	1			1	136.22		

End of Test Pit

TP terminated on inferred bedrock surface at 1.20m depth

(TP dry upon completion)

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Highway No. 7
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REMARKS

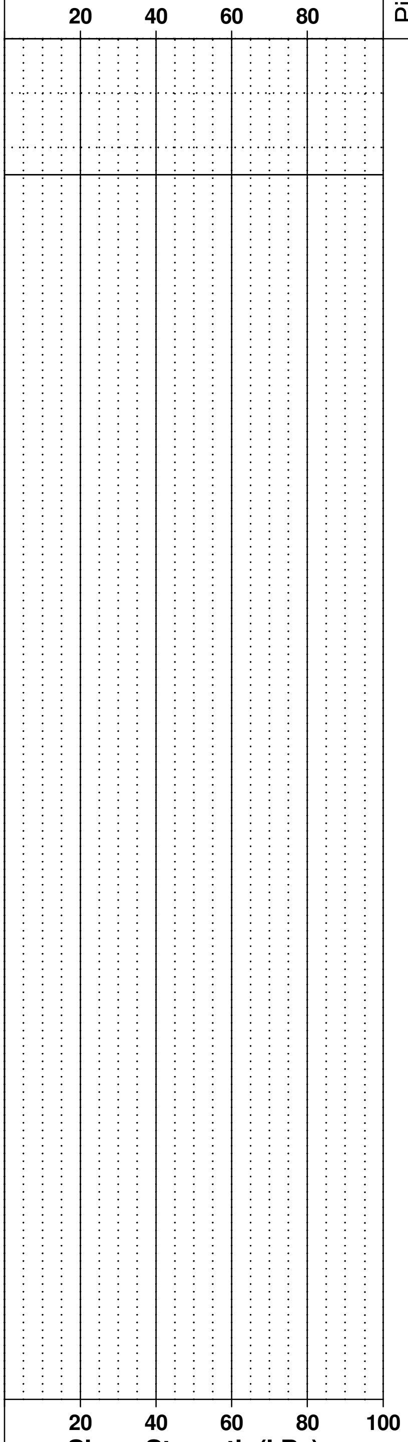
BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. PG5212

HOLE NO. TP14-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	138.07		
TOPSOIL 0.50	■	G	1						
End of Test Pit TP terminated on inferred bedrock surface at 0.50m depth (TP dry upon completion)									



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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REMARKS

