patersongroup

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Carp Airport Servicing and Residential Development - Phase 1
Carp Road - (Carp) Ottawa

Prepared For

West Capital Developments

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J7

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

July 22, 2013

Report: PG2450-2

TABLE OF CONTENTS **PAGE**

1.0 INTRODUCTION. 1

2.0 PROPOSED PROJECT. 1

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation. 2
3.2 Field Survey. 3
3.3 Laboratory Testing. 4
3.4 Analytical Testing. 4

4.0 OBSERVATIONS

4.1 Surface Conditions. 5
4.2 Subsurface Profile.. 5
4.3 Groundwater. 7

5.0 GEOTECHNICAL CONSIDERATIONS - RESIDENTIAL DEVELOPMENT

5.1 Geotechnical Assessment.. 9
5.2 Site Grading and Preparation. 9
5.3 Foundation Design. 10
5.4 Design for Earthquakes.. 13
5.5 Basement Slab. 14
5.6 Pavement Structure. 14
5.7 Foundation Drainage and Backfill. 17
5.8 Protection of Footings Against Frost Action. 17
5.11 Excavation Side Slopes. 17
5.12 Pipe Bedding and Backfill. 18
5.13 Groundwater Control.. 19
5.14 Winter Construction. 19
5.15 Corrosion Potential and Sulphate. 20
5.16 Limit of Hazard Lands.. 21
5.17 Landscaping Considerations.. 24

6.0 GEOTECHNICAL CONSIDERATIONS - SEWAGE TREATMENT AND WATER STORAGE FACILITY

6.1 Excavation Side Slopes. 25
6.2 Foundation Design 25
6.3 Design for Earthquakes.. 26
6.4 Uplift Resistance. 26
6.5 Storage Tank Walls.. 27
6.6 Groundwater Control. 29
6.7 Winter Construction. 29

7.0 GEOTECHNICAL CONSIDERATIONS - WATERMAIN ALIGNMENT

7.1 Excavation Side Slopes. 30
7.2 Pipe Bedding and Backfill. 31
7.3 Maintenance Holes. 32
7.4 Groundwater Control. 33
7.5 Winter Construction. 33

8.0 GEOTECHNICAL CONSIDERATIONS - DIAMONDVIEW ROAD

8.1 Introduction. 34
8.2 Surface Conditions. 34
8.3 Subsurface Conditions. 34
8.4 Recommendations. 35

9.0 GEOTECHNICAL CONSIDERATIONS - RUSS BRADLEY AND HUISSON ROAD

9.1 Introduction. 37
9.2 Surface Conditions. 37
9.3 Subsurface Conditions. 37
9.4 Recommendations. 39

10.0 RECOMMENDATIONS. 40

11.0 STATEMENT OF LIMITATIONS. 41

APPENDICES

Appendix 1:	Soil Profile and Test Data Sheets
	Symbols and Terms
	Grain Size Analysis
	Unidimensional Consolidation Testing Sheets
	Atterberg Limits' Results
	Analytical Test Results
Appendix 2:	Figure 1 - Key Plan
	Figure 2a to 7b - Slope Stability Analysis Sheets
	Drawing PG2450-2 - Limit of Hazard Lands
	Drawing PG2450-3 - Test Hole Location Plan
	Drawing PG2450-4 - Permissible Grade Raise Areas

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by West Capital Developments to conduct a geotechnical investigation for the proposed Carp Airport servicing and residential development to be located on Carp Road in the City of Ottawa (Carp) (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were:

- ❑ to determine the subsoil and groundwater conditions at this site by means of test holes;

- ❑ Provide geotechnical recommendations pertaining to design of the proposed development including construction considerations which may affect the design. These recommendations include, but are not limited to, slope stability issues, foundation design and pavement design, and will address OBC Part 4 requirements.

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.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation.

2.0 PROPOSED PROJECT

It is understood that the proposed development will consist of single family residential dwellings with asphaltic car parking, roadways and light aircraft taxiways. The sanitary small bore sewer and water main will connect to a sewage treatment and water storage facility located at the northeast corner of the residential development at Thomas Argue Road. The project also includes watermain servicing from the Village of Carp and roadway upgrades for Diamondview Road and Russ Bradley Road.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was carried out on August 15, 18, 19, 25, September 15, 16, 19, 20, 21, 2011 and June 24, 25, 2013. At that time, a total of 42 boreholes were completed for the proposed development. The test hole locations were chosen by Paterson in a manner to provide general coverage of the subject site and located in the field by Novatech Engineering Consultants. The locations of the test holes are shown on Drawing PG2450-3 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using both a track and truck-mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of augering to the required depths at the selected locations and sampling the overburden. The test hole locations are shown on Drawing PG2450-3 - Test Hole Location Plan included in Appendix 2. Sampling and testing the overburden was completed in general accordance with ASTM D5434-12 - Guide for Field Logging of Subsurface Explorations of Soil and Rock.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler or using 73 mm diameter thin walled (TW) Shelby tubes in conjunction with a piston sampler. All soil samples were visually inspected and initially classified on site. The split-spoon samples were placed in sealed plastic bags and the Shelby tubes were sealed at both ends on site. All samples were transported to the our laboratory for examination and classification. The depths at which the split-spoon and Shelby tube samples recovered from the test holes are shown as SS and TW, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm. This testing was done in general accordance with ASTM D1586-11 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

Undrained shear strength testing, using a vane apparatus, was carried out at regular intervals of depth in cohesive soils. Undrained shear strength testing in boreholes was completed using a MTO field vane apparatus. This testing was done in general accordance with ASTM D2573-08 - Standard Test Method for Field Vane Shear Test in Cohesive Soil.

All soil samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for visual inspection. Transportation of the samples was completed in general accordance with ASTM D4220-95 (2007) - Standard Practice for Preserving and Transporting Soil Samples.

The overburden thickness was evaluated by a dynamic cone penetration testing (DCPT) completed at BH 42-13. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

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

Groundwater

Flexible PVC standpipes were installed in half of the boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

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 test hole locations were chosen by Paterson Group (Paterson) in a manner to provide general coverage of the proposed project taking into consideration site features. The boreholes locations and ground surface elevation at each borehole location was provided Novatech Engineering Consultants and are assumed to be referenced to a geodetic datum. The locations and ground surface elevation at each borehole location are presented on Drawing PG2450-3 - Test Hole Location Plan in Appendix 2.

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. The subsurface soils were classified in general accordance with ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

A total of three (3) soil samples were submitted for grain size analysis in general accordance with ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates. Furthermore, a total of fifteen (15) soil samples were submitted for moisture contents in general accordance with ASTM D2216-10, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

Three (3) Shelby tube samples were submitted for unidimensional consolidation and one (1) soil sample for Atterberg limit testing from the boreholes completed for our investigation. The results of the consolidation and Atterberg testing are presented on the Unidimensional Consolidation Test Results and Atterberg Limits sheets presented in Appendix 1 and are further discussed in Sections 4 and 5.

The results of the grain size analysis and moisture contents are presented on the presented in Appendix 1 and are further discussed in Section 4.

3.4 Analytical Testing Results

A total of three (3) soil samples were submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The samples were analysed to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are discussed in Section 5.14 and shown in Appendix 1. It is expected that the selected soil samples is representative of the subsoils to be encountered at the subject site. Additionally, fine-grained soils such as silty clay, are considered to have a greater corrosion potential than coarse grained soil.

Paracel Laboratories (Paracel), of Ottawa, performed the laboratory analysis of the soil sample submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Environmental Analytical Laboratories (SCC/CAEAL). Paracel is accredited and certified by SCC/CAEAL for specific tests registered with the association. The following testing guidelines were utilized for the submitted soil samples. The anions were analyzed using EPA 300.1, the pH was analyzed using EPA 150.1, the resistivity was analyzed using EPA 120.1, and the percent solids was determined using gravimetrics.

4.0 OBSERVATIONS

4.1 Surface Conditions

The site is located to the southwest of the intersection of March and Carp Road in the City of Ottawa (Carp), Ontario. The central portion of the subject site is currently occupied by the Carp Airport facilities. The property is bounded to the north by agricultural lands, to the east by Carp Road, to the south by an active and an expired sand pit, and to the west by Diamondview Road followed by Highway 417.

The general topography of the site is relatively level to slightly undulating. The ground surface slopes generally slopes down towards the north, to northeast and is approximately at grade with the adjoining Carp and Diamondview Roads. A maximum difference in ground surface elevations of approximately 12 m was measured among the boreholes on the subject site. The northern portion of the site is currently occupied by agricultural land and generally free of trees and shrubs, whereas the south portion of the site is heavily treed.

One (1) shallow creek was observed on the west portion of the subject site running in a south to north direction. The lower portions of the meandering creek show some signs of erosion, but the slopes leading down from the tablelands on either side are shallow and do not present any evidence of erosion. Ditches were observed along Carp and Diamondview Roads and along the access roads on the subject site.

4.2 Subsurface Profile

Generally, the subsoil conditions at this site consist of a thin layer of topsoil or asphaltic concrete overlying granular crushed stone and/or in situ native brown silty clay and/or silty sand. The majority of the test holes were terminated in stratified layers of firm clayey silty to silty clay, and loose to compact silty fine sand and sandy silt. It should be noted that a 2.4 m thick layer of organic peat was encountered in BH40-11 at a depth of 2.6 m below existing ground surface. Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for details of the soil profiles encountered at the test hole locations.

Fifteen (15) soil samples were submitted for moisture contents. The results are summarized in the Table 1.

Table 1 - Summary of Moisture Content Analysis				
Borehole	**Sample**	**Depth (m)**	**Moisture Content %**	**Classification**
BH 5-11	SS2	0.8 to 1.4	14.6	Brown Silty fine to medium Sand
BH 8-11	SS4	2.3 to 2.9	21.5	Brown Silty Clay with Sand
BH 14-11	SS2	0.8 to 1.4	16	Brown Silty fine to medium Sand
BH 16-11	SS3	1.5 to 2.1	17	Grey Clayey Silt, trace Sand
BH 17-11	SS4	2.3 to 2.9	21.7	Brown Silty Clay, some Sand
BH 18-11	SS5	3.0 to 3.6	31.6	Grey Silty Clay, some Sand
BH 22-11	SS3	1.5 to 2.1	11.1	Brown Silty fine Sand
BH 24-11	SS4	2.3 to 3.9	26.6	Grey Clayey Silty to Silty Clay
BH 25-11	SS3	1.5 to 2.1	22.3	Brown Silty Clay, trace Sand
BH 32-11	SS4	2.3 to 2.9	21.8	Brown Silty Clay, with Sand
BH 33-11	SS4	3.0 to 3.6	24.3	Grey Silty Clay, some Sand
BH 34-11	SS3	1.5 to 2.1	22	Brown Silty Clay, some Sand
BH 35-11	SS4	2.3 to 2.9	31.3	Brown Silty Clay, trace Sand
BH 37-11	SS4	2.3 to 2.9	27.7	Brown Silty Clay
BH 39-11	SS6	4.6 to 5.2	16.3	Grey Silty fine to medium Sand

Three (3) soil samples were submitted for grain size analysis. The results are summarized in Table 2.

Table 2 - Grain Size Distribution				
Borehole	**Sample**	**Gravel (%)**	**Sand (%)**	**Silt and Clay (%)**
BH2-11	AU1	46.7	40.4	12.8
BH26-11	AU1	39	50.5	10.5
BH37-11	AU1	39	49.8	11.2

Bedrock

Based on available geological mapping, the bedrock in this area of the proposed residential development mostly consists of interbedded bioclastic limestone, sublithographic to fine crystalline Limestone and shale of the Verulam formation with an overburden drift thickness of 15 to 50 m depth. Based on the geological mapping, overburden drift thickness along Carp Road along the proposed watermain alignment varies between 5 to 50 m depth.

4.3 Groundwater

The measured groundwater levels in the boreholes are presented in Table 3. Groundwater conditions can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, it is estimated that groundwater can be expected between 1.5 to 2.5 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

Table 3 - Summary of Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 1-11	114.03	Dry	-	September 21, 2011
BH 3-11	116.29	1.56	114.73	September 21, 2011
BH 5-11	115.67	Blocked	-	September 27, 2011
BH 7-11	115.07	3.18	111.89	September 27, 2011
BH 8-11	114.57	2.98	111.59	September 27, 2011
BH 9-11	116.24	4.28	111.96	September 27, 2011
BH 10-11	116.94	1.55	115.39	September 27, 2011
BH 12-11	115.18	2.63	112.55	September 27, 2011
BH 16-11	116.02	1.22	114.80	September 27, 2011
BH 19-11	113.32	1.79	111.53	September 27, 2011
BH 22-11	111.88	3.88	108.00	September 27, 2011
BH 25-11	112.02	2.49	109.53	September 27, 2011
BH 27-11	112.83	2.53	110.30	September 27, 2011
BH 31-11	110.88	2.48	108.40	September 21, 2011
BH 32-11	110.29	2.66	107.63	September 27, 2011
BH 34-11	105.16	2.57	102.59	September 27, 2011
BH 35-11	100.78	2.88	97.90	September 21, 2011
BH 36-11	98.59	2.35	96.24	September 21, 2011
BH 37-11	95.63	3.02	92.61	September 21, 2011
BH 39-11	93.40	1.32	92.08	September 21, 2011
BH40-11	93.02	D amaged	-	September 21, 2011
BH41-13	116.13	1.23	114.90	July 3, 2013
BH42-13	114.95	1.46	113.49	July 3, 2013
BH43-13	116.80	1.51	115.29	July 3, 2013

Note: The ground surface elevation at each borehole location was provided by Novatech Engineering Consulting. It is assumed all ground surface elevations are referenced to a geodetic datum.

5.0 GEOTECHNICAL CONSIDERATIONS - RESIDENTIAL DEVELOPMENT

5.1 Geotechnical Assessment

It is understood that the proposed development will consist of single family residential dwellings with asphaltic car parking, roadways and light aircraft taxiways. The sanitary small bore sewer and water main will connect to a sewage treatment and water storage facility located at the northeast corner of the residential development at Thomas Argue Road. The project also includes water main servicing from the Village of Carp and roadway upgrades for Diamondview Road and Russ Bradley Road.

The majority of the residential development portion of the subject site is underlain by a deposit of clayey silty to silty clay with sand of unknown thickness. Therefore, the design of the proposed development, including the foundations of the proposed residential dwellings and the grading plan, should take into consideration the presence of the silty clay deposit. Due to the presence of the underlying silty clay layer, the proposed buildings will be subjected to grade raise restrictions.

It is expected that, for the most part, the dwellings will have basements and will be founded on shallow footings placed within the silty clay to silty sand/sandy silt, below any fill or topsoil.

From a geotechnical perspective, the subject site is suitable for the proposed development provided the required maximum grade raise is within the permissible range. Where grade raises are above permissible range, lightweight fill, preloading, surcharging and/or other means to reduce potential post-construction total and differential settlements could be required.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings and other settlement sensitive structures.

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. 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 building should be compacted to at least 98% of the material's 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 these materials are to be used to build up the subgrade level for areas to be paved, they 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.

5.3 Foundation Design

Shallow Foundation

For the most part, the founding conditions at the site are favourable for the proposed buildings provided that the grade raises at the buildings are within acceptable range. Based on the soil profiles encountered at the site, it is anticipated that silty clay to silty sand/sandy silt will be encountered at the founding level at most locations. Compact to loose silty fine to medium sand could also be encountered at the founding level at certain locations depending upon the grade raise at the buildings. These materials are suitable bearing media upon which to found footings for the support of typical residential dwellings and lightly-loaded commercial structures.

When considering a shear failure, strip or pad footings, up to 2 m wide, placed on undisturbed soil bearing surfaces at a maximum depth of 1.5 m below existing ground surface can be designed using the allowable bearing pressures presented in Table 2.

Bearing Resistance Values

Using continuously applied loads, footings, up to 3 m wide, placed on an undisturbed bearing surface can be designed using the following bearing resistance values:

Material	Bearing Resistance Values (kPa)	
	SLS	ULS
Stiff to very stiff silty clay	125	200
Compact silty sand/clayey silt	100	150
Firm silty clay	75	120
Loose sandy silt/silty sand	60	100

A geotechnical resistance factor of 0.5 was applied to the bearing resistance value 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.

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 compact silty sand/sandy silt or a stiff to firm 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.

Settlement/Grade Raise

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Three (3) site specific consolidation tests were conducted. The results of the consolidation tests from our investigation is presented in Table 4 and in Appendix 1.

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test sample. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 4 - Summary of Consolidation Test Results

Borehole	Sample	Depth	p'_c	p'_o	C_{cr}	C_c	Q
BH 41-13	TW 5	5.00	112	52	0.011	0.412	G
BH 42-13	TW 6	5.03	97	57	0.009	0.370	A
BH 43-13	TW 7	5.56	104	56	0.016	0.390	G

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed

The values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests carried out for the present investigation are based on the long term groundwater level observed at each borehole location. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be **25 and 20 mm**, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when building are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

The recommended permissible grade raise areas ranging from **1 to 1.5 m** are defined in Drawing PG2450-4 - Permissible Grade Raise Areas in Appendix 2.

Based on the above discussion, several options could be considered to accommodate proposed grade raises with respect to our permissible grade raise recommendations, such as, the use of lightweight fill, which allow for raising the grade without adding a significant load to the underlying soils. Alternatively, it is possible to preload or surcharge the subject site in localized areas provided sufficient time is available to achieve the desired settlements. It should be noted that the first stage of a settlement surcharge program is currently underway for lots within the northeast portion of the subject site.

Underground Utilities

The underground services will be subjected to similar total or differential settlements as the proposed structures. Once the final grade raises are established, it is expected that underground utilities will be slightly lower that the finished grades surrounding the residential units.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Site Class D or E** for the shallow foundations considered at this site. A site specific shear wave velocity test will be required to confirm the Class D. The soils underlying the proposed foundations are not susceptible to liquefaction. Reference should be made to the latest revision of the 2006 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

With the removal of all asphalt, topsoil and fill, containing organic matter, within the footprint of the proposed building, the native soils will be considered to be an acceptable subgrade surface 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. It is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Structure

Residential subdivision roadways and private aircraft taxiways are anticipated at this site. No anticipated traffic volume data was provided for the design of the proposed roadways. For preliminary design purposes, pavement structure guidelines are presented in Table 5 and Table 6.

Table 5 - Recommended Pavement Structure
Car Parking Only

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 in situ soils, acceptable fill or OPSS Granular B Type I or II material placed over in situ soil.	

Table 6 - Recommended Pavement Structure Light Aircraft Taxiways, Local Roadways and Access Lanes	
Thickness (mm)	**Material Description**
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils, acceptable fill or OPSS Granular B Type I or II material placed over in situ soil.	

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

Paving is to be completed in accordance with MTO OPSS 1151 and 310 or applicable City of Ottawa standards.

For residential driveways and car only parking areas, an Ontario Traffic Category A will be used. For local roadways, an Ontario Traffic Category B should be used for design purposes.

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 I or II material.

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.

Due to the high groundwater conditions at this site, consideration should be given to using a geotextile as a separation layer between the subbase material and the subgrade where service trenches are located beneath the proposed paved area. The geotextile should consists of a woven Terratrack 200w or equivalent.

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.

The subgrade soil will consist mostly of silty clay and/or silty sand/sandy silt. Consideration should be given to installing subdrains during the pavement construction. These drains should be installed on both sides of the pavement with their inverts approximately 300 mm below the subgrade level. The clear stone surrounding the drainage lines, or the pipe itself, should be wrapped with a suitable filter cloth. The drains should be connected to a positive outlet. The subgrade surface should be crowned to promote water flow to the drainage lines.

It is also understood that temporary haul roads are being considered during the construction of the proposed development. For preliminary design purposes, the following table should be considered

Table 7 - Recommended Pavement Structure
Proposed Construction Haul Road

Thickness (mm)	Material Description
200	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils, acceptable fill or OPSS Granular B Type I or II material placed over in situ soil.	

Consideration could also be given to using a geotextile and biaxial geogrid over the subgrade layer beneath the proposed haul road. The biaxial geogrid should consist of Terrafix BX2500 or Tensar BX1500 overlying a non-woven Terrafix 270R or equivalent.

5.7 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed residential dwellings. The system should consist of a 100 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 the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining non-frost susceptible granular materials, such as an OPSS Granular B Type I or clean sand. 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 blanket, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system.

5.8 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.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for exterior unheated footings, not thermally connected to a heated space, such as exterior columns and/or wing walls.

5.9 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes 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).

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 the 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.

5.10 Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. Where the invert of the excavation is within grey clayey silty to silty clay below the stiffer, upper crust, the thickness of the bedding should be increased to 300 mm. The bedding should extend to a minimum of 300 mm above the obvert of the pipe to provide an adequate protective cover. The bedding and cover materials should be placed in maximum 300 mm thick lifts compacted to a minimum of 95% of the material’s SPMDD.

It should generally be possible to re-use the moist (not wet) overburden material above the cover material if the excavation and filling operations are carried out in dry weather conditions. The wet silty sand/sandy silt and silty clay will be difficult to re-use as their high water contents make compacting these materials impractical without an extensive drying period.

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 reduce 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 where the excavation is through silty clay. The clay seals should be as per Standard Drawing No. S8 of the Department of Transportation, Utilities and Public Works Infrastructure Services Branch (TUPWISB) of the City of Ottawa. The seals should be at least 1.5 m long (in the trench direction) 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 300 mm thick loose layers 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.

Directional Drilling

Based on the existing borehole information, directional drilling is a suitable option for the proposed sanitary installation below the creek underlying proposed Street Six and the watermain installation below the Carp River located south of the intersection of Carp Road and Rivington Street. Directional drilling is further discussed in Subsection 7.2.

5.11 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.

Generally, the flow of groundwater into the shallow trench excavations anticipated at this site should be relatively low and is expected to be controllable using properly sized pumps and sumps. However, in areas of saturated sand, the rate of groundwater inflow through the sides of the excavations will be high. At these locations, it is recommended that the groundwater level be lowered by pumping from filtered sumps located outside the excavations, by ditching around the perimeter of the affected area, and/or by other means prior to completing the excavations. In that manner, it is expected that the groundwater infiltrating the excavations will be controllable using properly sized pumps and sumps from within the excavations.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

5.12 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.

5.13 Corrosion Potential and Sulphate

The results of analytical testing were evaluated according to industry accepted standards presented by A.B. Chance. It was stated that extremely acid soils (below a pH of 4.5) and very strong alkaline soils (above a pH of 9.1) are considered to have a significantly high corrosion loss rate.

The soil resistivity/corrosion rate potential was evaluated according to the following table:

Table 8 - Corrosion Potential

Resistance Classification	Soil Resistivity (ohm-cm)	Corrosion Potential
Low	0-2,000	Severe
Medium	2,000-10,000	Moderate
High	10,000-30,000	Mild
Very High	Above 30,000	Unlikely

The Canadian Standards Association (CSA) outlines the requirements for sulphate content in A23.1-04, Table 3. AASHTO T290-91 outlines the requirements for chloride content.

The results show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (Type GU, or 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 and the resistivity is indicative of an ‘unlikely’ to ‘moderate’ corrosion potential rating as indicated in Table 8.

5.14 Limit of Hazard Lands

The field program for the geotechnical slope stability analysis was carried out on April 27, 2012 with a representative from Novatech Engineering Consultants.

Generally, a 1 to 3 m wide creek meanders through the 2 to 3.5 m high and 40 to 50 m wide valley corridor which bisects the two parcels of land at the aforementioned site. Several small dry tributaries extending into the table lands were noted along the slope face. Some signs of active erosion and minor sloughing were noted along the waters edge, where the watercourse had meandered in close proximity to the toe of the slope.

Subsurface Profile

The soil profile along the subject slope consist of a thin layer of topsoil overlying a loose to compact red to brown silty sand. The silty sand was underlain by a stiff weathered brown silty clay crust and/or a firm grey silty clay to clayey silt.

A total of sixteen (16) cross-sections were completed in the field on April 27, 2012 at the locations where the meandering creek became in close proximity to the valley walls and where the existing slope was less than 6H:1V.

Slope Conditions

A geotechnical limit of hazard lands setback line has been provided from the top of slope for the valley corridor walls of the Carp Creek corridor. Six (6) slope cross-sections were studied as the worst case scenarios. The slope cross sections analysed are presented on Drawing PG2450-2 - Limit of Hazard Lands presented in Appendix 2. The subject section of Carp Creek is located with a 40 to 50 m wide valley corridor with a 2 to 3.5 m high valley wall varying between a stable 3H:1V to greater than 10H:1V. The valley corridor is less defined within the southwest portion of the site, where the valley walls are close to 2 m or less. The majority of the slope face was noted to be grass covered with sparse brush and small trees with minor surficial erosional activities noted. Some minor sloughing and undercutting along the waters edge where the watercourse has meandered and change direction.

Slope Stability Analysis

The analysis of the stability of the slope was carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

The cross-section was analyzed taking into account a groundwater level at 0.8 m below existing ground surface with cohesive soils in fully saturated conditions. Subsoil conditions at the cross-sections were inferred based on the findings at nearby borehole locations, field observations and general knowledge of the area's geology.

Static Analysis

The results for the existing slope conditions at Section A, B, C, D, E and F are shown in Figure 2a, 3a, 4a, 5a, 6a and 7a attached to the report. The factor of safety was found to be greater than 1.5 Sections A analyzed under static conditions.

Seismic Loading Analysis

An analysis considering seismic loading was also completed. A horizontal seismic acceleration, K_h, of 0.21G was considered for the analyzed sections. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The results of the analyses including seismic loading are shown in Figures 2b, 3b, 4b, 5b, 6b and 7b for the slope sections. The results indicate that the factors of safety for the slope section analyzed is greater than 1.1. Based on these results, the slopes are considered to be stable under seismic loading.

Limit of Hazard Lands

The limit of hazard lands includes a stable slope allowance taken from top of slope. The limit of hazard lands also includes a toe erosion and a 6 m erosion access allowance for slopes greater than 6H:1V. It should be noted that based on our analysis results, the subject slope is considered stable. The limit of hazard lands setback line for the proposed development is indicated on Drawing PG2450-2 - Limit of Hazard Lands in Appendix 2.

