

April 20, 2010  
File: PG1887-LET.01R

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Environmental Engineering  
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Geological Engineering  
Materials Testing  
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Attention: **Mr. Adam Thompson**

Subject: **Slope Stability Analysis**  
**2175 Prince of Wales Drive**  
**Ottawa, Ontario**

[www.patersongroup.ca](http://www.patersongroup.ca)

Dear Sir,

Further to your request, Paterson Group (Paterson) has conducted a slope stability analysis and determined the limit of hazard lands for the aforementioned site. The limit of hazard lands for the subject site extends along the west side of the Rideau River and along the south side of a ravine containing a tributary watercourse to the Rideau River. The present letter summarizes our findings.

The subject site is presently undeveloped and has an approximate area of 3.23 hectares. The majority of the subject site is grassed covered and slopes gradually downward to the west towards the Rideau River. The subject site is bordered by a ravine to the north, the Rideau River to the east, Waterbend Lane followed by residential housing to the south and Prince of Wales Drive to the west. A topographic survey was completed by Paterson to provide spot grade elevations across the subject site and two (2) slope cross sections for our slope stability analysis. A previous geotechnical investigation was completed by John D. Paterson and Associates (JDPA) for the subject site with the findings presented under cover Report S2853-83 dated December 30, 1983.

### **1.0 Existing Slope Conditions and Soils Information**

The south valley corridor wall of the drainage ravine along the north property boundary was noted to be vegetated with small brush and signs of erosion occurring at several localized outbends in the watercourse/creek channel. A 2 to 3 m wide watercourse was noted to meander throughout the valley corridor. The water depth was noted to vary between approximately 0.2 to 0.3 m.

Along the east property boundary, the west valley corridor wall of the Rideau River is undergoing active erosion within several areas, the slope was noted to have been undercut at the toe. It is expected that historical erosional activities have resulted in currently observed steep back scarp slope. Currently, the majority of the bank was vegetated with small brush and full grown trees (mainly deciduous).

The subsurface soil profile used for the slope stability analysis was based on existing test hole information and available geological mapping in the immediate area of the subject site. Generally, the soil profile at the test hole locations placed within the subject site, consists of a thin layer of topsoil overlying a sandy silt layer followed by a 1 to 3 m thick very stiff brown silty clay deposit. The silty clay layer was underlain by a sandy silt to silty sand deposit extending beyond a 12 m depth. Based on nearby borehole locations, glacial till was encountered at 18 to 20 m followed by bedrock at 25 to 30 m below ground surface. Based on available geological mapping, the bedrock surface in this area is encountered at depths varying between 15 to 25 m and consists of dolomite of the Oxford formation.

## **2.0 Slope Stability Analysis**

The slope stability analysis was completed using the topographical survey, as well as, a current slope condition review by Paterson field personnel. Two (2) slope cross-sections were studied as the worst case scenarios. The cross section locations are presented on Drawing PG1887-1 - Site Plan attached to the present letter.

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.

Subsoil conditions at the cross-sections were inferred based on the findings at nearby borehole locations and general knowledge of the area's geology.

The results for the existing slope conditions under static loading at Sections A and B are shown in Figures 1 and 3, respectively, attached to the present letter. The overall slope stability factors of safety for the subject sections were found to be less than 1.5. The stable slope allowance from top of slope required for a slope with a minimum factor of safety of 1.5 is identified for each profile in the attached figures.

### **Seismic Loading Analysis**

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

The results of the analyses including seismic loading are shown in Figures 2 and 4 for the slope sections. Where the minimum factor of safety is less than 1.1, the stable slope allowance from top of slope required for the slope section is identified in the attached figures.

### **3.0 Limit of Hazard Lands**

The limit of hazard lands includes a stable slope allowance taken from top of slope. The limit of hazard lands also includes a toe erosion and a 6 m erosion access allowance. The various allowances and the overall limit of hazard lands for the subject site are indicated on Drawing PG1887-1 - Site plan attached to the present letter.

The toe erosion allowance for the slopes was based on the nature of the soils, the observed current erosional activities and the width and location of the current watercourse. Signs of erosion were noted in areas where the existing watercourse has meandered in close proximity to the toe of the corridor wall of the north neighbouring tributary watercourse. It is considered that a toe erosion allowance of 5 m is appropriate for the tributary watercourse.

