Geotechnical Engineering

Environmental Engineering

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Paterson Group Inc.
Consulting Engineers
154 Colonnade Road
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

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Geotechnical Investigation

Proposed Office and Retail Development
7586 Village Centre Place
Greely (Ottawa), Ontario

Greely Family Farm Inc.

August 13, 2013
Updated November 19, 2018

Report: PH2017-REP.01R

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APPENDICES

1.0 INTRODUCTION

Paterson Group Inc. (Paterson) was commissioned by Greely Family Farm Inc. to conduct a site specific geotechnical investigation for a proposed office and a retail building located at 7586 Village Centre Place in the Village of Greely, Ontario. A previous geotechnical investigation was conducted for the subdivision, as a whole, with our findings reported under Report No. PH0145-06 dated October 6, 2008.

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 subject development as they are understood at the time of writing this report.

2.0 PROPOSED DEVELOPMENT

It is anticipated that the current development proposal will consist of an office building, which could be two storey walk-ups with a basement level, and a retail building. In the case of the two storey structure, the basement level will be a walkout. It is further understood that the development will have private services, with sewage being treated using a privately owned sewage treatment facility, and water supply will be accommodated using private wells. Access to the office building will be off of Village Centre Place.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

The fieldwork program was initiated on June 7, 2012, which consisted of putting down four test pits, for the purpose of delineating the soil profile in the building areas. The test pits were put down using a backhoe, supplied by the client. All fieldwork was conducted under the full-time supervision of a technician under the direction of an engineer from our firm.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile & Test Data sheets in Appendix 1 of this report.

3.2 Field Survey

The test hole locations and elevations were surveyed and provided by the client. The location and ground surface elevation of each test pit are presented on Drawing No. PH2017-1R, Test Hole Location Plan, in Appendix 2.

4.0 OBSERVATIONS

4.1 Surface Conditions

The site comprises part of the commercial / office portion of the Waters Edge Subdivision. The ground surface is generally uniform and slopes gradually to the stormwater management pond to the northeast. The site is also adjacent to Highway 31 (Bank Street) to the southwest.

4.2 Subsurface Profile

7586 Village Centre Place

The soil profile at this site consists of surficial topsoil overlying a silty sand to sandy silt which, in turn, overlays a stiff silty clay. Reference should be made to the Soil Profile & Test Data sheets in Appendix 1 for the details of the soil profiles encountered at each testhole location.

Any information pertaining to soils and all test hole logs are furnished as a matter of general information only, and test hole logs are not to be considered representative of conditions at locations other than those described by the test holes themselves.

4.3 Groundwater

Groundwater levels were measured in the open test pits at the time of the fieldwork. The measured groundwater levels ranged from 1.5 to 2.8 m below existing ground surface. The measured groundwater level (GWL) readings and corresponding geodetic elevations are presented in Table 1 below.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could be higher at the time of construction.

TABLE 1: SUMMARY OF GROUNDWATER LEVELS FOR 7586 VILLAGE CENTRE PLACE

TEST HOLE NUMBER	MEASURED GROUNDWATER LEVEL (m)		RECORDING DATE
	DEPTH	ELEVATION	
TP 1	2.80	87.20	June 7, 2012
TP 2	1.50	87.25	June 7, 2012
TP 3	1.50	88.20	June 7, 2012
TP 4	2.10	89.50	June 7, 2012

1. Open hole water level measurements.
2. The groundwater level elevation at each test hole location is referenced to the ground surface elevation at that test hole location. The ground surface elevation of each test hole was provided by Greely Family Farms Inc.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Geotechnical Assessment

It is understood that the proposed development will consist of an office and retail building. The office basement will be a walkout on Village Centre Place, north of the building. It is also understood that there are no municipal services, and the building will have private services, consistent with the overall site development.

5.2 Site Grading and Preparation

Stripping Depth

All fill and topsoil should be removed from within the building footprints and under hard surfaces (i.e. - roadways, sidewalks, etc.), and other settlement sensitive structures. Existing site excavated fill can be used in landscape areas.

