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Geotechnical Investigation

Proposed Residential Development
Cardinal CreekVillage South
Old Montreal Road
Ottawa, Ontario

Prepared For

Taggart Investments

November 29, 2021

Report: PG5201-1
Revision 5

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Taggart Investments to conduct a geotechnical investigation for Cardinal Creek Village South residential development to be located along Old Montreal Road in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objectives of the geotechnical investigation were to:

❑ determine the subsurface soil and groundwater conditions by means of boreholes.

❑ provide geotechnical recommendations for the design 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 geotechnical findings and includes recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

2.0 Proposed Development

It is expected that the proposed development will consist of single and townhouse style residential dwellings with basement or slab-on-grade construction, attached garages, associated driveways, local roadways and landscaped areas. It is further anticipated that the site will be serviced by future municipal services.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out in February, 2021 and consisted of excavating a total of 20 test pits to a maximum depth of 3.0 m below the existing ground surface. Previous geotechnical investigation for the overall development were conducted in January 2009, April 2012, June 2012 and from January to February 2013, and boreholes completed within the boundaries of the current site were reviewed as part of the current geotechnical investigation. A bedrock delineation program consisting of advancing probeholes to the bedrock surface was carried out in November of 2019 to assess the overburden thickness across the subject site.

The test hole locations were determined in the field by Paterson personnel and distributed in a manner to provide general coverage of the proposed residential development taking into consideration site features and underground utilities. The test hole locations are presented on Drawing PG5201-1 - Bedrock Contour Plan included in Appendix 2.

The boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. The drilling procedure consisted of augering to the required depths at the selected locations and sampling the overburden. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department.

Sampling and In Situ Testing

Soil samples from the boreholes were recovered from the auger flights or a 50 mm diameter split-spoon sampler. All soil samples were classified on site, placed in sealed plastic bags and transported to the laboratory for further review. The depths at which the auger and split spoon samples were recovered from the test holes are presented as AU and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

Standard Penetration Testing (SPT) was conducted and recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split-spoon sample 300 mm into the soil after a 150 mm initial penetration with a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was conducted at regular intervals in cohesive soils and completed using a MTO field vane apparatus.

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

Groundwater

Flexible standpipes were installed in the boreholes during the field investigation to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

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

3.2 Field Survey

The test hole locations were selected by Paterson to provide general coverage of the current phase of the residential development taking into consideration existing site features and underground utilities. The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson. The ground surface elevations at the borehole locations were referenced to a geodetic datum. The test hole locations are presented on Drawing PG5201-2 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually examined in our laboratory to review the results of the field logging. Gradation and Atterberg Limits testing were also completed on select samples obtained from the geotechnical investigations. The results of this testing are provided in Section 4.2.

4.0 Observations

4.1 Surface Conditions

The subject site consists mostly of agricultural lands and is presently undeveloped with treed areas. A series of tributary ravines, which drain into Cardinal Creek are presented within the subject site. The slopes of the ravines were noted to be treed and stable based on our most recent site visit.

4.2 Subsurface Profile

Overburden

Generally, the overburden profile consists of topsoil or fill overlying a stiff to very stiff silty clay deposit. Glacial till, consisting of silty clay with sand, gravel, cobbles and boulders was encountered below the silty clay. Bedrock was noted below the glacial till at several test holes.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the depth to bedrock across the site generally ranges from ground surface to 10 m. However, the depth to bedrock at some areas within the northwest side is expected to range between 15 to 50m. Available geological mapping indicates that Dolomite, Limestone and Shale is present in the subject area.

Laboratory Testing

Atterberg limits testing, as well as associated moisture content testing, was completed on the recovered silty clay samples at selected locations throughout the subject site. The results of the Atterberg limits tests are presented in Table 1 and on the Atterberg Limits Results sheet in Appendix 1. The test samples classify as inorganic clays of high plastcity (CH) and inorganic silts of high plasticity (MH), in accordance with the Unified Soil Classification System (USCS).

Table 1 - Atterberg Limits Results						
Sample	**Depth (m)**	**LL (%)**	**PL (%)**	**PI (%)**	**w (%)**	**Classification**
TP 1-21	2.0	61	31	30	36.0	CH
TP 3-21	1.85	69	31	38	40.7	CH
TP 4-21	1.11	57	32	25	37.6	MH
TP 5-21	2.1	73	37	36	45	MH
TP 6-21	0.94	63	34	29	42.3	MH
TP 7-21	0.70	59	32	27	38.5	MH
TP 8-21	0.95	70	44	26	49.7	MH
TP 9-21	0.6	58	32	26	23.6	MH
TP 10-21	1.5	60	33	27	35.8	MH
TP 11-21	2.11	65	35	30	43.6	MH
TP 12-21	0.8	75	37	38	37.4	MH
TP 16-21	0.3	57	29	28	36.9	CH
TP 17-21	0.6	65	36	29	39.9	MH
TP 17-21	1.3	57	31	26	35.1	MH
TP 18-21	0.4	66	36	30	35.5	MH
TP 19-21	1.5	61	32	29	32.9	MH
TP 20-21	1.0	76	39	37	39.2	MH
Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; w: water content; CH: Inorganic Clay of High Plasticity MH: Inorganic Silts of High Plasticity						

The results of the shrinkage limit test indicate a shrinkage limit of 22% and a shrinkage ratio of 1.71.

Grain size distribution (sieve and hydrometer analysis) was also completed on selected soil samples. The results of the grain size analysis are summarized in Table 2 and presented on the Grain-Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 2 - Summary of Grain Size Distribution Analysis					
Test Hole	**Sample**	**Gravel (%)**	**Sand (%)**	**Silt (%)**	**Clay (%)**
TP 2-21	G4	0.0	0.2	27.3	72.5
TP 7-21	G3	0.0	14.4	29.6	56.0
TP10-21	G4	0.0	14.4	31.2	67.5
TP12-21	G2	0.0	2.7	26.8	70.5
TP18-21	G1	0.0	15.4	34.1	50.5

4.3 Groundwater

The long-term groundwater level can be estimated based on the recovered soil samples' moisture levels, colouring and consistency. Based on these observations, the long-term groundwater level is anticipated at a depth of approximately 3 to 4 m below ground surface. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

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

Should existing grades be raised at the site for the proposed development, it is expected that several options, such as engineered fill or well graded blast rock, would act as suitable subgrade material for the proposed buildings provided the material is adequately placed and approved by the geotechnical consultant at the time of placement.

It is anticipated that some bedrock removal will be required for basement construction and site servicing activities. All contractors should be prepared for bedrock removal within the subject site.

A follow-up site visit was completed to review the slope conditions along the tributary ravine slopes to confirm that our original Limit of Hazard Lands recommendations are still applicable for the subject slopes. Photographs from our site visit are presented in Appendix 2.

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

5.2 Site Grading and Preparation

Stripping Depth

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

Fill Placement

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

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts compacted by the tracks of the spreading equipment to minimize voids. If the material is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Where blast rock it to be used as fill to build up the bearing medium, it should be suitably fragmented to produce a well-graded material with a maximum particle size of 400 mm placed in maximum 600 mm loose lifts and compacted using a large smooth drum vibratory roller making several passes per lift and approved by the geotechnical consultant at the time of placement. Any blast rock greater than 400 mm in diameter should be segregated and hoe rammed into acceptable fragments. The blast rock fill should be capped with a minimum of 300 mm of Granular B Type II or Granular A crushed stone material and should be compacted to at least 98% of its SPMDD.

Bedrock Removal

In areas where shallow bedrock is encountered, and only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming. However, dependent on the quantity and condition of the bedrock, line-drilling in conjunction with hoe-ramming may be required to remove the bedrock. All contractors should be prepared for bedrock removal within the subject site.

Vibration Considerations

Construction operations could cause 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 a cooperative environment with the residents.

Two parameters determine the recommended vibration limit: the maximum peak particle velocity and the frequency. 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). These guidelines are for current construction standards. These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people. A pre-construction survey is recommended to minimize the risks of claims during or following the construction of the proposed buildings.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 2 m wide, and pad footings, up to 4 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**.

Footings placed on an undisturbed, compact silty sand and/or glacial till bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **250 kPa**.

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

Footings placed on clean, surface-sounded bedrock can be designed using a factored bearing resistance value at ULS of **500 kPa**. A clean, weathered bedrock surface consists of one from which all topsoil, soils, deleterious materials and loose rock have been removed prior to concrete placement.

Footings placed over an approved engineered fill bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **250 kPa**.

Footings designed using the bearing resistance value at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support. Adequate lateral support is provided to a silty sand, clayey silt, silty clay, glacial till or engineered fill bearing medium above the groundwater table when a plane extending down and out from the bottom edge of the footing, at a minimum of 1.5H:1V passes through in situ soil of the same or high bearing medium soil.

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

Permissible Grade Raise Restrictions

Based on our soil information for the subject site, a 2 m permissible grade raise restriction is recommended for areas where the silty clay deposit is located below design footing level. The permissible grade areas are shown on Drawing PG5201-3 - Permissible Grade Raise Restriction Area, in Appendix 2.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

5.4 Design for Earthquakes

The subject site can be taken as seismic site response **Class D** as defined in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012 for foundations considered at this site. A site specific shear wave velocity test may be completed to accurately determine the applicable seismic site classification for foundation design of the proposed residential development.

The soils underlying the site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab / Slab-on-Grade Construction

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

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

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone. For structures with slab-on-grade construction, the upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

5.6 Pavement Structure

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

Table 3 - Recommended Pavement Structure - Driveways

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

Notes:
1-SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil
2- Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this Pavement Structure.

Table 4 - Recommended Pavement Structure - Local Residential Roadways

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II

Notes:
1-SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil
2- Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this Pavement Structure.

Table 5 - Recommended Pavement Structure - Collector/Arterial Roadways with Bus Traffic

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II

Notes:
1-SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil
2- Minimum Performance Graded (PG) 64-34 asphalt cement should be used for this Pavement Structure.

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

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

Pavement Structure Drainage

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

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 100 to 150 mm diameter perforated and corrugated plastic pipe surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as Miradrain G100N) connected to a drainage system is provided.

6.2 Protection Against Frost Action

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

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

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

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

It is recommended that a dewatering program, such as a series of well points design and installed by a licensed contractor specializing in dewatering, be completed for service installations completed below the groundwater level for areas in non-cohesive soils.

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

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

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

Excavation Base Stability

The base of supported excavations can fail by three (3) general modes:

- ❑ Shear failure within the ground caused by inadequate resistance to loads imposed by grade difference inside and outside of the excavation,
- ❑ Piping from water seepage through granular soils, and
- ❑ Heave of layered soils due to water pressures confined by intervening low permeability soils.

Shear failure of excavation bases is typically rare in granular soils if adequate lateral support is provided. Inadequate dewatering can cause instability in excavations made through granular or layered soils. The potential for base heave in cohesive soils should be determined for stability of flexible retaining systems.

The factor of safety with respect to base heave, FS_b, is:

$$FS_b = N_b s_u / \sigma_z$$

where:

N_b - stability factor dependent upon the geometry of the excavation and given in Figure 1 on the following page.
s_u - undrained shear strength of the soil below the base level
σ_z - total overburden and surcharge pressures at the bottom of the excavation

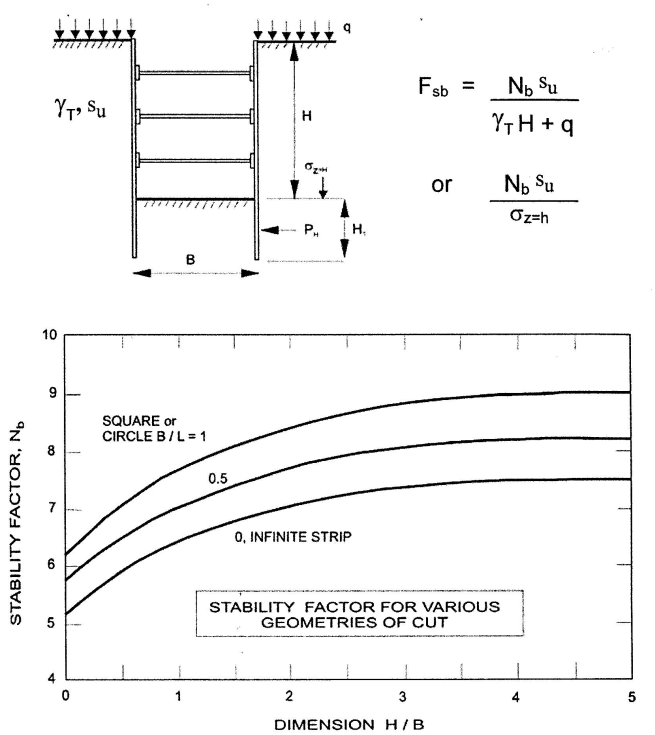


Figure 1 - Stability Factor for Various Geometries of Cut

In the case of soft to firm clays, a factor of safety of 2 is recommended for base stability.

6.4 Pipe Bedding and Backfill

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

At least 150 mm of OPSS Granular A crushed stone should be used for pipe bedding for sewer and water pipes. However, the bedding thickness should be increased to 300 mm for areas over a bedrock subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 98% of the material's SPMDD.

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

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay should be given a sufficient drying period to decrease its moisture content to an acceptable level to make compaction possible prior to being re-used. All cobbles greater than 200 mm in the longest direction should be removed prior to the site materials being reused.

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 consist of the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

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

6.5 Groundwater Control

Due to the relatively impervious nature of the silty clay, it is expected that groundwater infiltration into the excavations should be controllable using open sumps and pumps for the relatively shallow excavations.

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.

Permit to Take Water

A temporary MOECC permit to take water (PTTW) is recommended for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MOECC.

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

6.6 Winter Construction

The subsurface soil conditions mostly consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation 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.

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

6.7 Limit of Hazard Lands

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 field personnel. The initial site visit for slope condition review was completed in 2012 to document the conditions of the tributaries to the Cardinal Creek (south tributary, mid branch 1 and mid branch 2).

The subject tributaries to Cardinal Creek were observed to be stable based on the slope condition review conducted on April 18, 2012 and current review on September 10, 2020 with some toe erosion noted throughout where the watercourse is located in close proximity to the valley corridor wall. Photographs from our site visits are presented in Appendix 2.

Several slope cross-sections were studied along the tributaries' slopes. The cross section locations are presented on Drawings PG5201-2 - Test Hole Location Plan in Appendix 2.

The existing slopes bordering the watercourses are mainly overgrown with mature trees with grass covered areas along the valley corridor walls. The existing valley corridor of the subject tributaries contain an up to 6 m wide watercourse, which meanders throughout the valley floor.

Slope Stability Analysis

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

The sections for existing conditions were analyzed taking into account groundwater level at ground surface. Subsoil conditions at the sections were determined based on the findings at borehole locations along the top of slope, field observations during site visits and general knowledge of the area's geology. The soil parameters were determined for the slope soils based on subsoil conditions at the boreholes along the top of slope.

Static Conditions Analysis - Existing Conditions

The results for the existing static slope conditions at the slope stability sections are presented in Appendix 2. The slope stability factors of safety were found to be greater than 1.5 at all sections analyzed, except for Sections F and JJ, which are located along the south valley corridor wall of the stable slope allowance from top of slope, respectively.

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 of the analyses including seismic loading are presented in Appendix 2. The results indicate that the factors of safety for all the sections are greater than 1.1. Based on these results, the slopes are considered to be stable under seismic loading.

Limit of Hazard Lands

For existing conditions, the toe erosion allowance for the valley corridor slopes was based on the cohesive nature of the soils, the observed current erosional activities and the width and location of the current watercourse. Signs of erosion were noted along the valley floor of the subject tributaries. Some minor to moderate sloughing failures were noted in the lower portion of the slopes, leaving some exposed root systems along the slope face. It is considered that a toe erosion allowance of 5 m is appropriate for the corridor walls confining the subject tributaries. The toe erosion allowance should be applied from the top of stable slope. The limit of hazard lands, including a 6 m erosion access allowance, stable slope allowance (where required) and a 5 m toe erosion allowance, is presented on Drawing PG5201-2 - Test Hole Location Plan in Appendix 2.

In-filling The Side Slopes at Select Locations

Based on Paterson's geotechnical review of select locations along the creek, it can be observed that the creek is branching out towards the north side of the creek, just east of Section EE and section FF. Due to the presence of these branches, the limit of hazard lands line extends into the development area. Therefore, to mitigate this issue, it is recommended that the slope face be in-filled using the following methodology:

- ❏ Site excavated material such as workable, brown silty sand or any approved site excavated material, free of deleterious fill such as organics or construction debris, can be used as backfill material to in-fill the current slope and extend the slope face to match the existing adjacent slopes.
- ❏ The existing slope should be excavated in a benching style where each "bench" should be excavated with a minimum 1.2 m long horizontal ledge and maximum vertical cut of 600 mm.

- ❑ The backfill material should be placed in maximum 300 mm thick loose lifts and compacted to a minimum 98% of the material's SPMDD using suitable compaction equipment. The placement of the backfill material should be completed under dry conditions and above freezing temperatures to achieve optimum compaction levels.
- ❑ The backfill material should be topped with a minimum 300 mm thick layer of topsoil followed by an erosion control blanket (coco mat) and hardy grass seed. The erosion control blanket should be anchored to the top of the slope using steel pins penetrating the top of slope by a minimum of 600 mm to keep the erosion control blanket stable until vegetation is established.
- ❑ it is important that the proposed slope face be finished to match the adjacent slope faces material and inclination. Planting trees along the slope face can be beneficial to increase the stability of the slope face and minimize erosion, if applicable.
- ❑ All work within the slope face should be reviewed and approved by Paterson at the time of construction to ensure the work is being completed in accordance to the recommendations provided herein.
- ❑ Refer to Figure 42 - Recommended Slope In-filling Program presenting a cross section of the above noted program. The limit of hazard lands line will also be modified as a new top of slope line will be identified, please refer to Drawing PG5201-2 - Test Hole Location Plan, in appendix 2.

6.8 Landscaping Considerations

Tree Planting Restrictions

Paterson completed a soils review of the site to determine applicable tree planting setbacks, in accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines) for trees planted within a public right-of-way (ROW). Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. Grain size distribution analysis was also completed on selected soil samples. The above-noted test results were completed on samples taken at depths between the anticipated underside of footing elevation and a 3.5 m depth below finished grade. The results of our testing are presented in Tables 1 and 2 in Subsection 4.2 and in Appendix 1.

A low to medium sensitivity clay was encountered between the anticipated design underside of footing elevation and 3.5 m below finished grade as per City Guidelines. Based on the results of the Atterberg limit testing mentioned above, the modified plasticity index does not exceed 40% across the subject site.

The following tree planting setbacks are recommended for the proposed development. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to **4.5 m** for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the condition noted below are met:

- ❑ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan. Based on our review of the silty clay crust at the founding elevation, this number can be lowered to 1.8 m due to the depth of the groundwater table and our assessment of the impacts of tree planting on the founding medium.

- ❑ A small tree must be provided with a minimum of 25 m^3 of available soil volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ❑ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ❑ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ❑ Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree).

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

Aboveground Swimming Pools

The in-situ soils are considered to be acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer's recommendations.

Aboveground Hot Tubs

Additional grading around hot tubs should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer's specifications.

Decks and Building Additions

Additional grading around proposed decks or additions should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

7.0 Recommendations

The following is recommended to be completed once the site plan and development are determined:

- ❏ Review detailed grading plan(s) from a geotechnical perspective.
- ❏ Observation of all bearing surfaces prior to the placement of concrete.
- ❏ Sampling and testing of the concrete and fill materials used.
- ❏ Review and inspection of all foundation drainage systems.
- ❏ Observation of all subgrades prior to backfilling.
- ❏ Observation of clay seal placement at specified locations
- ❏ Field density tests to ensure that the specified level of compaction has been achieved.
- ❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❏ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming the construction has been completed in general accordance with Paterson's recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

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

A geotechnical investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test hole 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.

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 Taggart Investments, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Faisal I. Abou-Seido, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution
- ❑ Taggart Investments
- ❑ Paterson Group

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

GRAIN SIZE DISTRIBUTION ANALYSIS RESULTS

ATTERBERG LIMIT TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

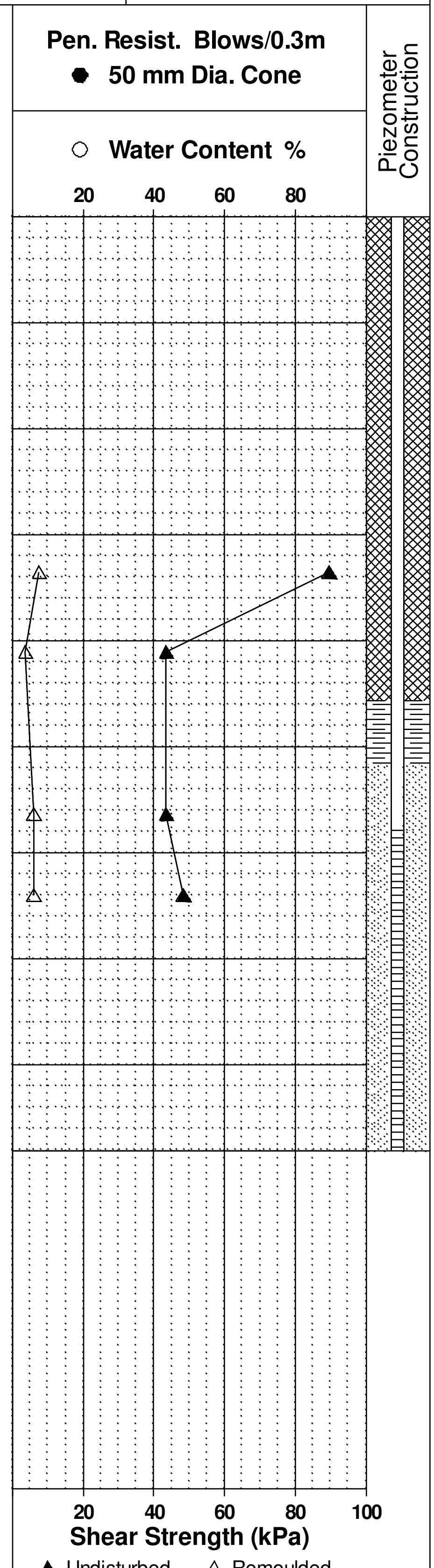
REMARKS

HOLE NO. BH24-12

BORINGS BY CME 55 Power Auger

DATE April 2, 2012

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.44
Brown **SILTY SAND,** trace clay (to 0.20)	AU	1				
	AU	2				
	SS	3	100	21	1	86.44
	SS	4	100	16	2	85.44
Very stiff to stiff, brown **SILTY CLAY**	SS	5	100	9		
- firm and grey by 3.6m depth					3	84.44
					4	83.44
	TW	6	100		5	82.44
(to 6.63)					6	81.44
					7	80.44
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders (to 8.81)	SS	7	62	15	8	79.44
End of Borehole						
Practical refusal to augering @ 8.81m depth						
(BH dry - April 13, 2012)						



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 2, 2012

FILE NO. PG1796

HOLE NO. BH25-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.91
TOPSOIL 0.20							
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders		AU	1				
		SS	2	50	25	1	80.91
		SS	3	20	50+		
		SS	4	67	50+	2	79.91
3.35		SS	5	71	50+	3	78.91
End of Borehole							
Practical refusal to augering @ 3.35m depth							
(GWL @ 0.66m-April 13, 2012)							

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH26-12

BORINGS BY CME 55 Power Auger **DATE** April 3, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.45
TOPSOIL 0.30							
Very stiff, brown **SILTY CLAY,** trace sand 1.45		SS	1	100	18	1	88.45
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders 2.16		SS	2	100	50+	2	87.45
End of Borehole							
Practical refusal to augering @ 2.16m depth							
(GWL @ 0.97m-April 13, 2012)							

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH27-12

BORINGS BY CME 55 Power Auger **DATE** April 9, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	96.23		
TOPSOIL 0.20		AU	1						
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 1.45		SS	2	60	50+	1	95.23		
End of Borehole Practical refusal to augering @ 1.45m depth (BH dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 3, 2012

FILE NO. PG1796

HOLE NO. BH28-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.10
TOPSOIL (0.30)		AU	1				
Very stiff, brown **SILTY CLAY**		AU	2				
		SS	3	100	23	1	88.10
(2.21)		SS	4	100	15	2	87.10
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders (2.82)		SS	5	79	49		

End of Borehole

Practical refusal to augering @ 2.82m depth

(GWL @ 0.40m-April 13, 2012)

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH29-12

BORINGS BY CME 55 Power Auger

DATE April 3, 2012

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25	AU	1		
Very stiff to stiff, brown **SILTY CLAY**	3.73	SS	2	100	21
		SS	3	100	20
		SS	4	100	17
		SS	5	100	12
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders	5.26	SS	6	50	34
		SS	7	4	9
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders	5.54	SS	8	100	50+

End of Borehole

Practical refusal to augering @ 5.54m depth

(Piezometer damaged - April 13, 2012)

DEPTH (m)	ELEV. (m)
0	87.20
1	86.20
2	85.20
3	84.20
4	83.20
5	82.20

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

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FILE NO. PG1796

REMARKS

HOLE NO. BH30-12

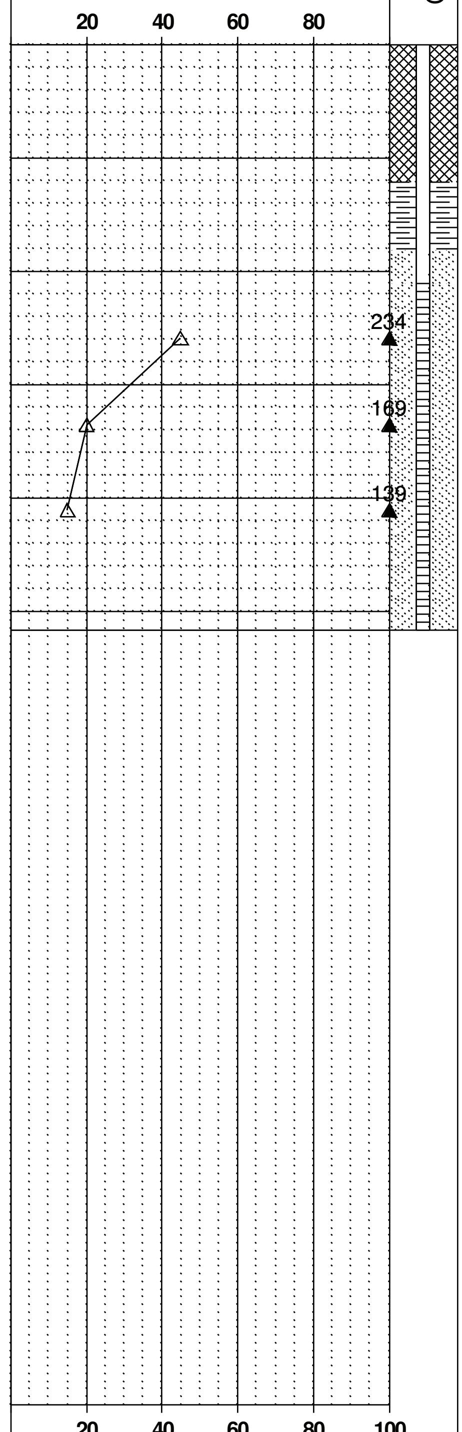
BORINGS BY CME 55 Power Auger **DATE** April 3, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.74
TOPSOIL 0.25		AU	1				
Hard to very stiff, brown **SILTY CLAY**		SS	2	83	18	1	87.74
		SS	3	75	12	2	86.74
						3	85.74
4.34						4	84.74
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders		SS	4	100	50+		
5.16						5	83.74
End of Borehole Practical refusal to augering @ 5.16m depth (Piezometer damaged-April 13,2012)							

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

○ Water Content %

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH31-12

BORINGS BY CME 55 Power Auger

DATE April 3, 2012

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	86.70
TOPSOIL (to 0.28)	AU	1				
Very stiff to stiff, brown **SILTY CLAY**	SS	2	100	12	1	85.70
	SS	3	100	19	2	84.70
(to 2.97)	SS	4	100	19	3	83.70
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders (to 3.76)	SS	5	82	50+		

End of Borehole

Practical refusal to augering @ 3.76m depth

(GWL @ 1.12m-April 13, 2012)

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

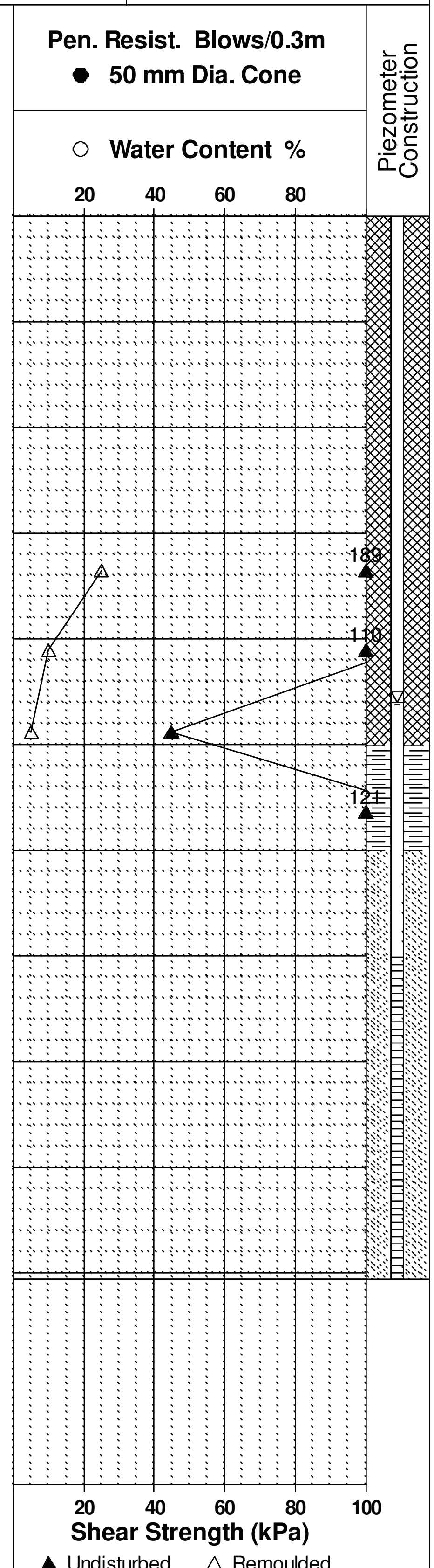
REMARKS

HOLE NO. BH32-12

BORINGS BY CME 55 Power Auger

DATE June 26, 2012

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.94
Very stiff to stiff, brown **SILTY CLAY**	SS	1	100	22	1	86.94
	SS	2	100	18	2	85.94
	SS	3	100	13	3	84.94
- firm by 4.3m depth					4	83.94
					5	82.94
					6	81.94
6.60	SS	4	100	2		
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders	SS	5	42	38	7	80.94
	SS	6	67	50+	8	79.94
	SS	7	100	50+	9	78.94
10.06					10	77.94
End of Borehole						
(GWL @ 4.6m depth based on field observations)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2012

FILE NO. PG1796

HOLE NO. BH33-12

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	91.15		
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders		AU	1						
0.86		SS	2	33	50+				
End of Borehole Practical refusal to augering at 0.86m depth (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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

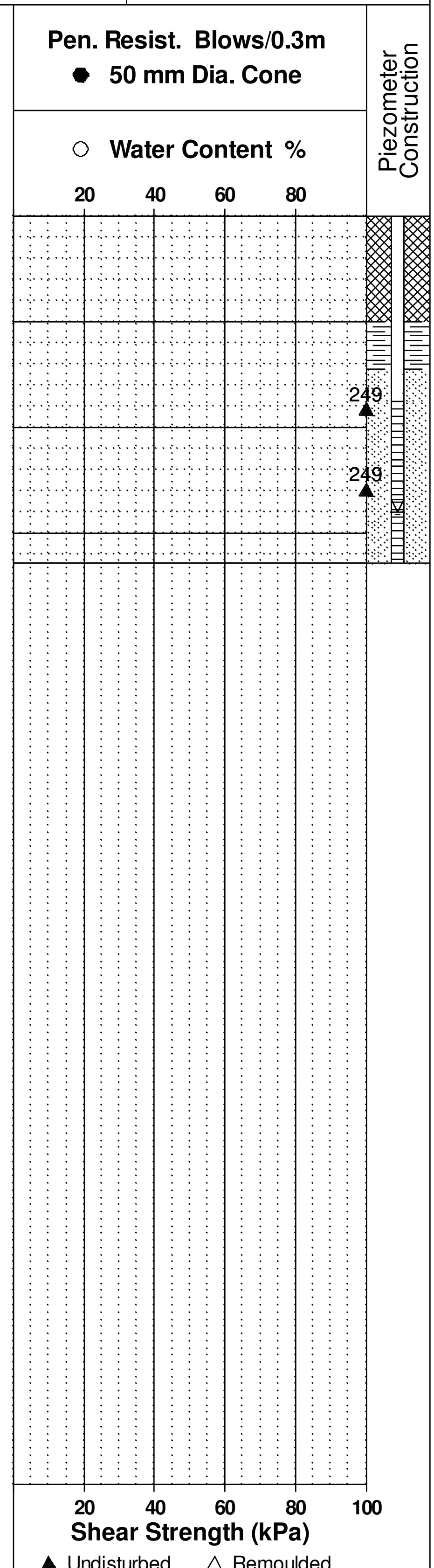
BORINGS BY CME 55 Power Auger

DATE June 26, 2012

FILE NO. PG1796

HOLE NO. BH34-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.99
Hard to very stiff, brown **SILTY CLAY**		AU	1				
		SS	2	100	17	1	88.99
						2	87.99
2.82							
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders						3	86.99
3.28		SS	3	33	50+		
End of Borehole							
Practical refusal to augering at 3.28m depth							
(GWL @ 2.8m depth based on field observations)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2012

FILE NO. PG1796

HOLE NO. BH35-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.07
Hard, brown **SILTY CLAY**		SS	1	100	23	1	89.07
1.90		SS	2	76	50+		
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 2.00						2	88.07

End of Borehole

Practical refusal to augering at 2.00m depth

(GWL @ 1.9m depth based on field observations)

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

○ Water Content %

20 40 60 80

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

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH36-12

BORINGS BY CME 55 Power Auger **DATE** June 26, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.15
Brown **SILTY SAND** with clay		AU	1				
0.60							
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders		SS	2	100	6	1	90.15
		SS	3	67	16	2	89.15
		SS	4	54	39	3	88.15
		SS	5	56	50+		
3.81							
End of Borehole Practical refusal to augering at 3.81m depth (BH dry upon completion)							

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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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH37-12**

BORINGS BY CME 55 Power Auger **DATE** June 26, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.42		
Hard, brown **SILTY CLAY**		SS	1	100	22	1	88.42		
		SS	2	100	16	2	87.42		
2.21									
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders		SS	3	75	50+				
2.87									
End of Borehole Practical refusal to augering at 2.87m depth (GWL @ 2.6m depth based on field observations)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH38-12

BORINGS BY CME 55 Power Auger **DATE** June 26, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.92
Very stiff to stiff, brown **SILTY CLAY**		SS	1	100	19	1	87.92
		SS	2	100	16	2	86.92
2.97		SS	3	100	20		
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders		SS	4	100	50+	3	85.92
4.22		SS	5	50	50+	4	84.92

End of Borehole

Practical refusal to augering at 4.22m depth

(GWL @ 3.5m depth based on field observations)

