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June 7, 2024

File: 100143.003

Geofirma Engineering Ltd.
200 - 1 Raymond Street
Ottawa, Ontario
K1R 1A2

Attention: Glen Briscoe

Re: Slope Stability Assessment
Proposed Residential Development
788 March Road, Ottawa, Ontario

This letter presents the results of a slope stability assessment carried out for a proposed residential development to be located at 788 March Road, Ottawa, Ontario.

The purpose of the slope stability assessment was to assess whether there is potential for slope instability at the site associated with the construction and establish the 'Erosion Hazard Limit' for the site in accordance with the Natural Hazard Policies set forth in Section 3.1 of the Provincial Policy Statements of the Planning Act of Ontario. The 'Erosion Hazard Limit' constitutes a safe setback, from a slope stability perspective, for any future development adjacent to the slope. In addition, the planned retaining wall outside the planning garage entrance was to be assessed for global stability.

This report is subject to the Conditions and Limitations of This Report, which follows the text of the report, and which are considered an integral part of the report.

DESCRIPTION OF SITE AND SLOPE

Site Location and Background Information

The site is located at 788 March Road in Ottawa, Ontario and is bordered by March Road to the west, Shirleys Brook to the east, Klondike road to the north and existing 3- storey dwellings to the south. The property is approximately rectangular in shape, is currently vacant with portions containing shrubs, mature trees, the surface is generally flat, with a sloping portion along the Shirleys Brook which is flowing from the southeast to the northwest beyond the property boundary. The site location is shown on Figure 1 (attached).

Based on the borehole logs from the geotechnical investigation previously carried out by Geofirma, the subsurface conditions at the site consist of topsoil/organics overlying a layer of weathered silty clay overlying grey silty clay, which in turn overlies bedrock. The borehole logs

indicate that the site is underlain by sandstone or dolostone bedrock of the March Formation at depths ranging between about 4.3 and 5.6 metres below ground surface.

Proposed Development

It is understood that the proposed development will consist of a six storey residential building with two underground parking levels. Details of the proposed development were provided to GEMTEC via a series of drawings prepared by SINA, dated February 2024. These drawings included a site plan with topographic survey data and showing the proposed positioning of the structures on the site, as well as elevation and plan views of the proposed structures. A site grading plan was not provided at the time of the geotechnical investigation; however, it is understood a grading plan is being prepared at this time.

Using the topographic data provided in the site plan "plan of survey with topographic information of Part of Lot 10 Concession 4, geographic township of March, City of Ottawa", dated January 2024, prepared by J.D. Barnes, the following three slope sections shown in Table 1 were considered.

Table 1 – Slope Cross Section Height and Slope Inclination

Cross Section	Approximate Slope Height (metres)	Overall inclination from horizontal (degrees)
A-A	2.5	5
B-B	2.5	5
C-C	2.7	5

SLOPE STABILITY ASSESSMENT

Stability Analysis and Results

The slope stability analysis was carried out at Section A-A', B-B', and C-C' using Slope/W, a two dimensional limit equilibrium slope stability program.

Soil Strength Parameters

The soil conditions used in the stability analyses were based, in part, on the results of the boreholes advanced at the site and other studies in the area of the site. To assess the factor of safety against overall rotational failure, the slope stability analysis was carried out using drained soil parameters, which reflect long term conditions.

The following table summarizes the soil parameters used in the analyses:

Table 1: Soil Parameters used in Slope Stability Analysis

Soil Type	Unit Weight (kilonewtons per cubic metre)	Cohesion (kilopascals)	Friction Angle (degrees)
Topsoil	14	0	32
Silty Clay	17	7	30
Bedrock			

The results of a stability analysis are highly dependent on the assumed groundwater conditions. The groundwater level measured during this investigation was at an elevation of about 73 metres. The groundwater level was conservatively taken to be at the top of the native soils for the static condition.

The slope stability analyses were carried out using soil parameters, groundwater conditions and a slope profile that attempt to model the slopes in question but do not exactly represent the actual conditions.

For the purposes of this study, a computed factor of safety of less than 1.0 to 1.3 is considered to represent a slope bordering on failure to marginally stable, respectively; a factor of safety of 1.3 to 1.5 is considered to indicate a slope that is likely to fail in the long term and provides a degree of confidence against failure ranging from marginal (1.3) to adequate (1.4 and greater) should conditions vary from the assumed conditions. A factor of safety of 1.5, or greater, is considered to indicate adequate long term stability.

For the seismic analysis, a computed factor of safety of less than 1.0 is considered to represent a slope bordering on failure; a factor of safety of 1.0 to 1.1 is considered to represent a marginally stable slope; and a factor of safety of 1.1, or greater, is considered to indicate adequate stability subject to the design earthquake event.