5.3 Foundation Design

Shallow Foundation

The commercial structures proposed for the subject development can be supported by footing foundations. Footings should be founded on undisturbed in situ soil bearing media or engineered granular fill materials placed over undisturbed in situ soil subgrade media and compacted to a minimum of 98% of their SPMDD value. The bearing resistance values for the various founding media are provided below.

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

Strip or square footings, up to 3 m wide, placed on undisturbed, stiff to very stiff silty clay or silty sand to sandy silt bearing surfaces can be designed using a bearing resistance at SLS (serviceability limit states) value of **100 kPa** and a factored bearing resistance at ULS (ultimate limit states) value of **150 kPa**. A geotechnical resistance factor of 0.5 has been applied to the above noted bearing resistance at ULS value. These values should be confirmed in the field by geotechnical personnel at the time of construction. These bearing resistance values are also applicable to pre-compacted loose to compact coarse grained soils, such as sand and silty sand.

Where the placing of engineered granular fill is required, to establish the bearing medium, the bearing resistance values can be taken to be equivalent to the bearing resistance values of the parent subgrade soil, as detailed above, provided OPSS Granular B Type II or Granular A materials, compacted to a minimum of 98% of their SPMDD values are used.

A Class D seismic site classification is applicable for this site.

Settlement

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

5.4 Basement Wall

The basement walls can be designed using a triangular earth pressure distribution with a maximum stress value at the base of the wall equal to K γ H where:

K = 0.33 - where slight movement is permissible

K = 0.5 - where no movement is permissible (normal basement wall)

γ = 22 kN/m^3, unit weight of the fill

H = height of the basement wall, m

An additional pressure having a magnitude equal to K q and acting on the entire height of the wall should be added for any surcharge loading, q, that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with seismic loading cases.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

5.5 Basement Slabs / Slabs-on-Grade

With the removal of all topsoil and deleterious fill within the footprints of the proposed buildings, the uppermost in situ soil surface will be considered to be an acceptable subgrade surface on which to commence backfilling for basement floor or slab-on-grade construction. OPSS Granular B Type "II" crushed stone, is recommended for backfilling below the floor slab if significant quantities of fill are required to re-establish the design elevation. It is recommended that the upper 150 to 200 mm of sub-slab fill (in basement areas) consist of 19 mm clear crushed stone. All backfill material within the zone of influence of a footing or within the footprints of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of the material's SPMDD.

5.6 Pavement

The paved areas are considered to be "light duty", and will be designed to accommodate car traffic associated with office functions. The following structure, summarized in Table 2, below, can be used as a guide:

TABLE 2: RECOMMENDED "LIGHT DUTY" PAVEMENT STRUCTURE

THICKNESS (mm)	MATERIAL DESCRIPTION
50	**WEAR COURSE** - HL-3 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type "II"
-	**SUBGRADE** - In situ soils, engineered fill (min. 95% SPMDD) or OPSS Granular B Type I or II material placed over in situ soil (min. 95% SPMDD).

The above recommended pavement design will be adequate throughout the fire route area. Access lanes should be provided with an additional 25 mm of asphalt, and an additional 75 mm of Granular B Type "II" material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of the material's SPMDD using suitable vibratory equipment.

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 100 mm to 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 a sump pit, from which water will be discharged using a sump pump. Consideration should be given to installing a line or lines of perforated pipe within the subfloor clear stone draining to a pumped sump pit or gravity outlet.

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose. A dampproofing layer should be applied to the exterior of the building foundation walls in order to prevent moisture infiltration from the backfill materials.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage system (such as Delta Drain 6000 or equivalent), connected to a perimeter drainage system, is provided. Imported granular material, such as clean sand or OPSS Granluar 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 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings, such as those for isolated piers.

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 excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

Above the groundwater table, the excavation side slopes extending to a maximum depth of 3 m in overburden should be cut back at 1H:1V or flatter.

Excavated soil should not be stockpiled 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.

6.4 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.

The rate of flow of groundwater into the excavation through the silty sand strata is expected to be moderate to high due to the relative pervious nature of these materials and perched water table conditions. It is expected that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

If greater than 50,000 L/day of groundwater is expected, a permit to take water or an Environmental Activity and Sector Registration (EASR) permit will be required. For volumes between 50,000 to 400,000 L/day, it is required to register an 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.