The toe erosion allowance for the walls of the valley corridor was based on the cohesive nature of the soils, the observed current erosional activities and the width and location of the current watercourse. Signs of minor erosion were noted along the existing watercourse where the watercourse has meandered in close proximity to the toe of the corridor wall. It is considered that a toe erosion allowance of 2 m is appropriate for the corridor walls confining the existing watercourse. At the worse case scenario, the toe erosion allowance was applied to the full water's edge and still maintaining a stable slope of greater than 3H:1V with a factor of safety of greater than 1.5.

Consideration could be given to infilling the existing drainage areas located to the east and west of the valley corridor with the existing watercourse. The majority of the drainage areas were noted to be dry and some areas with standing water. The existing drainage areas do not require a toe erosion allowance or an erosion access allowance.

The existing vegetation on the slope face should not be removed as it contributes to the stability of the slope and reduces erosion. If the existing vegetation needs to be removed, it is recommended that a 100 to 150 mm of topsoil mixed with a hardy seed or an erosional control blanket be placed across the exposed slope face.

5.15 Landscaping Considerations

Tree Planting Restrictions

The proposed development is located in an area of moderately to high sensitive silty clay deposits for tree planting. It is expected that the combination of the proposed finished grades and the thickness of the underlying weathered clay crust will provide approximately 4 to 5 m thick buffer to the underlying firm silty clay deposit.

Tree planting for this subject development should be limited to low water demand trees. The minimum permissible distance from the foundation will depend on the nature of the tree, the depth of the clay crust and the final grade raise in relation to the permissible grade raise. A minimum permissible distance of 5 m from the foundation wall is recommended for a tree planting setback.

It is well documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils that shrink on drying can result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows and some maples (i.e. Manitoba Maples) and, as such, they should not be considered in the landscaping design.

6.0 GEOTECHNICAL CONSIDERATIONS SEWAGE TREATMENT AND WATER STORAGE FACILITY

6.1 Excavation Side Slopes

The side slopes of excavations in the soil and fill 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.

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 the 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.

6.2 Foundation Design

Footings placed on undisturbed, firm grey clayey silt to silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **75 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **120 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

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

The modulus of subgrade reaction was estimated to be **1.1 MPa/m** for a contact pressure of **40 kPa**.

A permissible grade raise restriction ranging from 1 to 1.5 m at the proposed structures should be considered for design purposes.

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.

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 firm clayey silt to silty clay bearing medium 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 or engineered fill of the same or higher capacity as the soil.

6.3 Design for Earthquakes

The proposed wet well foundation can be designed using as seismic site response **Class D or E** as defined in the Ontario Building Code 2006 (OBC 2006; Table 4.1.8.4.A). A site specific shear wave velocity test will produce a definitive value which will most likely confirm a Class D designation. It should be noted that the soils underlying the proposed wet well are not susceptible to liquefaction. Reference should be made to the latest revision of the 2006 Ontario Building Code for a full discussion of the earthquake design requirements.

6.4 Uplift Resistance

The proposed sewage storage facility will be subjected to uplift forces due to the presence of groundwater. The long term groundwater level is expected at a depth of 3 m below the existing grade. However, the groundwater level fluctuates throughout the year and could be encountered seasonally at higher levels at the time of construction. Several design options are available for the proposed wet well to resist uplift forces. The following options are suggested for uplift resistance design:

Option 1 - Extended Sewage Storage Base Footing

The uplift resistance can be provided by the weight of the structure plus the weight of soil backfill placed above the perimeter of the base of the structure. Table 9 provides acceptable geotechnical parameters for resistance to uplift force design. The dry unit weight of the material should be used above the groundwater level and the effective unit weight should be used below the groundwater level. A minimum factor of safety of 1.5 against uplift should be provided.

Table 9 - Geotechnical Parameters for the Resistance to Uplift Pressures and Temporary Shoring Design

Material Description	Unit Weight (kN/m^3)		Friction Angle (°) φ'	Earth Pressure Coefficients		
	Dry γ_{dr}	Effective γ'		Active K_A	At-Rest K_O	Passive K_P
OPSS Granular A Fill (Crushed Stone)	22	13.5	40	0.22	0.36	4.58
OPSS Granular A Fill (Well-Graded Sand-Gravel)	21.5	13.5	36	0.26	0.41	3.85
OPSS Granular B Type II Fill (Crushed Stone)	22.5	14	42	0.2	0.33	5.04
OPSS Granular B Type I Fill (Well-Graded Sand-Gravel)	21.5	13.5	35	0.27	0.43	3.69
OPSS Granular B Type I Fill (Well-Graded Sand)	21.5	11.5	32	0.31	0.47	3.25
Silty Sand	19	12	42	0.29	0.46	3.39
Silty Clay	16.5	7	28	0.36	0.53	2.77

Notes:
- Properties for fill materials are for condition of 95% of Standard Proctor maximum dry density (i.e. moderately compacted).

Option 2 - Thickened Storage Tank Base Slab

This option can be completed in conjunction with a rubberized waterproofing membrane, if required. For uplift resistance design, the dry unit weight of concrete can be taken as 23.5 kN/m^3.

6.5 Storage Tank Walls

There are several combinations of backfill materials and retained soils that could be applicable for the wet well walls. The unit weights and friction angles for the applicable soils are presented in Table 10. The earth pressures acting on the shoring system may be calculated using the following parameters:

Table 10 - Soil Parameters	
Parameters	**Values**
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Unit Weight (γ), kN/m^3	20
Submerged Unit Weight(γ), kN/m^3	13

The total earth pressure (P_{AE}) includes both the static earth pressure component (P_o) and the seismic component (ΔP_{AE}).

Static Earth Pressures

The static horizontal earth pressure (P_o) can be calculated using a triangular earth pressure distribution equal to $K_o\ \gamma\ H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil
γ = unit weight of the fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

Seismic Earth Pressures

The seismic earth pressure (ΔP_{AE}) can be calculated using the earth pressure distribution equal to $0.375 a_c\ \gamma H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.42g according to OBC 2006. Note that the vertical seismic coefficient is assumed to be zero.

The total earth pressure (P_{AE}) is considered to act at a height, h, (m) from the base of the wall. Where:

$h = \{Po(H/3)+\Delta P_{AE}(0.6H)\}/P_{AE}$

The earth pressures calculated are unfactored. For the ULS case, the earth pressure loads should be factored as live loads, as per OBC 2006.

6.6 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 expected that the flow of groundwater into the excavation will be low to moderate through the sides of the excavation. However, it is expected that the groundwater inflow will be controllable using open sumps and pumps.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

6.7 Winter Construction

Precautions must be taken if winter construction is considered for this project. Precaution must be taken where excavations are carried out in proximity of existing structures which may be adversely affected due to the freezing conditions. In particular, it should be recognized that where a shoring system is used, the soil behind the shoring system will be subjected to freezing conditions and could result in heaving of the structure(s) placed within or above frozen soil. Provisions should be made in the contract document to protect the walls of the excavations from freezing, if applicable.

7.0 GEOTECHNICAL CONSIDERATIONS WATERMAIN AND SANITARY SERVICE ALIGNMENT

It is expected that the majority of the construction of the watermain and sanitary services will be completed using conventional open cut methods and will most likely be carried out within the confines of properly braced steel trench box. Groundwater infiltration through the sides of the excavations should be controllable using sumps and pumps.

It is understood that directional drilling will be utilized for the watermain installation below the existing bridge at the intersection of Rivington Street and Carp Road.

The above and other considerations are further discussed in the following sections.

7.1 Excavation Side Slopes

Overburden

Side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be shored from the start of the excavation until the structure is backfilled. It is assumed that the excavations will be carried out within the confines of a fully-braced steel trench box or other acceptable shoring system.

For open cut situations, above the groundwater level, the excavation side slopes extending to a maximum depth of 4 m in soil should be cut back at 1H:1V. The subsoil at this site is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

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.

Trench boxes should be designed for at least “at rest” earth pressures considering that the boxes will be pulled along the trench and will often be in contact with the soils. A quasi-hydrostatic earth pressure diagram can be used for the box design using an at rest earth pressure coefficient of 0.5 and a drained soil unit weight of 20 kN/m^3 above the groundwater level.

Where trenching below the groundwater level without controlling the groundwater, an effective soil unit weight of 11.5 kN/m^3 can be used below the groundwater level in conjunction with the hydrostatic pressure.

A surcharge pressure due to embankments, vehicle surcharges, construction equipment, adjacent structures, etc. should be added to the earth pressures using the at rest earth pressure coefficient of 0.5. If the top of the trench box is to be located below the ground surface, the extra soil weight above the box should be treated as a surcharge.

7.2 Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. Where the invert of the excavation is within grey clayey silty to silty clay below the stiffer, upper crust, the thickness of the bedding should be increased to 300 mm. 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 300 mm thick lifts compacted to a minimum of 95% of the material's SPMDD.

It should generally be possible to re-use the moist (not wet) overburden material above the cover material if the excavation and filling operations are carried out in dry weather conditions. The wet silty sand/sandy silt and silty clay will be difficult to re-use as their high water contents make compacting these materials impractical without an extensive drying period.

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 reduce 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 where the excavation is through silty clay. The seals should be at least 1.5 m long (in the trench direction) 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 300 mm thick loose layers 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.

Directional Drilling

Based on the existing borehole information, directional drilling is a suitable option for the proposed sanitary installation below the creek underlying proposed Street Six and the watermain installation below the Carp River located south of the intersection of Carp Road and Rivington Street.

It is anticipated that the horizontal drilling at the location of the sanitary installation will be through a stiff brown silty clay and/or firm grey silty clay. Directional drilling, if considered, underlying the Carp River will encounter compact silty fine to medium sand, organic peat, firm grey silty clay and overlying fill materials. Loose to dense silty fine to coarse sand with gravel was encountered at depths ranging between 5.3 and 6.8 m in BH 39-11 and BH 40-11, respectively. It should be noted that running sand and high groundwater infiltration was encountered at 4.5 m and 6.8 m depths. Although gravel and smaller cobbles may not be a problem with this technique, cobbles and boulders would be problematic for directional drilling. Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for details of the soil profiles encountered at the test hole locations.

A minimum soil cover for frost protection of 2.4 m should be provided between the top of the pipe and finished grade and below the underside of the pipe and the top of the culvert. Alternatively, the watermain could be positioned at a higher elevation below the watercourse crossing at Rivingston Street and Carp Road to avoid contact with the glacial till layer and the watermain could be insulated to compensate for the reduced soil cover.

7.3 Maintenance Holes

Maintenance holes or chambers may be founded on engineered fill placed on an undisturbed, clayey silt to silty clay or sandy silt to silty sand bearing surface and can be designed using an allowable bearing pressure of **60 kPa**. Engineered fill under maintenance holes or chambers should consist of OPSS Granular A (crushed stone) or Granular B Type II material placed in maximum 300 mm thick layer and compacted to a minimum of 98% of its SPMDD.

7.4 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.

Generally, the flow of groundwater into the shallow trench excavations anticipated at this site should be relatively low and is expected to be controllable using properly sized pumps and sumps. However, in areas of saturated sand, the rate of groundwater inflow through the sides of the excavations will be high. At these locations, it is recommended that the groundwater level be lowered by pumping from filtered sumps located outside the excavations, by ditching around the perimeter of the affected area, and/or by other means prior to completing the excavations. In that manner, it is expected that the groundwater infiltrating the excavations will be controllable using properly sized pumps and sumps from within the excavations.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

7.5 Winter Construction

If winter construction is considered for this assignment, the following precautions must be taken.

The subsoil conditions at this site mostly 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 or insulated 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 sufficient soil cover is provided to prevent freezing at the subgrade level.

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place.

8.0 GEOTECHNICAL CONSIDERATIONS - DIAMONDVIEW ROAD

8.1 Introduction

Further to your request and authorization, Paterson Group (Paterson) conducted an assessment of the existing pavement structure of Diamondview Road from March Road extending approximately 800 m south of March by completed four (4) boreholes as illustrated in Drawing PG2450-3 - Test Hole Location Plan, included in Appendix 2.

The objectives of the assessment were to:

- ❑ determine the existing pavement structure and subgrade conditions at borehole locations
- ❑ assess the pavement structure condition
- ❑ prepare pavement rehabilitation options.

The following section presents a summary of our findings and our recommendations pertaining to the rehabilitation of the aforementioned roadway.

8.2 Surface Conditions

Generally, the pavement surface is in fair to poor condition with some cracking along the edge of the existing roadway. It is understood that the aforementioned section of the roadway was resurfaced with 25 mm of asphaltic concrete approximately 8 to 10 years ago.

8.3 Subsurface Conditions

Field Program

A total of four (4) boreholes were completed for this portion of roadway Paterson. The boreholes were advanced to depths of 2.9 m below the existing grade and were sampled at regular intervals to recover soil samples for further laboratory review and testing. Standpipe piezometers were installed in two (2) boreholes to measure stabilized water levels. All boreholes were backfilled and the pavement surface sealed with cold patch asphalt.

Pavement Structure

The subsurface conditions observed at the borehole locations were recorded in detail in the field. The soil profiles are logged in the Soil Profile and Test Data sheets accompanying this report. The borehole locations are shown on Drawing PG2450-3 - Test Hole Location appended to this report.

Generally, the subsoil conditions consist of a flexible asphaltic pavement structure with a granular crushed stone base layer overlying native in situ brown silty clay and/or silty sand.

A summary of the pavement structure and subgrade encountered at each borehole location is presented in Table 11.

Table 11
Summary of Pavement Structure Thickness

Borehole	Asphaltic Concrete (mm)	Base and Subbase (mm)	Subgrade Type
BH1-11	25	380	Brown silty clay with sand
BH2-11	25	460	Brown silty clay with sand
BH3-11	25	330	Brown silty fine sand
BH4-11	25	380	Brown silty fine to medium sand
Average	**25**	**388**	

8.4 Recommendations

The section of Diamondview Road from March Road to approximately 800 m south of the intersection March Road and Diamondview Road was observed to be in fair to good condition with areas of deteriorated asphaltic concrete along the edges of the existing roadway. The two (2) options for preliminary discussion are provided for potential pavement rehabilitation.

Option A: Complete Reconstruction

The complete reconstruction of the existing pavement structure is only recommended if a pavement service life expectancy greater than 20 years is required. This option will consist of the removal and disposal of the existing asphaltic concrete and existing subgrade to 690 mm to accommodate the proposed new heavy duty pavement structure as described in the following table.

Table 12 - Recommended Pavement Structure - Diamondview Road	
Thickness (mm)	**Material Description**
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils, acceptable fill or OPSS Granular B Type I or II material placed over in situ soil.	

Option B: Pulverization

Pulverization of the existing pavement structure is recommended if a pavement service life expectancy of approximately 15 years is acceptable. This option will consist of pulverization of the existing asphaltic concrete and scarifying pulverized asphalt with underlying granular material, adding a further 150 mm of OPSS Granular A and resurfacing with heavy duty pavement structure as described in the following table:

Table 13 - Pulverization Pavement Structure - Diamondview Road	
Thickness (mm)	**Material Description**
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
BASE - Pulverized asphaltic concrete and existing granular material re-shaped to promote adequate surface drainage and compact the granular base to 98% of the material's SPMDD	

9.0 GEOTECHNICAL CONSIDERATIONS - RUSS BRADLEY AND HUISSON ROAD

9.1 Introduction

Further to your request and authorization, Paterson Group (Paterson) conducted an assessment of the pavement structure of Russ Bradley Road and the granular base and subbase of Huisson Road by completed six (6) boreholes as illustrated in Drawing PG2450-3 - Test Hole Location Plan, included in Appendix 2.

The objectives of the assessment were to:

- ❑ determine the existing pavement structure and subgrade conditions at borehole locations
- ❑ assess the pavement structure condition
- ❑ prepare pavement rehabilitation options and associated costs.

The following section presents a summary of our findings and our recommendations pertaining to the rehabilitation of the aforementioned roadway.

9.2 Surface Conditions

Generally, the pavement surface on Russ Bradley Road was observed to be in good condition with some traverse cracking of the existing roadway. The existing surface of Huisson Road consists of granular crushed stone and/or brown silty sand with crushed stone varying in thickness between 560 to 610 mm.

9.3 Subsurface Conditions

Field Program

A total of six (6) boreholes were completed for this section of roadway Paterson. The boreholes were advanced to depths of 2.9 m below the existing grade and were sampled at regular intervals to recover soil samples for further laboratory review and testing. Standpipe piezometers were installed in two (2) boreholes to measure stabilized water levels. All boreholes were backfilled and the pavement surface sealed with cold patch asphalt.

Pavement Structure

The subsurface conditions observed at the borehole locations were recorded in detail in the field. The soil profiles are logged in the Soil Profile and Test Data sheets accompanying this report. The borehole locations are shown on Drawing PG2450-3 - Test Hole Location appended to this report.

Generally, the subsoil conditions of Russ Bradley Road consist of a flexible asphaltic pavement structure with a granular crushed stone and/or brown silty sand with crushed stone base layer overlying native in situ brown silty clay and/or silty sand. Huisson Road consisted of a granular crushed stone and/or brown silty sand with crushed stone overlying in situ redish brown to brown silty find sand.

A summary of the pavement structure and subgrade encountered at each borehole location is presented in Table 14. The base layer consist mainly of crushed stone to silty sand with crushed stone.

Table 14
Summary of Pavement Structure Thickness

Borehole	Asphaltic Concrete (mm)	Base and Subbase (mm)	Subgrade Type
BH26-11	25	580	Brown silty clay / silty sand
BH27-11	25	580	Brown silty fine sand trace clay
BH28-11	25	430	Brown silty fine sand
BH29-11	none	610	Brown silty find sand trace clay
BH30-11	none	610	Redish brown silty find sand
BH31-11	none	560	Redish brown silty fine sand
Average	**25**	**562**	

9.4 Recommendations

Russ Bradley Road and Huisson Road was observed to be in good condition with some transverse cracking on Russ Bradley Road. The base materials and thickness observed during our field investigation was satisfactory. The following option is for preliminary discussion are provided for potential pavement rehabilitation.

Pulverization

Pulverization of the existing pavement structure is recommended if a pavement service life expectancy of approximately 15 to 20 years is acceptable. This will consist of pulverization of the existing asphaltic concrete on Russ Bradley Road and scarifying pulverized asphalt with underlying granular material and resurfacing with a heavy duty pavement structure as described in the following table.

Table 15 - Pulverization Pavement Structure - Russ Bradley Road and Huisson Road

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
BASE - Pulverized asphaltic concrete and existing granular material re-shaped to promote adequate surface drainage and compact the granular base to 98% of the material's SPMDD	

10.0 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 prior to finalizing grades.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and granular 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 asphaltic 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.

11.0 STATEMENT OF LIMITATIONS

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

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 immediate notification 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 Novatech Engineering Consultants, West Capital Developments or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Richard Groniger, C.Tech.

Carlos P. Da Silva, P.Eng.

Report Distribution:

- ❑ West Capital Developments (4 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

GRAIN SIZE ANALYSIS

UNIDIMENSIONAL CONSOLIDATION TESTING SHEETS

ATTERBERG LIMITS' TESTING RESULTS

ANALYTICAL TEST RESULTS

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 1-11

BORINGS BY CME 55 Power Auger **DATE** 18 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	114.03		
25mm Asphaltic concrete over crushed stone 0.15									
FILL: Crushed stone, trace sand 0.36		AU	1						
		SS	2	67	14	1	113.03		
Very stiff to firm, brown **SILTY CLAY** with sand		SS	3	75	6	2	112.03		
		SS	4	100	W				
2.97									
End of Borehole									
(BH dry - Sept. 21/11)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 2-11

BORINGS BY CME 55 Power Auger **DATE** 18 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	115.14
25mm Asphaltic concerete over crushed stone (to 0.48)		AU	1				
Brown **SILTY CLAY** with sand (to 1.45)		SS	2	92	4	1	114.14
Loose to very loose, brown **SILTY SAND** with clay - grey with trace clay by 2.2m depth (to 2.97)		SS	3	83	5	2	113.14
		SS	4	0	W		
Grey **CLAYEY SILT** to **SILTY CLAY** (to 3.73)		SS	5	100	W	3	112.14
End of Borehole (GWL @ 1.5m depth based on field observations)							

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

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 3-11

BORINGS BY CME 55 Power Auger **DATE** 18 August 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	116.29
25mm Asphaltic concrete over crushed stone	0.36	AU	1				
Compact, brown **SILTY** fine to medium **SAND**	1.45	SS	2	50	19	1	115.29
Compact, grey **SANDY SILT**	1.98	SS	3	67	11	2	114.29
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	2.97	SS	4	100	1		
End of Borehole							
(GWL @ 1.56m-Sept. 21/11)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 4-11

BORINGS BY CME 55 Power Auger

DATE 18 August 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	117.28
Asphaltic concrete	0.05						
FILL: Crushed stone	0.18						
FILL: Crushed stone with sand	0.41						
Compact, brown **SILTY** fine to medium **SAND** - grey by 1.4m depth		SS	1	67	21	1	116.28
		SS	2	50	11	2	115.28
	2.97	SS	3	67	19		
End of Borehole (GWL @ 1.5m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 5-11

BORINGS BY CME 55 Power Auger

DATE 21 September 2011

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	115.67
TOPSOIL	0.15	AU	1				
compact, brown **SILTY** fine to medium **SAND**	1.45	SS	2	25	18	1	114.67
Firm, grey **CLAYEY SILT** to **SILTY CLAY** with sand	2.97	SS	3	42	2	2	113.67
		SS	4	67	5		
Loose, grey **SANDY SILT**	3.73	SS	5	21	7	3	112.67
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	5.18	SS	6	75	2	4	111.67
		SS	7	83	2	5	110.67
End of Borehole							
(Piezometer blocked - Sept. 27/11)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 6-11

BORINGS BY CME 55 Power Auger **DATE** 21 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	115.88		
TOPSOIL 0.15									
Compact brown **SILTY FINE SAND** 0.45		AU	1						
Compact, brown **SILTY SAND** with clay 1.45		SS	2	50	12	1	114.88		
Firm, grey **CLAYEY SILT** to **SILTY CLAY,** trace sand 3.73		SS	3	75	7	2	113.88		
		SS	4	25	5				∇
		SS	5	42	6	3	112.88		
Firm, grey **SILTY CLAY** 4.50		SS	6	42	5	4	111.88		
Firm, grey **CLAYEY SILT** to **SILTY CLAY** 5.18		SS	7	50	2	5	110.88		
End of Borehole									
(GWL @ 2.7m depth based on field observations)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers
28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 7-11

BORINGS BY CME 55 Power Auger

DATE 21 September 2011

SOIL DESCRIPTION	Bottom depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	115.07
TOPSOIL	0.15						
Compact, red-brown **SILTY SAND**	0.60	AU	1				
Very stiff, brown **SILTY CLAY** with sand	2.21	SS	2	67	15	1	114.07
		SS	3	58	11	2	113.07
Compact, brown **SILTY SAND,** some clay	2.97	SS	4	67	30		
Compact, grey **CLAYEY SILT,** some sand	3.73	SS	5	58	8	3	112.07
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	5.18	SS	6	83	2	4	111.07
		SS	7	100	P	5	110.07
End of Borehole							

(GWL @ 3.18m-Sept. 27/11)

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

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 8-11

BORINGS BY CME 55 Power Auger **DATE** 20 September 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	114.57
TOPSOIL	0.15						
Loose, red-brown **SILTY SAND**	0.60	AU	1				
Stiff, brown **SILTY CLAY** with sand	3.35	SS	2	67	9	1	113.57
		SS	3	0	4	2	112.57
		SS	4	75	4	3	111.57
Firm, grey **CLAYEY SILT** to **SILTY CLAY,** some sand	5.18	SS	5	67	4	4	110.57
		SS	6	83	3	5	109.57
		SS	7	83	1		
End of Borehole							
(GWL @ 2.98m-Sept. 27/11)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH 9-11

BORINGS BY CME 55 Power Auger **DATE** 19 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	116.24
TOPSOIL 0.25		AU	1				
Compact, red-brown **SILTY** fine to medium **SAND** - brown by 1.2m depth 1.45		SS	2	50	19	1	115.24
Compact to loose, grey **SILTY FINE SAND** to **SANDY SILT** 4.50		SS	3	58	14	2	114.24
		SS	4	0	16	3	113.24
		SS	5	33	14	4	112.24
		SS	6	33	5		
Firm, grey **CLAYEY SILT** to **SILTY CLAY** 5.18		SS	7	67	3	5	111.24
End of Borehole (GWL @ 4.28m-Sept. 27/11)							

