



**GEOTECHNICAL ASSESSMENT
Residential Development
Phase 7, Wedge Woods, Whistler, BC**

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Date: March 9, 2020

Project No.: **K-180335-00**

Submitted to:

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Submitted by:

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TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	SOURCES OF INFORMATION	1
3.0	UNDERSTANDING OF PROJECT	2
4.0	SITE DESCRIPTION	2
4.1	General	2
4.2	Soil Conditions	2
4.3	Groundwater Conditions	3
5.0	COMMENTS AND RECOMMENDATIONS	3
5.1	General	3
5.2	Geologic Hazards	3
5.2.1	Slope Stability	3
5.2.2	Rockfall	3
5.2.3	Snow Avalanche	4
6.0	CLOSURE	4

APPENDICES

APPENDIX A

Interpretation and Use of Study and Report Document

APPENDIX B

Figures

APPENDIX C

Photographs

APPENDIX D

Appendix D: Landslide Assessment Assurance Statement



1.0 INTRODUCTION

As requested, Kontur Geotechnical Consultants Inc. (Kontur) has completed a geotechnical assessment of the proposed Phase 7, Wedge Woods development, Whistler (Squamish-Lillooet Regional District), BC. The purpose of the assessment was to provide a characterization of observed naturally occurring geologic hazards, including locations of the potential hazard, opinions as to the nature of the hazards, consequences and influence areas of the identified potential hazards. Kontur's assessment of potential naturally occurring geologic hazard events follow generally accepted guidelines provided by the Engineers and Geoscientists of British Columbia (EGBC) "Guidelines of Legislated Landslide Assessments for Proposed Residential Developments in BC", dated May 2010. The lack of comprehensive historical records spanning the time periods noted in the MOTI guidelines with respect to natural occurring geologic hazards within or adjacent to the subject property limits the ability of Kontur to complete a quantitative assessment of specifically identified hazards. Therefore, Kontur is providing a qualitative assessment based on Kontur's experience and interpretations of existing site conditions.

As the Squamish Lillooet Regional District (SLRD) does not provide a level of geologic hazard acceptability, Kontur has referenced the British Columbia Ministry of Transportation and Infrastructure (MOTI) guidance for acceptability of geologic hazard occurrence. The MOTI guidelines are:

- 1 in 475 years for damaging events related to landslides;
- 1 in 200 years for damaging events related to flooding;
- 1 in 300 years for damaging events related to snow avalanches;
- 1 in 10,000 years for life threatening events.

It should be noted that MOTI does not provide acceptability limits for hazard risk associated with residential development and the approving authority (SLRD) must determine risk acceptability for development approval.

Specifically, this assessment focused on the following naturally occurring geologic hazard events:

- Slope instabilities;
- Rockfall;
- Snow avalanche;
- Debris flows/ torrents;
- Flooding.

Attached to this report are a Site Plan, Site Photos and an Appendix D from the Guidelines for Legislated Landslide Assessment for Proposed Residential Developments in BC".

2.0 SOURCES OF INFORMATION

This geotechnical assessment is based on the following information:

- Historic aerial photographs extending back over a time frame of over 70 years, specifically aerial photographs for the years 1946, 1958, 1969, 1975, 1981, 1989, 1994, 2005 and 2016 were reviewed;
- Subdivision Plan provided by Creus Engineering;



- Previous experience by Kontur personnel in the vicinity of the proposed development during development of Phases 1 through 6;
- Site reconnaissance by senior Kontur personnel to observe, record and photograph features of geotechnical significance.

3.0 UNDERSTANDING OF PROJECT

The subject property consists of Lot A, District Lot 2247, Group 1, New Westminster District, Plan BCP39086 except Strata Plan BCS3916 (Phase 1-5).

Based on review of the Subdivision Plan the proposed development generally consists of 12 single family residential lots, a roadway about 200m to provide access and associated servicing.

4.0 SITE DESCRIPTION

4.1 General

The subject property was located within the southeastern portion of the Wedge Woods subdivision. The property is irregular in shape with the eastern boundary being about 1100m in length with a north-south orientation, the east-west dimension ranged from about 427m in the southern portion to about 130m in the northern portion. The proposed development is located in the southern portion of the property, south of Wedgemount Creek. The property was bounded by undeveloped land to the north and east, Wedge Woods development to the south and west.