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.

6.5 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site mostly consist of frost susceptible materials. In 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 difficult activites to complete during freezing conditions without introducing frost into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. The excavation and backfilling operations should be carried out in a manner as to avoid the introduction of frozen matter into these areas. Additional information can be provided, if required.

7.0 OBSERVATION AND MATERIAL TESTING SERVICES

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

- ❏ Observation of all bearing surfaces prior to the placement of concrete;
- ❏ Sampling and testing of the concrete and fill materials used;
- ❏ Observation of all subgrades prior to backfilling and follow-up field density tests to determine the level of compaction achieved; and
- ❏ 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 the completion of a satisfactory observation and material testing program by the geotechnical consultant.

8.0 STATEMENT OF LIMITATIONS

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete.

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

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, we request that we be notified immediately in order to permit reassessment of our 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 Greely Family Farm Inc. 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.

Michael S. Killam, P.Eng. (Minor corrections provided to original report - PH2017-REP.01)

Hydrogeologist

Report Distribution:

- ❑ Greely Family Farm Inc. (3 copies)
- ❑ Paterson Group Inc. (1 e-copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Block 63 - Greely Village Centre
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PH2017

REMARKS

HOLE NO. TP 1

BORINGS BY Backhoe **DATE** June 7, 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 %	Piezometer Construction
GROUND SURFACE						0	90.00	20 40 60 80	
TOPSOIL									
0.25									
Brown **SILTY SAND**						1	89.00		
0.90									
Grey to brown **SILTY SAND** to **SANDY SILT**						2	88.00		▽
2.80									
Very stiff to stiff, grey **SILTY CLAY**						3	87.00		
3.50									
End of Test Pit									
(Open hole GWL @ 2.8m depth)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Block 63 - Greely Village Centre
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PH2017

REMARKS

HOLE NO. TP 2

BORINGS BY Backhoe **DATE** June 7, 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 %	Piezometer Construction
GROUND SURFACE						0	88.75		
TOPSOIL									
0.20									
Brown **SILTY SAND**									
0.80									
Grey to brown **SILTY SAND** to **SANDY SILT**						1	87.75		
1.30									
Very stiff to stiff, grey **SILTY CLAY**						2	86.75		
3.00						3	85.75		
End of Test Pit									
(Open hole GWL @ 1.5m depth)									

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

Water Content %: 20, 40, 60, 80

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

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Block 63 - Greely Village Centre
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PH2017

REMARKS

HOLE NO. TP 3

BORINGS BY Backhoe **DATE** June 7, 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 %	Piezometer Construction
GROUND SURFACE						0	89.70	20 40 60 80	
TOPSOIL									
0.25									
Brown **SILTY SAND**						1	88.70		▽
0.95									
Grey to brown **SILTY SAND** to **SANDY SILT**									
1.50						2	87.70		
Very stiff to stiff, grey **SILTY CLAY**									
3.00						3	86.70		
End of Test Pit									
(Open hole GWL @ 1.5m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Block 63 - Greely Village Centre
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PH2017