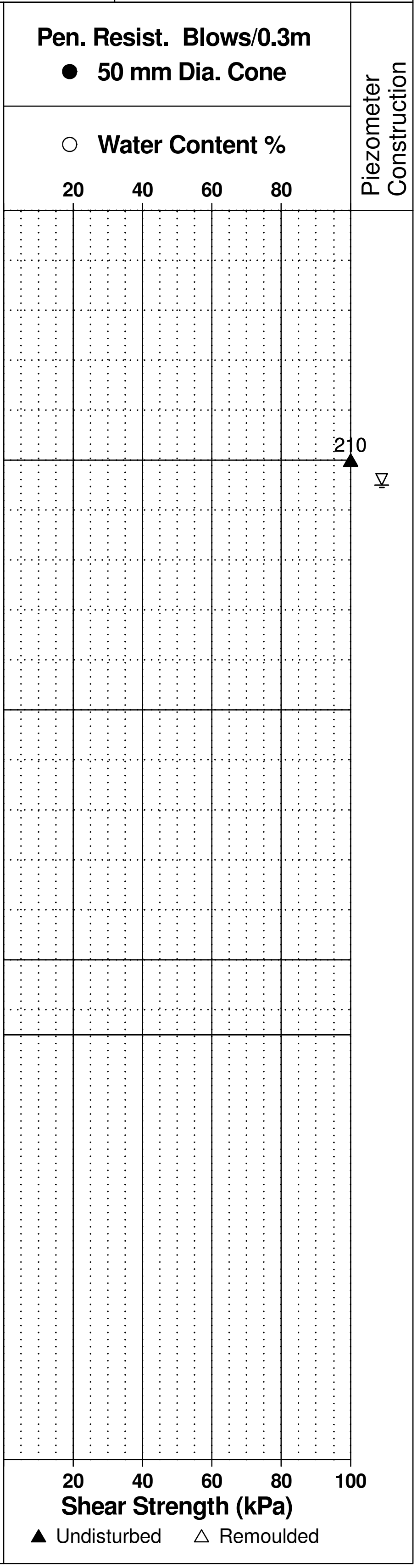
BORINGS BY Hydraulic Shovel

DATE 2020 January 9

FILE NO. **PG5212**

HOLE NO. **TP15-20**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	132.23
TOPSOIL 0.25		G	1				
Brown **SILTY SAND** 0.40		G	2				
Hard, brown **SILTY CLAY** 1.70		G	3			1	131.23
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles and boulders		G	4			2	130.23
3.30		G	5			3	129.23
End of Test Pit TP terminated on inferred bedrock surface at 3.30m depth (Groundwater infiltration at 1.1m depth)							



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. **PG2793**

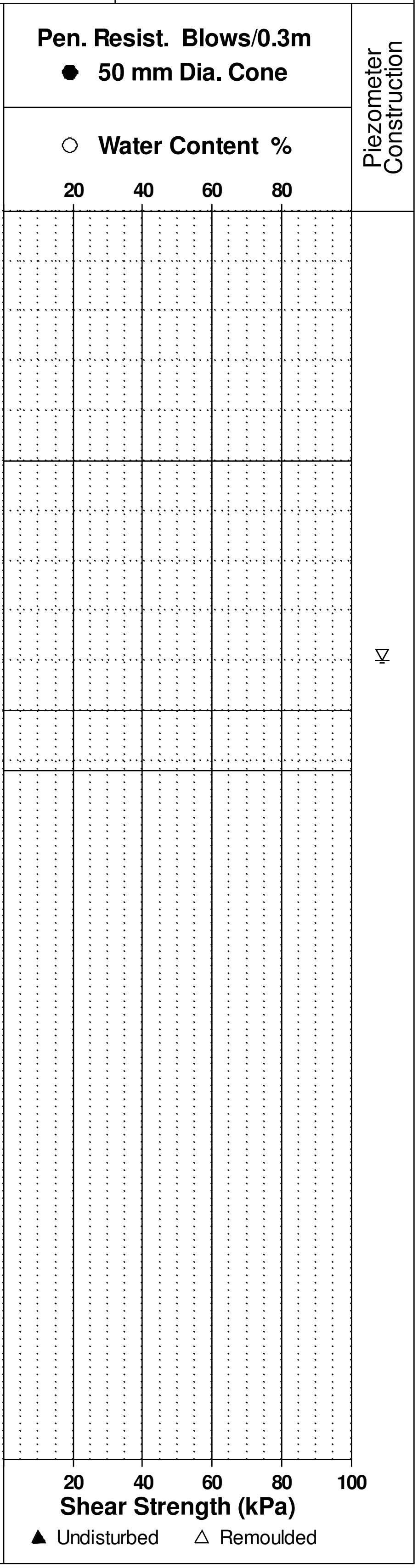
REMARKS

HOLE NO. **TP12**

BORINGS BY Backhoe

DATE October 22, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	130.15
Brown **SILTY CLAY** with sand	▨					1	129.15
	▨					2	128.15
2.24							
End of Test Pit Practical shovel refusal on inferred bedrock at 2.24m depth (Water infiltration at 1.8m depth)							



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
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Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG2793

REMARKS

HOLE NO. TP13

BORINGS BY Backhoe

DATE October 22, 2012

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 % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	137.82		
TOPSOIL 0.04									
End of Test Pit Practical shovel refusal on inferred bedrock at 0.04m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE October 22, 2012

FILE NO. PG2793

HOLE NO. TP14

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 % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	133.03		
TOPSOIL 0.28	■	G	1						
End of Test Pit Practical shovel refusal on inferred bedrock at 0.28m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. **PG2793**