Some erosional activities were noted along the toe of the subject valley corridor wall for the Rideau River. It is considered that a toe erosion allowance of 8 m is appropriate for the subject slope along the Rideau River.

#### 4.0 Recommendations

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

#### 5.0 Statement of Limitations

The information gathered for this report is based on a soils investigation, which 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 that we be notified immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Mr. Scott Thomson or Novatech Engineering or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

We trust that this letter satisfies your requirements.

Sincerely,

**Paterson Group Inc.**



Richard Groniger, Technologist.

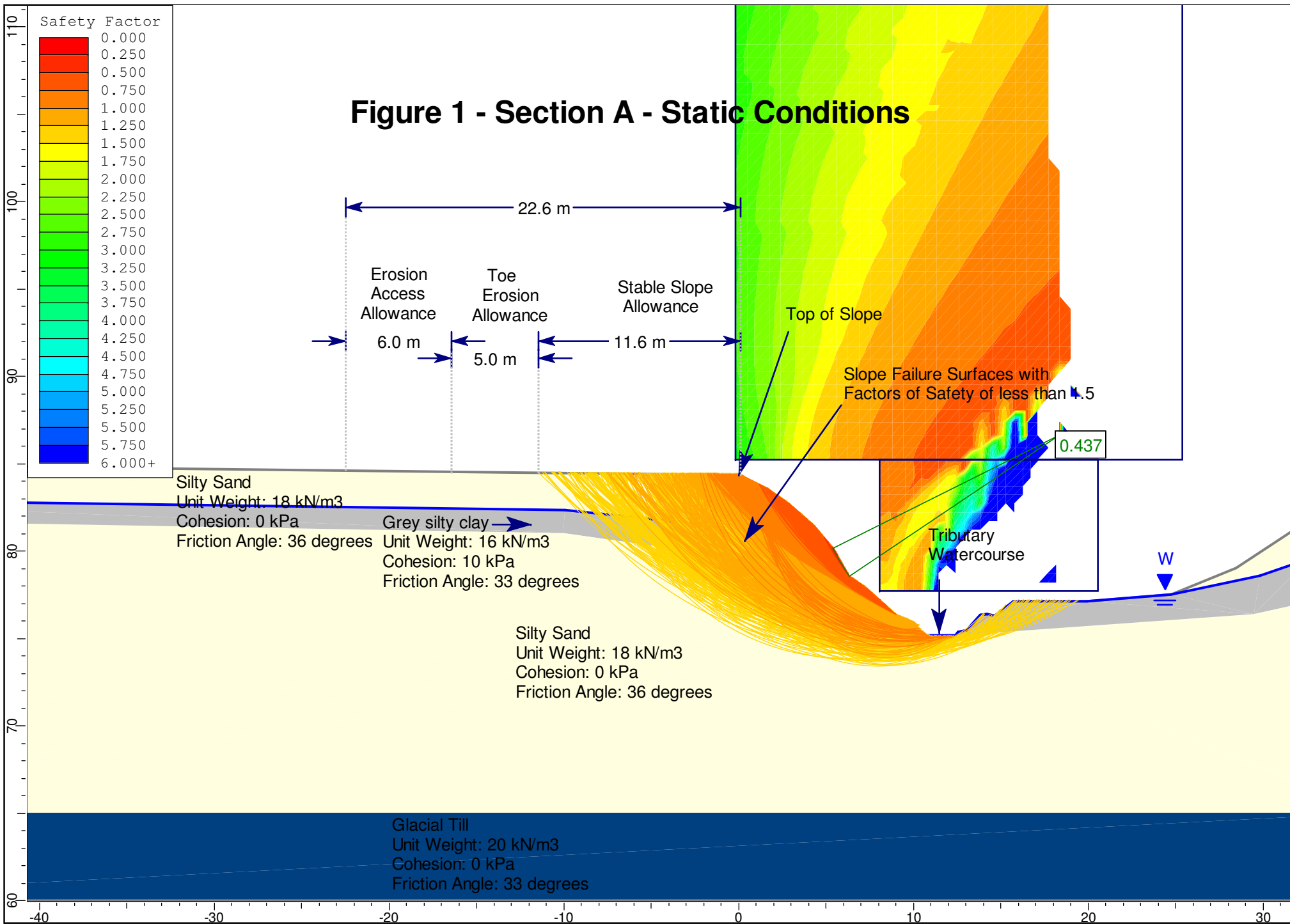


David J. Gilbert, P.Eng.

