PATERSON GROUP

Consulting Engineers
9 Auriga Drive
Ottawa, Ontario
K2E 7T9
Tel: (613) 226-7381

Geotechnical Engineering
Environmental Engineering
Hydrogeology
Materials Testing
Building Science
Rural Development Design
Temporary Shoring Design
Retaining Wall Design
Noise and Vibration Studies

patersongroup.ca

Date: June 20, 2023
PG3155-LET.06 Revision 1

KDSA Development Corporation
228 Bradford Street
Ottawa, Ontario
K2B 6Z6

Attention: **Ms. Susan Anglin**

Subject: **Geotechnical Investigation**
Future Rural Subdivision
Braeburn Estates - Phase 3
Burnstown, Ontario

Dear Ms. Anglin

Further to your request and authorization, Paterson Group (Paterson) prepared the following letter to provide geotechnical recommendations for the future rural subdivision to be located at the aforementioned site.

Based on the available conceptual plans, it is understood that a rural subdivision consisting of single-family dwellings is anticipated for the subject site. It is further understood that the site will be divided into fifteen estate lots of varying dimensions. Access lanes, parking areas and landscaped areas are also anticipated at the subject site (refer to Figure 1- Key Plan). It is anticipated that the proposed development will be privately serviced.

1.0 Field investigation

The field program for the current investigation was completed on May 17th and 18th, 2023. At that time, a total of 6 test pits were excavated to a maximum depth of 4.5 m below existing ground surface. Paterson also completed previous investigations within Phase 1 and 2 of the proposed Braeburn Estates Development. A total of two (2) existing test pits are located within the limits of Phase 3 of this future rural subdivision. The test pit procedure consisted of excavating to the required depth at the selected locations and sampling the overburden.

The current test pit locations were determined in the field by Paterson personnel and distributed in a manner to provide general coverage of the future development, taking into consideration existing site features and underground services.

The approximate locations of the test pits are presented on Drawing PG3155- 4 - Test Hole Location Plan, appended to this report. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division.

2.0 Field Observations

Surface Conditions

The subject site occupies approximately 800m of the south shore of the Madawaska River located at the end of Building Supply Road. The site is currently tree covered with a down slope from both sides of the site towards the central portion. A pedestrian trail was found to cross the site from Shady Maple Road along the southwest corner towards the central portion of the site. Based on the topographic mapping provided by the client, the ground surface varies up to 13 m in elevation across the subject site

The lot is bound by the Shady Maple Road and by residential homes to the northeast and northwest, and by vacant undeveloped land to the southeast and southwest.

Subsurface Conditions

Generally, the subsurface profile encountered at the test pit locations consists of topsoil underlain by glacial till and bedrock. Glacial till was observed underlying the topsoil layer at all test pits and extended to a maximum depth of 3.95 m below the existing ground surface. The glacial till deposit was observed to consist of compact to dense brown silty sand to sandy silt with gravel, cobbles, boulders trace clay. Practical refusal to excavation equipment was encountered on bedrock surface and/or boulders at all test pits at approximate depths of 3.1 to 4.5 m.

Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets appended to this letter report.

Bedrock

Based on available geological mapping, the bedrock in the subject area transitions from west to east across the site and consists of interbedded limestone and dolomite of the Gull River Formation, shale of the Rockcliffe Formation, and Dolomite of the Oxford formation.

Groundwater

Groundwater infiltration levels were observed in the open holes at the time of excavation. The water levels were observed to have low to moderate water infiltration rate at the time of excavation at depths ranging from 0.7 to 3.0 m, with the exception of TP 4-23 which was noted to be dry at the time of the excavation. Based on our observations, the long-term groundwater table can be expected within the bedrock. The majority of the water infiltration encountered is expected to be surface water infiltrating the upper sandy layers due to rain events or surface water runoff. Reference should be made to the Soil Profile and Test Data sheets attached to the current report for specific details of the soil profiles encountered at each test hole location.