REMARKS

HOLE NO. **TP15**

BORINGS BY Backhoe

DATE October 22, 2012

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	130.68		
TOPSOIL 0.12	■								
Brown **SILTY CLAY,** trace sand 0.59	▨	G	1						
End of Test Pit Practical shovel refusal on inferred bedrock at 0.59m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE October 22, 2012

FILE NO. PG2793

HOLE NO. TP19

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.15						0	135.41		
Brown to grey **SILTY SAND,** trace clay and gravel 1.60						1	134.41		∇
End of Test Pit Practical shovel refusal on inferred bedrock at 1.60m depth (Water infiltration at 1.0m depth)									

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

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG2793

REMARKS

HOLE NO. TP20

BORINGS BY Backhoe

DATE October 22, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	135.24		
TOPSOIL 0.11									
Brown **SILTY SAND** with clay 0.43		G	1						
End of Test Pit Practical shovel refusal on inferred bedrock at 0.43m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

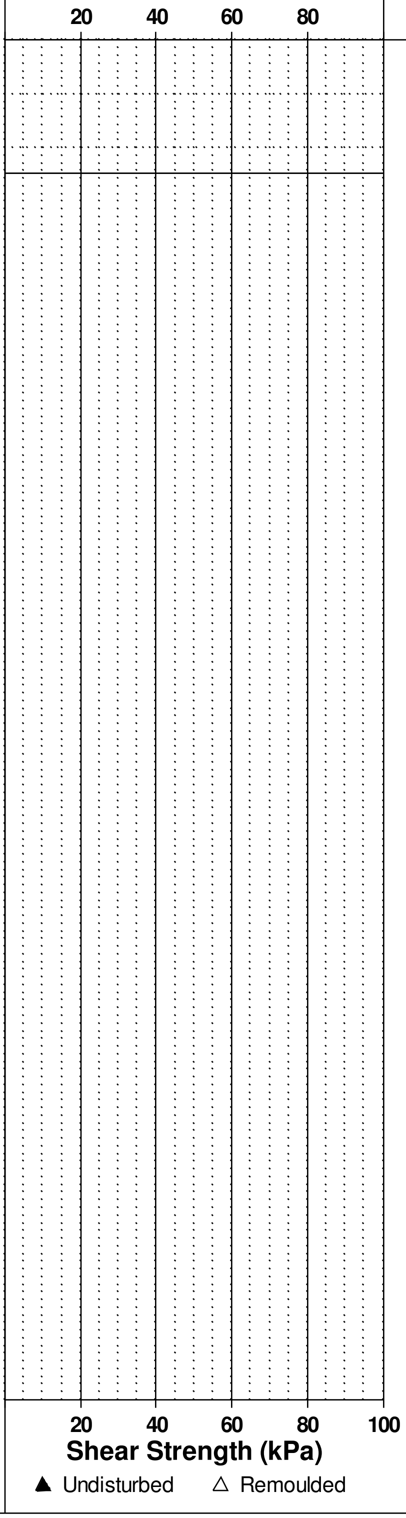
BORINGS BY Backhoe

DATE October 22, 2012

FILE NO. PG2793

HOLE NO. TP21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	135.50		
TOPSOIL 0.15									
Brown **SILTY SAND** with clay 0.49									
End of Test Pit Practical shovel refusal on inferred bedrock at 0.49m depth (TP dry upon completion)									



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG2793

REMARKS

HOLE NO. TP22

BORINGS BY Backhoe

DATE October 22, 2012

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	135.76		
TOPSOIL 0.23									
Brown **SILTY SAND** with clay 0.98		G	1						
End of Test Pit Practical shovel refusal on inferred bedrock at 0.98m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE October 22, 2012

FILE NO. PG2793

HOLE NO. TP23

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	135.71		
TOPSOIL 0.38	■								
End of Test Pit Practical shovel refusal on inferred bedrock at 0.38m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE October 22, 2012

FILE NO. PG2793

HOLE NO. TP24

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	138.56		
TOPSOIL 0.22	■	G	1						
End of Test Pit Practical shovel refusal on inferred bedrock at 0.22m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Residential Development - Highway 7
Carleton Place, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Ltd.