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

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

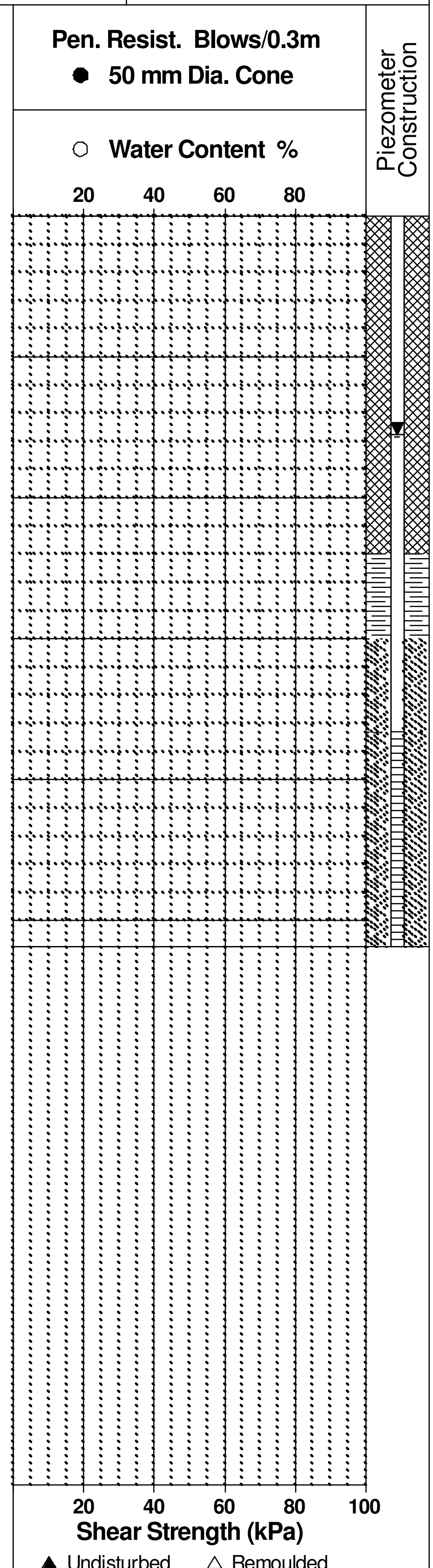
HOLE NO. BH10-11

BORINGS BY CME 55 Power Auger

DATE 16 September 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20	AU	1		
Compact, red-brown **SILTY** fine to medium **SAND** - brown by 0.6m depth	2.21	SS	2	0	11
		SS	3	25	2
Compact, grey **SILTY FINE SAND**	3.73	SS	4	50	24
		SS	5	58	20
Compact, grey **SANDY SILT**	4.72	SS	6	42	13
Grey **SANDY SILT** to **CLAYEY SILT**	5.18	SS	7	50	12
End of Borehole					
(GWL @ 1.55m-Sept. 27/11)					

DEPTH (m)	ELEV. (m)
0	116.94
1	115.94
2	114.94
3	113.94
4	112.94
5	111.94



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH11-11

BORINGS BY CME 55 Power Auger

DATE 16 September 2011

SOIL DESCRIPTION	Depth of base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	115.73
TOPSOIL	0.25	AU	1				
Compact, red-brown **SILTY** fine to medium **SAND**	0.60						
Compact, brown **SILTY FINE SAND** with clay	2.51	SS	2	75	23	1	114.73
		SS	3	75	15	2	113.73
Stiff, grey **CLAYEY SILT** with sand	3.73	SS	4	33	13		
		SS	5	50	5	3	112.73
Firm, grey **CLAYEY SILT** to **SILTY CLAY,** trace sand	5.18	SS	6	67	6	4	111.73
		SS	7	100	2	5	110.73

End of Borehole

(GWL @ 2.4m depth based on field observations)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup
Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH12-11

BORINGS BY CME 55 Power Auger

DATE 16 September 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	115.18
TOPSOIL	0.15	AU	1				
Loose, red-brown **SILTY** fine to medium **SAND**	0.60						
Very stiff to stiff, brown **SILTY CLAY** with sand	2.21	SS	2	58	8	1	114.18
		SS	3	0	5	2	113.18
Loose, grey **CLAYEY SILT**	2.98	SS	4	17	2		
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	5.18	SS	5	33	4	3	112.18
		SS	6	75	1	4	111.18
		SS	7	75	3	5	110.18
End of Borehole							
(GWL @ 2.63m-Sept. 27/11)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH13-11

BORINGS BY CME 55 Power Auger

DATE 16 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	115.98		
TOPSOIL 0.20		AU	1						
Compact, red-brown **SILTY** fine to medium **SAND** 0.60									
Compact, brown **SILTY FINE SAND,** trace clay 0.91									
Compact, grey **CLAYEY SILT** with sand		SS	2	42	20	1	114.98		
		SS	3	67	22	2	113.98		
		SS	4	58	6	3	112.98		∇
3.65		SS	5	33	9				
Firm, grey **CLAYEY SILT** to **SILTY CLAY**		SS	6	17	4	4	111.98		
5.18		SS	7	25	2	5	110.98		
End of Borehole (GWL @ 3.0m depth based on field observations)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH14-11

BORINGS BY CME 55 Power Auger

DATE 15 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	116.96		
TOPSOIL 0.20									
Compact, red-brown **SILTY** fine to medium **SAND**		SS	1	8	12				
- brown by 0.6m depth		SS	2	50	20	1	115.96		∇
- grey by 1.4m depth		SS	3	50	27	2	114.96		
2.21									
Compact, grey **CLAYEY SILT,** trace sand		SS	4	58	15				
2.97						3	113.96		
Compact, grey **CLAYEY SILT** to **SANDY SILT**		SS	5	50	20				
		SS	6	50	15	4	112.96		
		SS	7	42	18	5	111.96		
5.18									
End of Borehole									
(GWL @ 1.2m depth based on field observations)									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH15-11

BORINGS BY CME 55 Power Auger

DATE 15 September 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	116.34
TOPSOIL	0.15						
Loose, red-brown **SILTY** fine to medium **SAND**	0.60	SS	1	0	6		
Compact, grey **CLAYEY SILT,** trace sand	3.73	SS	2	42	8	1	115.34
		SS	3	50	14	2	114.34
		SS	4	50	13	3	113.34
		SS	5	58	12		
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	5.18	SS	6	83	4	4	112.34
		SS	7	100	4	5	111.34
End of Borehole							
(GWL @ 0.9m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

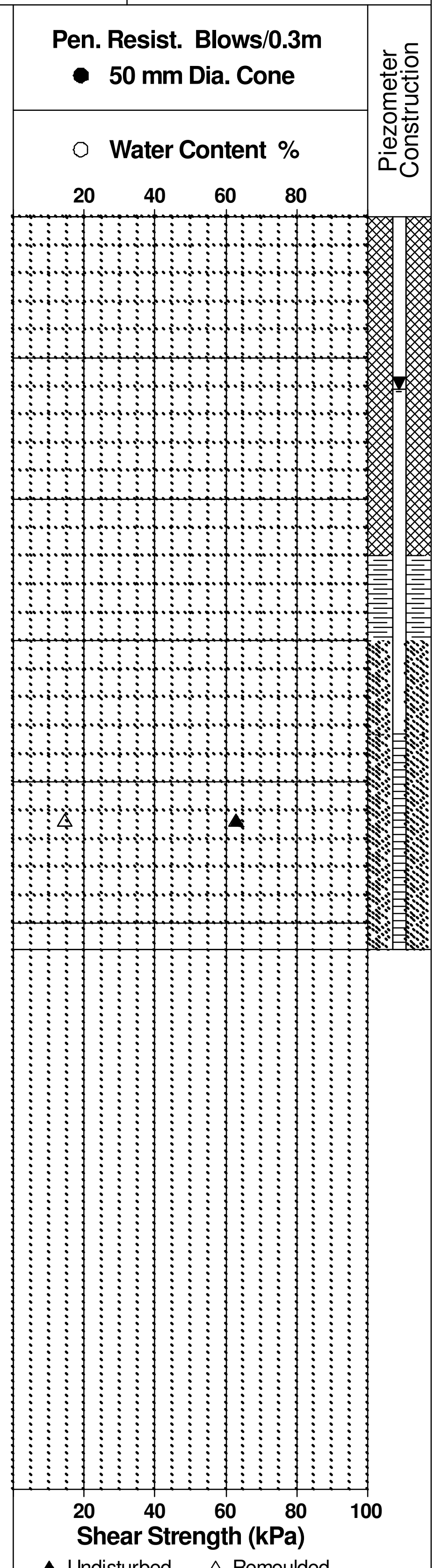
HOLE NO. BH16-11

BORINGS BY CME 55 Power Auger **DATE** 15 September 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	116.02
TOPSOIL	0.15						
Loose, red-brown **SILTY FINE SAND**	0.60	SS	1		7		
Compact, grey **CLAYEY SILT,** trace sand and seashells	2.21	SS	2	33	14	1	115.02
		SS	3	58	10	2	114.02
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	4.49	SS	4	33	4	3	113.02
		SS	5	67	2	4	112.02
Loose, grey **CLAYEY SILT,** trace sand	5.18	SS	6	83	4	5	111.02

End of Borehole

(GWL @ 1.22m-Sept. 27/11)



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH17-11

BORINGS BY CME 55 Power Auger

DATE 21 September 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	112.24
TOPSOIL	0.15						
Brown **SILTY FINE SAND**, trace clay	0.46	AU	1				
Very stiff to stiff, brown **SILTY CLAY**, some sand - firm and grey by 3.4m depth	5.86	SS	2	75	7	1	111.24
		SS	3	83	1	2	110.24
		SS	4	83	2	3	109.24
		SS	5	92	3	4	108.24
		SS	6	100	P	5	107.24
		SS	7	100	P		
		SS	8	100	P	6	106.24
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	8.23	SS	9	92	P	7	105.24
		SS	10	83	P	8	104.24
		SS	11	100	P		
End of Borehole (GWL @ 1.2m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH18-11

BORINGS BY CME 55 Power Auger **DATE** 20 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	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	111.04		
TOPSOIL (0.15)									
Loose, red-brown **SILTY FINE SAND,** trace clay (0.60)		AU	1						
		SS	2	83	4	1	110.04		
Stiff, brown **SILTY CLAY,** some sand - firm and grey by 2.2m depth		SS	3	83	3	2	109.04		
		SS	4	50	2				
		SS	5	79	1	3	108.04		
		SS	6	92	P	4	107.04		
(5.26)		SS	7	92	P	5	106.04		
		SS	8	92	P				
Firm, grey **CLAYEY SILT** to **SILTY CLAY**		SS	9	83	P	6	105.04		
		SS	10	83	P	7	104.04		
(8.23)		SS	11	100	P	8	103.04		
End of Borehole									

Pen. Resist. / Water Content axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH19-11

BORINGS BY CME 55 Power Auger

DATE 21 September 2011

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	113.32
TOPSOIL	0.15						
Loose, brown SILTY FINE SAND	0.46	AU	1				
Very stiff to stiff, brown SILTY CLAY, trace sand - firm and grey by 3.0m depth		SS	2	50	7	1	112.32
		SS	3	100	4	2	111.32
		SS	4	50	4		
		SS	5	25	1	3	110.32
		SS	6	67	P	4	109.32
		SS	7	75	P	5	108.32
End of Borehole	5.18						
(GWL @ 1.79m-Sept. 27/11)							

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

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH20-11

BORINGS BY CME 55 Power Auger

DATE 20 September 2011

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	113.22
TOPSOIL (to 0.15)	AU	1				
Loose, red-brown **SILTY FINE SAND** (to 0.60)						
	SS	2	8	9	1	112.22
	SS	3	92	3	2	111.22
Very stiff to stiff, brown **SILTY CLAY,** some sand	SS	4	83	2		
- fimr and grey by 3.0m depth					3	110.22
	SS	5	83	1		
	SS	6	83	1	4	109.22
	SS	7	83	P	5	108.22
(to 5.18) End of Borehole						
(GWL @ 3.0m depth based on field observations)						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 19 September 2011

FILE NO. PG2450

HOLE NO. BH22-11

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	111.88
TOPSOIL	0.20	AU	1				
Compact to loose, brown **SILTY FINE SAND**		SS	2	8	16	1	110.88
	2.13	SS	3	8	7	2	109.88
Stiff, brown **SILTY CLAY** with sand	2.97	SS	4	0	4		
Firm, grey **CLAYEY SILT** to **SILTY CLAY**		SS	5	75	3	3	108.88
		SS	6	0	3	4	107.88
		SS	7	92	1	5	106.88
		SS	8	92	1		
	6.70	SS	9	100	P	6	105.88
End of Borehole							

(GWL @ 3.88m-Sept. 27/11)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH23-11

BORINGS BY CME 55 Power Auger **DATE** 19 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	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	111.75		
TOPSOIL 0.20									
Compact to loose, brown **SILTY FINE SAND,** trace clay		AU	1						
		SS	2	8	13	1	110.75		
		SS	3	8	4				
2.21						2	109.75		
Stiff, brown **SILTY CLAY,** trace clay		SS	4	25	2				
- firm and grey by 3.0m depth						3	108.75		∇
		SS	5	83	2				
3.73									
Firm, grey **CLAYEY SILT** to **SILTY CLAY**		SS	6	75	1	4	107.75		
		SS	7	17	1	5	106.75		
		SS	8	83	P				
						6	105.75		
		SS	9	67	P				
6.70									
End of Borehole									
(GWL @ 3.0m depth based on field observations)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. **PG2450**

REMARKS

HOLE NO. **BH24-11**

BORINGS BY CME 55 Power Auger

DATE 20 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	112.03
TOPSOIL 0.15		AU	1				
Stiff, brown **SILTY CLAY** with sand		SS	2	12	7	1	111.03
		SS	3	8	4	2	110.03
2.21							
Firm, grey **CLAYEY SILT** to **SILTY CLAY**		SS	4	75	2		
		SS	5	100	W	3	109.03
		SS	6	83	W	4	108.03
		SS	7	75	1	5	107.03
		SS	8	50	W	6	106.03
		SS	9	50	W		
6.70							
End of Borehole (GWL @ 2.4m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ **Water Content %**

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 20 September 2011

FILE NO. PG2450

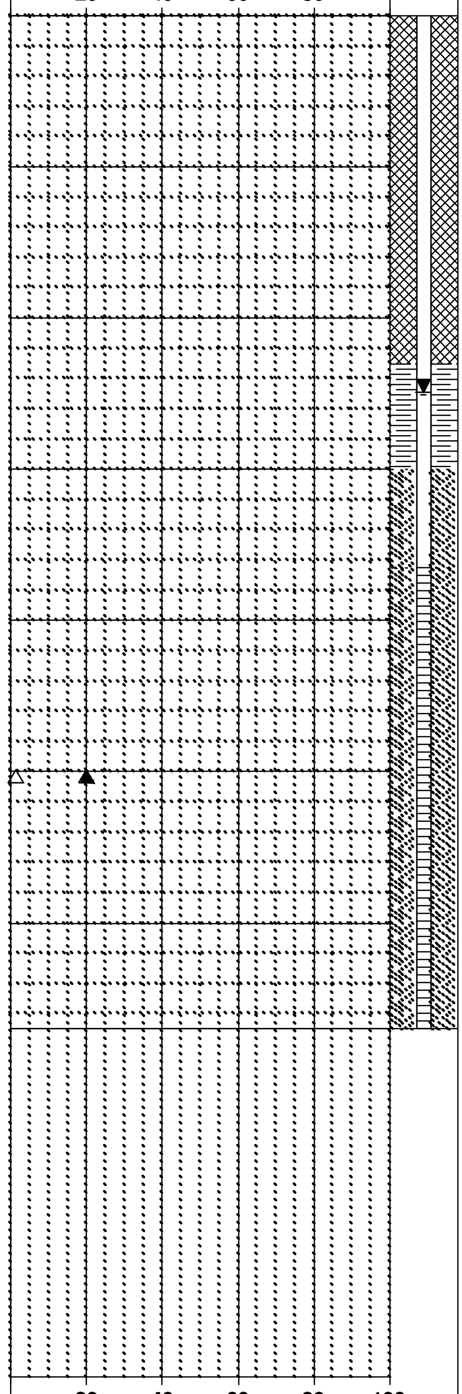
HOLE NO. BH25-11

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.20
Loose, brown **SILTY FINE SAND**	1.45
Stiff, brown **SILTY CLAY** with sand - firm and grey by 2.2m depth	2.97
Firm, grey **CLAYEY SILT** to **SILTY CLAY**	6.70
End of Borehole (GWL @ 2.49m-Sept. 27/11)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	12	5
SS	3	50	2
SS	4	75	1
SS	5	83	W
SS	6	83	W
SS	7	83	P
SS	8	83	P

DEPTH (m)	ELEV. (m)
0	112.02
1	111.02
2	110.02
3	109.02
4	108.02
5	107.02
6	106.02

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH26-11

BORINGS BY CME 55 Power Auger **DATE** 19 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	113.14
25mm Asphaltic concrete **FILL:** Crushed stone — 0.60		AU	1				
FILL: Brown silty sand, trace crushed stone — 1.22		SS	2	50	9	1	112.14
FILL: Brown silty clay, trace sand and organics — 1.45							
Compact, brown **SILTY SAND,** some clay - grey and fine by 2.2m depth — 2.97		SS	3	42	10	2	111.14
		SS	4	50	13		
End of Borehole (GWL @ 1.8m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH27-11

BORINGS BY CME 55 Power Auger **DATE** 19 August 2011

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	112.83
25mm Asphaltic concrete over crushed stone with some sand (to 0.60)	AU	1				
Loose to compact, brown **SILTY FINE SAND** - trace clay from 0.6 to 1.4m depth - grey by 2.2m depth (to 2.97)	SS	2	58	9	1	111.83
	SS	3	42	19	2	110.83
	SS	4	50			
End of Borehole (GWL @ 2.53m-Sept. 21/11)						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH28-11

BORINGS BY CME 55 Power Auger **DATE** 19 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	113.49		
25mm Asphaltic concrete over brown silty sand with crushed stone 0.46		AU	1						
Compact, brown **SILTY FINE SAND**		SS	2	58	15	1	112.49		
		SS	3	67	23	2	111.49		▽
- grey by 2.2m depth 2.90		SS	4	58	11				
End of Borehole (GWL @ 2.1m depth based on field observations)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH29-11

BORINGS BY CME 55 Power Auger **DATE** 19 August 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Crushed stone with silty sand	0.60	AU	1		
FILL: Brown silty sand, trace clay and gravel	1.22	SS	2	17	5
Compact, brown **SILTY FINE SAND** - trace clay from 1.2 to 2.2m depth - loose and grey by 2.2m depth	2.97	SS	3	67	11
		SS	4	50	7
End of Borehole (GWL @ 1.8m depth based on field observations)					

DEPTH (m)	ELEV. (m)
0	112.93
1	111.93
2	110.93

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

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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH30-11

BORINGS BY CME 55 Power Auger **DATE** 19 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	112.00		
FILL: Crushed stone		AU	1						
0.60									
Compact, red-brown **SILTY FINE SAND**		SS	2	33	19	1	111.00		
- brown by 1.4m depth		SS	3	67	16				▽
- trace clay by 2.2m depth						2	110.00		
		SS	4	50	11				
2.97									
End of Borehole									
(GWL @ 1.8m depth based on field observations)									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH31-11

BORINGS BY CME 55 Power Auger

DATE 19 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	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	110.88		
FILL: Brown silty sand with crushed stone 0.56		AU	1						
Compact to loose, red-brown **SILTY FINE SAND** - brown with trace to some clay by 1.4m depth		SS	2	67	22	1	109.88		
		SS	3	75	15	2	108.88		
2.97		SS	4	75	4				
End of Borehole (GWL @ 2.48m-Sept. 21/11)									

Water Content %: 20 40 60 80

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

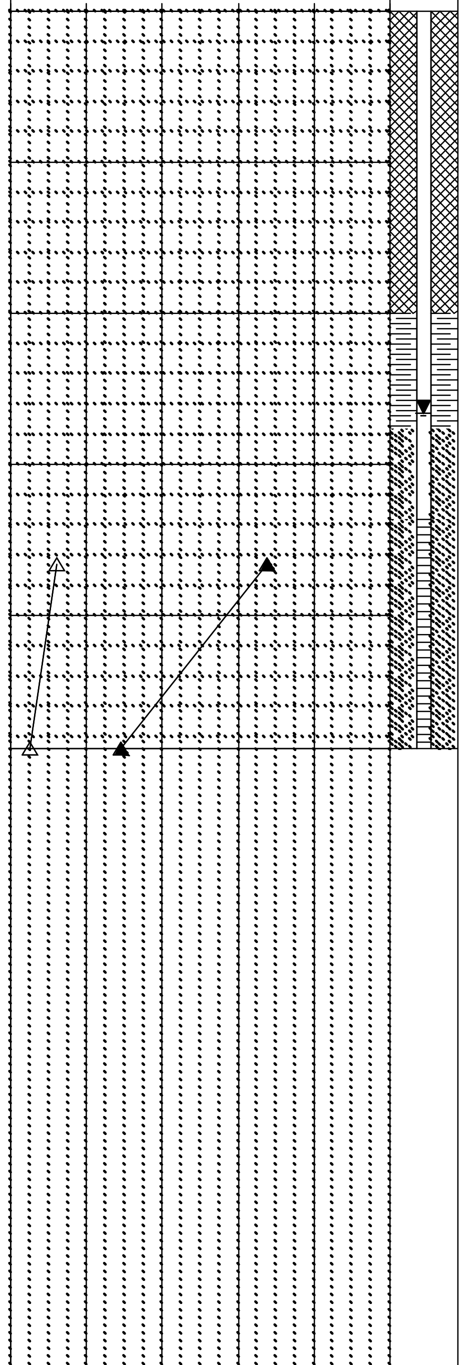
HOLE NO. BH32-11

BORINGS BY CME 55 Power Auger **DATE** 20 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	110.29
TOPSOIL 0.25		SS	1	83	14		
Stiff, brown **SILTY CLAY** with sand		SS	2	100	9	1	109.29
		SS	3	0	5	2	108.29
		SS	4	100	4		
						3	107.29
- firm and grey by 3.7m depth							
		SS	5	42	1	4	106.29
4.88							
End of Borehole							
(GWL @ 2.66m-Sept. 27/11)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup

Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH33-11

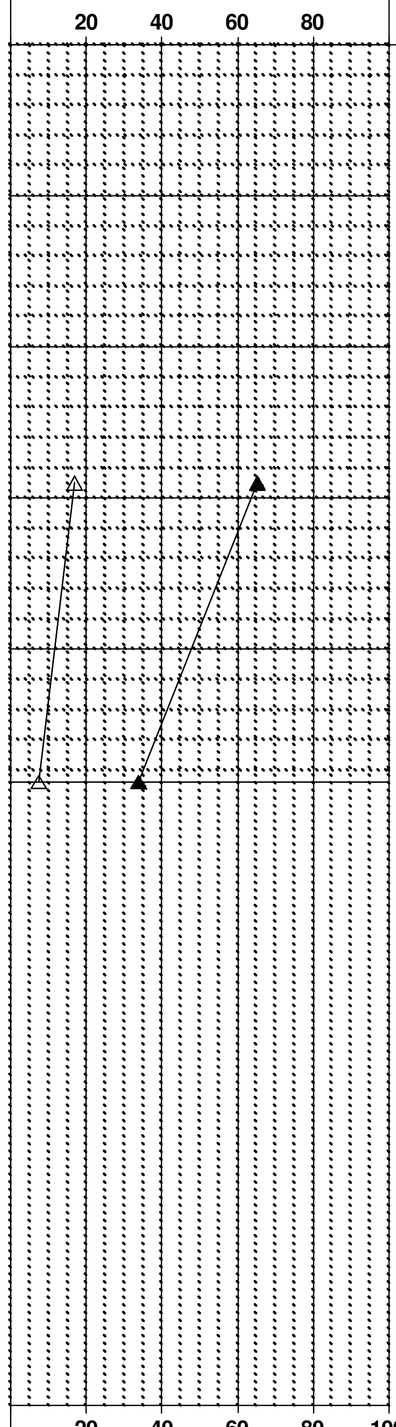
BORINGS BY CME 55 Power Auger

DATE 15 September 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.46
TOPSOIL (to 0.25)		SS	1	12	9		
		SS	2	50	9	1	107.46
Stiff, brown **SILTY CLAY,** some sand		SS	3	42	3	2	106.46
- firm and grey by 3.0m depth						3	105.46
		SS	4	50	4		
		SS	5	100	2	4	104.46
End of Borehole (at 4.88)							
(GWL @ 3.0m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

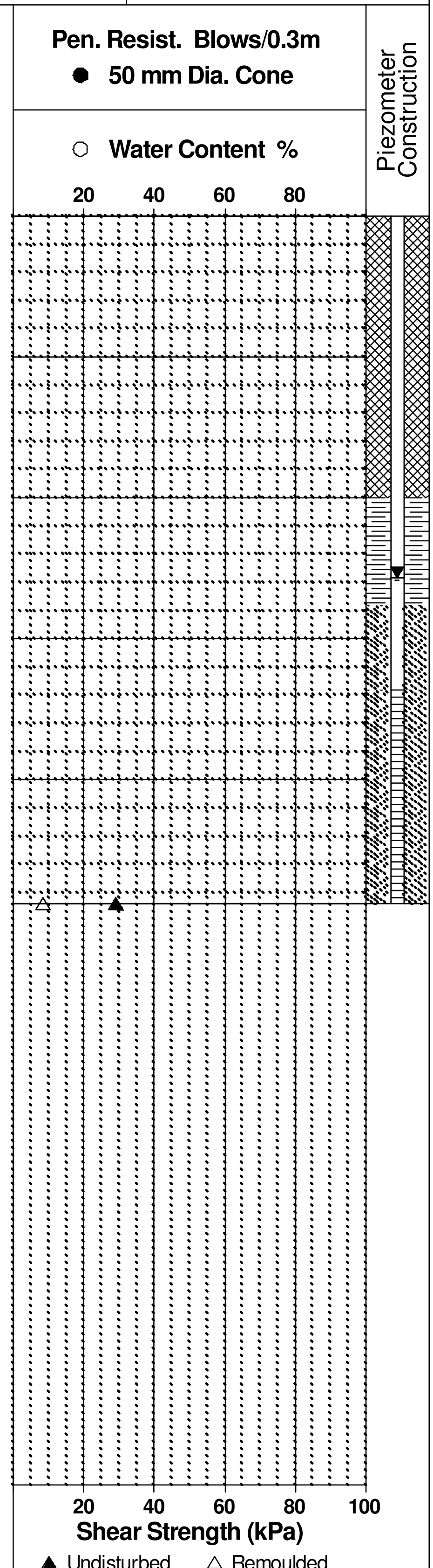
REMARKS

HOLE NO. BH34-11

BORINGS BY CME 55 Power Auger **DATE** 15 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.16
TOPSOIL (to 0.25)		SS	1	42	7		
Stiff, brown **SILTY CLAY,** some sand (0.25 – 3.65)		SS	2	25	5	1	104.16
		SS	3	42	6	2	103.16
		SS	4	58	7	3	102.16
		SS	5	25	4		
Firm, grey **SILTY CLAY** (3.65 – 4.88)		SS	6	100	1	4	101.16
End of Borehole (4.88)							