A gravel access road had been constructed east of the subject property and between the northern part of the proposed development and Wedgemount Creek. Access roads to a site trailer used for construction of the Wedge Woods development had been constructed in the southern portion of the proposed development.

Topography within the subject property generally consisted of a bedrock ridge oriented in a southwest-northeast direction. The ridge surface was undulating and was inclined downwards to the northeast towards Wedgemount Creek. On the east side of the ridge a gully, parallel to the ridge, was noted. The gully was wide at the south end narrowing to the north to about 10m wide with bedrock sides. In the central portion of the proposed development the east side of the gully formed a bedrock bluffs up to about 30m in height. North of the access road, the topography generally consisted of steeply inclined bedrock controlled north facing slopes.

Talus deposits were noted on the eastern portion of the proposed development area within the gully. The talus deposits originated with the bedrock bluffs near the subject property's eastern boundary.

Wedgemount Creek was located north of the proposed development area flowing from the east outletting into Green River, west of the Wedge Woods development.

4.2 Soil Conditions

Based on a review of surficial geology plan Open File 5324, "Surficial Geology and Landslide Inventory of the Upper Seat to Sky Corridor" obtained from the Geologic Survey of Canada the subject property is underlain by bedrock. Observations of bedrock outcrops throughout the proposed development area



generally confirm the surficial geology plan. Excavations to the bedrock surface was noted in the gully on the eastern portion of the proposed development where the bedrock was covered with talus deposits.

4.3 Groundwater Conditions

No groundwater seepage was noted with the proposed development area nor were any significant surface water runoff (other than Wedgemount Creek).

5.0 COMMENTS AND RECOMMENDATIONS

5.1 General

The proposed development area is located in an area of gentle to moderately inclined bedrock-controlled slopes. Talus deposits were noted in the eastern portion of the proposed development area. It is considered that the bedrock is generally suitable for construction of residential buildings with adequate bearing capacity and settlements within typical tolerances for such buildings.

The sections below provide comments and recommendations with regards to potential naturally occurring geologic hazards within and adjacent to the subject area that could influence the development.

5.2 Geologic Hazards

As previously discussed, the subject property is located in mountainous terrain with a nearby watercourse therefore the potential for such naturally occurring events as snow avalanche, debris flows, rockfall and slope stability to influence the proposed development should be considered.

Based on observations and interpretations during site reconnaissance and historical aerial photograph review, Kontur has develop a geotechnical characterization of the subject property, mountain slopes and drainage basin within and adjacent to the proposed development. This characterization forms the basis from which Kontur's opinions are provided regarding the likelihood of naturally occurring geologic events influencing the proposed development.

5.2.1 Slope Stability

The slopes within the proposed development are generally bedrock, with localized talus deposits. The global stability of the bedrock-controlled slopes are considered adequate for static and seismic conditions. No significant indications of slope movement were noted during site reconnaissance or during aerial photograph reviews.

5.2.2 Rockfall

Talus deposits noted near the eastern portion of the proposed development originated from rock ravelling from the bedrock bluffs. The talus deposits appeared to have a well defined western limit as the runout of rockfall was limited by the western side of the gully. The locations of the rocks furthest from the source bedrock bluffs were noted during site reconnaissance. The limits of the rockfall are shown on the attached Subdivision Plan. The area within the rockfall limits are considered to have a moderate to high annual probability of occurrence and areas outside of the rockfall limits are considered to have a very low annual probability of occurrence.



It is recommended that no habitable structures be constructed within the area within the rockfall limits shown on the Subdivision Plan. It may be possible to construct mitigative measures to reduce the rockfall hazard to very low in this area; however, such measures are considered to be uneconomical.

5.2.3 Snow Avalanche

In general, snow avalanche paths can be identified by vegetation consisting of deciduous trees such as aspen or cottonwoods, grouped together and separated from the surrounding coniferous trees. No area fitting this description were noted during site reconnaissance or aerial photograph review. The probability of snow avalanches influencing the property is considered to be very low.