3.0 Geotechnical Discussion

From a geotechnical perspective, the subject site is considered suitable for the future rural subdivision. It is expected that the future dwellings will be founded over conventional shallow foundations placed over undisturbed compact sandy silt to silty sand, compact to dense glacial till, or clean, surface sounded bedrock bearing surface.

Site Grading and Preparation

Topsoil and any deleterious fill, containing significant amounts of organic material and/or construction debris, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures. Care should be taken not disturb adequate bearing surfaces during site preparation activities.

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 compacted by a suitably sized equipment to minimize voids.

If excavated material, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved, the site-excavated material, 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.

Foundation Design

Using continuously applied loads, isolated footings, placed over an undisturbed compact sandy silty to silty sand, compact to dense glacial till, or clean, surface-sounded bedrock bearing surface can be designed using the bearing resistance values presented in Table 1 below.

Table 1 - Recommended Bearing Resistance Values – Conventional Shallow Foundations

Bearing Surface	SLS (kPa)	ULS (kPa)
Compact Sandy Silt	100	175
Compact to dense Glacial Till	150	225
Sound Bedrock	N/A	500

Note: A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

Where the sandy silt to silty sand subgrade is observed to be in a loose state of compactness, proof-rolling under dry conditions and above freezing temperatures should be completed by an adequately sized roller making several passes to achieve optimum compaction levels and approved by Paterson personnel at the time of construction. The compaction program should be reviewed and approved by Paterson at the time of construction. Soft or poor performing areas should be sub-excavated and replaced with an approved engineered fill such as OPSS Granular A or Granular B Type II compacted to a minimum of 98% of the material's SPMDD.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen, or disturbed soil, have been removed, in the dry, prior to the placement of concrete 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.

Footings bearing on an undisturbed soil bearing surface and designed using the bearing resistance values provided 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 value at ULS.

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 compact silty sand/glacial till 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 footing perimeter at a minimum of 1H:6V (or shallower) passes through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock bearing medium will require a lateral support zone of 1H:3V (or shallower).

Bedrock/Soil Transition

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long-term total and differential settlements. Also, at the soil/bedrock and bedrock/soil transitions, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the sub-excavation should be at least the future footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.

Pavement Structure

For design purposes, the pavement structure presented in Table 2 below can be used for car only parking areas.

Table 2 - Recommended Pavement Structure - Driveways	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
300	**BASE** - OPSS Granular A Crushed Stone
-	Non-woven geotextile layer
SUBGRADE - Either in situ soils, bedrock or OPSS Granular A material placed over in situ soil.	

Table 3 - Recommended Asphalt Pavement Structure – Car only parking areas	
Thickness (mm)	**Material Description**
50	**Wear Course** - Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils, bedrock or OPSS Granular A material placed over in situ soil.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. 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.

Where the subgrade is observed to be in a loose state of compactness, proof-rolling under dry conditions and above freezing temperatures should be completed by an adequately sized roller making several passes to achieve optimum compaction levels. The compaction program should be reviewed and approved by Paterson. Soft or poor performing areas should be sub-excavated and replaced with an approved engineered fill such as OPSS Granular A or Granular B Type II compacted to a minimum of 98% of the material's SPMDD.

4.0 Design and Construction Precautions

Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed residential dwellings with the subject site. 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 which is 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 a ditch or storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free draining non frost susceptible granular materials. Frost susceptible materials are not recommended for placement as backfill against the foundation walls unless used in conjunction with a composite drainage system, such as Delta Drain 6000. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be placed for this purpose.

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 should be provided for adequate frost protection of heated structures, or an equivalent combination of soil cover and foundation insulation.

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 heated structure and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation.

However, foundations which are founded directly on clean, surfaced-sounded bedrock with no cracks or fissures, and which is approved by Paterson at the time of construction, is not considered frost susceptible and does not require soil cover.

Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should be either cut back to acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation 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 shallower slope is required for excavation below groundwater level. The subsurface soils are considered to be a Type 1 or 2 soil according to the Occupational Health and Safety Act and Regulations.

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 Paterson in order to detect if the slopes are exhibiting signs of distress. A trench box is recommended 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.

Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsurface soil 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.

The trench excavations should be constructed to avoid the introduction of frozen materials, snow or ice into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving during construction.
Also, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure.

Corrosion Potential and Sulphates

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a non-aggressive to slightly aggressive corrosive environment.

5.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that the following material testing and observation program be performed by the geotechnical consultant:

- ❒ Review of grading plans from a geotechnical perspective.
- ❒ Observation of all bearing surfaces prior to the placement of concrete.
- ❒ Sampling and testing of the concrete and fill materials.
- ❒ 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 and placement concrete.
- ❒ Field density tests to determine the level of compaction achieved.
- ❒ Sampling and testing of the bituminous concrete including mix design reviews.

All excess soils, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management*.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

6.0 Statement of Limitations

The recommendations provided in this letter report are in accordance with Paterson's present understanding of the project. Should any conditions at the site be encountered which differ from the site observations, Paterson requests immediate notification to permit reassessment for the recommendations.

The present letter 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 KDSA Development Corporation, or their agents, is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

We trust this report meets your present requirements.

Best Regards,

Paterson Group Inc.

Puneet Bandi, M.Eng

Maha K. Saleh, M.A.Sc. P.Eng.

Attachments

- Soil Profile and Test Data Sheets
- Symbols and Terms
- Analytical Testing Results
- Figure 1 – Key Plan
- Drawing PG3155 - 4 - Test Hole Location Plan

Report Distribution

- KDSA Development Corporation (e-mail copy)
- Paterson Group (1 copy)

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Future Rural Subdivision - Braeburn Estates - Phase 3
Burnstown, Ontario

DATUM Elevations are referenced to a geodetic datum

FILE NO. PG3155

REMARKS

HOLE NO. TP 1-23

BORINGS BY Excavator **DATE** May 17, 2023

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
Ground Surface									
TOPSOIL with organics						0	181.63		
0.25									
		G	1			1	180.63		
		G	2			2	179.63		
GLACIAL TILL: Compact, brown silty sand to sandy silt, some gravel and cobbles, trace clay		G	3			3	178.63		
						4	177.63		
4.50									
End of Test Pit (Groundwater infiltration at 1.4m depth)									

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

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Future Rural Subdivision - Braeburn Estates - Phase 3
Burnstown, Ontario

DATUM Elevations are referenced to a geodetic datum

FILE NO. PG3155

REMARKS

HOLE NO. TP 2-23

BORINGS BY Excavator **DATE** May 17, 2023

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	169.55		
TOPSOIL with organics									
0.31									
		G	1			1	168.55		
		G	2			2	167.55		
GLACIAL TILL: Compact, brown silty sand to sandy silt, some cobbles and boulders, trace clay						3	166.55		
3.95									
End of Test Pit									
TP terminated on boulders at 3.46m depth									
(Groundwater infiltration at 1.1m depth)									

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

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Future Rural Subdivision - Braeburn Estates - Phase 3
Burnstown, Ontario

DATUM Elevations are referenced to a geodetic datum

FILE NO. PG3155

REMARKS

HOLE NO. TP 3-23

BORINGS BY Excavator **DATE** May 17, 2023

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	170.65		
TOPSOIL with organics									
0.35									
		G	1			1	169.65		
		G	2			2	168.65		
GLACIAL TILL: Brown silty sand to sandy silt, some gravel, cobbles, occasional boulders									
- increasing cobbles and boulders content with depth						3	167.65		
						4	166.65		
4.10									
End of Test Pit									
TP terminated on boulder at 4.10m depth									
(Groundwater infiltration at 0.7m depth)									

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

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Future Rural Subdivision - Braeburn Estates - Phase 3
Burnstown, Ontario

