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Proposed Mixed Use Development - Phase 1
Chaudière and Albert Islands
Ottawa, Ontario

Prepared For

Windmill Green Fund LPV

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TABLE OF CONTENTS

APPENDICES

1.0 Introduction

Paterson Group (Paterson) was commissioned by Windmill Green Fund LPV to prepare a geotechnical investigation report for Phase 1 of the proposed mixed use development to be located on Chaudière and Albert Islands in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan).

The objectives of the current investigation were to:

☐ detail subsurface soil and groundwater conditions based on test hole information from the current and previous investigations.

☐ provide geotechnical recommendations for the design of Phase 1 of the proposed development including construction considerations which may affect its design.

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

2.0 Proposed Development

Based on the conceptual drawings provided, the Phase 1 development will consist of several multi-storey mixed use structures, including one structure of more than 20 storeys and several structures between two to six storeys. A portion of the Phase 1 property is anticipated to have one level of underground parking for the subject site. Local roadways, access lanes, car parking areas and landscaping areas are also anticipated for the proposed Phase 1 development. The development is serviced with private storm and purple pipe system. The internal water and sanitary sewers are under private ownership outletting and connecting to the existing municipal system.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the investigation was completed on July 23, July 28 and August 5, 2015. At that time, eight boreholes and three test pits were advanced to a maximum depth of 5.7 m. The test hole locations were distributed in a manner to provide general coverage of the proposed Phase 1 development. The locations of all test holes are presented in Drawing PG3202-2 - Site Plan - Existing Conditions and PG3202-3 - Site Plan - Proposed Development - Phase 1, which presents the extent of the current phase of development, included in Appendix 2.

The boreholes were completed with a portable auger drill rig operated by a two-person crew. The borehole procedure consisted of augering or coring to the required depths at the selected locations, and sampling/testing the overburden and bedrock. The test pits were excavated using a rubber tired backhoe. The excavating procedure consisted of advancing each test pit to the surface of bedrock at the selected locations and sampling the overburden. All fieldwork was conducted with the full-time supervision of Paterson personnel under the direction of a senior engineer.

Sampling and In-situ Testing

Soil samples were recovered with a 50 mm diameter split-spoon sample or from the auger flights and along the sidewalls of the test pits during excavation. The split-spoon, auger and grab samples were classified on site and placed in sealed plastic bags. All samples were transported to Paterson's laboratory. The depths at which the split-spoon, auger and grab samples were recovered from the test holes are presented as SS, AU and G, respectively, on the Soil Profile and Test Data sheets 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 and 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.

Bedrock samples were recovered from BH1-15 to BH5-15, BH7-15 and BH8-15 using a core barrel and diamond drilling techniques. The bedrock samples were classified on site, placed in cardboard core boxes and transported to Paterson's laboratory. The depths at which rock core samples were recovered from the boreholes are presented as RC on the Soil Profile and Test Data sheets in Appendix 1.

The recovery and Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are presented on the Soil Profile and Test Data sheets in Appendix 1. The recovery value is the length of the bedrock sample recovered over the drilled length. The RQD value is the total length of intact rock pieces longer than 100 mm over the drilled length. The values indicate the bedrock quality ranges from poor to excellent.

Flexible polyethylene standpipes were installed in several of the boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. Two monitoring wells have been installed at BH4-15 and BH5-15.

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

Previous Investigation

A previous field investigation was completed by others and consisted of extending a total of 32 boreholes. The borehole locations are presented on Drawing PG3202-2 - Site Plan - Existing Conditions included in Appendix 2. Although, the test holes were completed by others, Paterson confirms that the subsurface information provided is similar to the subsurface soil and bedrock conditions encountered at the boreholes completed as part of our current investigation.

Also, monitoring wells were installed at all borehole locations with the exception of BH 1, BH15, BH25, BH27, BH28, BH30 to monitor the groundwater level subsequent to the completion of the sampling program. The groundwater observations recorded during the previous investigation are discussed in Subsection 4.3 and the results are detailed in the Log of Boreholes sheets presented in Appendix 1.

3.2 Field Survey

The ground surface elevations at the test hole locations were surveyed by Paterson personnel based on available topographic survey plans. The ground survey elevations at the test hole locations are referenced to the ‘Job Bench Mark #4, consisting of the bolt in the side of the existing foundation wall with an assigned geodetic elevation of 54.342 m provided on the drawing prepared by DSEL. The locations of the test holes and the ground surface elevations for each test hole are presented on Drawing PG3202-2 - Site Plan - Existing Conditions in Appendix 2.

The ground surface elevations at the borehole locations completed by others are assumed to be referenced to a Geodetic datum.

3.3 Laboratory Testing

The soil samples and bedrock cores from our investigation were recovered from the subject site and visually examined in Paterson’s laboratory to review the field logs.

Sample Storage

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

4.0 Observations

4.1 Surface Conditions

The subject site is located at 3, 4, and 6 Booth Street; encompassing the majority of Chaudière and Albert Islands in the City of Ottawa, Ontario. Albert Island located on the west side of Booth Street is occupied by several former industrial buildings along with asphalt and gravel covered parking areas. The existing building locations are presented in Drawing PG3202-2 - Site Plan - Existing Conditions in Appendix 2. Albert Island is relatively flat and bordered by a concrete retaining wall. Buchanan Channel and Slide Channel borders the Island to the north and south, respectively.

Chaudière Island is split in an east and west portions divided by Booth Street. Phase I of the proposed development is located within the west portion of the island. The west portion of Chaudière Island is located to the north of Albert Island and is occupied by several former Industrial buildings and the remainder of the site consists with asphalt, gravel and landscaping areas. The site is relatively flat and slightly above the Buchanan Channel to the south and approximately 10 m above the Ottawa River bordered to the north. The east portion of Chaudière Island is currently occupied by a three to four storey former industrial building and the remainder of the site consists of asphalt, gravel and landscaping areas. Historical aerial photographs of the site indicate previous in-filled areas and building additions constructed over the years across the site. Relevant aerial photographs are presented in Appendix 2. The east portion of Chaudière Island slopes gradually down towards the east and slopes significantly downward within the south, east and northwest boundaries of the west portion of the island.

4.2 Subsurface Profile

Generally, the subsurface profile encountered at the boreholes consist of a pavement structure, concrete slab or gravel fill overlying varying fill materials, consisting brown silty sand with crushed stone, wood debris and/or limestone bedrock. The majority of the borehole locations completed within the interior of the existing building footprints encountered a concrete slab poured directly over a limestone bedrock surface, which the exception of BH 3-15 where an approximate 1.5 m deep void was encountered between the concrete slab and underlying fill material and BH 6-15 where the borehole was terminated within the fill material below the concrete floor slab. A deep layer of sand and gravel fill material was encountered at the borehole locations completed by others along the west and north boundaries of Chaudière Island. A peat layer was encountered at one borehole location completed by DST (BHMW7) at a 4.6 m depth. The majority of the boreholes and test pits completed within the site encountered a shallow limestone bedrock below the overburden layers. Refer to the Soil Profile and Test Data sheets in Appendix 1.

Subsurface Profile at Existing Foundations - Buildings 508-A and 509

Three (3) test pits were excavated along the building foundations of selected buildings. TP 1 and TP 3 were excavated along the exterior side of the foundation wall for Building 509 and TP 2 was excavated along the interior side of the foundation wall within the basement level of Building 508-A. Based on field observations, a basement level was observed within Building 509, which extends to an approximate 51.8 m elevation. However, the exterior test pits at Building 509 were terminated over the bedrock surface at a 52.6 m elevation, which indicates that the existing foundation wall was poured directly against a vertical bedrock excavation face. TP 2 encountered the bedrock surface at a 49.8 m elevation. However, no footing was observed below the concrete foundation wall.

Bedrock

Weathered limestone bedrock was encountered at depths ranging between 0.3 m and 6 m below the existing ground surface. Bedrock was cored at the majority of the borehole locations for the current and previous investigations with the exception of BH6-15, BH1, BH15, BH25, BH27, BH28, BH30. Based on the coring results, rock quality designation (RQD) values were calculated for the rock core and the quality of the bedrock was assessed based on these results. Generally, based on these results, the upper 1.0 to 2.0 m of the bedrock is poor to fair quality. The remainder of the bedrock is generally fair to excellent quality.

Based on available geological mapping, the subject site is located in an area where the bedrock consists of interbedded limestone and shale of the Veralum Formation.

4.3 Groundwater

Groundwater levels (GWL) were measured in the standpipes and monitoring wells from the current investigation are presented in Table 1. Also, the previous groundwater measurements from others have been provided in the table below. Groundwater levels are subject to seasonal fluctuations and will be primarily controlled by the nearby dam and the Ottawa River level. Therefore, the groundwater level may vary at the time of construction. The groundwater level reading at BH1-15 and BH2-15, which are located near the Buchanan Channel, were noted to be above the existing floor slab. It should be noted that the water level within the adjacent Buchanan Channel is at an approximate elevation of 53.0 m. It is anticipated that the water within the adjacent Buchanan Channel is hydraulically connected to the groundwater within the upper portion of the weathered bedrock observed at the nearby borehole locations.

Table 1 - Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels		Recording Date
		Depth (m)	Elevation (m)	
*BH1-15	51.99	-0.11	52.10	August 5, 2015
*BH2-15	51.73	-0.50	52.23	August 5, 2015
BH3-15	51.80	0.42	51.38	August 5, 2015
*BH4-15	53.21	2.35	50.86	August 5, 2015
*BH5-15	52.45	2.26	50.19	August 5, 2015
* BHMW2	53.90	2.30	51.60	August 1, 2006
* BHMW3	54.12	1.70	52.42	August 1, 2006
BHMW4	54.16	1.80	52.36	August 1, 2006
* BHMW5	55.51	6.70	48.81	August 1, 2006
BHMW6	53.72	0.90	52.82	August 1, 2006
BHMW7	53.40	4.50	48.90	August 1, 2006
BHMW8	53.62	Dry	-	August 1, 2006
* BHMW9	53.75	3.90	49.85	August 1, 2006
* BHMW19	53.31	8.20	45.11	August 1, 2006

Borehole Number	Ground Elevation (m)	Groundwater Levels		Recording Date
		Depth (m)	Elevation (m)	
BHMW10	53.59	6.80	46.79	August 1, 2006
* BHMW11	53.60	7.60	46.00	August 1, 2006
* BHMW12	53.61	6.30	47.31	August 1, 2006
* BHMW13	53.83	1.30	52.53	August 1, 2006
* BHWM14	53.06	3.60	49.46	August 1, 2006
BHMW16	51.81	5.90	45.91	August 1, 2006
BHMW17	52.43	6.10	46.33	August 1, 2006
* BHMW18	53.26	15.60	37.66	August 1, 2006
* BHMW21	49.68	7.60	42.08	August 1, 2006
* BHMW22	47.64	4.50	43.14	August 1, 2006
* BHMW26	52.94	9.30	43.64	August 1, 2006
* BHMW31	53.64	1.70	51.94	August 1, 2006
* BHMW32	53.83	3.70	50.13	August 1, 2006

Notes:

- The ground surface elevations at the borehole locations from the current investigation were surveyed by Paterson personnel and are referenced to a geodetic datum.
- * Denotes monitoring wells sealed within the bedrock surface.

5.0 Discussion

5.1 Geotechnical Assessment

The subject site is considered satisfactory from a geotechnical perspective, for the proposed mixed use development, which includes one 20 storey structure and several two to six storey structures. Also, the current phase (Phase 1) of the proposed development includes the construction of one level of underground parking spanning from Block 206/207 south to 205A. It is expected that the proposed buildings will be founded on conventional spread footings placed over a clean, surface sounded bedrock surface.

Bedrock removal will be required to complete the underground parking level and portions of the site service alignments. Line drilling and hoe ramming or controlled blasting, where large quantities of bedrock need to be removed, may be required. The blasting operations should be planned and completed under the guidance of a professional engineer with experience in blasting operations.

It is anticipated that the proposed underground parking level will require a groundwater waterproofing system based on the groundwater observations at the boreholes completed within the basement level of the existing buildings along the Buchanan Channel.

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

5.2 Site Preparation

Stripping Depth

Topsoil and deleterious fill, such as material containing organics, should be stripped from under any buildings, paved areas, pipe bedding, and other settlement sensitive structures.

Due to the shallow depth of the bedrock at the subject site and the anticipated founding level for the proposed structure, all existing overburden material is expected to be excavated from within the footprint of the proposed structure(s). Bedrock excavation will be required for the construction of the basement level.

Bedrock Removal

Based on the volume of the bedrock encountered in the area, line-drilling in conjunction with hoe-ramming and/or controlled blasting should be required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be completed prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

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

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

Excavation side slopes in sound bedrock can be constructed using almost vertical side walls. A minimum 1 m horizontal ledge, should remain between the overburden excavation and bedrock surface to provide an area to allow for potential sloughing and a stable base for the overburden shoring system.

Vibration Considerations

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

The following construction equipments could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to be limited.

Two parameters are used to determine the permissible vibrations, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). The guidelines are for current construction standards.

Considering that the guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended to be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement and Placement of Excavated Blast Rock

Fill placed 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 maximum 300 mm thick lifts and compacted to 98% of standard Proctor maximum dry density (SPMDD).

As an alternative to the above, well graded blast rock from the excavation operation may be placed to backfill between footings, provided the largest size of blast rock is less than 300 mm. The material should be inspected and approved by the geotechnical engineer prior to placement. The backfilled areas between footings will also have to accommodate underfloor slab services and underfloor drainage required as part of the proposed sub-slab waterproofing system. The material should be placed in 300 mm lifts and compacted to a minimum density of 95% of the SPMDD.

5.3 Foundation Design

The majority of footings for the proposed structures within Phase 1 of the proposed development will be placed on surface sounded bedrock bearing surface. For buildings to be located along north and west portions of Chaudiere Island and at locations within the former building footprints with second basement levels or deep basement areas, bedrock may not be encountered at the proposed founding elevation. Consideration should be given to extending the footings to the bedrock surface or using lean concrete filled trenches. Figure 9 in Appendix 2 presents a lean concrete in-filled trench option for areas where bedrock is encountered below proposed footing level.

Bearing Resistance Values

Footings placed on a clean surface sounded limestone bedrock surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **3,000 kPa** incorporating a geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS and a bearing resistance value at serviceability limit states (SLS) of **1,000 kPa**.

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

For the excavated areas, sound bedrock will be encountered. A factored bearing resistance value at ULS of **5,000 kPa**, incorporating a geotechnical resistance factor of 0.5, and a bearing resistance at SLS of **3,000 kPa** could be used if founded on limestone bedrock and the bedrock is free of seams, fractures and voids within 1.5 m below the founding level. This should be verified by completing and probing 50 mm diameter drill holes to a depth of 1.5 m below the founding level within the footprint(s) of the footing(s). At least one drill hole should be completed per major footing. The drill hole should inspected be by the geotechnical consultant prior to placing reinforcing steel or concrete.

Since the footings will be placed on an area that has been previously blasted or hoe-rammed, the bedrock surface may not be level. The contractor should consider placing a lean-concrete mud slab to provide a level surface prior to placing reinforcing steel.

Lean Concrete Filled Trenches

For the deeper areas where mass excavation is not practical to access the underlying bedrock surface, consideration should be given to excavating vertical trenches to expose the underlying bedrock surface and backfilling with lean concrete (**20 MPa** 28-day compressive strength). Typically, the excavation side walls will act as the form to support the concrete. The additional width of the concrete poured against an undisturbed trench sidewall will suffice in providing a direct transfer of the footing load to the underlying bedrock.

The effectiveness of this operation will depend on the ability of maintaining vertical trenches until the lean concrete can be poured. Once the excavation is exposed, Paterson recommends excavating several test pits to delineate the bedrock surface, to assess the water infiltration and stability of the excavation sidewalls. Water infiltration is dependant on the depth and type of backfill materials encountered. The groundwater may be temporarily controlled by pumping groundwater within one or two deep test pits for a few days in advance of trenching.

The trench excavation should be a minimum of 300 mm beyond the footing perimeter to the base of the excavation. If the bedrock is sloping significantly, consideration should be given to hoe ramming the bedrock surface to create a relatively flat shelf. The excavation bottom should be relatively clean using the hydraulic shovel only (workers will not be permitted in the excavation below a 1.5 m depth). Once approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation. Refer to Figure 9 - Trench Footing Detail enclosed in Appendix 2.

Footings placed on lean concrete filled trenches up to 5 m in depth extending to the limestone bedrock surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **3,000 kPa** incorporating a geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS and a bearing resistance value at serviceability limit states (SLS) of **1,500 kPa**.

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 sound bedrock bearing medium when a plane extending vertically and horizontally from the footing perimter at a minimum of 1H:6V (or shallower) passing through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete.

In the upper levels of the bedrock where the weathered and highly fractured bedrock may be encountered, the bearing medium will require a lateral support zone of 1H:1V (or shallower). The weathered portion of the bedrock is a relatively thin layer (in most cases less than 0.5 m) and is considered to behave similar to a soil condition.

Settlement

Footings bearing on an acceptable bedrock bearing surface and designed using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

5.4 Design for Earthquakes

A site specific shear wave velocity test was completed to accurately determine the applicable seismic site classification for foundation design of the proposed building as presented in Table 4.1.8.4.A of the Ontario Building Code 2012. A seismic shear wave velocity test was completed by Paterson at the subject site. Two shear wave velocity profiles are presented in Appendix 2.

Field Program

The shear wave test location is presented in Drawing PG3202-2 - Site Plan - Existing Conditions in Appendix 2. Paterson field personnel installed 24 horizontal geophones in a straight line oriented roughly in a north-south direction along the west site boundary. The 4.5 Hz. horizontal geophones were mounted to the surface by means of two 75 mm ground spikes attached to the geophone land case. The geophones were spaced at 1 m intervals and connected by a geophone spread cable to a Geode 24 Channel seismograph.

The seismograph was connected to a computer and a trigger switch attached to a 12 pound dead blow hammer. The hammer trigger sends a signal to the seismograph to commence recording. The hammer strikes an I-Beam seated into the ground surface, which produces a polarized shear wave. The shots are repeated between four to eight times at each shot location to provide an accurate signal and reduce noise. The shot locations are completed in forward and reverse directions (i.e.- striking both sides of the I-Beam seated parallel to the geophone array). The shot locations were distributed at the centre of the geophone array, 2, 3, and 20 m away from the first and 2, 3 and 10 m from the last geophone.

The test method completed by Paterson are guided by the standard test procedures outlined by expert seismologists at Carleton University and Geological Survey of Canada (GSC).

Data Processing and Interpretation

Interpretation for the shear wave velocity results were completed by Paterson. The shear wave velocity measurement was calculated by the reflection/refraction methods. The interpretation is performed by recovering arrival times from direct and refracted waves. The interpretation is repeated at each shot location to provide an average shear wave velocity, V_{s30}, immediately below the proposed building foundation of the upper 30 m profile. To compute the bedrock depth at each location, the layer intercept times, velocities from different layers and critical distances are interpreted from the shear wave graphs. The bedrock velocity was interpreted by the main refractor wave velocity, which is considered a conservative estimate of the bedrock velocity due to the increasing quality of the bedrock with depth. As bedrock quality increases, the bedrock shear wave velocity increases.

Based on our analysis, the bedrock seismic shear wave velocity was calculated to be an average of 2,472 m/s. The fill overlying the bedrock has an average shear wave velocity of 222 m/s. It is anticipated that all building foundations will be extended to bedrock surface within the current phase of the proposed development. The V_{s30} was calculated using the standard equation for average shear wave velocity from the Ontario Building Code (OBC) 2012, as presented below:

$$V_{s30} = \frac{Depth_{OfInterest}(m)}{\left(\frac{(Depth_{Layer1}(m)}{Vs_{Layer1}(m/s)} + \frac{Depth_{Layer2}(m)}{Vs_{Layer2}(m/s)}\right)}$$

$$V_{s30} = \frac{30m}{\left(\frac{0m}{222m/s} + \frac{30m}{2{,}472m/s}\right)}$$

$$V_{s30} = 2{,}472m/s$$

Based on the seismic results, the average shear wave velocity, V_{s30}, for shallow foundations located at the subject site is 2,472 m/s. Therefore, a **Site Class A** is applicable for design of the proposed building at the subject site, as per Table 4.1.8.4.A of the OBC 2012. The soils underlying the subject site are not susceptible to liquefaction.

5.5 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure(s). However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m^3. A portion of the basement walls are to be poured against a composite drainage blanket, which will be placed against the exposed bedrock face. A nominal coefficient of at-rest earth pressure of 0.05 is recommended in conjunction with a bulk unit weight of 23.5 kN/m^3 (effective 15.5 kN/m^3). A seismic earth pressure component will not be applicable for the foundation wall, which is to be poured against the bedrock face. The seismic earth pressure is expected to be transferred to the underground floor slabs, which should be designed to accommodate the associated pressures. A hydrostatic groundwater pressure should be added for the portion below the groundwater level.

Undrained conditions are anticipated (i.e. below the groundwater level). Therefore, the applicable effective unit weight of the retained soil can be calculated with 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Two distinct conditions, static and seismic, should be reviewed for design calculations. The parameters for design calculations for the two conditions are presented below.

Lateral Earth Pressures

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

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. Note that surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

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

Seismic Conditions

The seismic earth pressure (ΔP_{AE}) can be calculated using the earth pressure distribution equal to $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ 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 0.32g according to OBC 2012. 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:

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

The earth pressures calculated are unfactored. For the ULS case, the earth pressure loads should be factored as live loads, as per OBC 2012.

5.6 Basement Slab

The bedrock surface, approved granular fill or lean concrete mudslab will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction with the removal of all topsoil and deleterious fill, such as material containing organics, within the proposed building(s) footprint.

The basement area for the proposed buildings will be mostly parking and the recommended pavement structure noted in Subsection 5.7 will be applicable. However, if storage or other uses of the lower level where a concrete floor slab will be constructed, the upper 300 mm of sub-slab fill is recommended to consist of 19 mm clear crushed stone. The upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone for slab on grade construction. All backfill material within the footprint of the proposed building(s) should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

All soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. All backfill material within the footprint of the proposed building(s) should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

In consideration of the groundwater conditions encountered at the time of the current and previous fieldwork, a subfloor drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the clear stone under the lower basement floor (discussed in Subsection 6.1).

5.7 Rock Anchor Design

Overview of Anchor Features

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or a 60 to 90 degree pullout of rock cone with the apex of the cone near the middle of the bonded length of the anchor. Interaction may develop between the failure cones of anchors that are relatively close to one another resulting in a total group capacity smaller than the sum of the load capacity of each individual anchor.

A third failure mode of shear failure along the grout/steel interface should be reviewed by the structural engineer to ensure all typical failure modes have been reviewed. Typical rock anchor suppliers, such as Dywidag Systems International (DSI Canada), have qualified personnel on staff to recommend appropriate rock anchor size and materials.

Centre-to-centre spacing between anchors should be at least four times the anchor hole diameter and greater than 1/5 of the total anchor length (minimum of 1.2 m) to lower the group influence effects. Anchors in close proximity to each other are recommended to be grouted at the same time to ensure any fractures or voids are completely in-filled and grout does not flow from one hole to an adjacent empty one.

The anchor be provided with a bonded length at the base of the anchor which will provide the anchor capacity, as well an unbonded length between the rock surface and the top of the bonded length.

Permanent anchors should be provided with corrosion protection. As a minimum, the entire drill hole should be filled with cementious grout. The free anchor length is provided by installing a plastic sleeve to act as a bond break, with the sleeve filled with grout or a corrosion inhibiting mastic. Double corrosion protection can be provided with factory assembled systems, such as those available from Dywidag Systems International or Williams Form Engineering Corp. Recognizing the importance of the anchors for the long term performance of the foundation of the proposed buildings, the rock anchors for this project are recommended to be provided with double corrosion protection.

Grout to Rock Bond

The Canadian Foundation Engineering Manual recommends a maximum allowable grout to rock bond stress (for sound rock) of 1/30 of the unconfined compressive strength(UCS) of either the grout or rock (but less than 1.3 MPa) for an anchor of minimum length (depth) of 3 m. Generally, the UCS of Limestone ranges between about 50 and 100 MPa, which is stronger than most routine grouts. A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.3, can be calculated. A minimum grout strength of 40 MPa is recommended

Rock Cone Uplift

As discussed previously, the geotechnical capacity of the rock anchors depends on the dimensions of the rock anchors and the configuration of the anchorage system. Based on existing bedrock information, a **Rock Mass Rating (RMR) of 65** was assigned to the bedrock, and Hoek and Brown parameters (**m and s**) were taken as **0.575 and 0.00293**, respectively.

Recommended Rock Anchor Lengths

Rock anchor lengths can be designed based on the required loads. Rock anchor lengths for some typical loads have been calculated and are presented in Table 3. Load specified rock anchor lengths can be provided, if required.

For our calculations the following parameters were used:

Table 2 - Parameters used in Rock Anchor Review	
Grout to Rock Bond Strength - Factored at ULS	1.0 MPa
Compressive Strength - Grout	40 MPa
Rock Mass Rating (RMR) - Good quality Limestone Hoek and Brown parameters	65 m=0.575 and s=0.00293
Unconfined compressive strength - Limestone bedrock	50 MPa
Unit weight - Submerged Bedrock	15 kN/m^3
Apex angle of failure cone	60°
Apex of failure cone	mid-point of fixed anchor length

The fixed anchor length will depend on the diameter of the drill holes. Recommended anchor lengths for a 75 mm and 125 mm diameter hole are provided in Table 3. The factored tensile resistance values given in Table 3 are based on a single anchor with no group influence effects. A detailed analysis of the anchorage system, including potential group influence effects, could be provided once the details of the loading for the proposed buildings are determined.

Table 3 - Recommended Rock Anchor Lengths - Grouted Rock Anchor

Diameter of Drill Hole (mm)	Anchor Lengths (m)			Factored Tensile Resistance (kN)
	Bonded Length	Unbonded Length	Total Length	
75	1.5	1.5	3	500
	2.5	2	4.5	1000
	5.5	3	8.5	2000
125	1.5	1	2.5	500
	2.5	1.5	4	1000
	4	2	6	2000

Other considerations

The anchor drill holes should be within 1.5 to 2 times the rock anchor tendon diameter, inspected by geotechnical personnel and should be flushed clean prior to grouting. A tremie tube is recommended to place grout from the bottom of the anchor holes. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day that grout is prepared.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on testing can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day grout is prepared.