Existing Conditions

The results of the slope stability analysis are provided in Appendix B.

The slope stability analysis indicates that the existing slope, in its current configuration, has a global factor of safety against instability of about 3.4 and 3.3 under static and seismic loading conditions (refer to Figure B1 and B6), respectively.

Based on the results of the slope stability assessment, the slope, in its current configuration, is considered globally stable from a geotechnical point of view and a setback allowance is not required for stability. The banks of the creek also do not exhibit signs of erosion requiring an

erosion allowance. An access allowance of 6 metres is required in accordance with the Ministry of Natural Resources (MNR) Technical Guide “Understanding Natural Hazards” dated 2001. Based on our understanding of the planned works, the proposed path and bridge should allow access to be maintained for maintenance of the creek banks, effectively meeting the requirements for the access allowance.

Geofirma previously carried out a slope stability assessment titled “Geofirma Engineering Ltd. – Slope Inspection Report”, 2018.

This report indicated that was no evidence of significant erosion at the toe of the slope.

The stability of the slope is unlikely to be materially reduced by construction of the proposed building given the foundations will be founded on bedrock. Additionally, a maximum grade raise of 1.8 metres will not result in the steepening of the slope beyond the 5H:1V threshold.

As indicated in the analysis of slope section A-A’ (shown in Figures B1 and B2), the proposed retaining wall outside of the underground parking garage entrance (along the east side of the proposed development) is outside of the limit of hazard lands, and as a result is considered to have no impact to the existing slope and is also indicated to be globally stable.

Determination of the Erosion Hazard Limit

In accordance with the Ministry of Natural Resources (MNR) Technical Guide “Understanding Natural Hazards” dated 2001, the Erosion Hazard Limit consists of three components: (1) Stable Slope Allowance, (2) Toe Erosion Allowance, and (3) Erosion Access Allowance. The assessment of each of these components for this site is provided below.

The Stable Slope Allowance, as described in the MNR procedures, is not required since the analysis indicates the slopes are stable.

In accordance with the MNR documents, a minimum Toe Erosion Allowance of between 1 to 2 metres is required for slopes consisting of soft to firm cohesive soils / loose granular soils and where no evidence of active erosion is occurring. A Toe Erosion Allowance of 2 metres should be used for this site, according to the soil conditions identified at the base of the slope. The toe erosion allowance can be applied between the base of the slope and the waters edge, assuming there is a floodplain at the toe of the slope.

The MNR guideline also includes the application of a 6 metre wide Erosion Access Allowance to allow for access by equipment to repair a possible failed slope or erosion, for construction access for maintenance, and to provide protection against other unforeseen conditions. Some judgement is required in the application of this component, as site access may be obtained in several manners, for instance across parking areas or landscaped areas (but not if structures have been installed within these portions of the site).

The approximate top of slope is shown on Figure 1 along with the required toe erosion and access allowance (i.e., 8 metres).

Retrogressive Landslide Potential

The City of Ottawa's screening criteria for large retrogressive landslide requires that the height of the slope be greater than 8 metres.

The slopes located at 788 March Road have a height of less than 3 metres; therefore, there is very low potential for retrogressive slides at this location.

CLOSURE

We trust this letter provides sufficient information for your present purposes. If you have any questions concerning this letter, please do not hesitate to contact our office.

Chris Clarkson, E.I.T.
Geotechnical Engineer in Training

Bill Cavers, P.Eng.,
Principal Geotechnical Engineer

Enclosures: Conditions and Limitations of This Report
Figure 1: Site Location Plan
Results of Slope Stability Analysis (Figures B1 to B6)

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Conditions and Limitations of This Report

1. **Standard of Care:** GEMTEC has prepared this report in a manner consistent with generally accepted engineering or environmental consulting practice in the jurisdiction in which the services are provided at the time of the report. No other warranty, expressed or implied is made.
2. **Copyright:** The contents of this report are subject to copyright owned by GEMTEC, save to the extent that copyright has been legally assigned by us to another party or is used by GEMTEC under license. To the extent that GEMTEC owns the copyright in this report, it may not be copied without our prior written agreement for any purpose other than the purpose indicated in this report. The methodology (if any) contained in this report is provided to the Client in confidence and must not be disclosed or copied to third parties without the prior written agreement of GEMTEC. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests.
3. **Complete Report:** This report is of a summary nature and is not intended to stand alone without reference to the instructions given to GEMTEC by the Client, communications between GEMTEC and the Client and to any other reports prepared by GEMTEC for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. GEMTEC can not be responsible for use of portions of the report without reference to the entire report.
4. **Basis of Report:** This Report has been prepared for the specific site, development, design objectives and purposes that were described to GEMTEC by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this report expressly addresses the proposed development, design objectives and purposes. Any change of site conditions, purpose or development plans may alter the validity of the report and GEMTEC cannot be responsible for use of this report, or portions thereof, unless GEMTEC is requested to review any changes and, if necessary, revise the report.
5. **Time Dependence:** If the proposed project is not undertaken by the Client within 18 months following the issuance of this report, or within the timeframe understood by GEMTEC to be contemplated by the Client, the guidance and recommendations within the report should not be considered valid unless reviewed and amended or validated by GEMTEC in writing.
6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.
7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in property value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
9. **Reliance on Provided Information:** The evaluation and conclusions contained in this report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions, misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of of the subsurface descriptions.