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH72-12

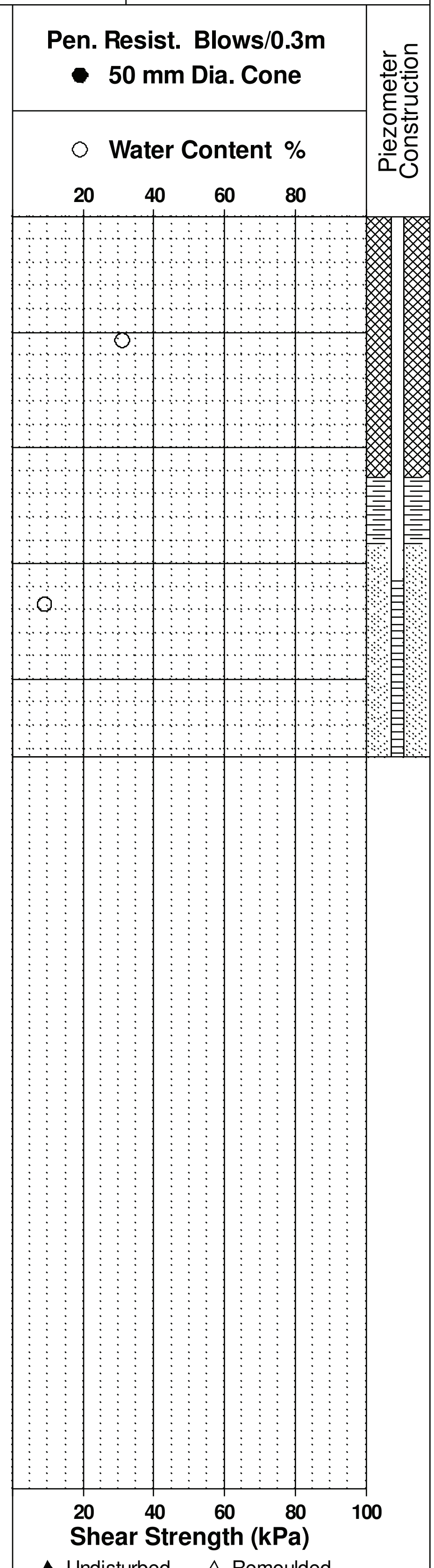
BORINGS BY CME 55 Power Auger

DATE February 4, 2013

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	77.23
Asphaltic concrete	0.20						
FILL: Crushed stone with sand	0.38	AU	1				
FILL: Brown silty sand with gravel	0.69	AU	2				
Stiff, brown **SILTY CLAY**	1.45	SS	3	50	23	1	76.23
GLACIAL TILL: Brown silty clay with sand, gravel, trace cobbles	2.20	SS	4	67	13	2	75.23
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders	4.67	SS	5	43	50+	3	74.23
		SS	6	83	27	4	73.23
		SS	7		50+		

End of Borehole

(BH dry upon completion)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH73-12

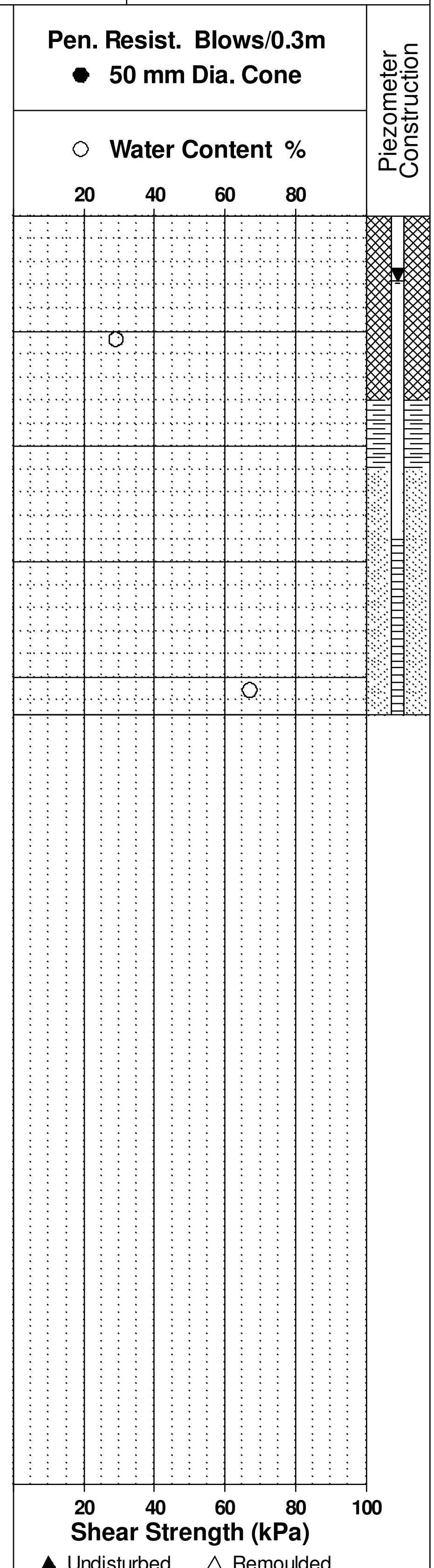
BORINGS BY CME 55 Power Auger **DATE** January 31, 2013

SOIL DESCRIPTION	Layer base depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	80.21
FILL: Crushed stone with sand	0.33	AU	1				
FILL: Brown silty sand with clay and gravel	0.69	AU	2				
Very stiff to stiff, brown **SILTY CLAY**		SS	3	33	9	1	79.21
		SS	4	83	13	2	78.21
	2.90	SS	5	100	18		
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders		SS	6	67	10	3	77.21
	3.73						
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay	4.32	SS	7		21	4	76.21

End of Borehole

Practical refusal to augering at 4.32m depth

(GWL @ 0.56m-Mar. 27, 2013)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH74-12

BORINGS BY CME 55 Power Auger

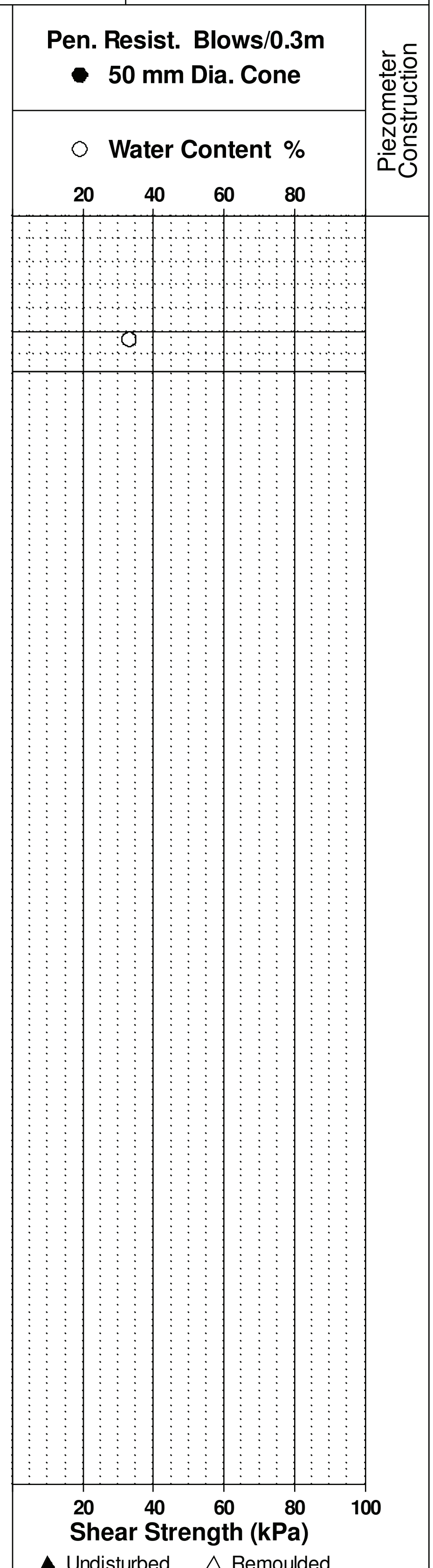
DATE January 31, 2013

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.02
FILL: Crushed stone with sand	0.30						
FILL: Brown silty sand with gravel	0.69						
Very stiff, brown **SILTY CLAY**	0.99						
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	1.35	SS	1	80	15	1	80.02

End of Borehole

Practical refusal to augering at 1.35m depth

(BH dry upon completion)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH75-12

BORINGS BY CME 55 Power Auger

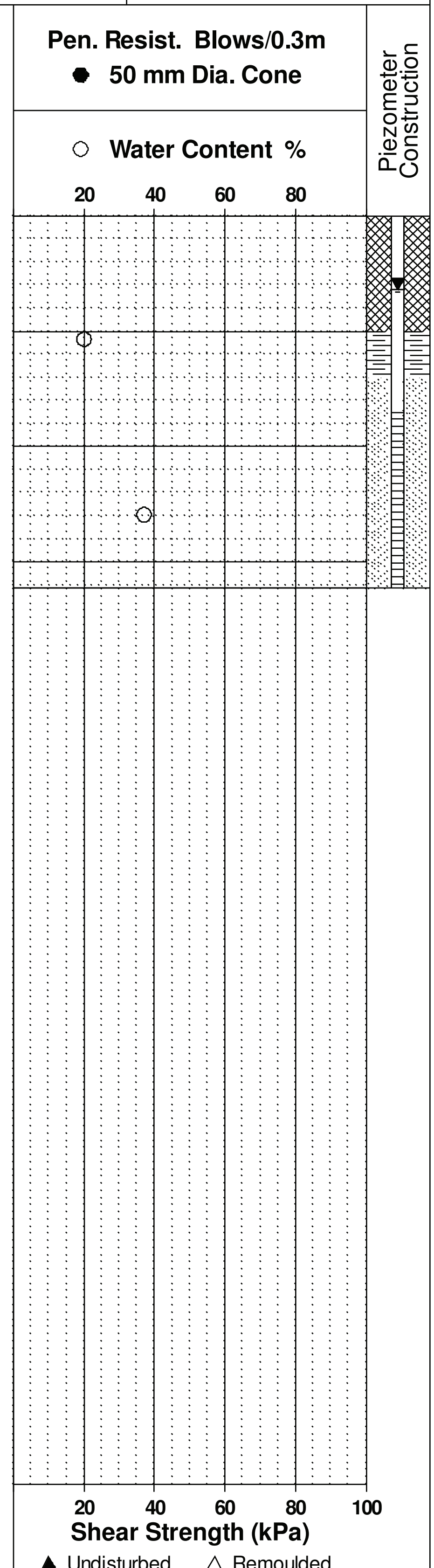
DATE February 1, 2013

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	83.02
Asphaltic concrete	0.20						
FILL: Crushed stone with sand	0.51	AU	1				
FILL: Brown silty sand with gravel	0.81	AU	2				
Compact, brown **SILTY SAND** with gravel	1.45	SS	3	50	10	1	82.02
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	3.22	SS	4	100	50+	2	81.02
		SS	5	0	50+	3	80.02

End of Borehole

Practical refusal to augering at 3.22m depth

(GWL @ 0.64m-Mar. 27, 2013)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH76-12

BORINGS BY CME 55 Power Auger **DATE** February 1, 2013

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.83
Asphaltic concrete	0.20						
FILL: Crushed stone with sand	0.46	AU	1				
FILL: Brown silty sand with gravel	0.69	AU	2				
Loose, brown **SILTY SAND** with gravel, trace cobbles	1.45	SS	3	83	6	1	86.83
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay - brown silty clay matrix from 1.8 to 3.0m depth	3.81	SS	4	100	50+	2	85.83
		SS	5	50	1	3	84.83
		SS	6	77	50+		

End of Borehole

Practical refusal to augering at 3.81m depth

(GWL @ 2.88m-Mar. 27, 2013)

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH77-12

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.17
FILL: Crushed stone with sand	0.28	AU	1				
FILL: Brown silty sand with gravel	0.69	AU	2				
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders		SS	3	33	15	1	87.17
	2.26	SS	4	0	14	2	86.17
End of Borehole Practical refusal to augering at 2.26m depth							

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

FILE NO. PG1796

HOLE NO. BH77A-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.17		
OVERBURDEN						1	87.17		
2.21						2	86.17		
End of Borehole Practical refusal to augering at 2.21m depth									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

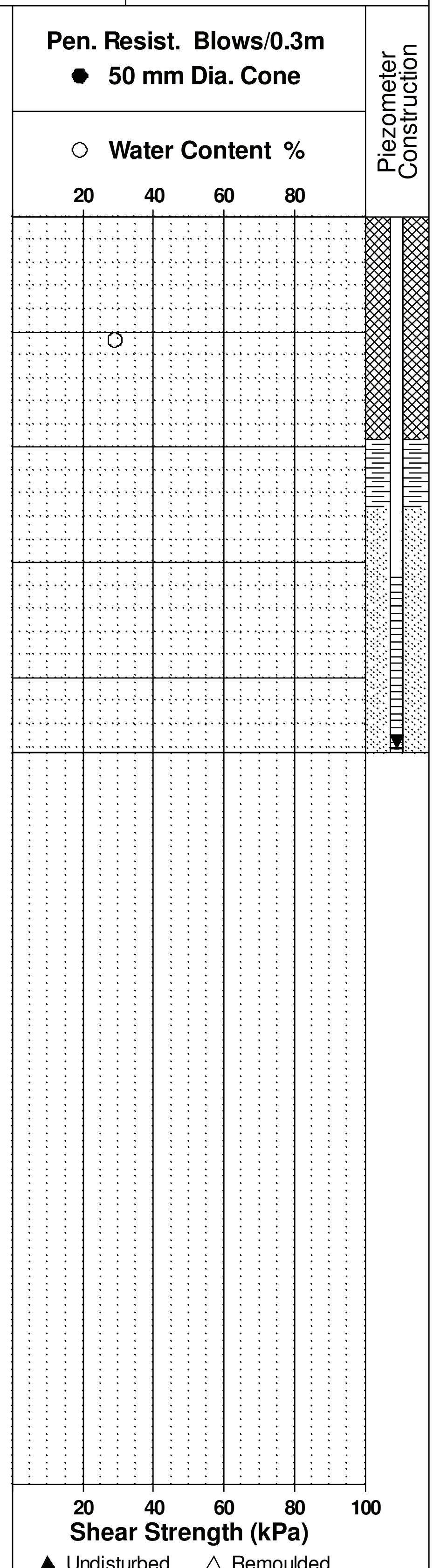
REMARKS

BORINGS BY CME 55 Power Auger **DATE** February 1, 2013

FILE NO. PG1796

HOLE NO. BH78-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.80
FILL: Crushed stone 0.30		AU	1				
FILL: Brown silty sand with gravel 0.69		AU	2				
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 1.75		SS	3	25	3	1	90.80
						2	89.80
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders		SS	4		50+		
		SS	5	100	50+	3	88.80
						4	87.80
4.65		SS	6	0	50+		
End of Borehole (GWL @ 2.88m-Mar. 27, 2013)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH79-12

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	94.45		
FILL: Crushed stone 0.28									
FILL: Brown silty sand with gravel 0.69		AU	1						
GLACIAL TILL: Brown silty sand with gravel, trace clay and organics		SS	2	50	8	1	93.45		
1.68		SS	3	100	50+				
End of Borehole Practical refusal to augering at 1.68m depth (BH dry upon completion)									

Chart axes: 20 40 60 80 (top); 20 40 60 80 100 (bottom)

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH80-12

BORINGS BY CME 55 Power Auger **DATE** January 31, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	96.02		
FILL: Crushed stone — 0.30		AU	1						
FILL: Brown silty sand with gravel, cobbles, clay — 1.07		AU	2						
		SS	3	38	20	1	95.02		
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders — 1.58		SS	4	100	50+				

End of Borehole

Practical refusal to augering at 1.58m depth

(BH dry upon completion)

Chart axes: Water Content % 20, 40, 60, 80; Shear Strength (kPa) 20, 40, 60, 80, 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH81-12

BORINGS BY CME 55 Power Auger **DATE** February 1, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	95.77		
FILL: Crushed stone with sand 0.30		AU	1						
FILL: Brown silty sand with gravel 0.69		AU	2						
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay 1.35		SS	3	57	15	1	94.77	○	
End of Borehole									
Practical refusal to augering at 1.35m depth									
(Piezometer damaged - March 27, 2013)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. BH81A-12

BORINGS BY CME 55 Power Auger **DATE** February 1, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	95.77		
OVERBURDEN						1	94.77		
1.35									
End of Borehole Practical refusal to augering at 1.35m depth									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

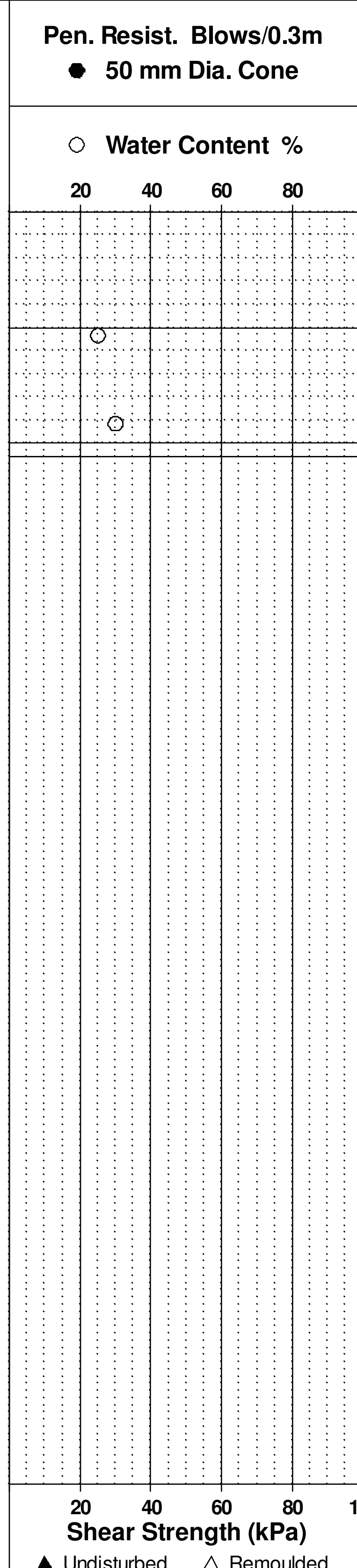
REMARKS

HOLE NO. BH82-12

BORINGS BY CME 55 Power Auger

DATE January 31, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	95.86
FILL: Crushed stone with gravel — 0.30		AU	1				
FILL: Brown silty sand with gravel — 1.45		SS	2	58	31	1	94.86
GLACIAL TILL: Brown silty sand with gravel, trace clay — 2.11		SS	3	78	31	2	93.86
End of Borehole Practical refusal to augering at 2.11m depth (BH dry upon completion)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

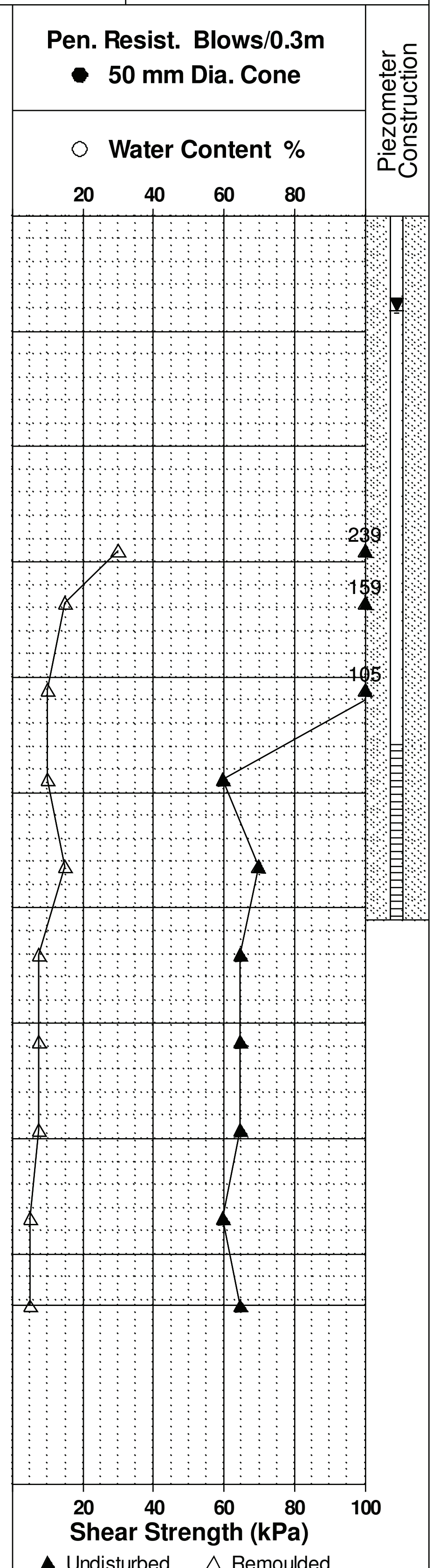
BORINGS BY CME 55 Power Auger

DATE January 23, 2009

FILE NO. PG1796

HOLE NO. BH 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.11
TIOPSOIL — 0.30		AU	1				
Hard to very stiff, brown **SILTY CLAY**		SS	2	42	9	1	86.11
		SS	3	67	5	2	85.11
						3	84.11
- stiff and grey-brown by 4.3m depth						4	83.11
						5	82.11
						6	81.11
						7	80.11
- grey by 7.9m depth						8	79.11
— 9.45						9	78.11
End of Borehole							
(GWL @ 0.82m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

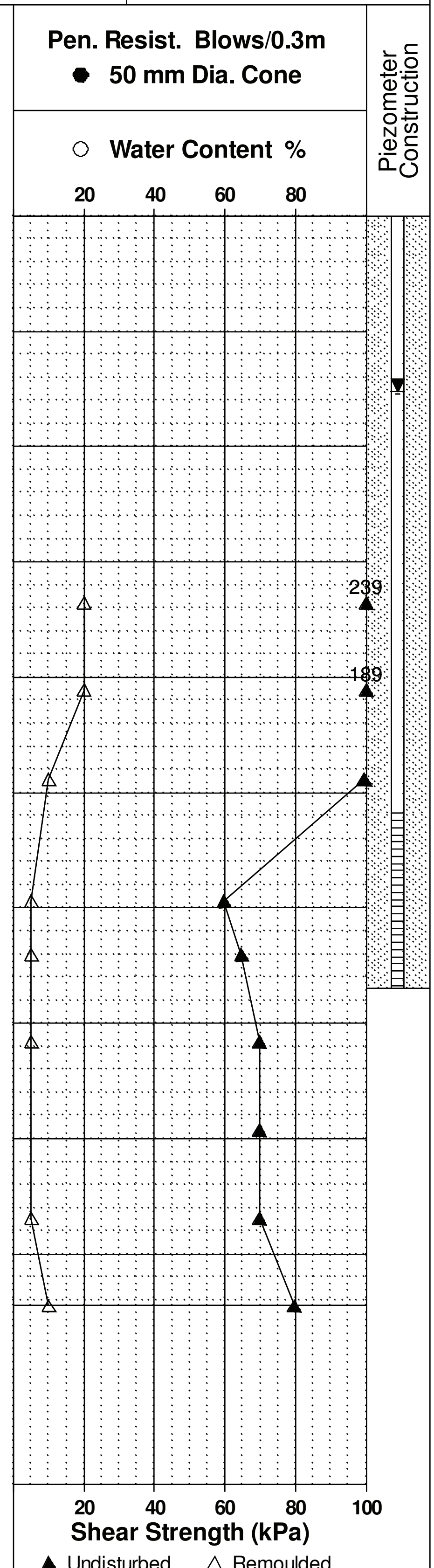
BORINGS BY CME 55 Power Auger

DATE January 22, 2009

FILE NO. PG1796

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.36
TOPSOIL 0.20		AU	1				
		SS	2	58	10	1	85.36
		SS	3	75	11	2	84.36
		SS	4	83	8		
Hard to very stiff, brown **SILTY CLAY**						3	83.36
- stiff and grey by 4.3m depth						4	82.36
						5	81.36
						6	80.36
						7	79.36
						8	78.36
9.45						9	77.36
End of Borehole							
(GWL @ 1.52m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH11

BORINGS BY CME 55 Power Auger **DATE** January 23, 2009

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.75
TOPSOIL 0.30	AU	1				
Very stiff, brown **SILTY CLAY** with organic matter 0.69						
GLACIAL TILL: Compact to dense, brown silty sand with clay, gravel, cobbles and boulders	SS	2	75	8	1	88.75
	SS	3	50	20	2	87.75
2.95	SS	4	80	50+		
End of Borehole						
Practical refusal to augering @ 2.95m depth						

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 26, 2009

FILE NO. PG1796

HOLE NO. BH13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	92.03		
TOPSOIL 0.30		AU	1						
Very stiff, brown **SILTY CLAY**, some sand 0.71									
End of Borehole Practical refusal to augering @ 0.71m depth									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH14**

BORINGS BY CME 55 Power Auger **DATE** January 26, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.88
TOPSOIL (0.20)		AU	1				
Very stiff, brown **SILTY CLAY** (0.91)							
GLACIAL TILL: Very dense, brown silty sand with clay, gravel, cobbles and boulders		SS	2	67	54	1	87.88
		SS	3	33	54	2	86.88
(2.21)							
GLACIAL TILL: Very stiff, grey silty clay with sand, gravel, cobbles and boulders		SS	4	50	24	3	85.88
		SS	5	50	13		
		SS	6	33	16	4	84.88
		SS	7	38	30	5	83.88
		SS	8	25	31	6	82.88
		SS	9	38	44		
		SS	10	42	42	7	81.88
(7.62)							
End of Borehole							
(GWL @ 0.61m-Feb. 3/09)							

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
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH15**

BORINGS BY CME 55 Power Auger **DATE** January 26, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.13
TOPSOIL 0.25		AU	1				
Stiff, brown **SILTY CLAY**, some organic matter to 1.4m depth		SS	2	8	9	1	87.13
		SS	3	42	4	2	86.13
2.82							
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles		SS	4	100	2	3	85.13
						4	84.13
5.13		SS	6	42	14	5	83.13
GLACIAL TILL: Compact, grey silty sand with gravel, cobbles and boulders 5.39		SS	7	0	50+		

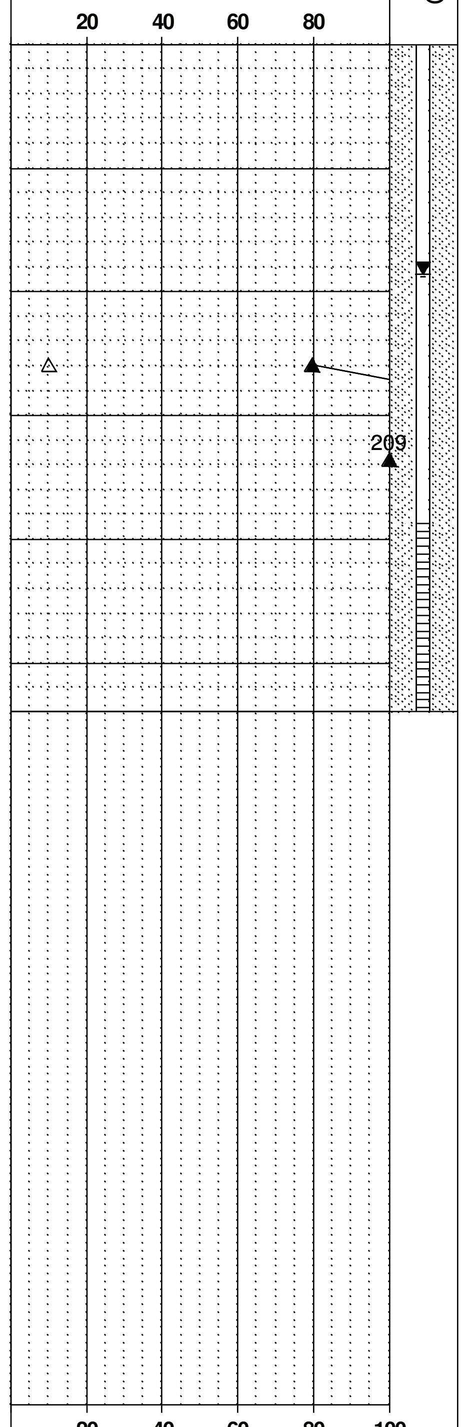
End of Borehole

Practical refusal to augering @ 5.39m depth

(GWL @ 1.86m-Feb. 3/09)

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

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

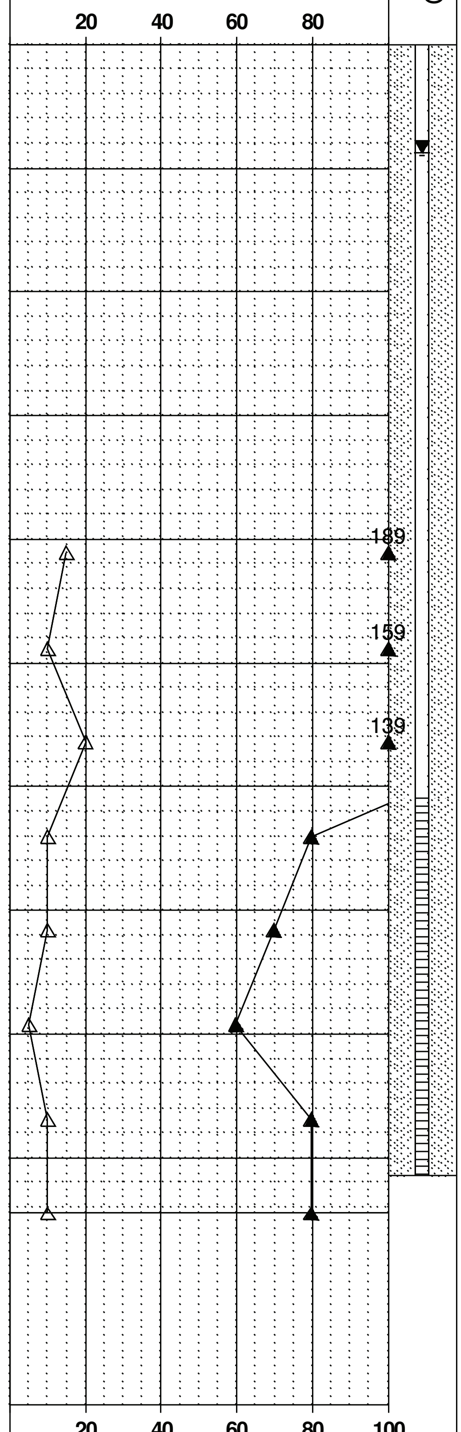
REMARKS

HOLE NO. **BH17**

BORINGS BY CME 55 Power Auger **DATE** January 23, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.28
TOPSOIL 0.20		AU	1				
Very stiff, brown SILTY CLAY		SS	2	54	14	1	85.28
		SS	3	50	12	2	84.28
		SS	4	71	9	3	83.28
		SS	5	75	5	4	82.28
						5	81.28
- stiff and grey-brown by 5.9m depth						6	80.28
- grey by 6.6m depth						7	79.28
						8	78.28
9.45						9	77.28
End of Borehole							
(GWL @ 0.88m-Feb. 3/09)							

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



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 = $(D30)^2 / (D10 \times D60)$
Cu	-	Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

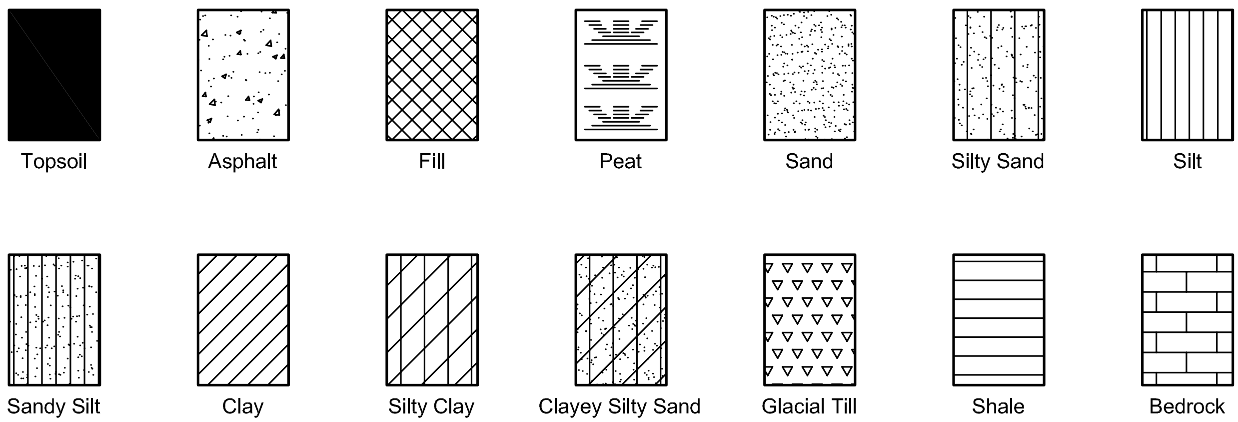
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

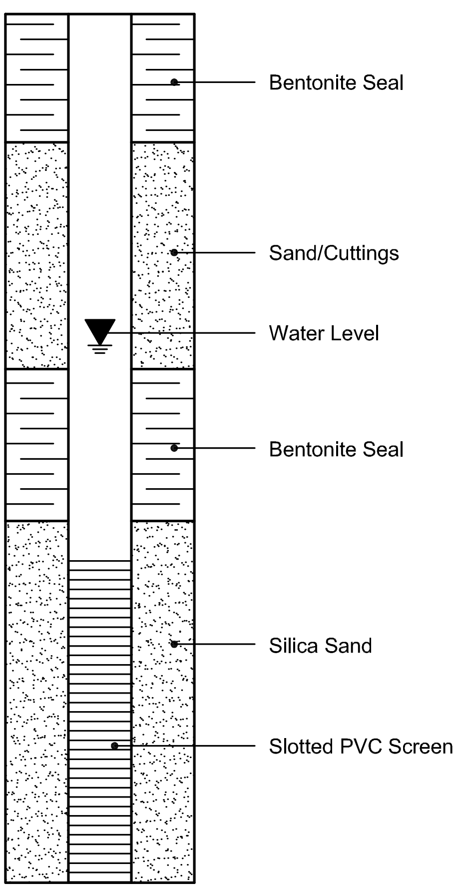
SYMBOLS AND TERMS (continued)

