Appendix D: Geotechnical Report

RYZUK
GEOTECHNICAL

July 15, 2025
Project #: 12541-1
Revised: July 30, 2025

[redacted]
By e-mail: [redacted]

PROPOSED DWELLING – GEOHAZARD ASSESSMENT
3139 Otter Point Road – Sooke, BC

1. INTRODUCTION

As requested, we attended the referenced property on June 18, 2025, and completed an assessment of the potential geohazards affecting the site as such relates to the proposed dwelling. We herein provide our associated observations, comments, recommendations, and conclusions to be incorporated into the design/construction. This has been completed in accordance with Sections 488 and 491 of the Local Government Act for development permit and so that the land may be used safely for the use intended in accordance with Section 56 of the Community Charter for building permit. Our work has been completed in accordance with, and is subject to, the previously accepted Terms of Engagement.

Our recommendations consider the guidance/requirements provided by the:

- Engineers and Geoscientists of BC – Professional Practice Guidelines for Landslide Assessments in BC V4.1 – March 1, 2023, and
- Capital Regional District (CRD) Juan de Fuca – 3819 – Otter Point Official Community Plan – Bylaw No. 1, 2014 – Section 6.3 – Development Permit Area (DPA) No. 1: Steep Slopes, Section 6.5 – DPA No. 3: Watercourses and Wetlands Areas

Pursuant to Section E.6.1.3(e) of DPA 6 above, a development permit exemption may be granted provided the work is carried out in accordance with recommendations from a qualified professional. Furthermore, confirmation that the proposed dwelling location is not exposed to significant risk from geohazard is included in this assessment, pursuant to Section 56 of the Community Charter. The CRD is considered an authorized user of this report and may rely on its contents when making decisions related to the property.

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2. SITE LOCATION AND PROPOSED DEVELOPMENT

The subject property is located in the Otter Point community of the Juan de Fuca Electoral Area – CRD approximately 3.8 km to the northwest of the Sooke community center. The property is approximately 6522 square meters in area and is bounded by partially developed single-family residential properties to the north and east, Otter Point Road to the south, and Young Lake Road to the west. Based on our review of the 3D Geomatics Land Surveying drawing dated May 14, 2025, we understand that a 2 m by 10 m dwelling is proposed near the southwestern corner of the property.

3. GEOHAZARD ASSESSMENT

Our geotechnical assessment has involved an office-based review of available information, a site reconnaissance to complete a visual assessment for signs of geohazard that would impact the proposed development area, and an office-based slope stability analysis.

3.1 OFFICE-BASED STUDY

The office-based work included review of development drawings as well as perusal of geological/terrain mapping, BC LiDAR data, and BC Water Resources Atlas (well information).

Based on our review of the CRD GIS map satellite imagery and contours and BC LiDAR data (BCGS 092b032, Year: 2019) analyzed in QGIS software, the natural grade on the property significantly varies. The dwelling is proposed on a relatively flat plateau at the southwestern corner of the property that has a geodetic surface elevation between 83 and 84 m. To the northeast of the plateau, the grade steeply slopes down at an angle of 66 degrees a height of 11 m to the base of the western side of De Mamiel Creek. On the northeastern side or inside of the creek where its point bar formation exists, the surface topography gently slopes upwards at a relatively consistent rate to 83 m geodetic elevation at the northeast corner of the property. In the QGIS software, we produced Section A from BC LiDAR data to analyze the slope geometry on the property. The location of Section A can be seen on the attached Site Plan and will be discussed further in the Slope Stability section of the report.

Based on our review of BC Geological Survey – Geological Fieldwork 1991 mapping of the Sooke Land District, we expected the native soil conditions to consist of sand, gravel, silt, and clay of the Capilano Sediments of the Quaternary period. Well installation soil logs from the BC Water Resources Atlas located approximately 140 m to the northwest of the property indicated that bedrock was encountered at a depth of 7 m below the ground surface.

3.2 SITE RECONNAISSANCE

During our site reconnaissance we traversed the property to identify any notable surface features typically associated with steep slopes, such as past/current indication of erosion, land slip,

overland flow, and/or rock fall. Our visual assessment generally confirmed the findings of our office-based study.