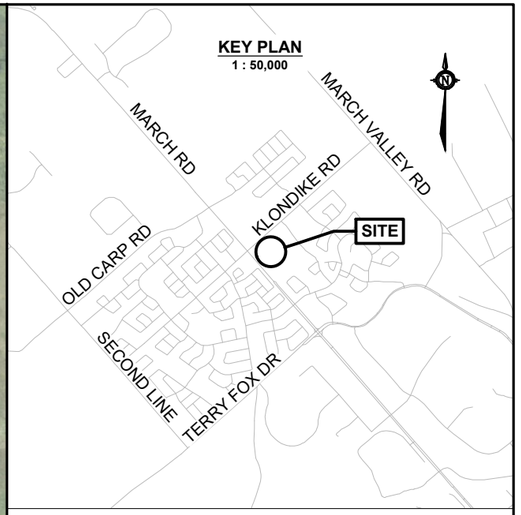
    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination-or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.
11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.
12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not

materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.
14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



LEGEND

- PROPOSED BUILDING FOOTPRINT
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE TOP OF SLOPE
- APPROXIMATE SHORELINE
- APPROXIMATE HAZARD LANDS LIMIT (INCLUDING EROSION AND ACCESS ALLOWANCE)
- A — A' SLOPE CROSS SECTION LOCATION

GENERAL NOTE(S)

1. Coordinate system: NAD83 (CSRS), UTM ZONE 18N, CGVD28
2. Distances, elevations, and coordinates are shown in metres unless denoted otherwise
3. This drawing is a schematic representation and should not be taken as a substitute for a legal survey.
4. Maps Data: Google, @2024 CNES / Airbus, First Base Solutions, Maxar Technologies
5. Contains information licensed under the Open Government Licence – Ontario
6. Geographic dataset source: Ontario GeoHub

SCALE 1:750

0 15 30 45m

DRAWING
SITE LOCATION PLAN

CLIENT
GEOFIRMA LTD.