STRATA PLOT

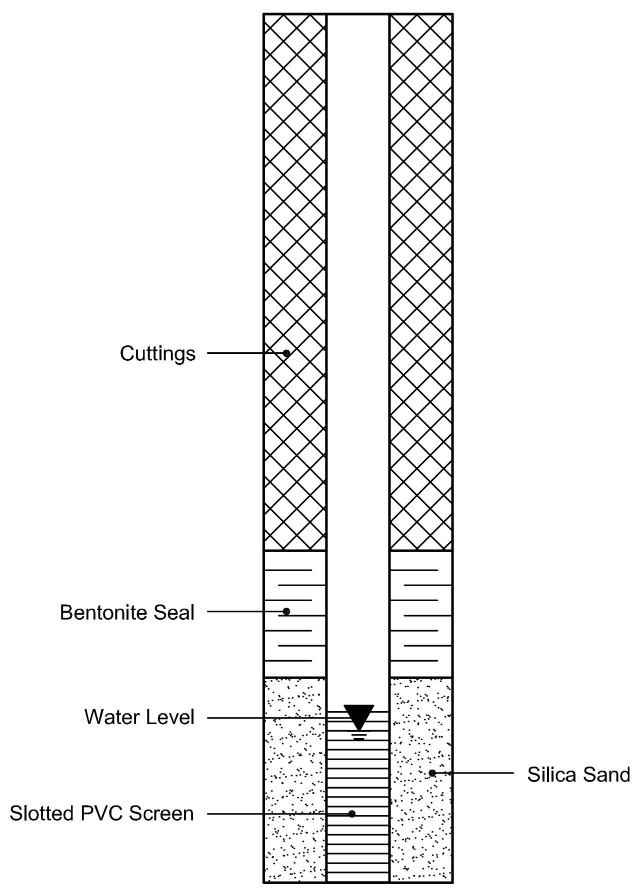


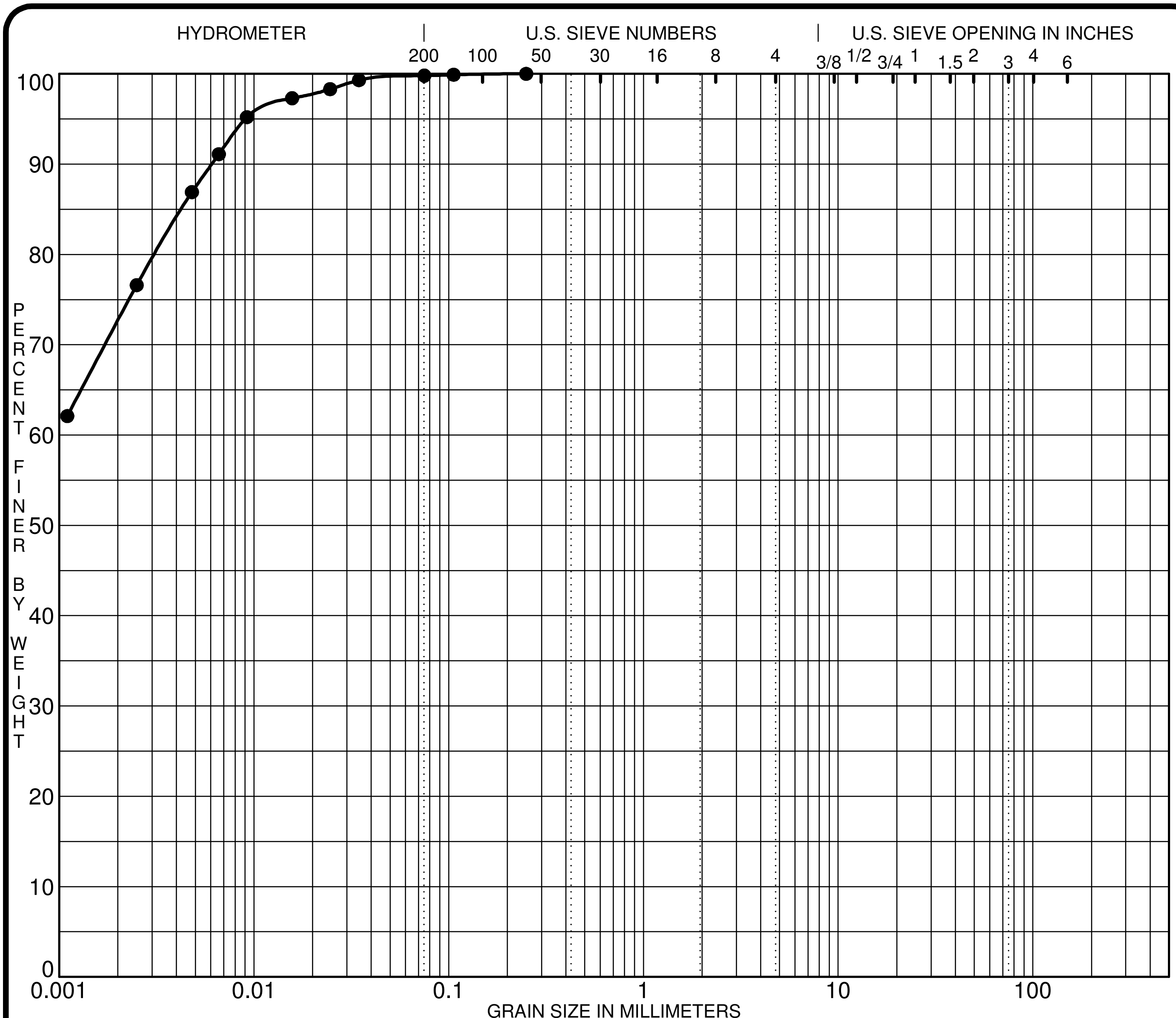
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP 2-21 G4**	**CH = Inorganic Clays of High Plasticity**		**71**	**29**	**42**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP 2-21 G4**	**0.25**				**0.0**	**0.2**	**99.8**	

CLIENT **Taggart Investments**

PROJECT **Geotechnical Investigation - Proposed Residential Development**

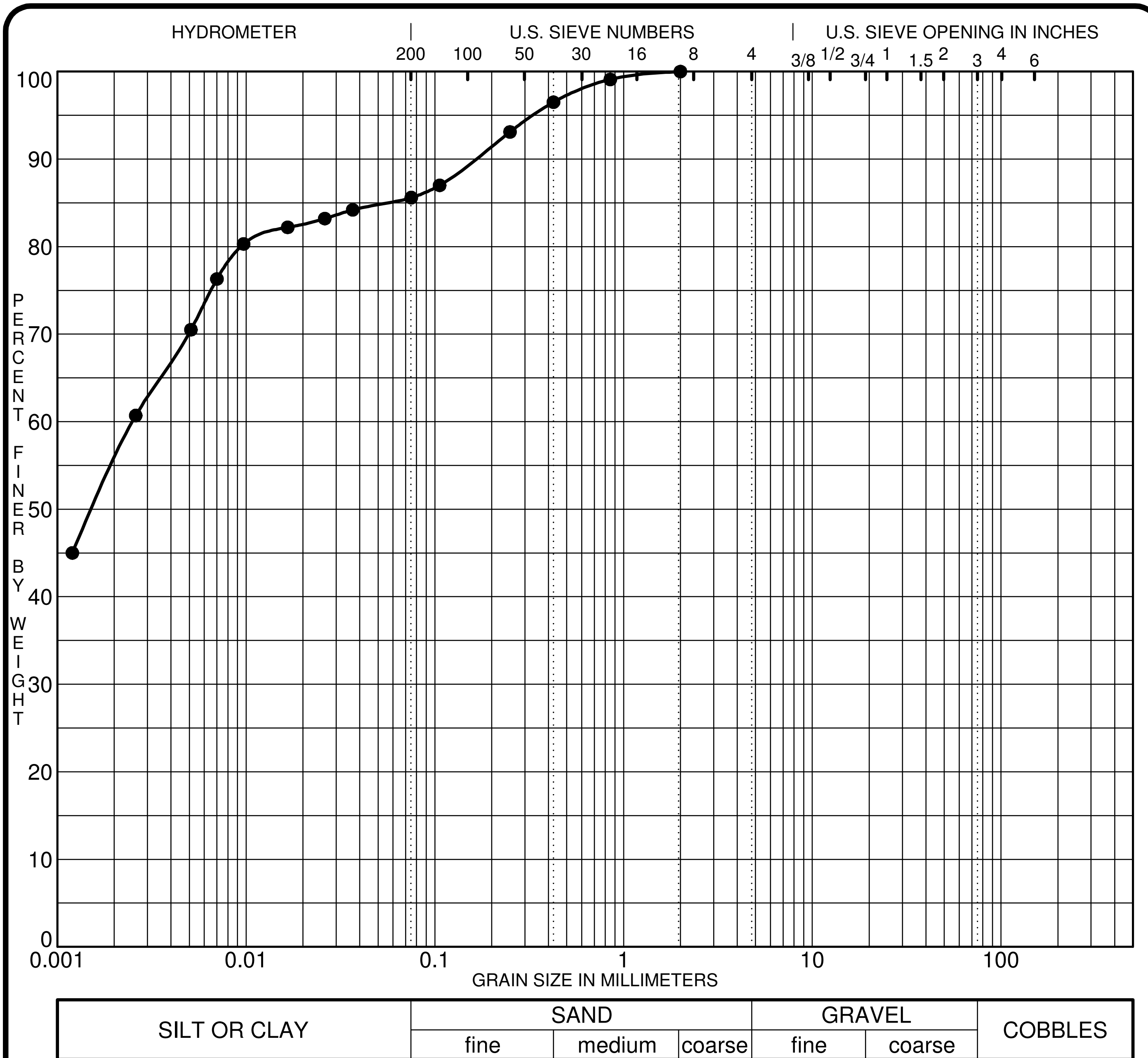
FILE NO. **PG5201**

DATE **26 Feb 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP 7-21 G3**	**MH = Inorganic Silts of High Plasticity**		**59**	**32**	**27**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP 7-21 G3**	**2.00**	**0.00**			**0.0**	**14.4**	**85.6**	

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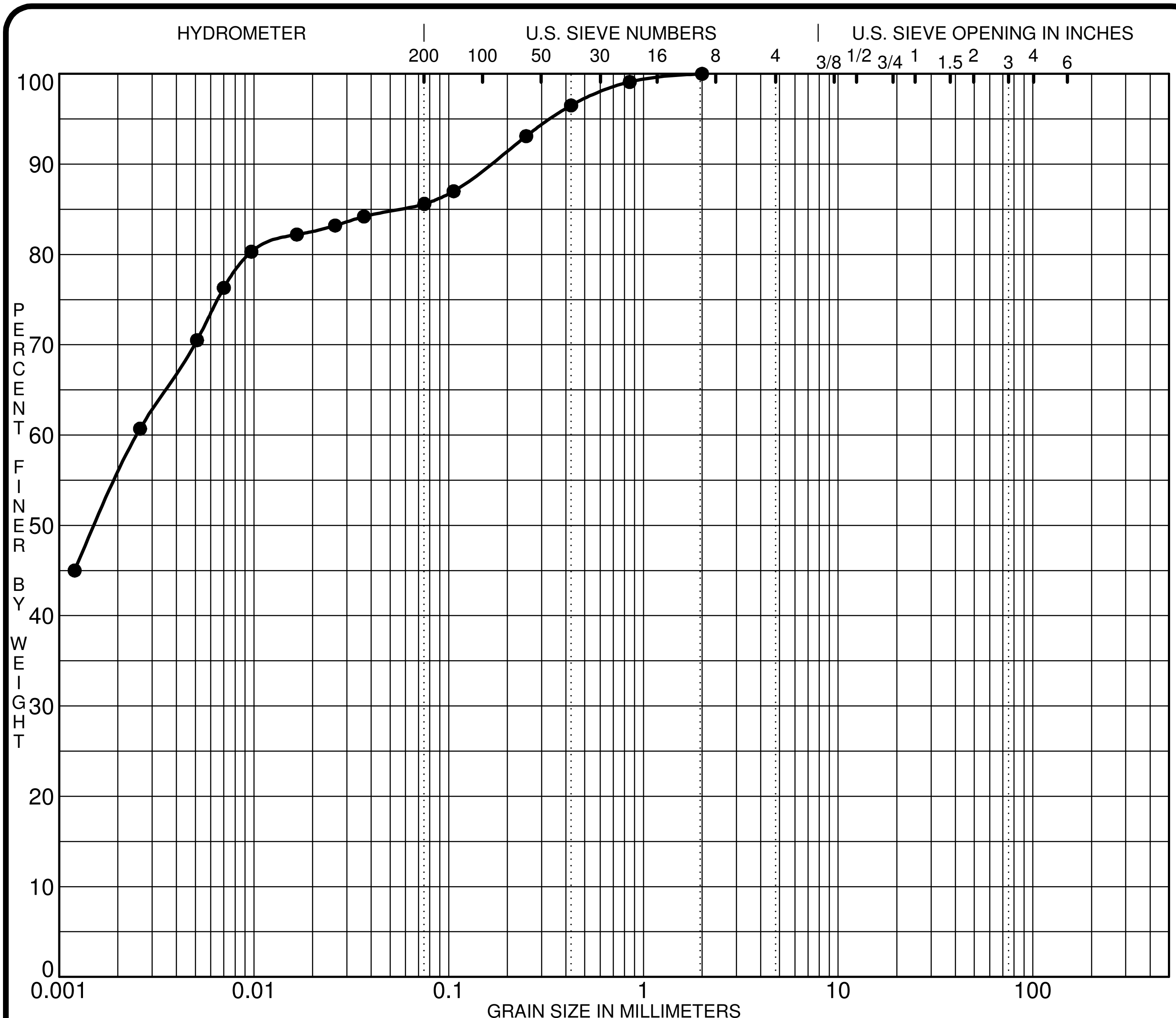
GRAIN SIZE DISTRIBUTION



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP10-21 G4**	**MH = Inorganic SIlts of High Plasticity**		**60**	**33**	**27**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP10-21 G4**	**2.00**	**0.00**			**0.0**	**14.4**	**85.6**	

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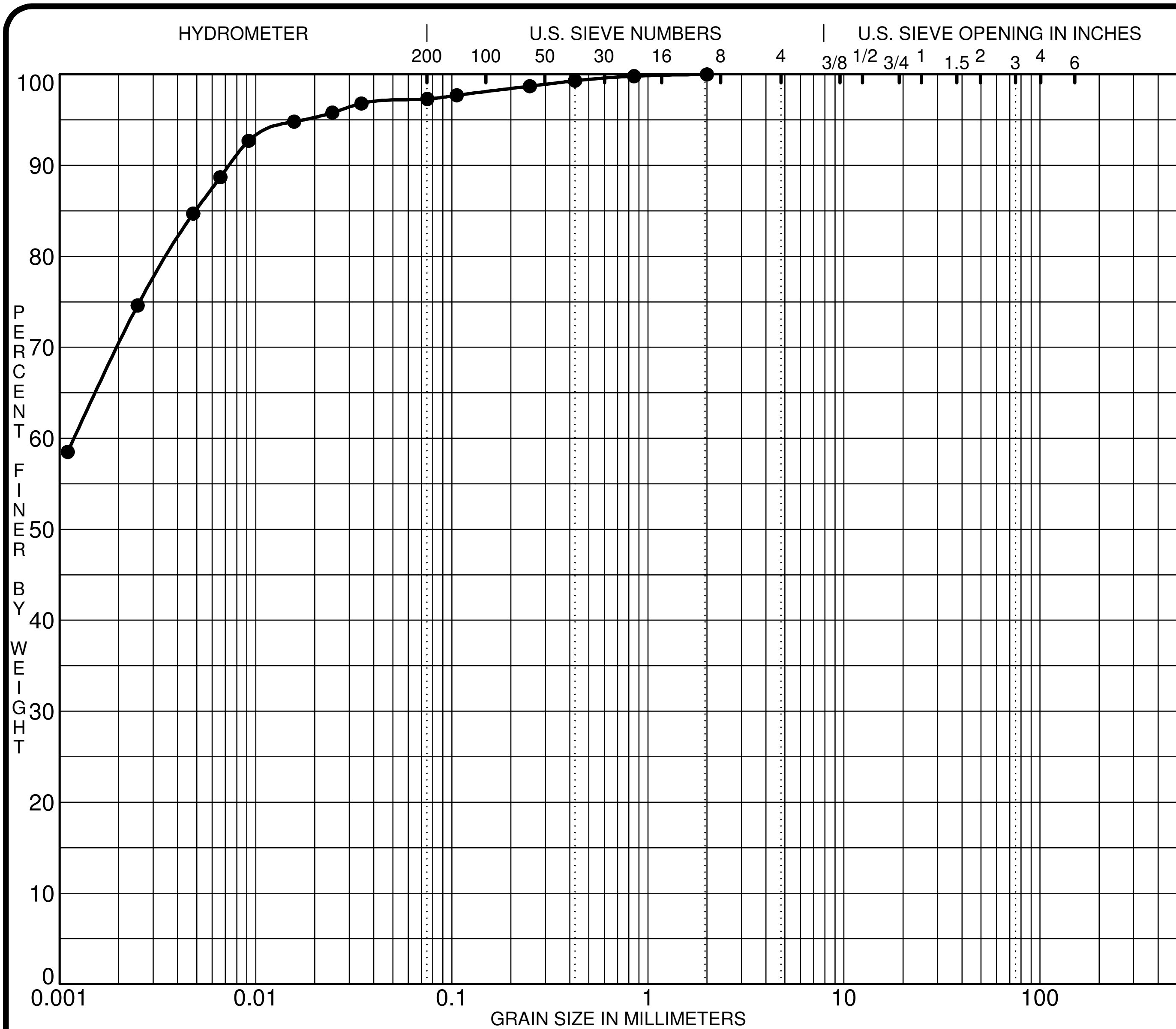
GRAIN SIZE DISTRIBUTION



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP12-21 G2**	**MH = Inorganic Silts of High Plasticity**		**75**	**37**	**38**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP12-21 G4**	**2.00**	**0.00**			**0.0**	**2.7**	**97.3**	

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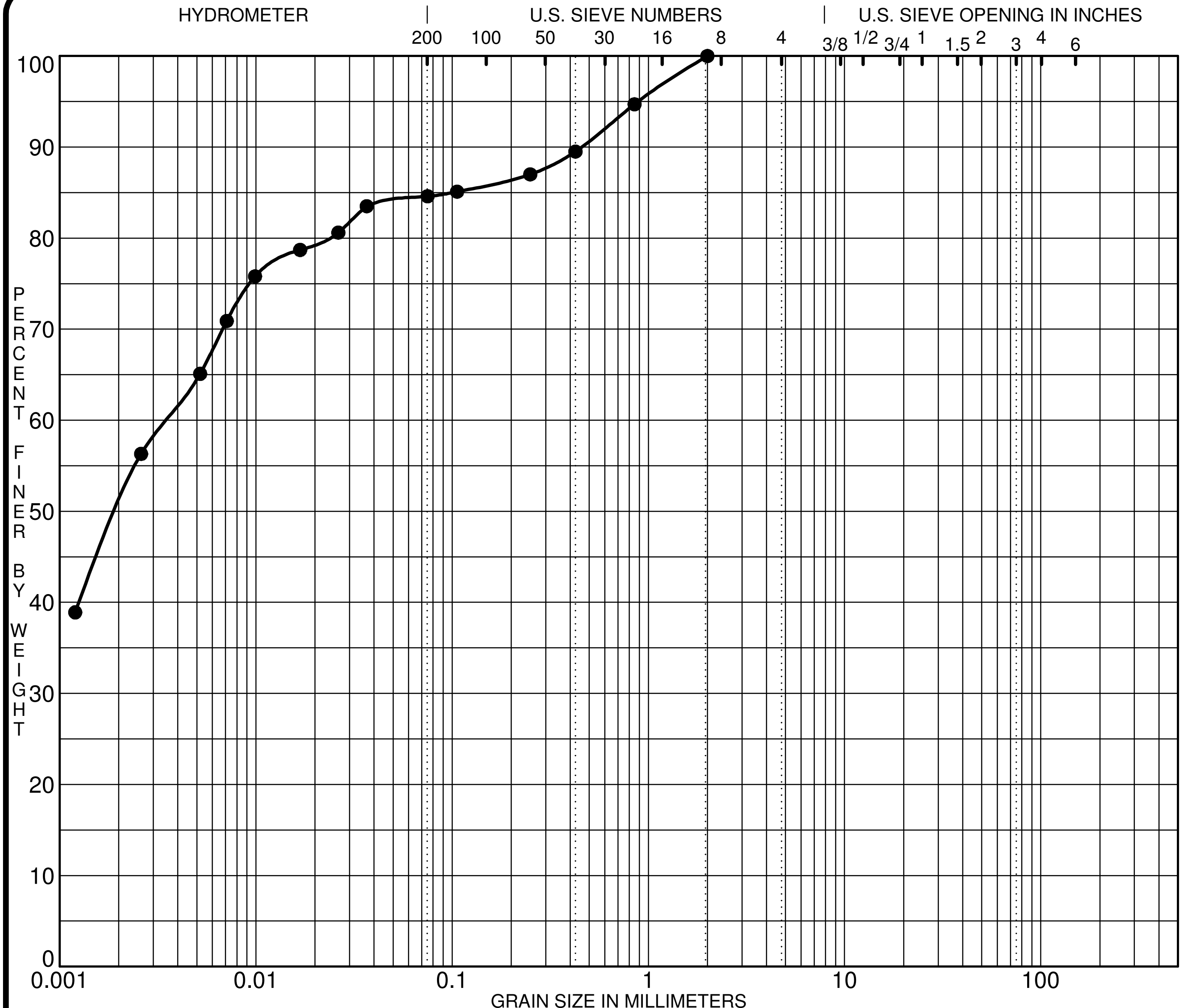
DATE **1 Mar 21**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP18-21 G1**	**MH = Inorganic Silts of High Plasticity**		**66**	**36**	**30**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP18-21 G1**	**2.00**	**0.00**			**0.0**	**15.4**	**84.6**	

CLIENT **Taggart Investments**

PROJECT **Geotechnical Investigation - Proposed Residential Development**

FILE NO. **PG5201**

DATE **1 Mar 21**

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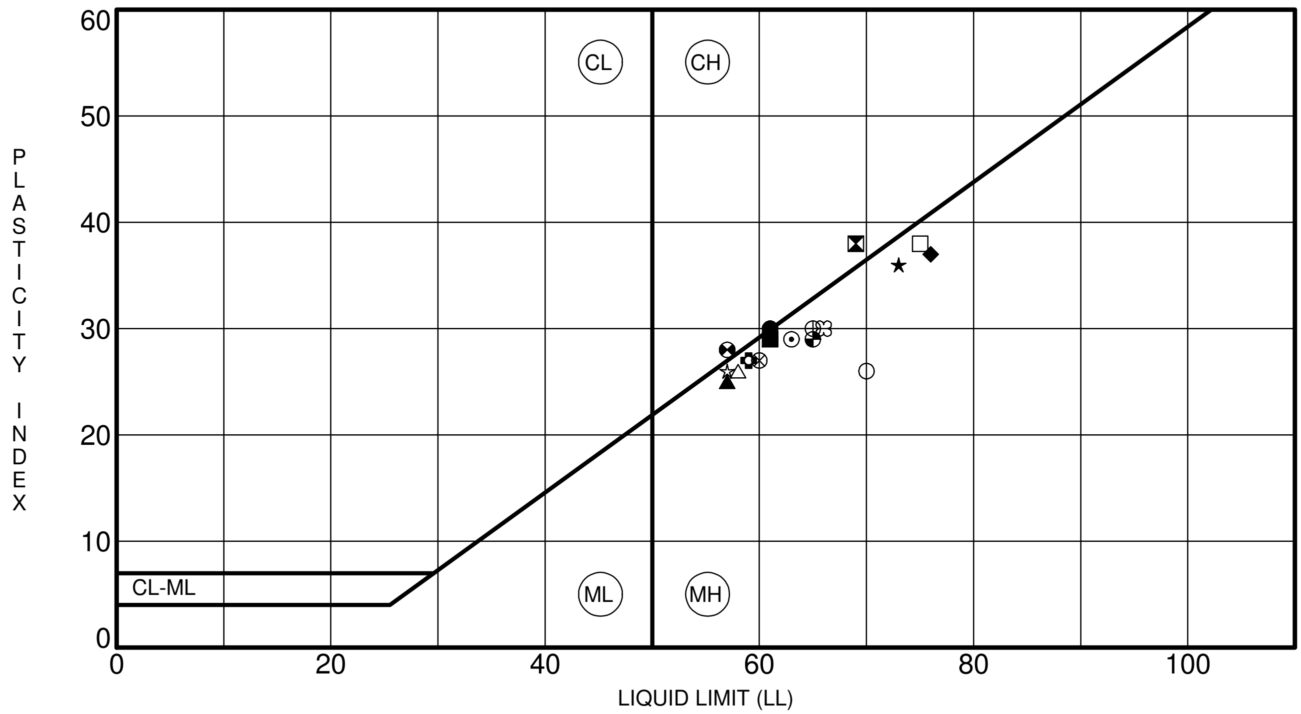
GRAIN SIZE DISTRIBUTION



	Specimen Identification	LL	PL	PI	Fines	Classification
●	**TP 1-21 G4**	**61**	**31**	**30**		**CH = Inorganic Clays of High Plasticity**
⧗	**TP 3-21 G3**	**69**	**31**	**38**		**CH = Inorganic Clays of High Plasticity**
▲	**TP 4-21 G3**	**57**	**32**	**25**		**MH = Inorganic Silts of High Plasticity**
★	**TP 5-21 G3**	**73**	**37**	**36**		**MH = Inorganic Silts of High Plasticity**
⊙	**TP 6-21 G2**	**63**	**34**	**29**		**MH = Inorganic Silts of High Plasticity**
✪	**TP 7-21 G3**	**59**	**32**	**27**	**85.6**	**MH = Inorganic Silts of High Plasticity**
○	**TP 8-21 G3**	**70**	**44**	**26**		**MH = Inorganic Silts of High Plasticity**
△	**TP 9-21 G2**	**58**	**32**	**26**		**MH = Inorganic Silts of High Plasticity**
⊗	**TP10-21 G4**	**60**	**33**	**27**	**85.6**	**MH = Inorganic SIlts of High Plasticity**
⊕	**TP11-21 G4**	**65**	**35**	**30**		**MH = Inorganic Silts of High Plasticity**
□	**TP12-21 G2**	**75**	**37**	**38**	**97.3**	**MH = Inorganic Silts of High Plasticity**
◉	**TP16-21 G1**	**57**	**29**	**28**		**CH = Inorganic Clays of High Plasticity**
◕	**TP17-21 G1**	**65**	**36**	**29**		**MH = Inorganic Silts of High Plasticity**
☆	**TP17-21 G2**	**57**	**31**	**26**		**MH = Inorganic Silts of High Plasticity**
✣	**TP18-21 G1**	**66**	**36**	**30**	**84.6**	**MH = Inorganic Silts of High Plasticity**
■	**TP19-21 G2**	**61**	**32**	**29**		**MH = Inorganic Silts of High Plasticity**
◆	**TP20-21 G1**	**76**	**39**	**37**		**MH = Inorganic Silts of High Plasticity**

CLIENT	**Taggart Investments**	FILE NO.	**PG5201**
PROJECT	**Geotechnical Investigation - Proposed Residential Development**	DATE	**1 Mar 21**

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

ATTERBERG LIMITS' RESULTS

APPENDIX 2

FIGURE 1 - KEY PLAN

PHOTOGRAPHS FROM OUR SITE VISITS - 2012 AND 2020

FIGURES 2 THROUGH 41 - SLOPE STABILITY SECTIONS

FIGURE 42 - SLOPE IN-FILLING DETAIL

DRAWING PG5201-1 - BEDROCK CONTOUR PLAN

DRAWING PG5201-2 - TEST HOLE LOCATION PLAN

DRAWING PG5201 - 3 - PERMISSIBLE GRADE RAISE RESTRICTION AREAS

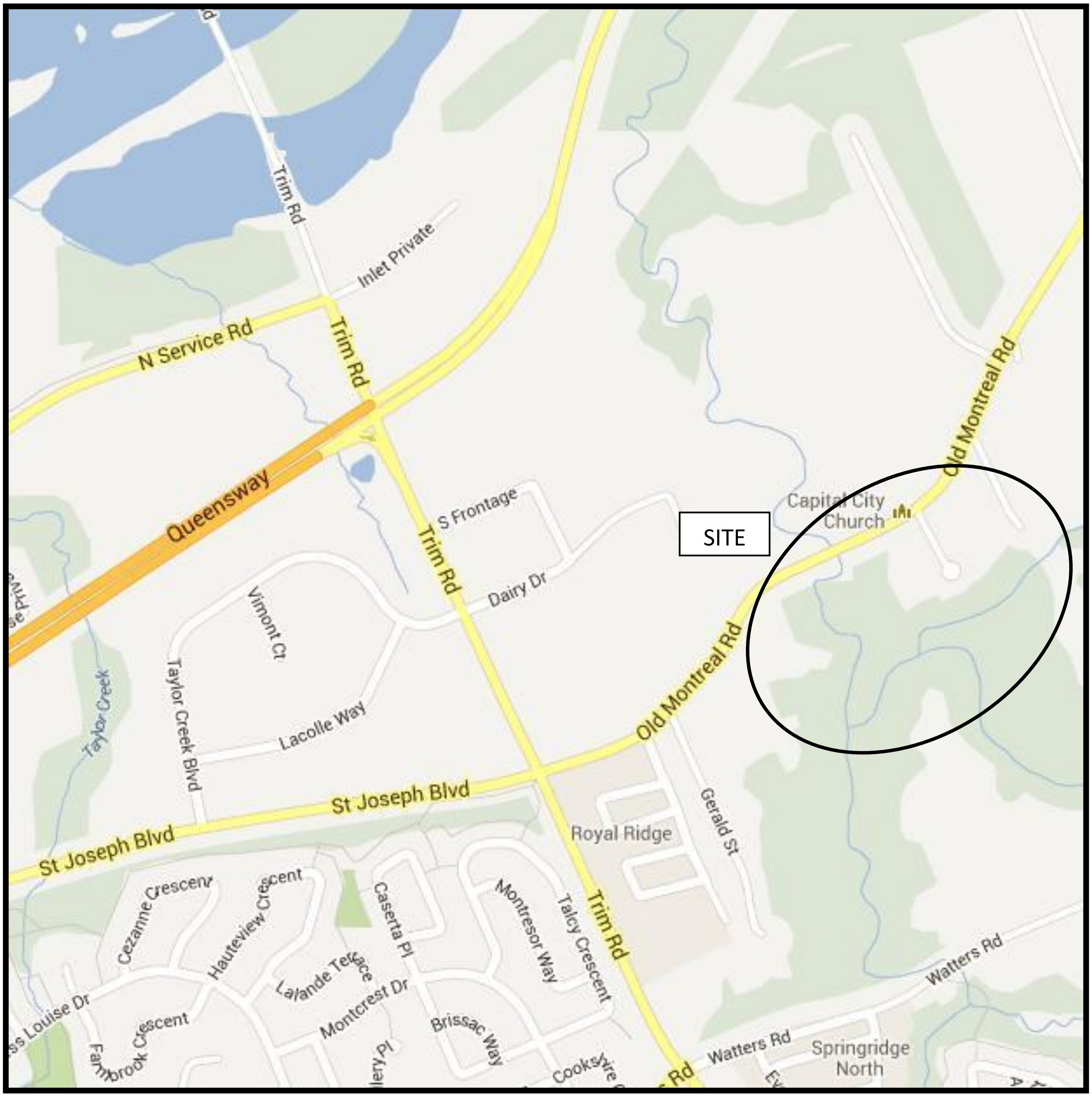


FIGURE 1

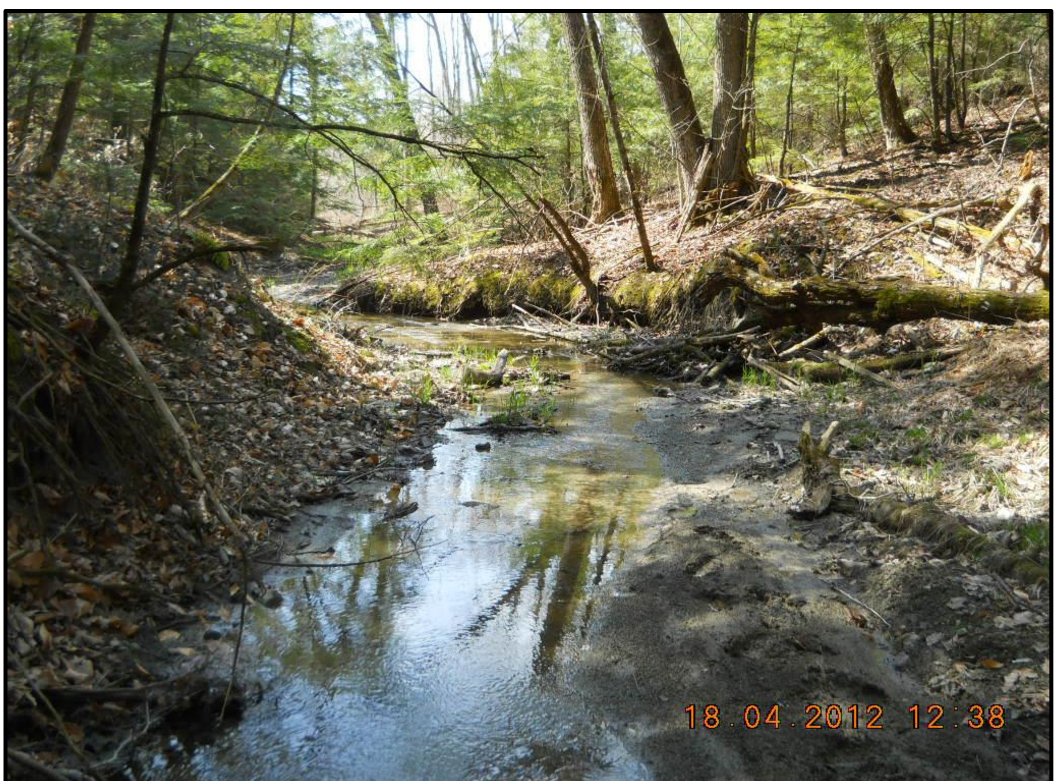
KEY PLAN

patersongroup

Photographs from Site Visit

Photo 1: Photo taken on April 18, 2012 from the north bank of the valley corridor wall along the South Tributary looking east (upstream) near Section I.

Photo 2: Photo taken on April 18, 2012 from the centre of the watercourse along the South Tributary looking west (downstream) near Section H.



Photographs from Site Visit

Photo 3: Photo taken on April 18, 2012 from the north bank of the valley corridor wall along the South Tributary looking west (downstream) at Section G.

Photo 4: Photo taken on April 18, 2012 from the south bank of the South Tributary looking west (downstream) near Section F.

Photographs from Site Visit

Photo 5: Photo taken on April 18, 2012 of the east bank of the valley corridor along Mid-Branch 1, north of Section J.

Photo 6: Photo taken on April 18, 2012 along the watercourse along Mid-Branch 1 looking east (upstream) near Section N.

Photographs from Site Visit

Photo 7: Photo taken on April 18, 2012 of the drainage ravine near Section K.

Photo 8: Photo taken on September 10, 2020 of the north slope face, looking northwest.

Photographs from Site Visit

Photo 9: Photo taken on September 10, 2020 of the north slope face, looking northwest.

Photo 10: Photo taken on September 10, 2020 of the north slope face, looking north.

Photo 11: Photo taken on September 10, 2020 of the south slope face, looking southeast near Section O

Photo 12: Photo taken on September 10, 2020 of the north slope face, looking northwest.

Photographs from Site Visit

Photo 13: Photo taken on September 10, 2020 of the north slope face, looking east (upstream) near Section H.

Photo 14: Photo taken on September 10, 2020 of the north slope face, looking northwest near Section CC.

Photographs from Site Visit

Photo 15: Photo taken on September 10, 2020 of the north slope face, looking northwest near sections G and II

Photo 16: Photo taken on September 10, 2020 of the south slope face near section HH.

Photo 17: Photo taken on September 10, 2020 along the watercourse, looking east (upstream).

Photo 18: Photo taken on September 10, 2020 of the north slope face, looking north at section GG.

Photo 19: Photo taken on September 10, 2020 along the watercourse, looking east (upstream).

Photo 20: Photo taken on September 10, 2020 along the watercourse along Mid-Branch 1 looking east (upstream) near Section OO.

Photo 21: Photo taken on September 10, 2020 along the watercourse along Mid-Branch 1 looking east (upstream) near Section N.

Photo 22: Photo taken on September 10, 2020 along the watercourse along Mid-Branch 1 looking north.