5.8 Pavement Design

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and local roadways.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas

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

Table 5 - Recommended Pavement Structure - 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
400	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type I or Type II material.

The pavement granulars (base and subbase) should be placed in maximum 300 mm thick layers and compacted to a minimum of 100% of the materials' SPMDD using suitable compaction equipment. Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

Table 6 - Recommended Rigid Pavement Structure - Lower Parking Level

Thickness (mm)	Material Description
150	**32 MPa Concrete**
300	**BASE** - OPSS Granular A Crushed Stone or 19 mm Clear Crushed Stone
SUBGRADE - Existing imported fill, or OPSS Granular B Type I or II material placed over bedrock.	

Pavement Design over Parking Garage

All pavement designs overtop of the parking garage area should be approved by the structural engineer to ensure loads are compatible with the parking garage structure design.

It is understood that consideration is being given to placing brick pavers over the parking garage structure. The following brick paver bedding structures are recommended for walking paths and access lanes over the garage structure.

Table 7 - Recommended Pavement Structure - Walking Paths (No Vehicle Traffic)

Thickness mm	Material Description
60	**WEAR COURSE -** Brick Paver
25	**LEVELLING COURSE -** Stone Dust and/or powdered grout
200	**BASE** - OPSS Granular A Crushed Stone

SUBGRADE - Either rigid insulation (HL-40 or equivalent) and/or composite drainage blanket (Terra Drain 900 or equivalent).
Note - Brick Pavers should comply with ASTM Designation: C0902-09.

Table 8 - Recommended Pavement Structure - Access Lanes and Vehicle Parking

Thickness (mm)	Material Description
80	**Wear Course -** Brick Paver
25	**Levelling Course -** Stone Dust and/or powdered grout
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II

SUBGRADE - Either rigid insulation (HL-40 or equivalent) and/or composite drainage blanket (Terra Drain 900 or equivalent).
Note - Brick Pavers should comply with ASTM Designation: C1272-07

6.0 Design and Construction Precautions

6.1 Foundation Drainage, Waterproofing and Backfill

Excavation Bottom Water Infiltration Control Measures

Most of the lower parking level is anticipated to be founded on sound bedrock. An inspection is recommended to be completed by the geotechnical engineer to determine if any significant bedrock fissures are water bearing causing significant water infiltration volumes. Although the sound limestone should be relatively watertight, any significant water infiltration from vertical fissures are recommended to be chemically grouted to reduce the volume of water infiltration to allow for a relatively dry excavation base.

Foundation Walls and Excavation Base for Waterproofing Requirements

For exposed bedrock areas below the water table, the bedrock surface should be prepared by spraying on a 75 mm thick layer of shotcrete and/or a sprayed on elastomeric membrane. The composite drainage layer can then be placed over the membrane prior to forming and pouring the concrete foundation wall.

Foundation Backfill

Above the bedrock surface, backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for placement as backfill against the foundation walls, unless placed in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

An insulation detail can be incorporated in the shoring design for the vertical portion for the upper 1.5 m depth below the exterior finished grade. A horizontal insulation detail should also be required for the sidewalks, entrances and any other areas sensitive to frost or settlement movements. The entrance slabs should be anchored to the building to avoid any potential differential movements. Consideration should also be given to subexcavating the fill material beneath any movement sensitive areas and replaced with a free-draining non frost susceptible granular material. Imported granular materials, such as clean sand or OPSS Granular B Type I pit run, Granular B Type II or Granular A materials can be used for this purpose.

6.2 Protection of Footings Against Frost Action

The parking garage is expected to not require protection against frost action due to the founding depth. Unheated structures such as the access ramp may required to be insulated against the deleterious effect of frost action.

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with adequate foundation insulation, should be provided. More details regarding foundation insulation can be provided, if requested.

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

It should be noted that the weathered limestone bedrock should be considered frost susceptible. However, a surface sounded limestone bedrock free of voids and soil in-filled seams within the upper 1 m below the footing can be considered a non-frost susceptible surface. A 50 mm probe hole extending at least 1 m below the bearing surface can be inspected by the geotechnical consultant at the time of construction to determine if a bedrock surface can be considered non-frost susceptible or not.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be excavated at acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled. Sufficient room is expected to be available to permit the building excavation(s) to be constructed 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 excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soil 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 directly at the top of excavations and heavy equipment should maintain safe working distance 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.

A trench box is recommended to be installed at all times to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not be remain exposed for extended periods of time.

In bedrock, almost vertical side slopes can be used provided that all loose rock and blocks with unfavourable weak planes are removed or stabilized with rock anchors.

_____Temporary Shoring

Should temporary shoring be required for support of the overburden soil, where insufficient room is available for open cut methods, additional information can be provided when the final design details are known.

6.4 Pipe Bedding and Backfill

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

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes for a soil subgrade. The bedding thickness should be increased to 300 mm for areas where the subgrade consists of bedrock. 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. 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.

The site excavated material may be placed above cover material if the excavation operations are completed in dry weather conditions. All stones greater than 200 mm in their longest dimension should be removed prior to the materials being reused. Well graded bedrock should be acceptable as backfill provided the rock fill is placed only from at least 300 mm above the top of the service pipe and all stones 200 mm or larger in the longest dimension are removed.

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 225 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD. No stones 200 mm or greater in the longest dimension should be placed. Within the frost zone (1.8 m below finished grade), non frost susceptible materials should be used when backfilling trenches below the original bedrock level.

6.5 Groundwater Control

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

The flow of groundwater into the excavation through the overburden materials is expected to be controllable using properly sized pumps and dewatering system.

A temporary Ontario Ministry of Environment (MOE) permit to take water (PTTW) will be required for this project since more than 50,000 L/day are to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MOE. The permit will be valid for the duration of the construction program from the time of issuance.

6.6 Winter Construction

Precaution must be provided where excavations are completed within close proximity of existing structures, which may be adversely affected due to the freezing conditions. In particular, where a shoring system is constructed, 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.

The subsurface soil conditions 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. 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.

6.7 Geotechnical Slope Review

Slope Condition Field Review

The slope stability analysis was completed using topographical mapping, as well as, a site visit to review slope condition by Paterson personnel. The site visit for the slope condition review was completed on March 21, 2014 to review the existing conditions around the perimeter of Chaudière and Albert Islands.

Some signs of erosion were noted in areas within the east portion of Chaudière Island where fill materials were observed at the water's edge. Minor sloughing failures were also noted in the lower portion of the slopes, leaving some exposed roots along the slope face.

For discussion purposes, Chaudière Island is divided into east and west portions by Booth Street which bisects the Island in a north and south direction.

East Portion of Chaudière Island

Several water channels bordered by concrete retaining walls were observed east of Booth Street within the east portion of Chaudière Island. Several of the water channels are currently dry and no longer in use. The slope stability section (Section G) presented in Figure 8A and Figure 8B included in Appendix 2 provides a slope review, which includes the approximate 10 m high concrete retaining wall(s) along the south side of Chaudière Island which extends approximately 150 m east of Booth Street. A photograph (Photograph 1) of the existing retaining wall is presented in Appendix 2.

The existing retaining wall is located at the approximate location of a former industrial building which is illustrated within the Aerial Photograph 1928 included in Appendix 2. Based on the aerial photograph from 1928, the eastern tip of Chaudière Island consists of a narrow channel with some bedrock outcrops extending from the surface of the water at that time. The aerial photographs between 1928 to 1967 indicate a narrow channel at the eastern tip of the Chaudière Island, which was in-filled at the time of our inspection. Figure 3A, 3B, 4A, 4B, 5A and 5B included illustrates the inferred bedrock depth and fill thickness at Slope Cross Section B, C and D, respectively. The slope stability sections are presented in Drawing PG3202-2 - Existing Conditions - Site Plan in Appendix 2. Photograph 2 and 3 were taken of the existing snow covered slope at the eastern tip of Chaudière Island, which is represented by Section B, C and D.

The north side of Chaudière Island, is occupied by an existing industrial building and a 2.5 to 3.5 m high wood-timber retaining wall (Photograph 3). The existing wood-timber retaining wall was observed to be in poor to fair condition. Based on the aerial photograph from 1928 and 1950 and our site visit observations (Photograph 4), a portion of the north edge of Chaudière Island near Booth Street was partially in-filled. Also, a bedrock outcrop was observed at the water’s edge on both sides of the in-filled area during our site visit. The area is represented by Section E and F for slope stability analysis purposes.

West Portion of Chaudière Island

The north portion of Chaudière Island, west of Booth Street is currently being used by Chaudière Hydro. The north boundary of the west portion is occupied by an approximate 10 m high concrete retaining wall which extends west toward the Chaudière Falls (Photograph 5).

The west portion of Chaudière Island is relatively flat and up to 2 m above the current water level of the Ottawa River. Based on the subsurface soil profile of BHMW6, BHMW7 and BHMW8 the west portion of Chaudière Island consists of imported fill. BHMW6 and BHMW8 terminated in imported fill at depths of 3.7 and 4.3 m below existing ground surface, respectively. BHMW7 was terminated in an organic peat at a depth of 4.9 m below existing ground surface. The majority of the in-filling within the west portion of the island was completed between 1950 and 1967 and the remainder was completed between 1967 and 1989 based on available aerial photographs.

Currently, the south side of Chaudière Island is occupied by an industrial building and a concrete retaining wall bordering the north side of Buchanan Channel which travels between Chaudière Island and Albert Island.

Albert Island

Albert Island is located to the south of Buchanan Channel and to the west of Booth Street. The island is predominantly occupied by a two-storey industrial building, which is surrounded by a concrete retaining wall running along the perimeter of the island (Photographs 7 and 8).

Slope Stability Analysis

The slope stability analysis was calculated with SLIDE, a computer program, which permits a two-dimensional slope stability analysis with several methods including the Bishop's method. The Bishop's Method 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 subsurface soil 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.

Subsurface soil, bedrock and groundwater conditions at the sections were determined based on nearby borehole information, aerial photographs, field observations during the site visit and general knowledge of the area's geology. The soil parameters used in the analysis are summarized in Table 9.

Table 9 - Slope Stability Analysis Parameters			
Static Conditions - Mohr-Coulomb Strength Type			
Soil Type	**Internal Angle of Friction (degrees)**	**Effective Cohesion (kPa)**	**Unit Weight (kN/m^3)**
Imported Fill	31	1	19
Limestone Bedrock	Infinite Strength		
Seismic Loading - Undrained Conditions[1]			
Soil Type	**Internal Angle of Friction (degrees)**	**Effective Cohesion (kPa)**	**Unit Weight (kN/m^3)**
Imported Fill	31	1	19
Limestone Bedrock	Infinite Strength		

Static Conditions Analysis - Existing Conditions

A slope stability analysis considering static conditions was completed for the subject slope sections. The slope stability factors of safety were found to be less than 1.5 at all sections analyzed, except for Section G. Section A, B, C, D, E and F require geotechnical stable slope allowances of 7, 6.8, 1.9, 8, 8.9 and 9.8 m from top of slope under static conditions, respectively. The analysis results when considering the static conditions at the subject sections are presented in Appendix 2.

Seismic Loading Analysis

An analysis considering seismic loading was also completed. A horizontal seismic acceleration, K_h, of 0.16G 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 indicate that the subject slope sections have factors of safety less than 1.1, except Section G. Sections A, B, C, D, E and F require geotechnical stable slope allowances of 7, 7.5, 4, 9.2, 8.9 and 11.1 m from top of slope under seismic loading, respectively. The slope stability results with seismic loading are presented in Appendix 2.

Geotechnical Stable Slope Allowance

The overall geotechncial stable slope allowance for each section is based on the greatest setback between the static and seismic analyses. Based on the results, the geotechnical stable slope allowances are 7, 7.5, 4, 9.2, 8.9 and 11.1 m for Slope Cross Section A, B, C, D, E and F, respectively. The geotechnical stable slope allowance is illustrated in Figure 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 7A, 7B, 8A, 8B and on Drawing PG3202-2- Site Plan - Existing Conditions presented in Appendix 2.

A detailed inspection of the existing wood-timber and concrete retaining walls around the perimeter of the islands should be completed to assess the general condition and construction of the existing walls. Based on Paterson’s cursory review of the exposed concrete retaining walls, the majority of the walls appear to be in fair to good condition. However, the wood-timber retaining wall located to the west of Section D was noted to be in poor to fair condition and will require remedial work or replacement.

Several options are available for a remedial slope program at Sections A, B, C, D, E and F that improve the overall slope stability. The overall objective of a remedial slope program is to provide a stable slope along with an adequate toe erosion protection system. Where required, a stable slope can be provided by removing any previously failed material and placing a series of geogrids along with an appropriate granular fill and reinforced topsoil finish to allow vegetation to re-establish and reduce surficial erosion. Alternatively, a segmental stone or concrete retaining wall and/or rip-rap can be used to provide a stable slope.

7.0 Recommendations

The geotechnical investigation program was completed for design purposes. Once the project development details are further finalized, a detailed geotechnical investigation is recommended to place supplemental boreholes and monitoring wells to address soil, bedrock and groundwater conditions within the vicinity of specific structures for construction purposes.

The foundation design data herein is considered applicable provided that a materials testing and observation services program is completed for the proposed development. The following aspects should be performed by Paterson Group:

❑ Review of the geotechnical aspects of the excavating contractor's shoring design, prior to construction.

❑ Review the bedrock stabilization and excavation requirements.

❑ Review proposed waterproofing and foundation drainage design and requirements.

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

❑ Sampling and testing of the concrete and fill materials.

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

❑ Observation of all subgrades prior to backfilling.

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

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

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

8.0 Statement of Limitations

The recommendations made in this report are for review and design purposes. 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 recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine its suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

A geotechnical investigation is a limited sampling of a site. 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 Windmill Green Fund LPV and their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Joe A. Forsyth, P.Eng.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Jan. 8, 2016
D. J. GILBERT
100116130
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LOG OF BOREHOLES (by others)

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior borehole in basement level of Building 503

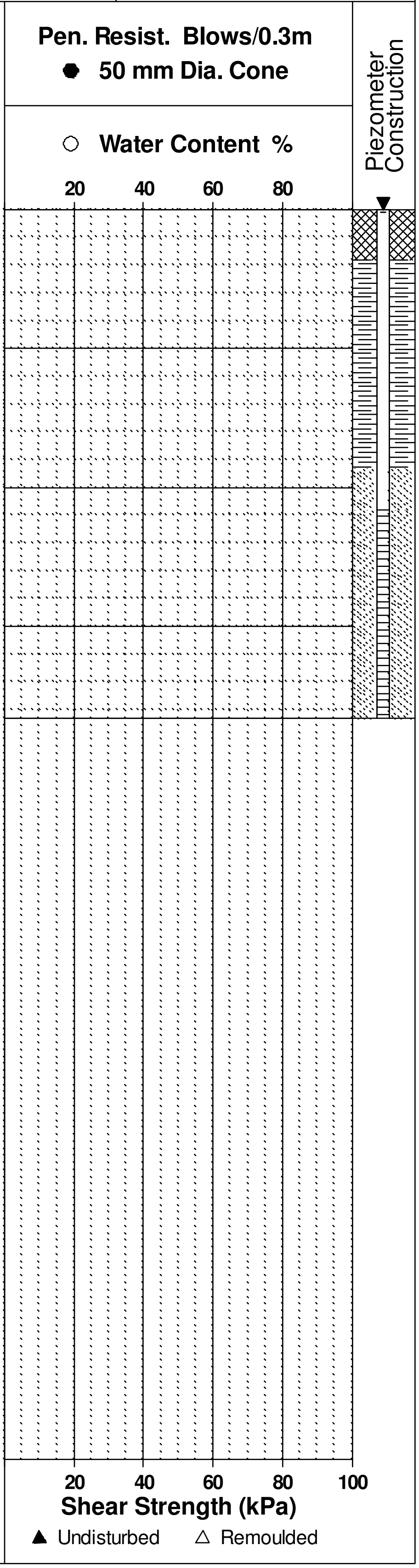
BORINGS BY Portable Drill

DATE July 23, 2015

FILE NO. PG3202

HOLE NO. BH 1-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	51.99
Concrete slab 0.30							
		RC	1	95	68	1	50.99
		RC	2	100	75		
BEDROCK: Poor to fair quality, grey limestone with interbedded shale						2	49.99
		RC	3	96	69		
						3	48.99
		RC	4	100	61		
3.66							
End of Borehole (GWL at ground surface based on field observations) (GWL at 0.11m above ground surface - August 5, 2015)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior borehole in basement level of Building 502

BORINGS BY Portable Drill

DATE July 23, 2015

FILE NO. PG3202

HOLE NO. BH 2-15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	51.73
Concrete slab	RC	1				
					1	50.73
1.24						
	RC	2	67	0		
BEDROCK: Fair to excellent, grey limestone with interbedded shale	RC	3	90	73		
					2	49.73
	RC	4	98	89	3	48.73
3.63						
End of Borehole (GWL at ground surface based on field observations) (GWL at 0.50m above ground surface - August 5, 2015)						

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

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior borehole in basement level of Building 501

BORINGS BY Portable Drill

DATE July 23, 2015

FILE NO. PG3202

HOLE NO. BH 3-15

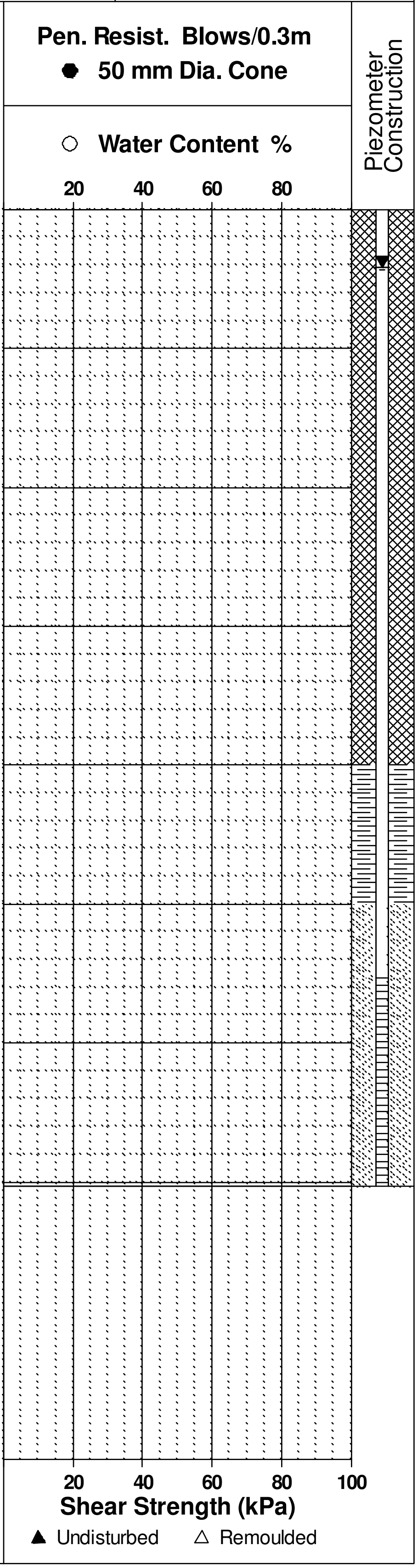
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Concrete slab	RC	1	92	
	RC	2	90	
1.22	RC	3	100	
VOID				
2.70				
FILL: Brown silty sand, some gravel, cobbles, boulders, trace concrete	SS	1	100	50+
	RC	4	50	
	RC	5	7	
	RC	6	17	
6.00	RC	7	77	50
BEDROCK: Excellent quality, grey limestone with interbedded shale	RC	8	85	62
7.03	RC	9	90	65

End of Borehole

Note: Third attempt at borehole, first 2 boreholes terminated on metal plate surface at approx. 0.3m depth.

(GWL @ 0.42m-August 5, 2015)

DEPTH (m)	ELEV. (m)
0	51.80
1	50.80
2	49.80
3	48.80
4	47.80
5	46.80
6	45.80
7	44.80



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior borehole in basement level of Building 501

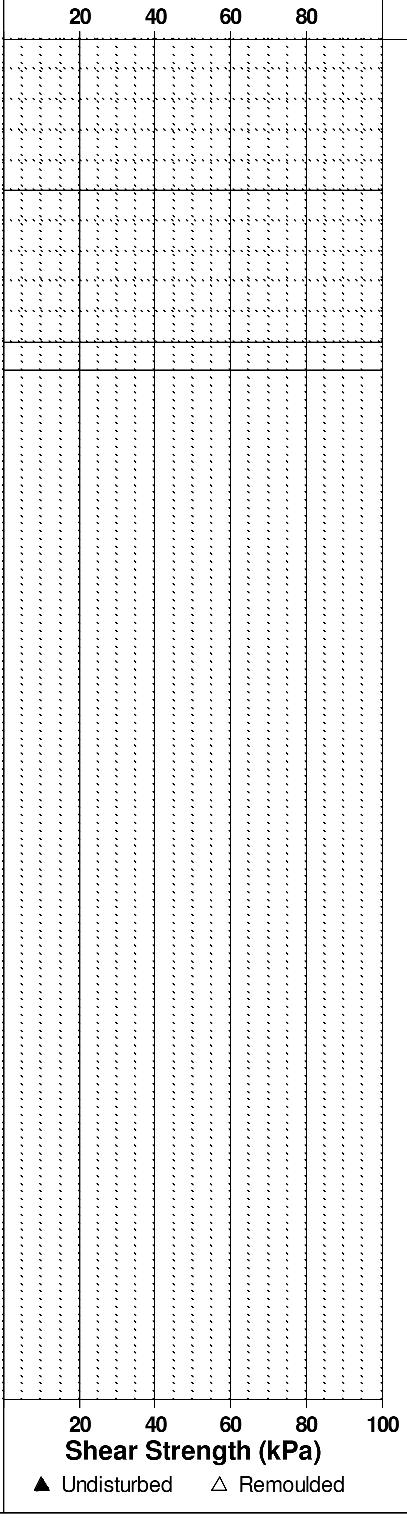
BORINGS BY Portable Drill

DATE August 5, 2015

FILE NO. PG3202

HOLE NO. BH 3A-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone	Piezometer Construction
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %	
						0	51.81		
Concrete slab									
0.53		RC	1	97	53				
						1	50.81		
BEDROCK: Good quality, grey limestone with interbedded shale		RC	2	92	78				
						2	49.81		
2.19									
End of Borehole									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

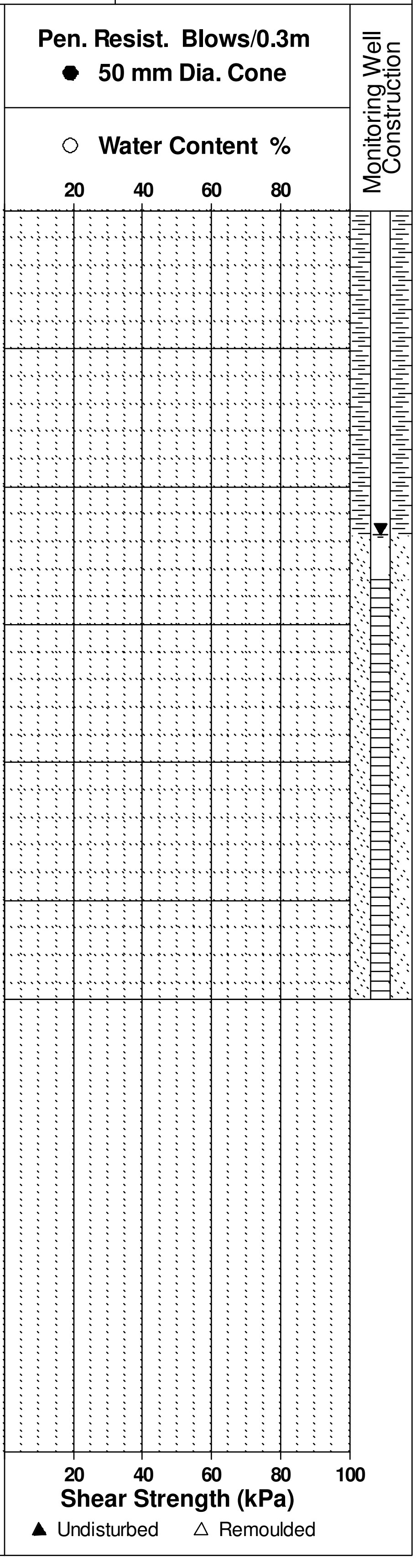
BORINGS BY CME 55 Power Auger

DATE July 24, 2015

FILE NO. PG3202

HOLE NO. BH 4-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
						0	53.21
FILL: Crushed stone with sand, some silt	▨	AU	1				
0.79							
		RC	1	93	36	1	52.21
		RC	2	98	88	2	51.21
BEDROCK: Poor to fair quality, grey limestone with interbedded shale						3	50.21
		RC	3	95	83		
						4	49.21
		RC	4	97	93	5	48.21
5.72							
End of Borehole (GWL @ 2.35m-August 5, 2015)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