PROJECT
GEOTECHNICAL STUDY
SLOPE STABILITY ANALYSIS
13109 -788 MARCH ROAD
OTTAWA, ONTARIO

DRAWN BY	CHECKED BY
S.L.	B.C.
PROJECT NO.	REVISION NO.
100143.003	0
DATE	FIGURE NO.
JUNE 2024	**FIGURE 1**

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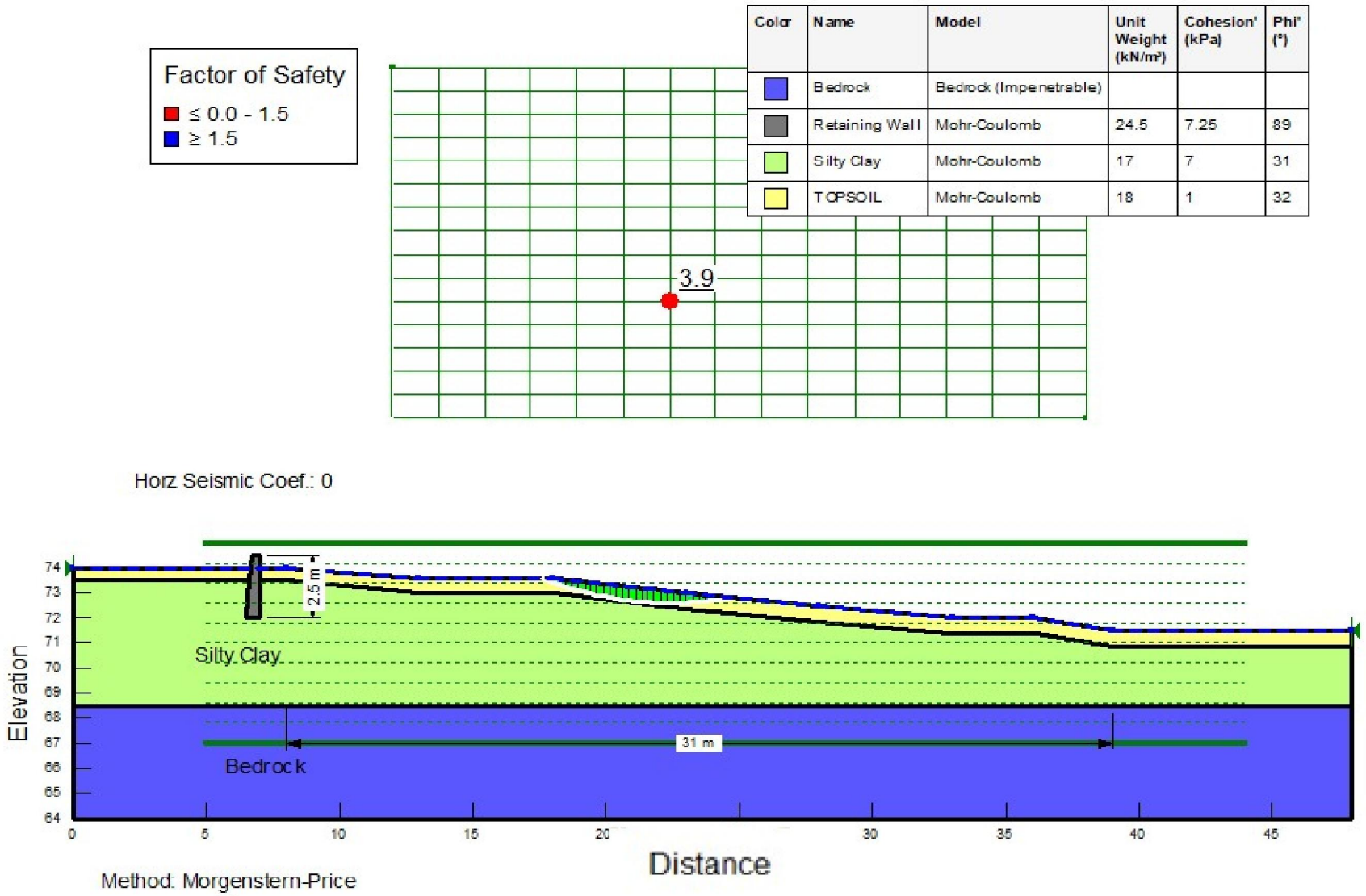
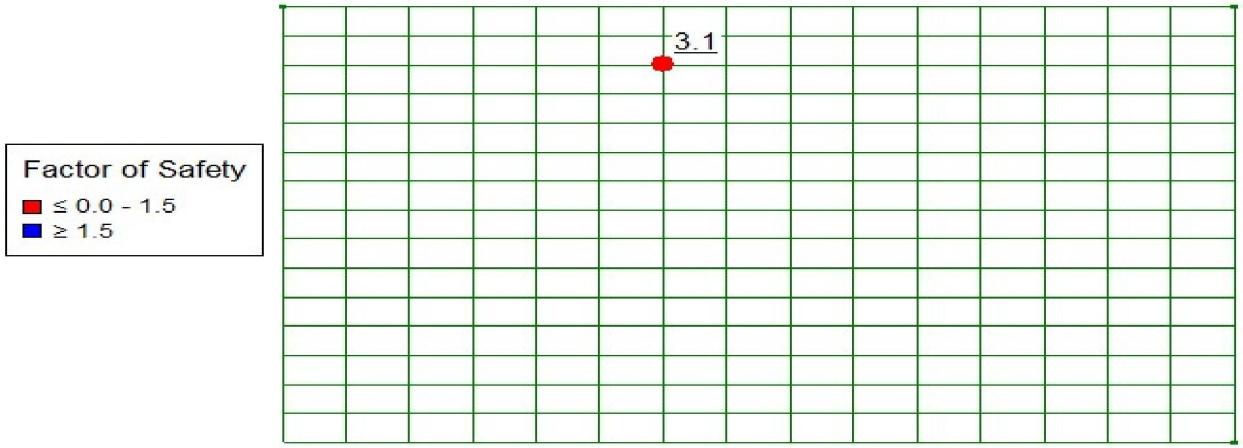
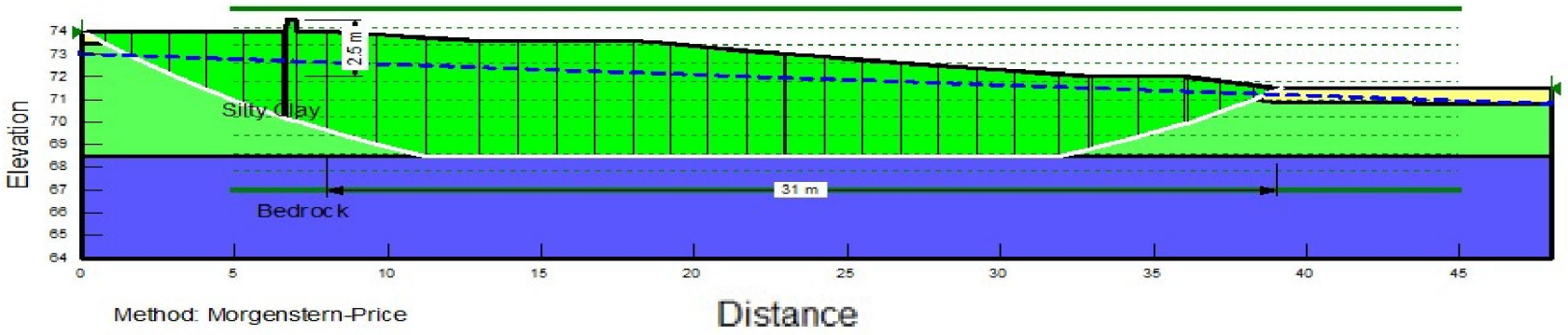