(GWL @ 2.57m-Sept. 27/11)



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

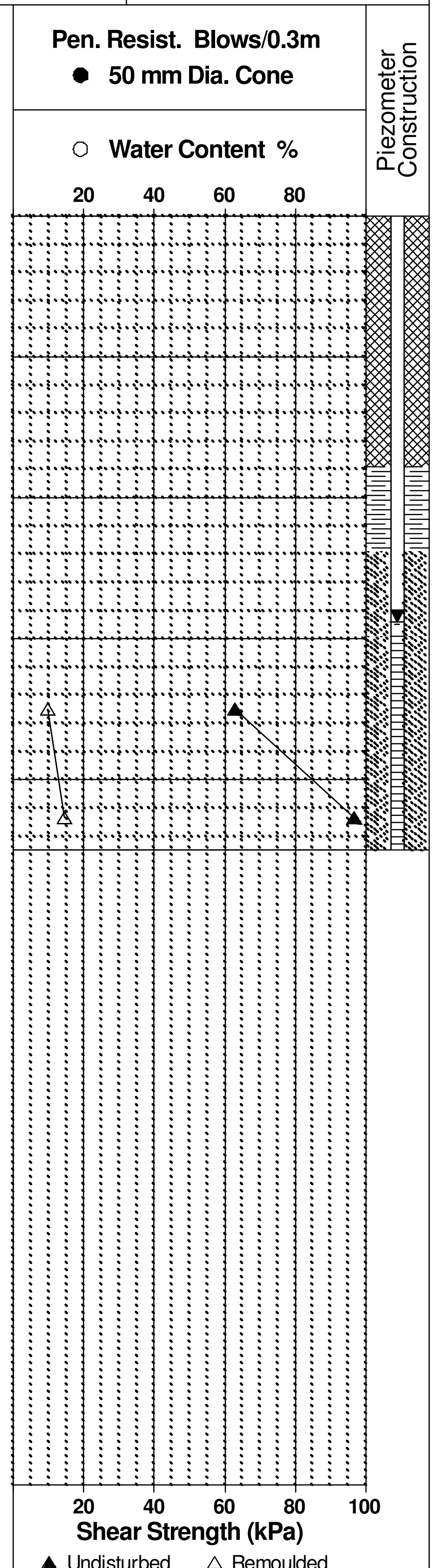
REMARKS

HOLE NO. BH35-11

BORINGS BY CME 55 Power Auger **DATE** 19 August 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.08				
FILL: Brown silty sand with crushed stone	0.59	AU	1		
FILL: Brown silty sand with crushed stone, trace clay	1.45	SS	2	25	20
Stiff, brown **SILTY CLAY,** trace sand - grey by 3.0m depth	4.50	SS	3	50	5
		SS	4	100	1
End of Borehole (GWL @ 2.88m-Sept. 21/11)					

DEPTH (m)	ELEV. (m)
0	100.78
1	99.78
2	98.78
3	97.78
4	96.78



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

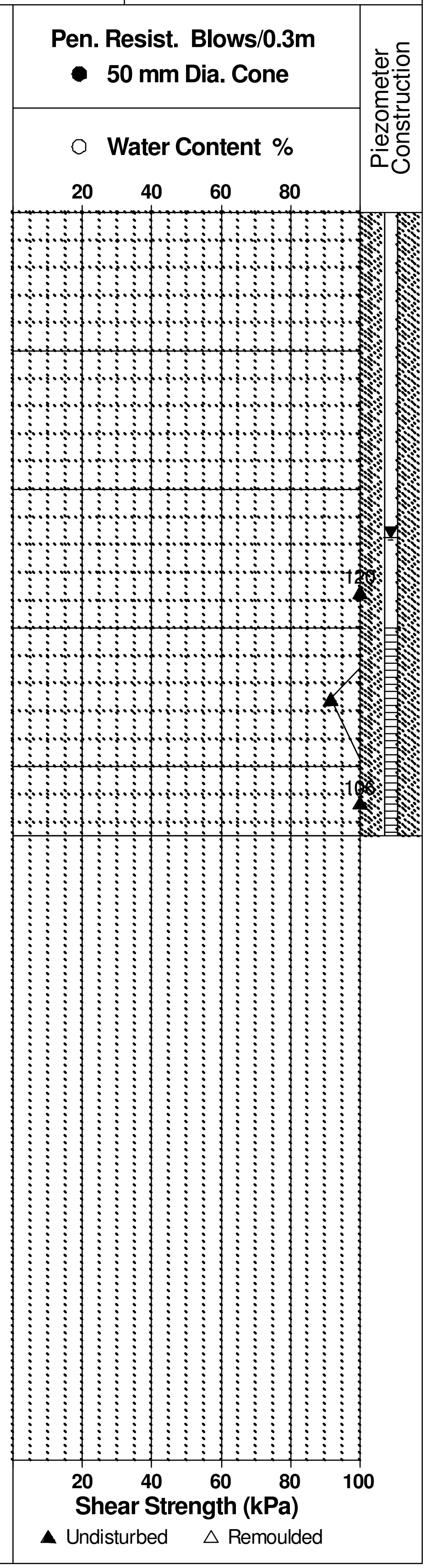
REMARKS

HOLE NO. BH36-11

BORINGS BY CME 55 Power Auger **DATE** 25 August 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.08				
FILL: Crushed stone	0.91	AU	1		
FILL: Brown silty sand, some gravel, trace clay	1.45	SS	2	17	9
Very stiff, brown **SILTY CLAY**	4.50	SS	3	42	3
End of Borehole					
(GWL @ 2.35m-Sept. 21/11)					

DEPTH (m)	ELEV. (m)
0	98.59
1	97.59
2	96.59
3	95.59
4	94.59



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. **PG2450**

REMARKS

HOLE NO. **BH37-11**

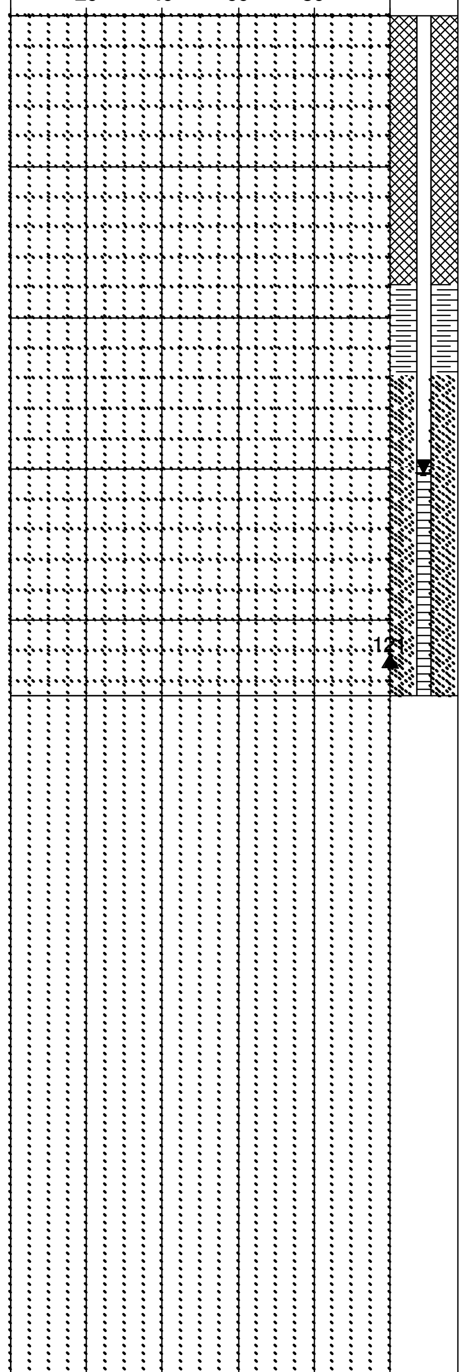
BORINGS BY CME 55 Power Auger **DATE** 18 August 2011

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	95.63
FILL: Crushed stone — 0.15						
FILL: Brown silty sand with crushed stone — 0.60	AU	1				
FILL: Brown silty clay with sand, trace gravel and organics	SS	2	42	10	1	94.63
— 1.45						
Very stiff to stiff, brown **SILTY CLAY**	SS	3	75	7	2	93.63
	SS	4	100	8		
	SS	5	100	7	3	92.63
					4	91.63
— 4.50						
End of Borehole						
(GWL @ 3.02m-Sept. 21/11)						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80



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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH38-11

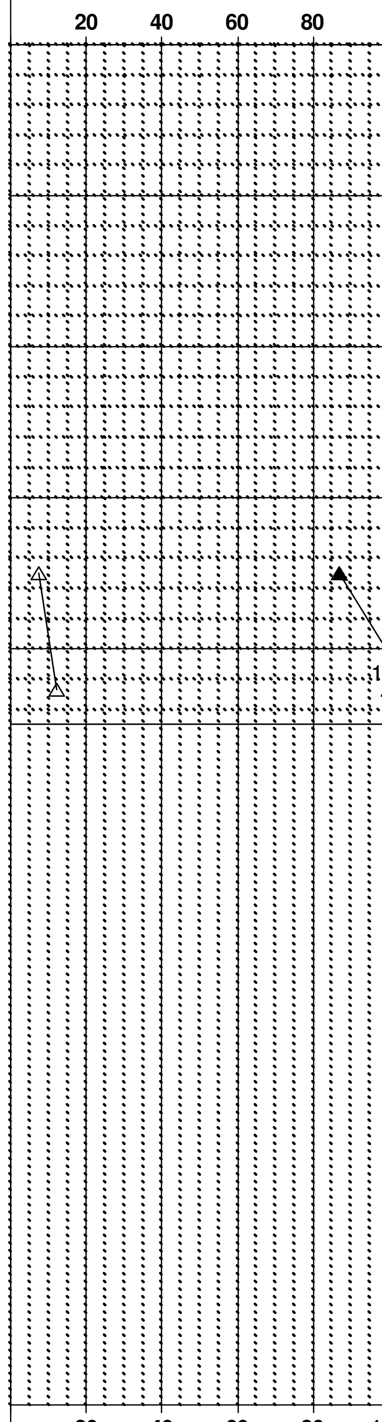
BORINGS BY CME 55 Power Auger **DATE** 18 August 2011

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.03
FILL: Crushed stone	0.20	AU	1				
TOPSOIL	0.36						
Very stiff to stiff, brown **SILTY CLAY**		SS	2	67	12	1	92.03
		SS	3	100	9	2	91.03
- grey by 3.0m depth		SS	4	100	3	3	90.03
	4.50					4	89.03
End of Borehole							
(GWL @ 2.4m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH39-11

BORINGS BY CME 55 Power Auger

DATE 18 August 2011

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.40
FILL: Crushed stone (to 0.15)							
FILL: Brown silty sand, some crushed stone (to 1.45)		SS	1	42	9	1	92.40
FILL: Brown silty sand, trace clay and crushed stone (to 2.21)		SS	2	17	8	2	91.40
FILL: Brown silty clay with sand, some topsoil, trace gravel (to 2.74)		SS	3	8	5		
Compact, grey **SILTY** fine to medium **SAND** - running sand encountered at 4.5m depth - high groundwater infiltration level observed at 4.5m depth (to 5.25)		SS	4	42	19	3	90.40
		SS	5	67	13	4	89.40
		SS	6	100	17	5	88.40
Dense, grey **SILTY** fine to coarse **SAND,** trace gravel (to 8.31)		SS	7	50	26	6	87.40
		SS	8	83	35		
		SS	9	100	41	7	86.40
		SS	10	100	45	8	85.40
End of Borehole (GWL @ 1.32m-Sept. 21/11)							

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

Piezometer Construction

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

patersongroup

Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

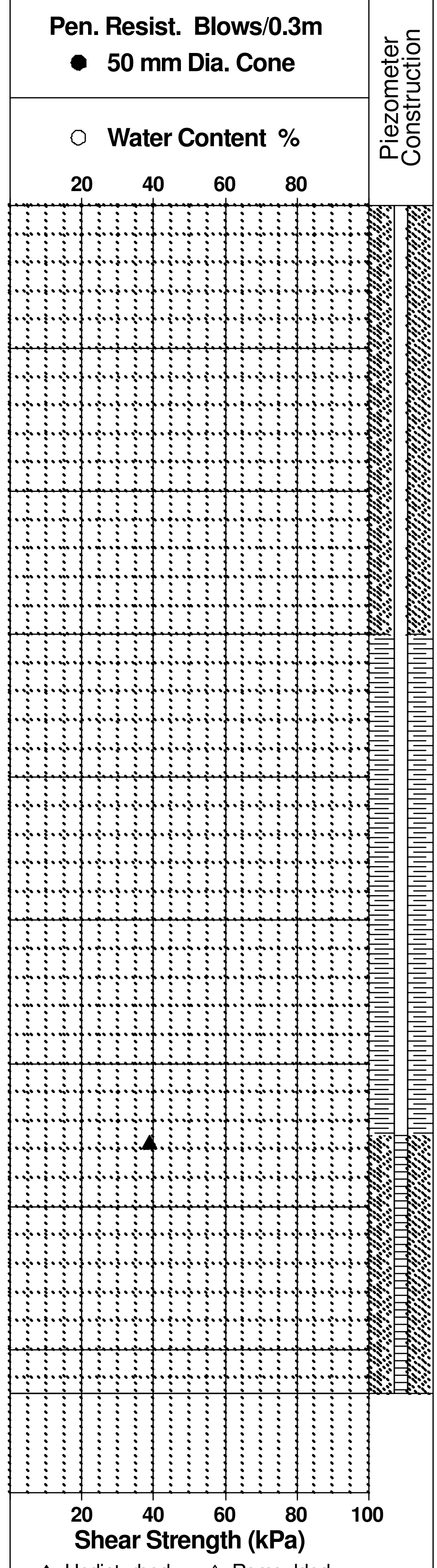
REMARKS

HOLE NO. BH40-11

BORINGS BY CME 55 Power Auger

DATE 25 August 2011

SOIL DESCRIPTION	Bottom depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.02
50mm Asphaltic concrete over crushed stone with silty sand	0.41	AU	1				
FILL: Brown silty sand with gravel, come clay		SS	2	42	9	1	92.02
		SS	3	25	5	2	91.02
	2.59						
PEAT		SS	4	4	1	3	90.02
		SS	5	50	4		
		SS	6	83	1	4	89.02
	5.03	SS	7	83	2	5	88.02
Firm, grey **SILTY CLAY**		SS	8	100	W	6	87.02
	6.78						
Grey **SILTY** fine to coarse **SAND** trace gravel - high groundwater infiltration level observed at 6.8m depth - running sand encountered at 6.8m depth		SS	9	83	1	7	86.02
	8.31	SS	10	67	6	8	85.02
End of Borehole (Piezometer damaged)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH41-13

BORINGS BY CME 55 Power Auger

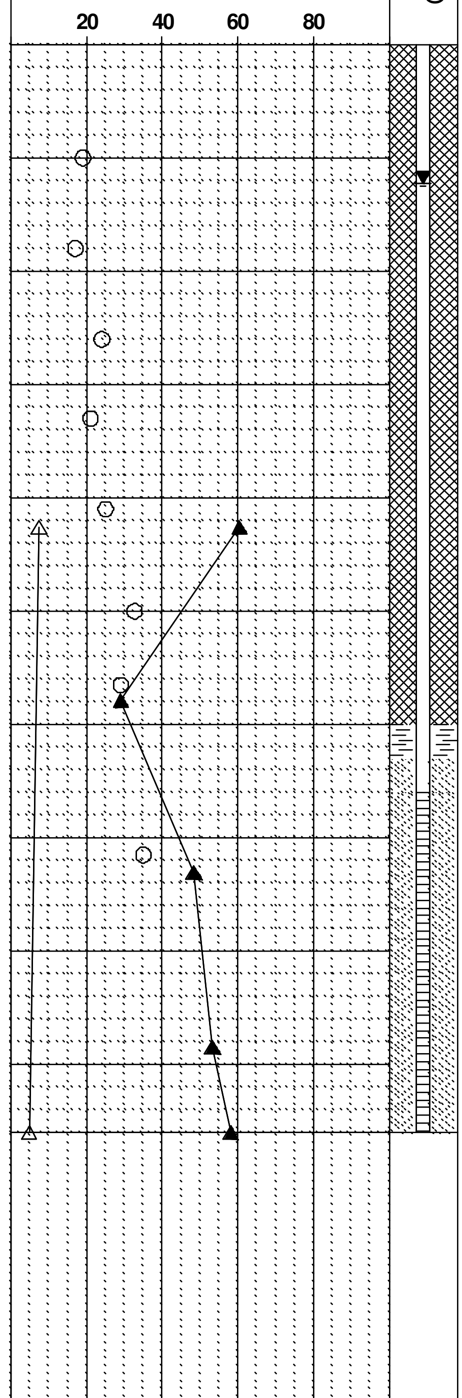
DATE June 25, 2013

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
UNDERSIDE OF FOOTING						0	116.13
TOPSOIL	0.30						
Brown **SILTY SAND**		SS	1	83	10	1	115.13
-grey by 1.45m depth	2.21	SS	2	100	9	2	114.13
Grey, **SILT** to **CLAYEY SILT**	2.97	SS	3	83	2	3	113.13
Grey **CLAYEY SILT** to **SILTY CLAY**, frequent silt / sand seams		SS	4	83	7	4	112.13
		TW	5	100		5	111.13
		TW	6	75		6	110.13
		TW	7	92		7	109.13
						8	108.13
	9.60					9	107.13
End of Borehole							
GWL @ 1.23m depth on July 3, 2013							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. **PG2450**

REMARKS

HOLE NO. **BH42-13**

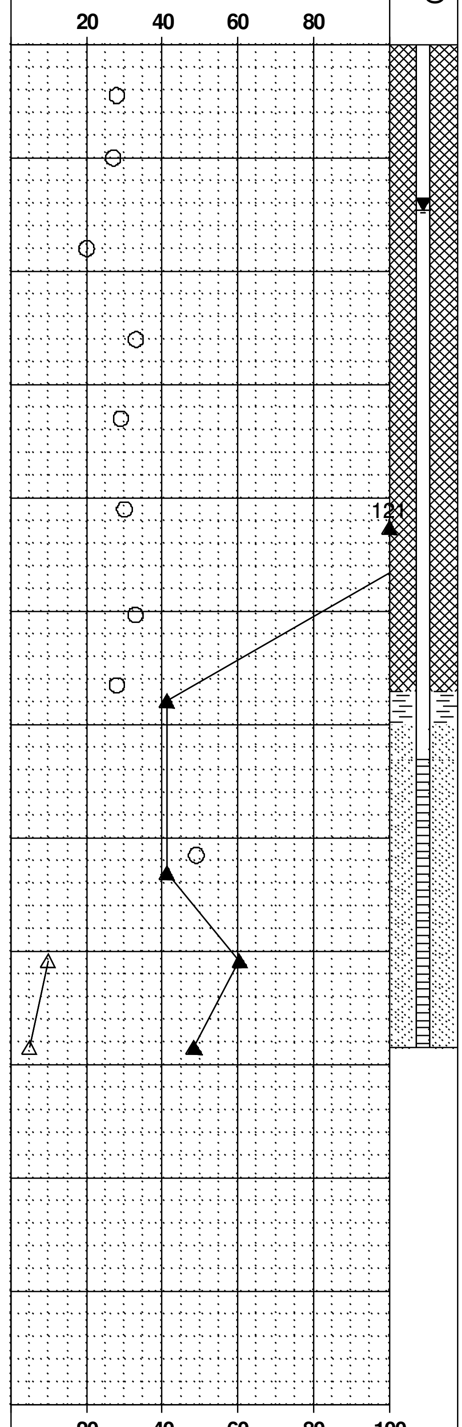
BORINGS BY CME 55 Power Auger **DATE** June 24, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
UNDERSIDE OF FOOTING						0	114.95
TOPSOIL 0.30							
Compact, brown **SILTY SAND** trace clay		AU	1				
		SS	2	83	10	1	113.95
2.21		SS	3	100	14	2	112.95
Grey **SILT** to **CLAYEY SILT** 2.97		SS	4	100	3		
Grey **CLAYEY SILT** to **SILTY CLAY**, frequent silt / sand seams		SS	5	100	W	3	111.95
						4	110.95
		TW	6	92		5	109.95
						6	108.95
		TW	7	100		7	107.95
8.84						8	106.95
Start of DCPT						9	105.95
Inferred grey **CLAYEY SILT** to **SILTY CLAY**						10	104.95
						11	103.95
						12	102.95

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ **Water Content %**

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotehnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

FILE NO. PG2450

REMARKS

HOLE NO. BH42-13

BORINGS BY CME 55 Power Auger

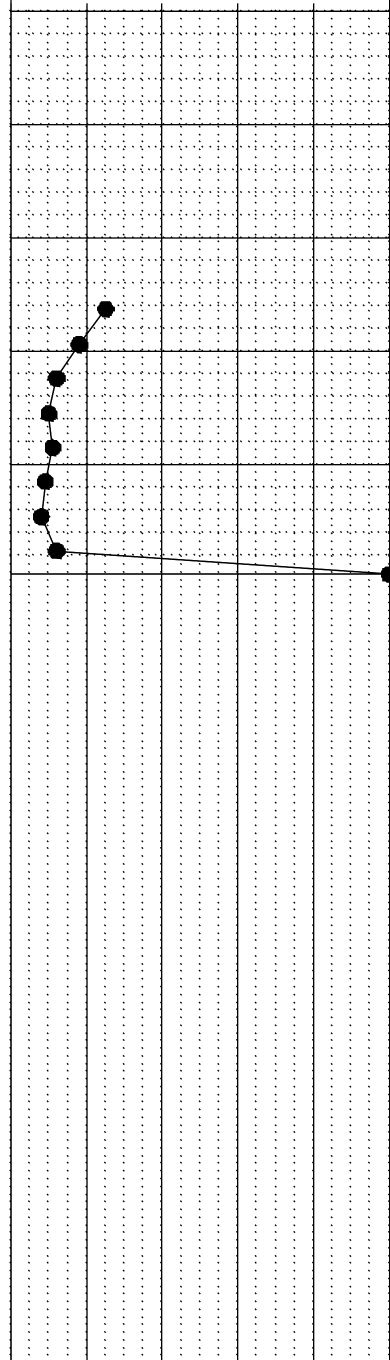
DATE June 24, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
UNDERSIDE OF FOOTING						12	102.95
Inferred grey **CLAYEY SILT** to **SILTY CLAY**						13	101.95
						14	100.95
						15	99.95
						16	98.95
16.97							
End of Borehole Practical refusal to DCPT @ 16.97m depth GWL @ 1.46m depth on July 3, 2013							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80



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

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Carp Airport Servicing and Residential Development
Ottawa, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

REMARKS

BORINGS BY CME 55 Power Auger **DATE** June 24, 2013

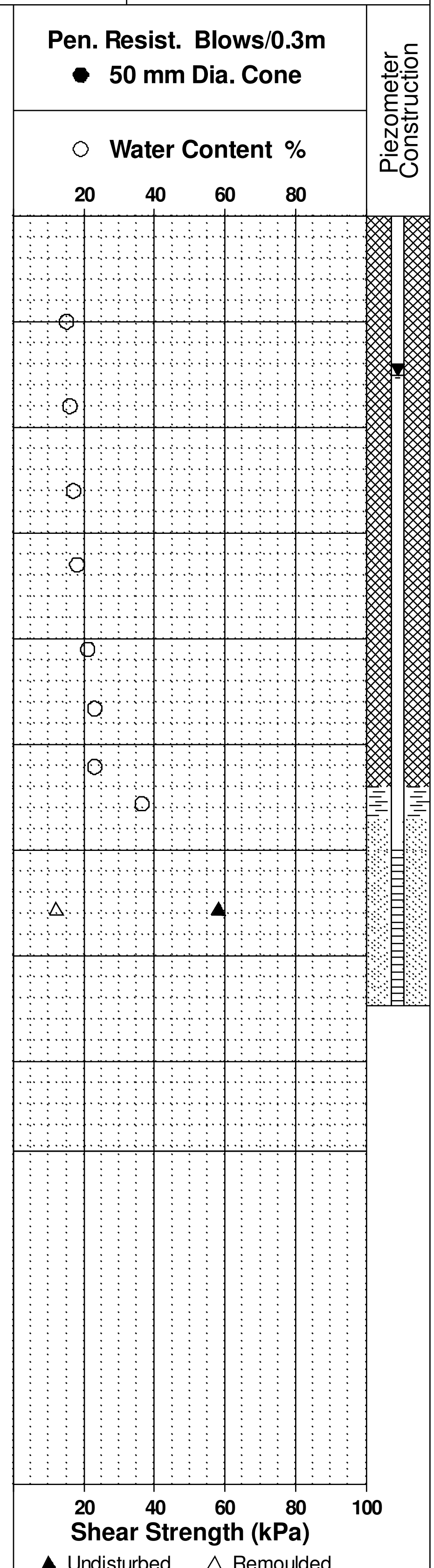
FILE NO. PG2450

HOLE NO. BH43-13

SOIL DESCRIPTION	Depth to base of layer (m)
UNDERSIDE OF FOOTING	
TOPSOIL	0.33
Loose, brown **SILTY SAND** -grey by 1.45m depth	3.73
Grey **SILT** to **CLAYEY SILT**	5.13
Grey **CLAYEY SILT** to **SILTY CLAY**, frequent silt / sand seams	8.84
End of Borehole GWL @ 1.51m depth on July 3, 2013	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	83	6
SS	2	83	7
SS	3	100	14
SS	4	100	10
SS	5	100	6
SS	6	100	3
TW	7	100	
TW	8	0	

DEPTH (m)	ELEV. (m)
0	116.80
1	115.80
2	114.80
3	113.80
4	112.80
5	111.80
6	110.80
7	109.80
8	108.80



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 8 Dec 05

FILE NO. PG0739

HOLE NO. TP 1

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE							0	114.30		
TOPSOIL	0.15									
Compact, brown medium **SAND**	0.41		G	1						
Compact, grey fine to medium **SAND** with seashells	1.02		G	2			1	113.30		▽
Very loose, brown medium to coarse **SAND** with gravel and cobbles	2.74		G	3			2	112.30		
End of Test Pit										
(Water infiltration @ 1.0m depth)										