DATUM Elevations are referenced to a geodetic datum

FILE NO. PG3155

REMARKS

HOLE NO. TP 4-23

BORINGS BY Excavator **DATE** May 17, 2023

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
Ground Surface									
TOPSOIL with organics						0	176.45		
0.26									
GLACIAL TILL: Compact, brown silty sand to sandy silt with gravel, cobble, some to trace boulders		G	1			1	175.45		
- grey by 1.7m depth		G	2			2	174.45		
						3	173.45		
3.90									
End of Test Pit									
TP terminated on bedrock surface at 3.46m depth									
(TP dry upon completion)									

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

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Future Rural Subdivision - Braeburn Estates - Phase 3
Burnstown, Ontario

DATUM Elevations are referenced to a geodetic datum

FILE NO. PG3155

REMARKS

HOLE NO. TP 5-23

BORINGS BY Excavator **DATE** May 17, 2023

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	177.22		
TOPSOIL with organics									
0.31									
GLACIAL TILL: Compact, brown silty sand to sandy silt with gravel cobbles, some to trace boulders		G	1			1	176.22		
- grey by 1.6m depth		G	2			2	175.22		
						3	174.22		
3.10									
End of Test Pit									
TP terminated on bedrock surface at 3.10m depth									
(Groundwater infiltration at 3.0m depth)									

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

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Future Rural Subdivision - Braeburn Estates - Phase 3
Burnstown, Ontario

DATUM Elevations are referenced to a geodetic datum

FILE NO. PG3155

REMARKS

HOLE NO. TP 6-23

BORINGS BY Excavator **DATE** May 17, 2023

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	169.15		
TOPSOIL with organics									
0.31									
		G	1						
		G	2			1	168.15		
GLACIAL TILL: Compact to dense, grey sitly sand to sandy silt with gravel, cobbles, some to trace boulders									
- grey by 1.2m depth						2	167.15		
						3	166.15		
3.46									
End of Test Pit									
TP terminated on bedrock surface at 3.46m depth									
(Groundwater infiltration at 2.6m depth)									

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

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

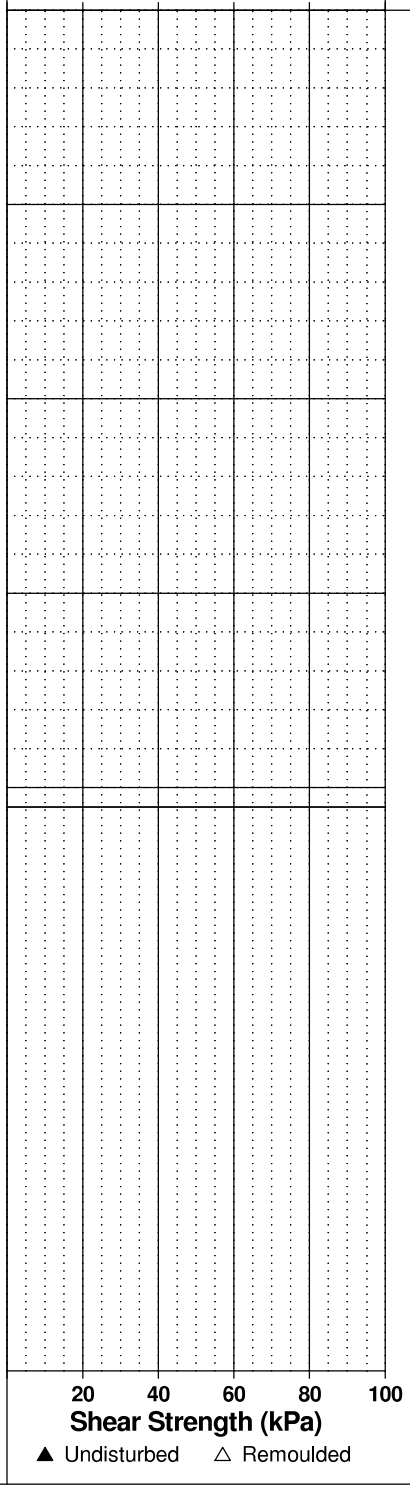
FILE NO. PG3155

REMARKS

HOLE NO. TP12-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.20		G	1			0	184.96		
		G	2			1	183.96		
Loose to compact, brown **SILTY SAND,** some gravel, cobbles and boulders						2	182.96		
		G	3			3	181.96		
4.10						4	180.96		
End of Test Pit									
TP terminated in silty sand at 4.10m depth									
(TP dry upon completion)									