The southeastern plateau was generally cleared of vegetation and a fence was constructed at the crest of the soil slope above De Mamiel Creek. A hand dug test pit was advanced on the plateau and we determined the topsoil layer was approximately 0.6 m thick atop native silty sand and gravel. The steepest portion of the slope is located at the south end of the property where the cutbank on the western outside curve of De Mamiel Creek is undergoing the most significant erosion. The slope crest was lined with young to middle aged trees that increased in size and age towards the north where the slope becomes less steep. In this area trees were also observed on the slope itself due to its shallower inclination and there is an access foot path to the base of the slope. A very dense "cemented" silty sand and gravel (inferred basal glacial till) was observed within the soil slope on the foot path down to the creek and at the toe of the cutbank of the slope. Basal glacial till is formed directly beneath a glacial which explains its very dense nature. The upper 1 m of the slope below the topsoil layer was noted to be lighter in colour indicating that it may be ablation till meaning it was formed by the melting of glacial ice, particularly from the upper layers of a glacier, and is considered to have a lower density than basal till. Small vegetation was visible on the steepest portions of the slope and a few trees on sloping areas of the property were 'pistol-butted'. There was loose soil collected at the base of the slope. The vertical scour height likely due to swift-flowing water at the base of the western cutbank of De Mamiel Creek was approximately 1.5 m in height. The material at the base of the creek was sorted to only contain primarily large gravel, cobbles, and boulders. This indicates that transportation of smaller sediment particles has occurred and that seasonally or in storm events the creek has a relatively high flow rate. At the time of our site reconnaissance, the creek was not flowing and shallow in depth.

3.3 SLOPE STABILITY ASSESSMENT

The native basal glacial till soil observed within the creek slope is typically hard/very dense and globally stable therefore deep-seated failure is considered unlikely. The high friction angle and cohesion of this material is shown through its steep inclination observed in static conditions. However, the slope section is considered over-steepened and potentially susceptible to movement in an earthquake event. Therefore, we have completed a slope stability analysis to confirm that the global slope stability factor of safety and movement meets the minimum requirements for both static and seismic conditions outlined in the EGBC guidelines. Another contributing factor to slope instability that has been considered in our analysis is the erosion rate of the creek at the toe of the slope that could be amplified by the effects of climate change.

We completed limit equilibrium slope stability analysis using RocScience Slide2 software and topography contour information extracted from the online BC LiDAR data (Section A). Section A was produced for our slope stability modelling and is a cross section of the steepest topography of the slope at the southwestern cutbank of the creek. We have modelled a proposed dwelling location offset approximately 11 m to the southwest of the slope crest determined from LiDAR. We understand that a variance is being requested to reduce the side yard setback from 6 m to 4.5 m. To model the most conservative case, we used the furthest setback of the proposed dwelling (4.5 m from the southwest property line) in combination with the steepest slope cross

section (Section A). Conservative soil strength properties were applied based on our observations, background review, and our past experience with similar soil types, and bedrock was not assumed to be present.

As part of our slope reconnaissance, we traversed near the toe of the ravine slope where the De Mamiel Creek has produced a cutbank from its seasonal flow scouring. We observed very dense "cemented" basal glacial till at the toe of the slope that is considered to have a low susceptibility to erosion due to its relatively high cohesion. However, we have conservatively incorporated into our analysis models the potential effects of slope regression including the effect of long-term scour, erosion, and bank undercutting. Additionally, we have included the potential impacts of climate change, including increased frequency and intensity of extreme rainfall events, that could also contribute to long-term erosion and subsequent regression of the ravine slopes. We determined that a horizontal slope regression of 5 m was appropriate to account for long-term erosion over the anticipated 75-year design life of the ravine slope. The slope crest in our modelling has been modified to be 5 m further back from the 2019 LiDAR slope crest geometry.

The pseudo-static analysis was run with seismic loading based on the Earth Design Ground Motion from the BC Building Code (BCBC) 2024 (National Building Code of Canada [NBCC] 2020 seismic hazard values) for a 2% probability of exceedance in 50 years (1 in 2475-year event), which is the requirement of the current 2024 BCBC. The associated peak ground acceleration (PGA) k value is 0.818 g which was determined using the online 2020 NBCC Seismic Hazard Tool and an estimated Site Classification for Seismic Site Response of 'C' based on observed soil conditions.

The results of our modelling indicate a minimum Factor of Safety (FS) of 1.53 in static conditions and a minimum FS of 0.60 in seismic conditions. Acceptable values of FS are typically >1.5 in static and >1.0 in seismic, as stated within the EGBC Landslide Guidelines Table B-6: Types of Static and Seismic Slope Stability Analysis. Given the NBCC 2020 seismic Factor of Safety resulted in less than the required threshold, and as per the methodology outlined in the guidelines, we used advanced functionality in the software to determine the critical seismic yield coefficient (k_y) value (0.408) and used this value in Travasarou's equation to estimate the anticipated permanent displacement resulting from a seismic event. The calculation using Travasarou's "Method 1" (2007) and conservative parameters resulted in a displacement of 12.1 cm, which is within the acceptable maximum limit of 15 cm.