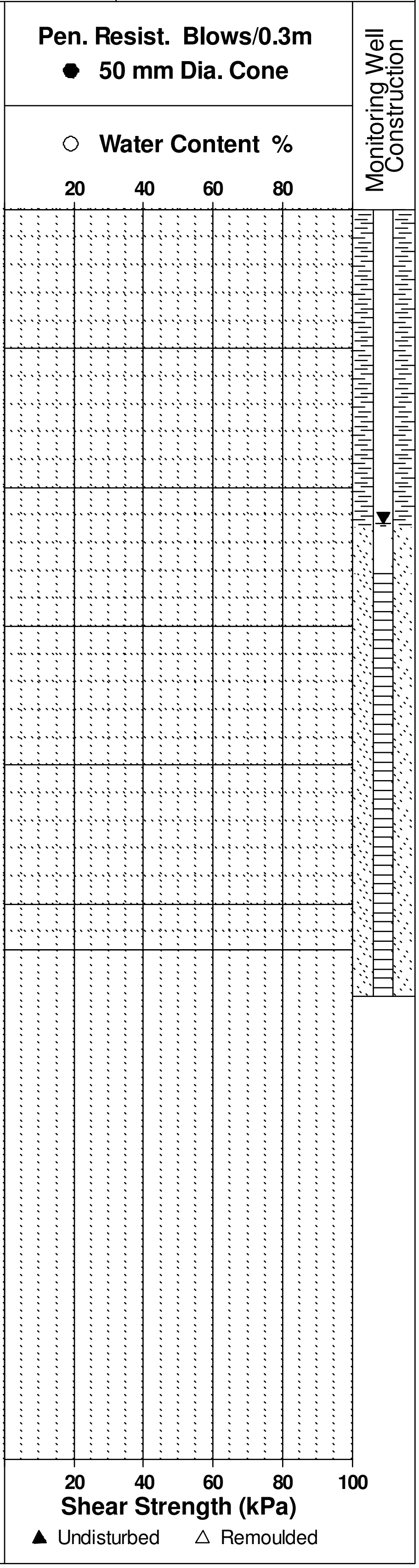
BORINGS BY CME 55 Power Auger

DATE July 24, 2015

FILE NO. PG3202

HOLE NO. BH 5-15

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	52.45
Asphaltic concrete 0.05						
FILL: Crushed stone, some sand 0.79	AU	1				
	RC	1	75	75	1	51.45
	RC	2	95	47	2	50.45
BEDROCK: Poor to good quality, grey limestone with interbedded shale					3	49.45
	RC	3	93	53		
					4	48.45
	RC	4	98	75		
5.66					5	47.45
End of Borehole						
(GWL @ 2.26m-August 5, 2015)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic
REMARKS Interior borehole at ground level of Building 543
BORINGS BY Portable Drill
DATE July 22, 2015
FILE NO. PG3202
HOLE NO. BH 6-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20 40 60 80	
GROUND SURFACE						0	54.24		
Concrete slab 0.15									
FILL: Brown silty sand with gravel, trace cobbles 0.89		SS	1	87	53				
End of Borehole (BH dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior borehole adjacent to concrete column in basement level of Building 501

BORINGS BY Portable Drill

DATE August 5, 2015

FILE NO. PG3202

HOLE NO. BH 7-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	51.61
Concrete slab							
0.66		RC	1	92	67		
						1	50.61
BEDROCK: Poor to fair quality, grey limestone with interbedded shale		RC	2	100	69		
						2	49.61
		RC	3	89	53		
2.49							
End of Borehole							

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior borehole adjacent to concrete column in basement level of Building 501

BORINGS BY Portable Drill

DATE August 5, 2015

FILE NO. PG3202

HOLE NO. BH 8-15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	51.68
Concrete slab 0.36						
BEDROCK: Poor to fair quality, grey limestone with interbedded shale	RC	1	92	77	1	50.68
	RC	2	94	77	2	49.68
2.13 End of Borehole						

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Exterior test pit extended against foundation wall of Building 509

BORINGS BY Backhoe

DATE July 28, 2015

FILE NO. PG3202

HOLE NO. TP 1-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	53.39		
FILL: Dark brown silty sand with gravel, some cobbles, concrete and brick 0.81	▨	G	1						
End of Test Pit TP terminated on bedrock surface at 0.81m depth 300mm thick over poured concrete overlying the bedrock surface, extending 100 to 300mm from the exterior concrete foundation wall.									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Interior test pit extended against foundation wall of Building 508-A

BORINGS BY Backhoe

DATE July 28, 2015

FILE NO. PG3202

HOLE NO. TP 2-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	51.89
Concrete slab — 0.25							
		G	1				
		G	2			1	50.89
FILL: Blast rock with gravel and cobbles, some sand and concrete							
		G	3				
2.08						2	49.89
End of Test Pit TP terminated on bedrock surface at 2.08m depth No footing observed							

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Chaudiere Island & Albert Island
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS Exterior test pit extended against foundation wall of Building 509

BORINGS BY Backhoe

DATE July 28, 2015

FILE NO. PG3202

HOLE NO. TP 3-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	53.41		
FILL: Brown silty sand with crushed stone, trace cobbles, metal and concrete 0.79	▨	G	1						
End of Test Pit TP terminated on bedrock surface at 0.79m depth 100mm thick over poured concrete overlying the bedrock surface, extending 120mm from the exterior concrete foundation wall.									

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

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the 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

SYMBOLS AND TERMS (continued)

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)

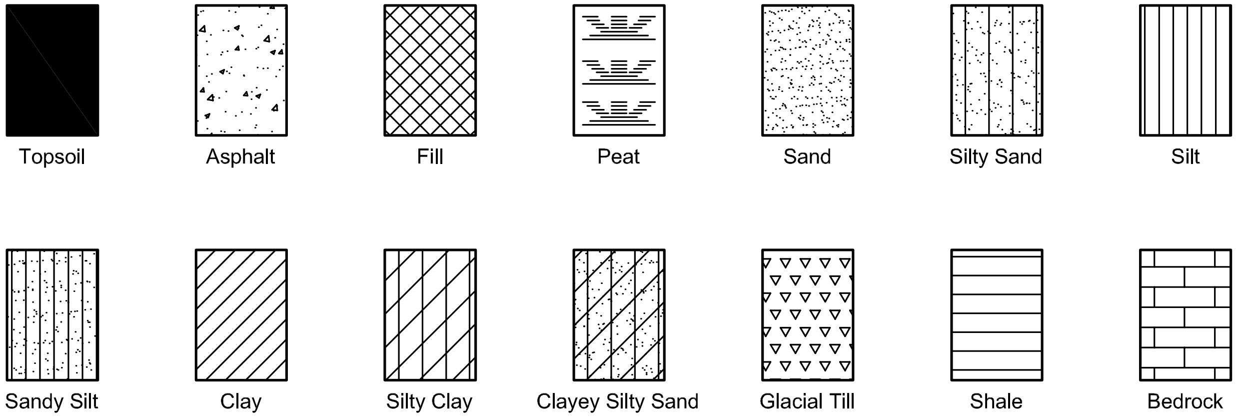
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

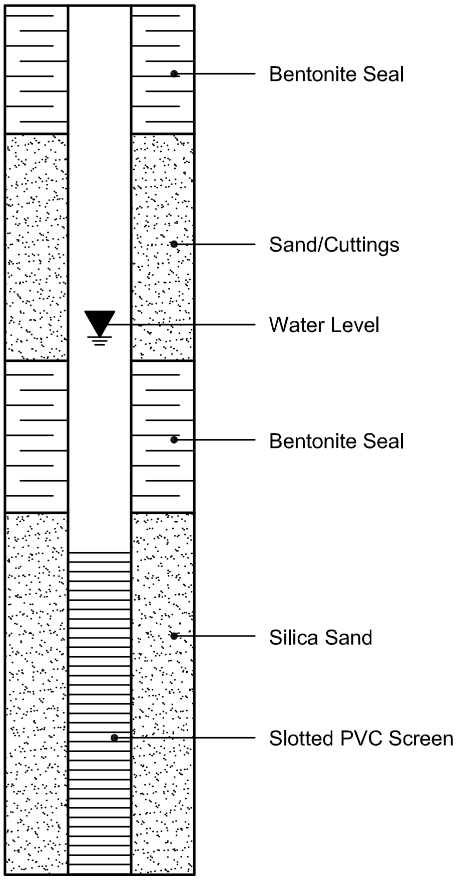
SYMBOLS AND TERMS (continued)

STRATA PLOT

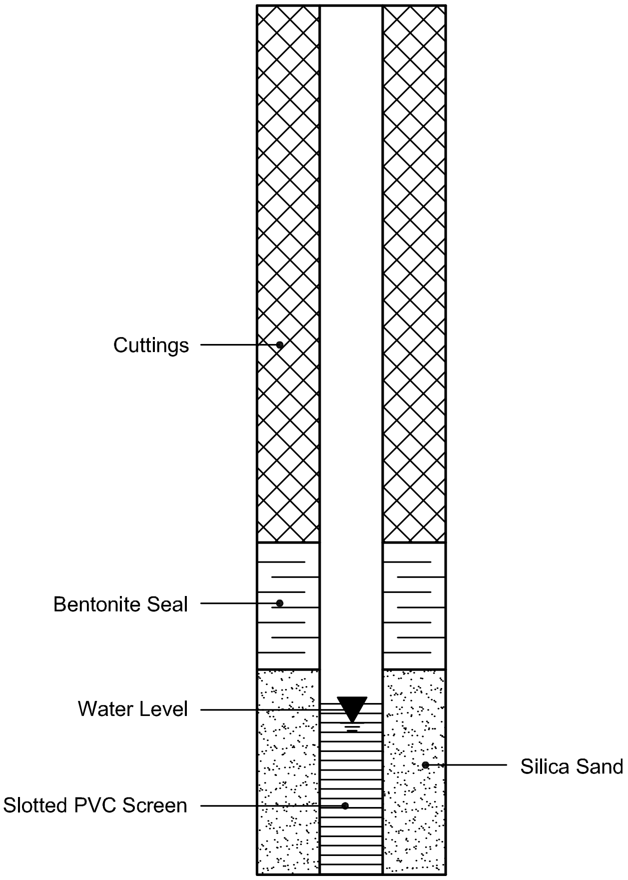


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



LOG OF BOREHOLE BH1

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:

DATE: **July 24 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					REMARKS
○ RKI EAGLE (PPM) 20 40 60 80 □ MINIRAE (PPM) 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	
						SURFACE				
					■	CONCRETE				Flushmount installed.
					△	SAND - trace gravel, loose, dry, brown (fill)				
○ □	0 2.7	SS1	▨		△		0.5			
○ □	0 2.9	SS2	▨		△		1.0			
○ □	5 3.5	SS3	▨		△		1.5			
○ □	0 1.2	SS4	▨		△		2.0			
						End of borehole at 2.5 m depth due to possible bedrock.				Spoon refusal at 2.5 m depth.

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Email: ottawa@dstgroup.com
Web: www.dstgroup.com

* - Catalytic Combustible Gas Detector

SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☰ Grab Sample	

APPENDIX C

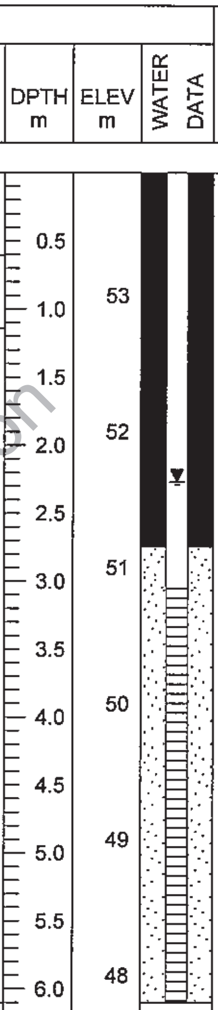
LOG OF BOREHOLE / MONITORING WELL BHMW2

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.9 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	SAMPLES Type	SAMPLES SPT N-Value	SYMBL	MATERIAL DESCRIPTION	REMARKS
						SURFACE	
○□	0 *1*	SS1	▨	39		SAND AND GRAVEL - trace silt (fill)	Flushmount installed.
○ □	0 *3.1*	SS2	▨	100		BEDROCK - fragments (fill)	
						BEDROCK - limestone bedrock	Spoon refusal at 1.1 m depth. Groundwater level recorded at 2.3 m depth on August 1, 2006. Down hole hammer from 1.1 m to 6.1 m depth.
						End of borehole at 6.1 m depth	



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SAMPLE TYPE LEGEND

☰ Auger Sample	▦ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☷ Grab Sample	

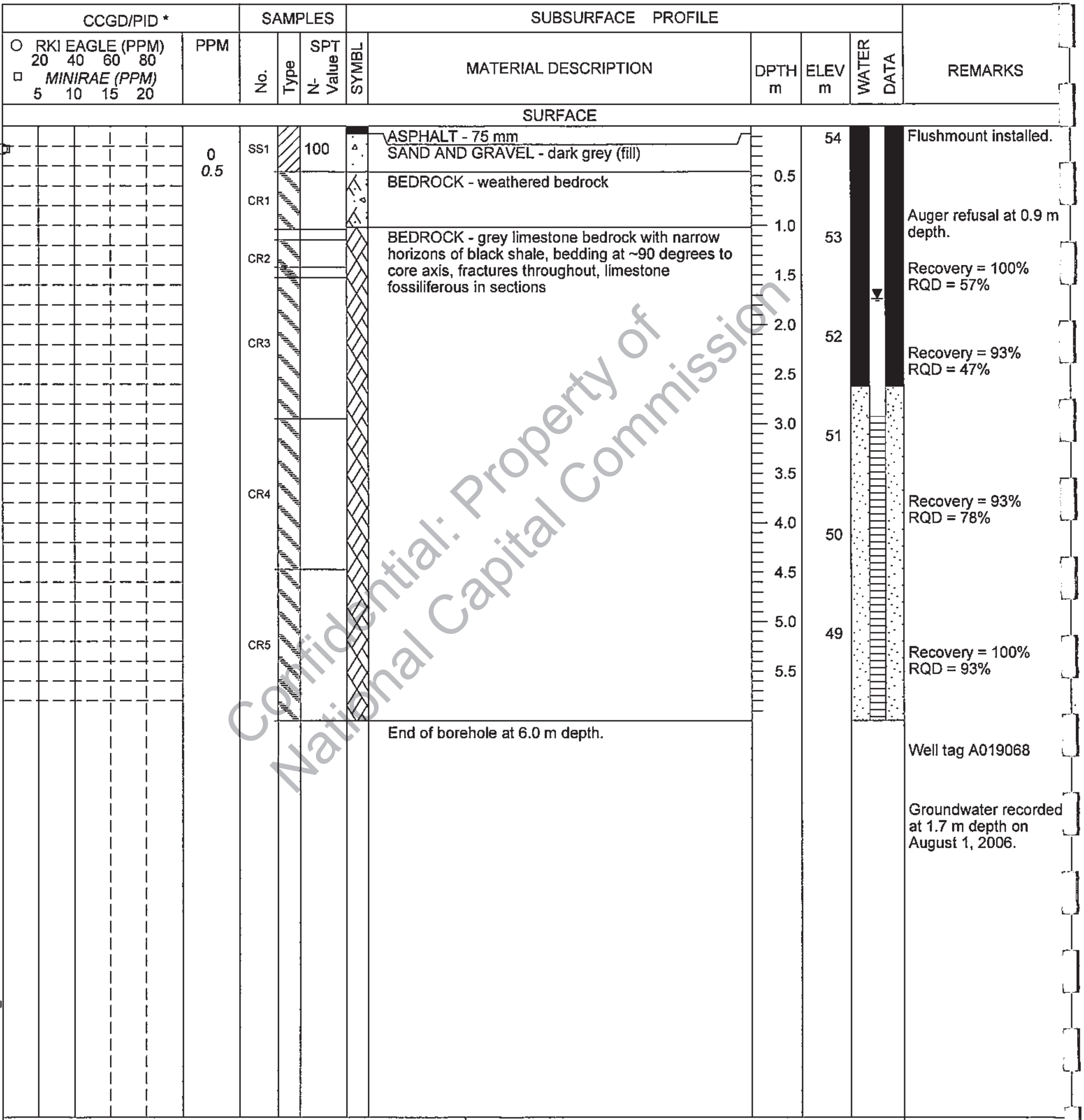
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW3

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **54.12 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**



PPM	No.	SPT N-Value	MATERIAL DESCRIPTION	REMARKS
0 *0.5*	SS1	100	ASPHALT - 75 mm SAND AND GRAVEL - dark grey (fill)	Flushmount installed.
	CR1		BEDROCK - weathered bedrock	Auger refusal at 0.9 m depth.
	CR2		BEDROCK - grey limestone bedrock with narrow horizons of black shale, bedding at ~90 degrees to core axis, fractures throughout, limestone fossiliferous in sections	Recovery = 100% RQD = 57%
	CR3			Recovery = 93% RQD = 47%
	CR4			Recovery = 93% RQD = 78%
	CR5			Recovery = 100% RQD = 93%
			End of borehole at 6.0 m depth.	Well tag A019068 Groundwater recorded at 1.7 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW4

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **54.16 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**
DATE: **July 24 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
					SURFACE			
					ASPHALT - 75 mm		54	Flushmount installed.
○ □	0 0.7	SS1	▨	11	SAND - some gravel, brown - asphalt noted at 0.5 m depth (fill)	0.5		
○ □	0 0.9	SS2	▨	9		1.0	53	
○	0 0	SS3	▨	13	SAND - silty, brick fragments, black (fill)	1.5		
○ □	0 1.8	SS4	▨	6		2.0	52	Groundwater level recorded at 1.8 m depth on August 1, 2006.
○ □	0 2.2	SS5	▨	6		2.5		
○ □	0 0.4	SS6	▨	5	- trace gravel, black	3.0 3.5	51	
					End of borehole at 3.7 m depth.			

GASTECBH (OTTAWA) OE06544.GPJ DST_MIN.GDT 1/6/07

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* - Catalytic Combustible Gas Detector

SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
▯ Thin Wall Tube	▿ Grab Sample	

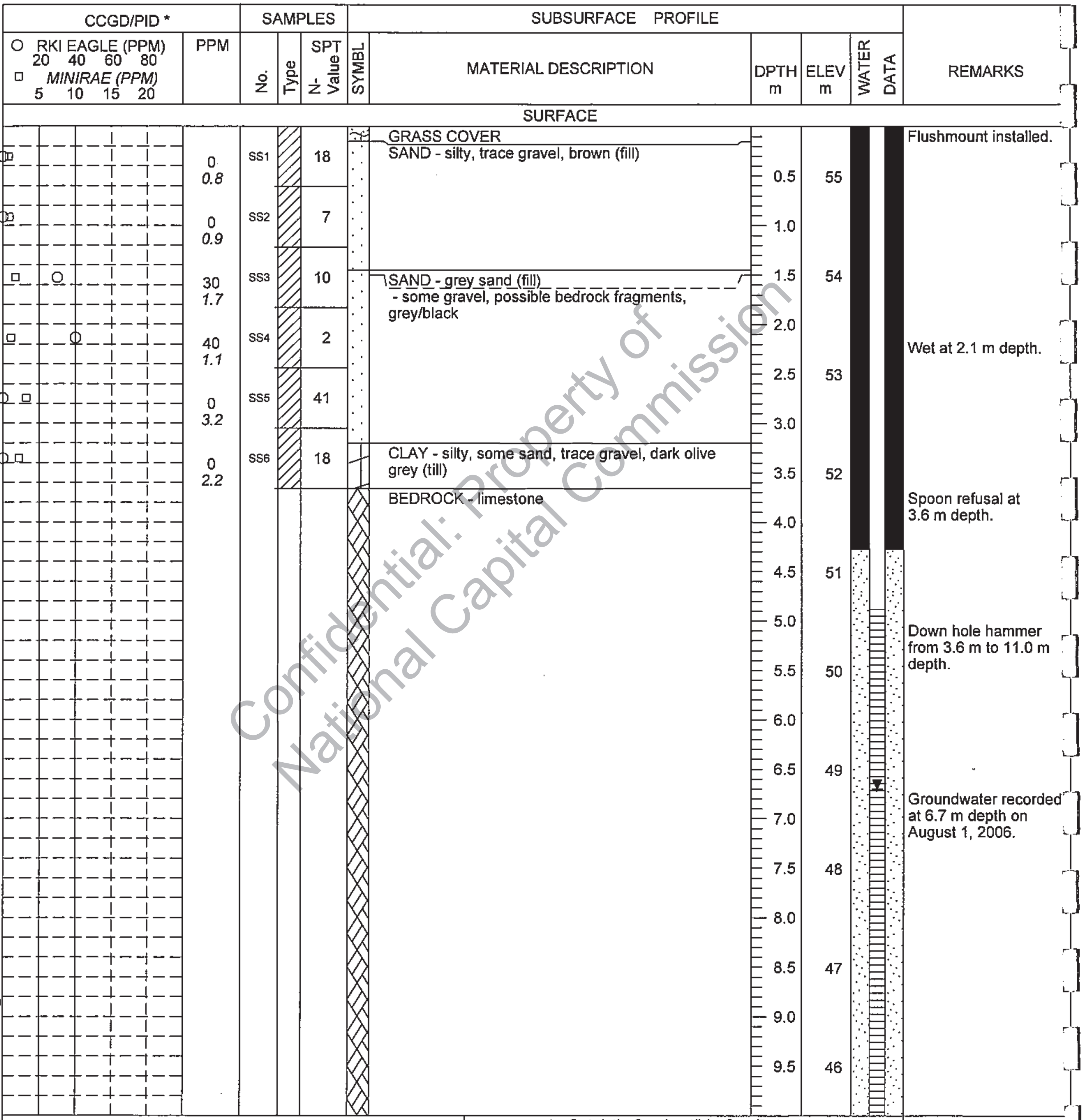
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW5

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **55.51 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**



PPM	No.	Type	SPT N-Value
0 *0.8*	SS1	▨	18
0 *0.9*	SS2	▨	7
30 *1.7*	SS3	▨	10
40 *1.1*	SS4	▨	2
0 *3.2*	SS5	▨	41
0 *2.2*	SS6	▨	18

MATERIAL DESCRIPTION
GRASS COVER
SAND - silty, trace gravel, brown (fill)
SAND - grey sand (fill) - some gravel, possible bedrock fragments, grey/black
CLAY - silty, some sand, trace gravel, dark olive grey (till)
BEDROCK - limestone

DPTH m	ELEV m
0.5	55
1.0	
1.5	54
2.0	
2.5	53
3.0	
3.5	52
4.0	
4.5	51
5.0	
5.5	50
6.0	
6.5	49
7.0	
7.5	48
8.0	
8.5	47
9.0	
9.5	46

REMARKS

Flushmount installed.

Wet at 2.1 m depth.

Spoon refusal at 3.6 m depth.

Down hole hammer from 3.6 m to 11.0 m depth.

Groundwater recorded at 6.7 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW5

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **55.51 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					REMARKS
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	
						SURFACE				
					▨		10.5	45		
						End of borehole at 11.0 m depth.				

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Thin Wall Tube
- Rock Core
- Side Sampler
- Grab Sample
- Ponar Sample

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW6

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.72 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**

CCGD/PID *
○ RKI EAGLE (PPM) 20 40 60 80
□ *MINIRAE (PPM)* 5 10 15 20

SAMPLES

No.	Type	SPT N-Value	RKI EAGLE (PPM)	*MINIRAE (PPM)*	PPM
SS1	▨	10	○	>>□	5 *116*
SS2	▨	12	○	□	0 *1.1*
SS3	▨	7	○	□	0 *5*
SS4	▨	13	○	□	0 *2*
SS5	▨	7	○	□	0 *1.6*
SS6	▨	3			

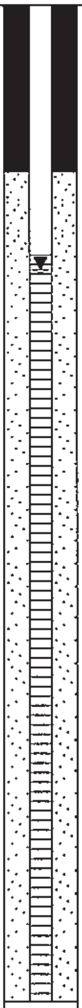
SUBSURFACE PROFILE

SURFACE

MATERIAL DESCRIPTION
TOPSOIL - silty, sand, brown topsoil (fill)
SAND - gravelly, some silt, brown (fill)
SAND - some silt, grey (fill)
SAND - silty, some gravel, grey (fill)
End of borehole at 3.7 m depth.

DPTH m	ELEV m
0.5	
	53
1.0	
1.5	
	52
2.0	
2.5	
	51
3.0	
3.5	

WATER DATA



REMARKS

Flushmount installed.

Groundwater recorded at 0.9 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	⏚ Grab Sample	

APPENDIX C

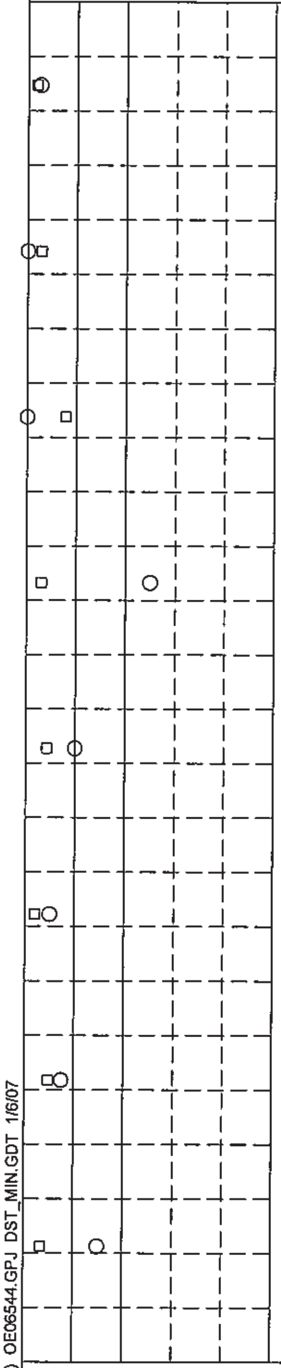
LOG OF BOREHOLE / MONITORING WELL BHMW7

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.4 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

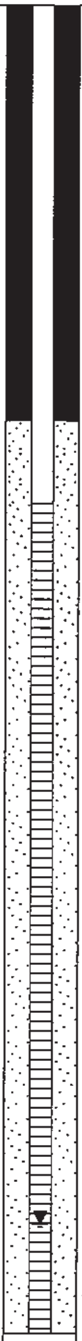
DATE: **July 24 2006**

CCGD/PID *



PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
					SURFACE			
		▨			SAND - some silt, grey (fill)			Flushmount installed.
5 0.9	SS1	▨	21		- black soil layer between 0.3 - 0.9 m depth.		53	
		▨			SAND - trace gravel, brown (fill)	0.5		
0 1.4	SS2	▨	23					
		▨				1.0		
		▨					52	
0 3.9	SS3	▨	27		- grey	1.5		
		▨				2.0		
50 1.5	SS4	▨	8					
		▨			- some gravel		51	
		▨			- sand and gravel, black grey to brown	2.5		
20 2.1	SS5	▨	10					
		▨			SAND - silty, trace clay and gravel, brown (fill)	3.0		
10 1.0	SS6	▨	14				50	
		▨				3.5		
15 2.4	SS7	▨	100		- possible boulders	4.0		
		▨					49	
		▨			SAND - light brown	4.5		
30 1.7	SS8	▨	19					Groundwater recorded at 4.5 m depth on August 1, 2006.
		▨			PEAT - black			
					End of borehole at 4.9 m depth.			