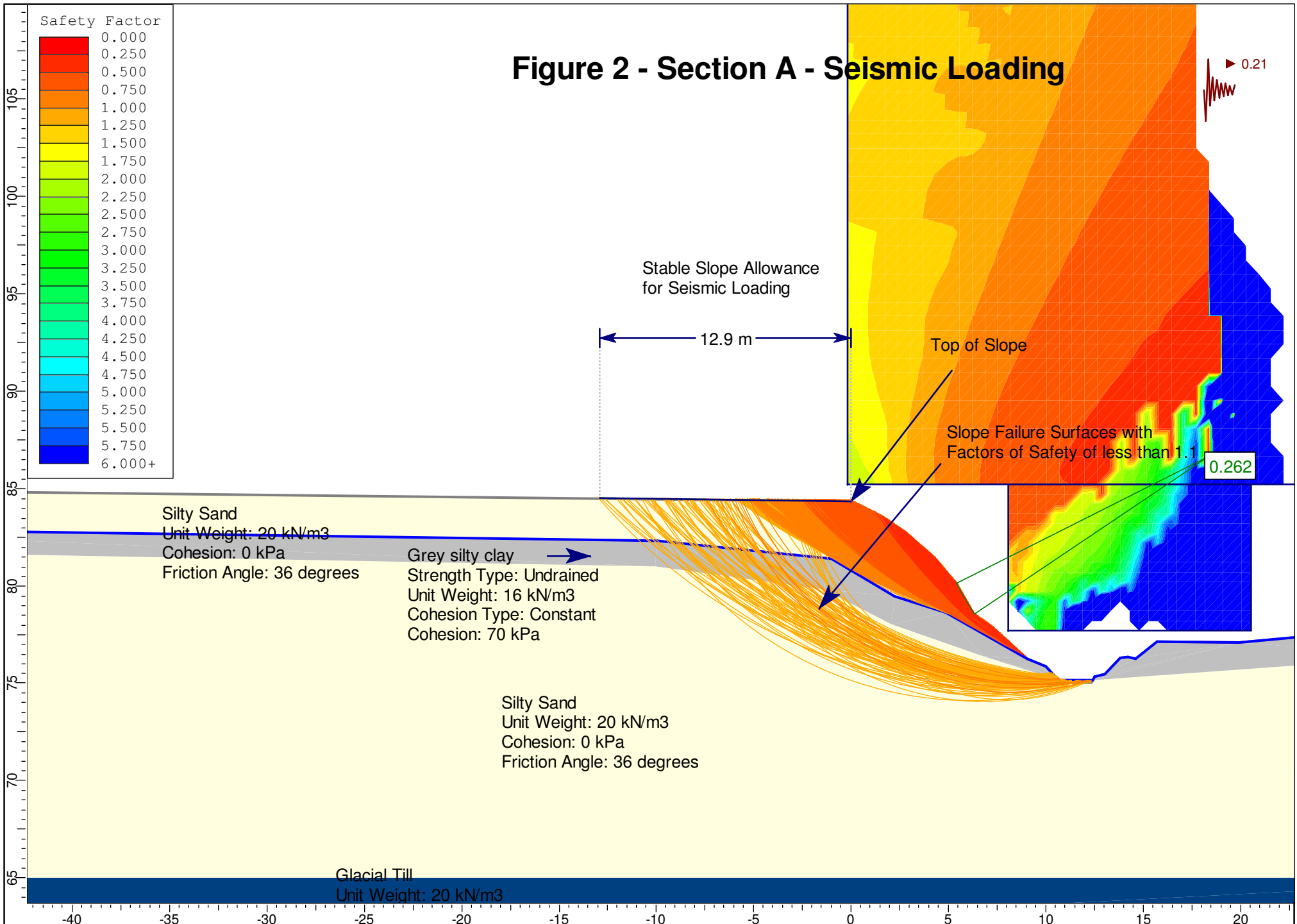
**Attachments:**

- Figures 1 to 4 - Slope Stability Analysis
- Soil and Profile Test Data sheets (JDPA)
- Drawing PG1887-1 - Site Plan