FILE NO. PG2793

REMARKS

HOLE NO. TP25

BORINGS BY Backhoe

DATE October 22, 2012

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 % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	139.04		
TOPSOIL 0.27	■								
End of Test Pit Practical shovel refusal on inferred bedrock at 0.27m depth (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity: $S_t < 2$
Medium Sensitivity: $2 < S_t < 4$
Sensitive: $4 < S_t < 8$
Extra Sensitive: $8 < S_t < 16$
Quick Clay: $S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW - Thin wall tube or Shelby tube, generally recovered using a piston sampler
G - "Grab" sample from test pit or surface materials
AU - Auger sample or bulk sample
WS - Wash sample
RC - Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic Limit, % (water content above which soil behaves plastically)
PI - Plasticity Index, % (difference between LL and PL)

Dxx - Grain size at which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

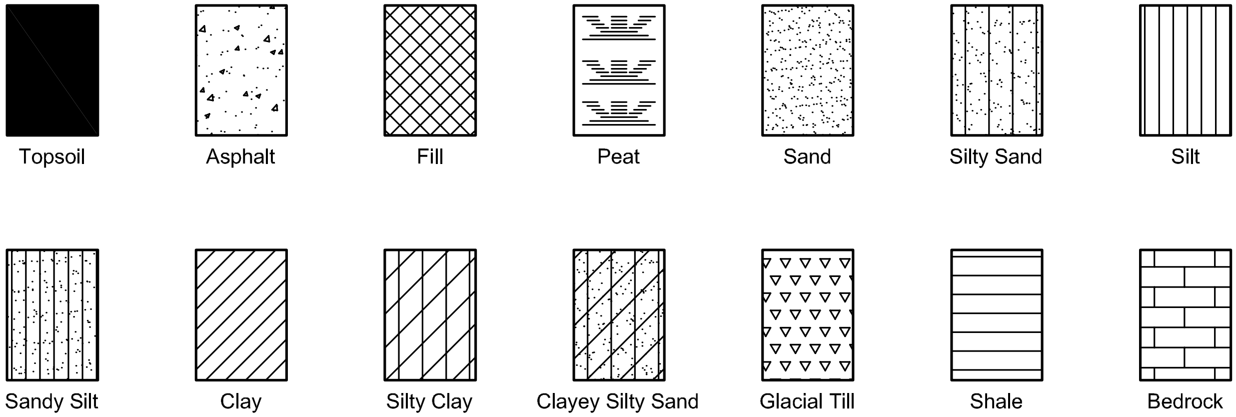
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

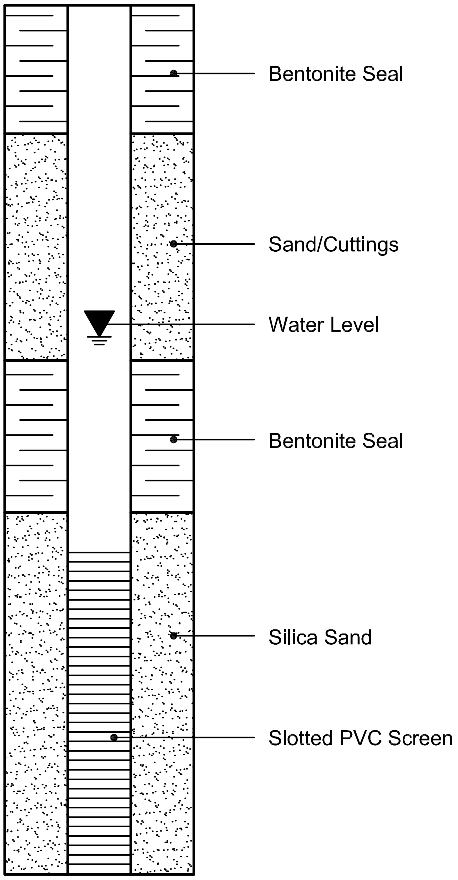
SYMBOLS AND TERMS (continued)