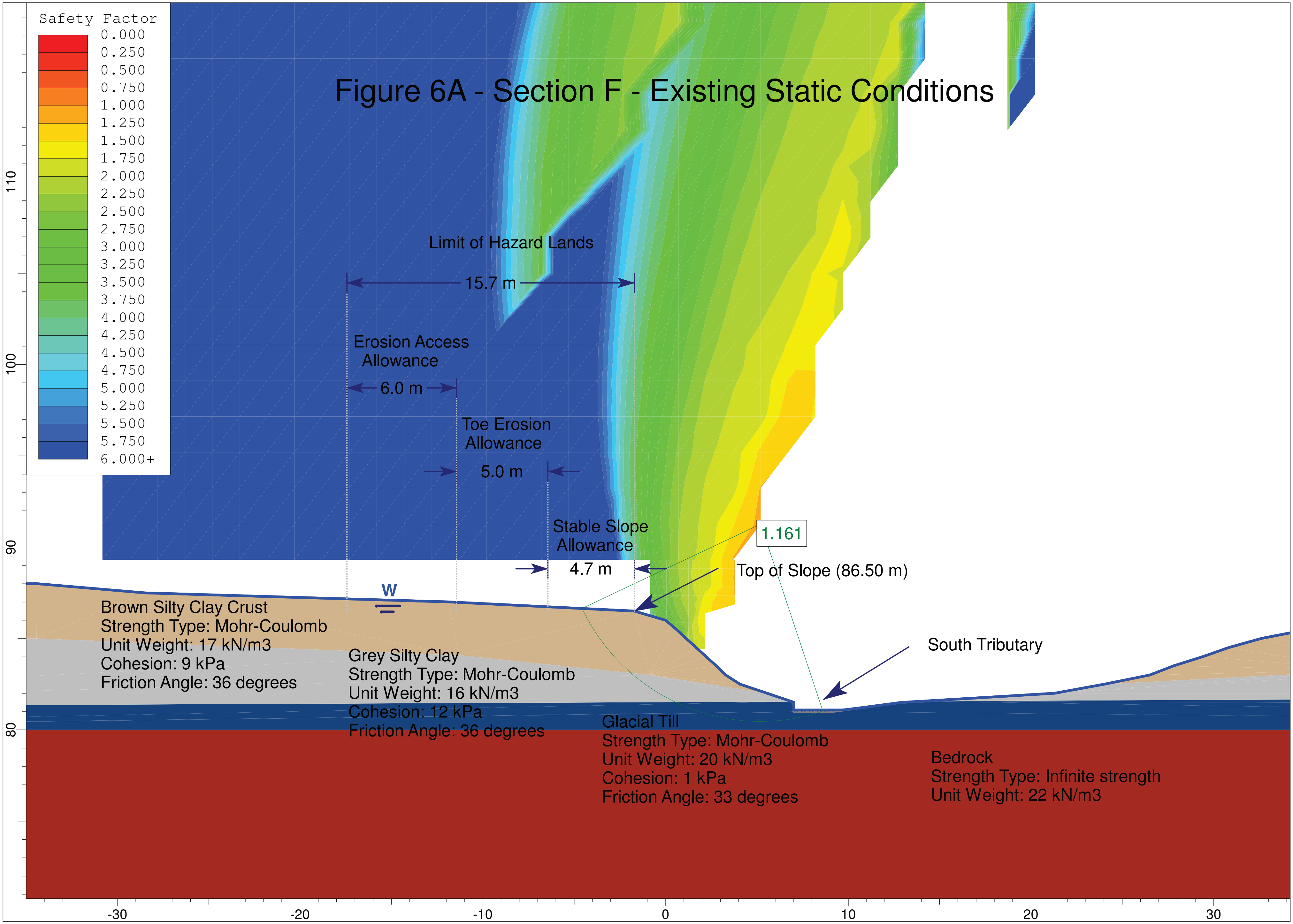


Figure 6A - Section F - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
15.7 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Stable Slope Allowance
4.7 m
1.161
Top of Slope (86.50 m)
W
South Tributary
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
110
100
90
80
-30
-20
-10
0
10
20
30

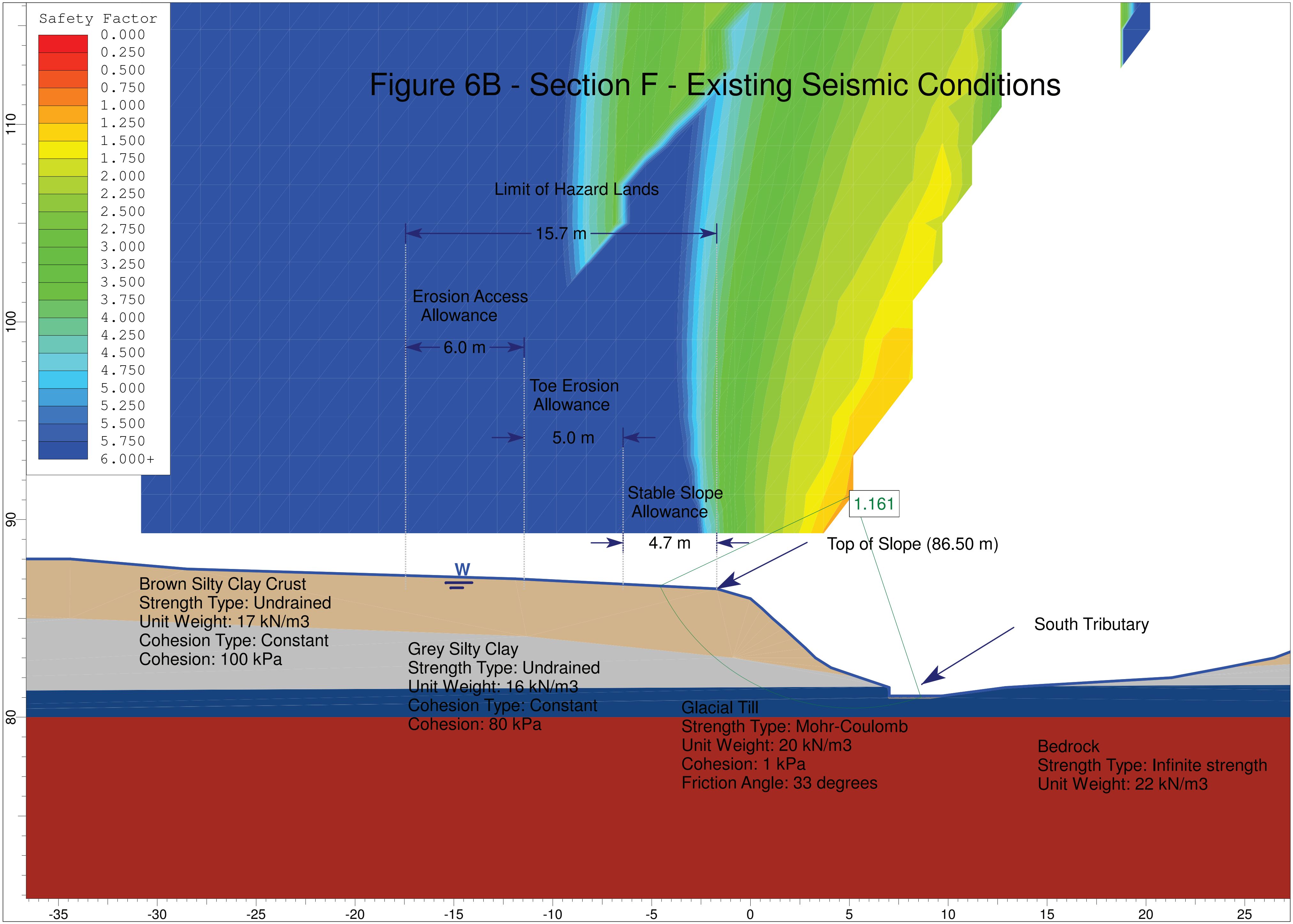


Figure 6B - Section F - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
15.7 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Stable Slope Allowance
4.7 m
1.161
Top of Slope (86.50 m)
W
South Tributary
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
110
100
90
80
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25

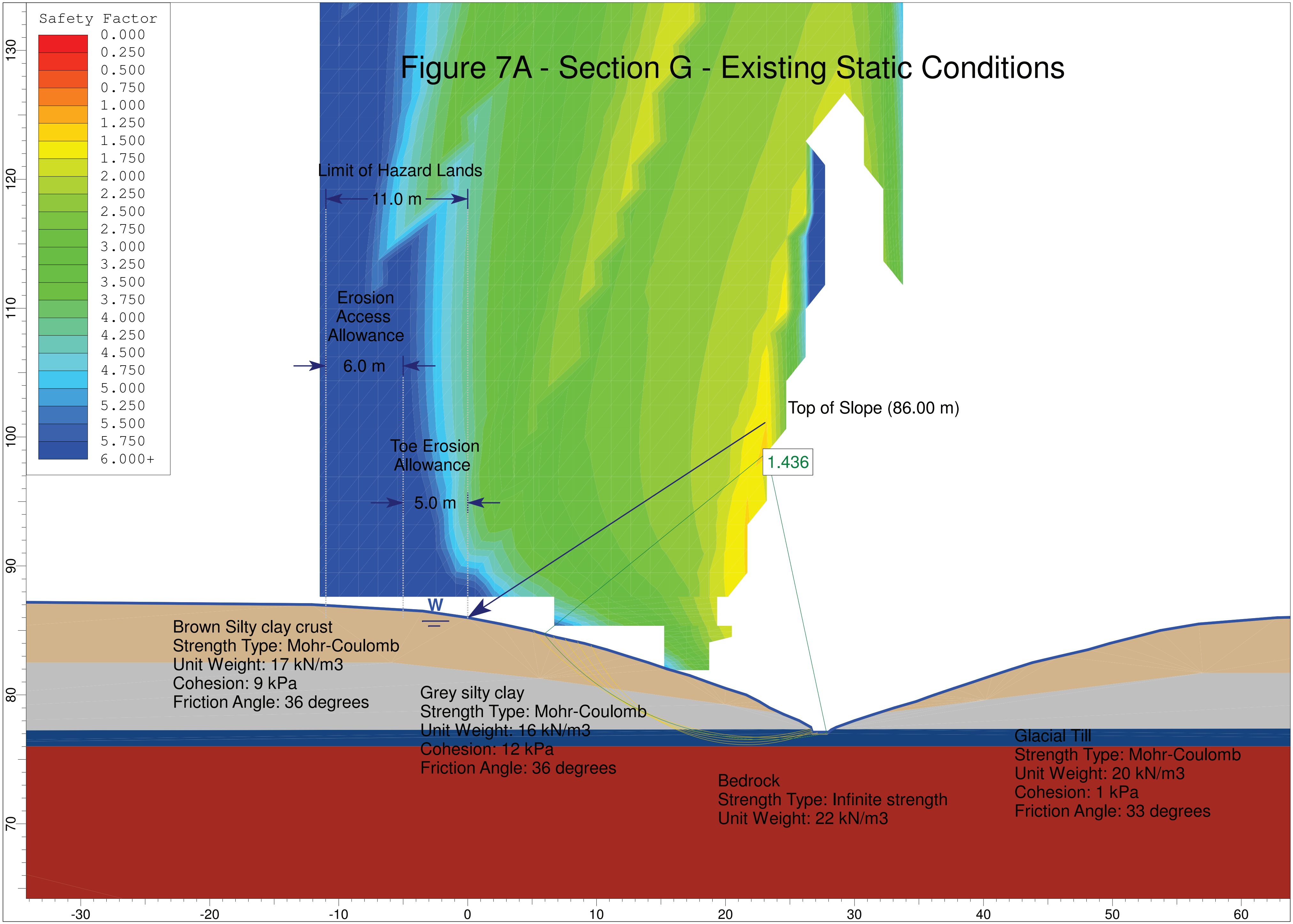
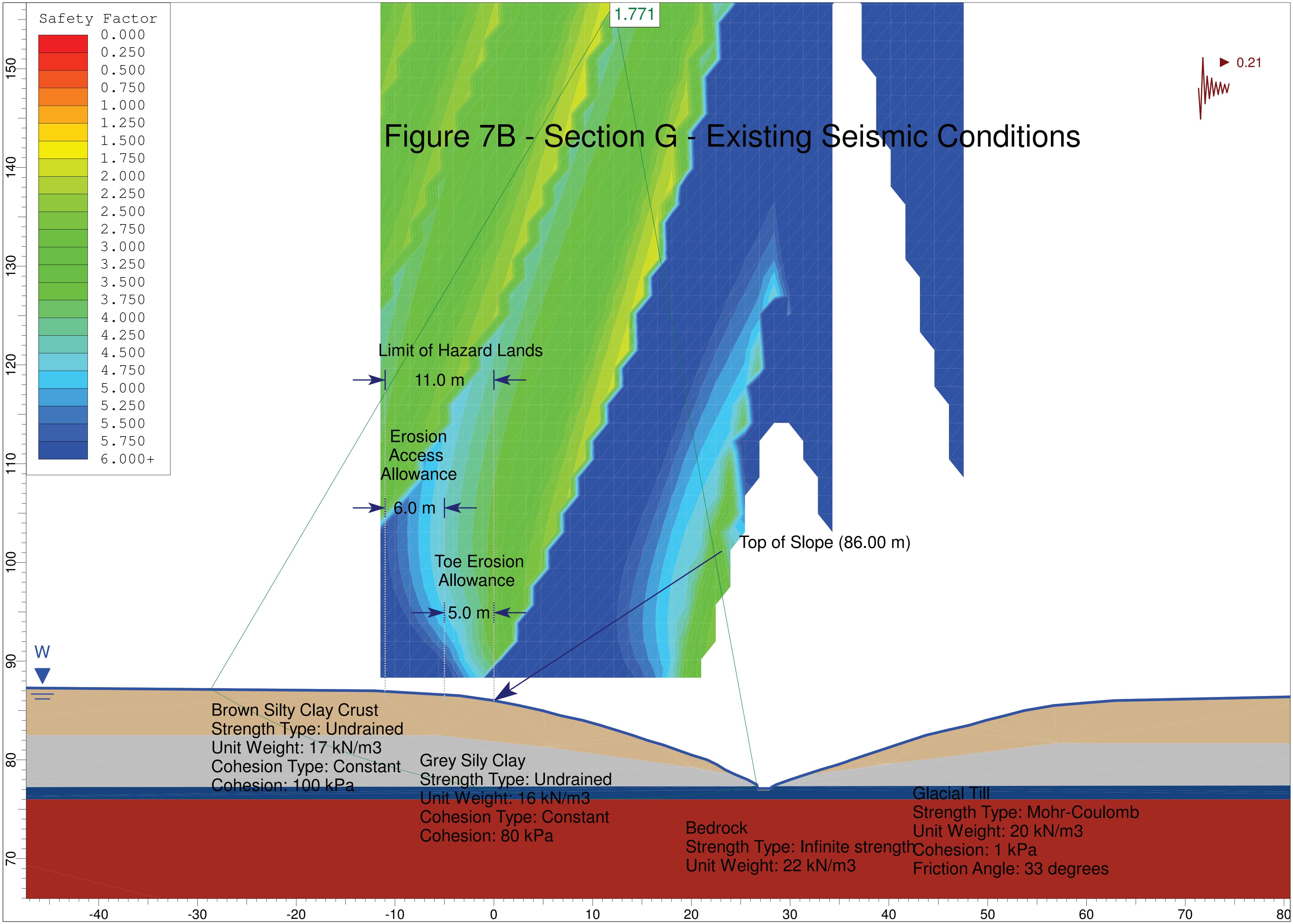


Figure 7A - Section G - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.00 m)
1.436
W
Brown Silty clay crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey silty clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
130
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40
50
60

Figure 7B - Section G - Existing Seismic Conditions



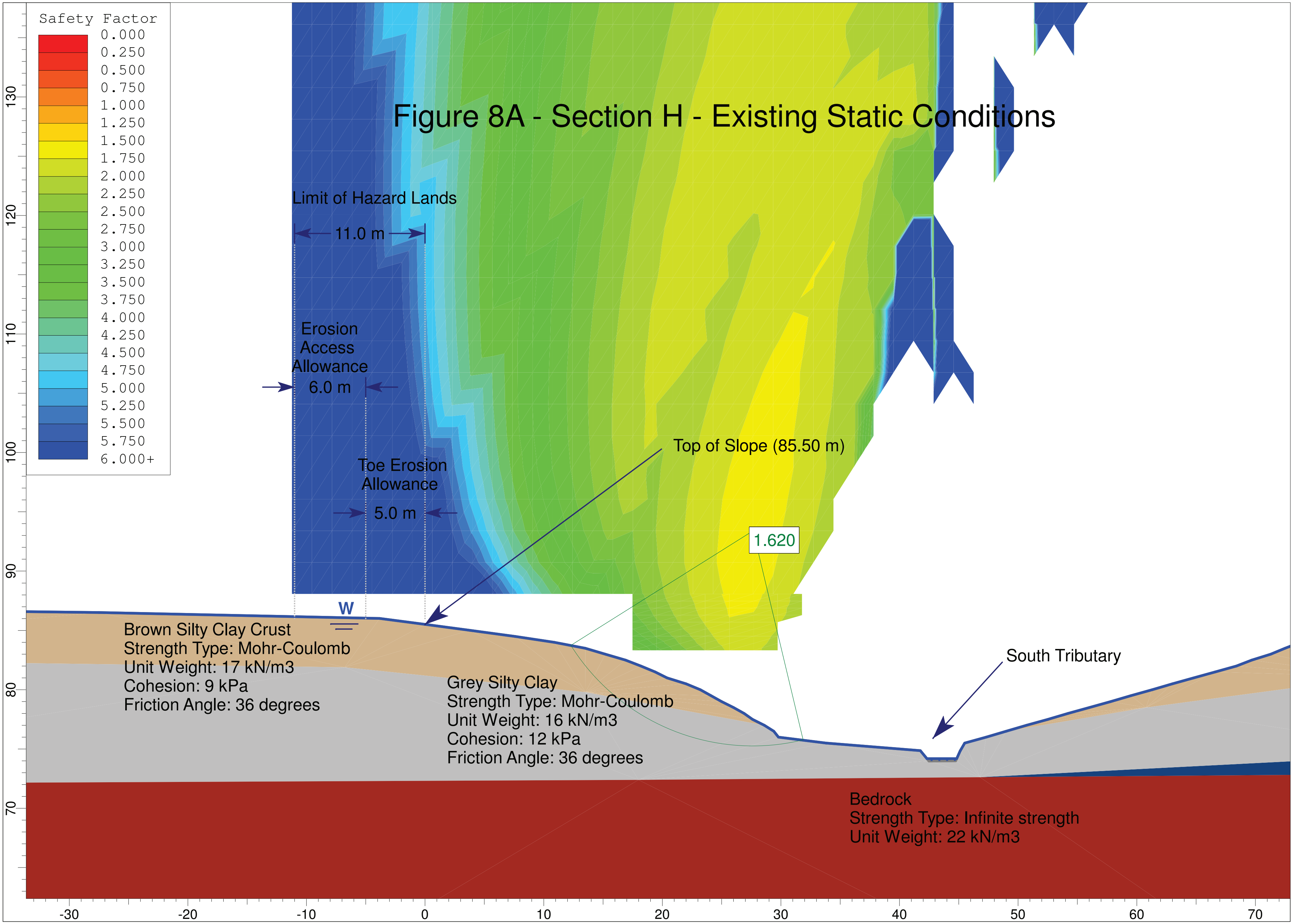


Figure 8A - Section H - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (85.50 m)
1.620
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
South Tributary
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
130
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40
50
60
70

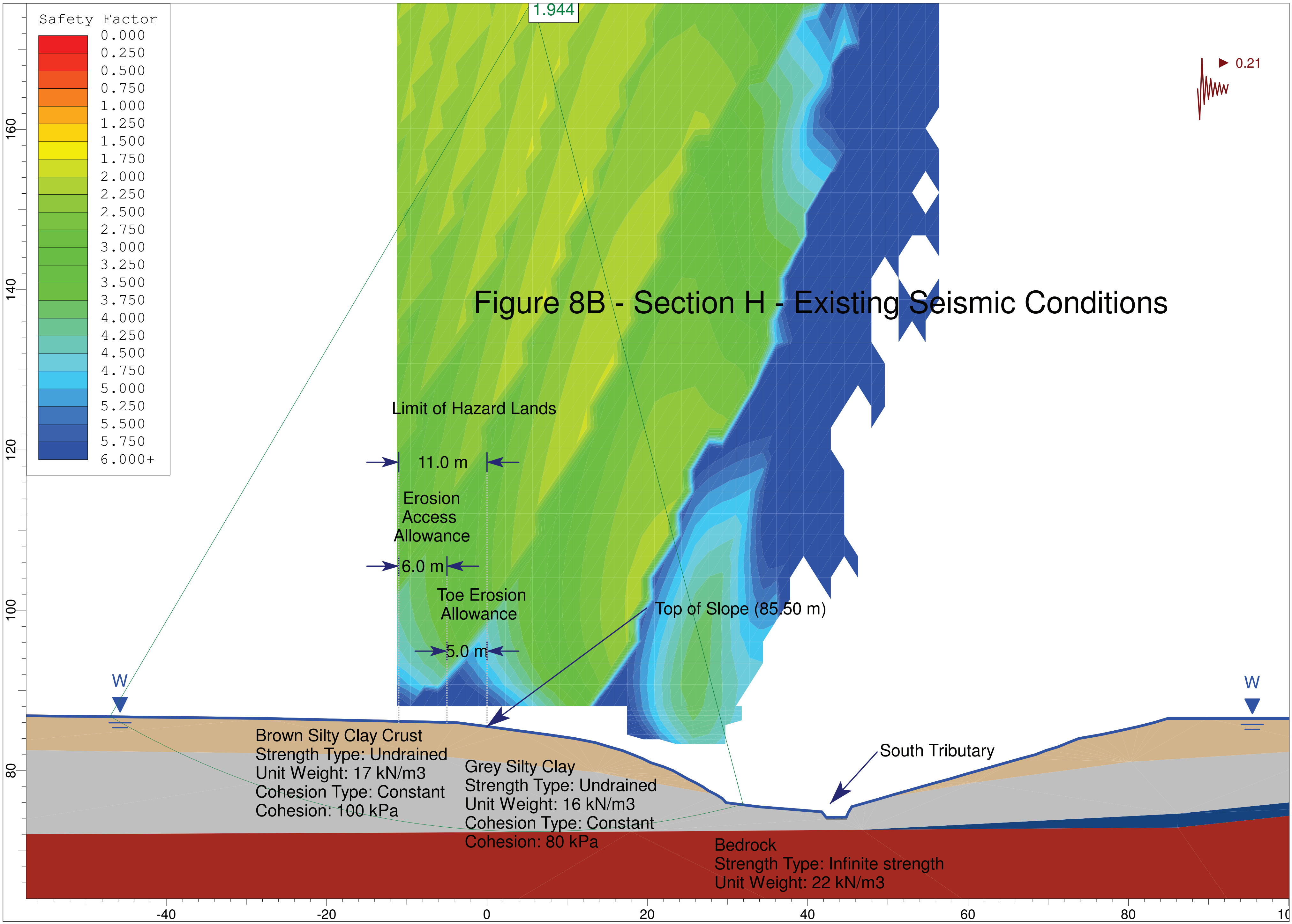


Figure 8B - Section H - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.944
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (85.50 m)
W
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
South Tributary
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
160
140
120
100
80
-40
-20
0
20
40
60
80

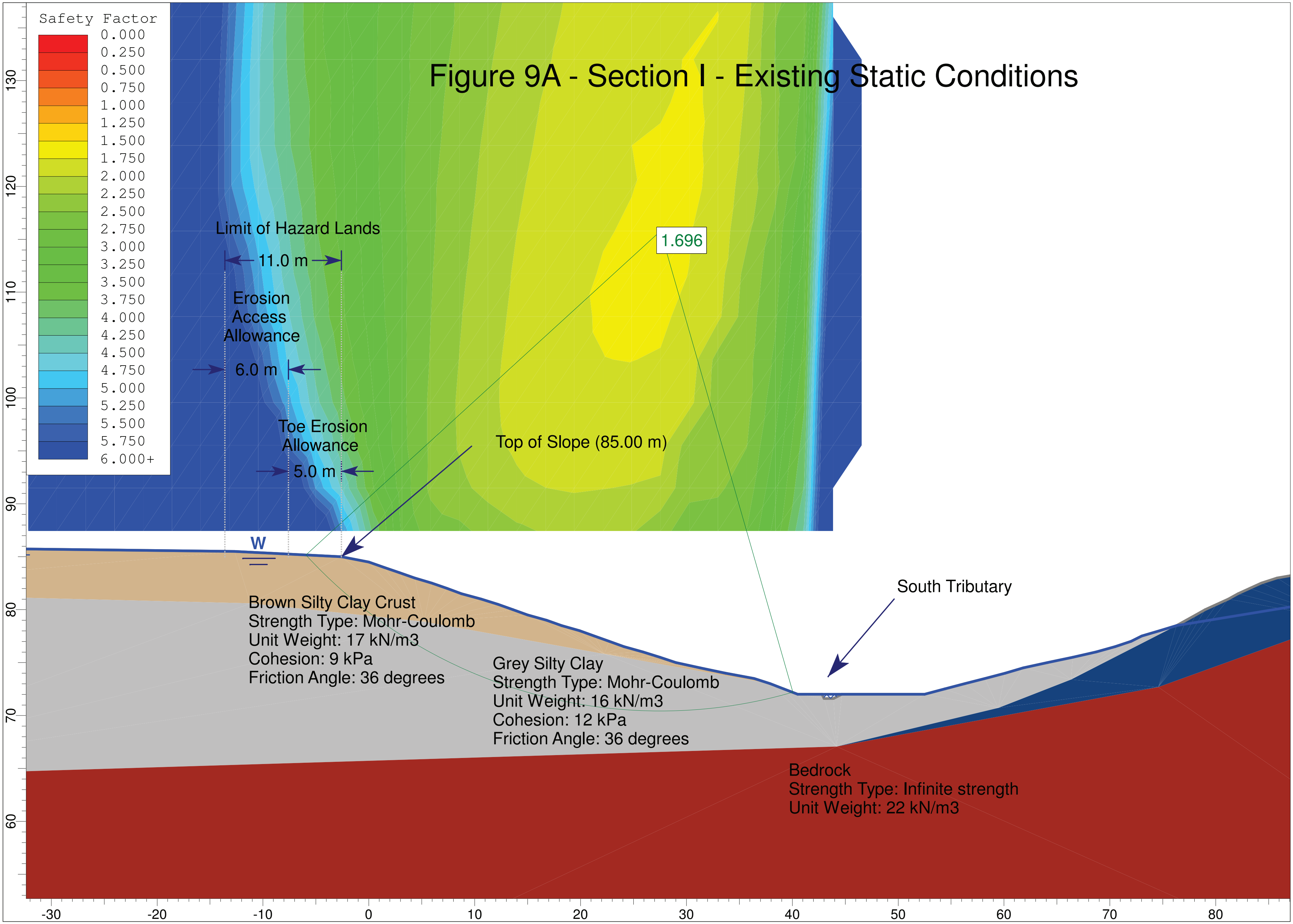


Figure 9A - Section I - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
1.696
Top of Slope (85.00 m)
W
South Tributary
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
130
120
110
100
90
80
70
60
-30
-20
-10
0
10
20
30
40
50
60
70
80

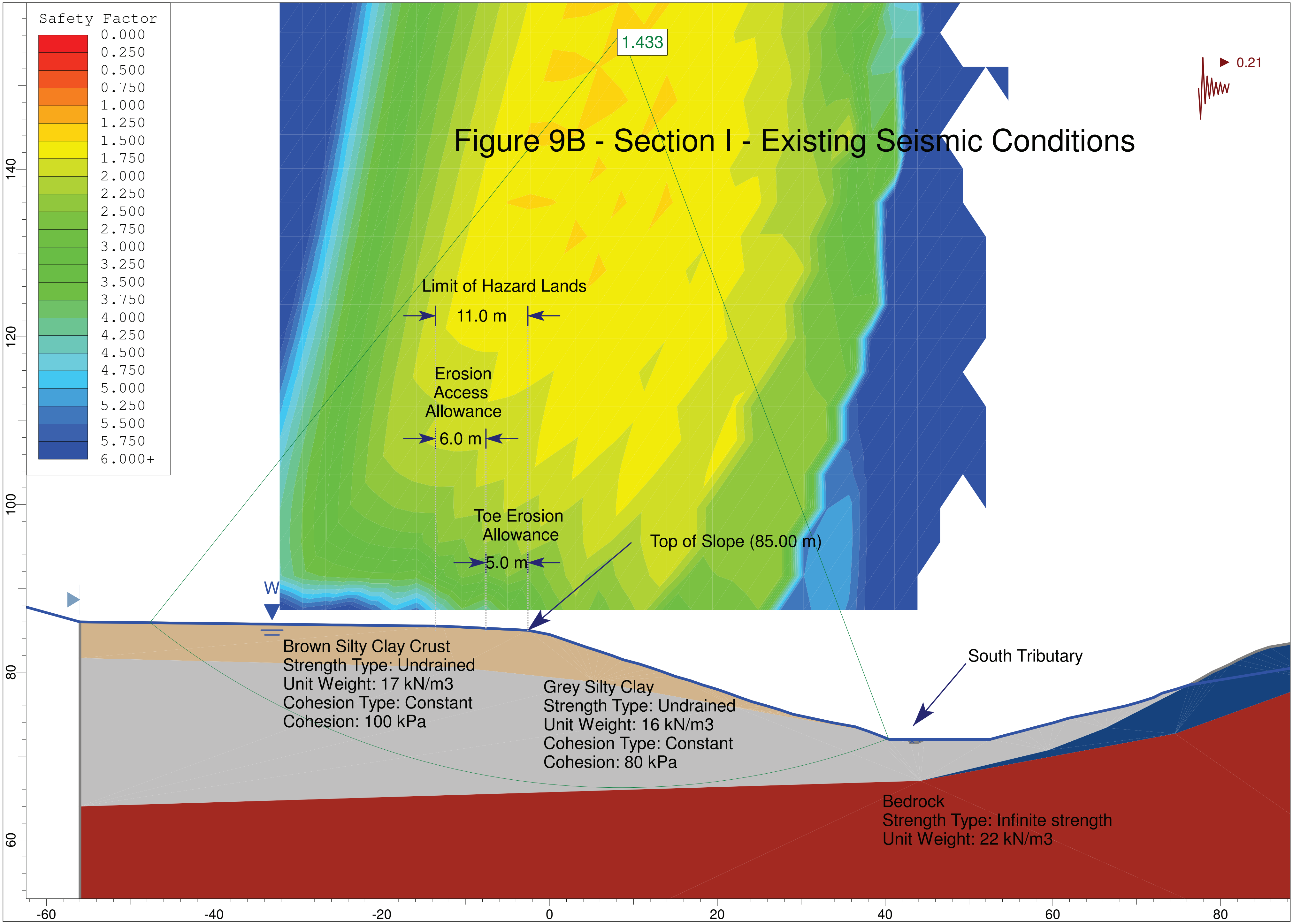
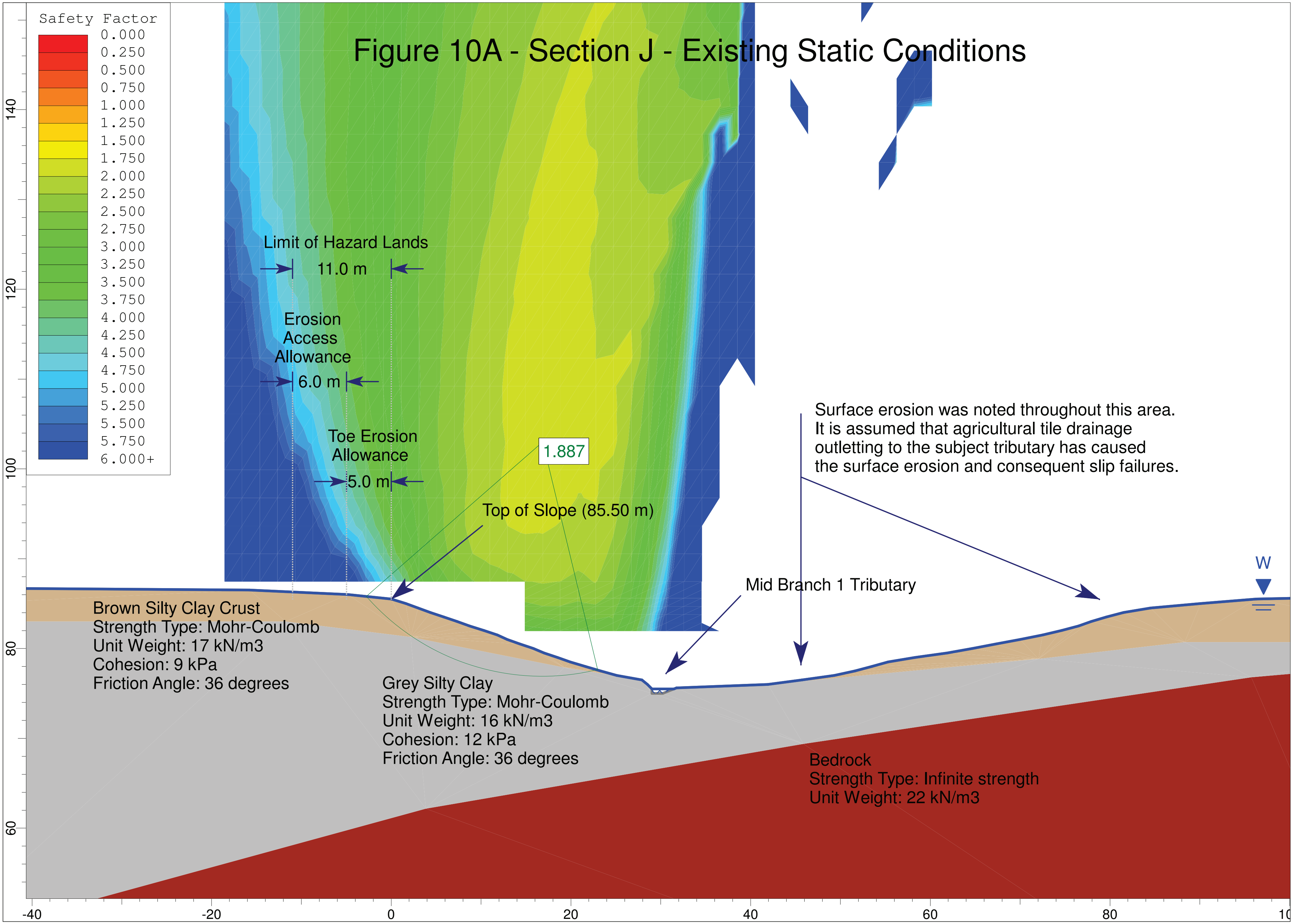


Figure 9B - Section I - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.433
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (85.00 m)
W
South Tributary
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
140
120
100
80
60
-60
-40
-20
0
20
40
60
80

Figure 10A - Section J - Existing Static Conditions



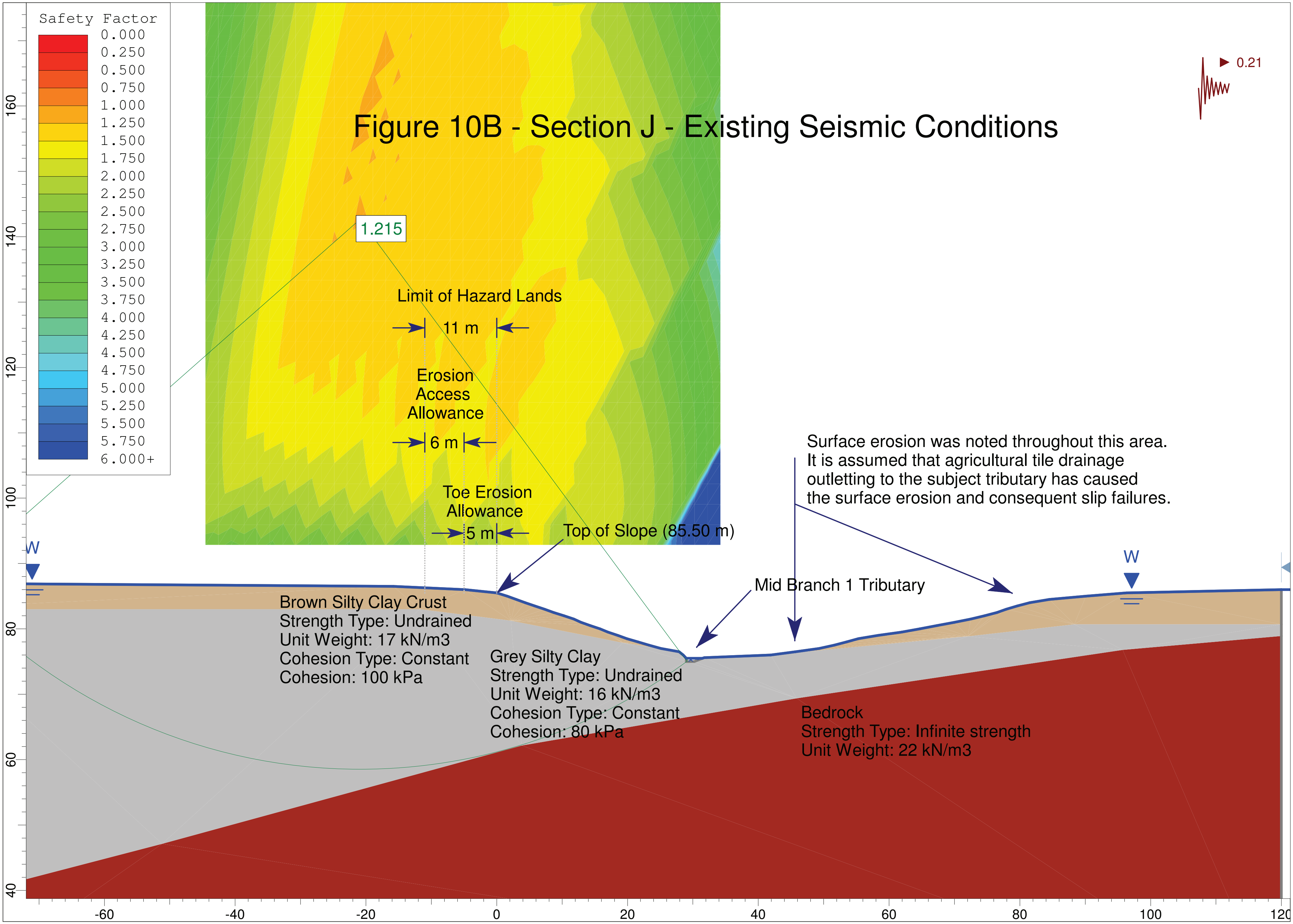


Figure 10B - Section J - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
1.215
Limit of Hazard Lands
11 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
5 m
Top of Slope (85.50 m)
Surface erosion was noted throughout this area. It is assumed that agricultural tile drainage outletting to the subject tributary has caused the surface erosion and consequent slip failures.
Mid Branch 1 Tributary
W
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
160
140
120
100
80
60
40
-60
-40
-20
0
20
40
60
80
100
120