GEMTEC Consulting Engineers and Scientists	**Static Slope Stability Section A-A' - Minimum** **Geotechnical Study, Slope Stability Assessment** **788 March Road, Ottawa, Ontario**	Project No. 100143.003 Drawn: CC Date: 2024-06-07	**Figure B1**



Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)			
	Retaining Wal	Mohr-Coulomb	24.5	7.25	89
	Silty Clay (Seismic)	Undrained (Phi=0)	19.7		
	TOPSOL	Mohr-Coulomb	18	1	32



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Seismic Slope Stability Section A-A' - Minimum

Geotechnical Study, Slope Stability Assessment

788 March Road, Ottawa, Ontario

Project No.	100143.003
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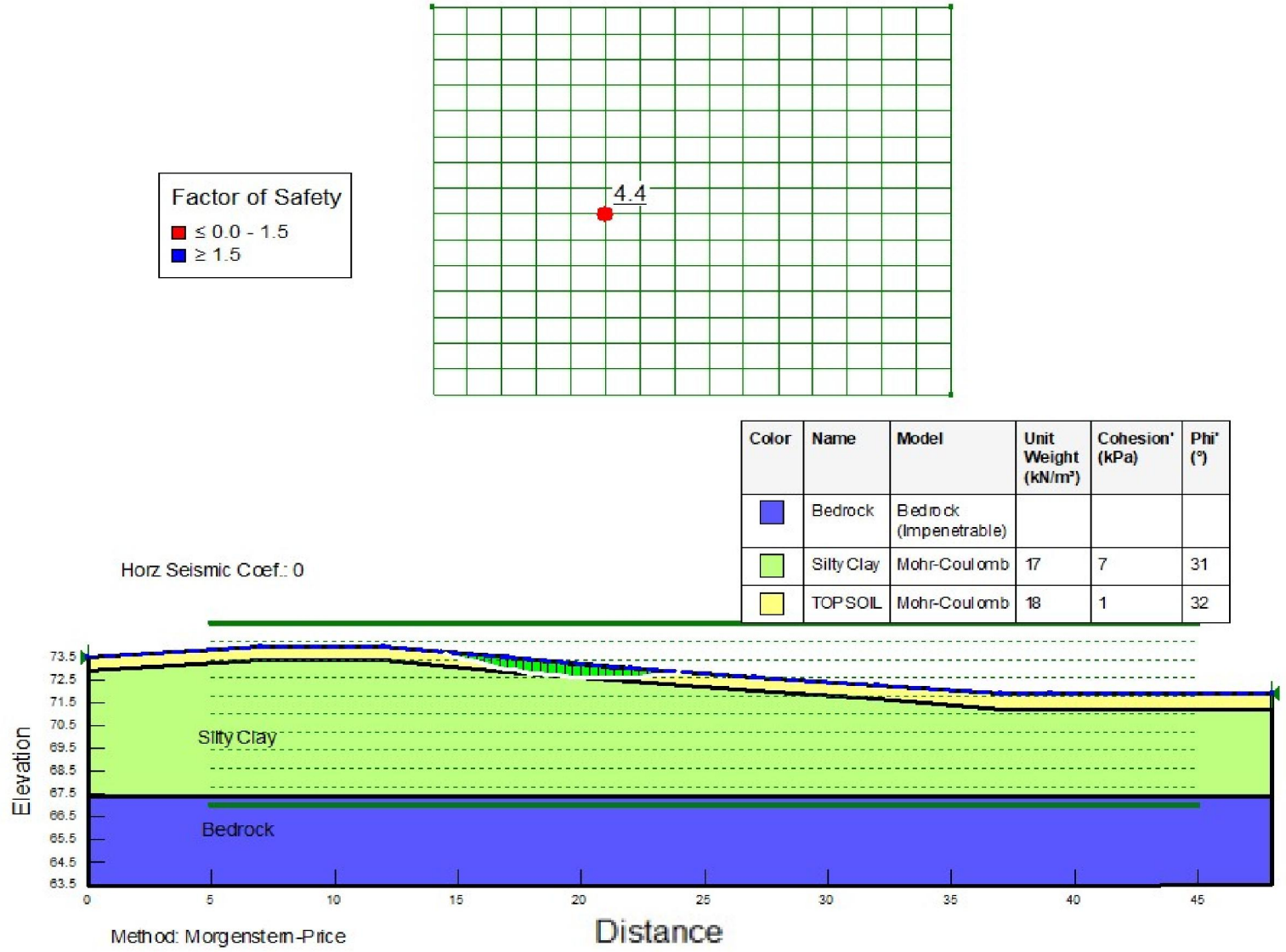
Date:	2024-06-07