STRATA PLOT

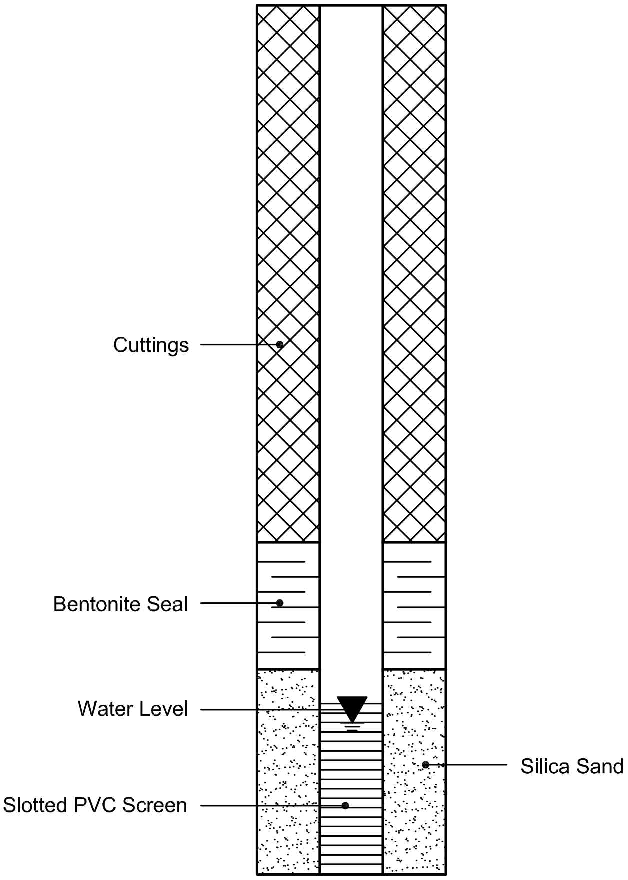


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 25635

Report Date: 15-Jan-2020

Order Date: 13-Jan-2020

Project Description: PG5212

	Client ID:	TPR GS4 - 1.9 To 2.0	-	-	-
	Sample Date:	09-Jan-20 13:00	-	-	-
	Sample ID:	2003096-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	73.4	-	-	-
General Inorganics					
pH	0.05 pH Units	7.80	-	-	-
Resistivity	0.10 Ohm.m	73.2	-	-	-
Anions					
Chloride	5 ug/g dry	11	-	-	-
Sulphate	5 ug/g dry	16	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG5212-1- TEST HOLE LOCATION PLAN