The attached Slope Stability Analysis Results show the stratigraphy, soil parameters, and slip plane in static conditions, seismic 2%, and seismic (k_y) conditions.

For the purposes of the attached Appendix D: Landslide Assessment Assurance Statement, in accordance with Section 219 of the Land Title Act, we recommend a covenant be registered on title indicating that the steep slope above the creek is subject to geohazard, that the indicated safe building area is considered safe, and that any future building site(s) contemplated closer to the crest of the slope above the creek be assessed by a geotechnical professional to confirm such location is safe for residential construction. Given the above, it is our professional opinion that the proposed safe building area, as indicated on the attached Site Plan, setback 11 m from the slope crest is not subject to risk of geohazard.

The steep topography and location of De Mamiel Creek creates an access constraint to the northeast portion of the property, upslope from the point bar formation. Therefore, we consider that construction of a building on the northeast portion of the property to be impractical.

3.4 FLOOD ASSESSMENT

Under Bylaw No. 2040 of Schedule "A" of the CRD Juan de Fuca Land Use Bylaw, Part 5, we understand that a Floodplain Setback of a minimum of 30 m is required from the Natural Boundary of De Mamiel Creek. Due to the significant change in elevation from the toe of the slope at De Mamiel Creek (72 m geodetic) to the building site of the proposed dwelling (83 m geodetic), we consider the flooding risk on the property due to the creek to be negligible.

3.5 LIQUEFACTION ASSESSMENT

Based on our past experience in the area, soil mapping, and observed surficial soil deposits at the property, we expect the subsurface soils to be of glacial origin and over-consolidated. Generally being of cohesive and of a stiff consistency or well graded and of a dense consistency; therefore, we do not consider the soils at the site to be susceptible to liquefaction.

4. PRELIMINARY GEOTECHNICAL DESIGN

We anticipate site preparation for the proposed dwelling would include minor excavation and removal of any organic and loamy soils, as well as potential fills associated with previous land development. We recommend that the proposed dwelling is founded directly atop native very dense basal glacial till as analyzed in our slope stability modelling. It may also be desirable to utilize minor amounts of engineered fill (crushed gravel, shot rock etc.) to create a flatter and more level building site or to achieve the design bottom of footing grade. We anticipate that the building would be constructed on conventional shallow spread footings. We consider that foundation elements placed directly on undisturbed native very dense basal glacial till, or approved engineered fill atop such, will provide suitable long-term support for the construction of the proposed dwelling. For design purposes, foundations may be dimensioned considering Serviceability and Ultimate Limit State bearing resistance values of 150 kPa (SLS) and 225 kPa (ULS), respectively. We recommend that foundation subgrade surfaces, as well as engineered fill placed below foundation areas (if any), be reviewed by a geotechnical professional prior to pouring concrete. Additionally, footings should be embedded at least 450 mm below finished grade for protection from frost.

Based on our background review and observations of the soil conditions at site, we consider the appropriate Site Classification for Seismic Site Response (Site Class) would be 'C', as per the current BC Building Code.

We expect that conventional perimeter foundation drainage tied into a free draining backfill material would be suitable to limit hydrostatic pressure on the foundation walls. This, however, does not

preclude the possibility of dampness and/or minor seepage, which would be considered building envelop concerns.

The foundation drain arrangement (perforated pipe and uniform gravel/drain rock) should be covered with a non-woven geotextile filter fabric (not landscape fabric), or a suitably graded granular medium as approved by ourselves, to prevent the migration of finer materials from the backfill into voids within the drain arrangement.

To maintain the long-term surficial stability of the slope, the native soils should be protected from erosion caused by turbulent waterflows within drainage channels and at discharge locations. We recommend that all water from collected from perimeter drains and roof leaders is transmitted via closed piping to a municipal stormwater system or downslope and discharged onto a splash pad or atop the creek at the base of the slope.

5. CLOSURE

Provided the above recommendations are followed, we consider the land may be used safely for the use intended, that being the construction of a single-family dwelling. Our assessment is in accordance with Section 56 of the Community Charter, Sections 488 and 491 of the Local Government Act, Section 219 of the Land Title Act, the CRD Juan de Fuca Otter Point OCP, the BC Building Code, and the Professional Practice Guidelines for Legislated Landslide and Flood Assessments in BC (assurance statements attached). Our assessment has considered a design seismic occurrence with a 2% probability of exceedance in 50 years as well as the potential effects of future climate change.

We trust the preceding is suitable for your purposes at present. Please do not hesitate to contact the undersigned if we can be of further assistance.