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 8 Dec 05

FILE NO. PG0739

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	111.50		
TOPSOIL 0.38									
Compact, mottled brown and grey **SILTY** fine **SAND**									
- grey by 1.1m depth		G	1			1	110.50		
- seashells and occasional gravel and cobbles by 1.7m depth						2	109.50		
2.74		G	2						
Loose to compact, dark grey **SANDY SILT/SILTY** fine **SAND** with seashells 3.05						3	108.50		
End of Test pit									
(TP dry upon completion)									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

FILE NO. PG0739

REMARKS

HOLE NO. TP 3

BORINGS BY Backhoe **DATE** 8 Dec 05

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	108.15
TOPSOIL (to 0.36)						
Compact, mottled brown and grey **SILTY** fine **SAND/SANDY SILT**, trace clay	G	1				
- compact to dense and grey with seashells by 0.9m depth	G	2			1	107.15
- compact, trace seashells by 1.8m depth (to 2.74)					2	106.15
Loose, grey **SANDY SILT** with clay (to 3.04)	G	3			3	105.15
End of Test Pit						
(TP dry upon completion)						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 8 Dec 05

FILE NO. PG0739

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	108.15		
TOPSOIL (to 0.23)									
Compact, mottled brown and grey **SILTY** fine **SAND/SANDY SILT** with clay		G	1			1	107.15		
- compact to dense by 1.1m depth									∇
- some seashells by 1.5m depth		G	2			2	106.15		
- grey by 2.7m depth (to 3.05)		G	3			3	105.15		
Loose, dark grey **SANDY SILT** with clay (to 3.81)									
End of Test Pit (Slow water infiltration @ 1.4m depth)									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

FILE NO. PG0739

REMARKS

HOLE NO. TP 6

BORINGS BY Backhoe

DATE 8 Dec 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	110.65		
TOPSOIL									
0.56									
Stiff, mottled brown and grey **SILTY CLAY** with sand									
- grey by 0.9m depth									
		G	1			1	109.65		
									▽
- firm by 1.8m depth									
						2	108.65		
						3	107.65		
		G	2						
3.66									
End of Test Pit									
(Moderate water infiltration @ 1.4m depth)									

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

patersongroup Consulting Engineers
28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

FILE NO. PG0739

REMARKS

HOLE NO. TP 7

BORINGS BY Backhoe **DATE** 8 Dec 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	114.36
TOPSOIL 0.30							
Compact, mottled brown and grey **SILTY** fine **SAND/SANDY SILT** with clay - grey by 0.8m depth - compact to dense by 1.1m depth - some seashells by 2.0m depth 2.44		G	1			1	113.36
						2	112.36
Soft, grey stratified layer of **SILTY CLAY, SILTY** fine **SAND** and **SILT** 3.66		G	2			3	111.36
End of Test Pit (Slow water infiltration @ 1.1m depth)							

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

Piezometer Construction

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 8 Dec 05

FILE NO. PG0739

HOLE NO. TP 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	116.90		
TOPSOIL 0.13									
Compact, brown medium **SAND** 0.46		G	1						
Loose, grey medium to coarse **SAND**		G	2			1	115.90		▽
2.74						2	114.90		
End of Test Pit (Heavy water infiltration @ 0.8m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 14 Dec 05

FILE NO. PG0739

HOLE NO. TP 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	116.25		
TOPSOIL 0.08									
Compact to loose, red-orange fine to medium **SAND** - grey by 0.6m depth 0.84		G	1						
						1	115.25		∇
Dense, grey **SILTY** fine **SAND/SANDY SILT** 3.05		G	2			2	114.25		
						3	113.25		
Soft, grey stratified layers of **SILTY CLAY, SILTY** fine **SAND** and **SILT** 3.66									
End of Test Pit (Slow water infiltration @ 1.1m depth)									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 14 Dec 05

FILE NO. PG0739

HOLE NO. TP10

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE							0	114.60		
TOPSOIL	0.20									
Compact, brown **SILTY** fine **SAND/SANDY SILT** - grey by 0.8m depth - some clay by 1.6m depth - occasional seashells by 2.7m depth	3.05						1 2 3	113.60 112.60 111.60		
Soft, grey stratified layers of **SILTY CLAY, SILTY** fine **SAND** and **SILT**	3.66									
End of Test Pit (TP dry upon completion)										

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 14 Dec 05

FILE NO. PG0739

HOLE NO. TP11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	115.75		
TOPSOIL 0.28									
Loose to compact, brown medium **SAND** 0.71									⊻
Compact, grey **SILTY** fine **SAND/SANDY SILT** with seashells, some clay		G	1			1	114.75		
2.13						2	113.75		
Soft, grey stratified layers of **SILTY CLAY, SILTY** fine **SAND** and **SILT**						3	112.75		
3.50		G	2						
End of Test Pit (Slow water infiltration @ 0.7m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

FILE NO. PG0739

REMARKS

HOLE NO. TP14

BORINGS BY Backhoe

DATE 14 Dec 05

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.24				
Loose to compact, brown medium **SAND** - grey by 0.6m depth	0.86	G	1		
Compact, grey **SILTY** fine to medium **SAND** with seashells - layers of sandy silty clay by 3.4m depth	3.66	G	2		
End of Test Pit (Slow water infiltration @ 0.9m depth)					

DEPTH (m)	ELEV. (m)
0	117.35
1	116.35
2	115.35
3	114.35

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

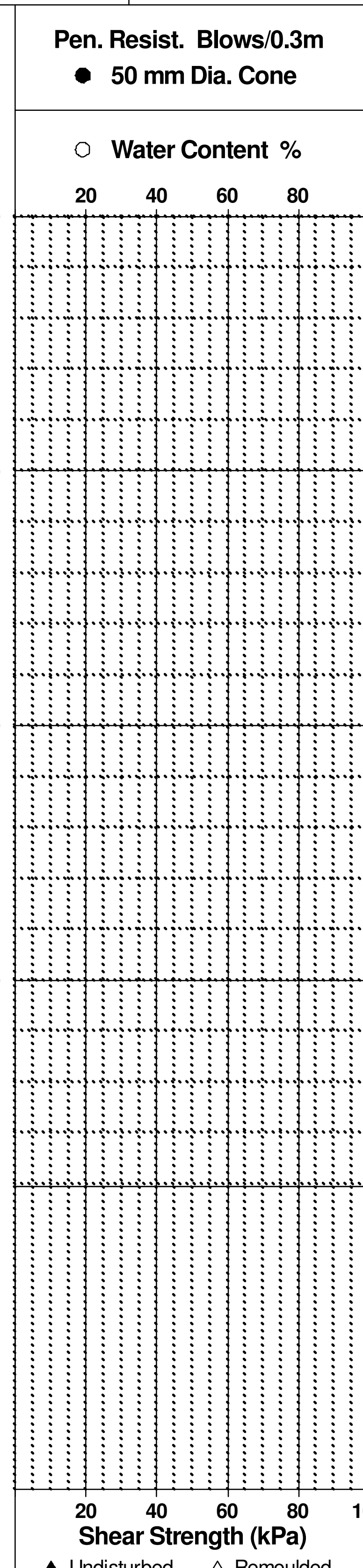
BORINGS BY Backhoe

DATE 14 Dec 05

FILE NO. PG0739

HOLE NO. TP16

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	113.80
TOPSOIL	0.22						
Compact, mottled brown and grey **SANDY SILT** with clay - grey by 0.7m depth	2.74	G	1			1	112.80
						2	111.80
Soft, grey stratified layers of **SILTY CLAY, SILTY** fine **SAND** and **SILT**	3.81	G	2			3	110.80
End of Test Pit (TP dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 14 Dec 05

FILE NO. PG0739

HOLE NO. TP17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	113.60		
TOPSOIL — 0.24									
Compact, brown **SILTY** fine **SAND/SANDY SILT**		G	1						
- with trace clay and grey by 0.8		G	2			1	112.60		
									▽
						2	111.60		
3.05						3	110.60		
Soft, grey, stratified **SILTY CLAY, SILT** and **SANDY SILTY CLAY** — 3.96		G	3						
End of Test Pit									
(Slow water infiltration @ 1.5m depth)									

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

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

FILE NO. PG0739

REMARKS

HOLE NO. TP18

BORINGS BY Backhoe

DATE 8 Dec 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	106.00		
TOPSOIL 0.22									
						1	105.00		
Compact, mottled brown and grey **SILTY** fine **SAND** with clay		G	1						
- grey by 2.0m depth						2	104.00		
- some seashells by 2.4m depth									
						3	103.00		
3.66									
End of Test Pit									
(TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Residential/Business Park Development, Carp Airport
Ottawa, Ontario

DATUM Geodetic, as provided by Novatech Engineering Consultants Ltd.

REMARKS

BORINGS BY Backhoe

DATE 8 Dec 05

FILE NO. PG0739

HOLE NO. TP19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	104.60
TOPSOIL — 0.25							
Compact, mottled brown and grey **SANDY SILT/SILTY** fine **SAND** with clay							
- grey by 0.9m depth						1	103.60
		G	1				
						2	102.60
- loose to compact by 2.4m depth							
- some seashells by 3.0m depth						3	101.60
3.35							
End of Test Pit							
(TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Piezometer Construction

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 strength of cohesionless soils is the relative density, 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.

Relative Density	'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 vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

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

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

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 NXL size core. However, it can be used on smaller core sizes, such as BX, 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
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture 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 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

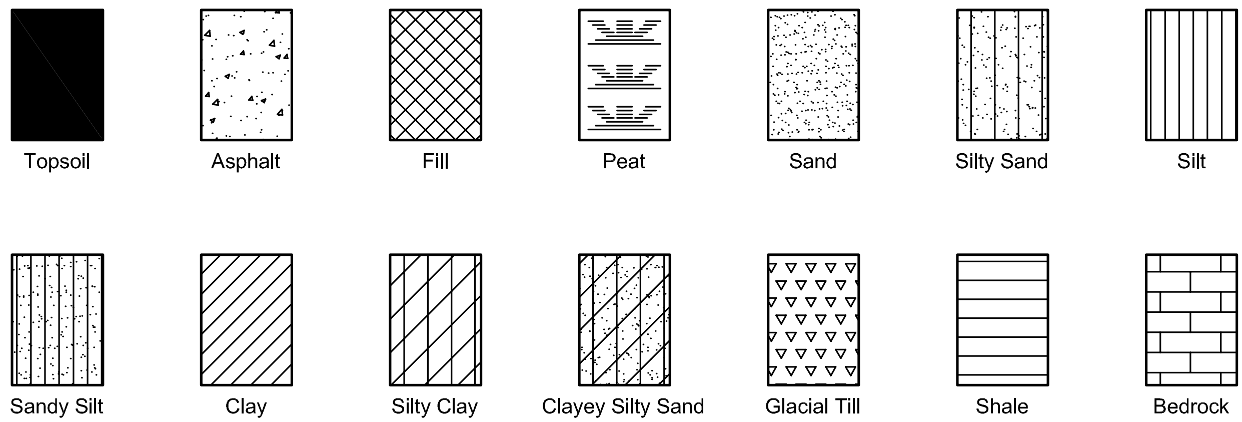
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

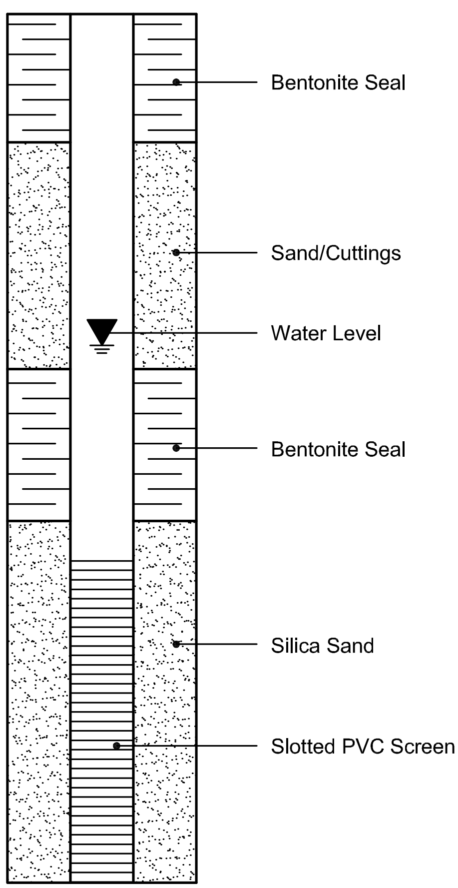
SYMBOLS AND TERMS (continued)

STRATA PLOT

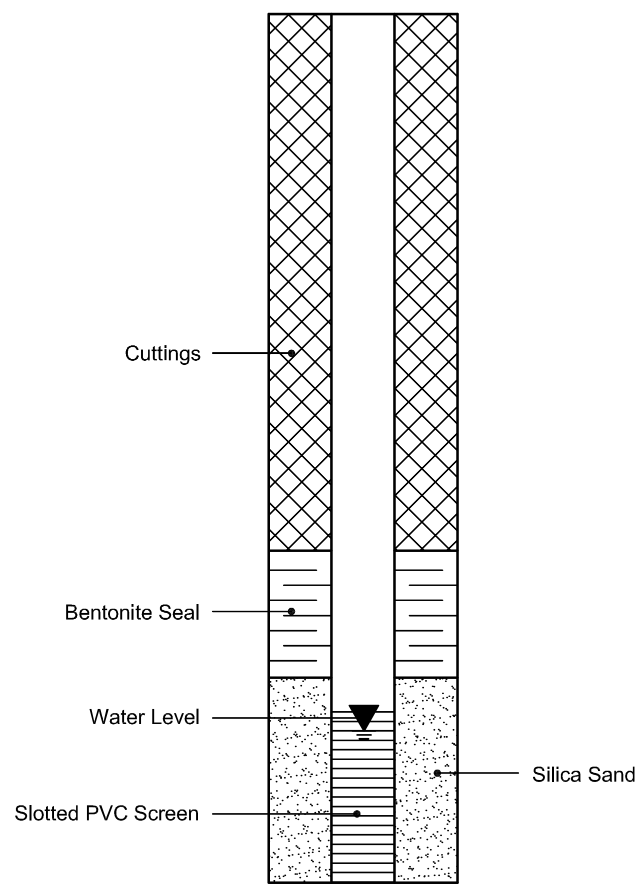


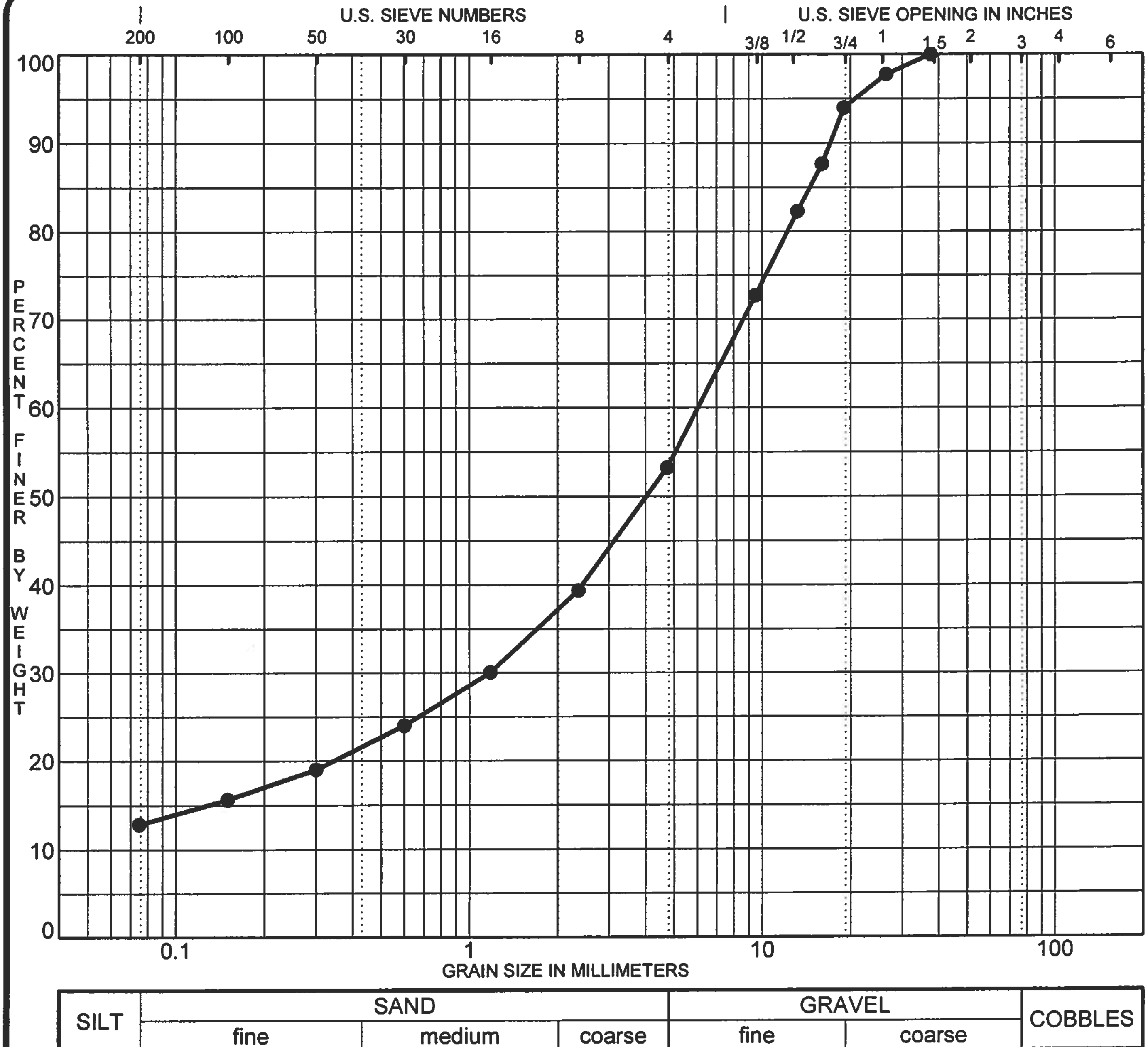
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	BH 2-11	AU 1	**Granular crushed stone with silty sand**						
⊠									
▲									
★			Based on ASTM D 2487						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH 2-11	AU 1	37.50	6.04	1.174		46.7	40.4	12.8	
⊠										
▲										
★										

CLIENT **Novatech Engineering Consultants Ltd.**

FILE NO. **PG2450**

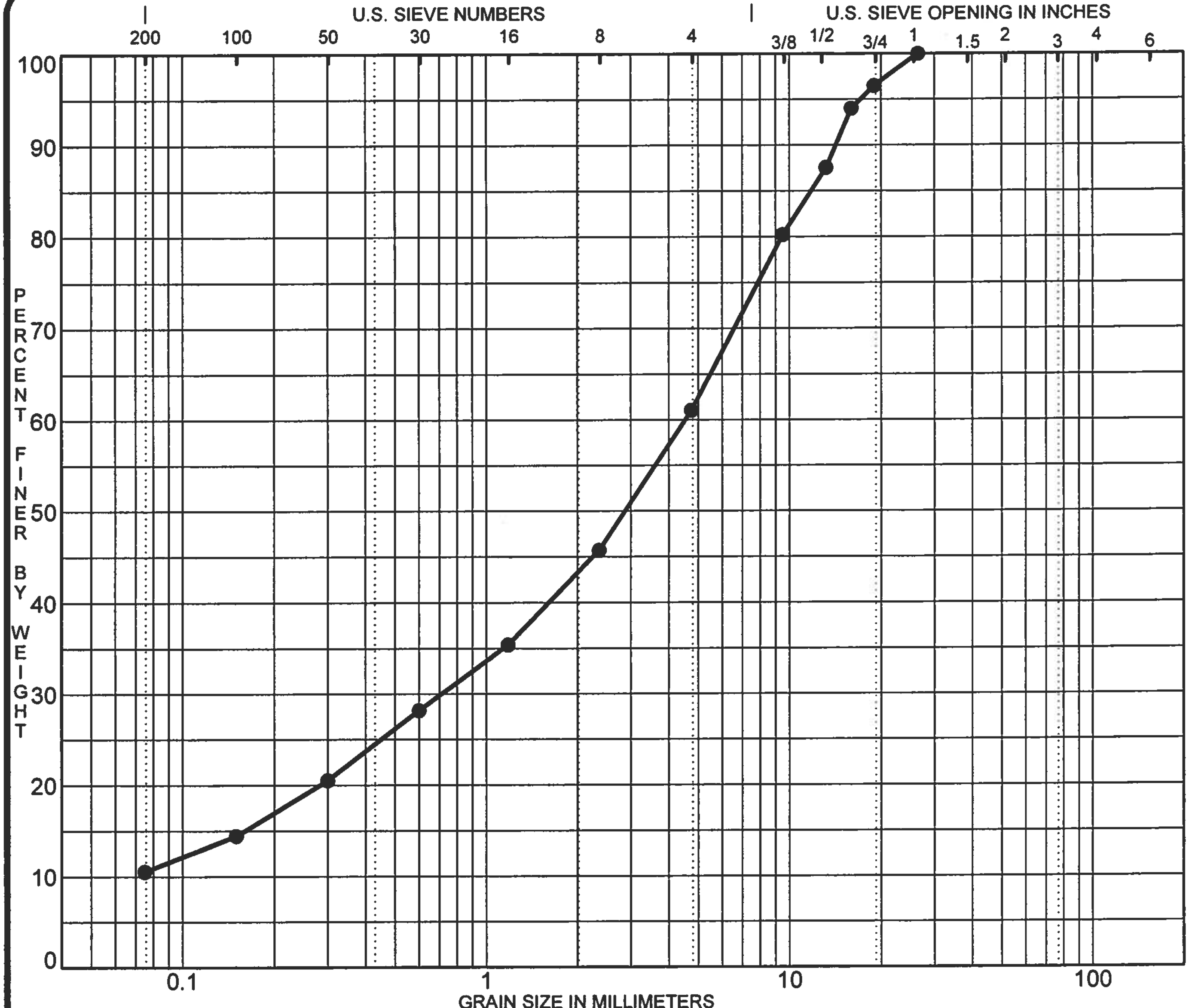
PROJECT **Geotehnical Investigation - Carp Airport Servicing and Residential Development**

DATE **18 Aug 11**

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH26-11**	**AU 1**	**Silty sand with granular crushed stone**					**1.64**	**66.3**
⊠									
▲									
★			Based on ASTM D 2487						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH26-11**	**AU 1**	**26.50**	**4.53**	**0.712**		**39.0**	**50.5**	**10.5**	
⊠										
▲										
★										

CLIENT **Novatech Engineering Consultants Ltd.**

PROJECT **Geotehnical Investigation - Carp Airport Servicing and Residential Development**

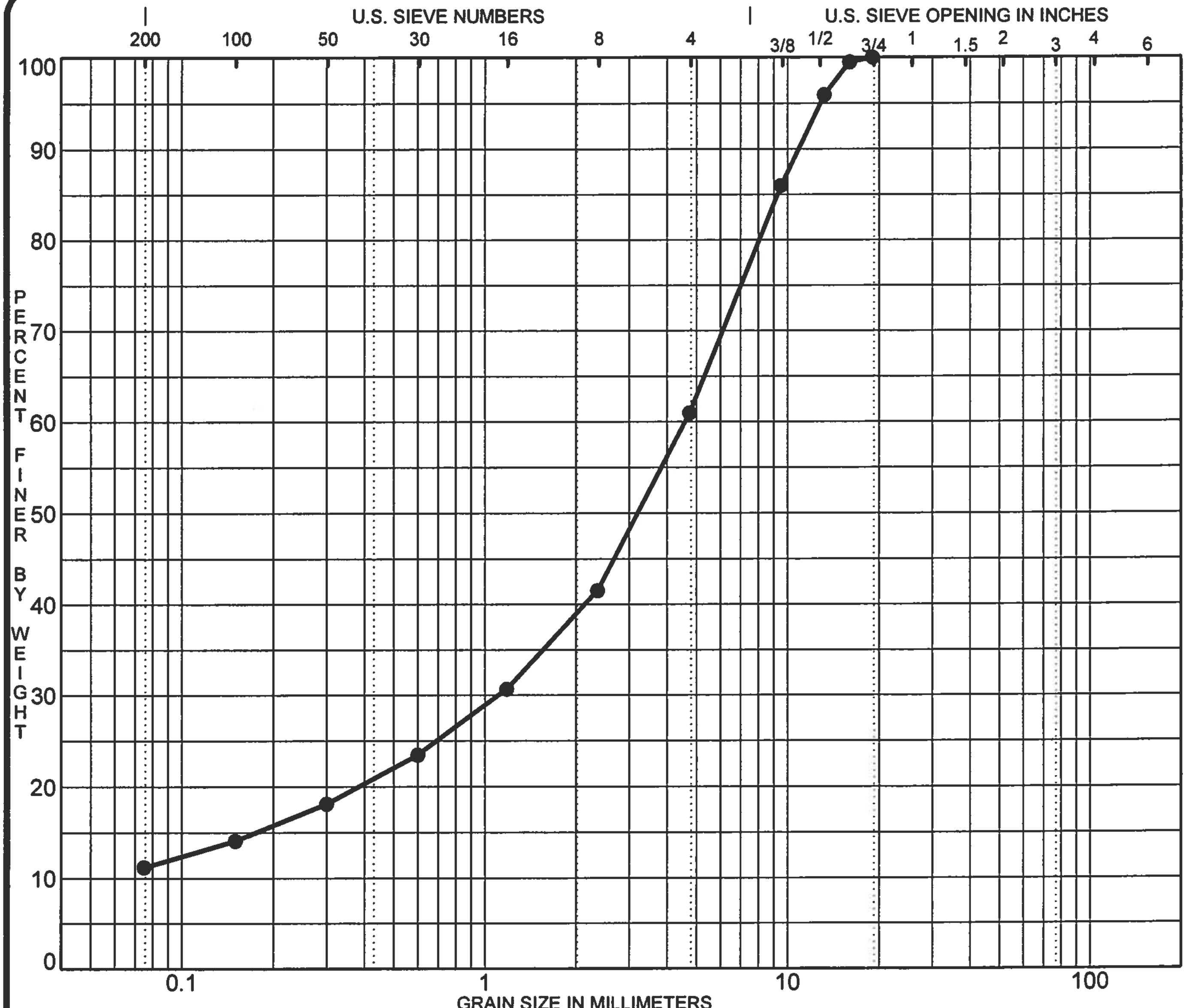
FILE NO. **PG2450**

DATE **19 Aug 11**

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	BH37-11	AU 1	**Silty sand with granular crushed stone**					4.77	81.7
⊠									
▲									
★			Based on ASTM D 2487						