DRAWING PG5212-2 - PERMISSIBLE GRADE RAISE AREAS

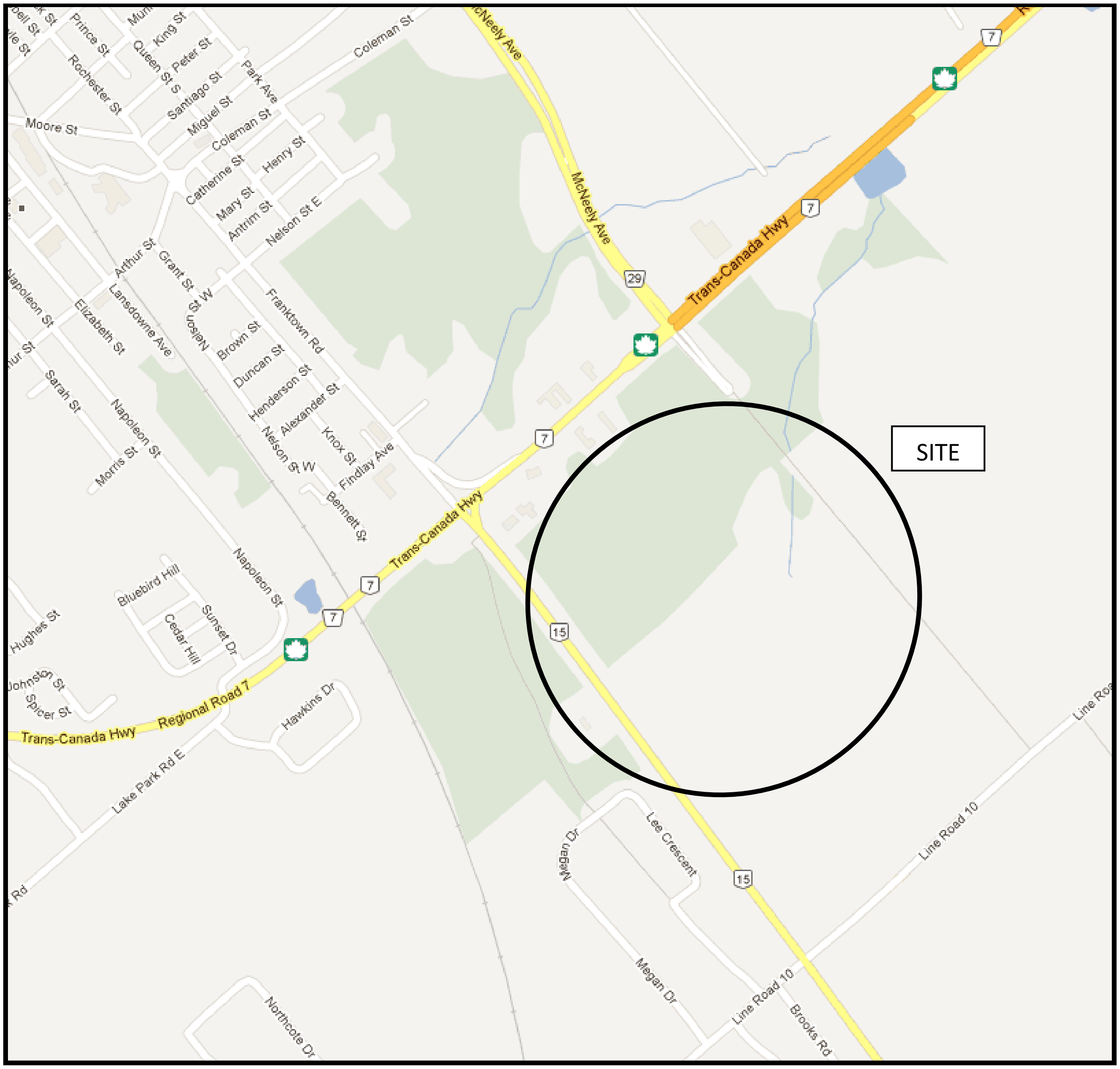
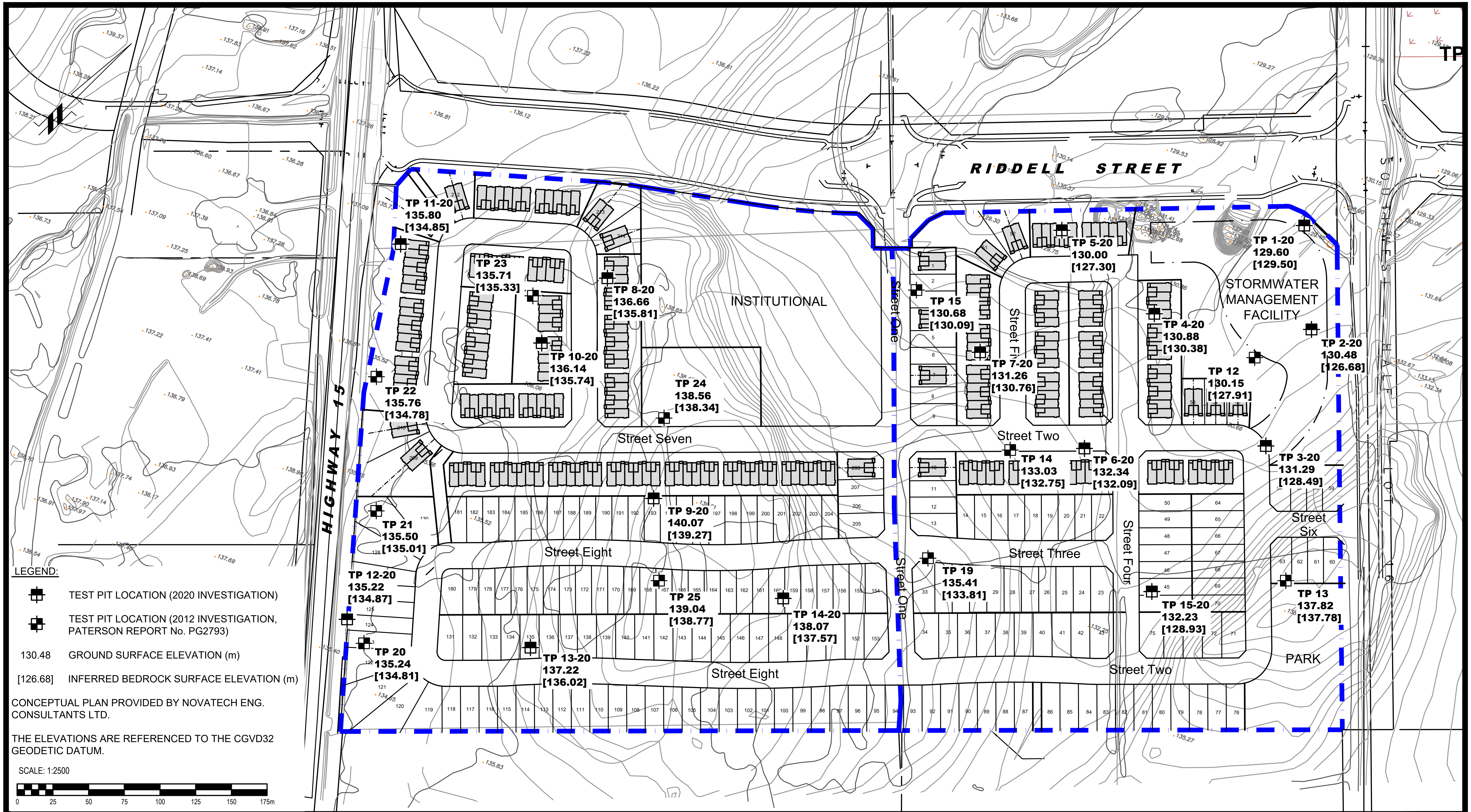