Sincerely,

Ryzuk Geotechnical

Ben Brownoff, EIT
Advanced Junior Engineer

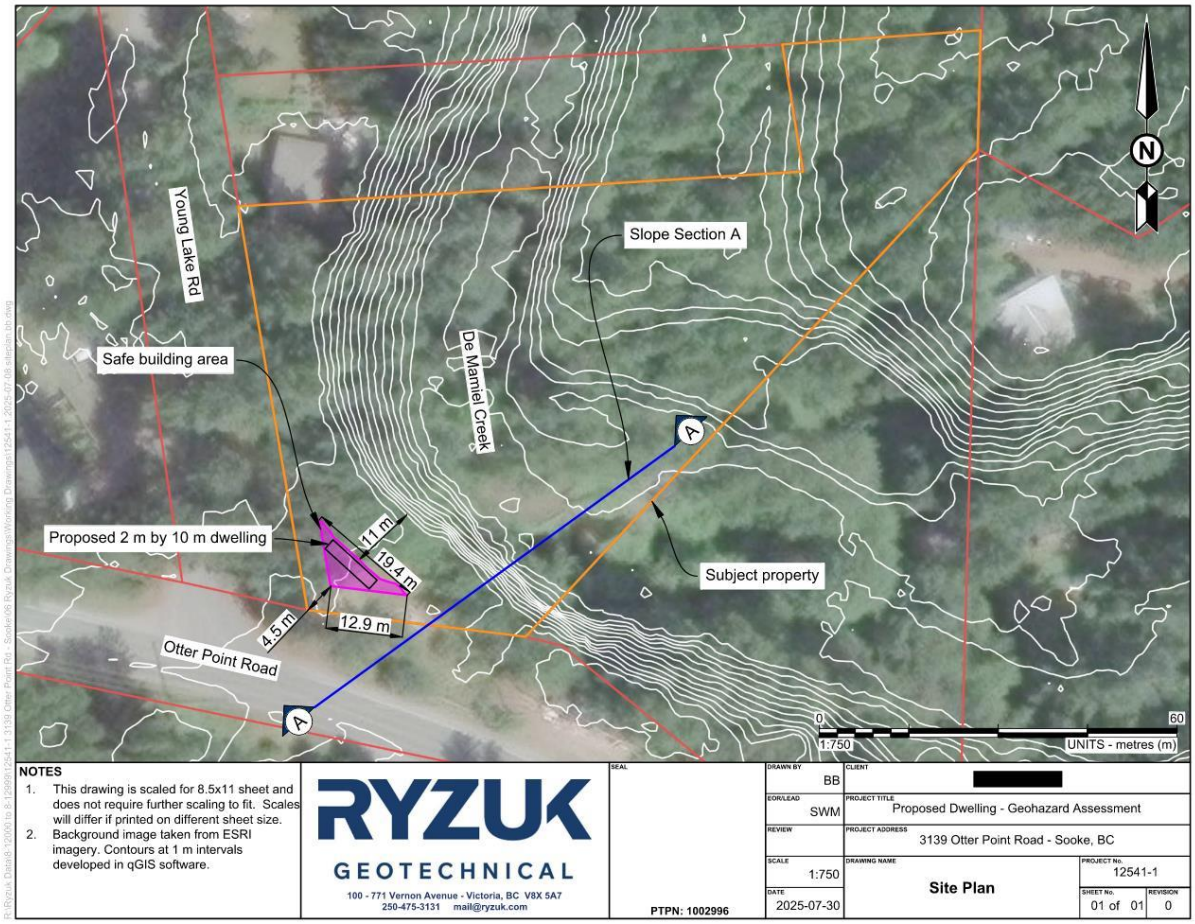
Jul. 31 2025

Shane Moore, P.Geo.
Senior Geoscientist

Permit to Practice Number: 1002996

Attachments:

- Site Plan
- Slope Stability Analysis Results
- EGBC Landslide Assurance Statement



NOTES

1. This drawing is scaled for 8.5x11 sheet and does not require further scaling to fit. Scales will differ if printed on different sheet size.
2. Background image taken from ESRI imagery. Contours at 1 m intervals developed in qGIS software.