WATER DATA



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SAMPLE TYPE LEGEND

▤ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW8

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.62 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 / □ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
					SURFACE			
					SAND AND GRAVEL - some silt, grey (fill)			Flushmount installed.
□ ○	100 *1.0*	SS1	▨	100				Spoon refusal at 0.3 m depth.
						0.5	53	
□ ○	90 *3.6*	SS2	▨	22		1.0		
□ >>○	240 *3.1*	SS3	▨	17		1.5	52	
□ >>○	410 *3.1*	SS4	▨	14		2.0		
□ >>○	390 *3.3*	SS5	▨	18		2.5	51	
		SS6		60		3.0		
						3.5	50	
□ >>○	>1000 *3.4*	SS7	▨	13		4.0		
					SAND - silty, black (fill)			Well noted to be dry on August 1, 2006.
					End of borehole at 4.3 m depth.			

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SAMPLE TYPE LEGEND

▭ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW9

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.75 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
○□	0 *0.6*	SS1	▨	19		SAND AND GRAVEL - silty (fill)				Flushmount installed.
							0.5	53		
						BEDROCK - limestone	1.0			Spoon refusal at 0.8 m depth.
							1.5	52		
							2.0			
							2.5	51		Down hole hammer from 0.8 m to 11.1 m depth.
							3.0			
							3.5	50	▼	
							4.0			
							4.5	49		
							5.0			Groundwater recorded at 3.9 m depth on August 1, 2006.
							5.5	48		
							6.0			
							6.5	47		
							7.0			
							7.5	46		
							8.0			
							8.5	45		
							9.0			
							9.5	44		

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SAMPLE TYPE LEGEND

☰ Auger Sample	▦ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☷ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW9

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.75 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	SAMPLES Type	SAMPLES SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
							10.5 11.0	43		
						End of borehole at 11.1 m depth.				

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SAMPLE TYPE LEGEND

- ☰ Auger Sample
- ▨ Split Spoon Sample
- ☐ Thin Wall Tube
- ▩ Rock Core
- ▧ Side Sampler
- ▽ Grab Sample
- ▥ Ponar Sample

APPENDIX C

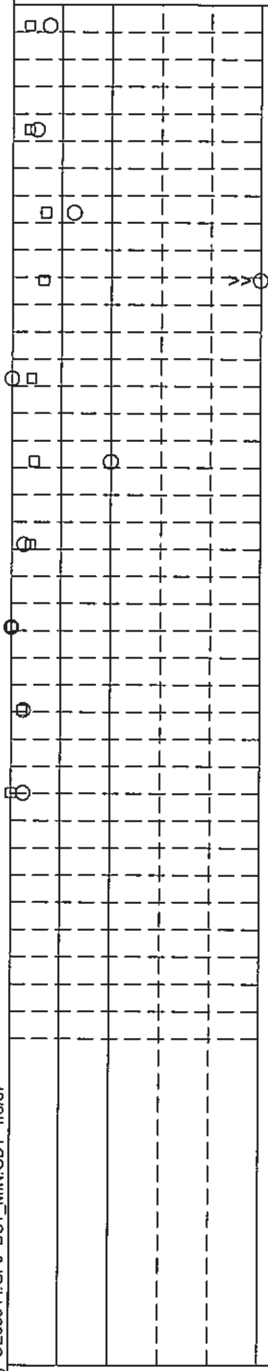
LOG OF BOREHOLE / MONITORING WELL BHMW10

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.59 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID *



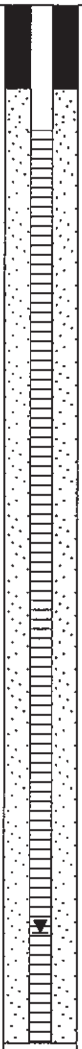
PPM	SAMPLES No.	Type	SPT N-Value
15 *1.7*	SS1	▨	100
10 *1.7*	SS2	▨	47
25 *3.4*	SS3	▨	18
>1000 *3.2*	SS4	▨	100
0 *2*	SS5	▨	9
40 *2.3*	SS6	▨	8
5 *1.9*	SS7	▨	10
0 *0*	SS8	▨	35
5 *1.1*	SS9	▨	28
5 *0*	SS10	▨	14

SUBSURFACE PROFILE

SURFACE

MATERIAL DESCRIPTION	DPTH m	ELEV m
SAND - silty, trace gravel, dark grey (fill) - metal debris noted	0.5	53
SAND AND GRAVEL - some silt, boulders throughout, grey (fill)	1.0	
	1.5	52
- boulders	2.0	
	2.5	51
	3.0	
	3.5	50
	4.0	
	4.5	49
	5.0	
	5.5	48
	6.0	
	6.5	47
BEDROCK - limestone	7.0	
	7.5	46
End of borehole at 7.6 m depth.		

WATER DATA



REMARKS

Flushmount installed.

Spoon refusal at 0.3 m depth.

Spoon refusal at 2.2 m depth.

Groundwater recorded at 6.8 m depth on August 1, 2006.

Auger advanced to 7.0 m depth.

Auger refusal at 7.0 m depth.

Down hole hammer from 7.0 m to 7.6 m depth.

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SAMPLE TYPE LEGEND

☰	Auger Sample	▩	Rock Core	▥	Ponar Sample
▨	Split Spoon Sample	▧	Side Sampler		
☐	Thin Wall Tube	▽	Grab Sample		

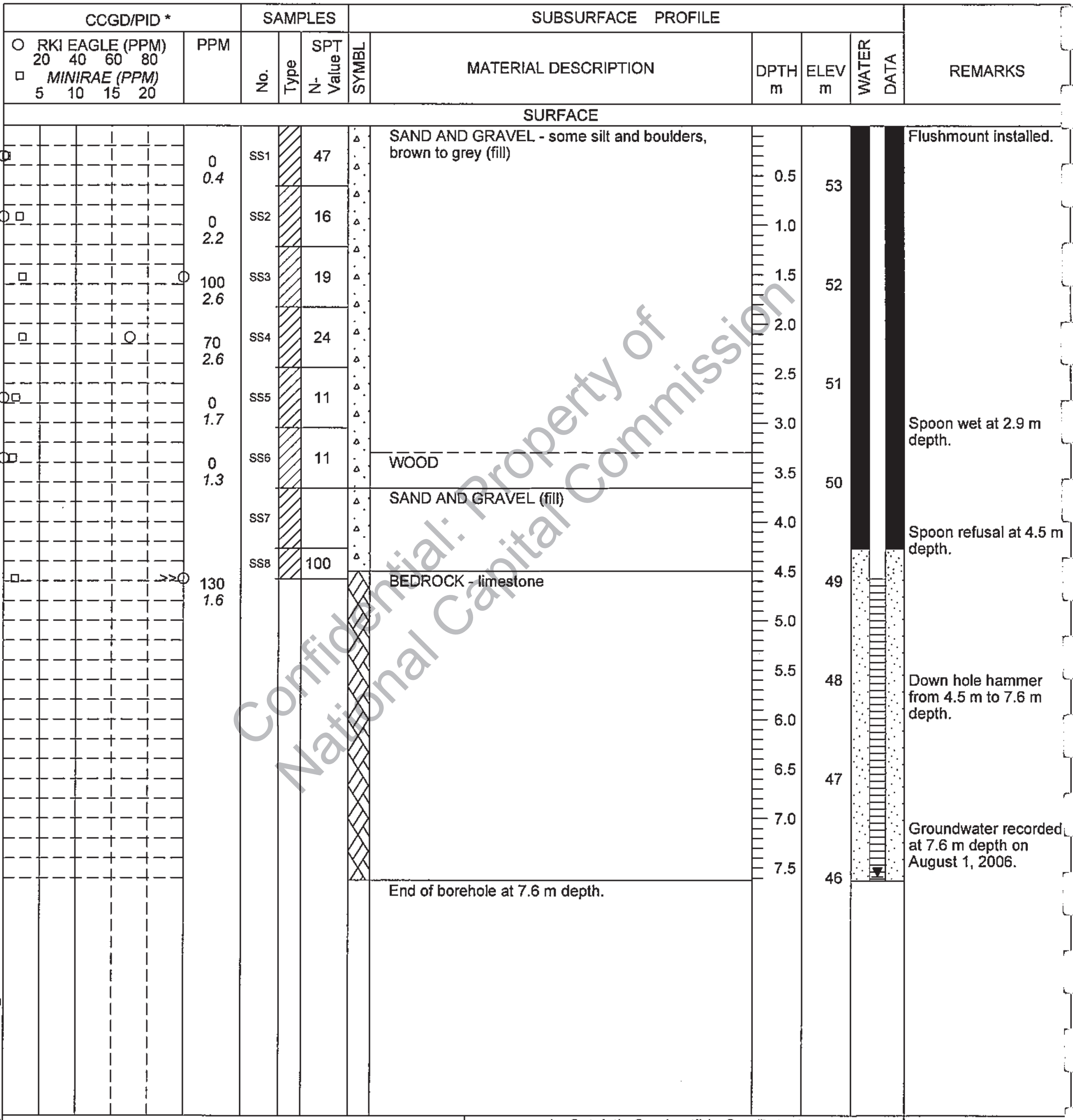
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW11

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.6 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**



SAMPLES No.	Type	SPT N-Value	PPM
SS1	Split Spoon	47	0 0.4
SS2	Split Spoon	16	0 2.2
SS3	Split Spoon	19	100 2.6
SS4	Split Spoon	24	70 2.6
SS5	Split Spoon	11	0 1.7
SS6	Split Spoon	11	0 1.3
SS7	Split Spoon		
SS8	Split Spoon	100	130 1.6

MATERIAL DESCRIPTION	DPTH m
SAND AND GRAVEL - some silt and boulders, brown to grey (fill)	0 – 3.3
WOOD	3.3 – 3.7
SAND AND GRAVEL (fill)	3.7 – 4.5
BEDROCK - limestone	4.5 – 7.6
End of borehole at 7.6 m depth.	

REMARKS
- Flushmount installed.
- Spoon wet at 2.9 m depth.
- Spoon refusal at 4.5 m depth.
- Down hole hammer from 4.5 m to 7.6 m depth.
- Groundwater recorded at 7.6 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☰ Auger Sample	▦ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

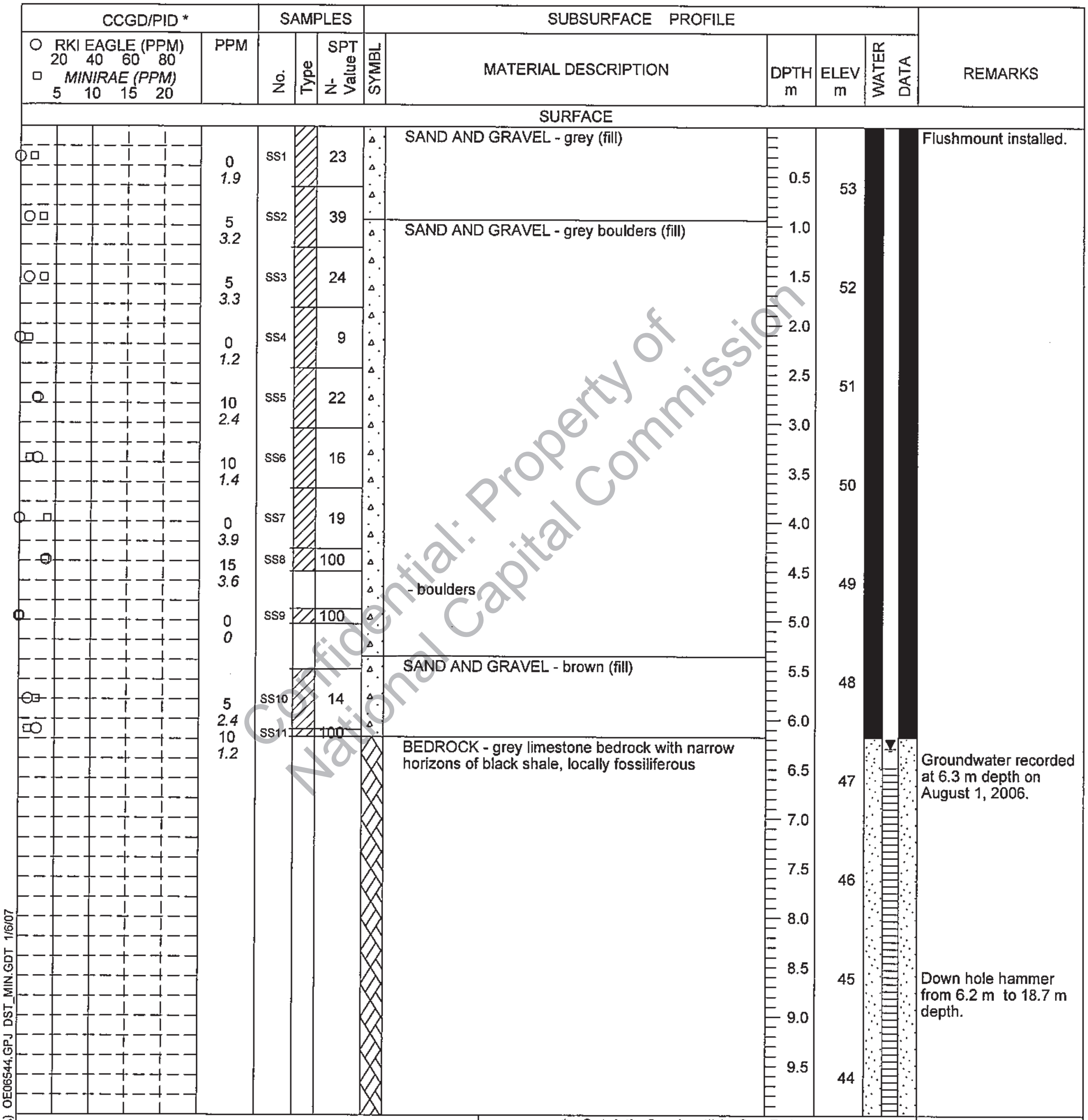
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW12

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.61 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**



PPM	SAMPLES No.	Type	SPT N-Value	MATERIAL DESCRIPTION	REMARKS
0 *1.9*	SS1	▨	23	SAND AND GRAVEL - grey (fill)	Flushmount installed.
5 *3.2*	SS2	▨	39		
5 *3.3*	SS3	▨	24	SAND AND GRAVEL - grey boulders (fill)	
0 *1.2*	SS4	▨	9		
10 *2.4*	SS5	▨	22		
10 *1.4*	SS6	▨	16		
0 *3.9*	SS7	▨	19		
15 *3.6*	SS8	▨	100	- boulders	
0 *0*	SS9	▨	100		
5 *2.4*	SS10	▨	14	SAND AND GRAVEL - brown (fill)	
10 *1.2*	SS11	▨	100	BEDROCK - grey limestone bedrock with narrow horizons of black shale, locally fossiliferous	Groundwater recorded at 6.3 m depth on August 1, 2006.
					Down hole hammer from 6.2 m to 18.7 m depth.

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
▯ Thin Wall Tube	▽ Grab Sample	

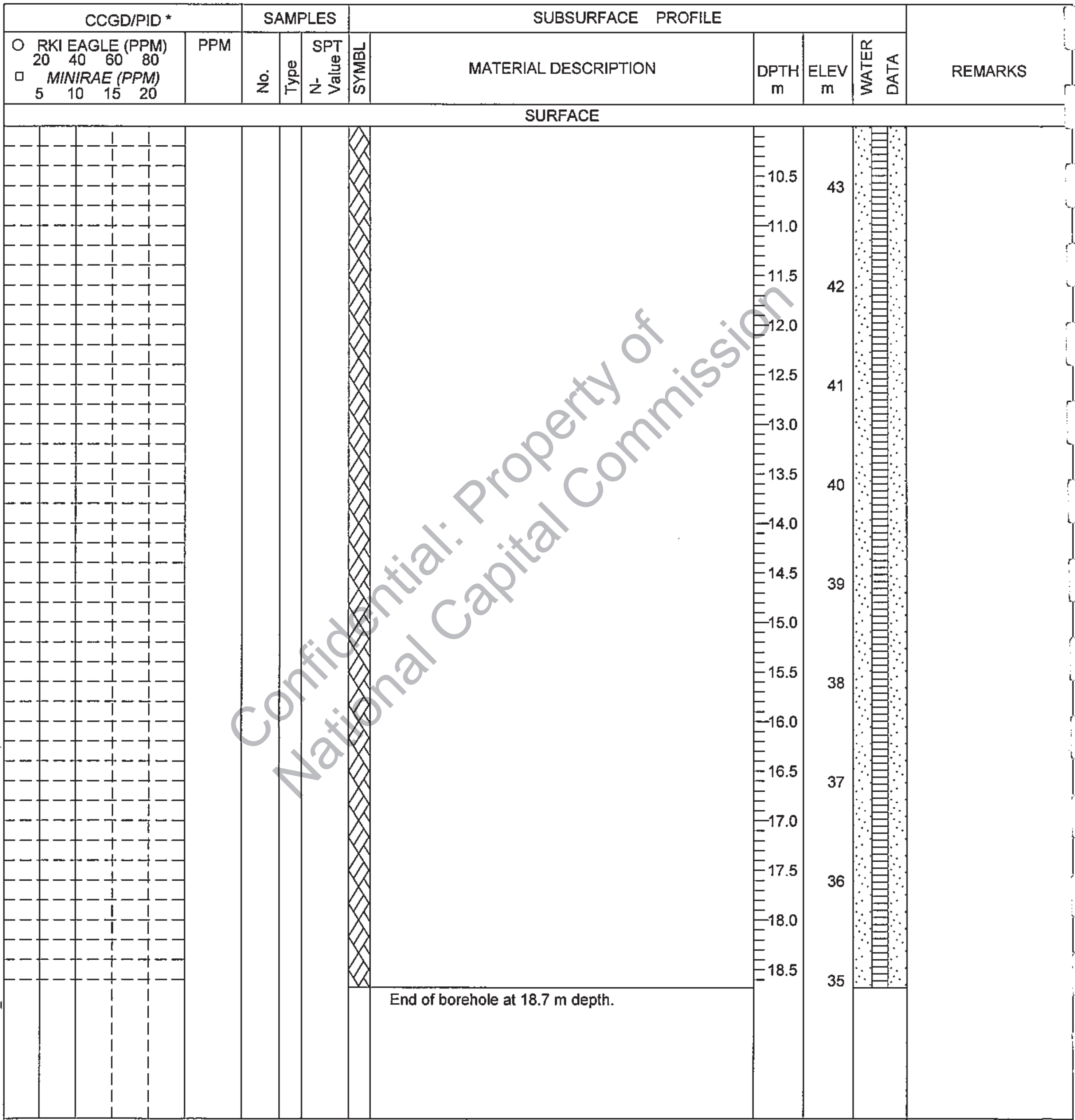
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW12

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.61 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**



End of borehole at 18.7 m depth.

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW13

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.83 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**

CCGD/PID *
○ RKI EAGLE (PPM) 20 40 60 80
▫ MINIRAE (PPM) 5 10 15 20

SURFACE

PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION
0 *0.3*	SS1	▨	30		SAND AND GRAVEL - trace rust, grey (fill)
0 *1.2*	SS2	▨	19		
0 *0.8*	SS3	▨	100		
					BEDROCK - grey limestone bedrock with narrow horizons of black shale, some fossiliferous sections
					End of borehole at 6.5 m depth.

DPTH m	ELEV m
0.5	
	53
1.0	
1.5	
	52
2.0	
2.5	
	51
3.0	
3.5	
	50
4.0	
4.5	
	49
5.0	
5.5	
	48
6.0	

WATER DATA

REMARKS

Flushmount installed.

Possible heavy oil staining from 0.4 m to 0.5 m depth.

Spoon refusal at 1.3 m depth.

Groundwater recorded at 1.3 m depth on August 1, 2006.

Down hole hammer from 1.3 m to 6.5 m depth.

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

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LOG OF BOREHOLE / MONITORING WELL BHMW14

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.06 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
						GRAVEL - some sand and silt, dark brown (fill)		53		Flushmount installed.
	0 1.5	SS1	▨	14		SAND - some silt, trace gravel, dark brown (fill)	0.5			
	0 3.4 25 2.9	SS2	▨	100		SAND AND GRAVEL - silty, some boulders, grey (fill)	1.0	52		
		CR3				BEDROCK - grey limestone bedrock with narrow horizons of black shale, fossiliferous in sections, bedding and fractures noted at ~ 90 degrees to core axis	1.5			Recovery 67% RQD 0%
		CR4					2.0 2.5	51		Recovery 95% RQD 52%
							3.0	50		Groundwater recorded at 3.6 m depth on August 1, 2006.
		CR5					3.5 4.0 4.5	49	▼	Recovery 98% RQD 88%
		CR6					5.0 5.5 6.0	48 47		Recovery 98% RQD 80%
		CR7					6.5 7.0 7.5	46		Recovery 95% RQD 90%
						End of borehole at 7.6 m depth.				

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

LOG OF BOREHOLE BH15

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:

DATE: **July 26 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
☐ ○	35 *2.9*	SS1	▨			SILT - sandy, dark brown (fill)				Slight odour noted.
						End of borehole at 0.3 m depth due to possible slab.				

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☰ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW16

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **51.81 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID * — ○ RKI EAGLE (PPM) 20 40 60 80; □ *MINIRAE (PPM)* 5 10 15 20

SURFACE

PPM	No.	SPT N-Value	MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
10 *3.6*	SS1	23	SAND AND GRAVEL - silty, some brick, possible boulders, dark brown (fill)	0.5		Flushmount installed.
5 *1.2*	SS2	11		1.0	51	
160 *2.8*	SS3	8	CLAY - silty, trace coal, dark grey (fill) SAND - silty, some coal and brick, trace gravel, dark brown (fill)	1.5		
10 *3.4*	SS4	31	SAND AND GRAVEL - trace clay, possible boulders, grey (fill)	2.0	50	
70 *3.9*	SS5	20		2.5 3.0	49	
580 *3.3*	SS6	12		3.5		Groundwater recorded at 5.9 m depth on August 1, 2006.
430 *3.5*	SS7	11		4.0	48	
110 *3.6*	SS8	15		4.5	47	
	SS9	19	GRAVEL - some sand, trace silt, grey (fill)	5.0 5.5		Spoon refusal at 6.5 m depth.
450 *1.5*	SS10	22		6.0	46	
300 *0*	SS11	100	SAND AND GRAVEL - trace silt (fill)	6.5		
15 *2.8*	SGS12			7.0	45	Black soil with stong odour noted from auger cuttings at 6.7 m depth.
			BEDROCK - limestone	7.5		Down hole hammer from 7.0 m to 7.8 m depth.
			End of borehole at 7.8 m depth.			

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

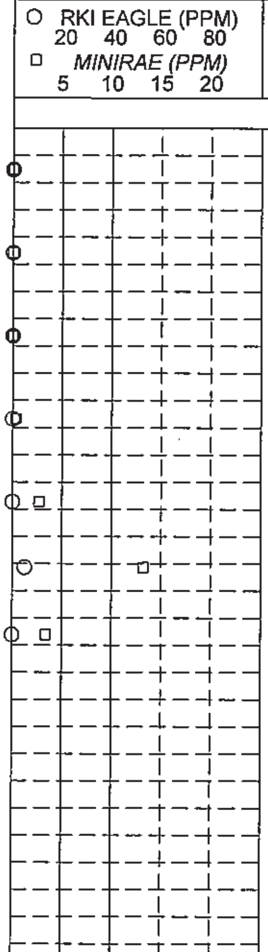
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW17

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**52.43 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**



CCGD/PID * PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
					SURFACE			
0 0	SS1	▨	13		SILT - woody, some sand, brown (fill) SAND AND GRAVEL - trace brick, grey (fill)	0.5	52	Flushmount installed.
0 0	SS2	▨	5		SAND - silty, some brick, wood, and coal pieces, trace clay, dark brown (fill)	1.0		Groundwater recorded at 6.1 m depth on August 1, 2006.
0 0	SS3	▨	3			1.5	51	
0 0.3	SS4	▨	19		COBBLES - some sand, grey (fill)	2.0		
0 2.7	SS5	▨	9			2.5	50	Slight odour detected at 3.0 m depth.
5 13.2	SS6	▨	100		SAND - silty, some cement (possible abandoned pipe), trace clay, black (fill)	3.0		
0 3.4	SS7	▨	100		BEDROCK - limestone	3.5	49	Strong odour detected at 3.3 m depth.
						4.0		
						4.5	48	Spoon refusal at 3.8 m depth.
						5.0		
						5.5	47	Down hole hammer from 3.8 m to 6.1 m depth.
						6.0		
					End of borehole at 6.1 m depth.			

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW18

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.26 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID *
○ RKI EAGLE (PPM) 20 40 60 80
□ *MINIRAE (PPM)* 5 10 15 20

SURFACE

PPM	No.	Type	SPT N-Value	MATERIAL DESCRIPTION	REMARKS
110 *0.4*	SS1	▨	10	GRASS COVER - silty, sand and organics (topsoil) SAND AND GRAVEL - boulders, grey (fill)	Flushmount installed.
0 *0*	SS2	▨	18	- brick	
0 *1.8*	SS3	▨	6	SAND - some silt, brown (fill)	
0 *1.0*	SS4	▨	38	SAND - silty, organics, black (fill) - cement	
					Drop in auger from 2.4 m to 3.1 m depth.
0 *2.7*	SS5	▨	1	SAND - some silt and gravel, brown to light brown (fill)	
0 *0*	SS6	▨	17		
0 *0*	SS7	▨	23	- black layer and rust SAND AND GRAVEL - some silt, grey (fill)	
5 *3.1*	SS8	▨	12		
0 *0*	SS9	▨	5		
0 *3.8*	SS10	▨	7	SAND AND GRAVEL - possible boulders, grey (fill)	
5 *3.8*	SS11		100	BEDROCK - limestone	Down hole hammer from 6.7 m to 18.9 m depth.