FIGURE 1

KEY PLAN



LEGEND:

■ TEST PIT LOCATION (2020 INVESTIGATION)

■ TEST PIT LOCATION (2012 INVESTIGATION, PATERSON REPORT No. PG2793)

130.48 GROUND SURFACE ELEVATION (m)

[126.68] INFERRED BEDROCK SURFACE ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY NOVATECH ENG. CONSULTANTS LTD.

THE ELEVATIONS ARE REFERENCED TO THE CGVD32 GEODETIC DATUM.

SCALE: 1:2500

0 25 50 75 100 125 150 175m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO NEW CONCEPTUAL PLAN	05/19/2021	FAS

REGIONAL GROUP c/o NOVATECH ENGINEERING CONSULTANTS LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - HIGHWAY 7

CARLETON PLACE, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2500
Date: 01/2020
Drawn by: NFRV
Report No.: PG5212-1
Checked by: DP
Dwg. No.: PG5212-1
Approved by: FAS
Revision No.: 1

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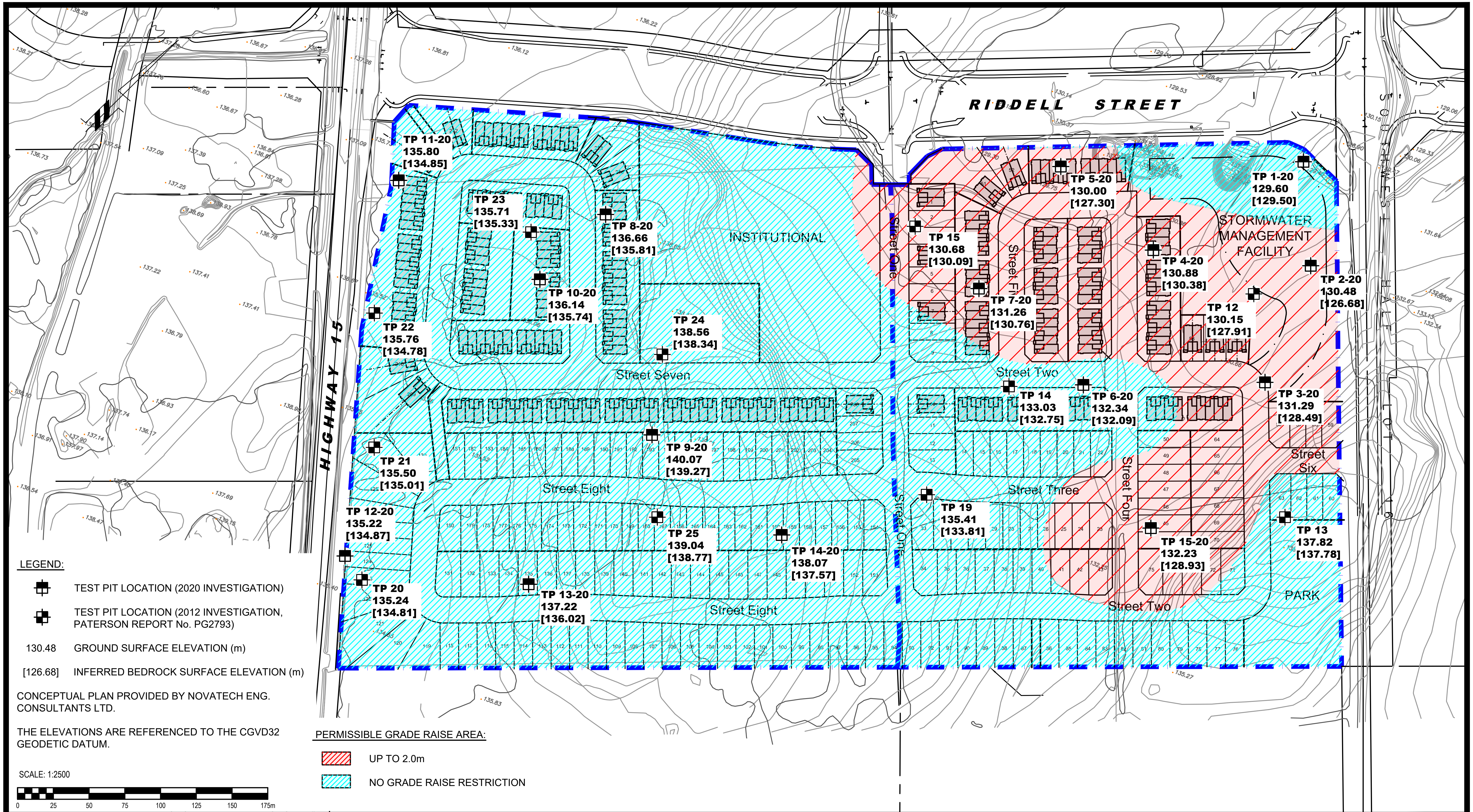

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CONCEPTUAL PLAN PROVIDED BY NOVATECH ENG.
CONSULTANTS LTD.

THE ELEVATIONS ARE REFERENCED TO THE CGVD32
GEODETIC DATUM.

SCALE: 1:2500

0 25 50 75 100 125 150 175m

PERMISSIBLE GRADE RAISE AREA:

🟥 UP TO 2.0m

🟦 NO GRADE RAISE RESTRICTION

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Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL
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REGIONAL GROUP c/o NOVATECH ENGINEERING CONSULTANTS LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - HIGHWAY 7

CARLETON PLACE, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Scale: 1:2500
Drawn by: NFRV
Checked by: DP
Approved by: FAS
Date: 01/2020
Report No.: PG5212-1
Dwg. No.: PG5212-2
Revision No.: 1

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