REMARKS

HOLE NO. TP 4

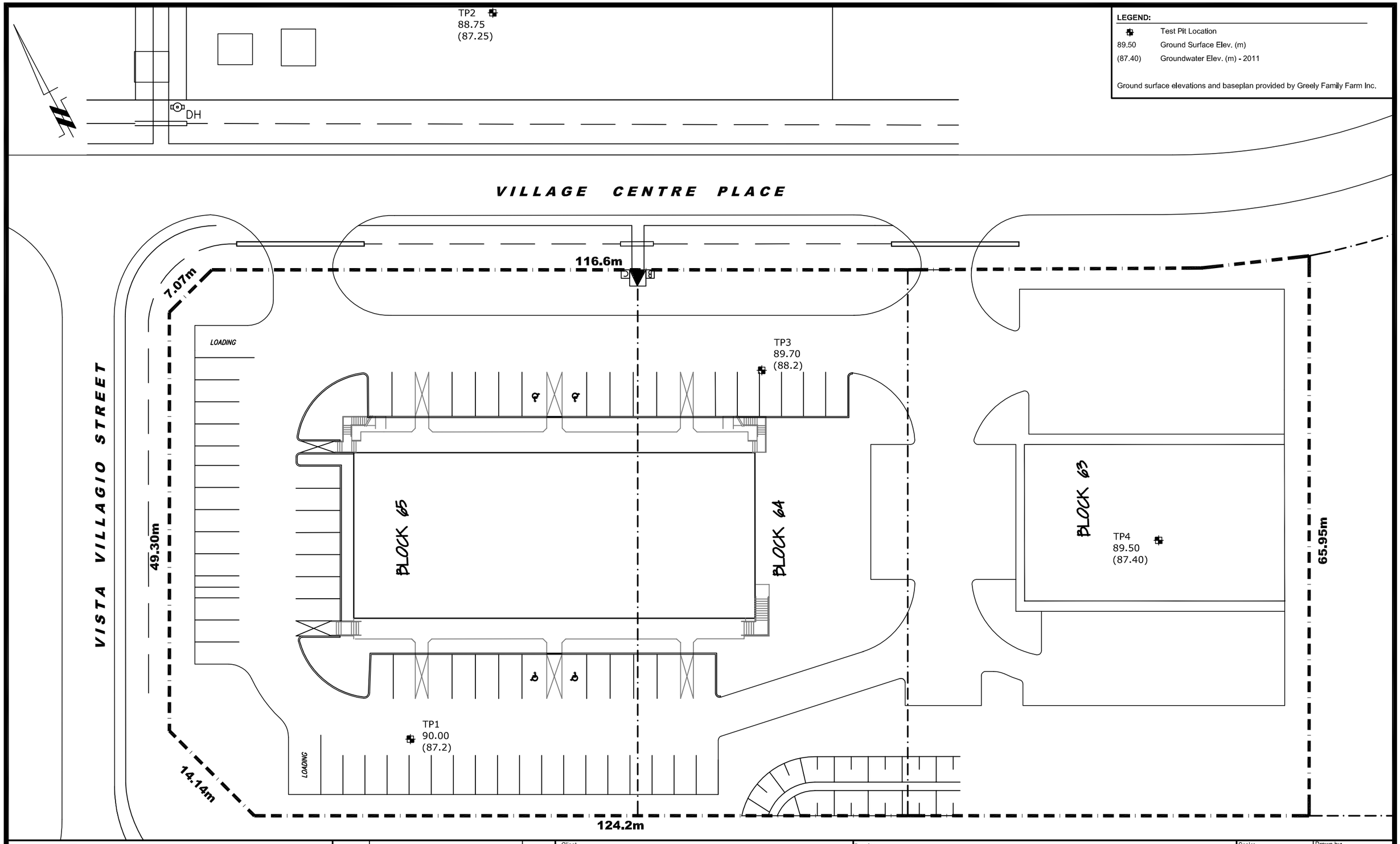
BORINGS BY Backhoe **DATE** June 7, 2012

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 %	Piezometer Construction
GROUND SURFACE						0	89.50	20 40 60 80	
TOPSOIL 0.25									
Brown **SILTY SAND** 0.80						1	88.50		
Grey to brown **SILTY SAND** to **SANDY SILT** 1.90						2	87.50		▽
Very stiff to stiff, grey **SILTY CLAY** 3.00						3	86.50		
End of Test Pit									
(Open hole GWL @ 2.1m depth)									

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

APPENDIX 2

DRAWING NO. PH2017-1R - TEST HOLE LOCATION PLAN



patersongroup
consulting engineers
154 Colonnade Road, Ottawa, Ontario K2E 7J5

12/11/18	Site Plan Update	1
DD/MM/YY	Description	Rev.

Client: **GREELY FAMILY FARM INC.**

Project: **GEOTECHNICAL INVESTIGATION**
7586 VILLAGE CENTRE PLACE
OTTAWA (GREELY), ONTARIO

Drawing: **TEST HOLE LOCATION PLAN**

Scale: 1:400	Drawn by: HV
Date: 11/2018	Checked by: AVS

Drawing no.: **PH2017-1R**

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