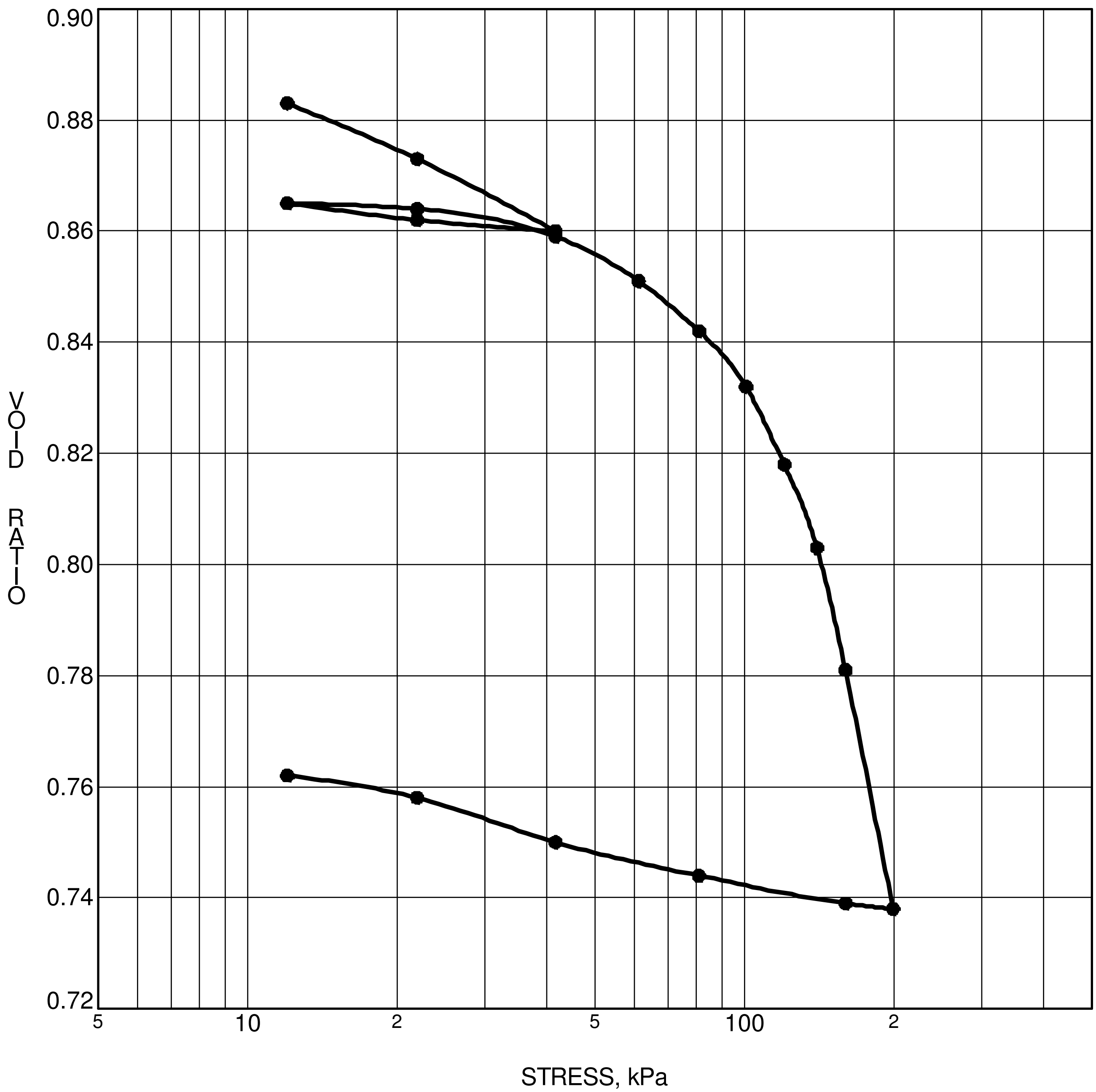
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH37-11	AU 1	19.00	4.59	1.108		39.0	49.8	11.2	
⊠										
▲										
★										

CLIENT **Novatech Engineering Consultants Ltd.**
PROJECT **Geotehnical Investigation - Carp Airport Servicing and Residential Development**

FILE NO. **PG2450**
DATE **18 Aug 11**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



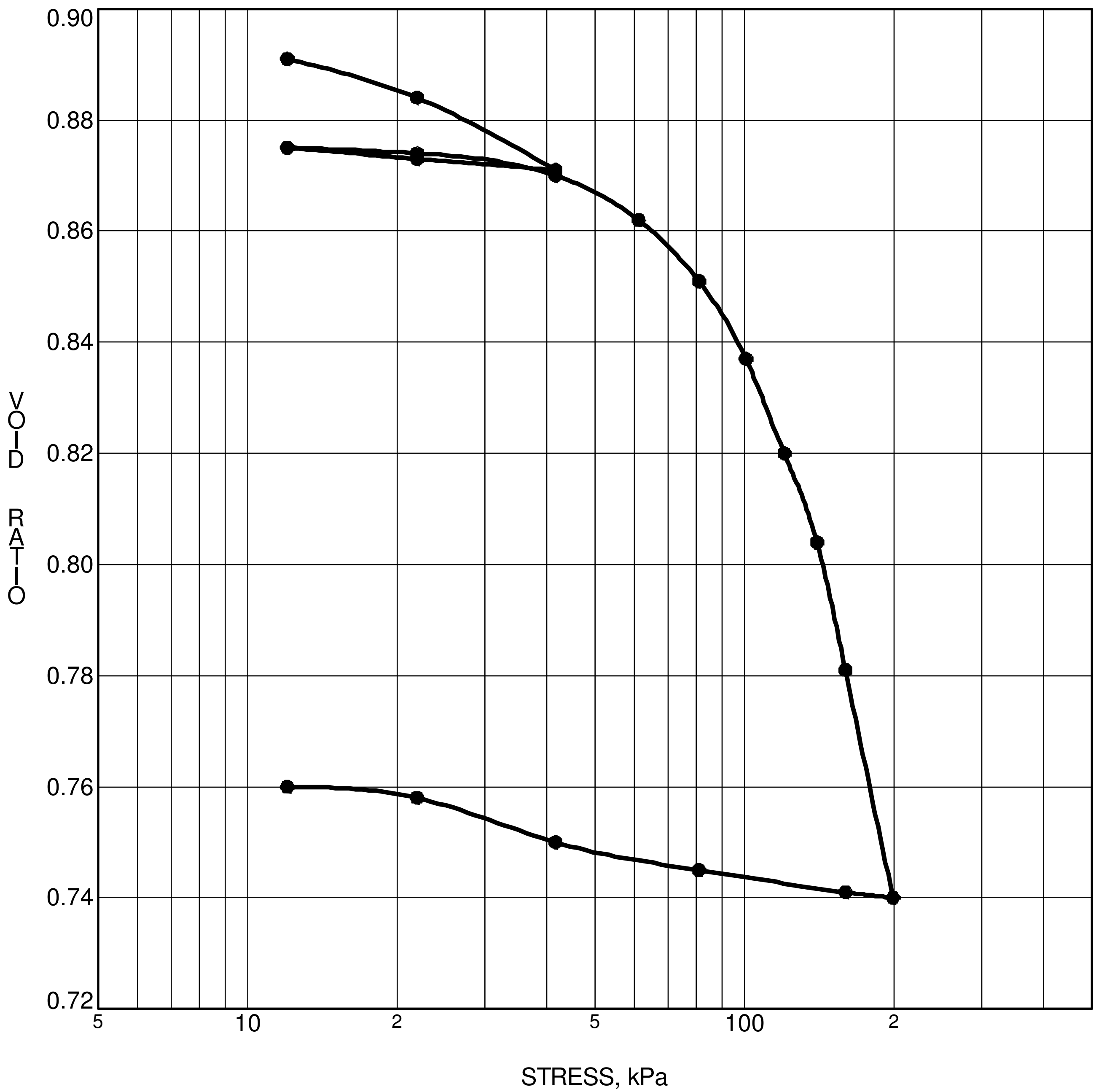
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH41-13**	p'_o	**52** kPa	Ccr	**0.011**
Sample No.	**TW 5**	p'_c	**112** kPa	Cc	**0.412**
Sample Depth	**5.00** m	OC Ratio	**2.2**	Wo	**32.6** %
Sample Elev.	**111.13** m	Void Ratio	**0.762**	Unit Wt.	**18.0** kN/m^3

CLIENT	**Novatech Engineering Consultants Ltd.**	FILE NO.	**PG2450**
PROJECT	**Geotehnical Investigation - Carp Airport Servicing and Residential Development**	DATE	**02/07/13**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



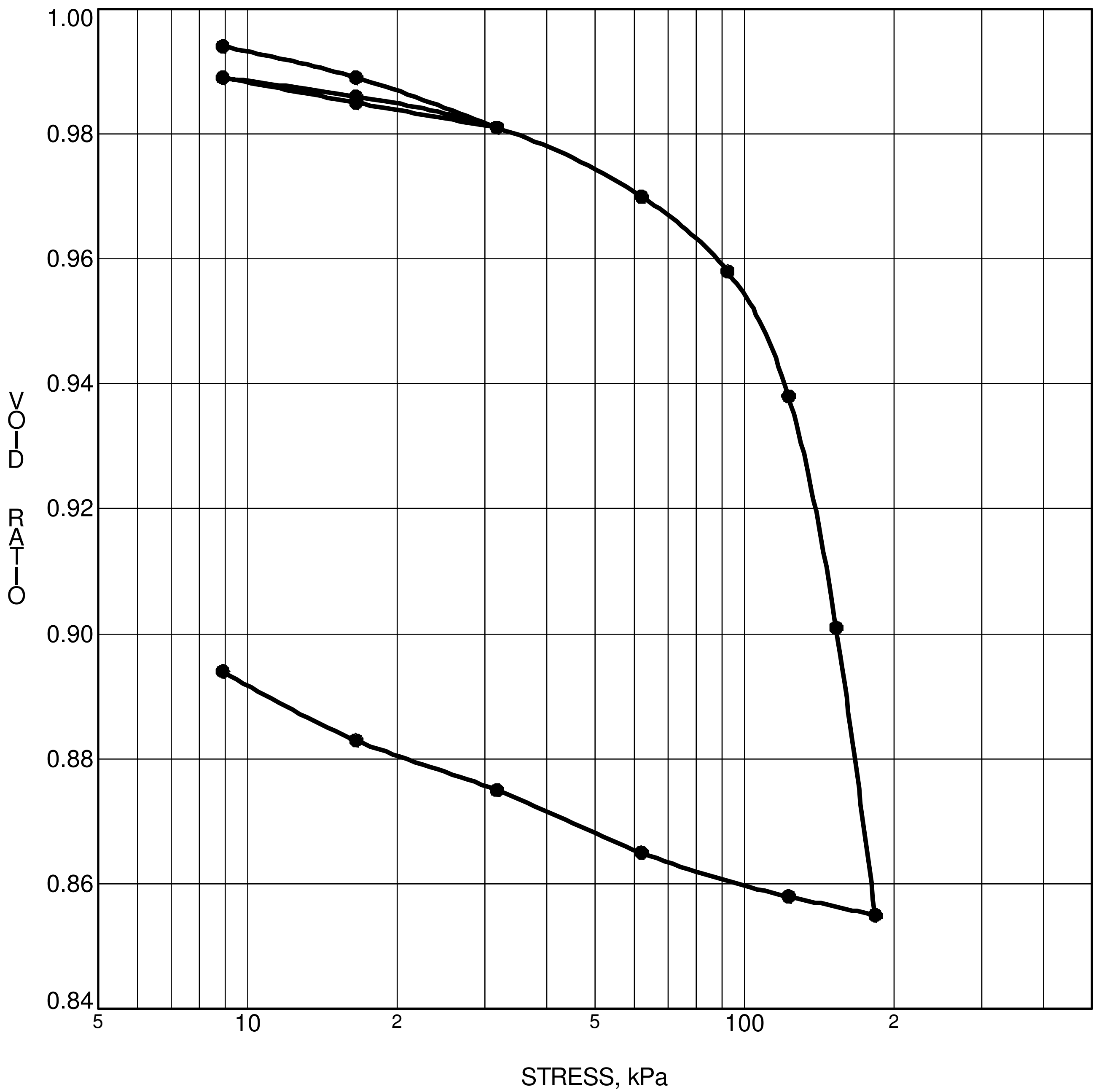
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH42-13	p'_o	57 kPa	Ccr	0.009
Sample No.	TW 6	p'_c	97 kPa	Cc	0.370
Sample Depth	5.03 m	OC Ratio	1.7	Wo	32.9 %
Sample Elev.	109.92 m	Void Ratio	0.905	Unit Wt.	18.0 kN/m^3

CLIENT	**Novatech Engineering Consultants Ltd.**	FILE NO.	**PG2450**
PROJECT	**Geotehnical Investigation - Carp Airport Servicing and Residential Development**	DATE	**02/07/13**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



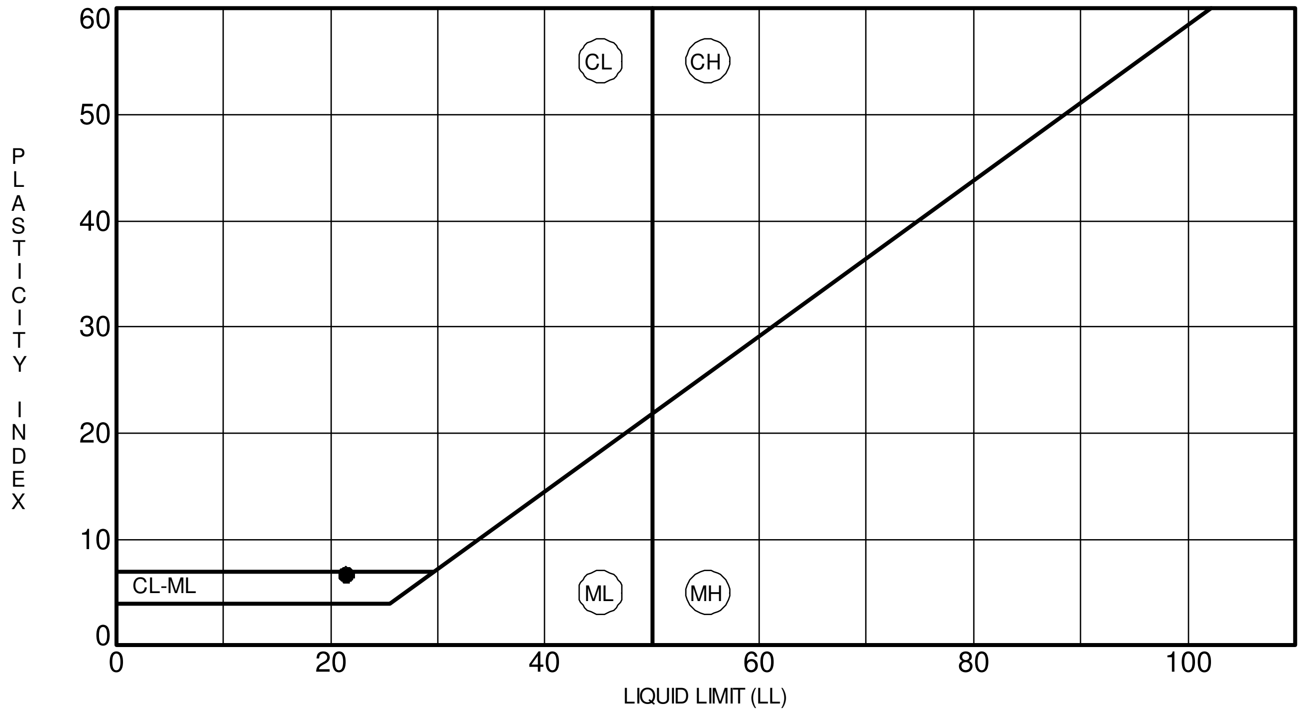
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH43-13**	p'_o	**56** kPa	Ccr	**0.016**
Sample No.	**TW 7**	p'_c	**104** kPa	Cc	**0.390**
Sample Depth	**5.56** m	OC Ratio	**1.9**	Wo	**36.4** %
Sample Elev.	**111.24** m	Void Ratio	**1.001**	Unit Wt.	**18.0** kN/m^3

CLIENT	**Novatech Engineering Consultants Ltd.**	FILE NO.	**PG2450**
PROJECT	**Geotehnical Investigation - Carp Airport Servicing and Residential Development**	DATE	**02/07/13**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



	Specimen Identification	LL	PL	PI	Fines	Classification
●	**BH41-13**	**21**	**15**	**7**		**CL - Inorganic Clays of Low Plasticity**

CLIENT	**Novatech Engineering Consultants Ltd.**	FILE NO.	**PG2450**
PROJECT	**Geotehnical Investigation - Carp Airport Servicing and Residential Development**	DATE	**25 Jun 13**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

Certificate of Analysis

Client: **Paterson Group Consulting Engineers**

Client PO: 11646

Report Date: 28-Sep-2011

Order Date:22-Sep-2011

Project Description: PG2450

	MDL/Units				
Client ID:		BH11-11 - SS3	BH23-11 - SS5	-	-
Sample Date:		16-Sep-11	19-Sep-11	-	-
Sample ID:		1139201-01	1139201-02	-	-
		Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	82.4	75.6	-	-
General Inorganics					
pH	0.1 pH Units	7.6	7.7	-	-
Resistivity	0.10 Ohm.m	98.1	48.3	-	-
Anions					
Chloride	5 ug/g dry	<5	15	-	-
Sulphate	5 ug/g dry	14	36	-	-

PARACEL LABORATORIES LTD.

Order #: 1135019

Certificate of Analysis

Client: **Paterson Group Consulting Engineers**

Client PO: 11691

Project Description: PG2450

Report Date: 25-Aug-2011

Order Date:22-Aug-2011

	Client ID:	BH38-11 SS4	-	-	-
	Sample Date:	18-Aug-11	-	-	-
	Sample ID:	1135019-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	66.8	-	-	-
General Inorganics					
pH	0.1 pH Units	7.2	-	-	-
Resistivity	0.10 Ohm.m	13.3	-	-	-
Anions					
Chloride	5 ug/g dry	656	-	-	-
Sulphate	5 ug/g dry	66	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2A TO 7B - SLOPE STABILITY ANALYSIS SHEETS

DRAWING PG2450-2 - LIMIT OF HAZARD LANDS

DRAWING PG2450-3 - TEST HOLE LOCATION PLAN

DRAWING PG2450-4 - PERMISSIBLE GRADE RAISE AREAS

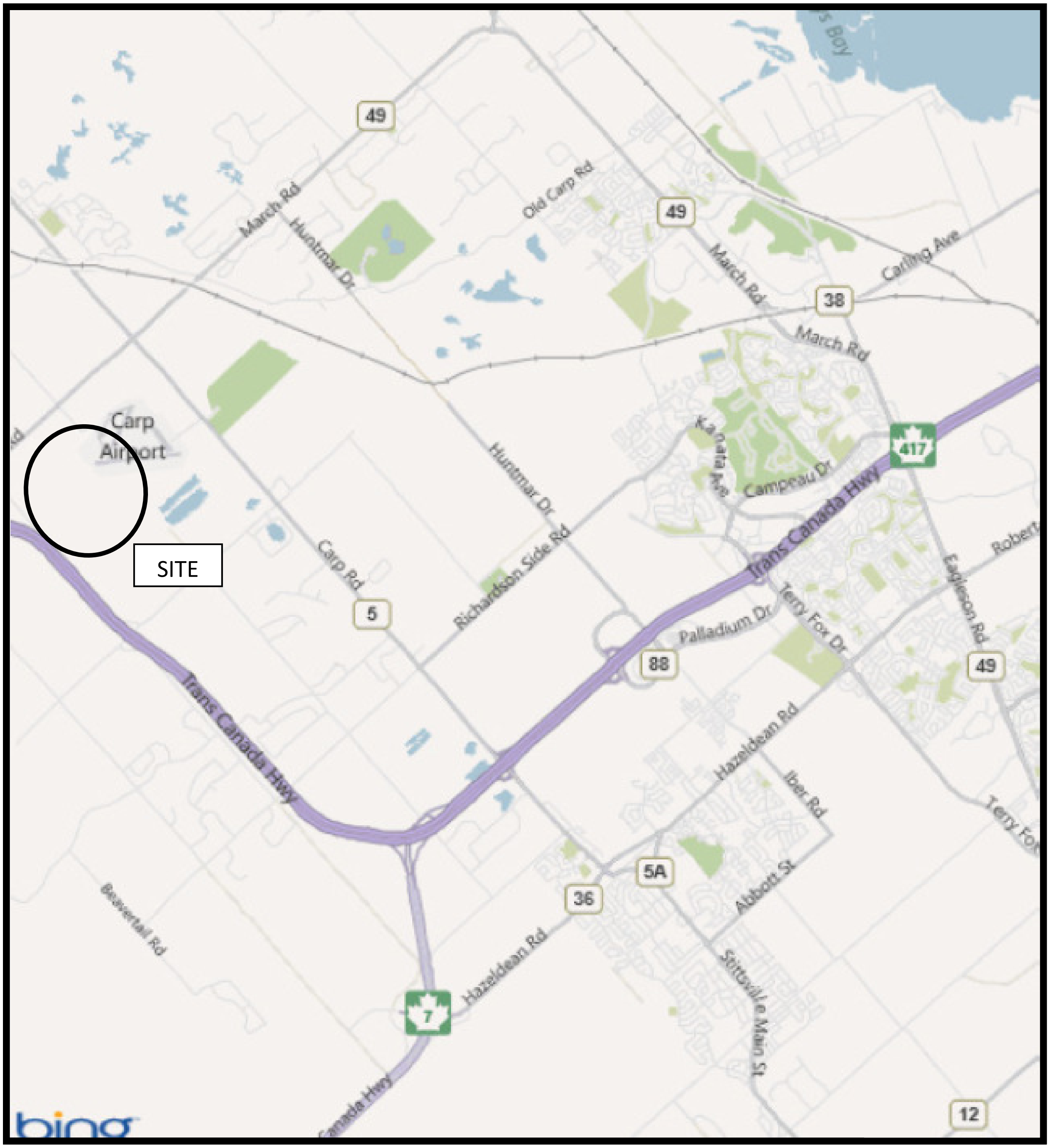


FIGURE 1

KEY PLAN

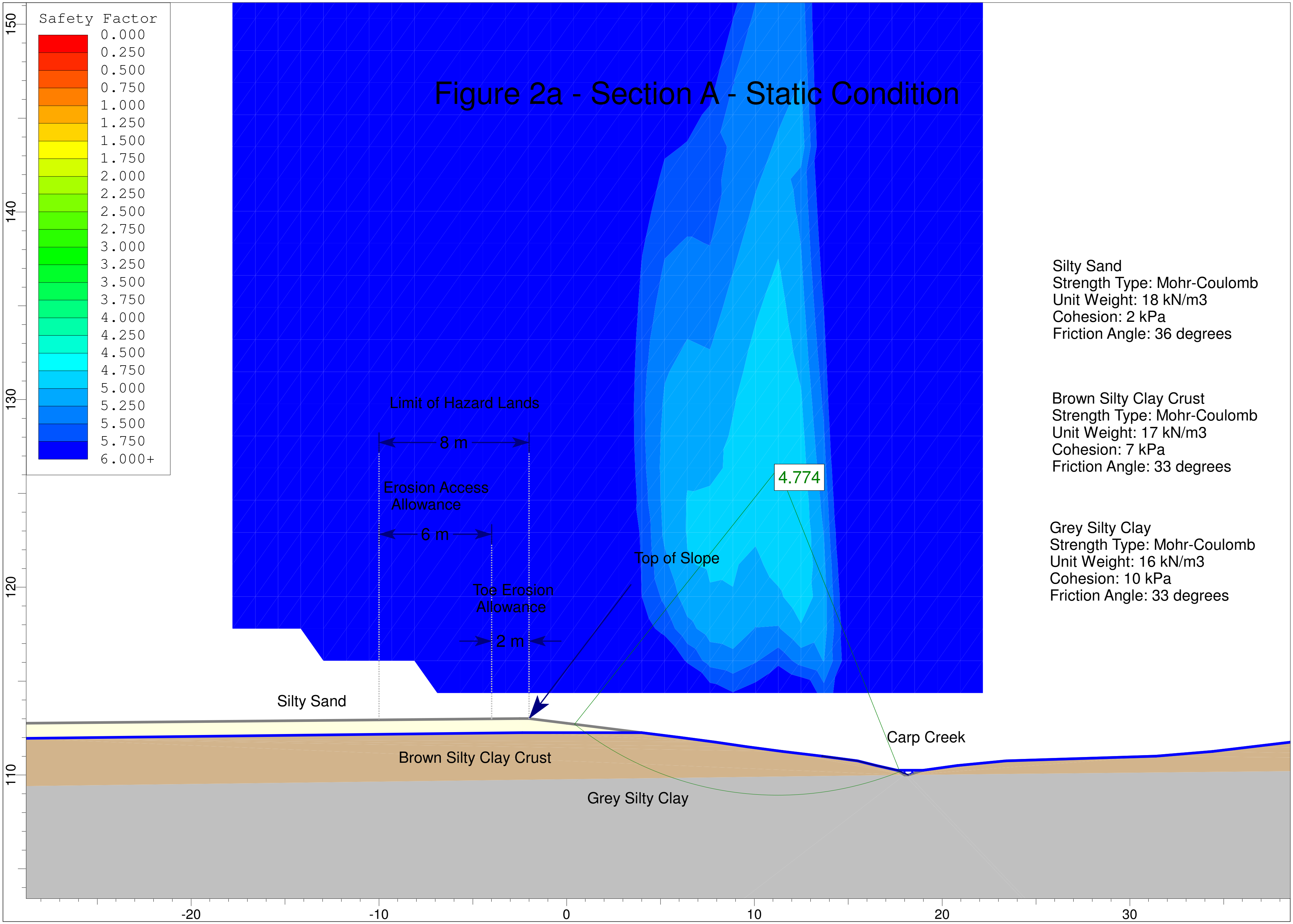


Figure 2a - Section A - Static Condition
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
4.774
Limit of Hazard Lands
8 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
2 m
Top of Slope
Silty Sand
Brown Silty Clay Crust
Grey Silty Clay
Carp Creek
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
150
140
130
120
110
-20
-10
0
10
20
30