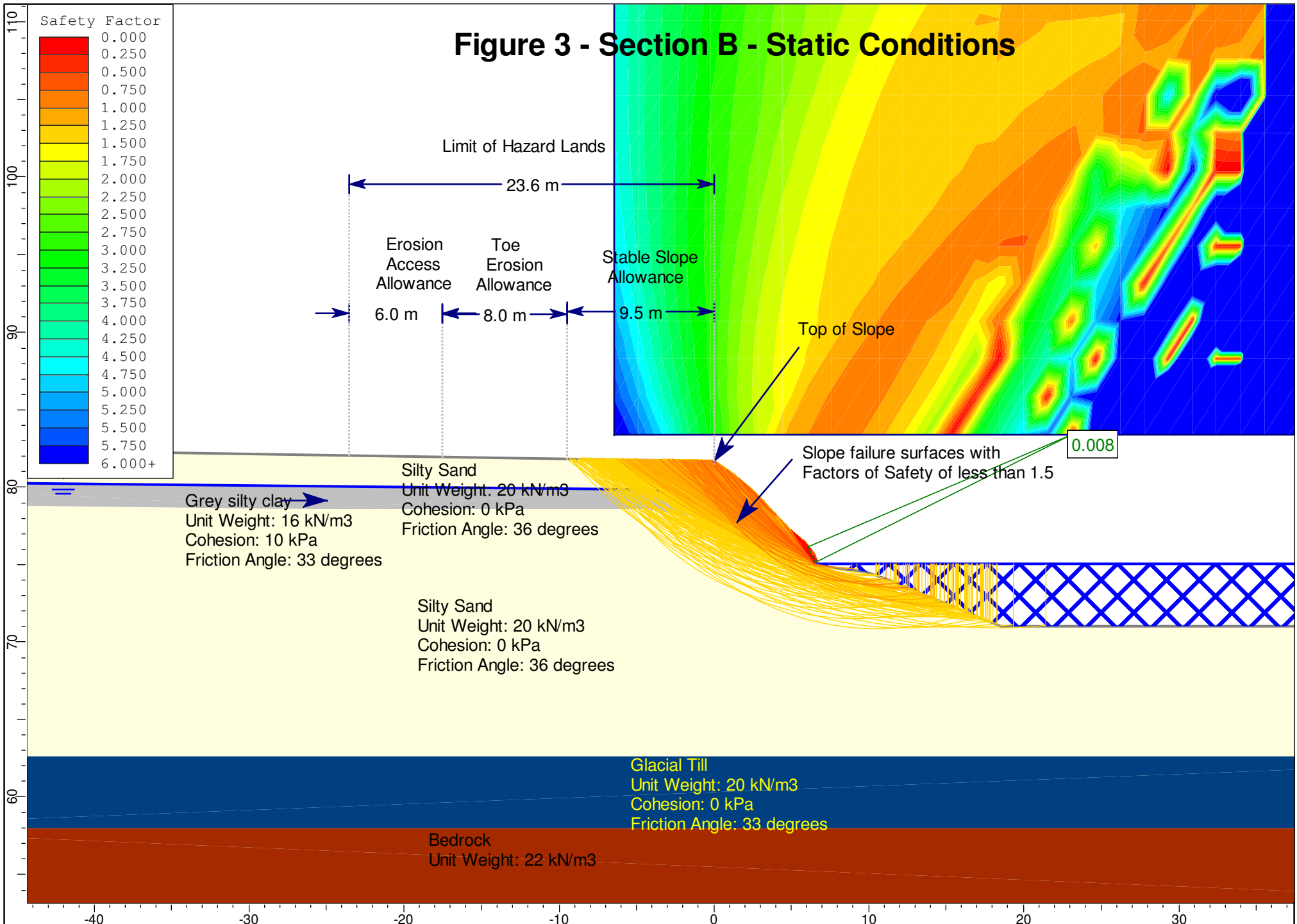
# Figure 1 - Section A - Static Conditions