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP13-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.30		G	1			0	182.17		
Loose to compact, dark brown **SILTY SAND,** some cobbles and boulders 0.80		G	2			1	181.17		
GLACIAL TILL: Compact to very dense, brown silty sand, some gravel, cobbles and boulders						2	180.17		▽
						3	179.17		
3.60		G	3						
End of Test Pit TP terminated on possible bedrock surface at 3.60m depth (GWL @ 2.0m depth)									

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

Shear Strength (kPa): 20 40 60 80 100; ▲ 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 = $(D30)^2 / (D10 \times D60)$
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

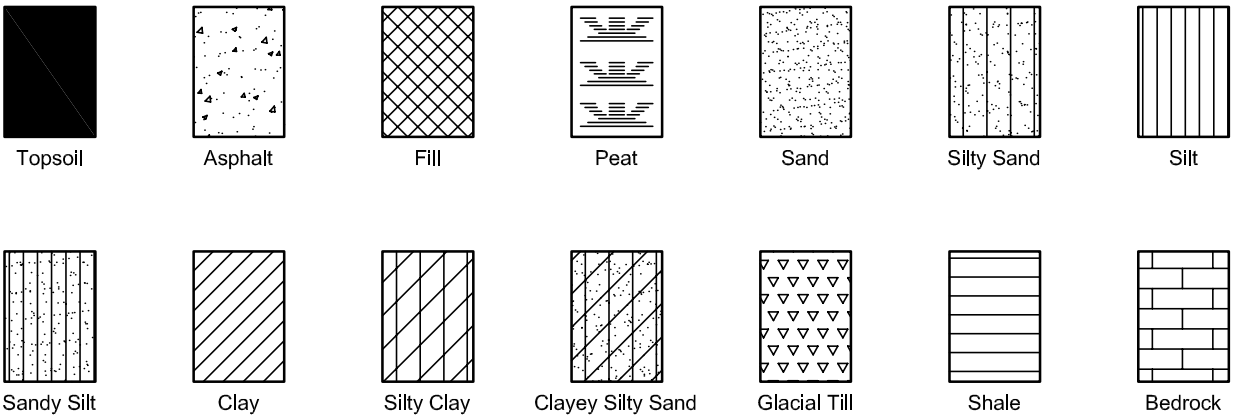
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

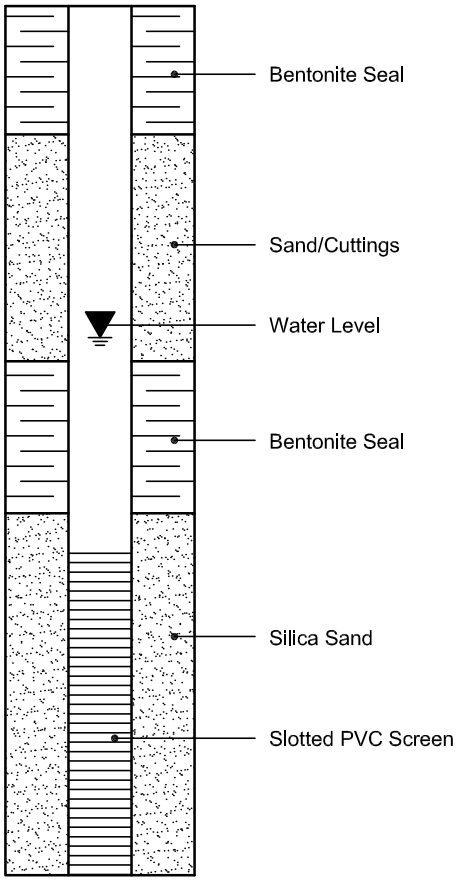
SYMBOLS AND TERMS (continued)