DPTH m: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

ELEV m: 53, 52, 51, 50, 49, 48, 47, 46, 45, 44

WATER DATA

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

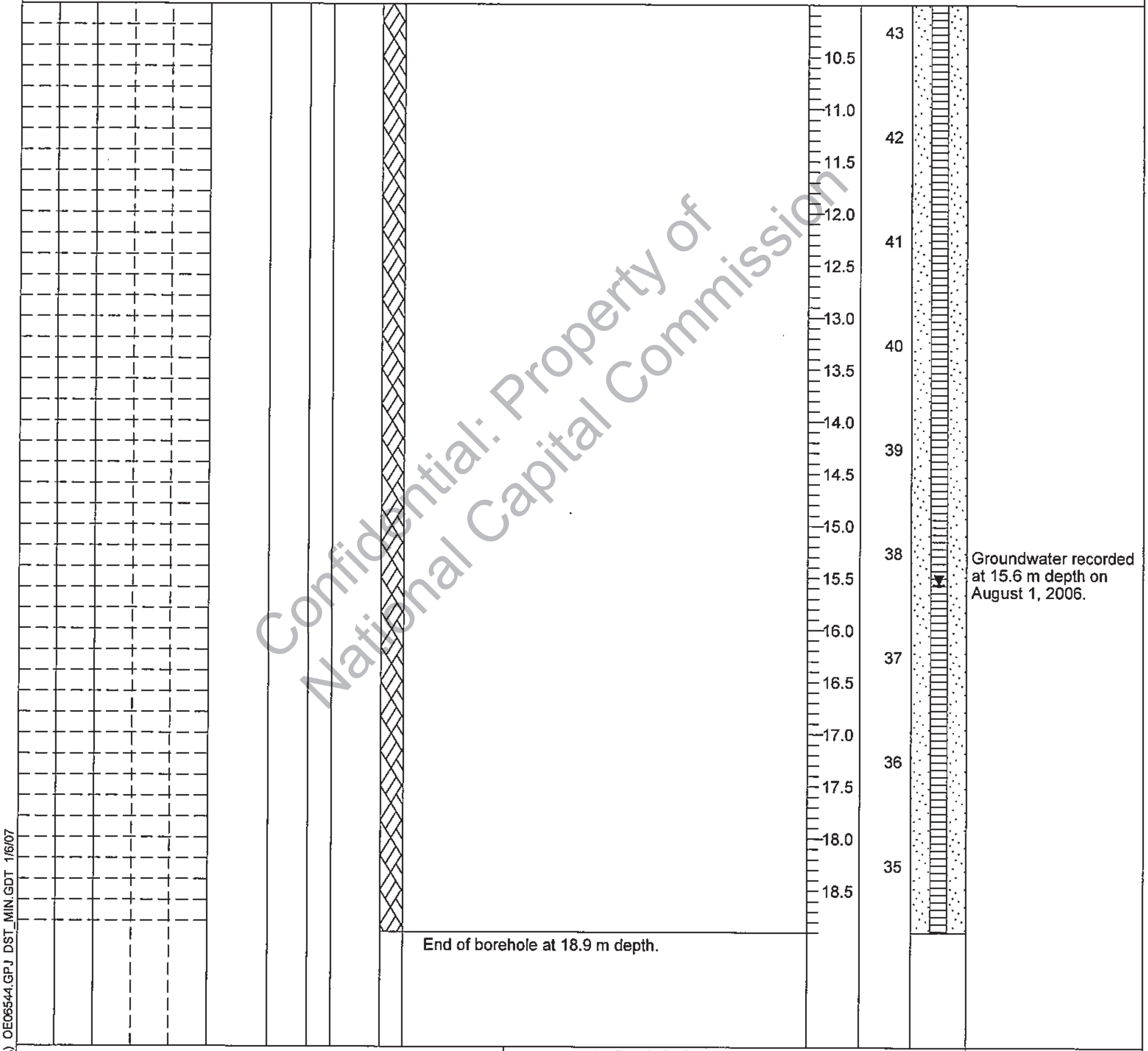
LOG OF BOREHOLE / MONITORING WELL BHMW18

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.26 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
						End of borehole at 18.9 m depth.				Groundwater recorded at 15.6 m depth on August 1, 2006.



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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
▯ Thin Wall Tube	☰ Grab Sample	

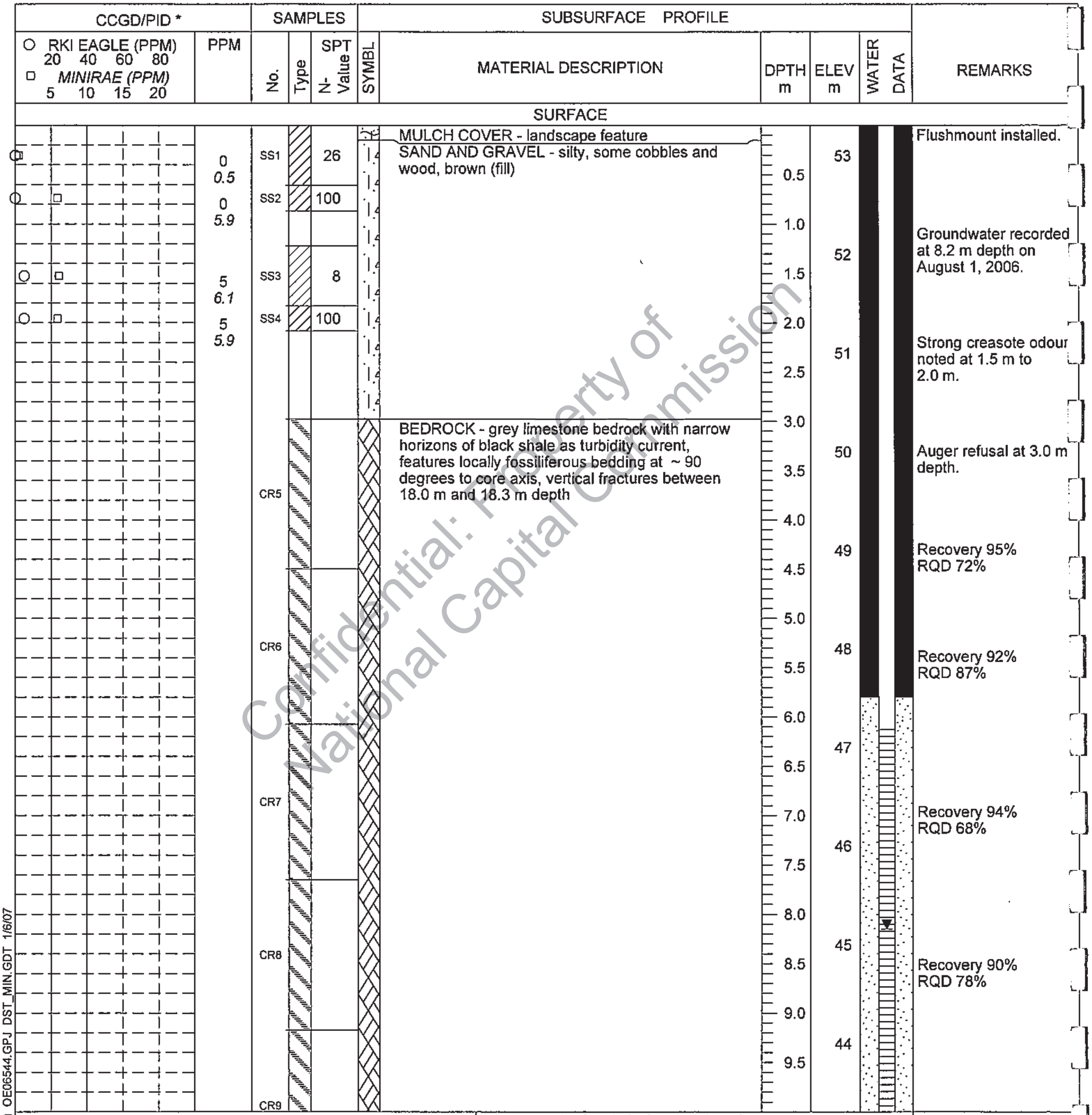
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW19

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.31 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**



PPM	No.	Type	SPT N-Value
0 0.5	SS1	▨	26
0 5.9	SS2	▨	100
5 6.1	SS3	▨	8
5 5.9	SS4	▨	100
	CR5	▧	
	CR6	▧	
	CR7	▧	
	CR8	▧	
	CR9	▧	

MATERIAL DESCRIPTION	DPTH m	ELEV m
MULCH COVER - landscape feature SAND AND GRAVEL - silty, some cobbles and wood, brown (fill)	0.5 1.0 1.5 2.0 2.5	53 52 51
BEDROCK - grey limestone bedrock with narrow horizons of black shale as turbidity current, features locally fossiliferous bedding at ~ 90 degrees to core axis, vertical fractures between 18.0 m and 18.3 m depth	3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5	50 49 48 47 46 45 44

REMARKS

Flushmount installed.

Groundwater recorded at 8.2 m depth on August 1, 2006.

Strong creasote odour noted at 1.5 m to 2.0 m.

Auger refusal at 3.0 m depth.

Recovery 95%
RQD 72%

Recovery 92%
RQD 87%

Recovery 94%
RQD 68%

Recovery 90%
RQD 78%

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SAMPLE TYPE LEGEND

☐ Auger Sample	▦ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW19

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.31 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
										Recovery 98% RQD 93%
								43		
							10.5			
							11.0			
								42		
		CR10					11.5			Recovery 100% RQD 97%
							12.0			
								41		
							12.5			
		CR11					13.0			Recovery 98% RQD 97%
								40		
							13.5			
							14.0			
								39		
		CR12					14.5			Recovery 97% RQD 88%
							15.0			
								38		
							15.5			
		CR13					16.0			Recovery 92% RQD 87%
								37		
							16.5			
							17.0			
								36		
		CR14					17.5			Recovery 93% RQD 77%
							18.0			
						End of borehole at 18.3 m depth.				

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

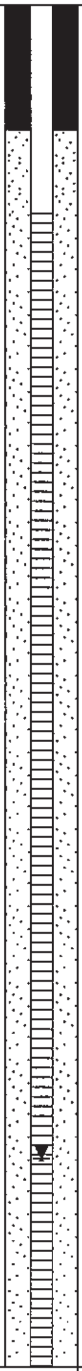
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW20

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **51.46 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**



CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	SAMPLES Type	SAMPLES SPT N-Value	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
□	0 *0.7*	SS1	▨	100		SAND - silty, trace gravel, brown and black layers (fill)	0.5	51		Flushmount installed.
						BEDROCK - limestone bedrock				Spoon refusal at 0.6 m depth.
							1.0			Down hole hammer from 0.6 m to 10.7 m depth.
							1.5	50		
							2.0			
							2.5	49		
							3.0			
							3.5	48		
							4.0			
							4.5	47		
							5.0			
							5.5	46		
							6.0			
							6.5	45		
							7.0			
							7.5	44		
							8.0			Groundwater recorded at 8.5 m depth on August 1, 2006.
							8.5	43	▼	
							9.0			
							9.5	42		

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SAMPLE TYPE LEGEND

☐	Auger Sample	▩	Rock Core	▥	Ponar Sample
▨	Split Spoon Sample	▧	Side Sampler		
▯	Thin Wall Tube	☐	Grab Sample		

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW20

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **51.46 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
					▨		10.5	41		
						End of borehole at 10.7 m depth.				

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▤ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW21

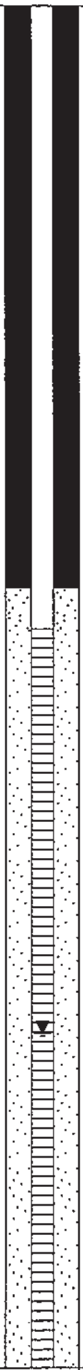
DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**49.68 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 ☐ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SUBSURFACE PROFILE MATERIAL DESCRIPTION	REMARKS
					SURFACE	
					ASPHALT - 150 mm thick	Flushmount installed.
○	0 *0*	SS1	▨	41	SAND - silty, some gravel, orange (fill)	
○ ☐	0 *2.8*	SS2	▨	100		Spoon refusal at 0.8 m depth.
					BEDROCK - weathered limestone bedrock	Auger refusal at 1.0 m depth.
					BEDROCK - grey limestone with narrow horizons of black shale, locally fossiliferous	Down hole hammer from 0.8 m to 10.7 m depth. Groundwater recorded at 7.6 m depth on August 1, 2006.

DPTH m	ELEV m
0.5	49
1.0	
1.5	48
2.0	
2.5	47
3.0	
3.5	46
4.0	
4.5	45
5.0	
5.5	44
6.0	
6.5	43
7.0	
7.5	42
8.0	
8.5	41
9.0	
9.5	40



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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
▯ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW21

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**49.68 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
					▨		10.5			
						End of borehole at 10.7 m depth.		39		

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SAMPLE TYPE LEGEND

☰	Auger Sample	▩	Rock Core	▥	Ponar Sample
▨	Split Spoon Sample	▧	Side Sampler		
☐	Thin Wall Tube	▽	Grab Sample		

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW22

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**47.64 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SUBSURFACE PROFILE MATERIAL DESCRIPTION	REMARKS
					SURFACE	
○ ☐	5 *0*	SS1	Split Spoon Sample	26	SAND AND GRAVEL - silty, trace brick, grey to orange (fill)	Flushmount installed.
○	0 *0*	SS2	Split Spoon Sample	27		Groundwater recorded at 4.5 m depth on August 1, 2006.
○	0 *0.2*	SS3	Split Spoon Sample	100		
					BEDROCK - weathered limestone/shale bedrock	
		CR4	Rock Core		BEDROCK - grey limestone bedrock with narrow horizons of black shale as turbidity current, features locally fossiliferous bedding at ~ 90 degrees to core axis	Recovery 98% RQD 78%
		CR5	Rock Core			Recovery 98% RQD 93%
		CR6	Rock Core			Recovery 92% RQD 70%
		CR7	Rock Core			Recovery 93% RQD 78%
		CR8	Rock Core			Recovery 97% RQD 82%
		CR9	Rock Core			

DPTH m	ELEV m
0.5	47
1.0	
1.5	46
2.0	
2.5	45
3.0	
3.5	44
4.0	
4.5	43
5.0	
5.5	42
6.0	
6.5	41
7.0	
7.5	40
8.0	
8.5	39
9.0	
9.5	38

WATER DATA

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SAMPLE TYPE LEGEND

- ☐ Auger Sample
- ▨ Split Spoon Sample
- ☐ Thin Wall Tube
- ▩ Rock Core
- ▧ Side Sampler
- ☐ Grab Sample
- ▥ Ponar Sample

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW22

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **47.64 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 26 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
			▨		⊠					Recovery 98% RQD 83%
						End of borehole at 10.6 m depth.		37		

* - Catalytic Combustible Gas Detector

SAMPLE TYPE LEGEND

☰	Auger Sample	▩	Rock Core	▥	Ponar Sample
▨	Split Spoon Sample	▧	Side Sampler		
▯	Thin Wall Tube	⏚	Grab Sample		

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APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW23

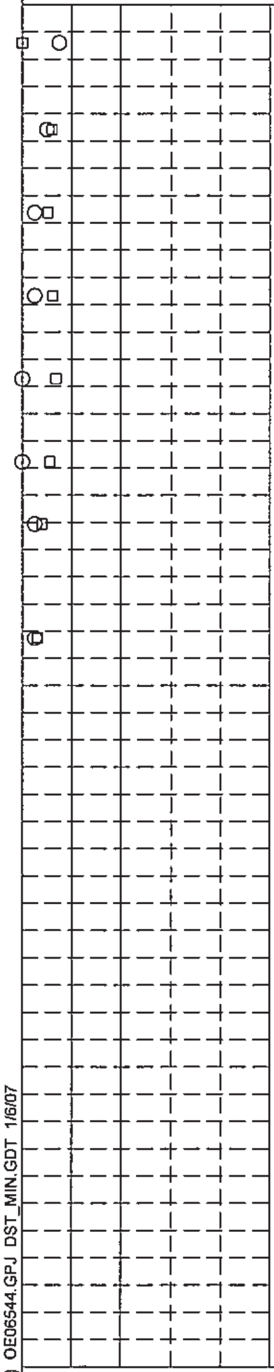
DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **50.00 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**

CCGD/PID *

○ RKI EAGLE (PPM) 20 40 60 80
□ *MINIRAE (PPM)* 5 10 15 20



PPM	No.	Type	SPT N-Value
15 *0*	SS1	▨	15
10 *3.0*	SS2	▨	12
5 *2.6*	SS3	▨	8
5 *3.1*	SS4	▨	14
0 *3.4*	SS5	▨	4
0 *2.8*	SS6	▨	100
5 *2.0*	SS7	▨	100
5 *1.5*	SS8	▨	100

SUBSURFACE PROFILE

SURFACE

MATERIAL DESCRIPTION	DPTH m	ELEV m
SAND - silty, some gravel, trace cobbles, brick, rust and coal, orange (fill)		50
	0.5	
	1.0	49
	1.5	
	2.0	48
	2.5	
	3.0	47
	3.5	
	4.0	46
	4.5	
BEDROCK - grey limestone bedrock with narrow horizons of black shale, locally fossiliferous	5.0	45
	5.5	
VOID	6.0	44
	6.5	
	7.0	43
	7.5	
	8.0	42
	8.5	
	9.0	41
	9.5	
		40

WATER DATA

REMARKS

Flushmount installed.

Minor rust stains noted at 1.6 m depth.

Trace coal noted at 2.3 m depth.

Black fiborous material noted at 2.7 m depth.

Trace coal noted at 3.5 m depth.

Split spoon refusal at 3.8 m depth.

Groundwater recorded at 7.5 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW23

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **50.00 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
								40		
							10.5			
							11.0	39		
							11.5			
						End of borehole at 11.5 m depth.				

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SAMPLE TYPE LEGEND

▭ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▨ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW24

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:
DATE: **July 26 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
□ ○	60 *0.3*	SS1	▨			GRAVEL - sandy and silty, grey (fill)	0.5		▼	Groundwater recorded at 0.03 m depth on August 1, 2006.
□ ○	55 *2.1*	SS2	▨							Black staining and strong odours noted at 0.5 m depth.
						End of borehole at 0.8 m depth due to possible concrete.				

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

LOG OF BOREHOLE BH25

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:
DATE: **July 26 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
						GRAVEL - sandy and silty, dry (fill)				
							0.5			
○ □	10 *0*	SS1	▨							
							1.0			
○ □	10 *0*	SS2	▨							
							1.5			
						End of borehole at 1.5 m depth due to possible concrete slab.				

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Thin Wall Tube
- Rock Core
- Side Sampler
- Grab Sample
- Ponar Sample

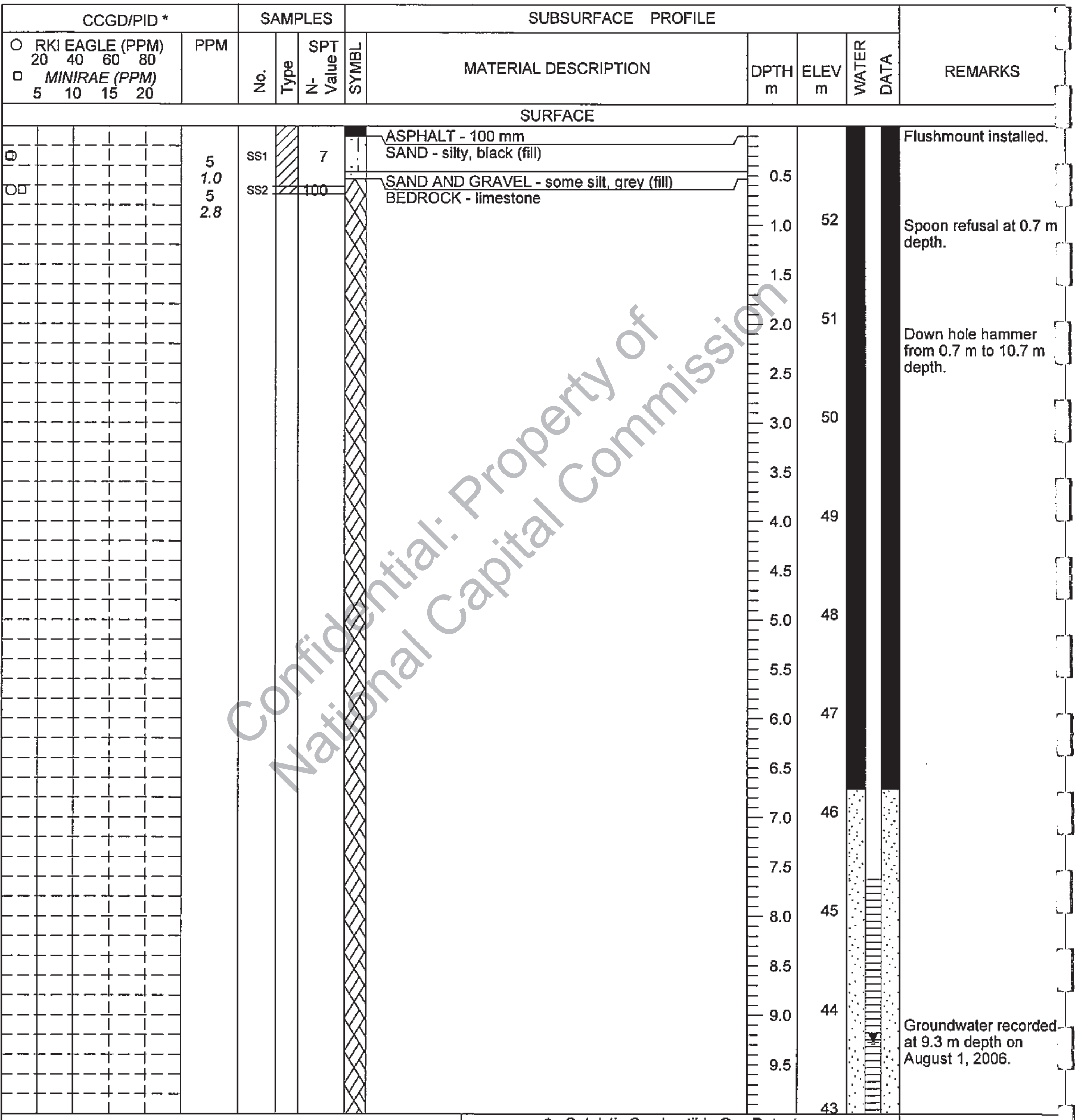
APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW26

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**52.94 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**



PPM	No.	Type	SPT N-Value	MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
				ASPHALT - 100 mm			Flushmount installed.
5 *1.0*	SS1	▨	7	SAND - silty, black (fill)			
				SAND AND GRAVEL - some silt, grey (fill)	0.5		
5 *2.8*	SS2	▨	100	BEDROCK - limestone			
					1.0	52	Spoon refusal at 0.7 m depth.
					2.0	51	Down hole hammer from 0.7 m to 10.7 m depth.
					9.0	44	Groundwater recorded at 9.3 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☷ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW26

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**52.94 m (Geodetic)**

Drilling Data
METHOD: **CME 55 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 27 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 ☐ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	SAMPLES Type	SAMPLES SPT N-Value	SUBSURFACE PROFILE SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	SUBSURFACE PROFILE DPTH m	SUBSURFACE PROFILE ELEV m	SUBSURFACE PROFILE WATER DATA	REMARKS
						SURFACE				
					▨		10.5		▥	
						End of borehole at 10.7 m depth.		42		

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
▯ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

LOG OF BOREHOLE BH27

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:

DATE: **July 25 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					REMARKS
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	
						SURFACE				
					▨	CONCRETE - concrete slab 110 mm in depth				
						End of borehole at 0.1 m depth due to possible bedrock.				

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	▽ Grab Sample	

APPENDIX C

LOG OF BOREHOLE BH28

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: --/--

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:

DATE: **July 25 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					REMARKS
○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	
						SURFACE				
					▨	CONCRETE - concrete slab 175 mm in depth				
						End of borehole at 0.2 m depth due to possible bedrock.				

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SAMPLE TYPE LEGEND

☰ Auger Sample
▨ Split Spoon Sample
☐ Thin Wall Tube
■ Rock Core
▧ Side Sampler
▽ Grab Sample
▥ Ponar Sample

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW29

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: --/--

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:

DATE: **July 25 2006**

CCGD/PID * ○ RKI EAGLE (PPM) 20 40 60 80 ☐ *MINIRAE (PPM)* 5 10 15 20	PPM	SAMPLES No.	SAMPLES Type	SAMPLES SPT N-Value	SUBSURFACE PROFILE SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	SUBSURFACE PROFILE DPTH m	SUBSURFACE PROFILE ELEV m	WATER DATA	REMARKS
SURFACE										
					■	CONCRETE - 150 mm				Black staining with strong odour noted.
○ >>☐	0 *58.5*	SS1	▨			SILT - sandy (possible fill)			▼	
						End of borehole at 0.5 m depth due to possible bedrock.				Groundwater recorded at 0.2 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☰	Auger Sample	▩	Rock Core	▥	Ponar Sample
▨	Split Spoon Sample	▧	Side Sampler		
☐	Thin Wall Tube	▽	Grab Sample		

APPENDIX C

LOG OF BOREHOLE BH30

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: --/--

Drilling Data
METHOD: **Portable Drill Rig**
DIAMETER:

DATE: **July 25 2006**

CCGD/PID *	PPM	SAMPLES			SUBSURFACE PROFILE					REMARKS
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20		No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	
						SURFACE				
					▒	CONCRETE - concrete slab 195 mm in depth				
						End of borehole at 0.2 m depth due to possible bedrock.				