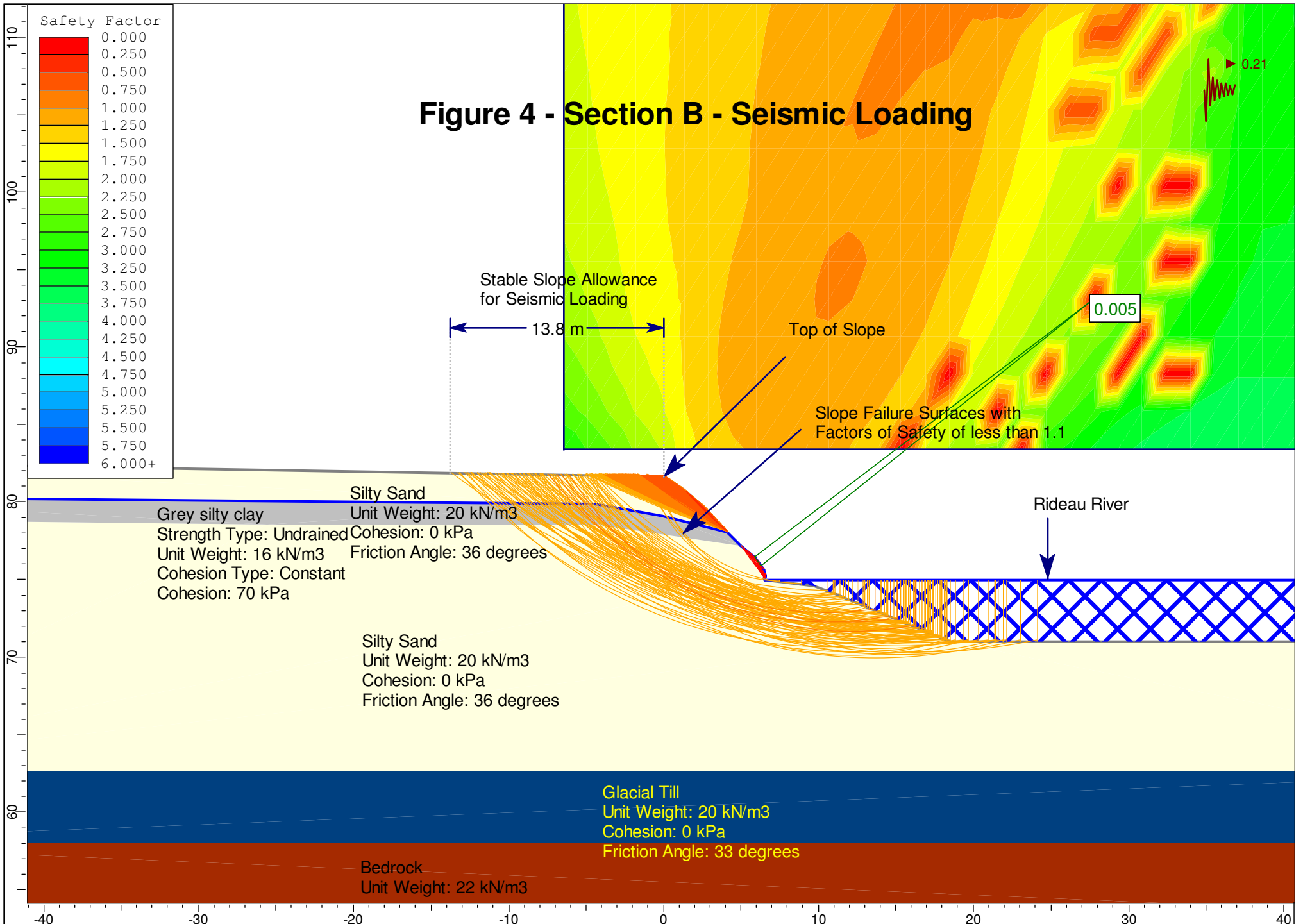


# Figure 2 - Section A - Seismic Loading



# Figure 3 - Section B - Static Conditions







**SOIL PROFILE AND TEST DATA**

Proposed Residential Subdivision  
 South 1/2 Lot 26, Concession "A", R.F.  
 Nepean, Ontario

**JOHN D. PATERSON & ASSOCIATES LTD.**  
 Consulting Engineers & Geologists  
 Soil Investigations  
 Inspection & Testing Services  
 Damage Claims

Offices & Laboratory  
 1479 Laperrriere Ave.  
 Ottawa, Canada K1Z 7S8  
 Telephone (613) 728-3505