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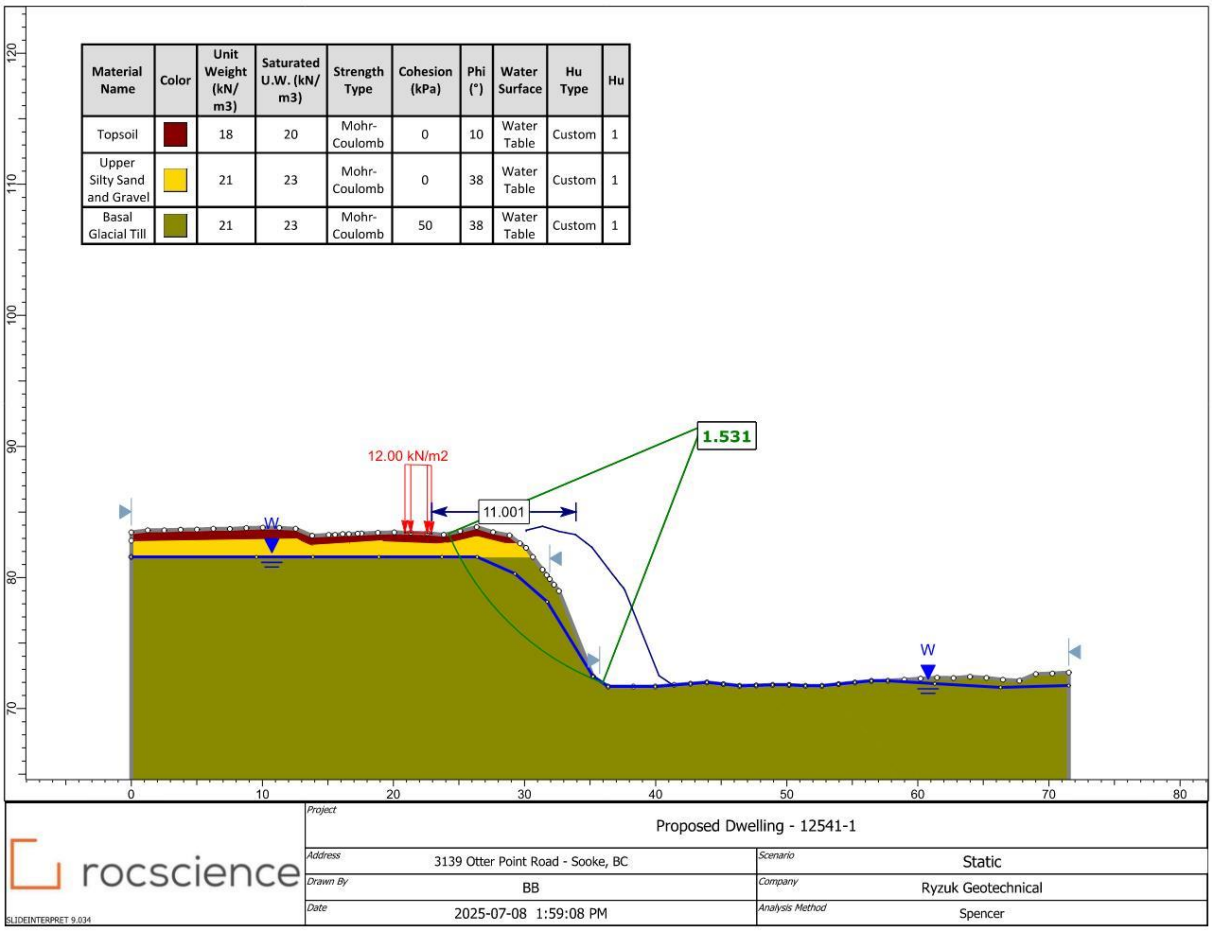
250-475-3131 mail@ryzuk.com