Figure B2



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Static Slope Stability Section B-B' - Minimum

Geotechnical Study, Slope Stability Assessment

788 March Road, Ottawa, Ontario

Project No.	100143.003
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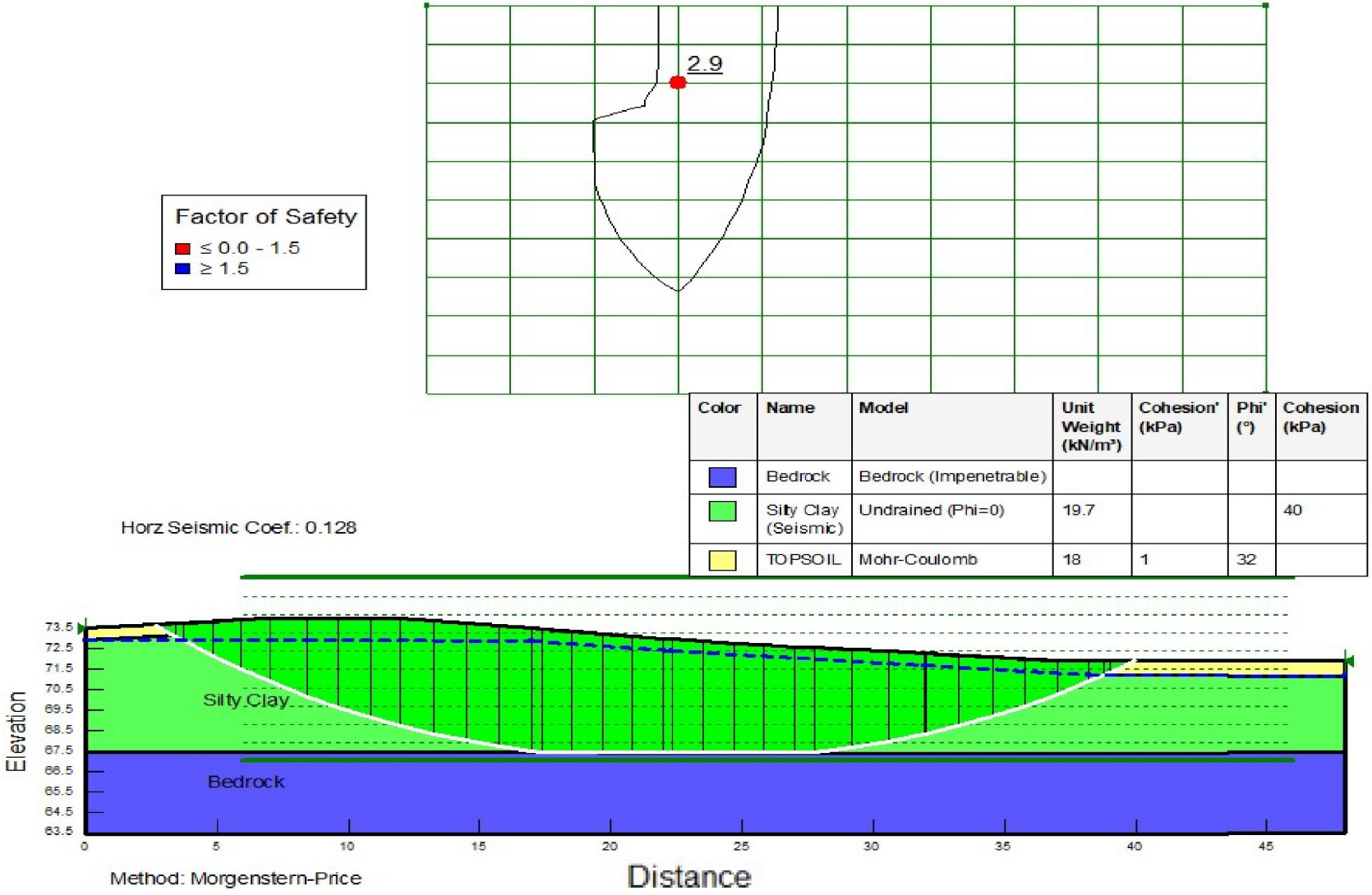
Date:	2024-06-07