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SAMPLE TYPE LEGEND

☰ Auger Sample
▨ Split Spoon Sample
☐ Thin Wall Tube
▩ Rock Core
▧ Side Sampler
☐ Grab Sample
▥ Ponar Sample

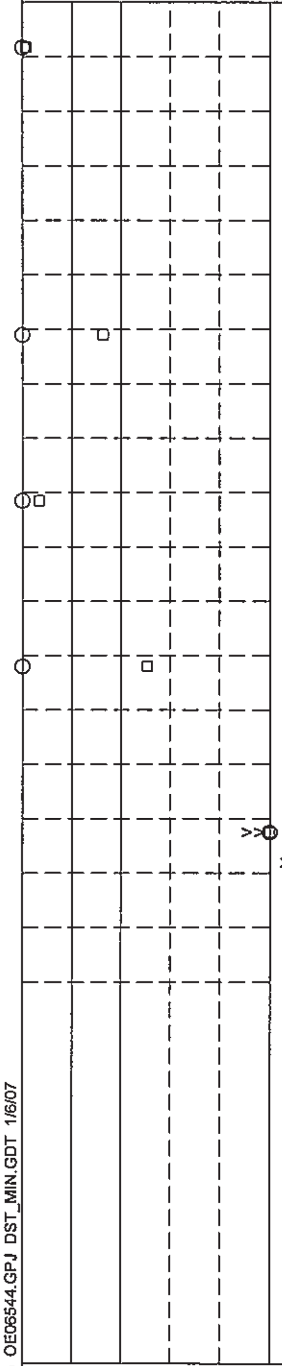
APPENDIX C

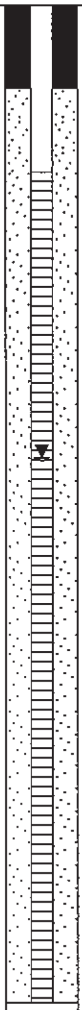
LOG OF BOREHOLE / MONITORING WELL BHMW31

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.: **53.64 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 24 2006**





PPM	No.	Type	SPT N-Value	MATERIAL DESCRIPTION	DPTH m	ELEV m	REMARKS
				SURFACE			
				ASPHALT - 130 mm			Flushmount installed.
0 0.3	SS1	▨	100	SAND AND GRAVEL - some boulders and wood timbers, brown (fill)			
					0.5	53	Auger advanced to 0.9 m depth.
					1.0		
0 8.2	SS2	▨	1				
					1.5	52	Groundwater recorded at 1.7 m depth on August 1, 2006.
0 1.7	SS3	▨	0				
					2.0		
0 12.7	SS4	▨	25				
					2.5	51	Wood present throughout SS4 and SS5.
				- wood	3.0		
100 >1000							
	SS5	▨	28				
					3.5	50	
				End of borehole at 3.7 m depth.			

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SAMPLE TYPE LEGEND

☰	Auger Sample	▩	Rock Core	▥	Ponar Sample
▨	Split Spoon Sample	▧	Side Sampler		
☐	Thin Wall Tube	▤	Grab Sample		

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW32

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.83 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**
DATE: **July 25 2006**

CCGD/PID *
○ RKI EAGLE (PPM) 20 40 60 80
□ *MINIRAE (PPM)* 5 10 15 20

SUBSURFACE PROFILE

SURFACE

PPM	No.	Type	SPT N-Value	MATERIAL DESCRIPTION	REMARKS
				ASPHALT - 100 mm	Flushmount installed.
20 *8.9*	SS1	▨	31	SAND AND GRAVEL - grey (fill)	
0 *3.7*	SS2	▨	100	CLAY - some sand and gravel, trace coal and wood, grey (fill)	Auger advanced to 1.1 m depth.
				BEDROCK - weathered limestone bedrock	
	CR3	▩		BEDROCK - grey limestone bedrock with narrow horizons of black shale as turbidity current, features locally fossiliferous bedding at ~ 90 degrees to core axis	Recovery 91% RQD 91%
	CR4	▩			Recovery 100% RQD 83%
	CR5	▩			Recovery 100% RQD 72%
	CR6	▩			Recovery 97% RQD 67%
	CR7	▩			Recovery 95% RQD 65%
	CR8	▩			Recovery 92% RQD 82%
	CR9	▩			Recovery 98% RQD 82%

DPTH m: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5

ELEV m: 53 52 51 50 49 48 47 46 45 44

WATER DATA

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SAMPLE TYPE LEGEND

☰ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☰ Grab Sample	

APPENDIX C

LOG OF BOREHOLE / MONITORING WELL BHMW32

DST REF. No.: **OE06544**
CLIENT: **National Capital Commission**
PROJECT: **Phase I & II Environmental Site Assessment**
LOCATION: **Chaudiere and Albert Islands, Ottawa, Ontario**
SURFACE ELEV.:**53.83 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **July 25 2006**

CCGD/PID *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
			▨		▨		10.5			
						End of borehole at 10.6 m depth.		43		Groundwater recorded at 3.7 m depth on August 1, 2006.

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SAMPLE TYPE LEGEND

☐ Auger Sample	▩ Rock Core	▥ Ponar Sample
▨ Split Spoon Sample	▧ Side Sampler	
☐ Thin Wall Tube	☐ Grab Sample	

APPENDIX C

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2a to FIGURES 8b - SLOPE CROSS SECTIONS

FIGURE 9 - TRENCH FOOTING DETAIL

FIGURES 10 AND 11 - SEISMIC SHEAR WAVE VELOCITY PROFILES

AERIAL PHOTOGRAPHS

SITE VISIT PHOT0GRAPHS

DRAWING PG3202-2 - SITE PLAN - EXISTING CONDITIONS

DRAWING PG3202-3 - SITE PLAN - PROPOSED DEVELOPMENT - PHASE 1

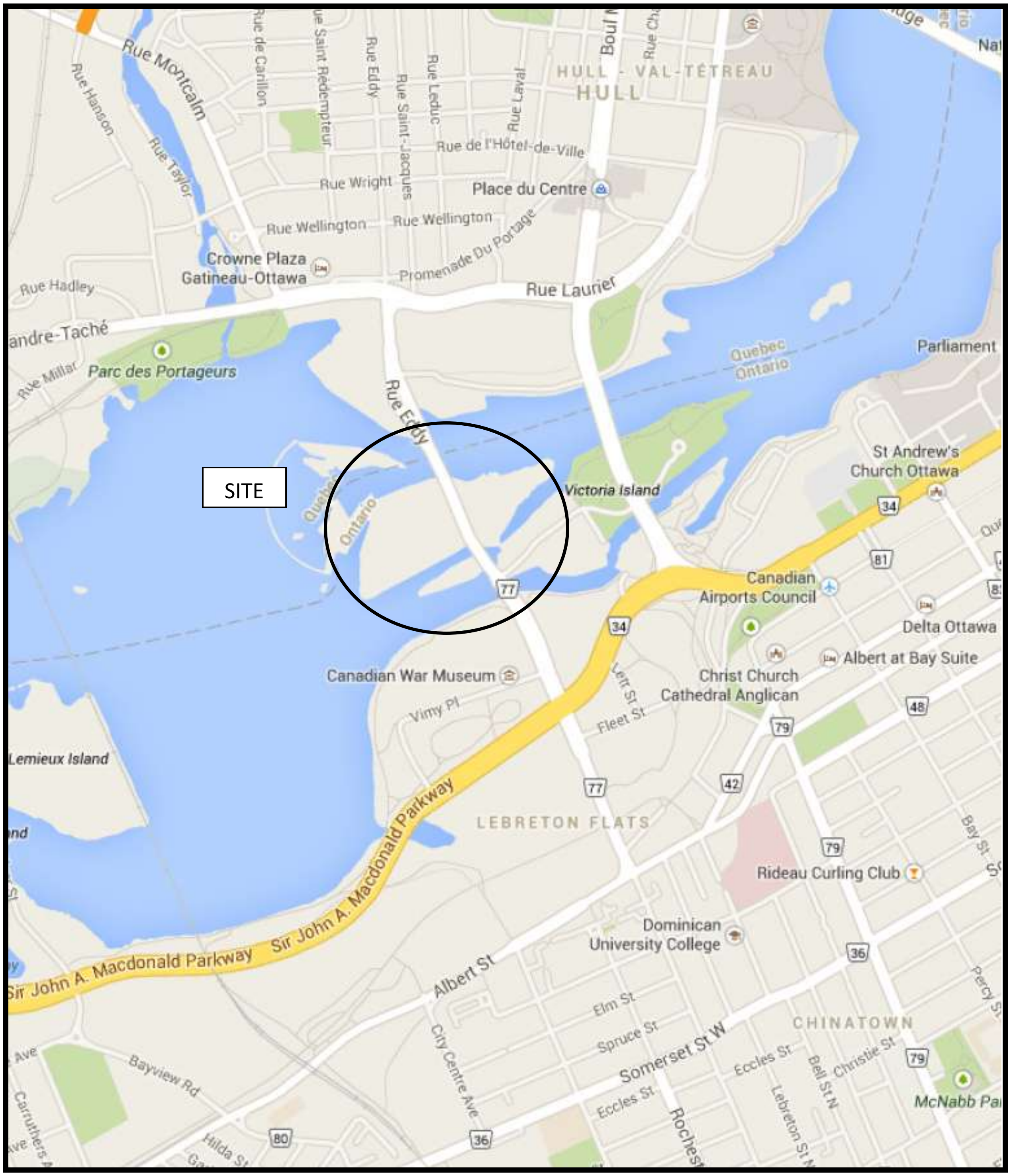


FIGURE 1

KEY PLAN

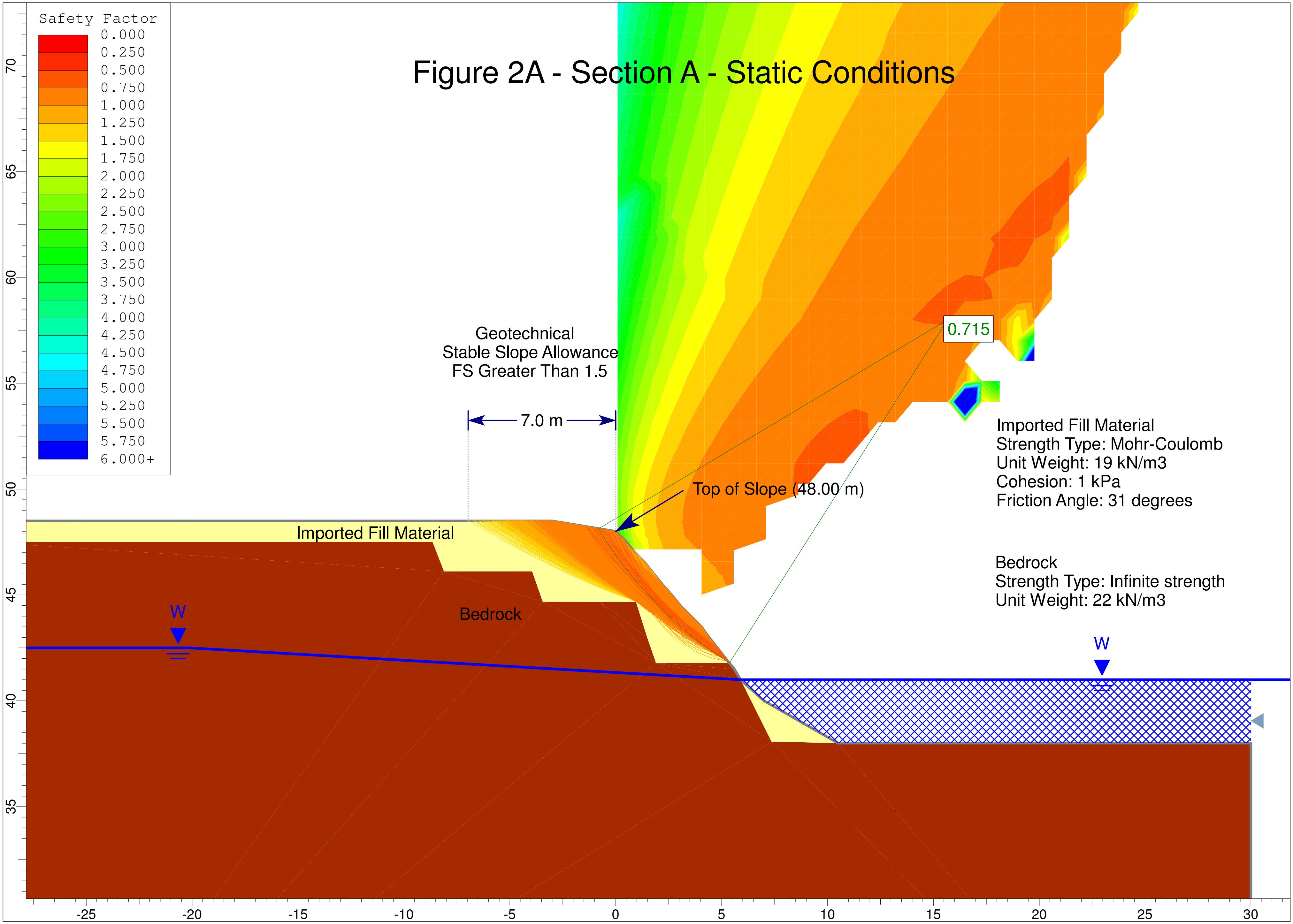


Figure 2A - Section A - Static Conditions

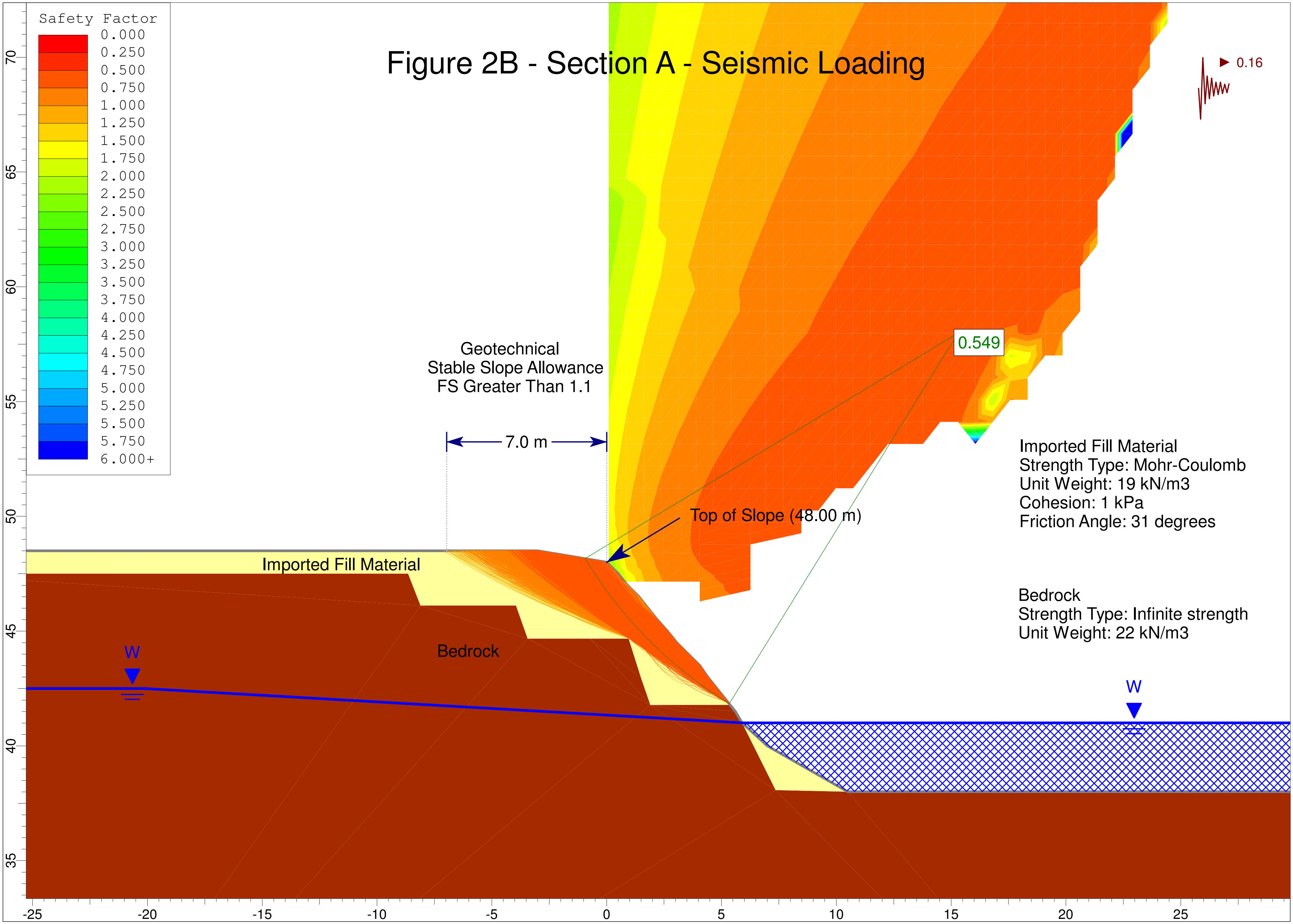


Figure 2B - Section A - Seismic Loading

Geotechnical
Stable Slope Allowance
FS Greater Than 1.1

Top of Slope (48.00 m)

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3

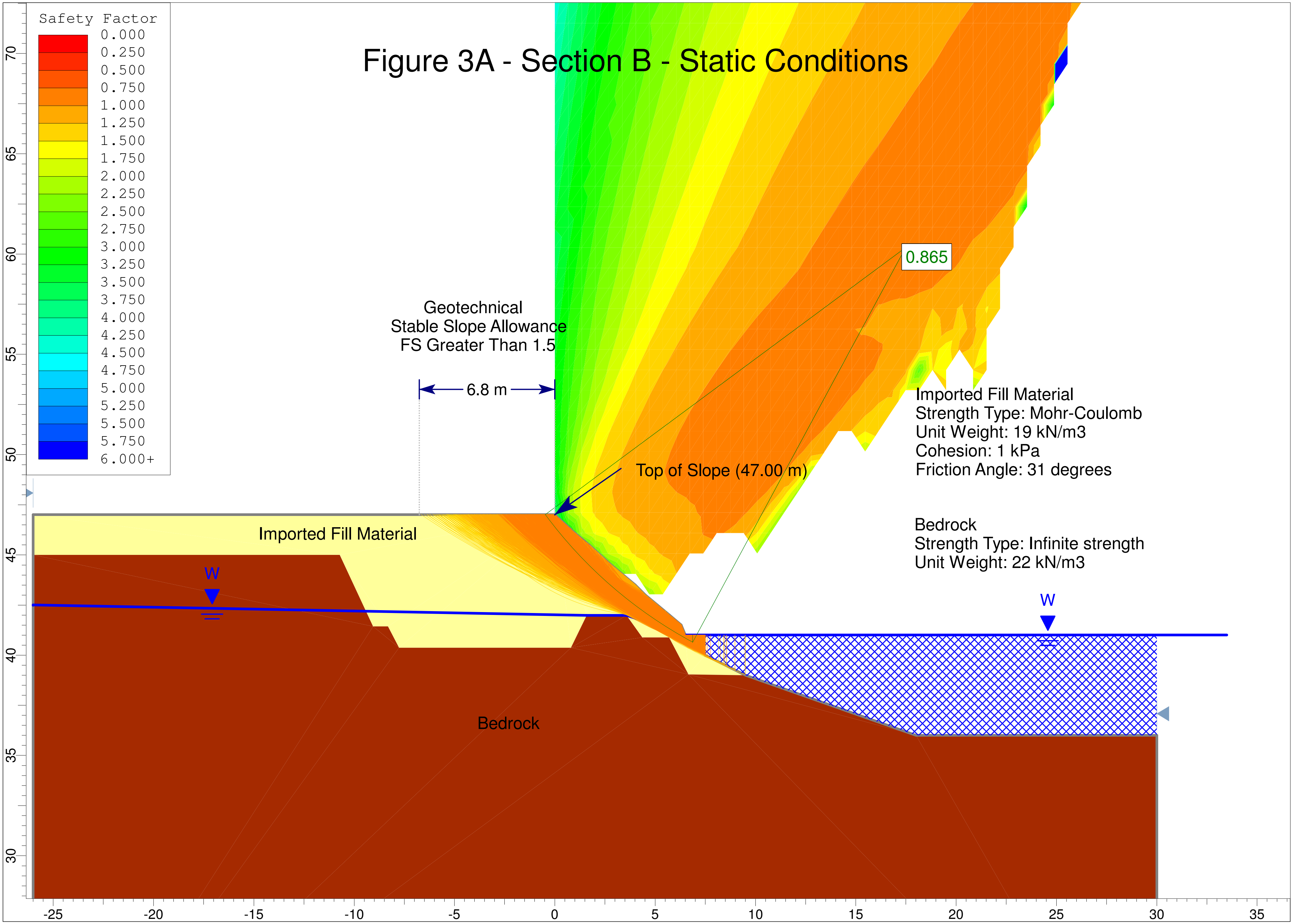
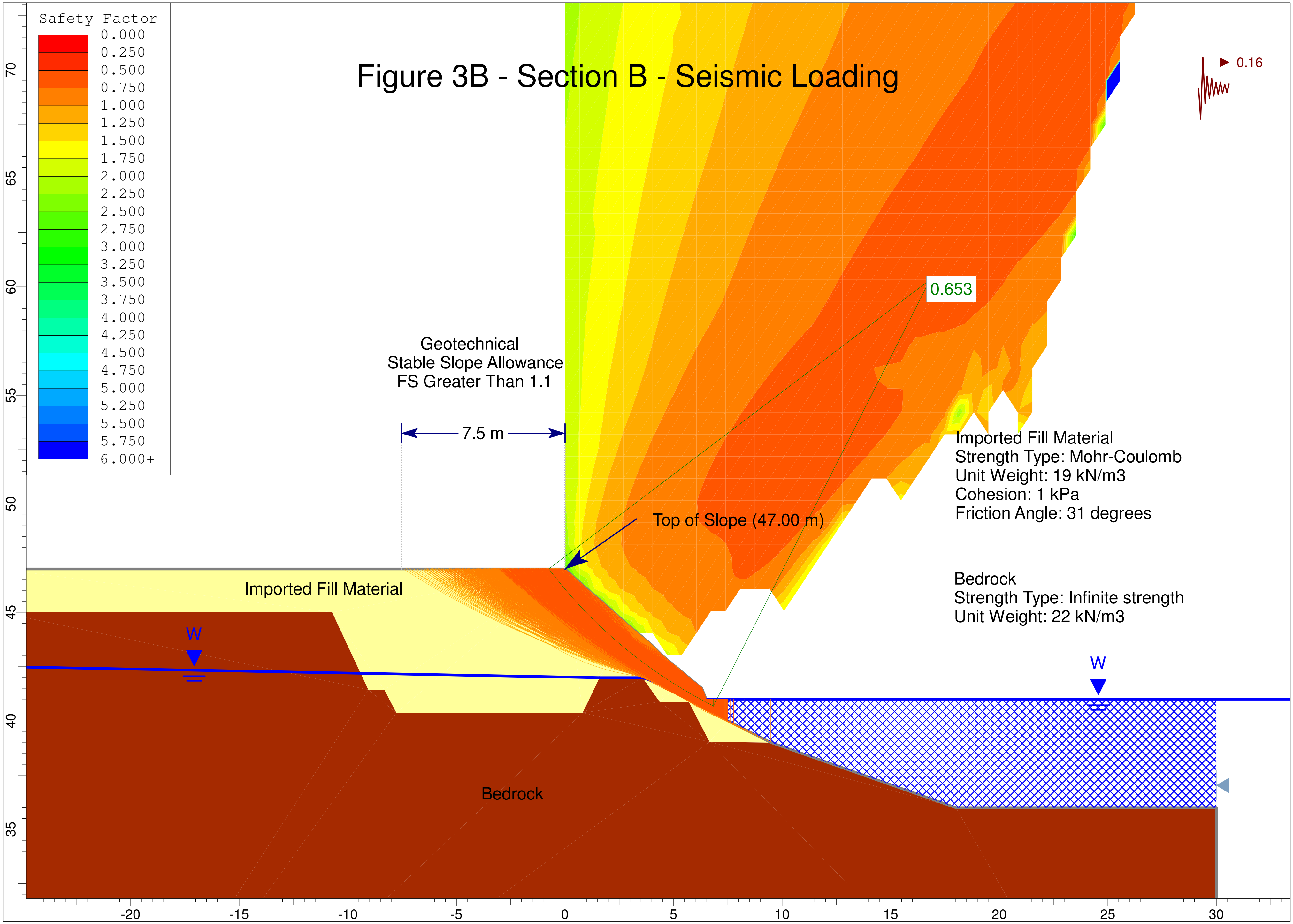