SEAL
PTPN: 1002996

DRAWN BY	BB
EOR/LEAD	SWM
REVIEW	
SCALE	1:750
DATE	2025-07-30
CLIENT	[redacted]
PROJECT TITLE	Proposed Dwelling - Geohazard Assessment
PROJECT ADDRESS	3139 Otter Point Road - Sooke, BC
DRAWING NAME	Site Plan
PROJECT No.	12541-1
SHEET No.	01 of 01
REVISION	0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Upper Silty Sand and Gravel | 21 | 23 | Mohr-Coulomb | 0 | 38 | Water Table | Custom | 1
Basal Glacial Till | 21 | 23 | Mohr-Coulomb | 50 | 38 | Water Table | Custom | 1
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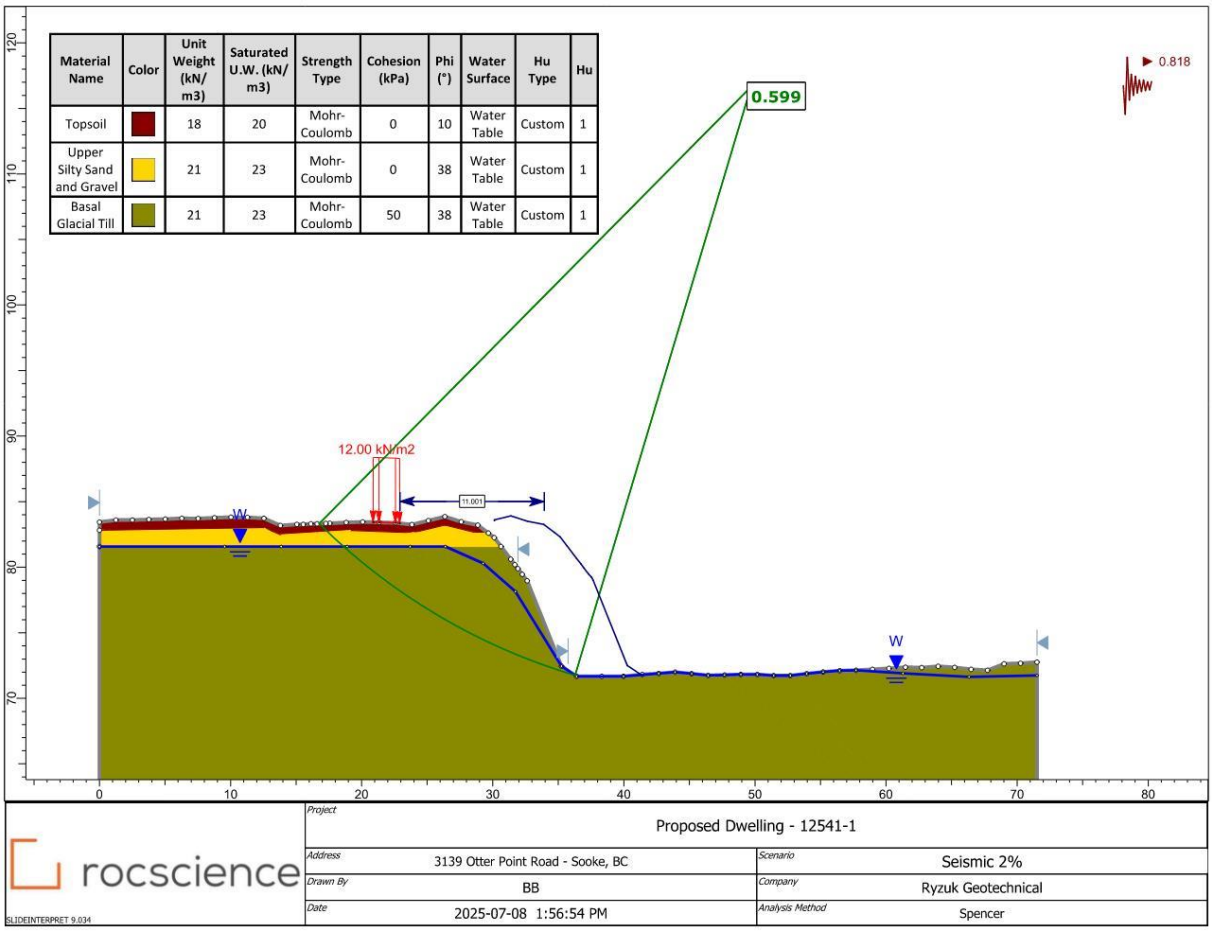
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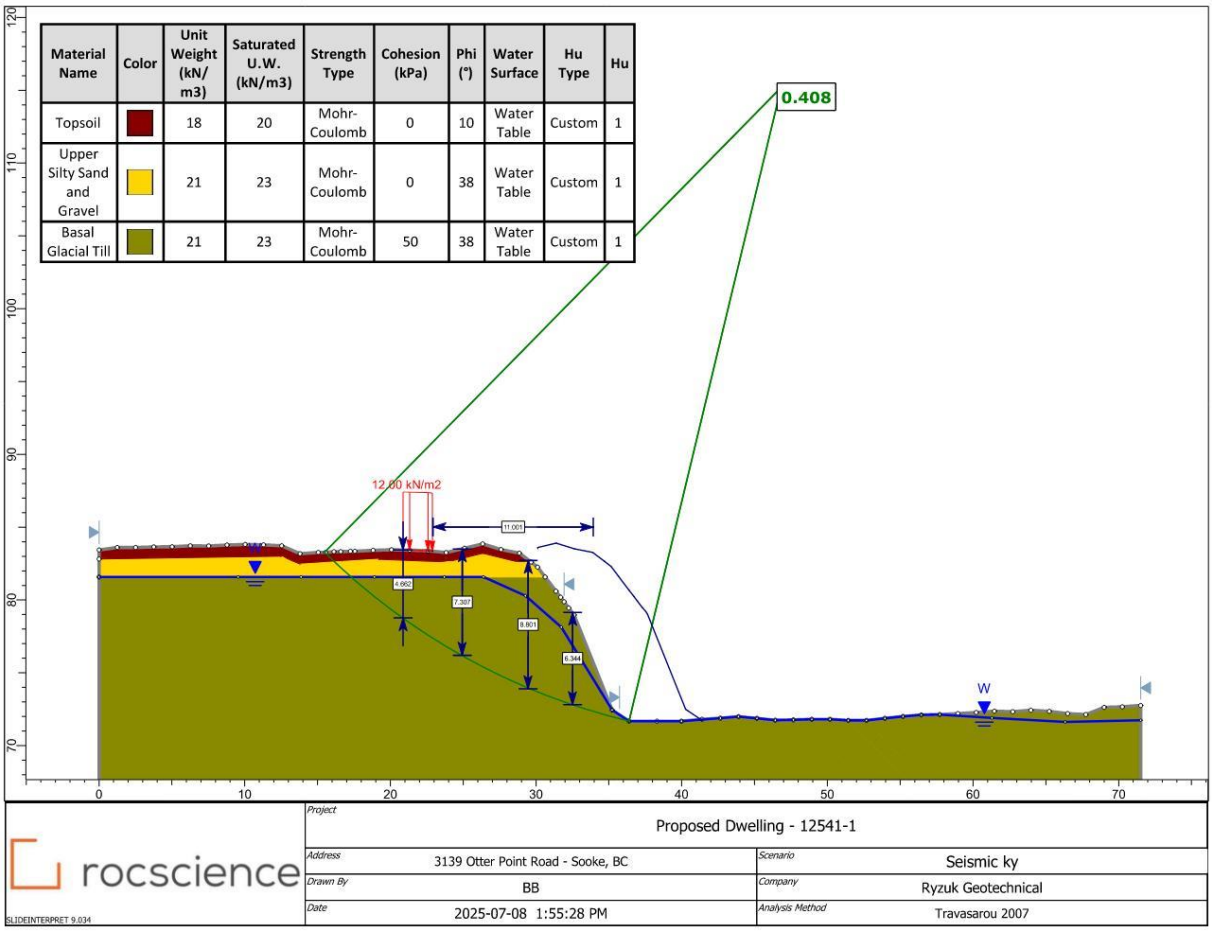
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Topsoil | 18 | 20 | Mohr-Coulomb | 0 | 10 | Water Table | Custom | 1
Upper Silty Sand and Gravel | 21 | 23 | Mohr-Coulomb | 0 | 38 | Water Table | Custom | 1
Basal Glacial Till | 21 | 23 | Mohr-Coulomb | 50 | 38 | Water Table | Custom | 1
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LANDSLIDE ASSESSMENT ASSURANCE STATEMENT