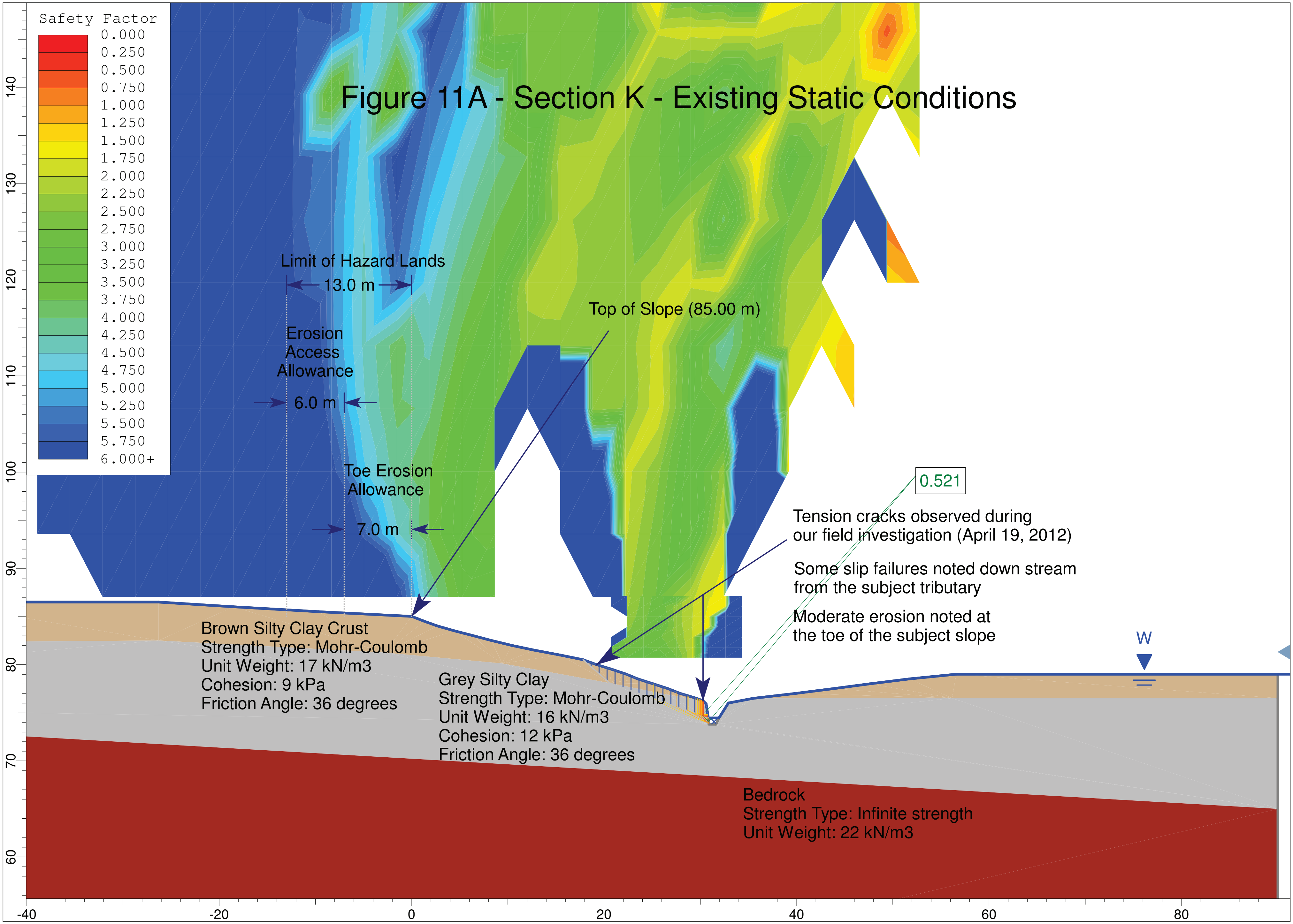


Figure 11A - Section K - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
13.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
7.0 m
Top of Slope (85.00 m)
0.521
Tension cracks observed during our field investigation (April 19, 2012)
Some slip failures noted down stream from the subject tributary
Moderate erosion noted at the toe of the subject slope
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
140
130
120
110
100
90
80
70
60
-40
-20
0
20
40
60
80

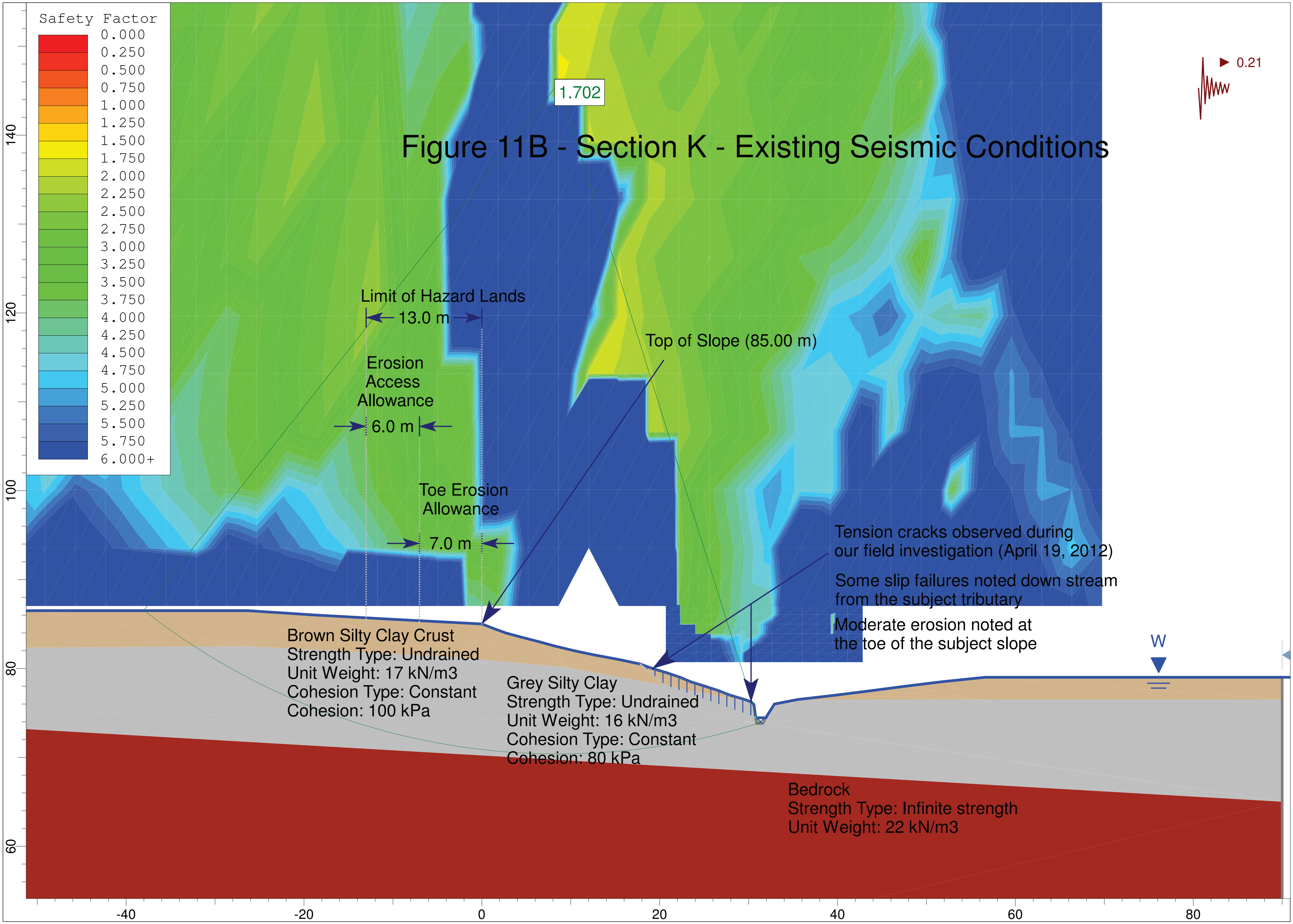


Figure 11B - Section K - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.702
0.21
Limit of Hazard Lands
13.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
7.0 m
Top of Slope (85.00 m)
Tension cracks observed during our field investigation (April 19, 2012)
Some slip failures noted down stream from the subject tributary
Moderate erosion noted at the toe of the subject slope
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
140
120
100
80
60
-40
-20
0
20
40
60
80

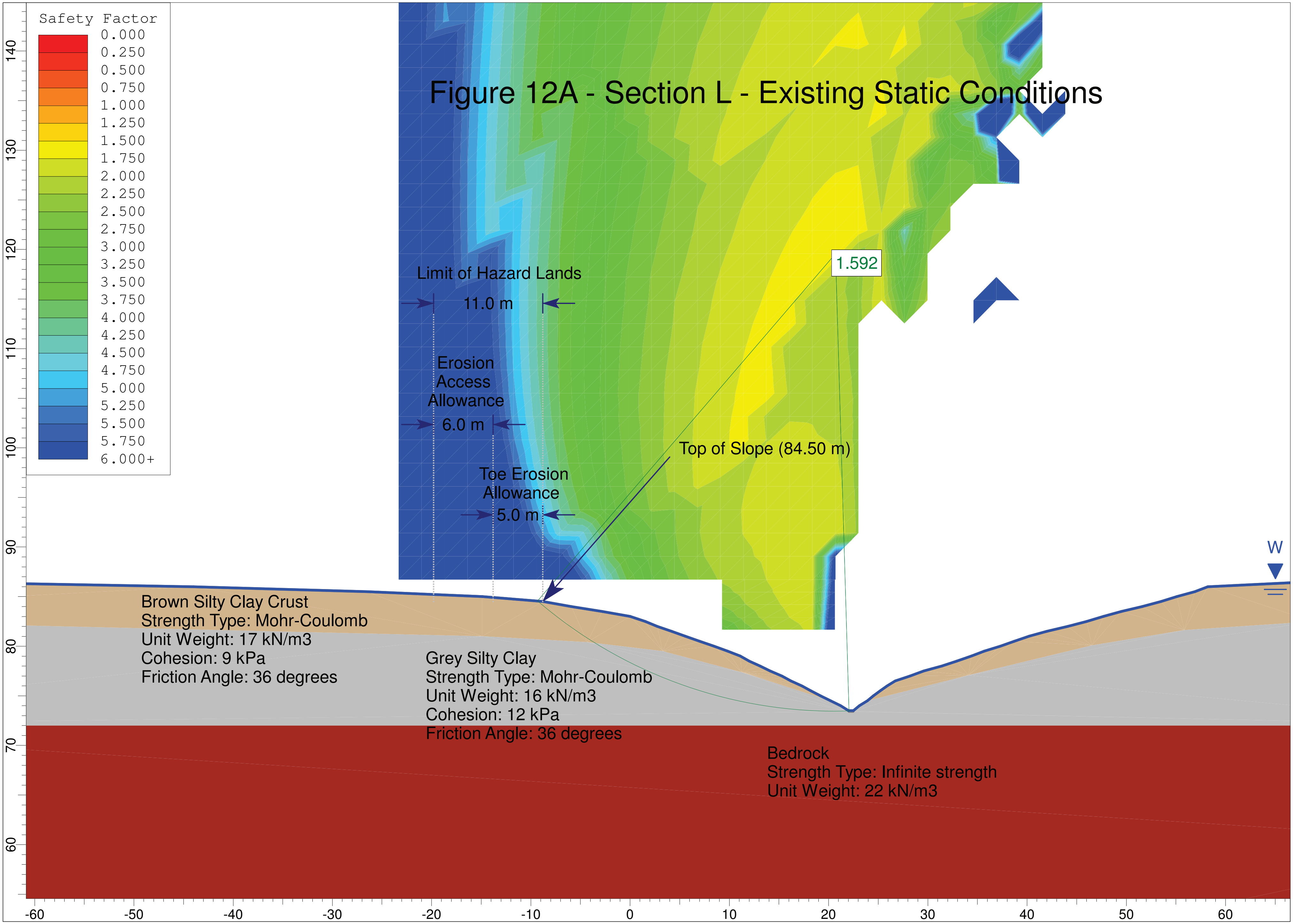


Figure 12A - Section L - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion
Access
Allowance
6.0 m
Toe Erosion
Allowance
5.0 m
1.592
Top of Slope (84.50 m)
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
140
130
120
110
100
90
80
70
60
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60

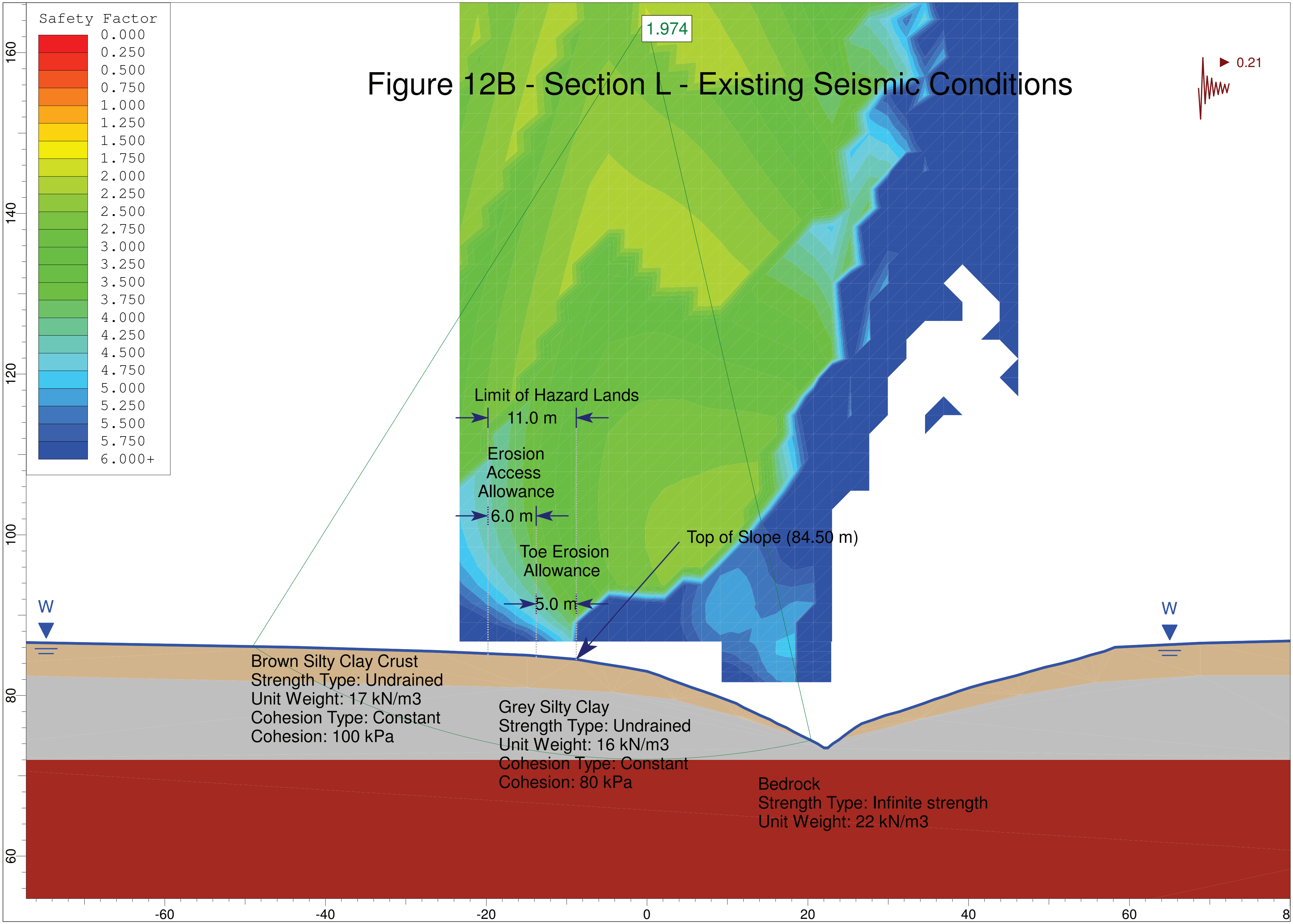


Figure 12B - Section L - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.974
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (84.50 m)
W
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
160
140
120
100
80
60
-60
-40
-20
0
20
40
60
8

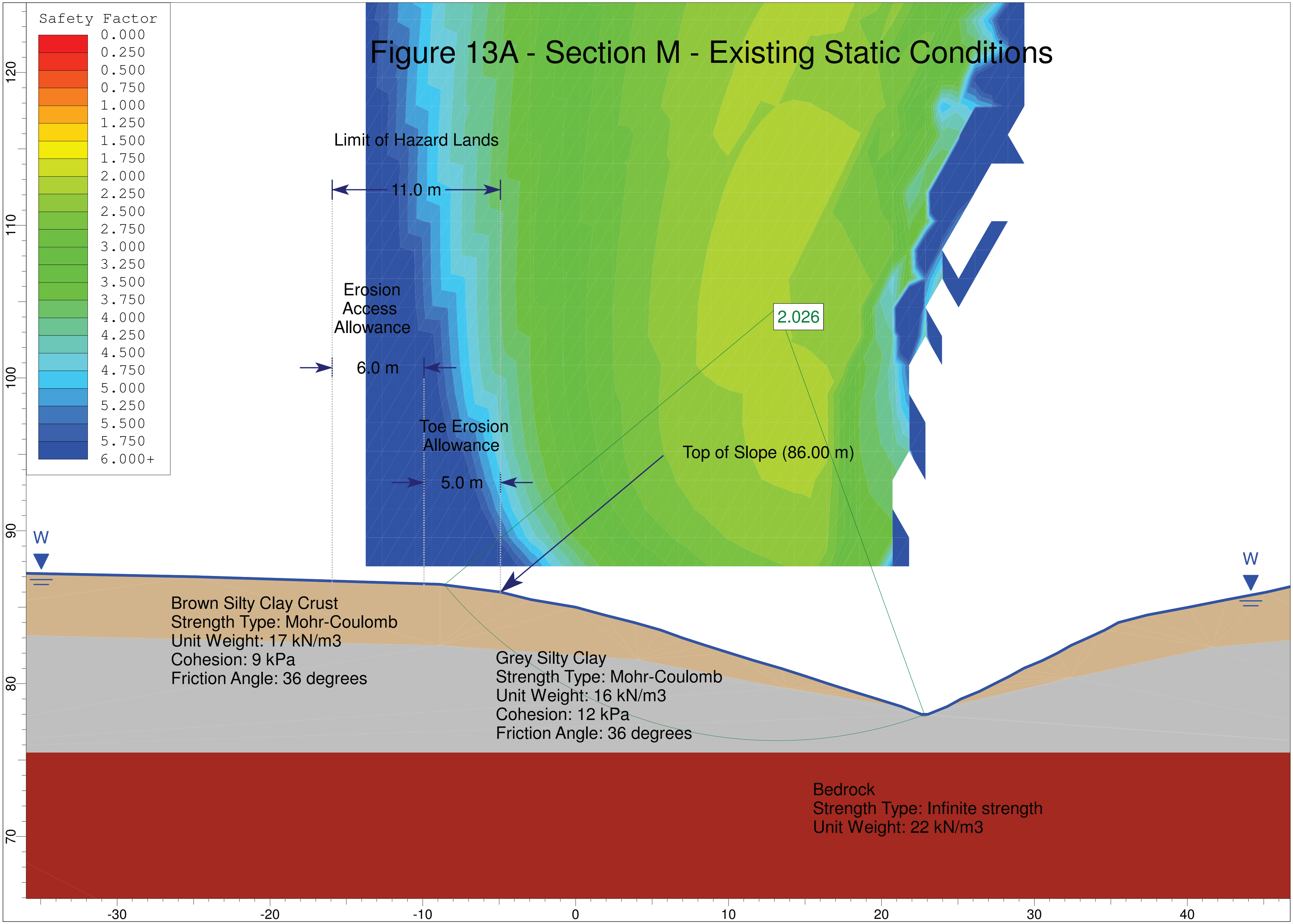
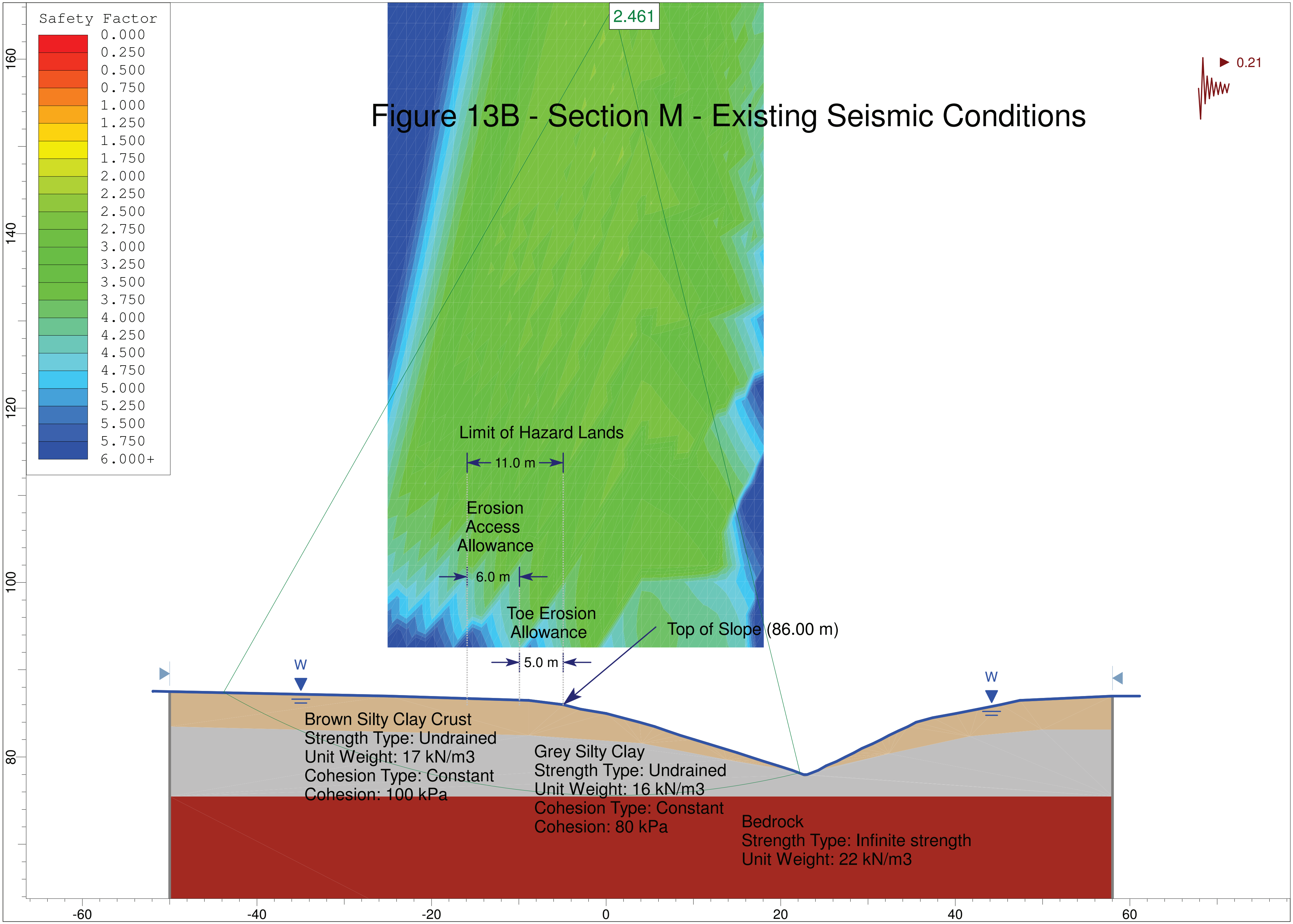


Figure 13A - Section M - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
2.026
Top of Slope (86.00 m)
W
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.461
0.21
Figure 13B - Section M - Existing Seismic Conditions
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.00 m)
W
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
160
140
120
100
80
-60
-40
-20
0
20
40
60

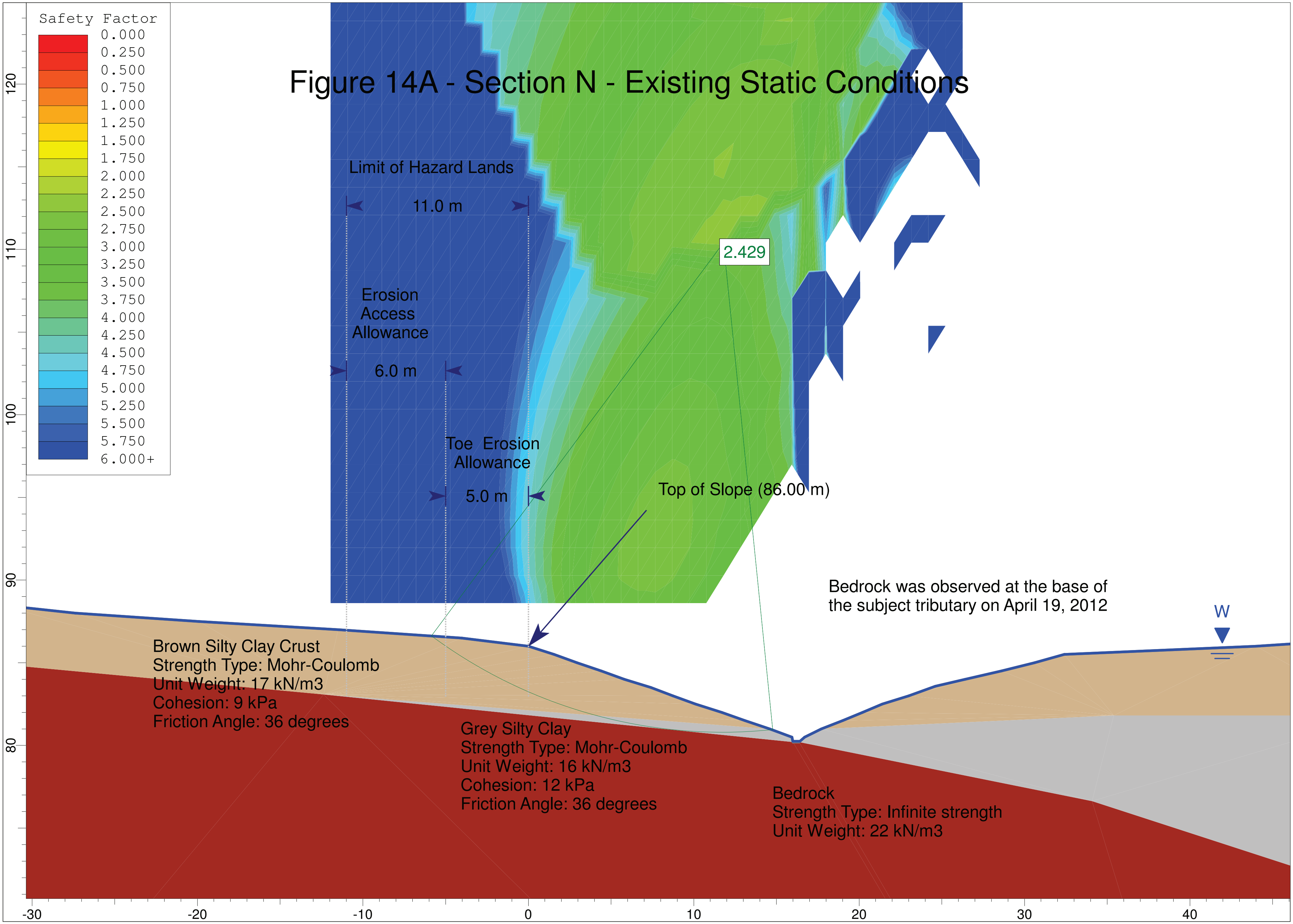


Figure 14A - Section N - Existing Static Conditions

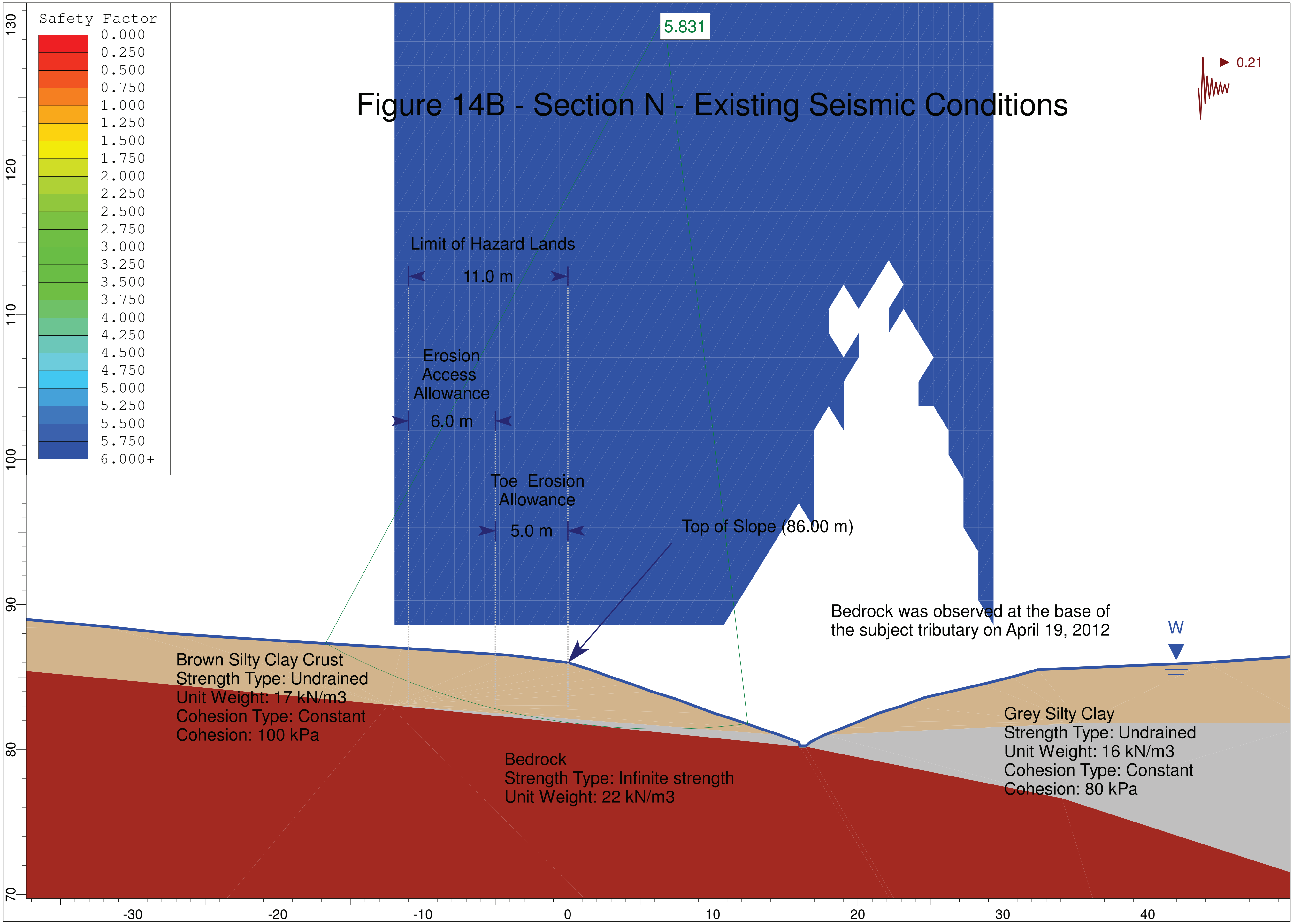


Figure 14B - Section N - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
5.831
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.00 m)
Bedrock was observed at the base of the subject tributary on April 19, 2012
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
130
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40

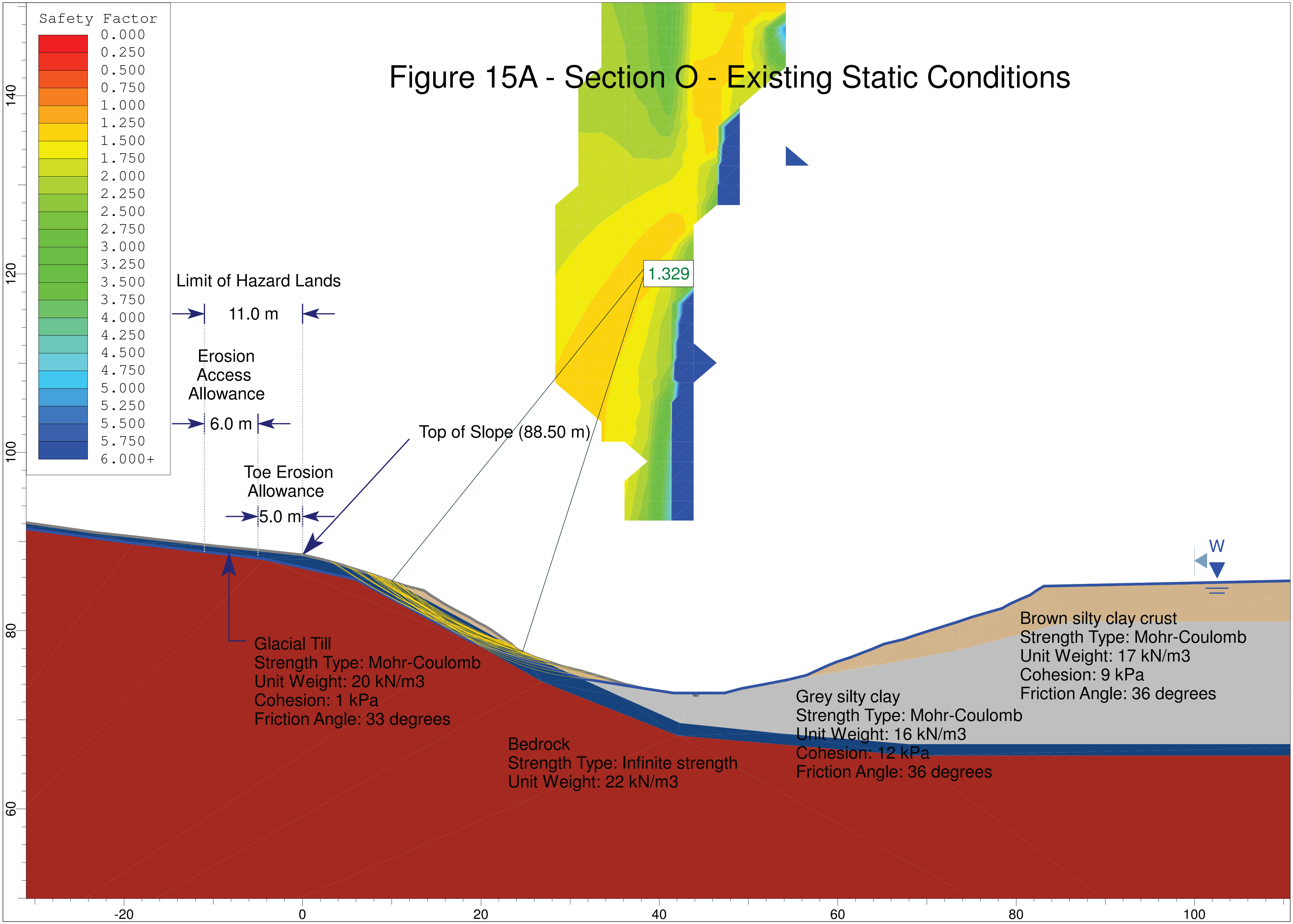


Figure 15A - Section O - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.329
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (88.50 m)
W
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Grey silty clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Brown silty clay crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
140
120
100
80
60
-20
0
20
40
60
80
100