Figure 3A - Section B - Static Conditions

Figure 3B - Section B - Seismic Loading



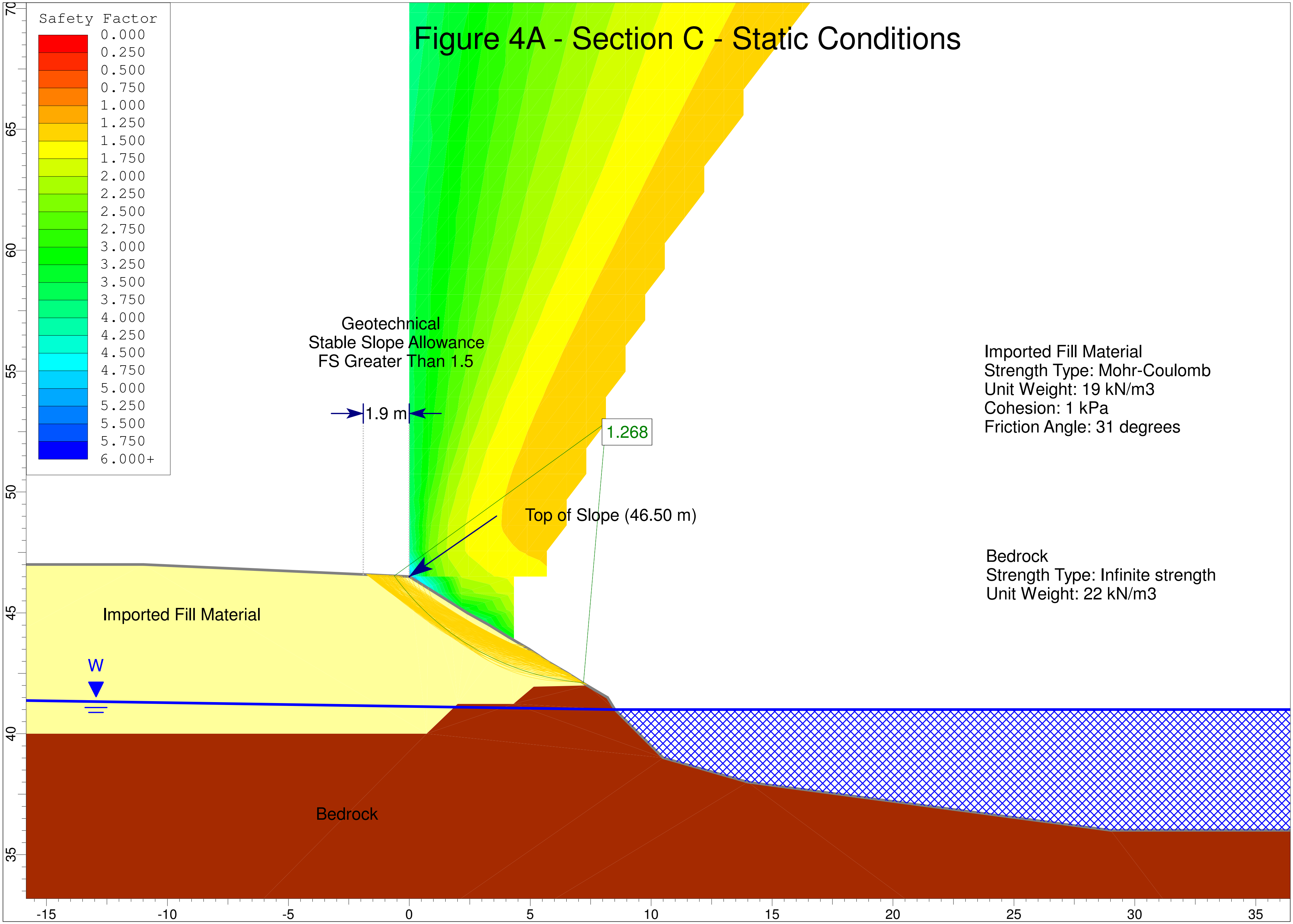


Figure 4A - Section C - Static Conditions

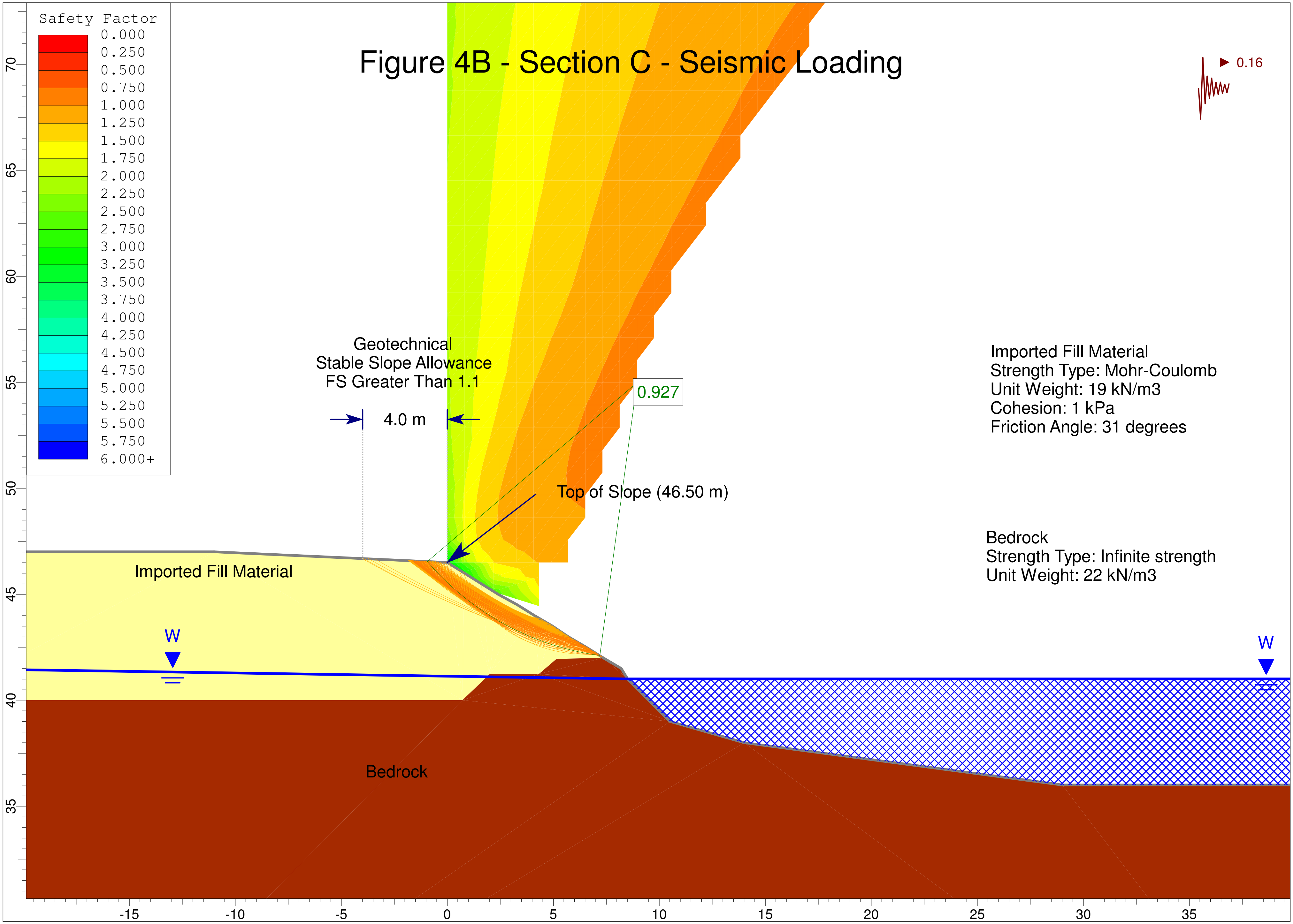


Figure 4B - Section C - Seismic Loading

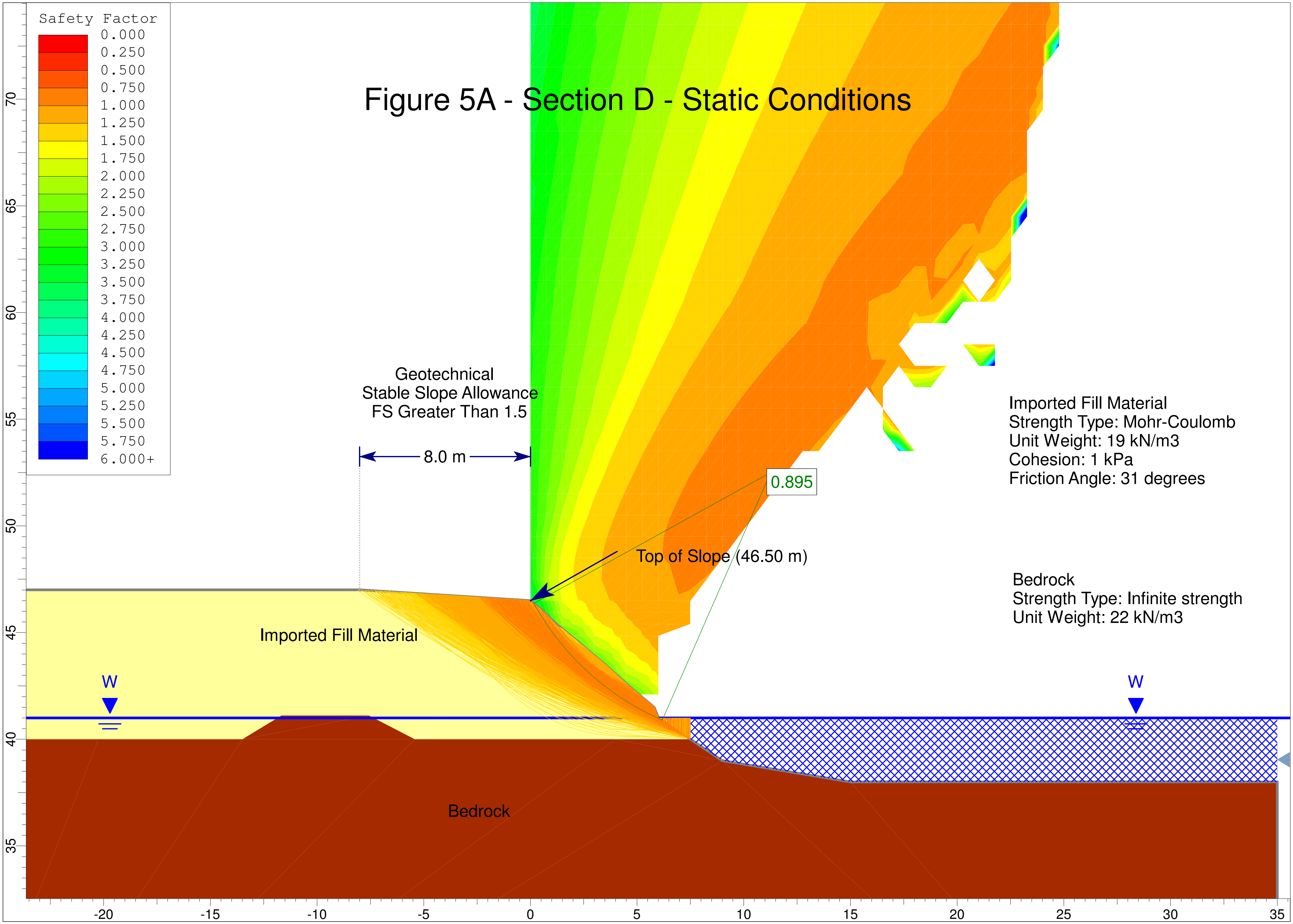


Figure 5A - Section D - Static Conditions

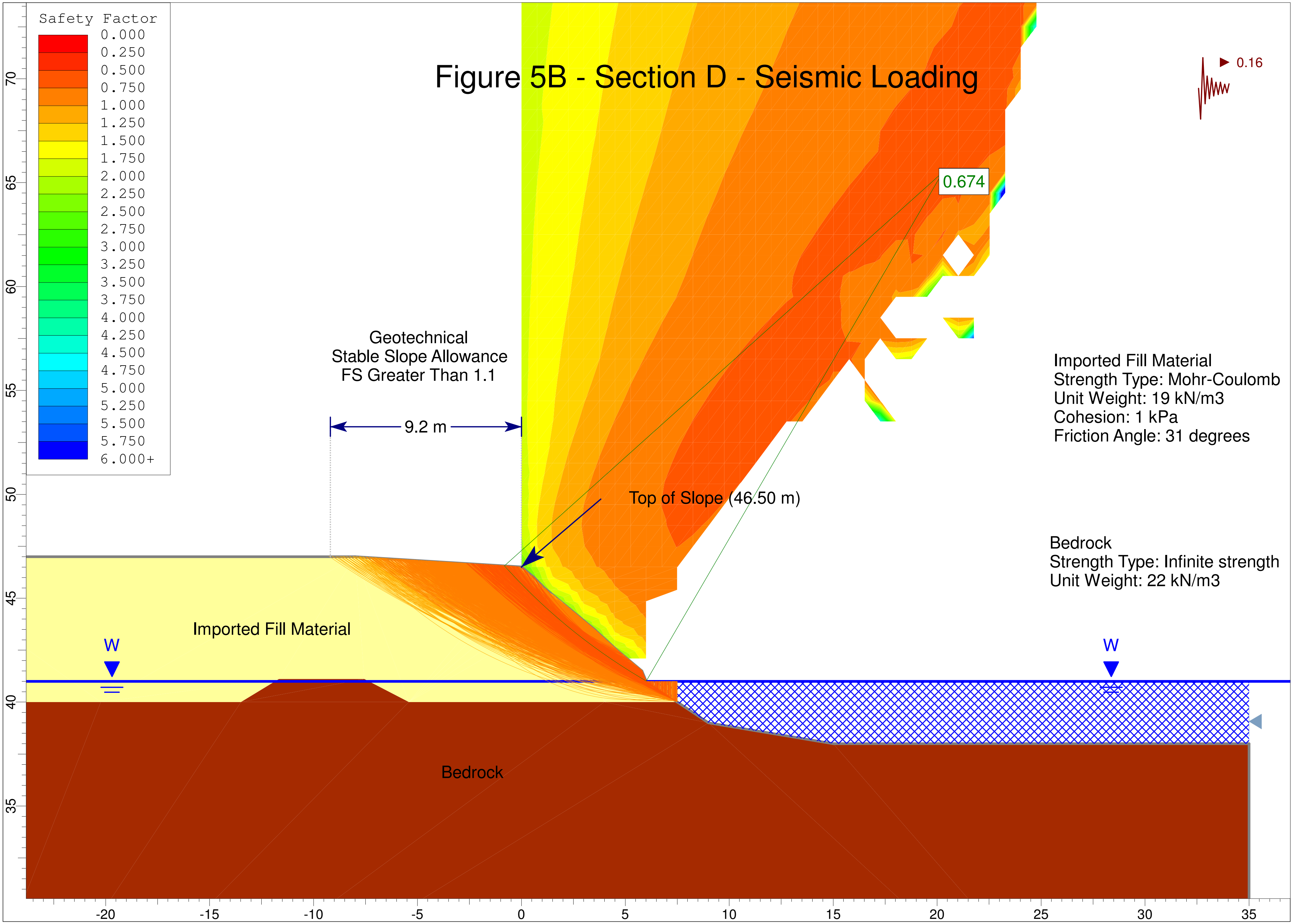


Figure 5B - Section D - Seismic Loading

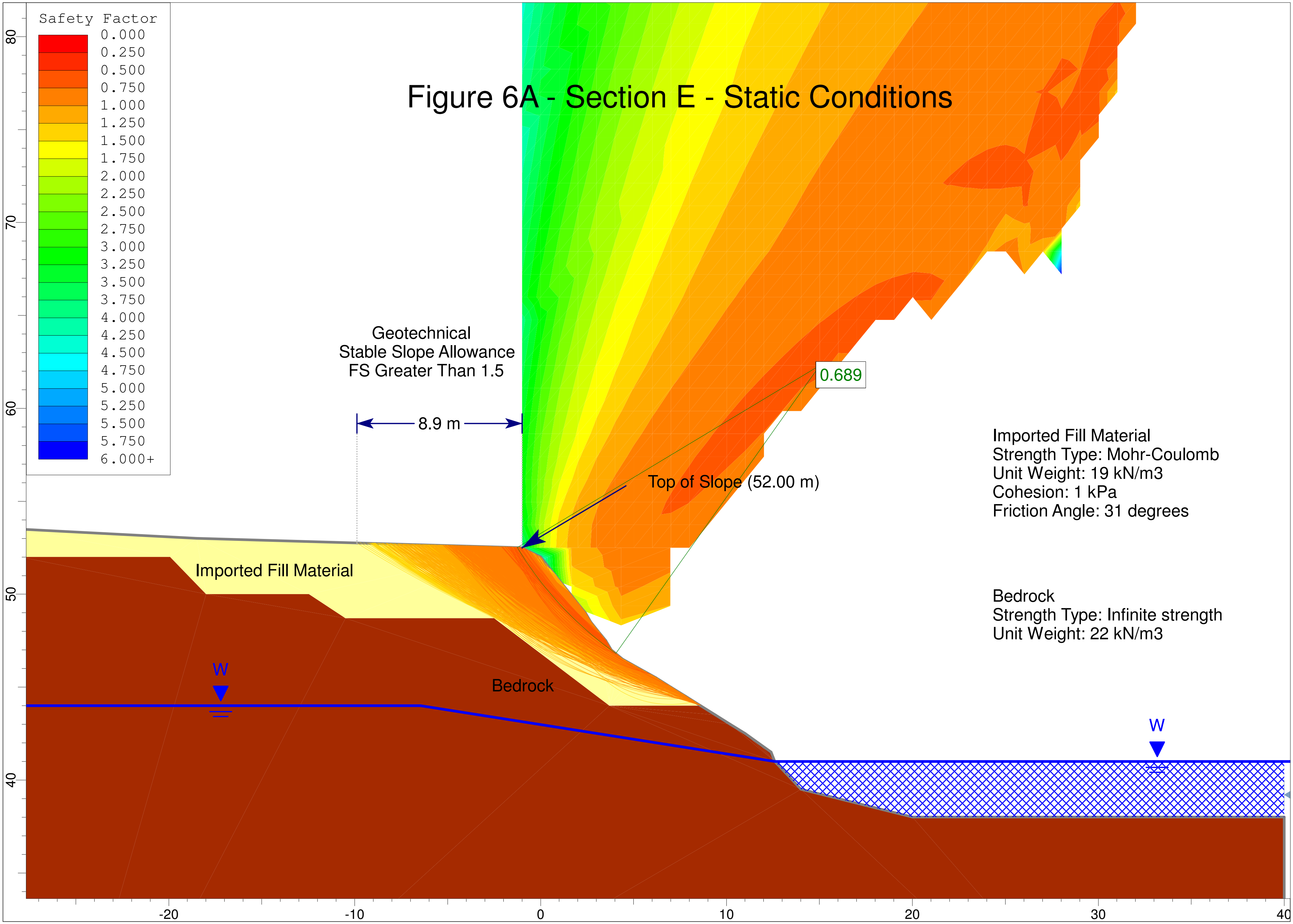


Figure 6A - Section E - Static Conditions

Geotechnical
Stable Slope Allowance
FS Greater Than 1.5

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3

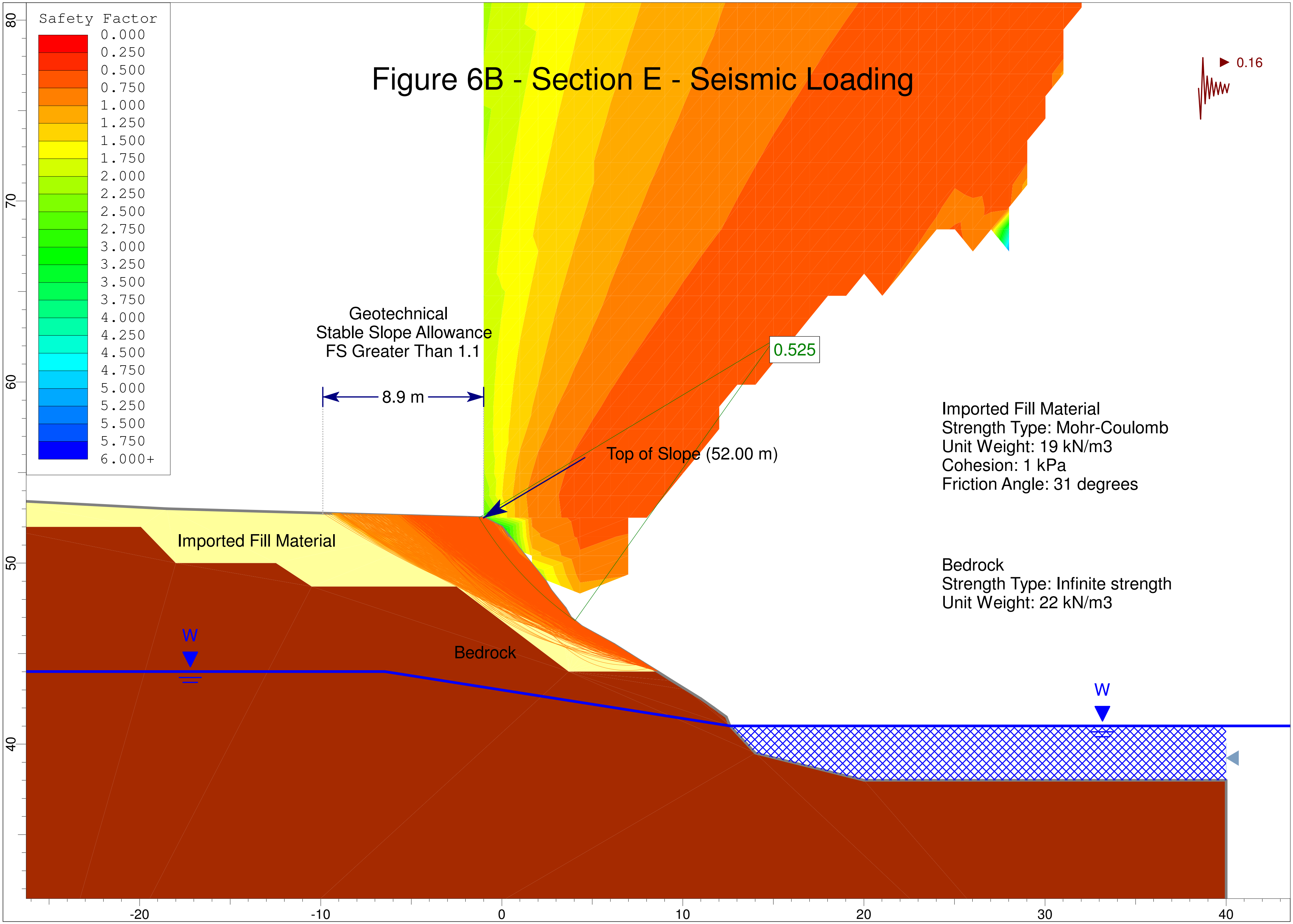


Figure 6B - Section E - Seismic Loading

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3

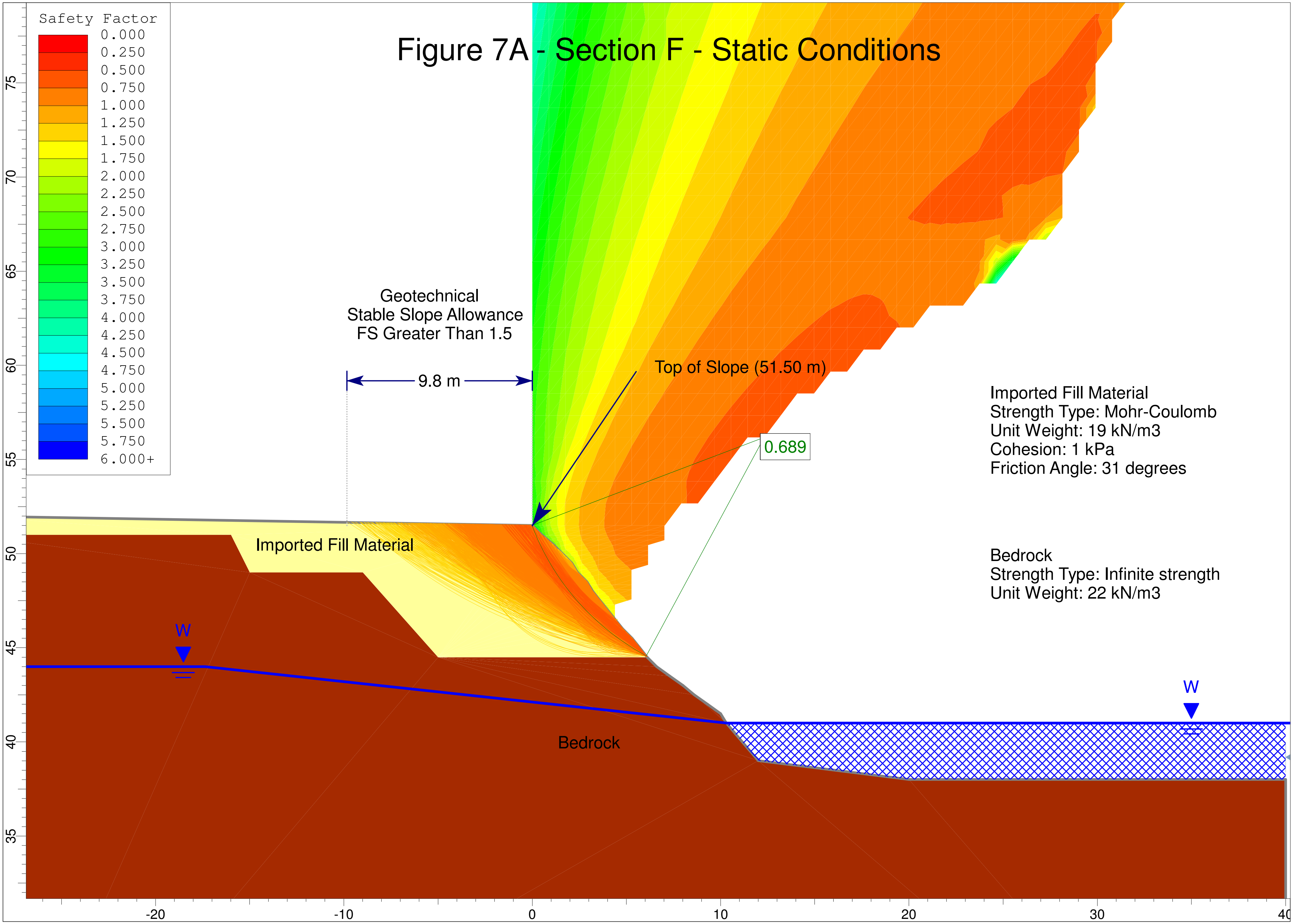


Figure 7A - Section F - Static Conditions

Geotechnical
Stable Slope Allowance
FS Greater Than 1.5

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3

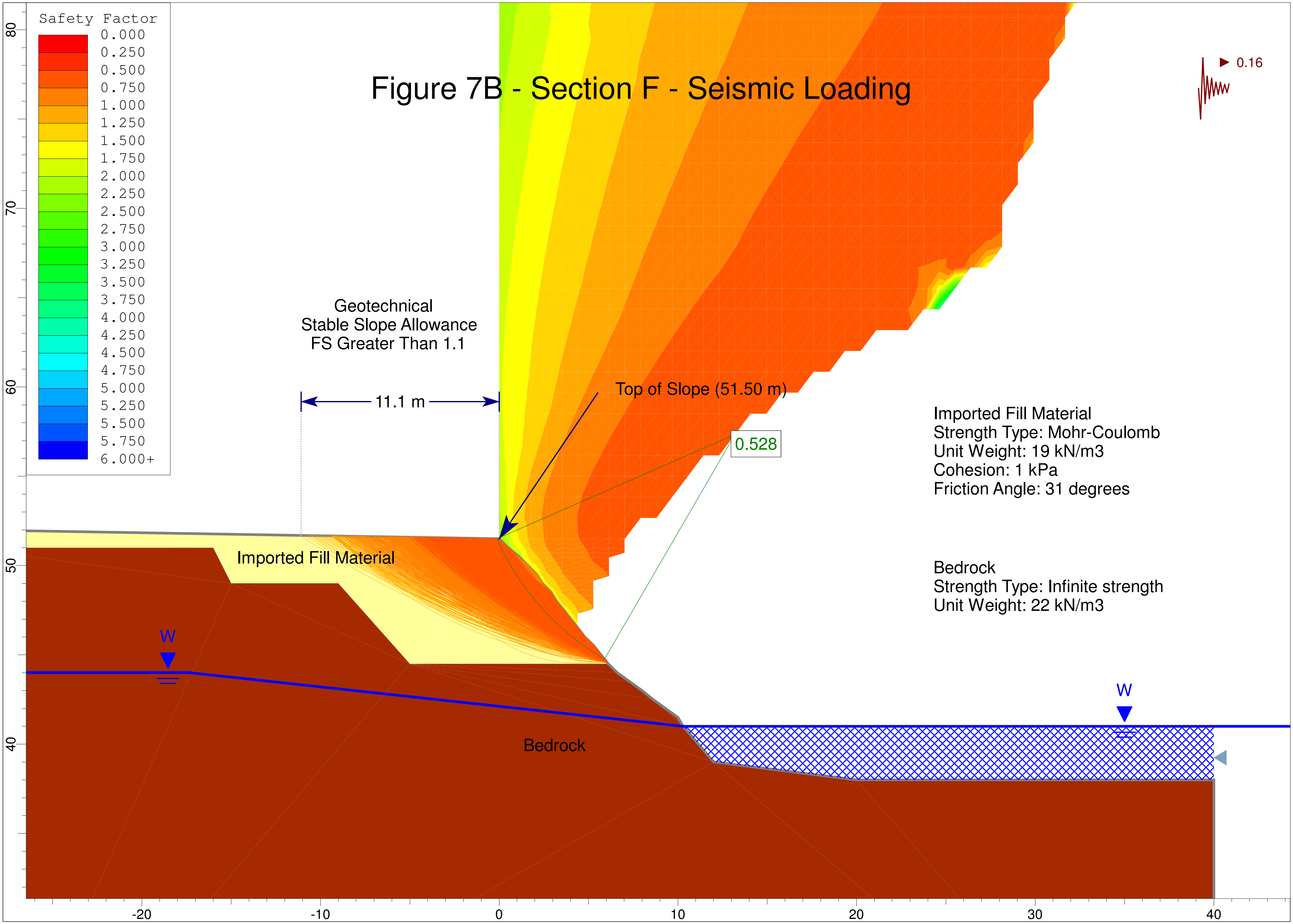


Figure 7B - Section F - Seismic Loading

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3

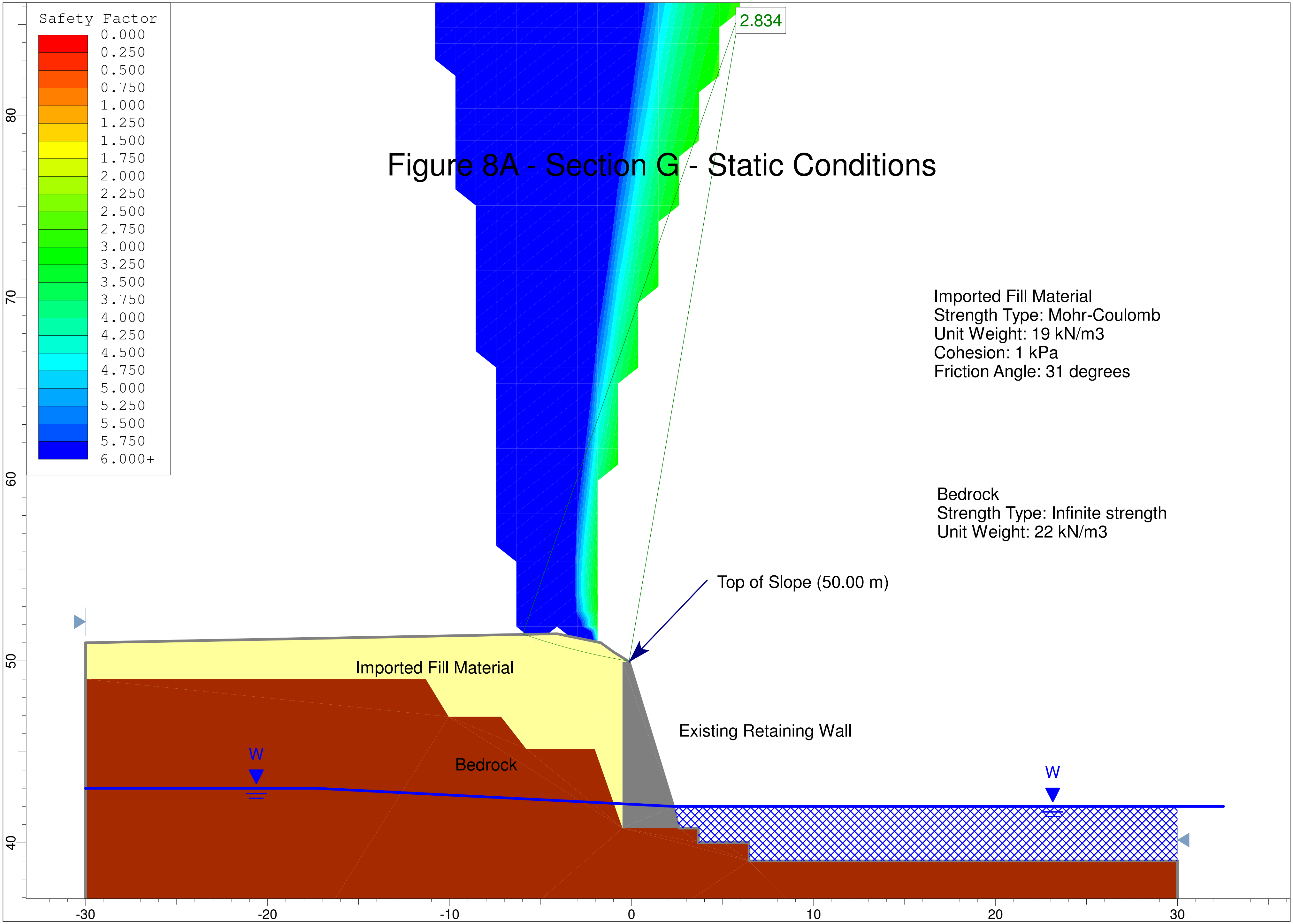


Figure 8A - Section G - Static Conditions

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3

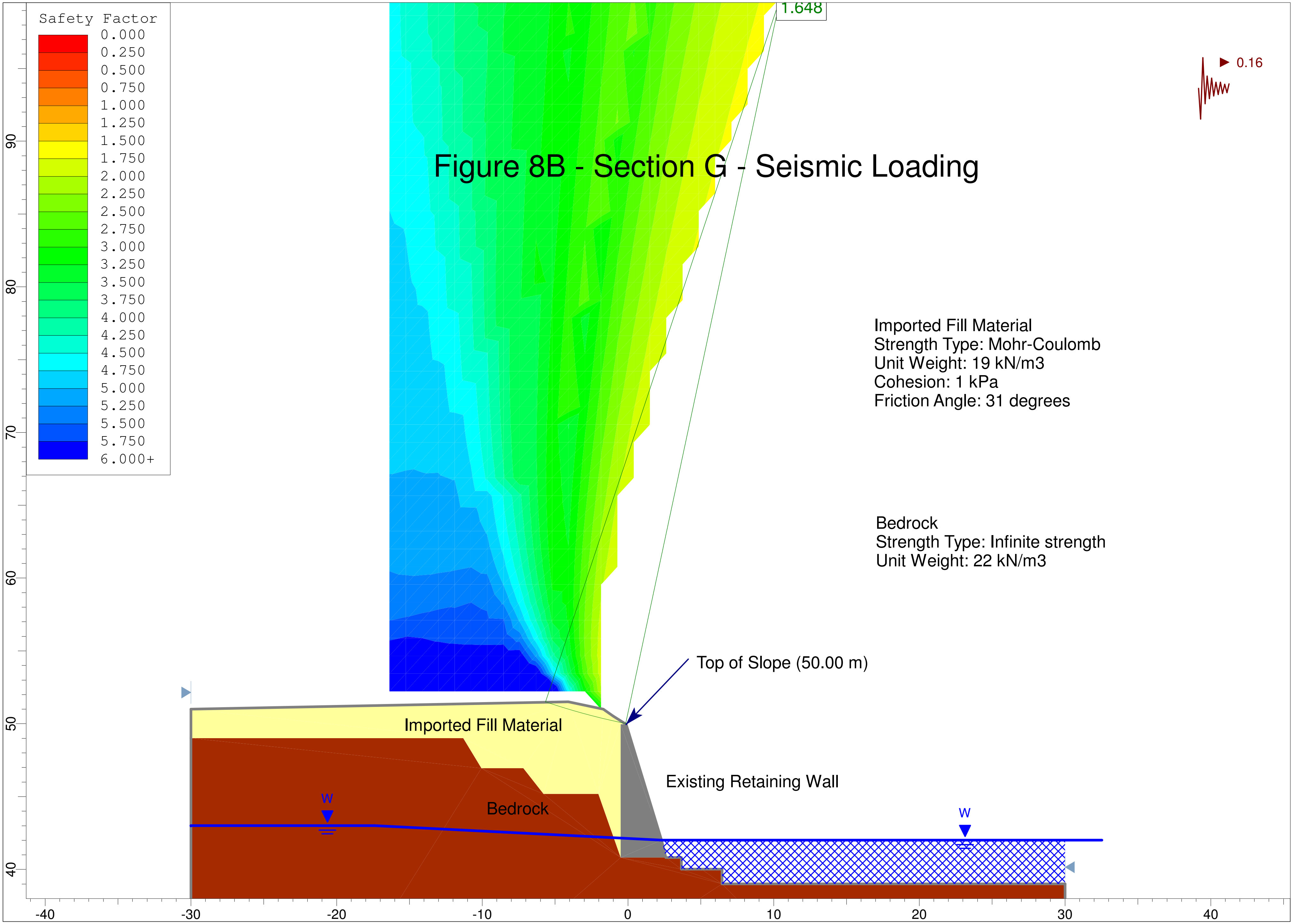
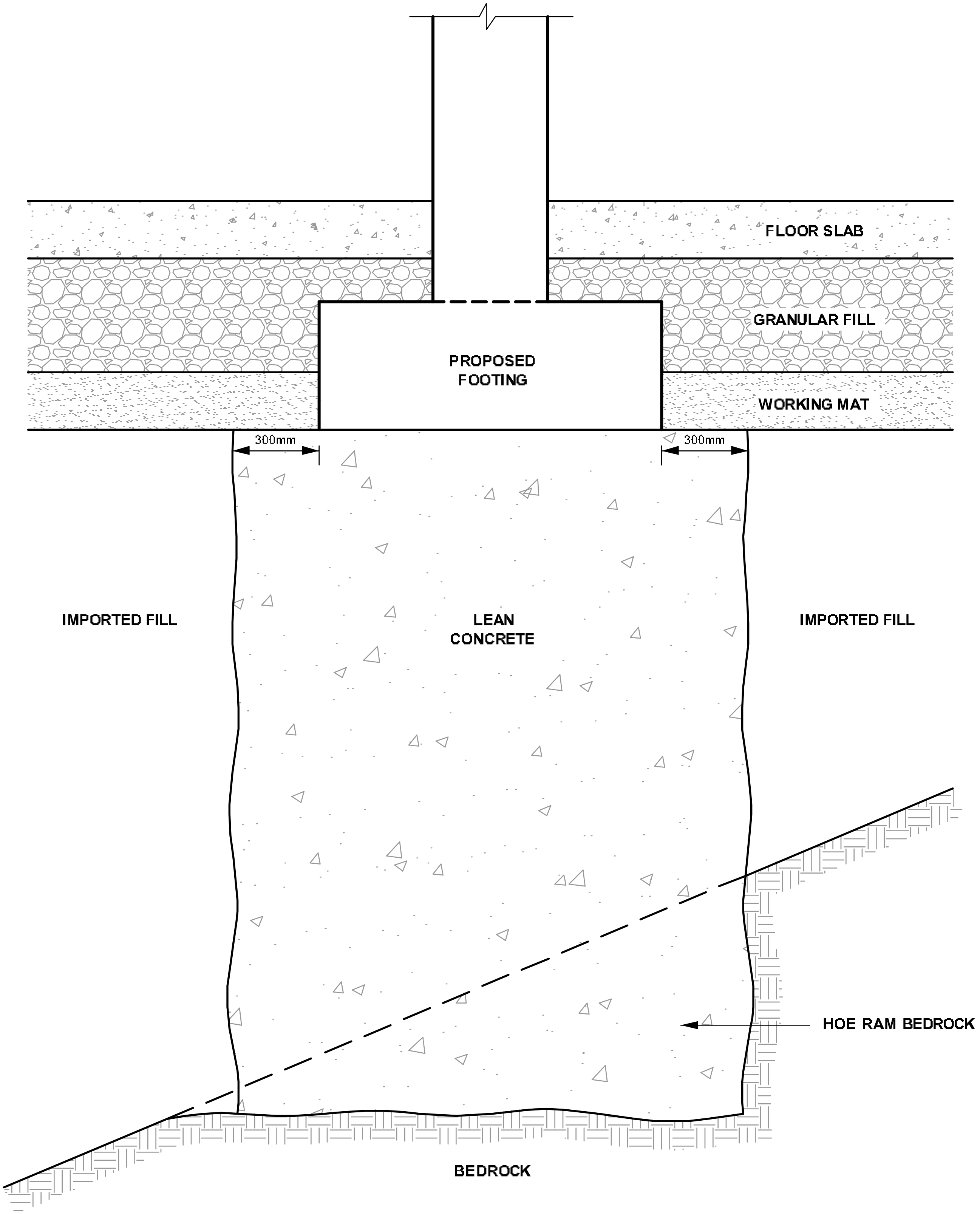


Figure 8B - Section G - Seismic Loading

Imported Fill Material
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 31 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3



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WINFMILL GREEN FUND LPV

TRENCH FOOTING DETAIL
CHAUDIERE AND ALBERT ISLANDS, OTTAWA, ON.

Drawing No.: FIGURE 9	Scale: N.T.S.

Date:	Drawn:	Approved:
03/2014	MPG	CDS

PG3202 FIGURE 9 TRENCH FOOTING

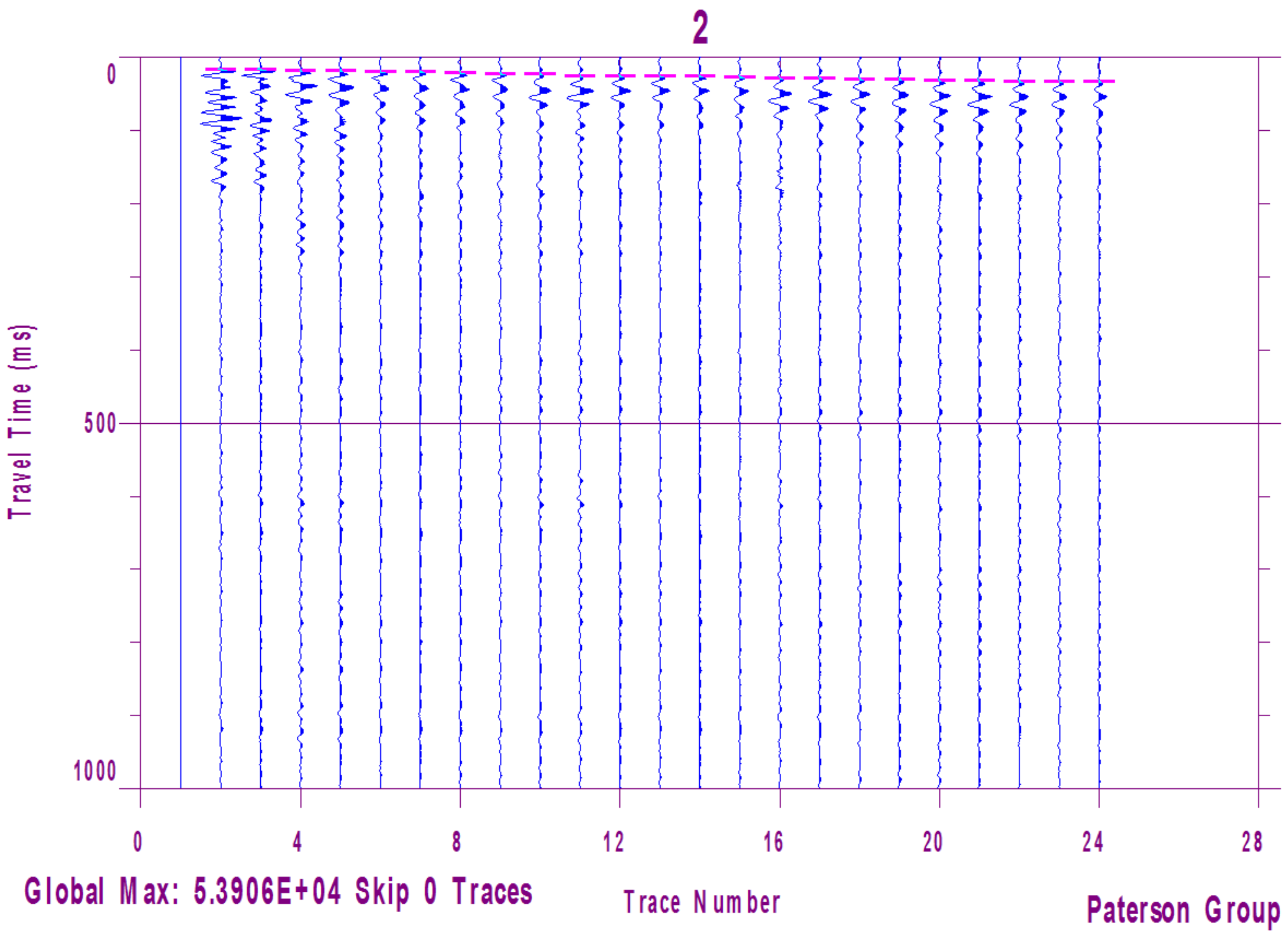

Figure 10 – Shear Wave Velocity Profile at Shot Location -20 m

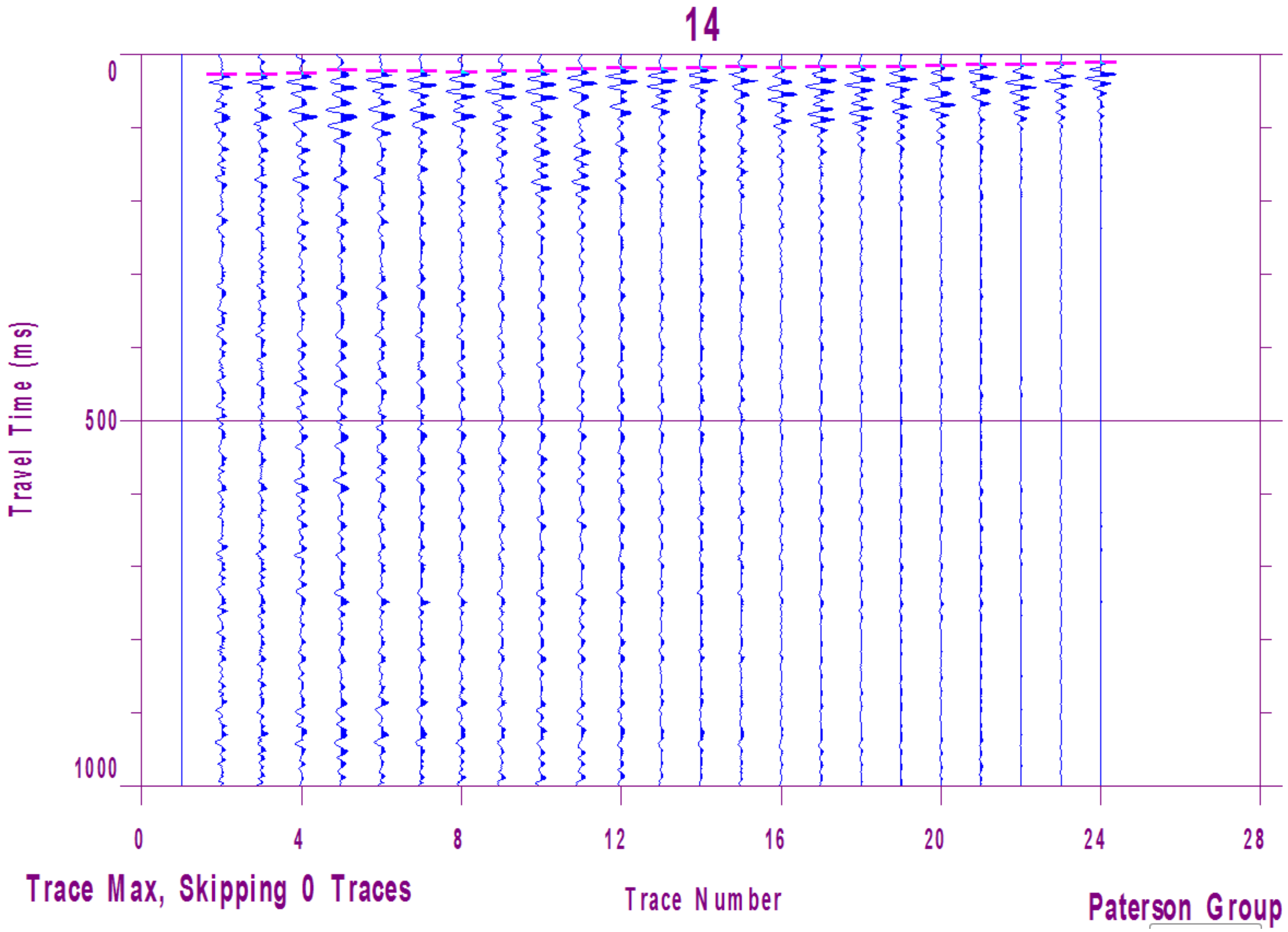

Figure 11 – Shear Wave Velocity Profile at Shot Location 56 m

AERIAL PHOTOGRAPH
1928

AERIAL PHOTOGRAPH
1950

AERIAL PHOTOGRAPH
1967

AERIAL PHOTOGRAPH
1979

AERIAL PHOTOGRAPH
1989

Photographs – March 21, 2014

Photo 1: Photograph taken of the existing retaining wall located near Slope Cross Section G.

Photo 2: Photograph taken of the existing snow covered slope located near Slope Cross Section B.

Photo 3: Photograph taken of the existing snow covered slope located near Slope Cross Section D.

Photo 4: Photograph taken of the snow covered slope located near Slope Cross Section E and F.

Photo 5: Photograph taken of the existing retaining wall located on the north side of Chaudiere Island, west of Booth Street.

Photo 6: Photograph taken of the snow covered slope located at the southwest corner of Chaudiere Island.

Photo 7: Photograph taken of the ice covered channel between Chaudiere and Albert Islands looking west.