Notes: This statement is to be read and completed in conjunction with the Engineers and Geoscientists BC *Professional Practice Guidelines – Landslide Assessments in British Columbia* ("the guidelines") and the current *BC Building Code* (*BCBC*), and is to be provided for Landslide Assessments (not floods or flood controls), particularly those produced for the purposes of the *Land Title Act*, *Community Charter*, or *Local Government Act*. Some jurisdictions (e.g., the Fraser Valley Regional District or the Cowichan Valley Regional District) have developed more comprehensive assurance statements in collaboration with Engineers and Geoscientists BC. Where those exist, the Qualified Professional is to fill out the local version only. Defined terms are capitalized; see the Defined Terms section of the guidelines for definitions.

To: The Approving Authority (or Client) Date: July 15, 2025

Capital Regional District - Juan de Fuca

625 Fisgard Street, Victoria, BC, V8W 1R7

Jurisdiction/name and address

With reference to (CHECK ONE):

- ☐ A. *Land Title Act* (Section 86) – Subdivision Approval
- ☒ B. *Local Government Act* (Sections 919.1 and 920) – Development Permit
- ☒ C. Community Charter (Section 56) – Building Permit
- ☐ D. Non-legislated assessment

For the following property (the "Property"):

3139 Otter Point Road - Sooke, BC

Civic address of the Property

The undersigned hereby gives assurance that they are a Qualified Professional and a professional engineer or professional geoscientist who fulfils the education, training, and experience requirements as outlined in the guidelines.

I have signed, authenticated, and dated, and thereby certified, the attached Landslide Assessment Report on the Property in accordance with the guidelines. That report must be read in conjunction this statement.