Figure B3



Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Bedrock	Bedrock (Impenetrable)				
	Silty Clay (Seismic)	Undrained (Phi=0)	19.7			40
	TOPSOIL	Mohr-Coulomb	18	1	32	

GEMTEC
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Seismic Slope Stability Section B-B' - Minimum

Geotechnical Study, Slope Stability Assessment

788 March Road, Ottawa, Ontario

Project No.	100143.003
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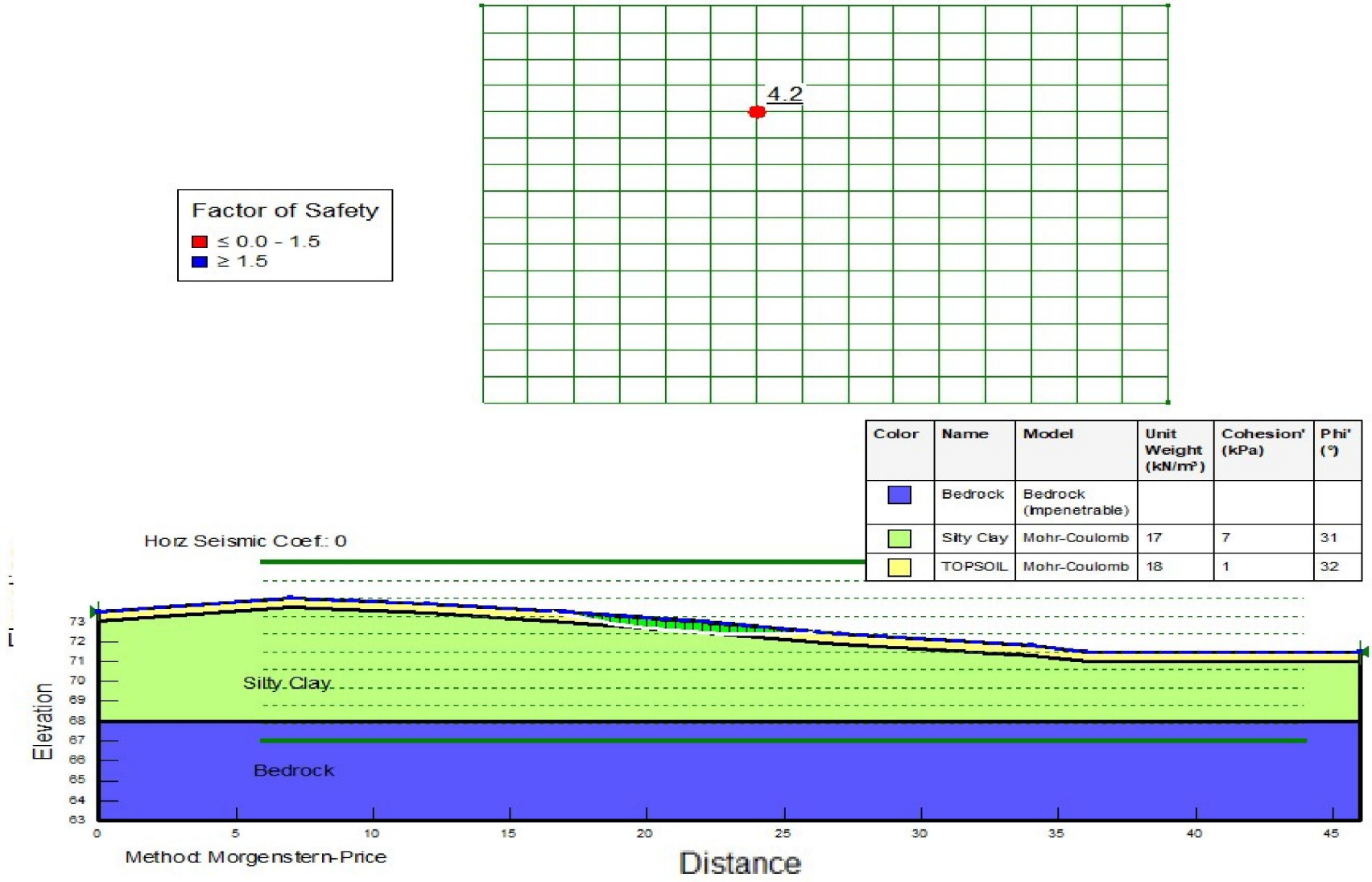
Figure B4