STRATA PLOT

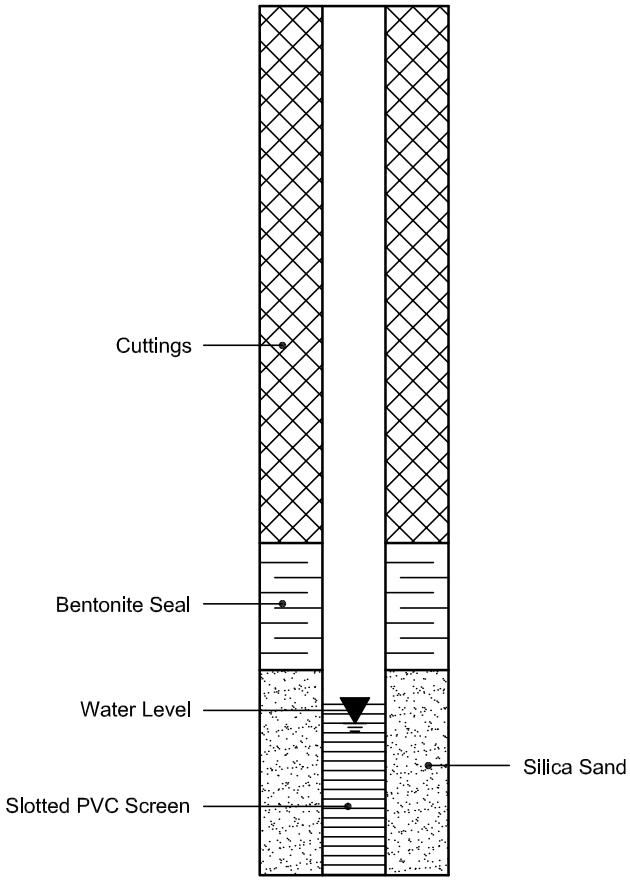


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 26-May-2023

Client: Paterson Group Consulting Engineers

Order Date: 19-May-2023

Client PO: 57537

Project Description: PG3155

	Client ID:	TP3-23 G1 [0.8-0.9m]	-	-	-
	Sample Date:	17-May-23 09:00	-	-	-
	Sample ID:	2320500-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	84.4	-	-	-
General Inorganics					
pH	0.05 pH Units	6.91	-	-	-
Resistivity	0.1 Ohm.m	209	-	-	-
Anions					
Chloride	10 ug/g dry	<10	-	-	-
Sulphate	10 ug/g dry	<10	-	-	-