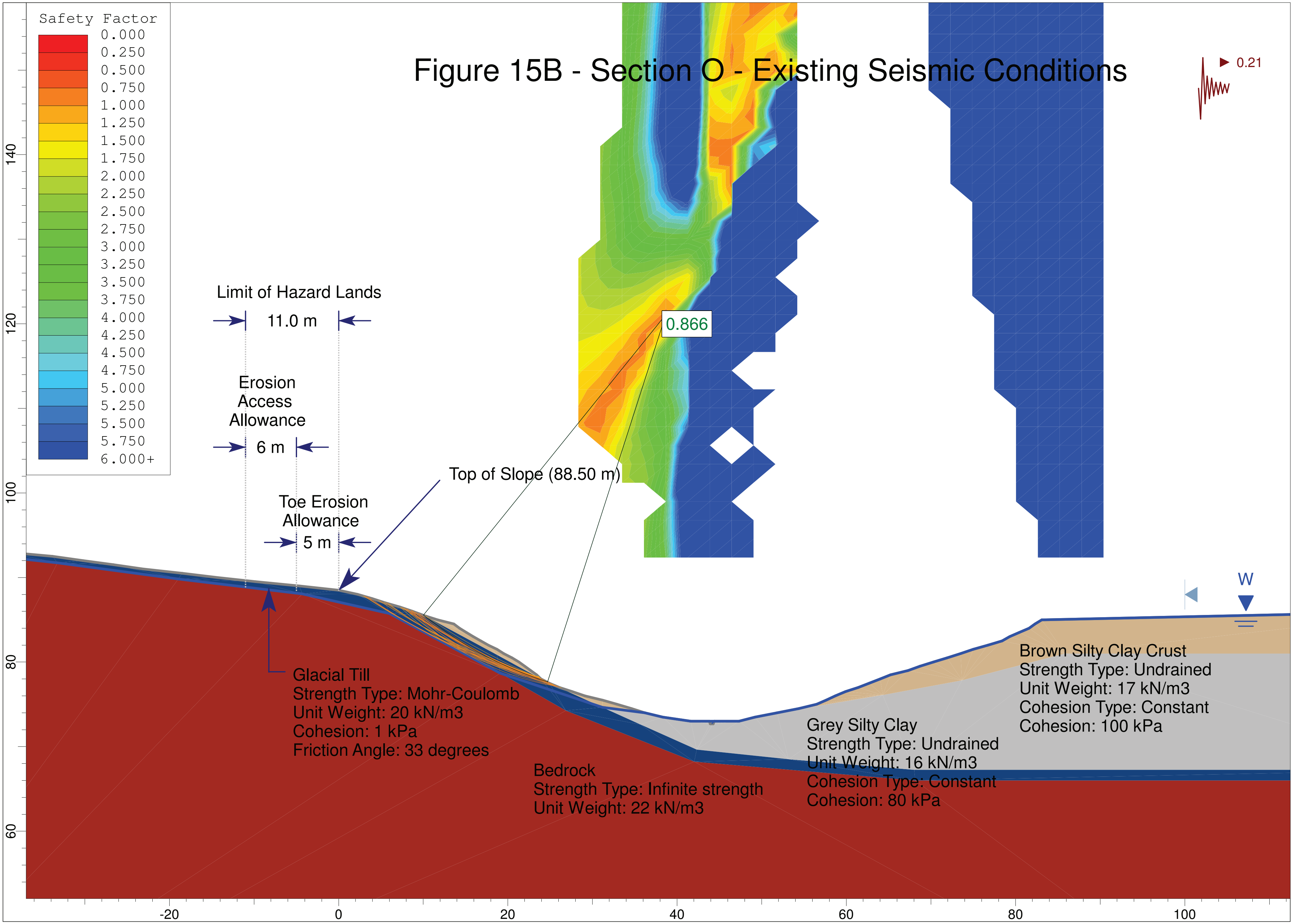


Figure 15B - Section O - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6 m
Toe Erosion Allowance
5 m
Top of Slope (88.50 m)
0.866
W
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
140
120
100
80
60
-20
0
20
40
60
80
100

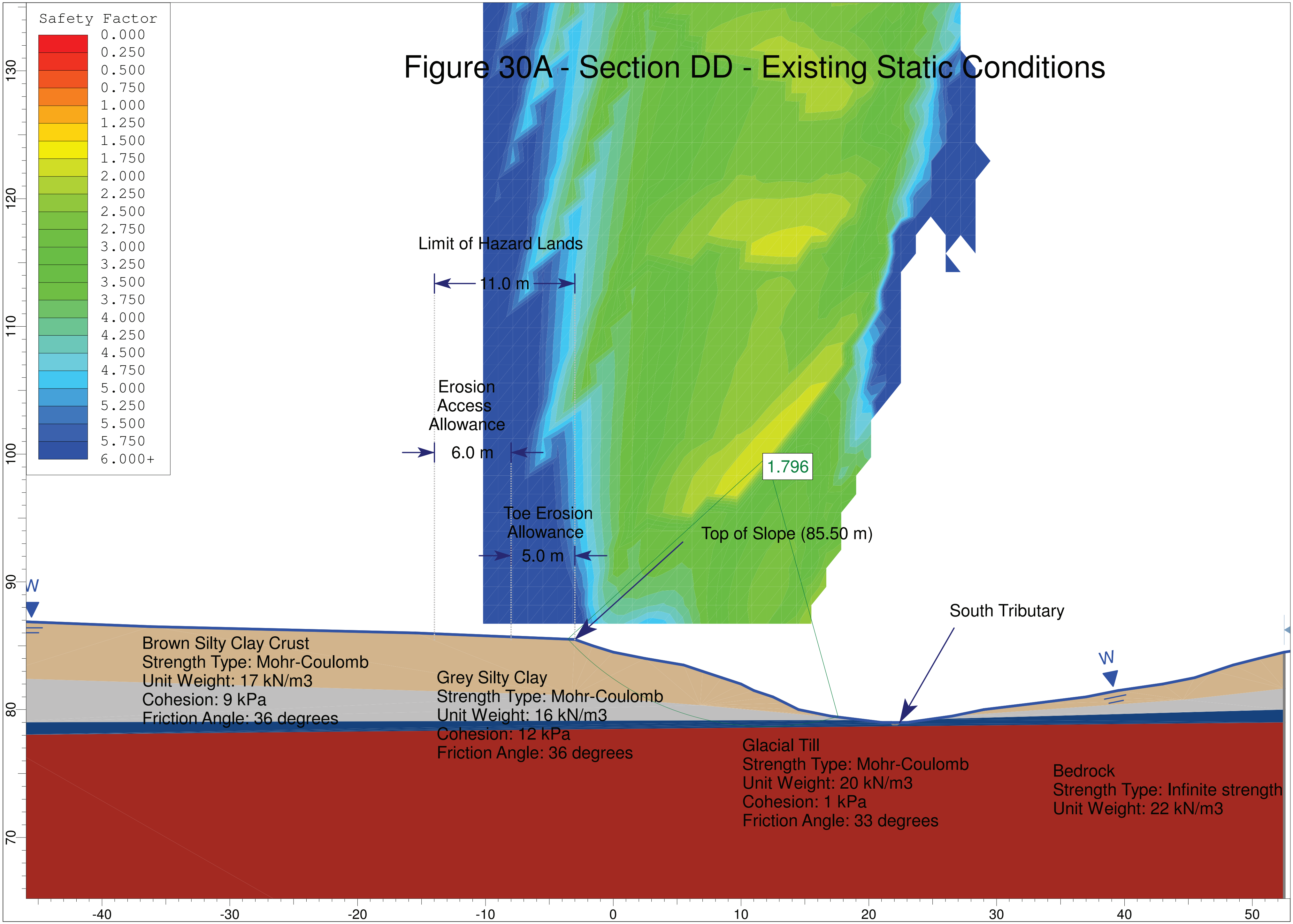
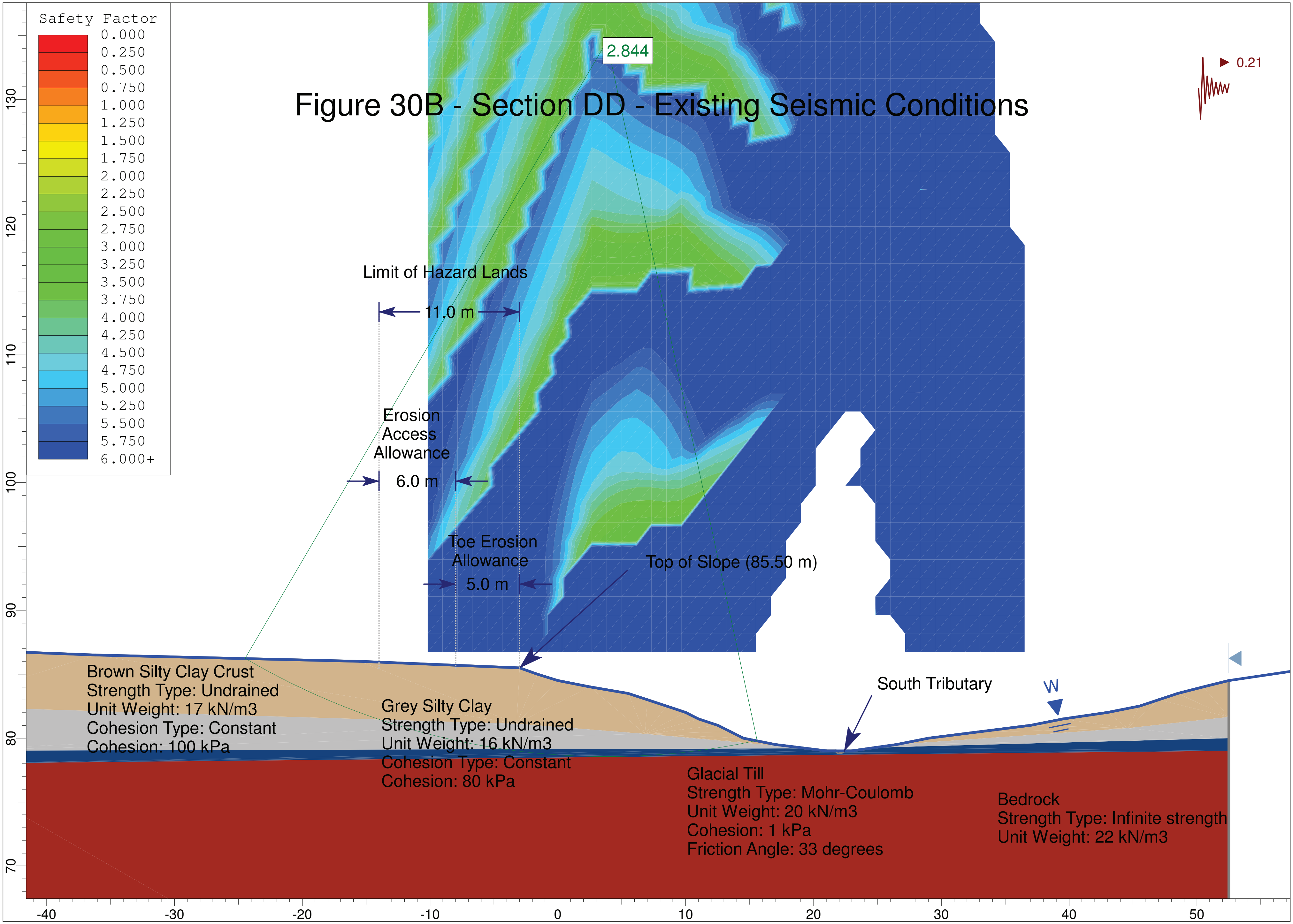


Figure 30A - Section DD - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion
Access
Allowance
6.0 m
1.796
Toe Erosion
Allowance
5.0 m
Top of Slope (85.50 m)
South Tributary
W
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
130
120
110
100
90
80
70
-40
-30
-20
-10
0
10
20
30
40
50

Figure 30B - Section DD - Existing Seismic Conditions



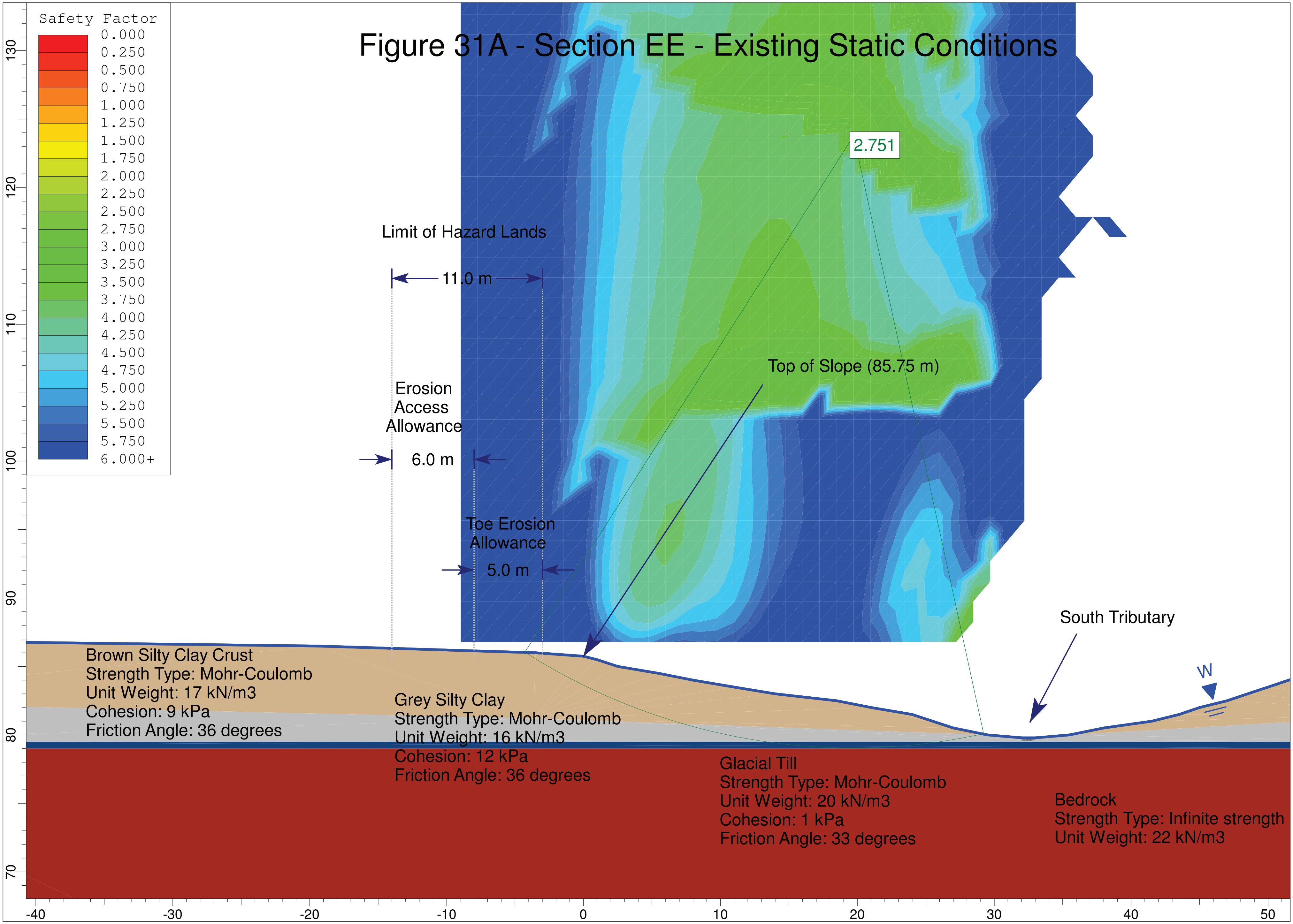


Figure 31A - Section EE - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.751
Limit of Hazard Lands
11.0 m
Top of Slope (85.75 m)
Erosion
Access
Allowance
6.0 m
Toe Erosion
Allowance
5.0 m
South Tributary
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
130
120
110
100
90
80
70
-40
-30
-20
-10
0
10
20
30
40
50

Figure 31B - Section EE - Existing Seismic Conditions

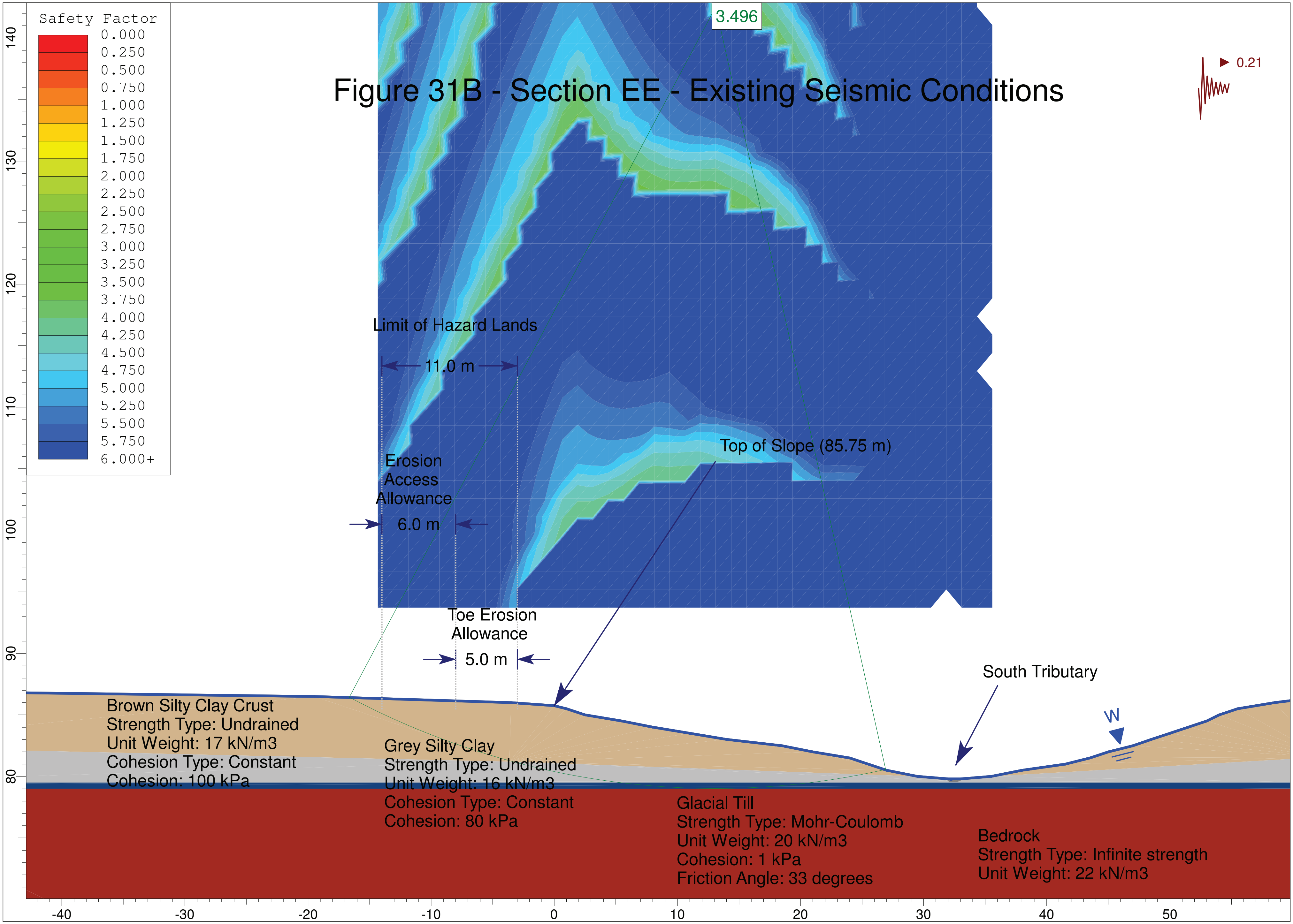


Figure 32A - Section FF - Existing Static Conditions

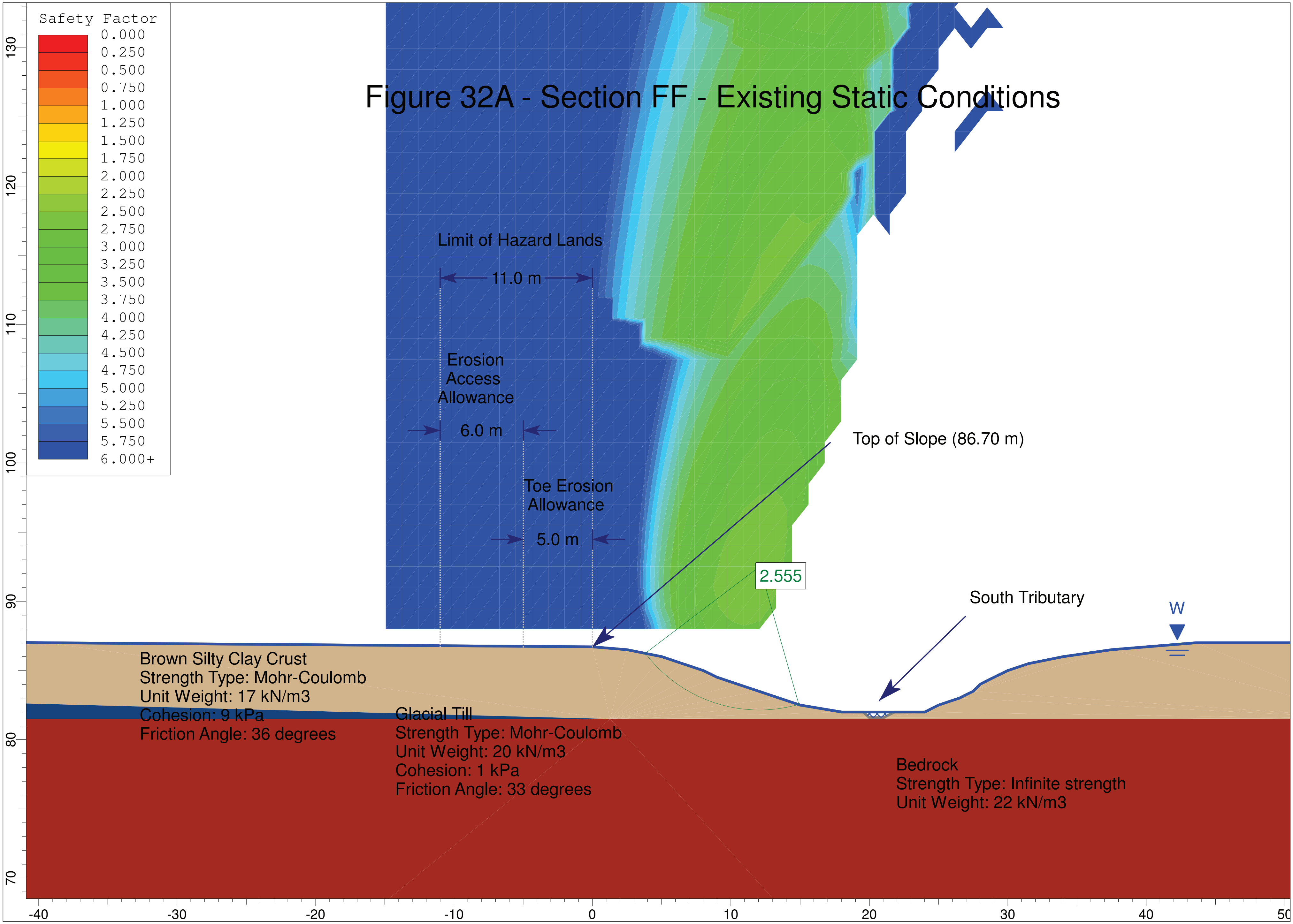


Figure 32B - Section FF - Existing Seismic Conditions

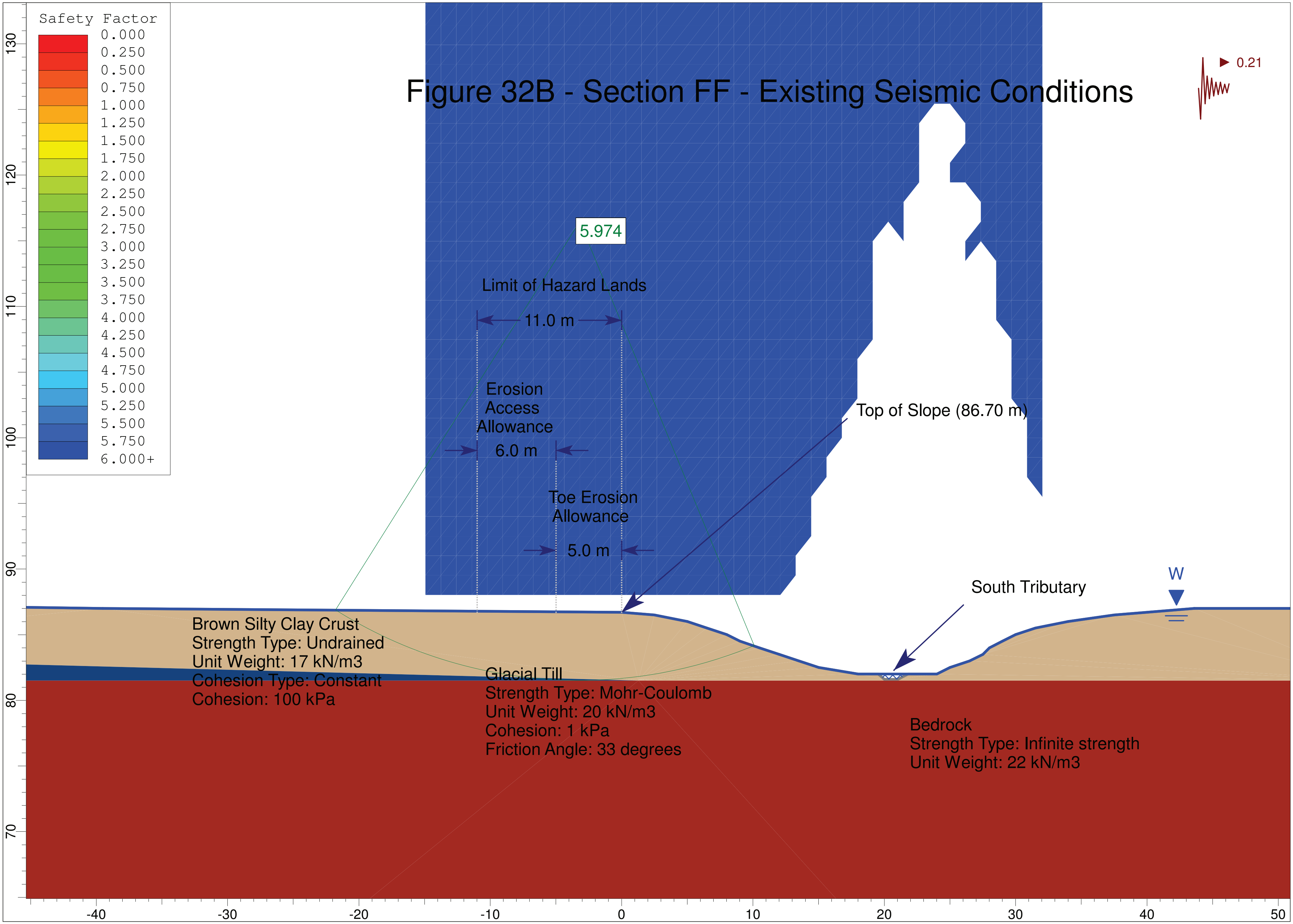
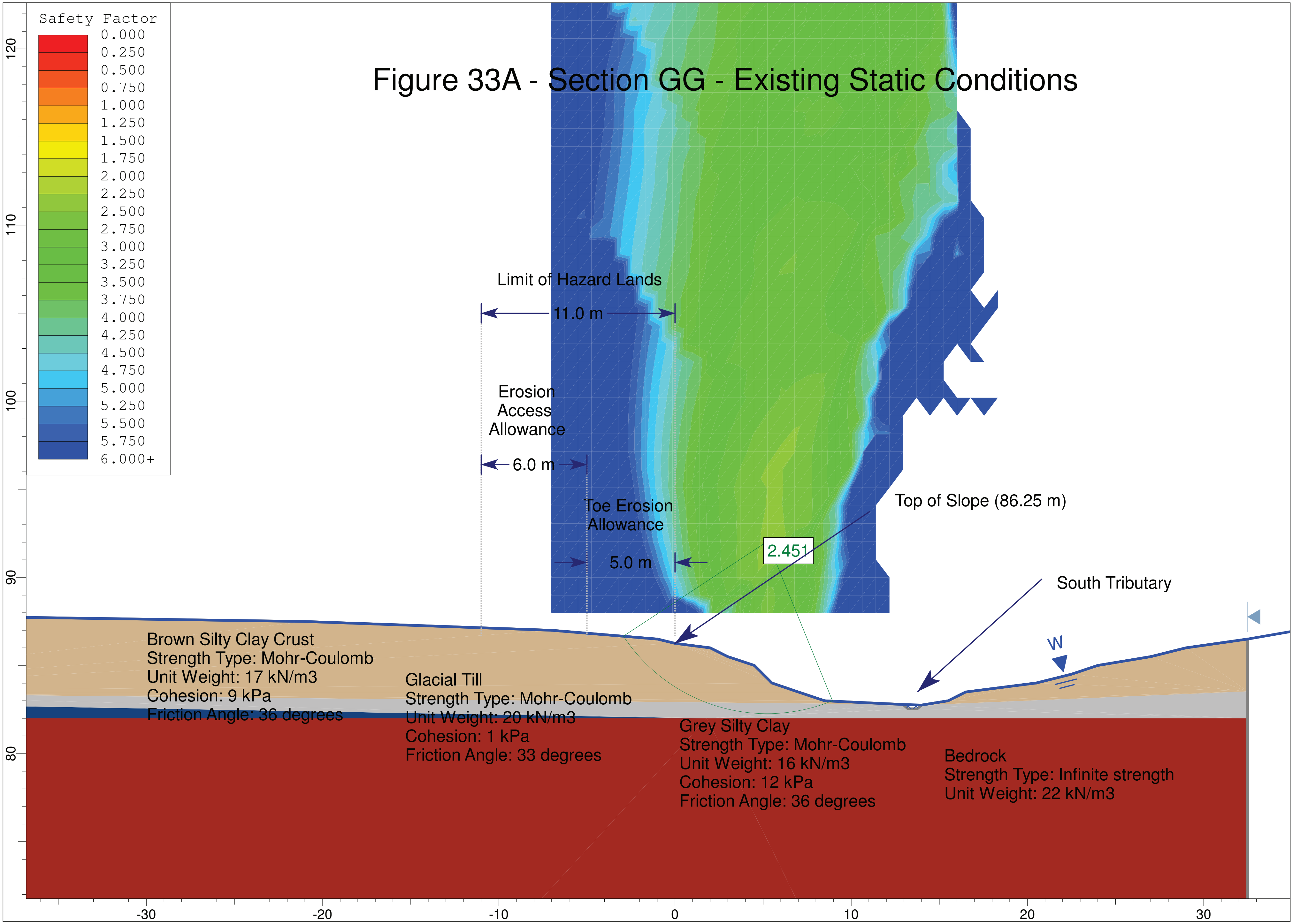


Figure 33A - Section GG - Existing Static Conditions



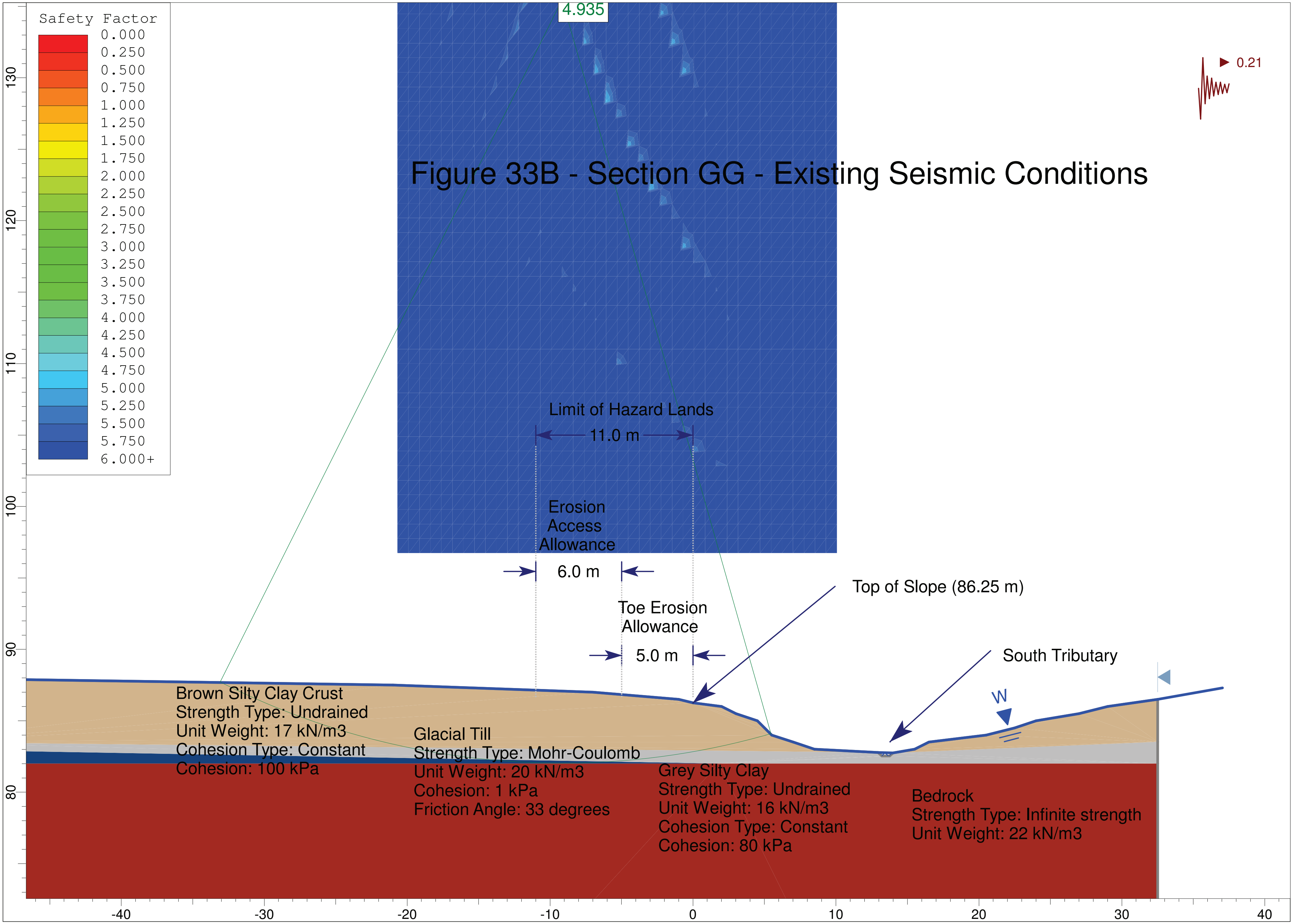


Figure 33B - Section GG - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
4.935
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.25 m)
South Tributary
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
130
120
110
100
90
80
-40
-30
-20
-10
0
10
20
30
40