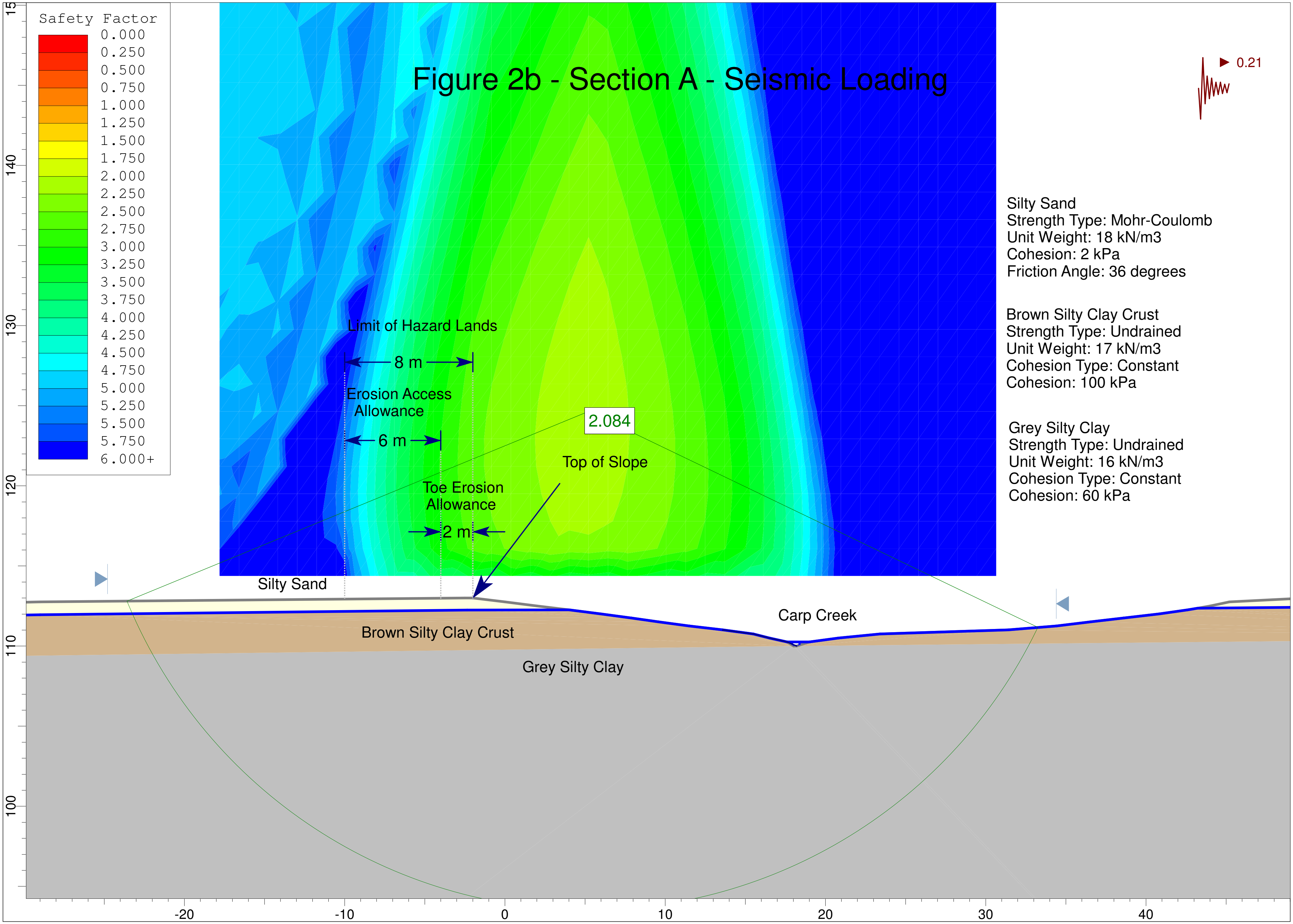
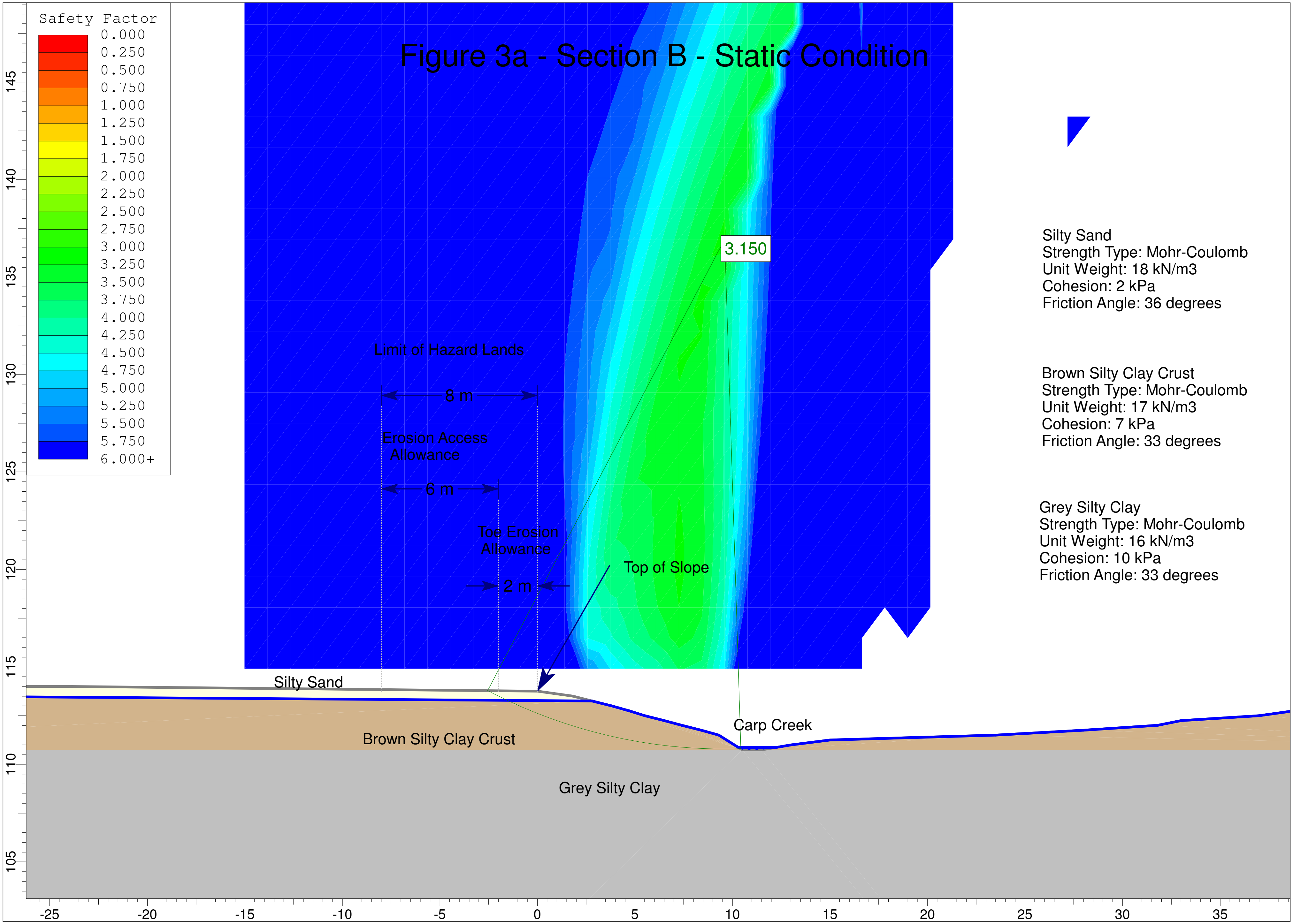


Figure 2b - Section A - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Limit of Hazard Lands
8 m
Erosion Access Allowance
6 m
2.084
Top of Slope
Toe Erosion Allowance
2 m
Silty Sand
Carp Creek
Brown Silty Clay Crust
Grey Silty Clay
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 60 kPa
140
130
120
110
100
-20
-10
0
10
20
30
40

Figure 3a - Section B - Static Condition



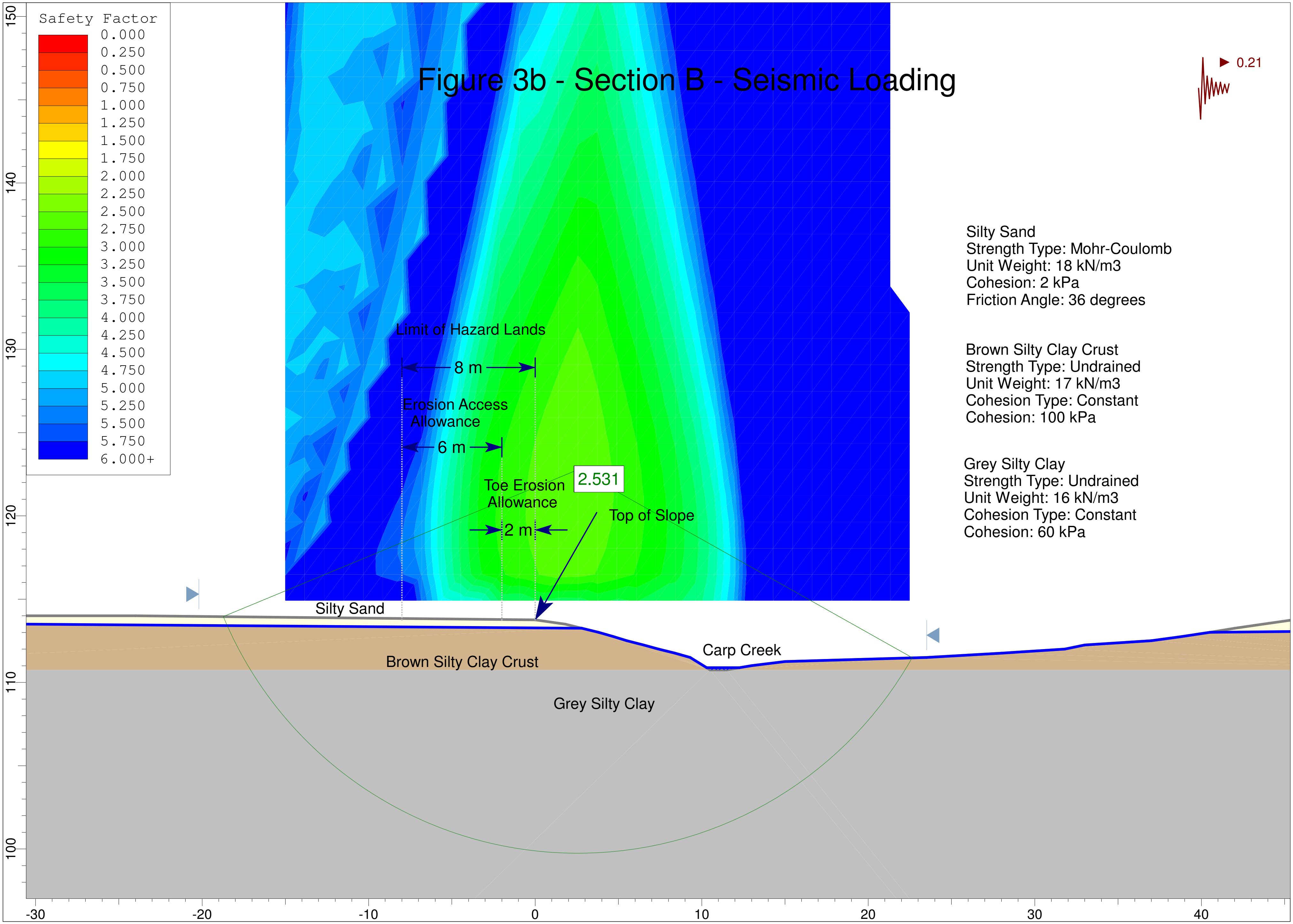


Figure 3b - Section B - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 60 kPa
Limit of Hazard Lands
8 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
2 m
2.531
Top of Slope
Silty Sand
Carp Creek
Brown Silty Clay Crust
Grey Silty Clay
150
140
130
120
110
100
-30
-20
-10
0
10
20
30
40

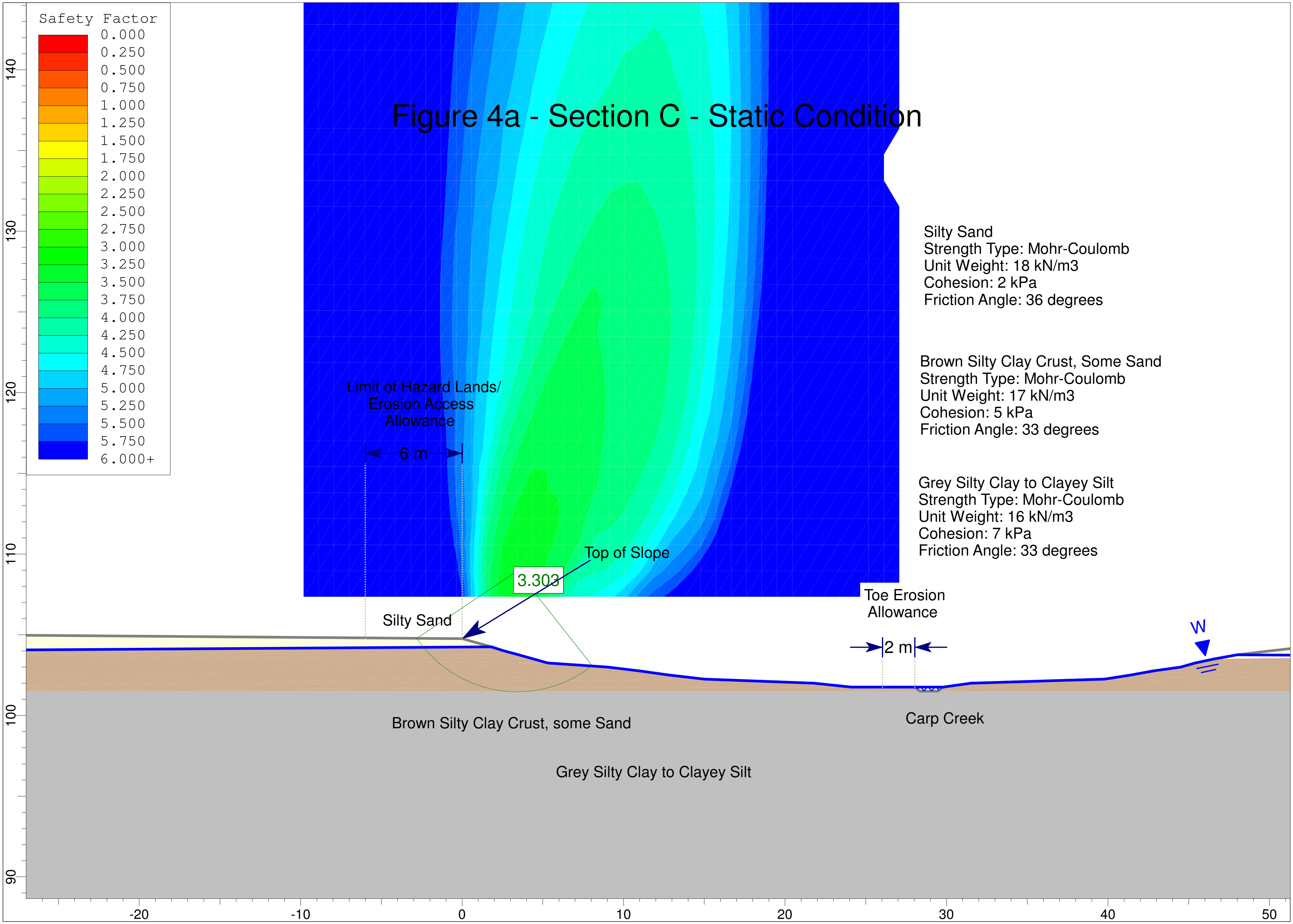


Figure 4a - Section C - Static Condition
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Grey Silty Clay to Clayey Silt
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
Limit of Hazard Lands/
Erosion Access
Allowance
6 m
Top of Slope
3.303
Silty Sand
Toe Erosion
Allowance
2 m
W
Brown Silty Clay Crust, some Sand
Carp Creek
Grey Silty Clay to Clayey Silt
140
130
120
110
100
90
-20
-10
0
10
20
30
40
50

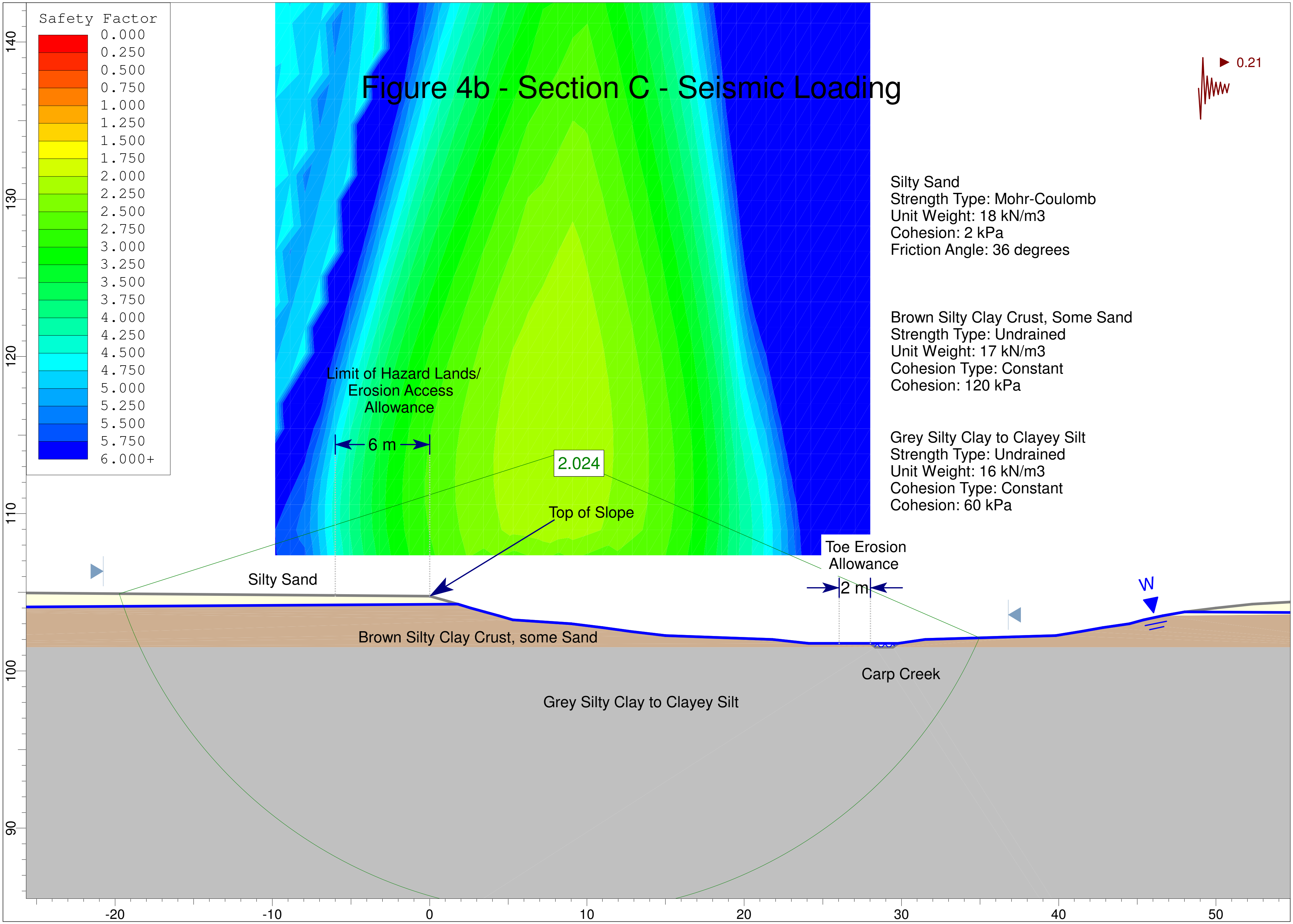


Figure 4b - Section C - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 120 kPa
Grey Silty Clay to Clayey Silt
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 60 kPa
Limit of Hazard Lands/
Erosion Access
Allowance
6 m
2.024
Top of Slope
Toe Erosion
Allowance
2 m
Silty Sand
W
Brown Silty Clay Crust, some Sand
Carp Creek
Grey Silty Clay to Clayey Silt
140
130
120
110
100
90
-20
-10
0
10
20
30
40
50

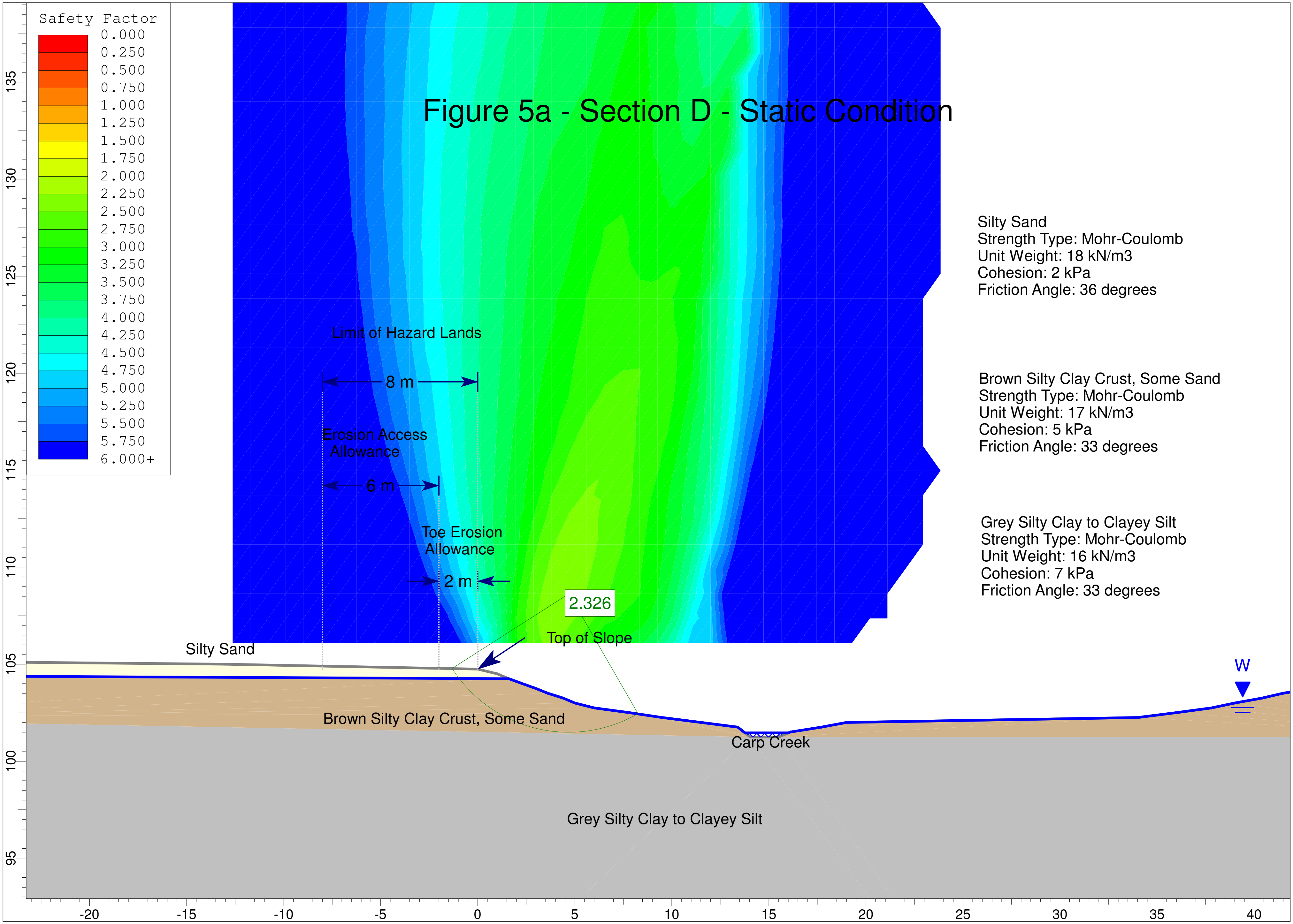


Figure 5a - Section D - Static Condition
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
8 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
2 m
2.326
Top of Slope
Silty Sand
Brown Silty Clay Crust, Some Sand
Carp Creek
Grey Silty Clay to Clayey Silt
W
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Grey Silty Clay to Clayey Silt
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
135
130
125
120
115
110
105
100
95
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40