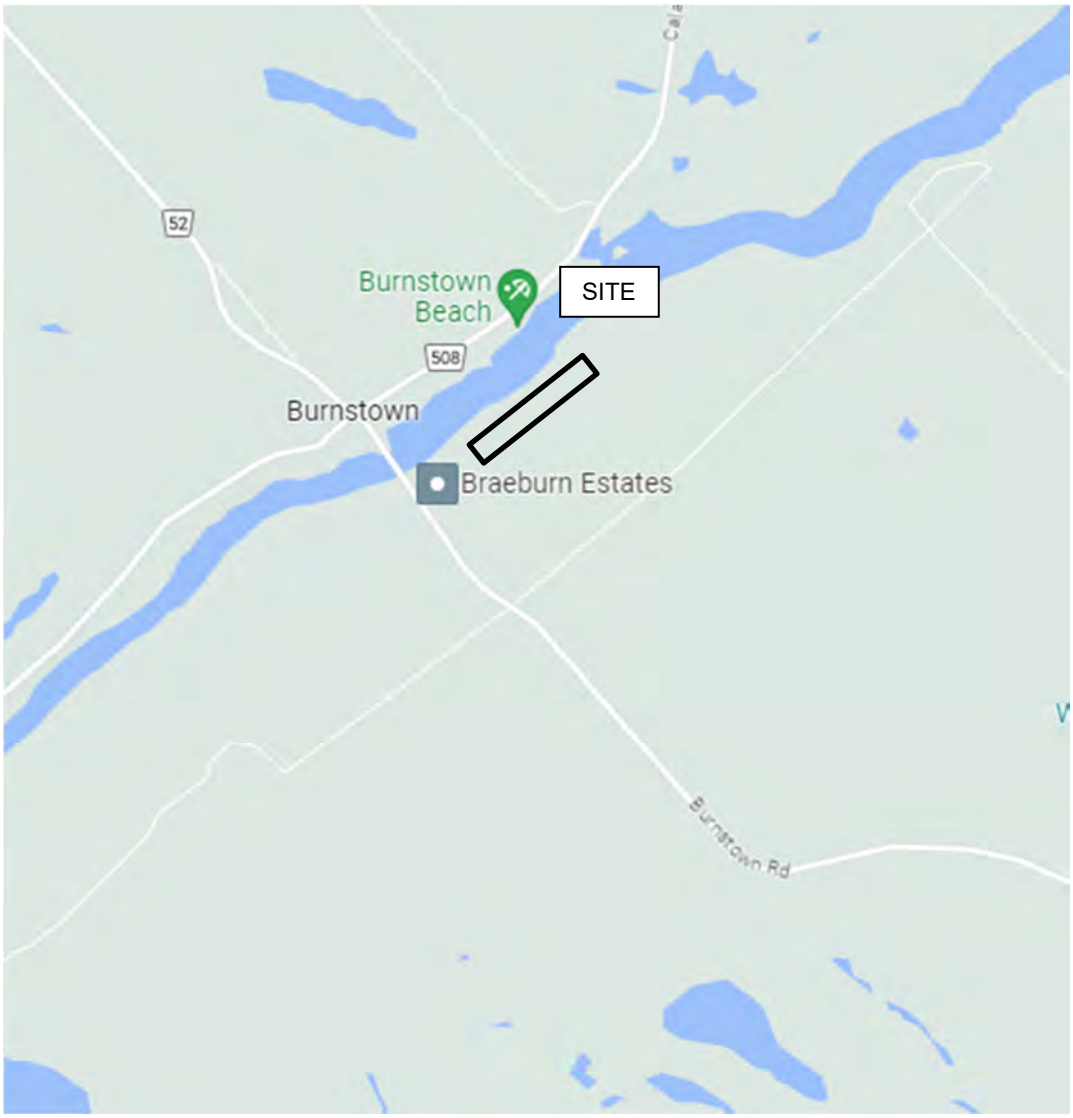
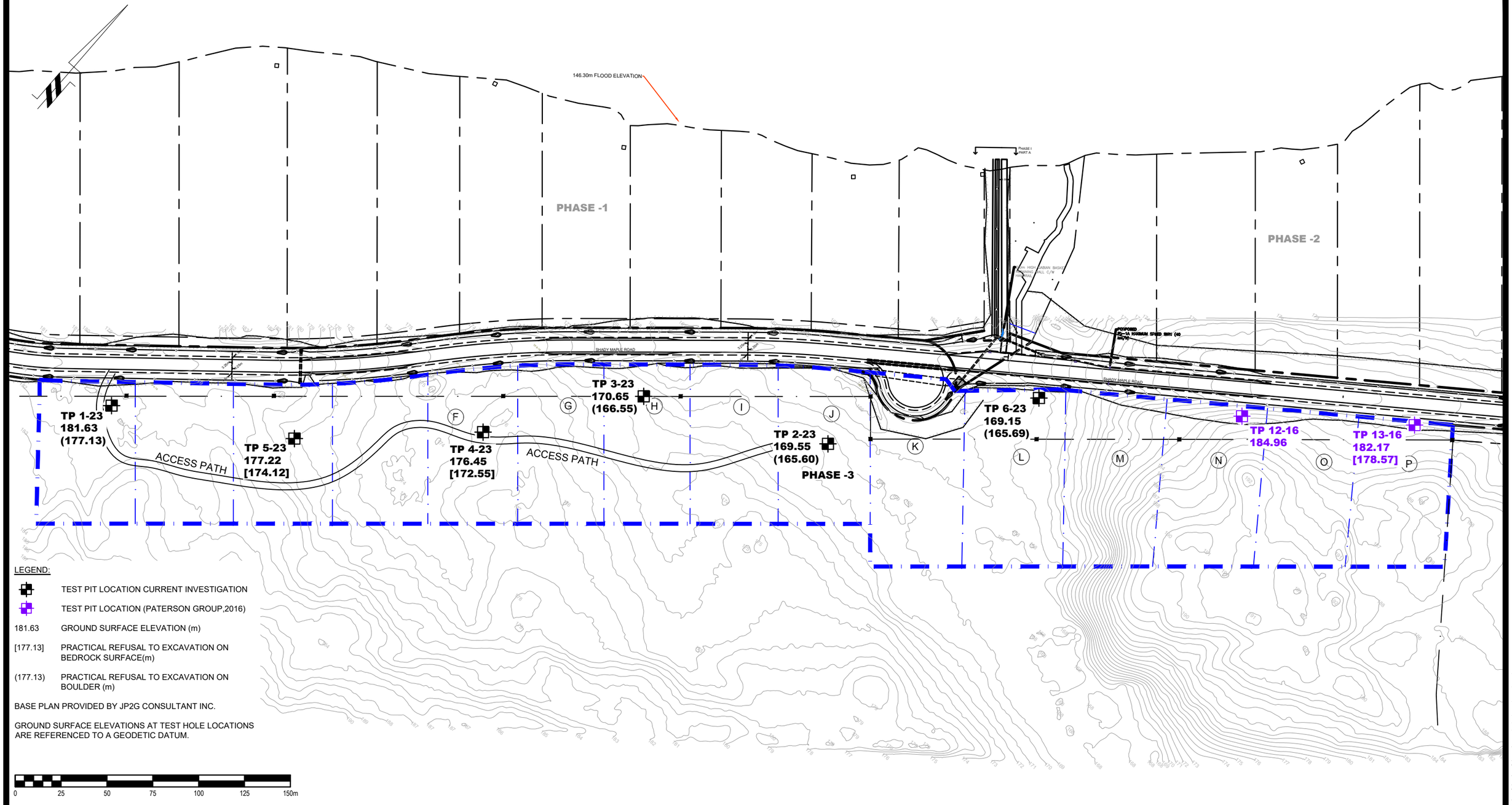


FIGURE 1

KEY PLAN

PATERSON GROUP



LEGEND:

- TEST PIT LOCATION CURRENT INVESTIGATION
- TEST PIT LOCATION (PATERSON GROUP,2016)
- 181.63 GROUND SURFACE ELEVATION (m)
- [177.13] PRACTICAL REFUSAL TO EXCAVATION ON BEDROCK SURFACE(m)
- (177.13) PRACTICAL REFUSAL TO EXCAVATION ON BOULDER (m)

BASE PLAN PROVIDED BY JP2G CONSULTANT INC.

GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

KDSA DEVELOPMENT CORP.

GEOTECHNICAL INVESTIGATION
FUTURE RURAL SUBDIVISION - PHASE 3
BUILDING SUPPLY ROAD STREET

BURNSTOWN, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Date: 05/2023
Drawn by: GK	Report No.: PG3155-LET.06
Checked by: PB	Dwg. No.: PG3155-4
Approved by: MS	Revision No.:

11x17

p:\autocad drawings\geotechnical\pg31xx\pg3155\pg3155-4 test hole location plan.dwg