In preparing that report I have:

[CHECK TO THE LEFT OF APPLICABLE ITEMS]

- ☑ 1. Collected and reviewed appropriate background information
- ☐ 2. Reviewed the proposed Residential Development or other development on the Property
- ☑ 3. Conducted field work on and, if required, beyond the Property
- ☑ 4. Reported on the results of the field work on and, if required, beyond the Property
- ☑ 5. Considered any changed conditions on and, if required, beyond the Property
- 6. For a Landslide Hazard analysis or Landslide Risk analysis, I have:
  - ☑ 6.1 reviewed and characterized, if appropriate, any Landslide that may affect the Property
  - ☑ 6.2 estimated the Landslide Hazard
  - ☑ 6.3 identified existing and anticipated future Elements at Risk on and, if required, beyond the Property
  - ☑ 6.4 estimated the potential Consequences to those Elements at Risk
- 7. Where the Approving Authority has adopted a Level of Landslide Safety, I have:
  - ☐ 7.1 compared the Level of Landslide Safety adopted by the Approving Authority with the findings of my investigation
  - ☐ 7.2 made a finding on the Level of Landslide Safety on the Property based on the comparison
  - ☐ 7.3 made recommendations to reduce Landslide Hazards and/or Landslide Risks

LANDSLIDE ASSESSMENT ASSURANCE STATEMENT

8. Where the Approving Authority has **not** adopted a Level of Landslide Safety, or where the Landslide Assessment is not produced in response to a legislated requirement, I have:
   - ☑ 8.1 described the method of Landslide Hazard analysis or Landslide Risk analysis used
   - ☑ 8.2 referred to an appropriate and identified provincial, national, or international guideline for Level of Landslide Safety
   - ☑ 8.3 compared those guidelines (per item 8.2) with the findings of my investigation
   - ☑ 8.4 made a finding on the Level of Landslide Safety on the Property based on the comparison
   - ☑ 8.5 made recommendations to reduce Landslide Hazards and/or Landslide Risks

☑ 9. Reported on the requirements for future inspections of the Property and recommended who should conduct those inspections

Based on my comparison between:

[CHECK ONE]

☐ the findings from the investigation and the adopted Level of Landslide Safety (item 7.2 above)
☑ the appropriate and identified provincial, national, or international guideline for Level of Landslide Safety (item 8.4 above)

Where the Landslide Assessment is not produced in response to a legislated requirement, I hereby give my assurance that, based on the conditions[1] contained in the attached Landslide Assessment Report:

A. SUBDIVISION APPROVAL

☐ For subdivision approval, as required by the *Land Title Act* (Section 86), "the land may be used safely for the use intended"

[CHECK ONE]

- ☐ with one or more recommended additional registered Covenants
- ☐ without an additional registered Covenant(s)

B. DEVELOPMENT PERMIT

☑ For a development permit, as required by the *Local Government Act* (Sections 488 and 491), my report will "assist the local government in determining what conditions or requirements it will impose under subsection (2) of [Section 491]"

[CHECK ONE]

- ☑ with one or more recommended additional registered Covenants
- ☐ without an additional registered Covenant(s)

C. BUILDING PERMIT

☑ For a building permit, as required by the *Community Charter* (Section 56), "the land may be used safely for the use intended"

[CHECK ONE]

- ☑ with one or more recommended additional registered Covenants
- ☐ without any additional registered Covenant(s)

[1] When seismic slope stability assessments are involved, Level of Landslide Safety is considered to be a "life safety" criteria, as described in Commentary JJJ of the *National Building Code of Canada (NBC) 2015*, Structural Commentaries (User's Guide – NBC 2015: part 4 of division B). This states:

> "The primary objective of seismic design is to provide an acceptable level of safety for building occupants and the general public as the building responds to strong ground motion; in other words, to minimize loss of life. This implies that, although there will likely be extensive structural and non-structural damage, during the DGM (design ground motion), there is a reasonable degree of confidence that the building will not collapse, nor will its attachments break off and fall on people near the building. This performance level is termed 'extensive damage' because, although the structure may be heavily damaged and may have lost a substantial amount of its initial strength and stiffness, it retains some margin of resistance against collapse."

LANDSLIDE ASSESSMENT ASSURANCE STATEMENT

Shane Moore, P.Geo.
Name (print)

July 15, 2025
Date

#100-771 Vernon Avenue
Address

Victoria, BC V8X 5A7

250-475-3131
Telephone

shane@ryzuk.com
Email

(Affix PROFESSIONAL SEAL and signature here)

The Qualified Professional, as a registrant on the roster of a registrant firm, must complete the following:

I am a member of the firm Ryzuk Geotechnical Ltd.
(Print name of firm)

with Permit to Practice Number 1002996
(Print permit to practice number)

and I sign this letter on behalf of the firm.