GEMTEC
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Static Slope Stability Section C-C' - Minimum

Geotechnical Study, Slope Stability Assessment

788 March Road, Ottawa, Ontario

Project No.	100143.003
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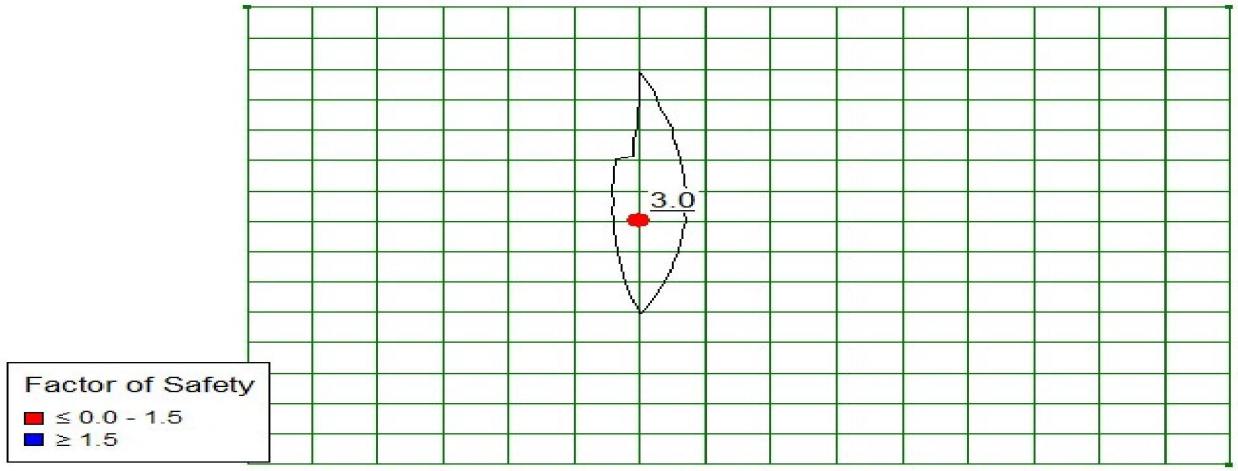
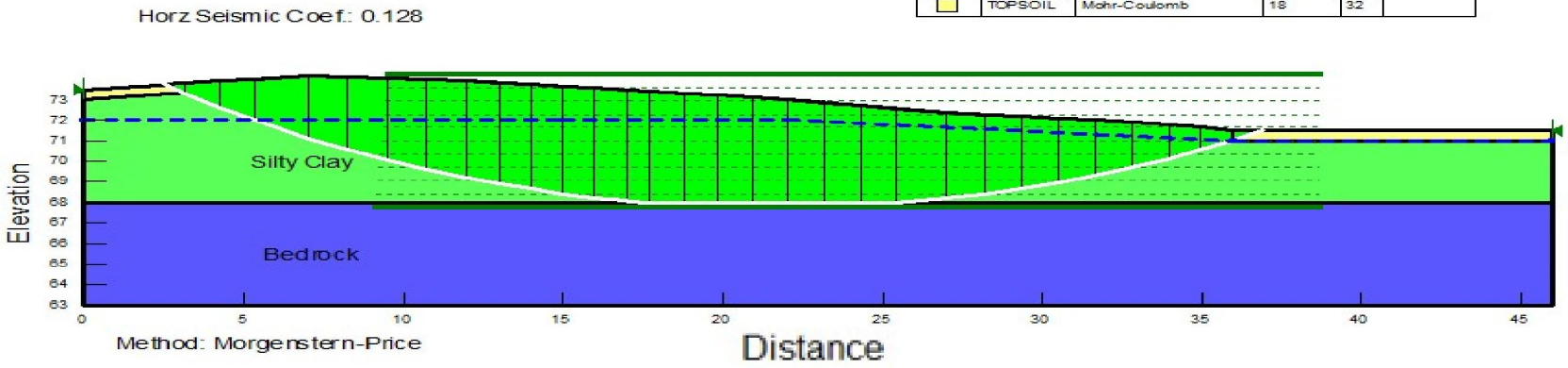
Figure B5



Color	Name	Model	Unit Weight (kN/m³)	Phi' (°)	Cohesion (kPa)
	Bedrock	Bedrock (Impenetrable)			
	Silty Clay (Seismic)	Undrained (Phi=0)	19.7		40
	TOPSOIL	Mohr-Coulomb	18	32	



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Seismic Slope Stability Section C-C' - Minimum

Geotechnical Study, Slope Stability Assessment

788 March Road, Ottawa, Ontario

Project No.	100143.003
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Date:	2024-06-07

Figure B6