SHEET NO. 1 OF 3  
 HOLE NO. BH 1  
 GROUND SURFACE 86.04 BOTTOM HOLE 73.84  
 BEDROCK GROUNDWATER DRY

| DESCRIPTION   | LEGEND | SAMPLE TYPE | SAMPLE NUMBER | ELEV. DEPTH | WATER CONTENT % | UNIT WEIGHT kN/m <sup>3</sup> | SHEAR STRENGTH (kPa) |           | STANDARD (N) WATER PENETRATION TEST LEVEL |            |
|---|--------|-------------|---------------|-------------|-----------------|-------------------------------|----------------------|-----------|---|------------|
|   |        |             |               |             |                 |                               | UNDISTURBED          | REMOULDED | OPEN PENETRATION RESISTANCE               | RESISTANCE |
| Ground Surface  |        | G           | 1             | 86.04       |                 |                               |                      |           |   |            |
| 250 mm TOPSOIL over a compact grey interbedded FINE SAND and SANDY SILT 0.8                             |        | SS          | 2             | 0.80        |                 |                               |                      |           |   |            |
| Very stiff to stiff fissured olive grey SILTY CLAY with pinkish grey banding containing fine sand seams |        | TW          | 3             | 1.60        |                 |                               |                      |           |   |            |
|   |        |             | 4             | 2.40        |                 |                               |                      |           |   |            |
|   |        |             | 5             | 3.20        |                 |                               |                      |           |   |            |
| Compact brown SILTY FINE SAND containing clayey silt seams approximately 5 mm thick                     |        | SS          | 7             | 4.00        |                 |                               |                      |           |   |            |
|   |        |             | 8             | 4.80        |                 |                               |                      |           |   |            |
| Very dense grey SANDY SILT containing silty fine sand seams   |        | SS          | 10            | 5.60        |                 |                               |                      |           |   |            |
|   |        |             | 11            | 6.40        |                 |                               |                      |           |   |            |
| Dense pale grey FINE SAND with some hairlike black banding. Becoming coarser with depth.                |        | SS          | 12            | 7.20        |                 |                               |                      |           |   |            |
|   |        |             | 13            | 7.80        |                 |                               |                      |           |   |            |
|   |        |             | 14            | 8.00        |                 |                               |                      |           |   |            |
|   |        |             | 15            | 8.80        |                 |                               |                      |           |   |            |
| Borehole terminated in sand   |        | SS          | 16            | 9.60        |                 |                               |                      |           |   |            |
|   |        |             | 17            | 10.40       |                 |                               |                      |           |   |            |
|   |        |             | 19            | 11.20       |                 |                               |                      |           |   |            |
|   |        |             | 20            | 12.00       |                 |                               |                      |           |   |            |



**SOIL PROFILE AND TEST DATA**

Proposed Residential Subdivision  
 South 1/2 Lot 26, Concession "A", R.F.  
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SHEET NO. 2 OF 3  
 HOLE NO. BH 2

GROUND SURFACE 80.59 BOTTOM HOLE 71.59  
 BEDROCK \_\_\_\_\_ GROUNDWATER DRY

| DESCRIPTION  | LEGEND | SAMPLE TYPE | SAMPLE NUMBER | ELEV. (m) | DEPTH (m) | WATER CONTENT     |             | UNIT WEIGHT<br>kN/m <sup>3</sup> | SHEAR STRENGTH (kPa) |                        | STANDARD (N) WATER PENETRATION TEST LEVEL |
|--|--------|-------------|---------------|-----------|-----------|-------------------|-------------|----------------------------------|----------------------|------------------------|---|
|  |        |             |               |           |           | WATER CONTENT (%) | UNDISTURBED |                                  | REMOULDED            | PENETRATION RESISTANCE |   |
| Ground Surface   |        |             |               | 80.59     |           |                   |             |                                  |                      |                        |   |
| 300 mm TOPSOIL over a loose brown SANDY SILT interbedded with layers of clayey silt and fine sand. |        | G 21        |               | 0.00      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 22       |               | 0.80      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 23       |               | 1.60      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 24       |               | 2.40      |           |                   |             |                                  |                      |                        |   |
| Stiff fissured olive grey SILTY CLAY   |        | SS 25       |               | 3.20      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 26       |               | 4.00      |           |                   |             |                                  |                      |                        |   |
| Compact grey FINE SANDY SILT with a trace of clay  |        | TW 27       |               | 4.80      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 28       |               | 5.60      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 29       |               | 6.40      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 30       |               | 7.20      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 31       |               | 8.00      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 32       |               | 8.80      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 33       |               | 9.60      |           |                   |             |                                  |                      |                        |   |
|  |        | SS 34       |               | 10.40     |           |                   |             |                                  |                      |                        |   |
| Dense light brown to grey SILTY FINE SAND  |        |             |               |           |           |                   |             |                                  |                      |                        |   |
| Borehole terminated in silty fine sand   |        |             |               |           |           |                   |             |                                  |                      |                        |   |

(psf) 1000 2000 3000 BLOWS/0.3m.