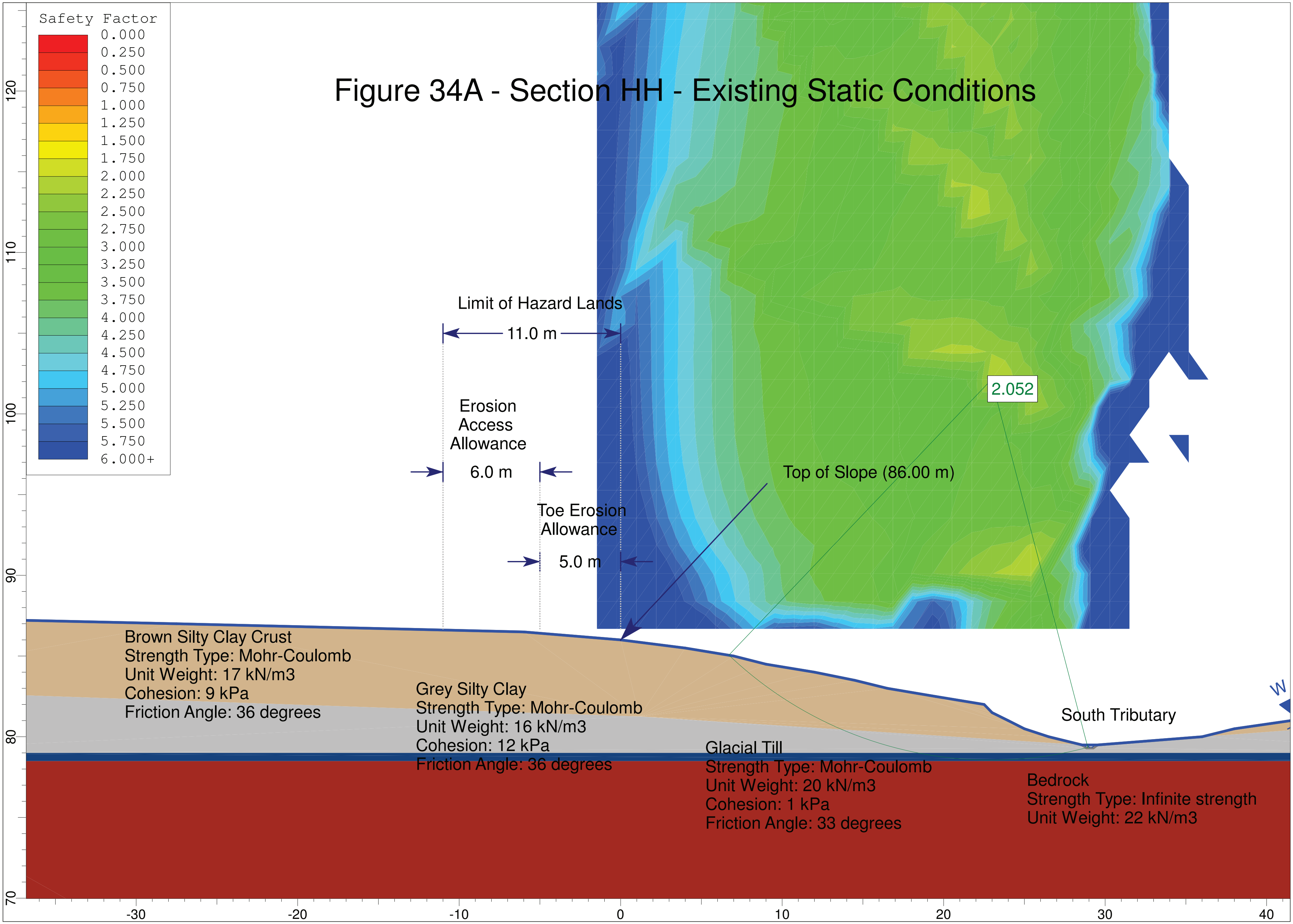
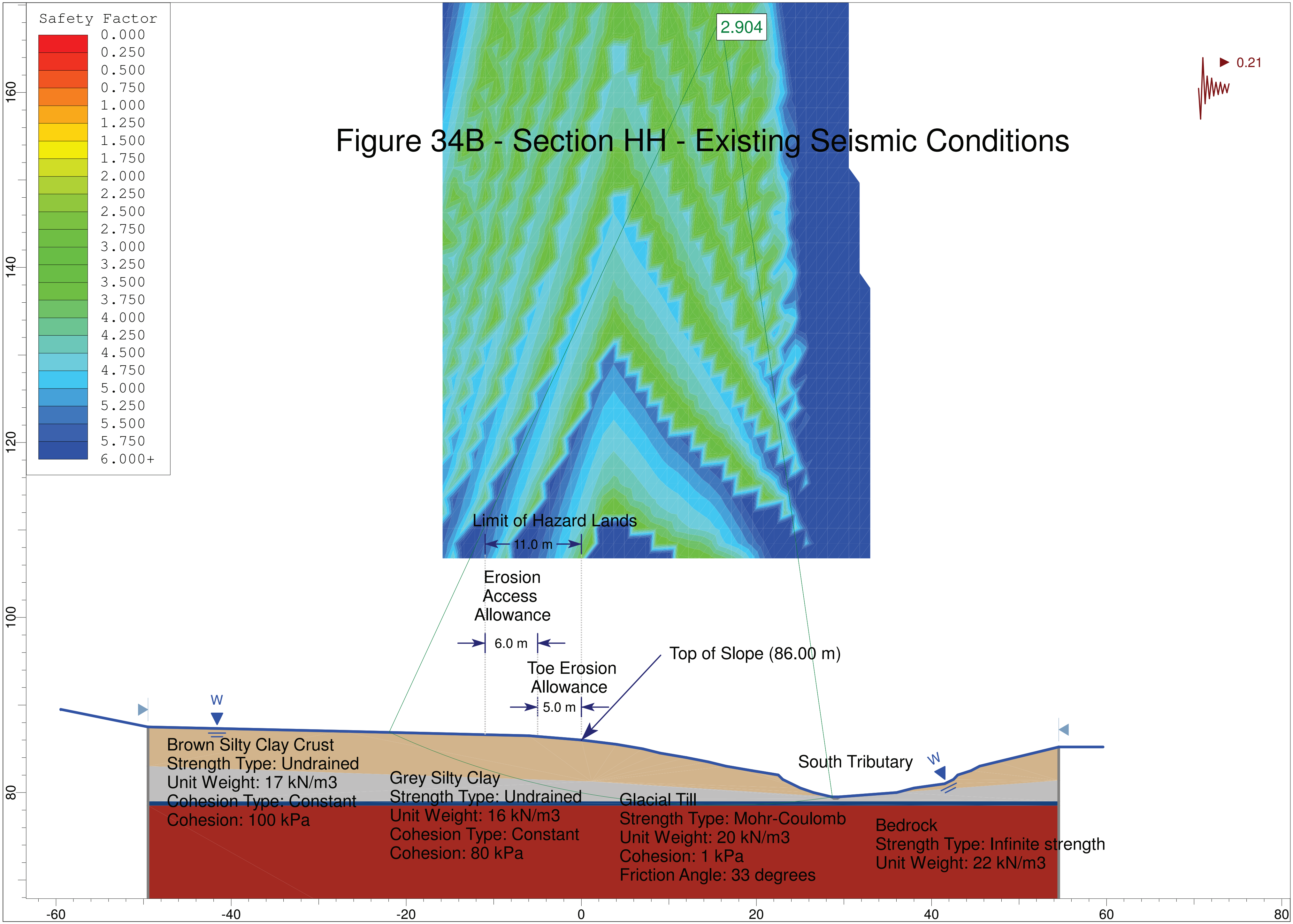


Figure 34A - Section HH - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.00 m)
2.052
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
South Tributary
W
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40

Figure 34B - Section HH - Existing Seismic Conditions



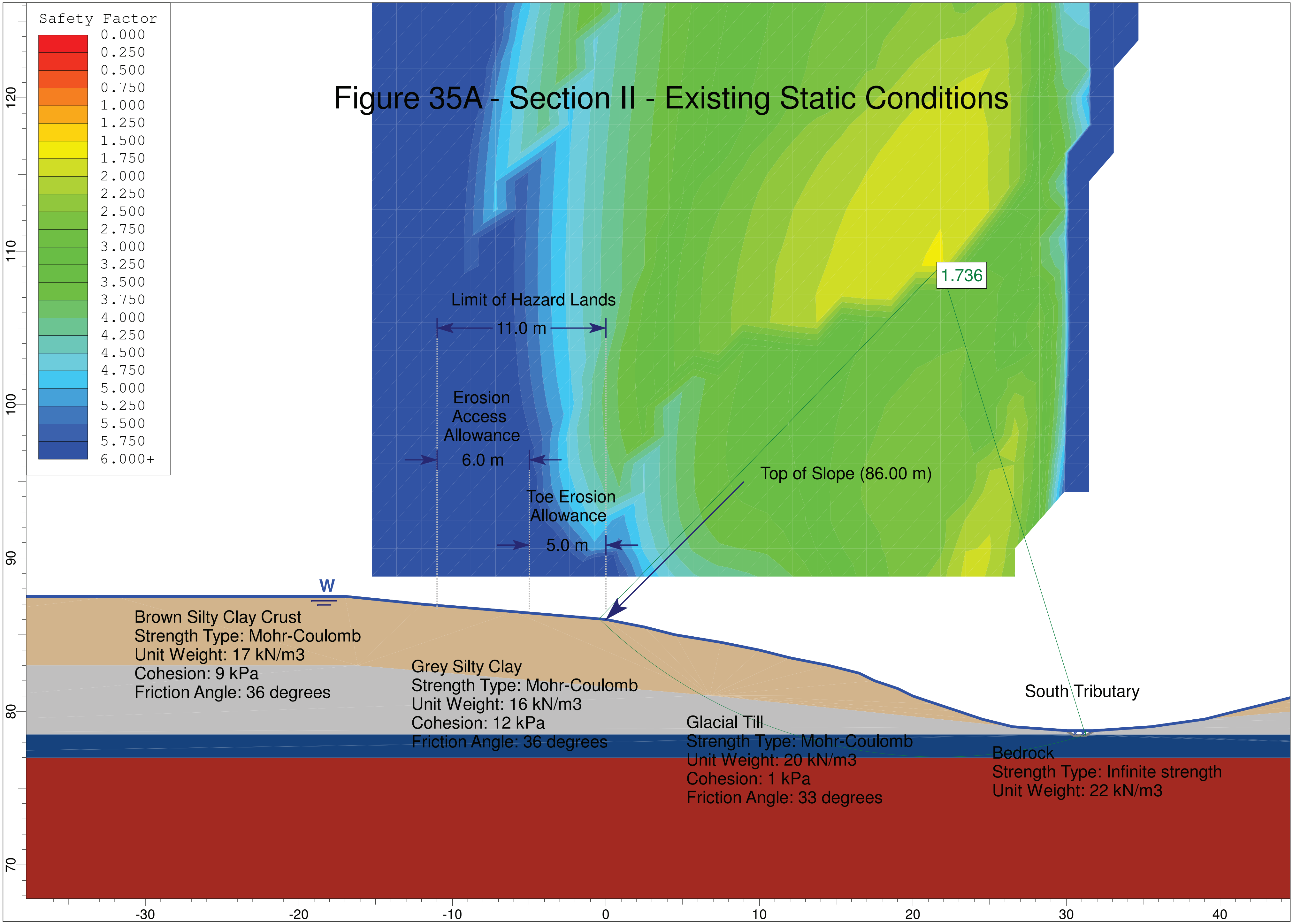


Figure 35A - Section II - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.736
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.00 m)
W
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
South Tributary
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40

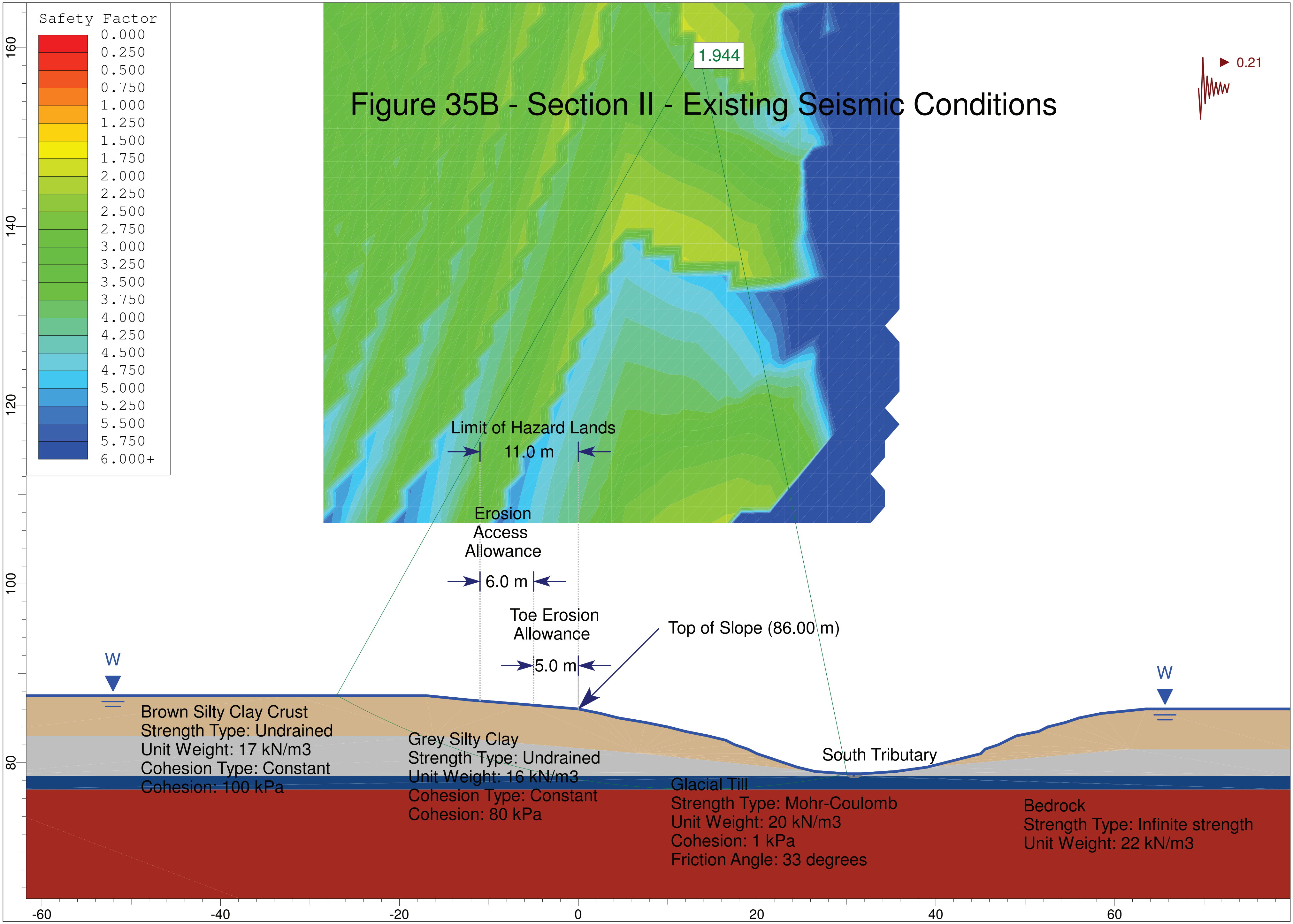


Figure 35B - Section II - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.944
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (86.00 m)
W
W
South Tributary
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
160
140
120
100
80
-60
-40
-20
0
20
40
60

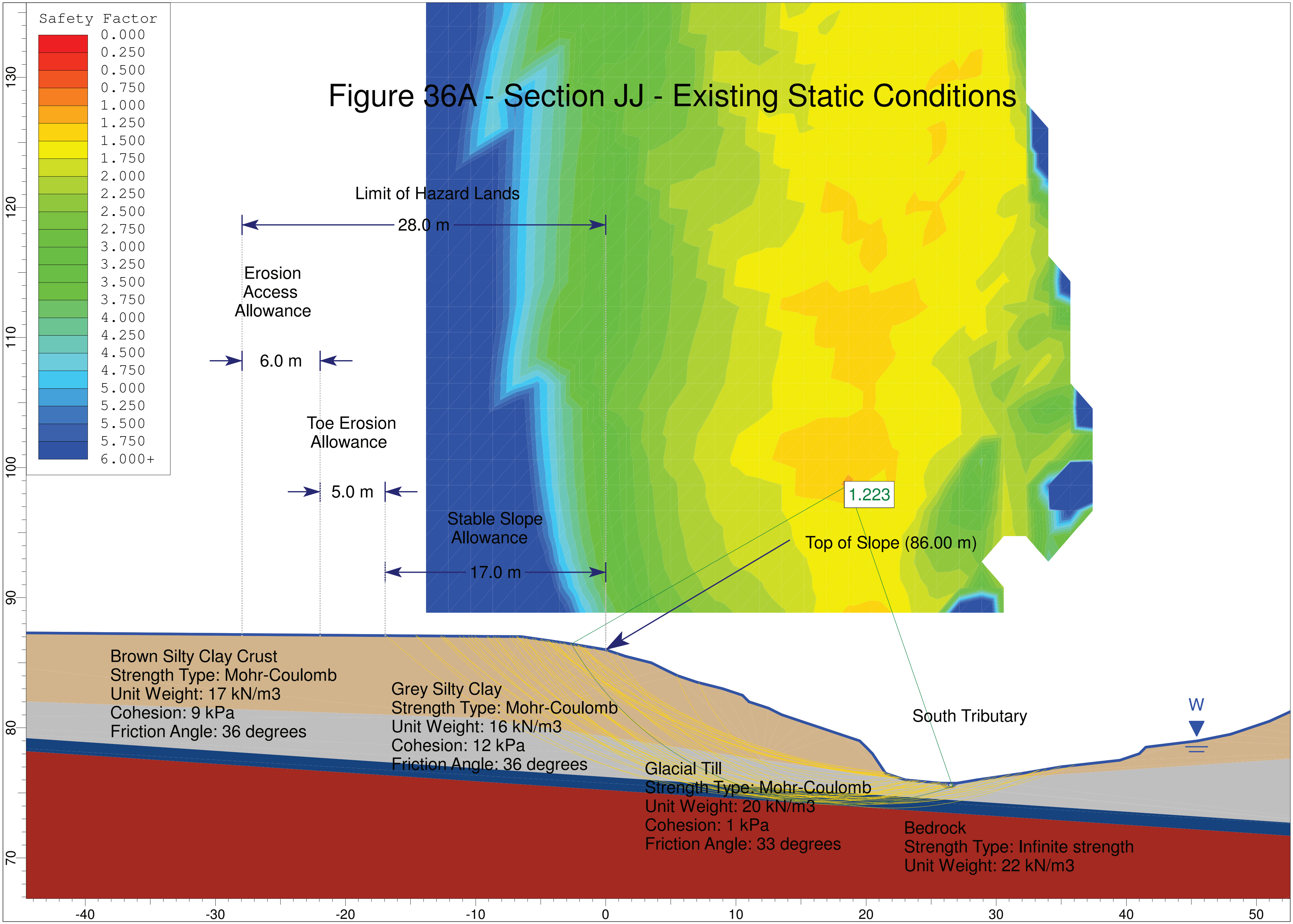
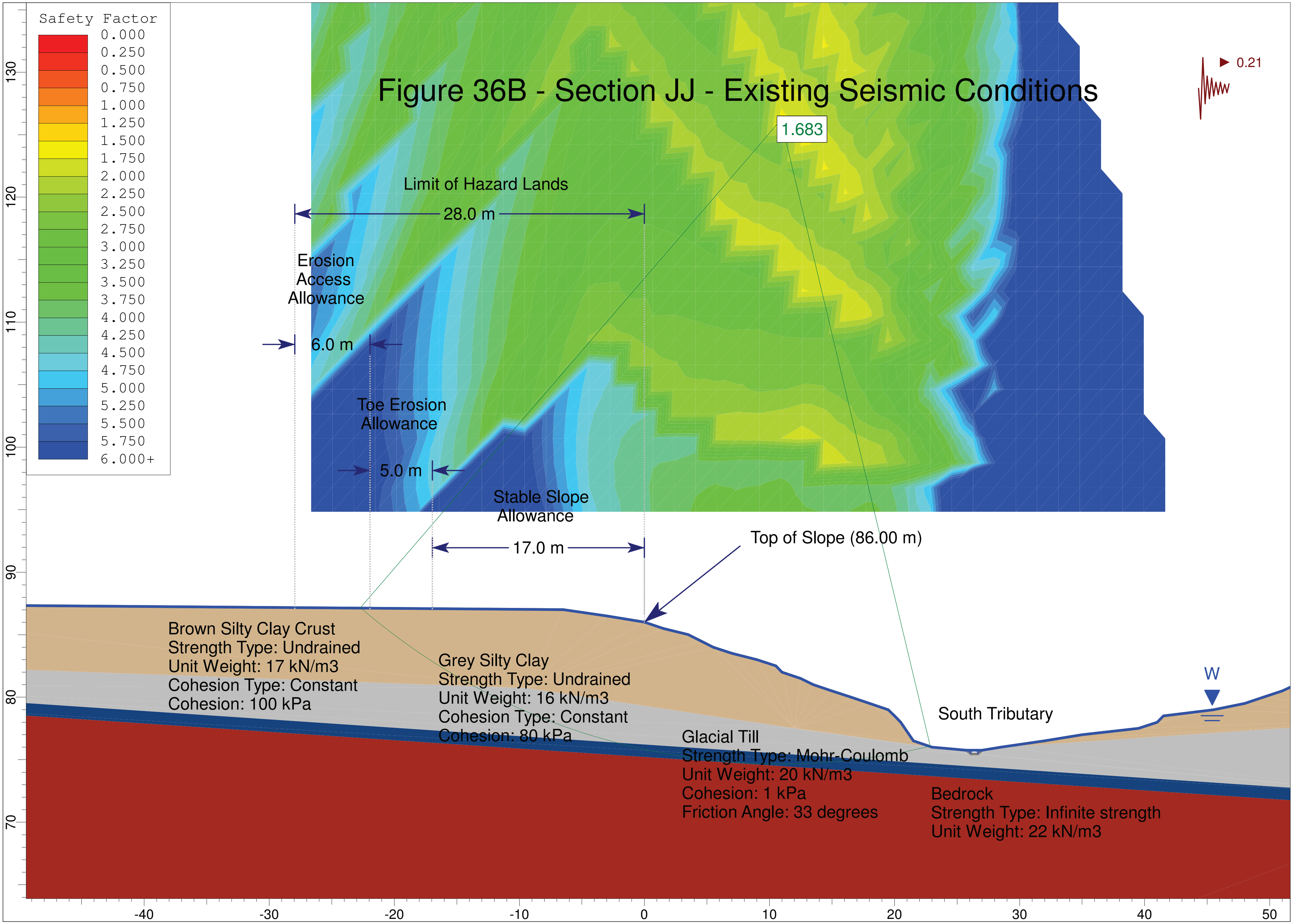


Figure 36A - Section JJ - Existing Static Conditions

Figure 36B - Section JJ - Existing Seismic Conditions



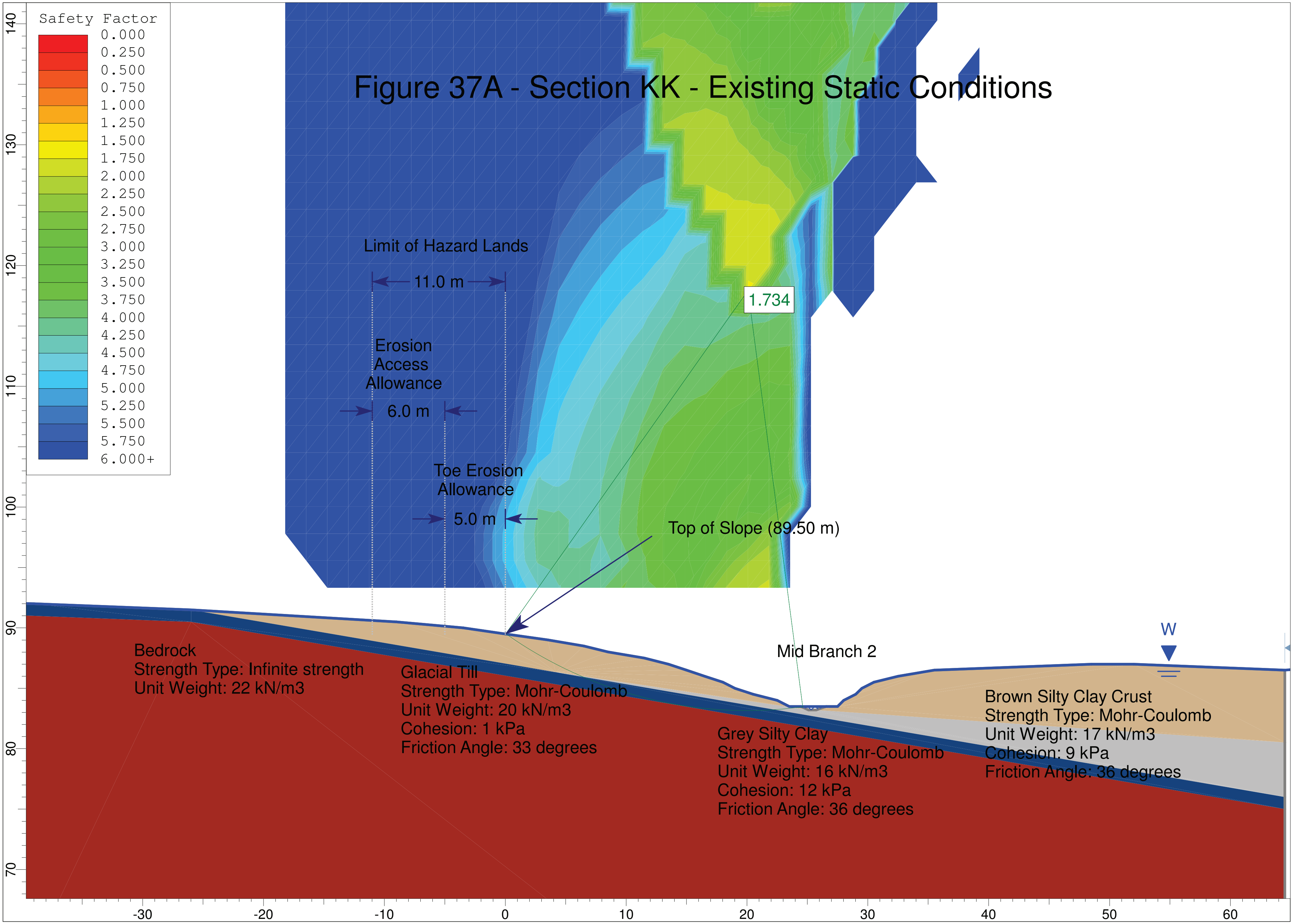
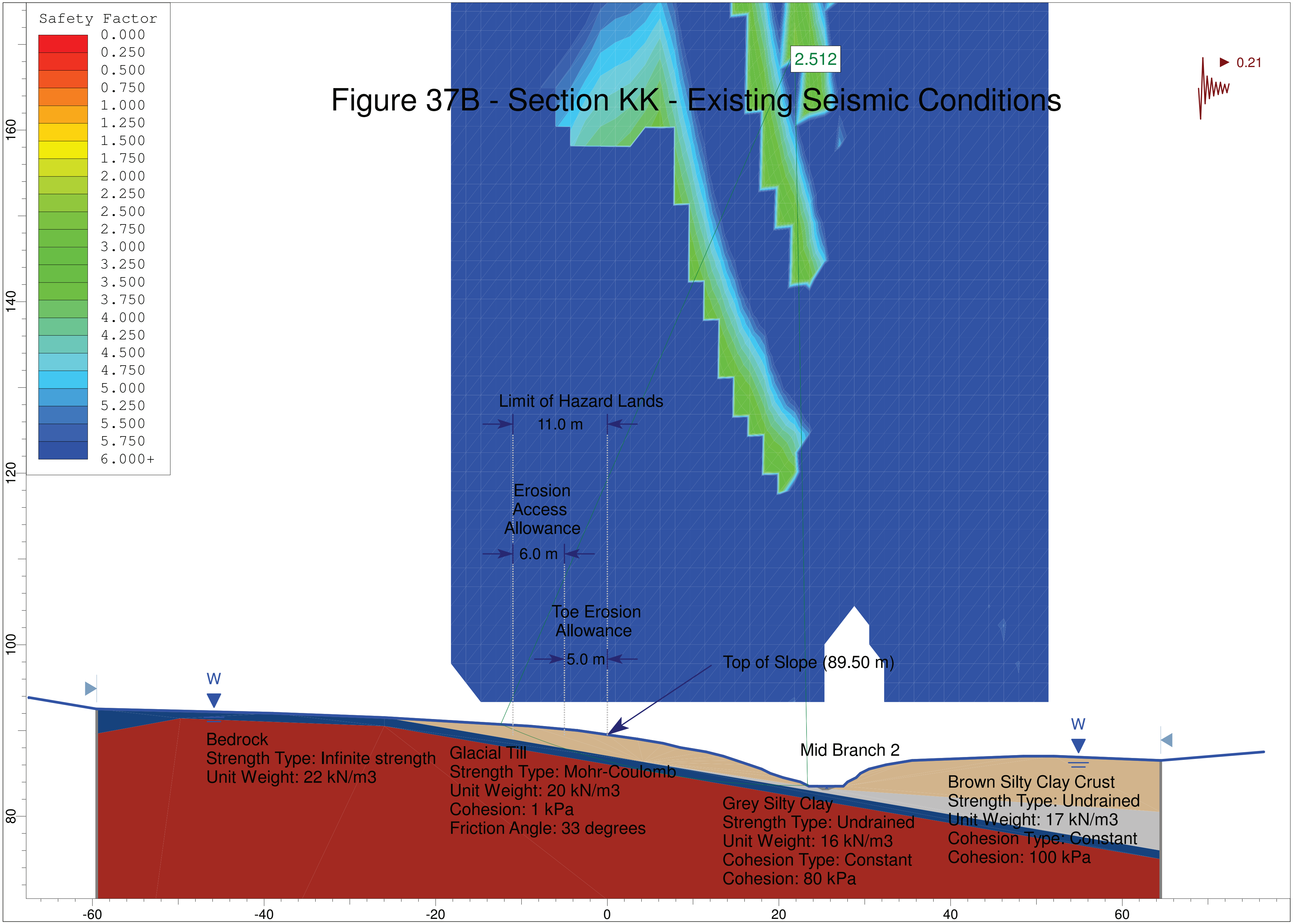


Figure 37A - Section KK - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
1.734
Top of Slope (89.50 m)
Mid Branch 2
W
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16 kN/m3
Cohesion: 12 kPa
Friction Angle: 36 degrees
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
140
130
120
110
100
90
80
70
-30
-20
-10
0
10
20
30
40
50
60

Figure 37B - Section KK - Existing Seismic Conditions



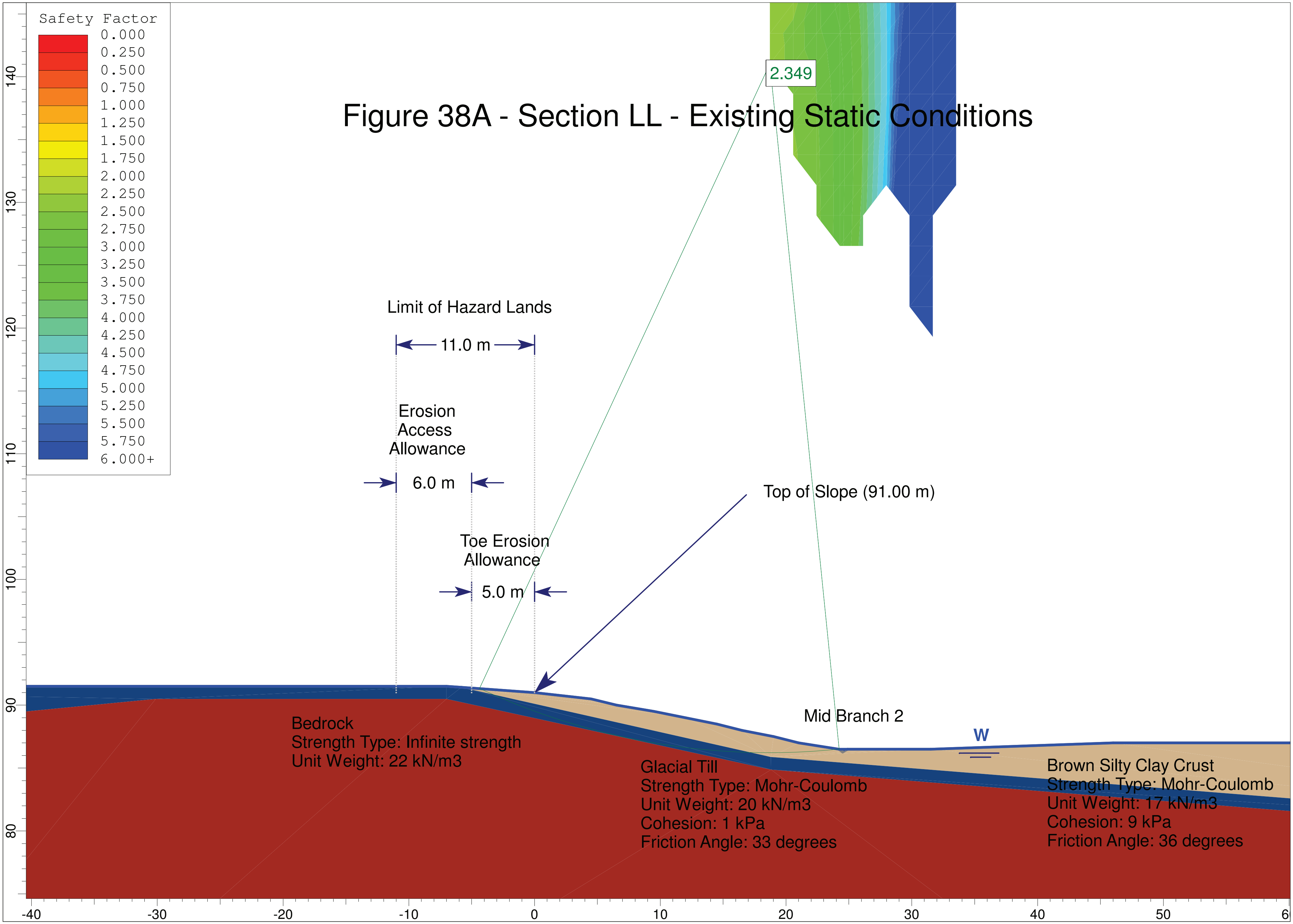
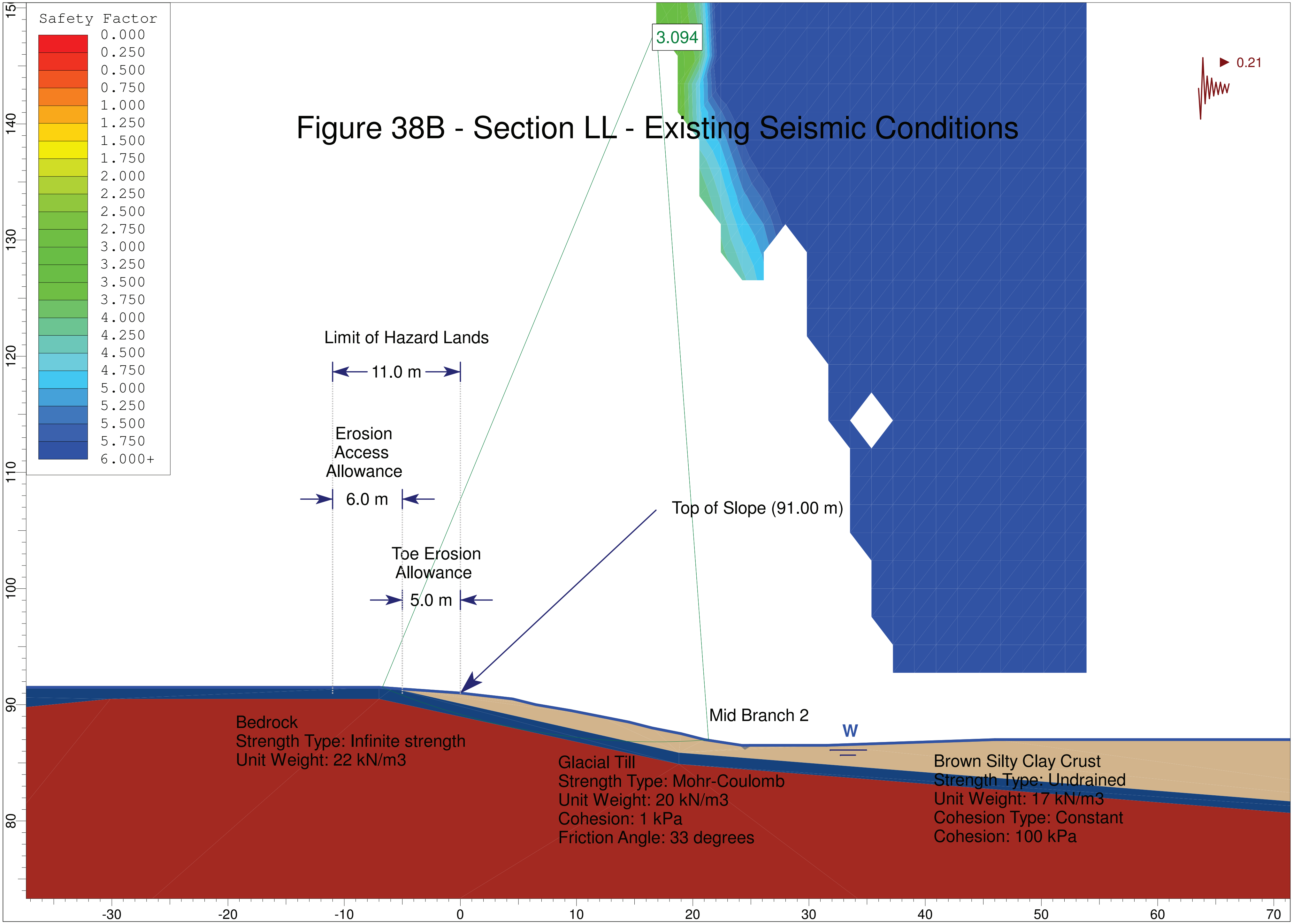