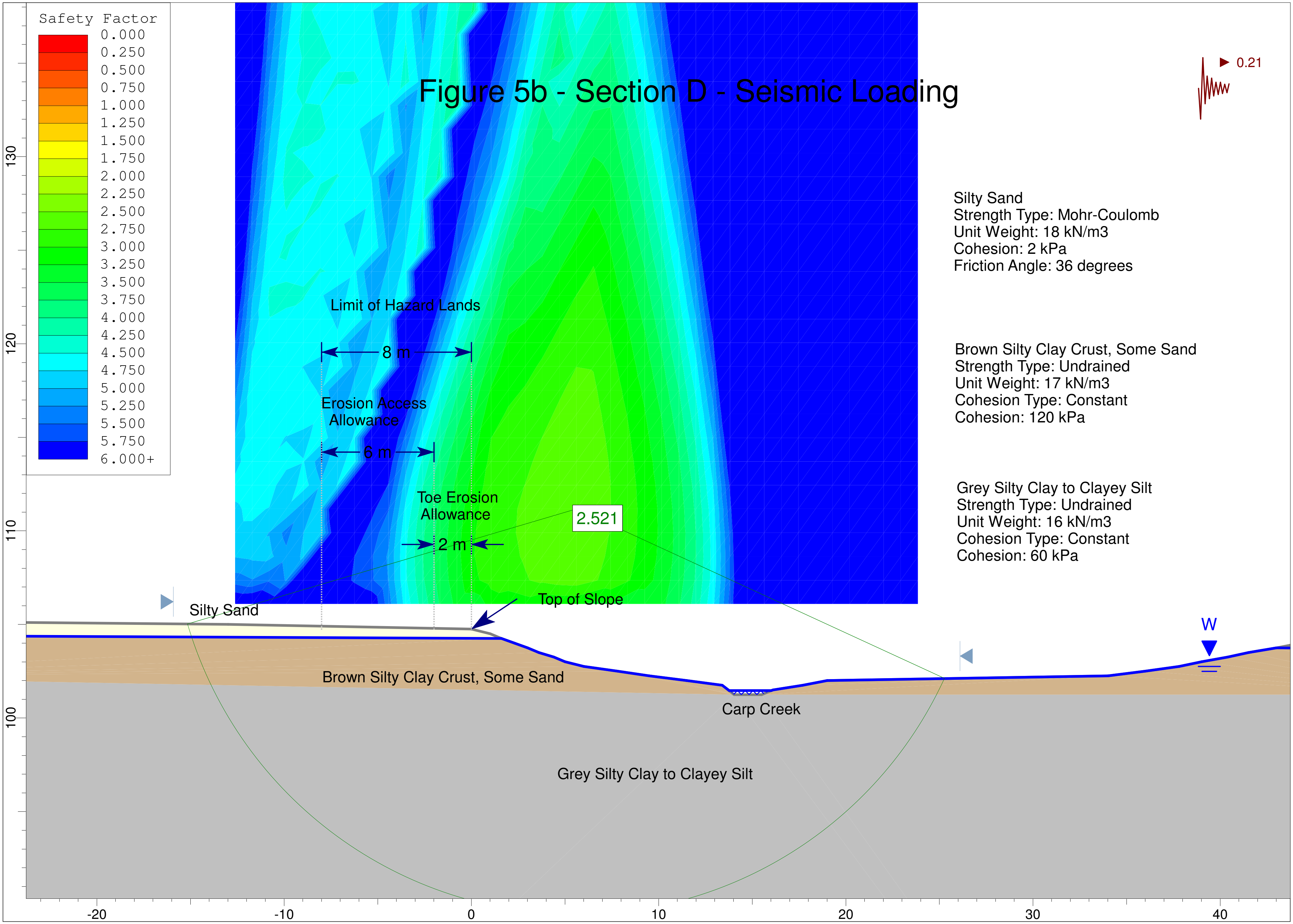


Figure 5b - Section D - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 120 kPa
Grey Silty Clay to Clayey Silt
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 60 kPa
Limit of Hazard Lands
8 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
2 m
2.521
Top of Slope
Silty Sand
W
Brown Silty Clay Crust, Some Sand
Carp Creek
Grey Silty Clay to Clayey Silt
130
120
110
100
-20
-10
0
10
20
30
40

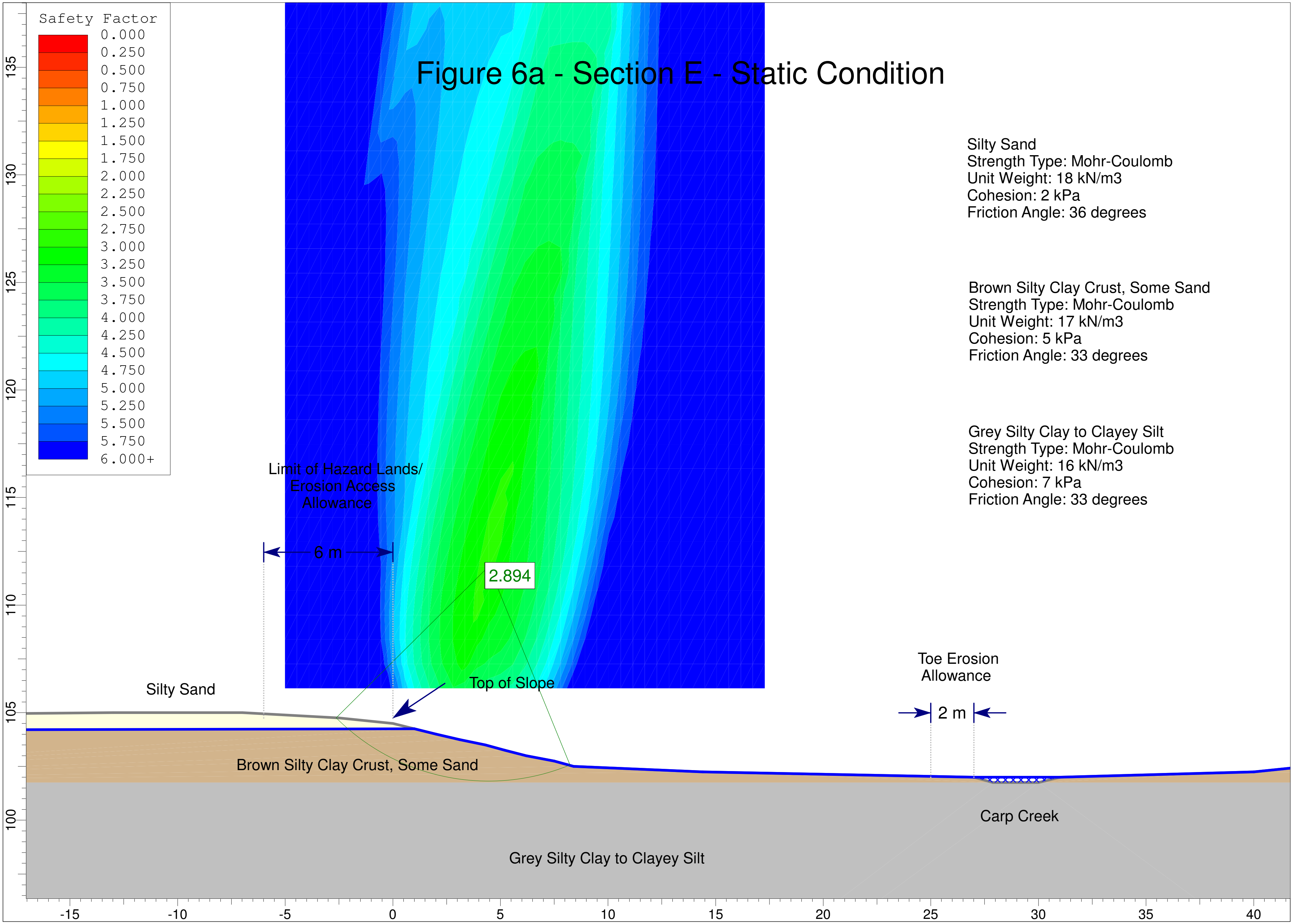


Figure 6a - Section E - Static Condition
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Grey Silty Clay to Clayey Silt
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
Limit of Hazard Lands/ Erosion Access Allowance
6 m
2.894
Top of Slope
Toe Erosion Allowance
2 m
Silty Sand
Brown Silty Clay Crust, Some Sand
Carp Creek
Grey Silty Clay to Clayey Silt
135
130
125
120
115
110
105
100
-15
-10
-5
0
5
10
15
20
25
30
35
40

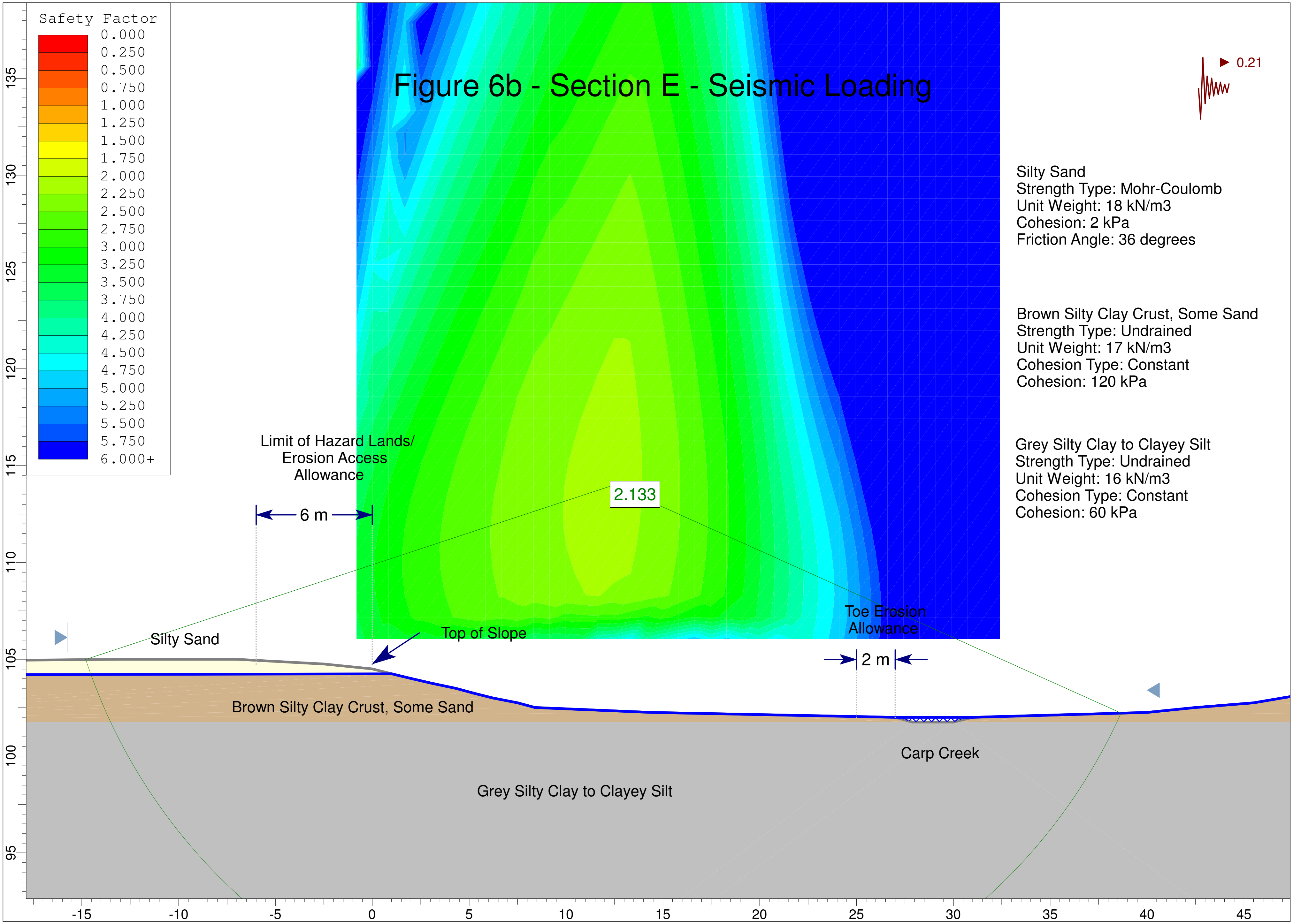


Figure 6b - Section E - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 120 kPa
Grey Silty Clay to Clayey Silt
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 60 kPa
Limit of Hazard Lands/
Erosion Access
Allowance
6 m
2.133
Top of Slope
Toe Erosion
Allowance
2 m
Silty Sand
Brown Silty Clay Crust, Some Sand
Carp Creek
Grey Silty Clay to Clayey Silt
135
130
125
120
115
110
105
100
95
-15
-10
-5
0
5
10
15
20
25
30
35
40
45

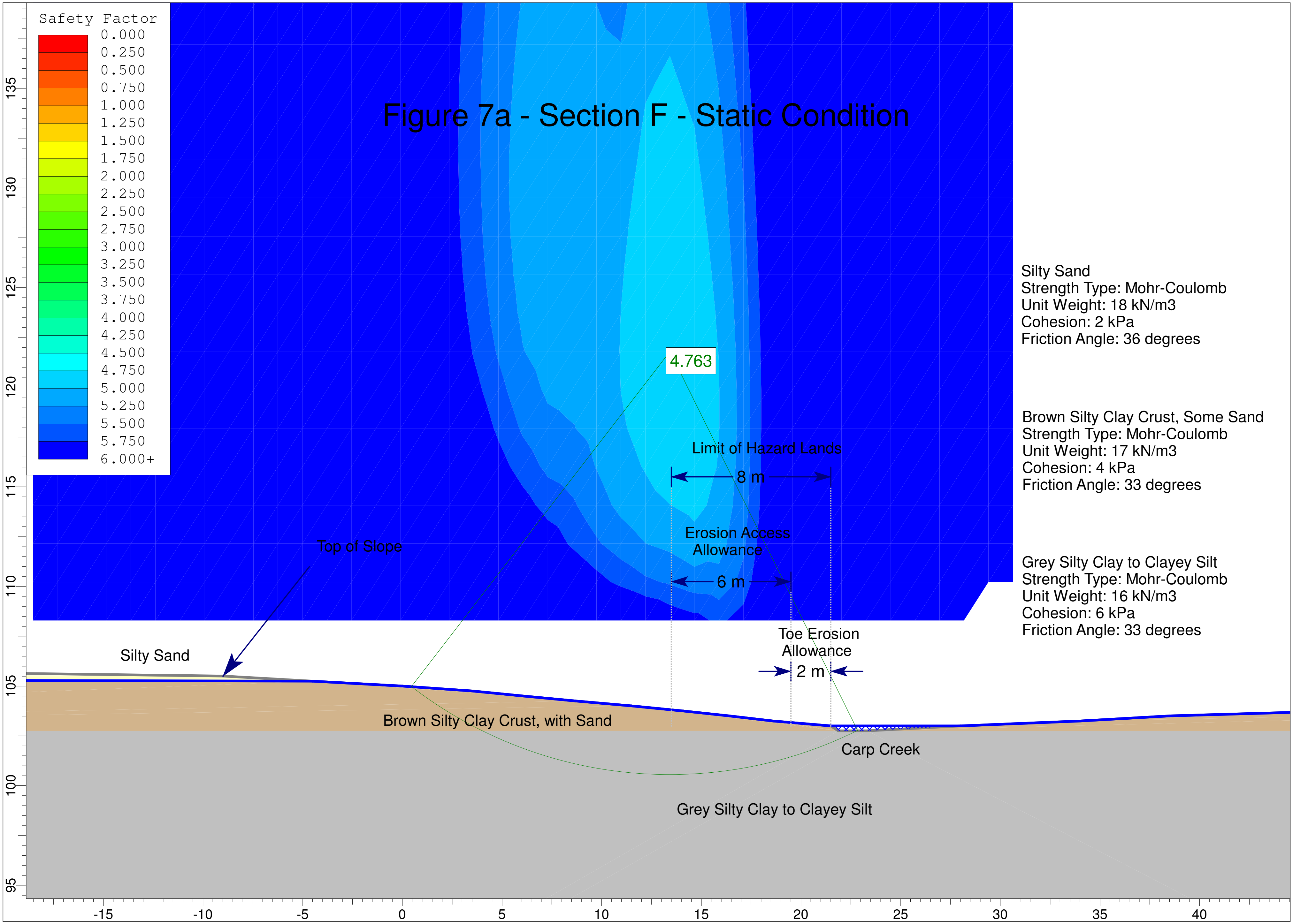


Figure 7a - Section F - Static Condition
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
4.763
Limit of Hazard Lands
8 m
Erosion Access
Allowance
6 m
Toe Erosion
Allowance
2 m
Top of Slope
Silty Sand
Brown Silty Clay Crust, with Sand
Carp Creek
Grey Silty Clay to Clayey Silt
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 4 kPa
Friction Angle: 33 degrees
Grey Silty Clay to Clayey Silt
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 6 kPa
Friction Angle: 33 degrees
135
130
125
120
115
110
105
100
95
-15
-10
-5
0
5
10
15
20
25
30
35
40

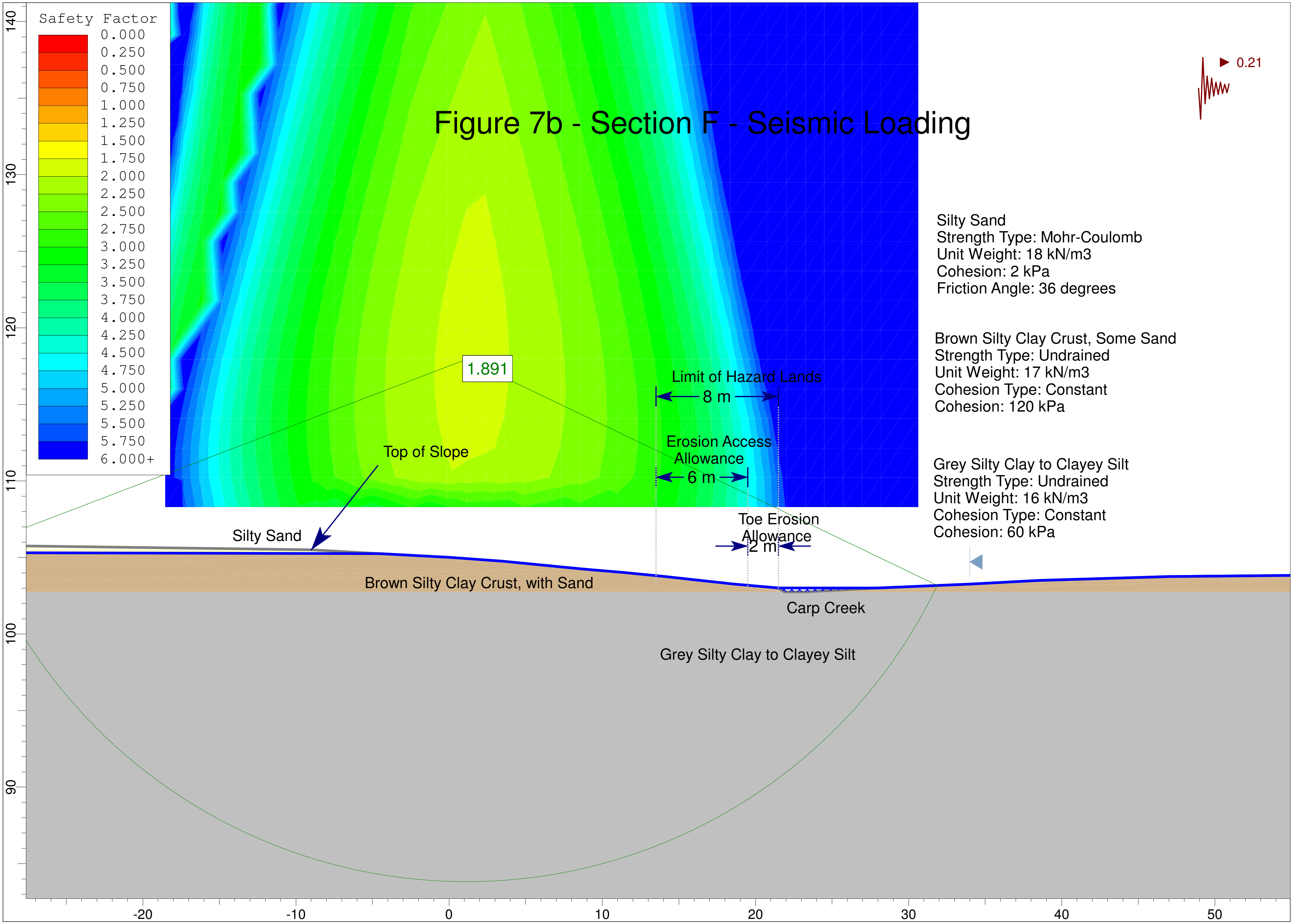


Figure 7b - Section F - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
1.891
Limit of Hazard Lands
8 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
2 m
Top of Slope
Silty Sand
Brown Silty Clay Crust, with Sand
Carp Creek
Grey Silty Clay to Clayey Silt
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 2 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust, Some Sand
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 120 kPa
Grey Silty Clay to Clayey Silt
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 60 kPa
140
130
120
110
100
90
-20
-10
0
10
20
30
40
50

SCALE - 1:1000

0 10 20 30 40 50 100m

NO.	REVISIONS	DATE	INITIAL

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

SCALE	1:1000
DESIGN	RG
DRAWN	MPG
CHECKED	DG
DATE	05/2013

GEOTECHNICAL INVESTIGATION
CARP AIRPORT SERVICING - PHASE 1
OTTAWA, ONTARIO

DWG. NO. PG2450-2

WEST CAPITAL DEVELOPMENTS

SLOPE STABILITY ANALYSIS

NO.	REVISIONS	DATE	INITIAL

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

SCALE: 1:5000
DESIGN: RG
DRAWN: MPG
CHECKED: DG
DATE: 05/2013

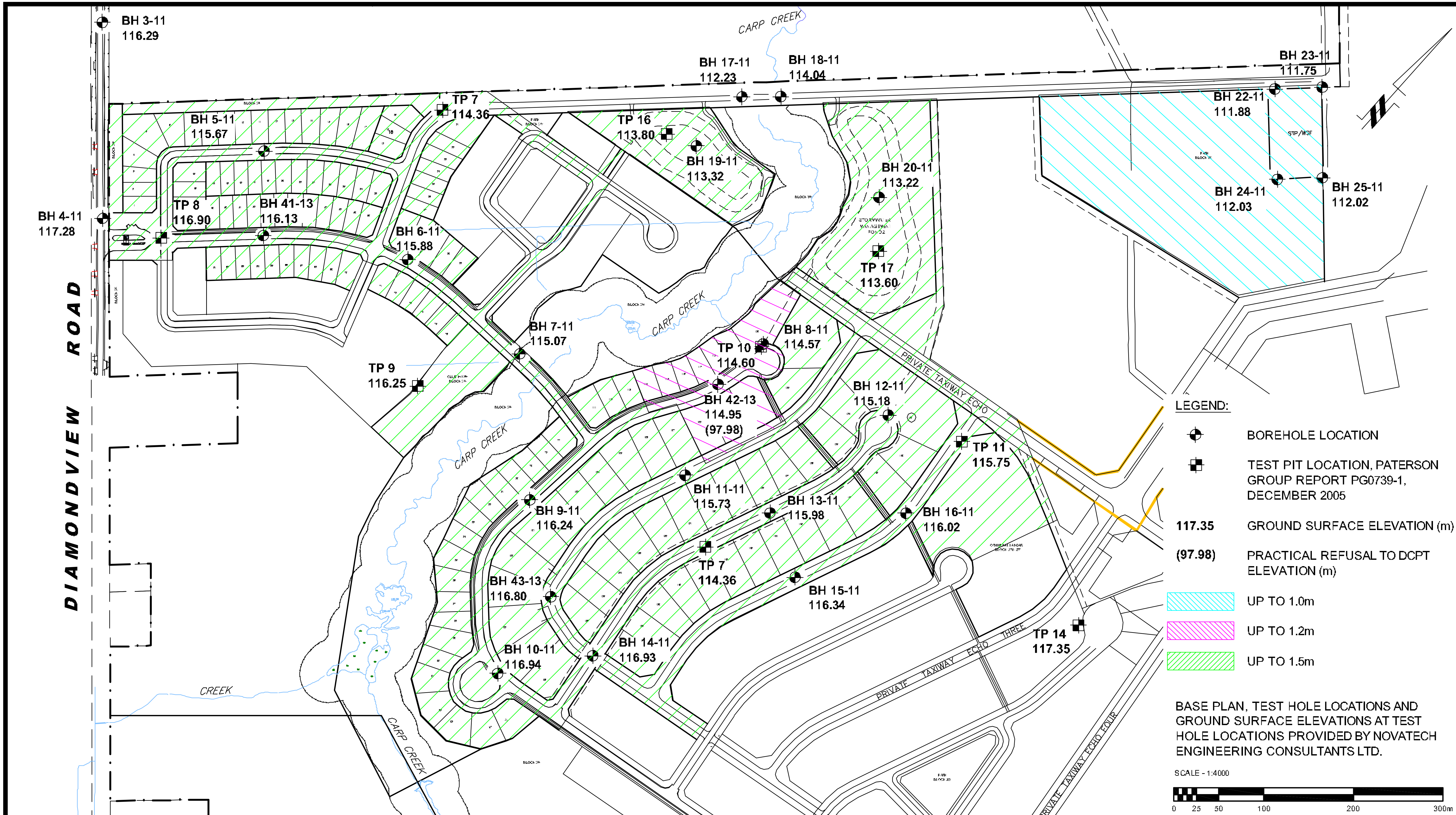
GEOTECHNICAL INVESTIGATION
CARP AIRPORT SERVICING - PHASE 1
OTTAWA, ONTARIO

DWG. NO. PG2450-3

WEST CAPITAL DEVELOPMENTS

TEST HOLE LOCATION PLAN

A1



paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	1:4000
Des.:	RG
Dwn:	CPB
Chkd:	DG

WEST CAPITAL DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
CARP AIRPORT SERVICING - PHASE I

OTTAWA, ONTARIO

PERMISSIBLE GRADE RAISE AREAS

Dwg. No.	PG2450-4
Report No.:	PG2450-1
Date:	07/2013

11x17