Photo 8: Photograph taken of the channel between Albert Island and the City of Ottawa looking west.

Photo 9: **TP1-15** located adjacent to Building 509 which terminated on the bedrock surface at a depth of 0.8 m below existing ground surface. An over-poured concrete surface beyond the foundation wall face was observed over the bedrock surface.

Photo 10: Photo taken at **TP1-15** which illustrates the perimeter foundation drainage system and over poured concrete at the interface between the exterior concrete foundation wall and the bedrock surface.

Photo 11: **TP2-15** located in Building 508-A with excavated backfill material against the existing interior concrete foundation wall.

Photo 12: Recovered at **TP2-15** with minor groundwater infiltration observed at the base of the test pit overlying the bedrock surface.

Photo 13: **TP3-15** located adjacent to Building 509 which was terminated on the bedrock surface at a depth of 0.8 m below existing ground surface. Some over poured concrete was observed at the interface between the exterior concrete foundation wall and the bedrock surface.

Photo 14: Recovered at **TP3-15** illustrating the 100 mm thick over poured concrete extending 120 mm from the exterior face of the concrete foundation wall.

LEGEND:

⌖	BOREHOLE WITH MONITORING WELL LOCATION, CURRENT INVESTIGATION
◕	BOREHOLE LOCATION, CURRENT INVESTIGATION
▚	TEST PIT LOCATION, CURRENT INVESTIGATION
⊕	APPROXIMATE LOCATION OF BOREHOLE WITH MONITORING WELL BY OTHERS
●	APRROXIMATE LOCATION OF INTERIOR BOREHOLE BY OTHERS
	INTERIOR TEST HOLE LOCATIONS MARKED IN RED
53.60	GROUND SURFACE ELEVATION (m)
[49.10]	BEDROCK SURFACE ELEVATION (m)
(2.5)	DEPTH TO SPLIT SPOON REFUSAL (m)
—●—●—●—	GEOPHONE LOCATION
(20)	GEOPHONE NUMBER
⌖ -2.0	SHOT LOCATION
🟥	TOP OF SLOPE
🟦	GEOTECHNICAL STABLE SLOPE ALLOWANCE
Ⓐ—Ⓐ	SLOPE CROSS-SECTION LOCATIONS

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NO.	REVISIONS	DATE	INITIAL
1	BUILDING FOOTPRINT & BASEMENT BLOCKS	05/10/2015	RG

WINDMILL GREEN FUND LP V

GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - CHAUDIERE ISLAND AND ALBERT ISLAND
OTTAWA, ONTARIO

Title:

SITE PLAN - EXISTING CONDITIONS

Stamp:

Scale: 1:750
Drawn by: CPB
Checked by: RG
Approved by: DG
Date: 10/2015

Report No.: PG3202-2R
Drawing No.: PG3202-2
Revision No.: 1

\pg32xx\pg3202\pg3202-2 rev 1.dwg

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NO.	REVISIONS	DATE	INITIAL
02	REVISED AS PER CITY OF OTTAWA COMMENTS	01/07/2016	RG
01	UPDATED TO REFLECT FUTURE DEVELOPMENT	05/10/2015	RG

WINDMILL GREEN FUND LP V

GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - CHAUDIERE ISLAND AND ALBERT ISLAND
OTTAWA, ONTARIO

Title:

SITE PLAN - PROPOSED DEVELOPMENT - PHASE I

Stamp:

Scale: 1:750
Drawn by: CPB
Checked by: RG
Approved by: DG
Date: 10/2015

Report No.: PG3202-2R
Drawing No.: PG3202-3
Revision No.: 2

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