Figure 38A - Section LL - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.349
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (91.00 m)
Mid Branch 2
W
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
140
130
120
110
100
90
80
-40
-30
-20
-10
0
10
20
30
40
50
6

Figure 38B - Section LL - Existing Seismic Conditions



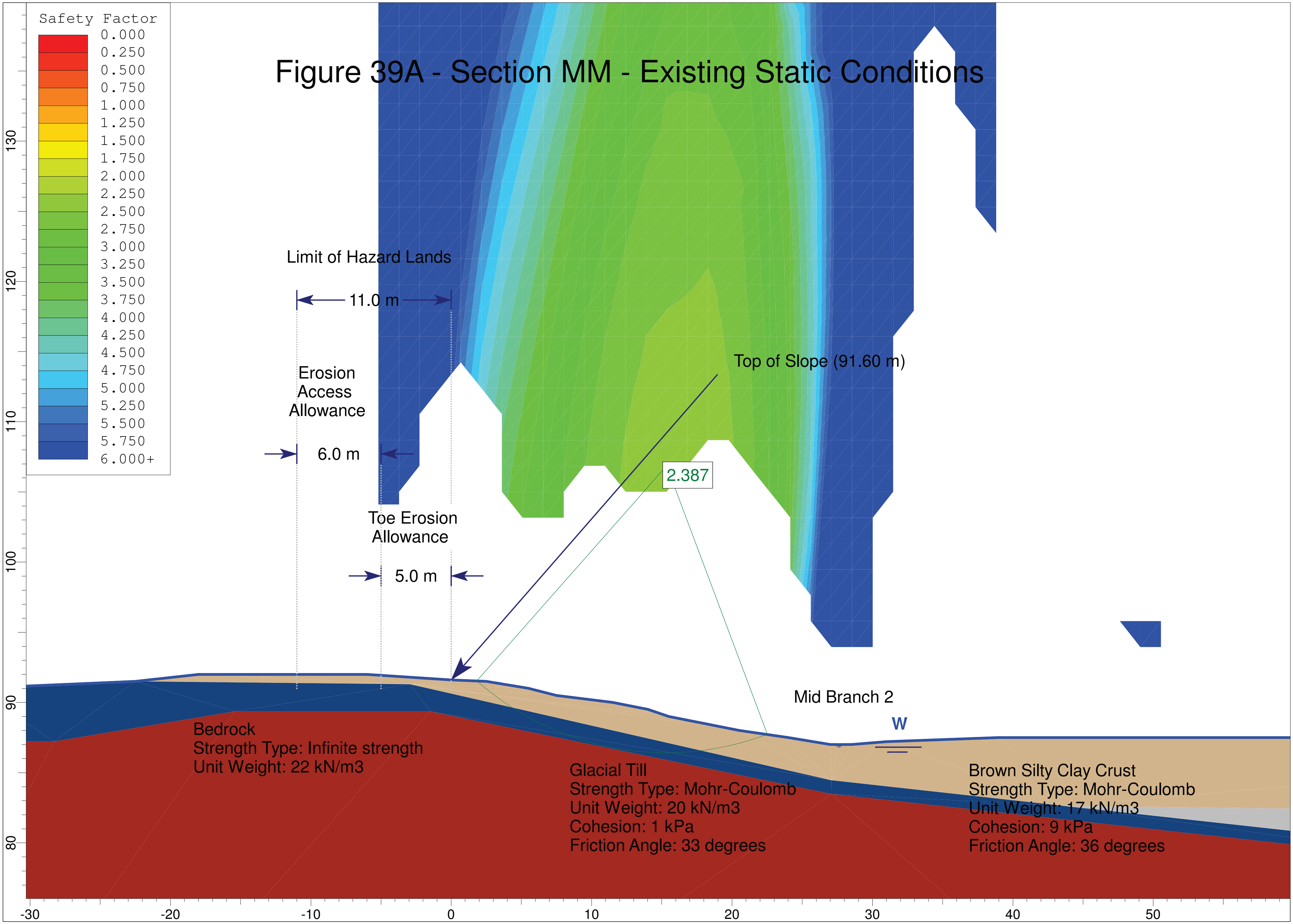


Figure 39A - Section MM - Existing Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (91.60 m)
2.387
Mid Branch 2
W
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Brown Silty Clay Crust
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 9 kPa
Friction Angle: 36 degrees
130
120
110
100
90
80
-30
-20
-10
0
10
20
30
40
50

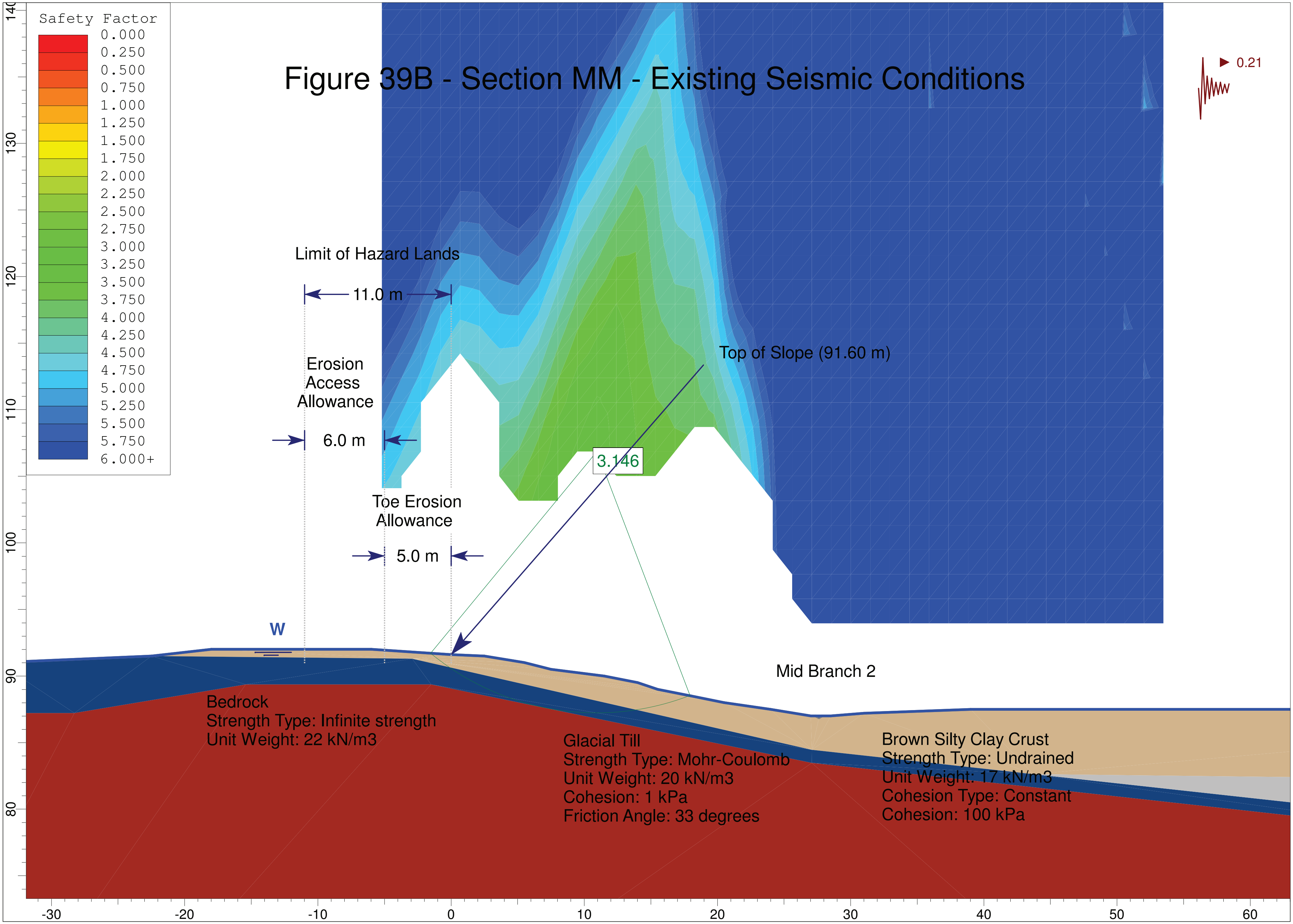
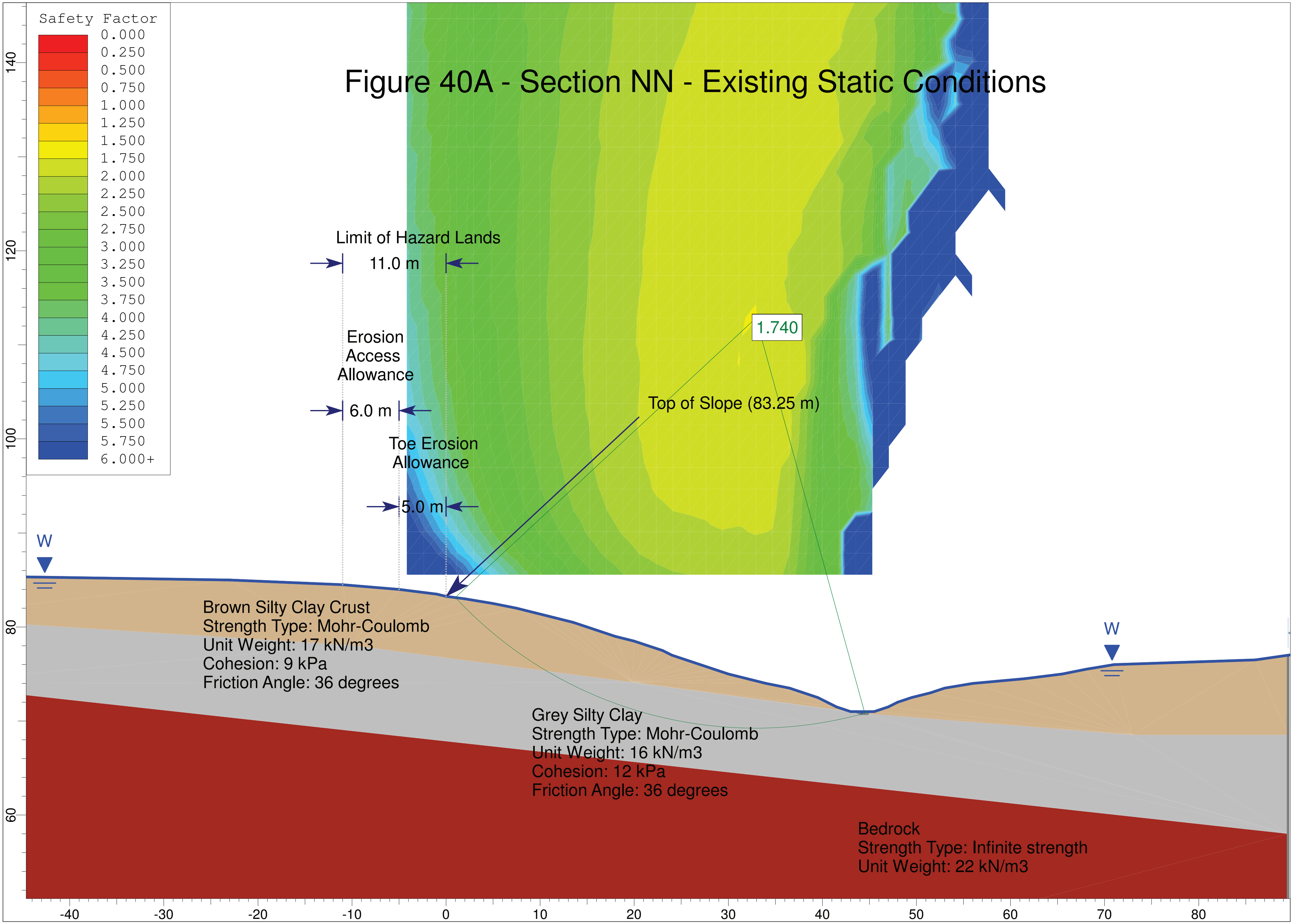


Figure 39B - Section MM - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
Limit of Hazard Lands
11.0 m
Erosion
Access
Allowance
6.0 m
Toe Erosion
Allowance
5.0 m
Top of Slope (91.60 m)
3.146
W
Mid Branch 2
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 33 degrees
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
140
130
120
110
100
90
80
-30
-20
-10
0
10
20
30
40
50
60

Figure 40A - Section NN - Existing Static Conditions



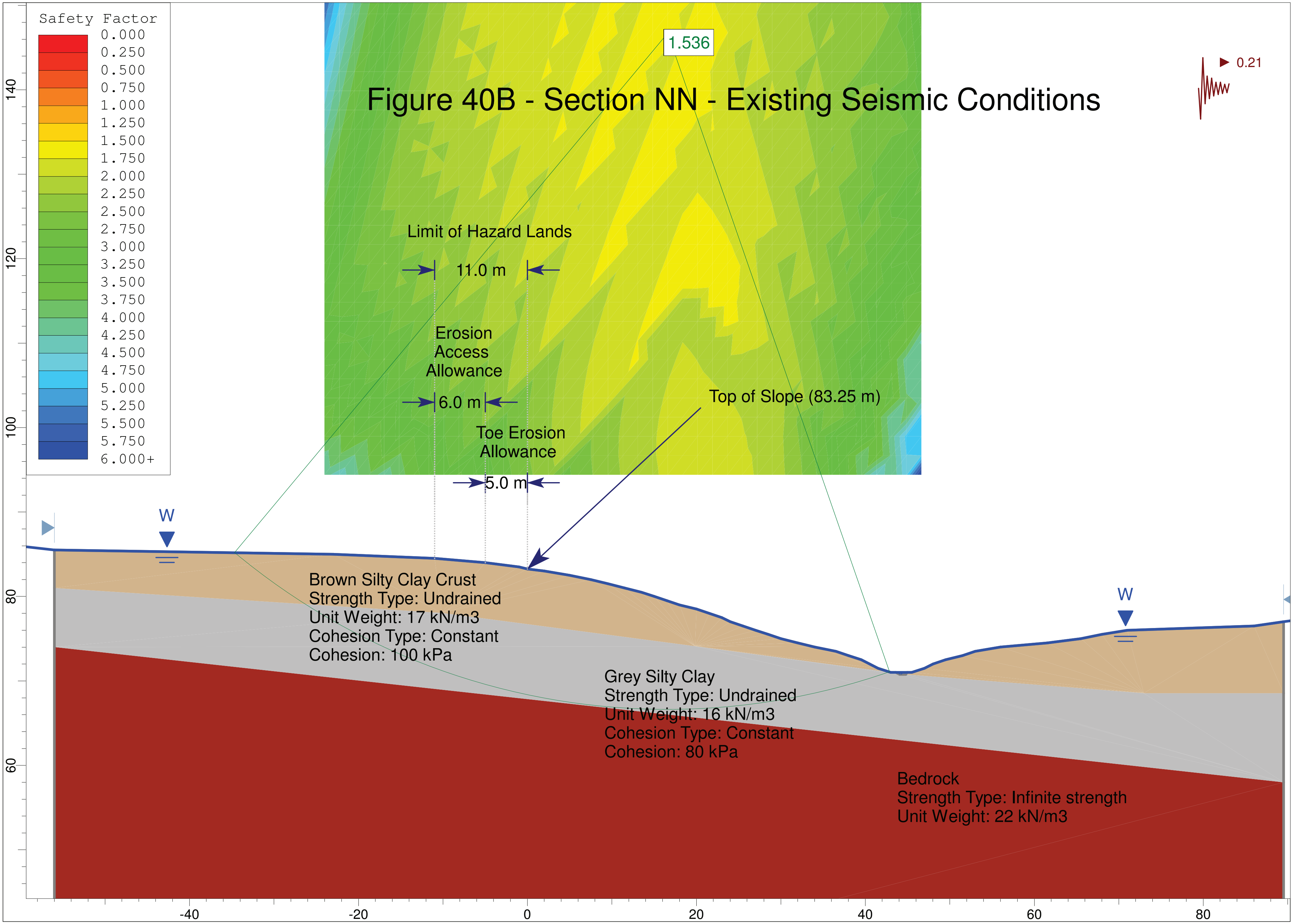
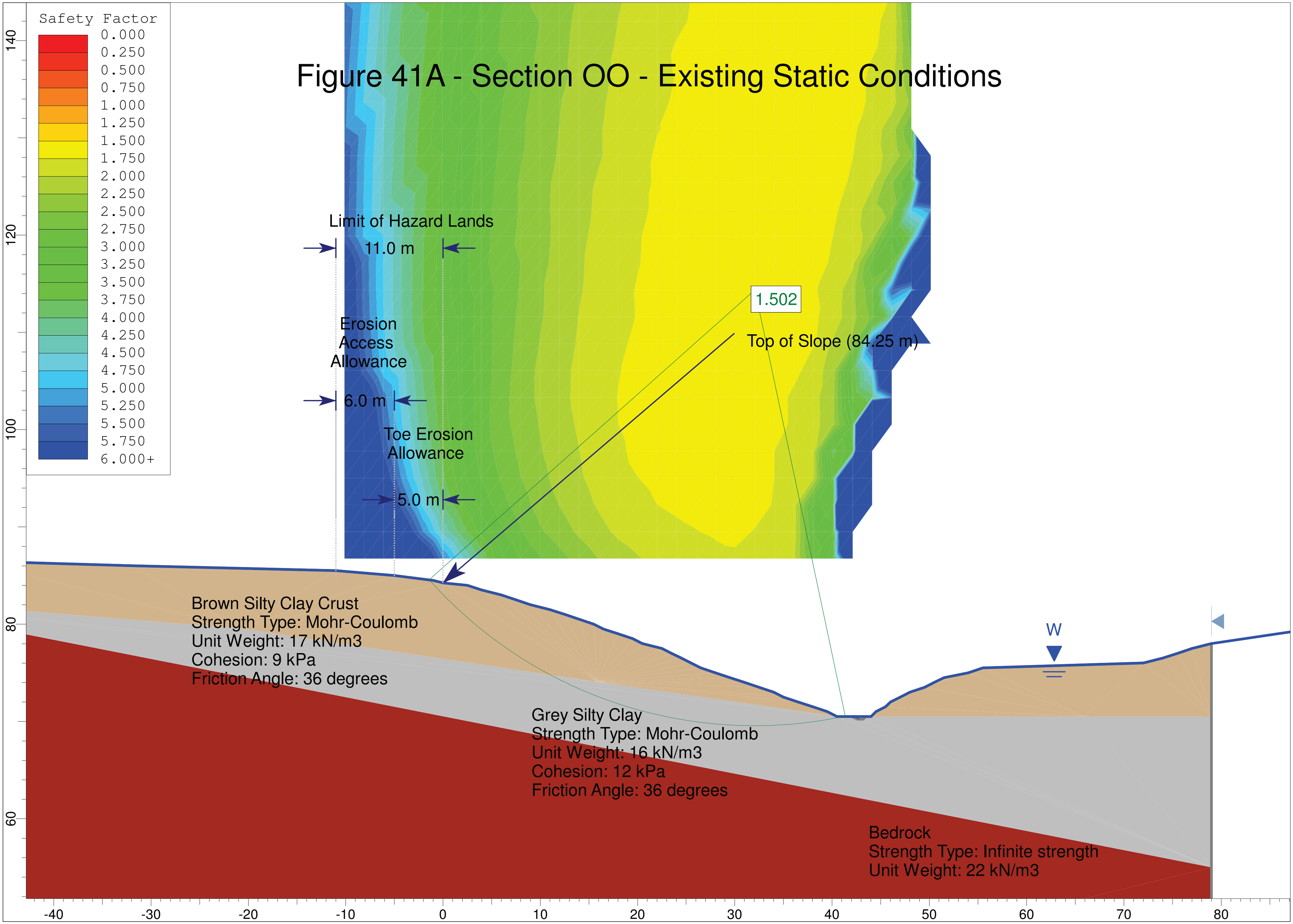


Figure 40B - Section NN - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.536
0.21
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (83.25 m)
W
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
140
120
100
80
60
-40
-20
0
20
40
60
80

Figure 41A - Section OO - Existing Static Conditions



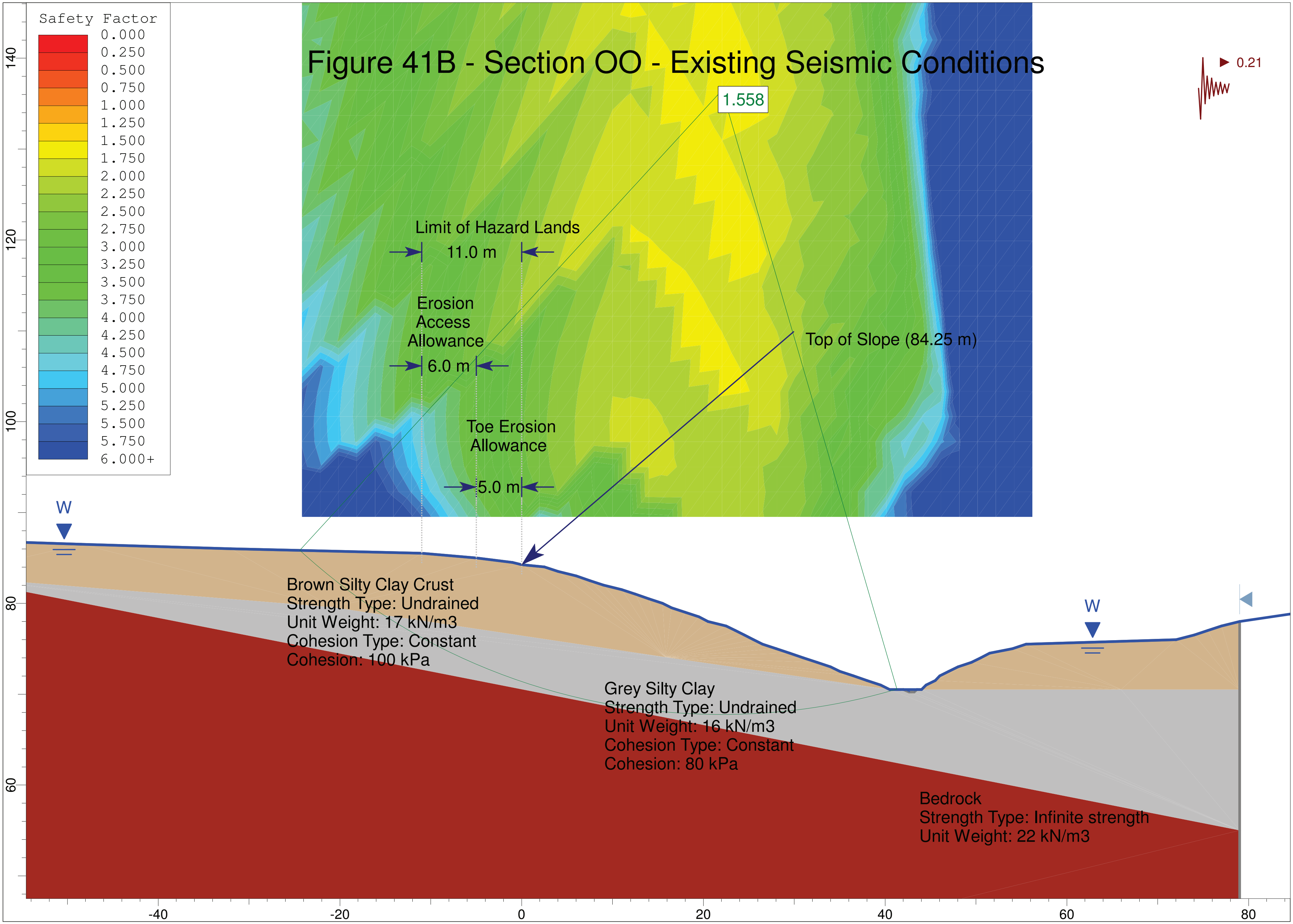
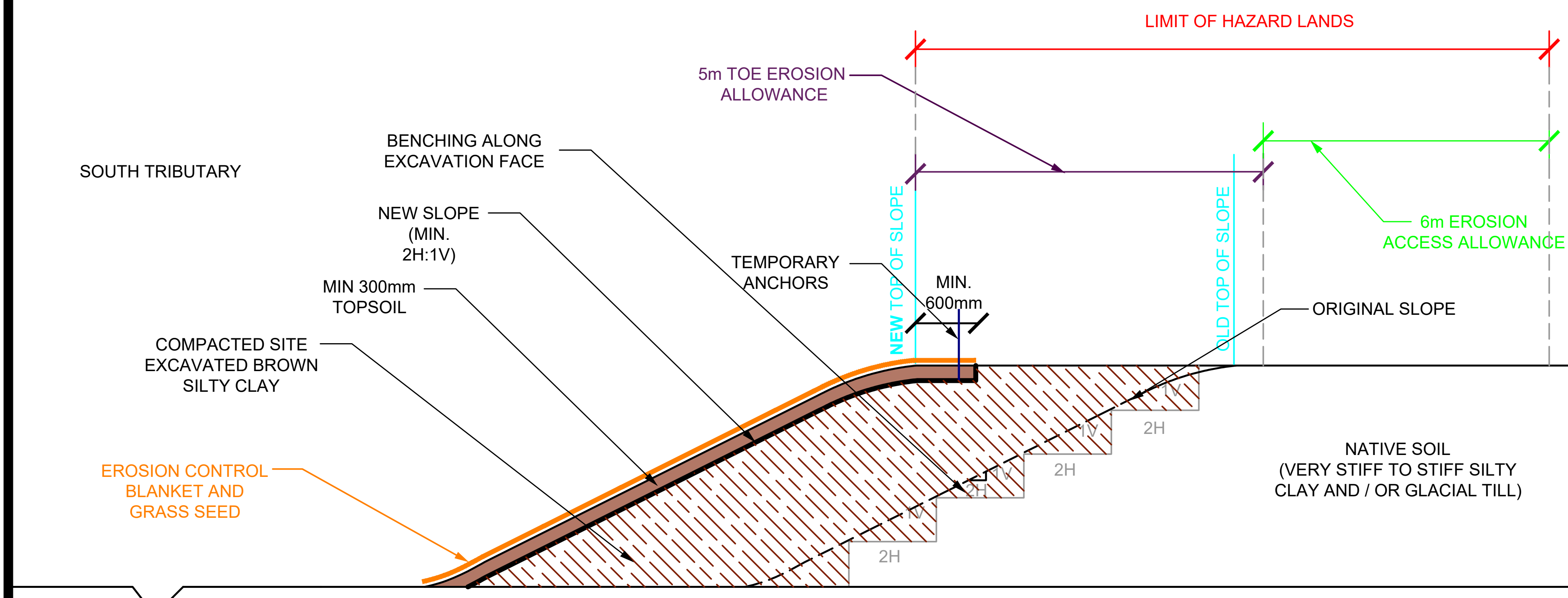


Figure 41B - Section OO - Existing Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.21
1.558
Limit of Hazard Lands
11.0 m
Erosion Access Allowance
6.0 m
Toe Erosion Allowance
5.0 m
Top of Slope (84.25 m)
W
W
Brown Silty Clay Crust
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa
Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16 kN/m3
Cohesion Type: Constant
Cohesion: 80 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
140
120
100
80
60
-40
-20
0
20
40
60
80



NOTES:

- SITE EXCAVATED MATERIAL SUCH AS WORKABLE, BROWN SILTY SAND OR ANY APPROVED SITE EXCAVATED MATERIAL, FREE OF DELETERIOUS FILL SUCH AS ORGANICS OR CONSTRUCTION DEBRIS, CAN BE USED AS BACKFILL MATERIAL TO IN-FILL CURRENT SLOPE AND EXTEND THE SLOPE FACE TO MATCH THE EXISTING ADJACENT SLOPES.
- THE EXISTING SLOPE SHOULD BE EXCAVATED IN A BENCHING STYLE WHERE EACH "BENCH" SHOULD BE EXCAVATED WITH A MINIMUM 1.2m LONG HORIZONTAL LEDGE AND MAXIMUM VERTICAL CUT OF 600mm.
- THE BACKFILL MATERIAL SHOULD BE PLACED IN MAXIMUM 300mm THICK LOSE LIFTS AND COMPACTED TO A MINIMUM 98% OF THE MATERIAL'S SPMDD USING SUITABLE COMPACTION EQUIPMENT. THE PLACEMENT OF THE BACKFILL MATERIAL SHOULD BE COMPLETED UNDER DRY CONDITIONS AND ABOVE FREEZING TEMPERATURES TO ACHIEVE OPTIMUM COMPACTION LEVELS.
- THE BACKFILL MATERIAL SHOULD BE TOPPED WITH A MINIMUM 300mm THICK LAYER OF TOPSOIL FOLLOWED BY AN EROSION CONTROL BLANKET (COCO MAT) AND HARDY GRASS SEED. THE EROSION CONTROL BLANKET SHOULD BE ANCHORED TO THE TOP OF THE SLOPE USING STEEL PINS PENETRATING THE TOP OF SLOPE BY A MINIMUM 600mm TO KEEP THE EROSION CONTROL BLANKET STABLE UNTIL VEGETATION IS ESTABLISHED.
- IT IS IMPORTANT THAT THE PROPOSED SLOPE FACE BE FINISHED TO MATCH THE ADJACENT SLOPE FACES MATERIAL AND INCLINATION. PLANTING TREES ALONG THE SLOPE FACE CAN BE BENEFICIAL TO INCREASE THE STABILITY OF THE SLOPE FACE AND MINIMIZE EROSION, IF APPLICABLE.
- ALL WORK WITHIN THE SLOPE FACE SHOULD BE REVIEWED AND APPROVED BY PATERSON AT THE TIME OF CONSTRUCTION TO ENSURE THE WORK IS BEING COMPLETED IN ACCORDANCE TO THE RECOMMENDATIONS PROVIDED HEREIN.

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TAGGART INVESTMENTS

GEOTECHINCAL INVESTIGATION
CARDINAL CREEK VILLAGE SOUTH

OTTAWA, ONTARIO

Title:

SLOPE INFILLING DETAIL

Scale: N.T.S.	Date: 04/2021
Drawn by: YA	Report No.: PG5201
Checked by: FA	Drawing No.: FIG. 42
Approved by: FA	Revision No.:

p:\autocad drawings\geotechnical\pg52xx\pg5201\pg5201-fig.42-slope infilling detail.dwg

NOTE:

THE BEDROCK CONTOURS ARE BASED ON PROBE HOLES COMPLETED AT AN APPROXIMATE SPACING OF 100m CENTRE TO CENTRE. BEDROCK MAY VARY IN DEPTH IN SOME AREAS. THE MAJORITY OF THE PROBE HOLES WERE TERMINATED AT A DEPTH OF 6.5m(DEEPER THAN ALL THE PROPOSED SERVICES). BEDROCK DEEPER THAN 6.5m MAY RANGE FROM 7 TO 12m IN DEPTH. RANDOM PROBE HOLES WERE ADVANCED TO REFUSALS WHERE BEDROCK WAS NOT ENCOUNTERED WITHIN THE UPPER 6.5m BELOW EXISTING GRADE.

LEGEND:

- BOREHOLE LOCAITON (PREVIOUS INVESTIGATION)
- PROBEHOLE LOCATION (CURRENT INVESTIGATION)
- BOREHOLE BY OTHERS LOCATION (EXP)
- 97.47 GROUND SURFACE ELEVATION(m)
- (94.78) PRACTICAL REFUSAL TO AUGERING ELEV.(m)
- [83.46] BEDROCK SURFACE ELEVATION(m)
- 94.00 BEDROCK CONTOUR (m)

TOPOGRAPHIC MAPPING FOR CITY OF OTTAWA (2005)

SCALE: 1:3000

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NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO INCLUDE BOREHOLES BY OTHERS (EXP)	05/21/2021	FA

TAGGART INVESTMENTS

GEOTECHNICAL INVESTIGATION - PROPOSED RESIDENTIAL DEVLELOPMENT
CARDINAL CREEK VILLAGE SOUTH
OTTAWA, ONTARIO

Title:

BEDROCK CONTOUR PLAN

Stamp:

Scale:	1:3000
Drawn by:	RCG
Checked by:	FA
Approved by:	FA
Date:	03/2020
Report No.:	PG5201-1
Drawing No.:	PG5201-1
Revision No.:	1

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NO.	REVISIONS	DD/MM/YYYY	INITIAL
4	UPDATED INFILL WORK AREAS	16/06/2021	FA
3	UPDATED POTENTIAL INFILL WORK AREAS	31/03/2021	FA
2	TEST PITS TP 1-21 TO TP 20-21 ADDED	05/03/2021	OM
1	NEW PHOTO LOCATION ADDED TO PLAN	14/09/2020	KP

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GEOTECHNICAL INVESTIGATION - PROPOSED RESIDENTIAL DEVLELOPMENT
CARDINAL CREEK VILLAGE SOUTH
OTTAWA, ONTARIO

Stamp:

Title:

TEST HOLE LOCATION PLAN

Scale:	1:2000
Drawn by:	RCG
Checked by:	FA
Approved by:	FA
Date:	08/2020
Report No.:	PG5201-1
Drawing No.:	PG5201-2
Revision No.:	4

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NO.	REVISIONS	DATE	INITIAL

TAGGART INVESTMENTS

GEOTECHNICAL INVESTIGATION - PROPOSED RESIDENTIAL DEVLELOPMENT
CARDINAL CREEK VILLAGE SOUTH
OTTAWA, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Stamp:

Scale:	1:3000
Drawn by:	RCG
Checked by:	FA
Approved by:	FA
Date:	03/2020
Report No.:	PG5201-1
Drawing No.:	PG5201-3
Revision No.:	