6.0 CLOSURE

The above noted and attached information presents Kontur's understating of the proposed development, interpretations of site conditions and opinions as to the existence of naturally occurring geologic hazards, within and adjacent to the proposed development, and the influence areas of those hazards that could affect the proposed development. The lack of comprehensive historical records with respect to naturally occurring geologic hazards within or adjacent to the proposed development limits the ability of Kontur to complete a quantitative assessment of specifically identified hazards. Therefore, Kontur has provided a qualitative assessment based on Kontur's experience and interpretations of existing site conditions. Some understanding of terminology and associated ranges of annual probability of occurrence connected with this approach is provided in a reference prepared by the Resource Inventory Committee, Government of British Columbia, Slope Stability Task Force (1996) as shown in Table A below.

TABLE A
Relative Terms and Ranges of Annual Probability of Hazard Occurrence
(Resource Inventory Committee, 1996)

Relative Term of Probability	Range of Annual Probability of Occurrence (Pa)	Comments
Very High	>1/20	Indicates the hazard is imminent and well within the lifetime of a person or typical structure. Events occurring with a return interval of 1/20 or less generally have clear and relatively fresh signs of disturbance.
High	1/100 to 1/20	Indicates that the hazard can happen within the approximate lifetime of a person or typical structure. Events are clearly identifiable by deposits and vegetation but may not appear fresh.
Moderate	1/500 to 1/100	Indicates that the hazard, within a given lifetime, is not likely but possible. Signs of previous events, such as vegetation damage may not be easily identified.
Low	1/2500 to 1/500	Indicates the hazard is of uncertain significance.
Very Low	<1/2500	



March 9, 2020
Project No.: K-180335-00

Geotechnical Assessment
Residential Development
Phase 7, Wedge Woods, Whistler, BC

Provided the recommendations of this report are implemented the property is considered to be safe for the intended use, that being the development of the property for commercial residential purposes. The term "safe" specifically refers to the ability of the subsurface soils to provide adequate bearing to support a building within typical settlement tolerances and global slope stability is adequate and the subject property is free of hazards with a return period less than that indicated in Section 1.0; however, the approving authority must determine risk acceptability for development approval.

The comments and recommendations presented in this report are based on the referenced information and Kontur's understanding of the project as described herein. If site conditions or project parameters differ from those described in this report, Kontur should be notified promptly to review geotechnical aspects of the project and provide additional or modified comments and recommendations, as deemed appropriate. Contractors should make their own assessments of subsurface conditions at this site and select the construction means and methods that are most appropriate for encountered site conditions.

This report has been prepared for the exclusive use of the 28165 Yukon Inc., Squamish Lillooet Regional District and/or their designated agents or consultants. Any use of the information contained in this letter for other than its intended purpose or by any other party must first be verified in writing by Kontur. Kontur does not accept any responsibility or damages because of any other party relying on or using the information, interpretations, opinions, comments, and/or recommendations that are contained in this report.

Kontur trusts that the information described above meets your current requirements. If you should have any concerns or questions, please do not hesitate to contact the undersigned.

Sincerely,

Kontur Geotechnical Consultants Inc.

Per:

Evan Sykes, P.Eng.
Principal Geotechnical Engineer

Reviewed by:

Matthew Yip, M.Eng., P.Eng.
Principal Geotechnical Engineer



March 9, 2020
Project No.: **K-180335-00**
Geotechnical Assessment
Residential Development
Phase 7, Wedge Woods, Whistler, BC

APPENDIX A
Interpretation and Use of Study and Report Document



INTERPRETATION AND USE OF STUDY AND REPORT DOCUMENT

1.0 STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental engineering or consulting.

2.0 COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3.0 BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4.0 USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5.0 INTERPRETATION OF THE REPORT

Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

Reliance on Provided information: The evaluation and conclusions contained in the 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 the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

To avoid misunderstandings, KONTUR should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by KONTUR. Further, KONTUR should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with KONTUR's recommendations. Any reduction from the level of services normally recommended will result in KONTUR providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When KONTUR submits both electronic file and hard copies of reports, drawings and other documents and deliverables (KONTUR's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by KONTUR shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by KONTUR shall be deemed to be the overall original for the Project.

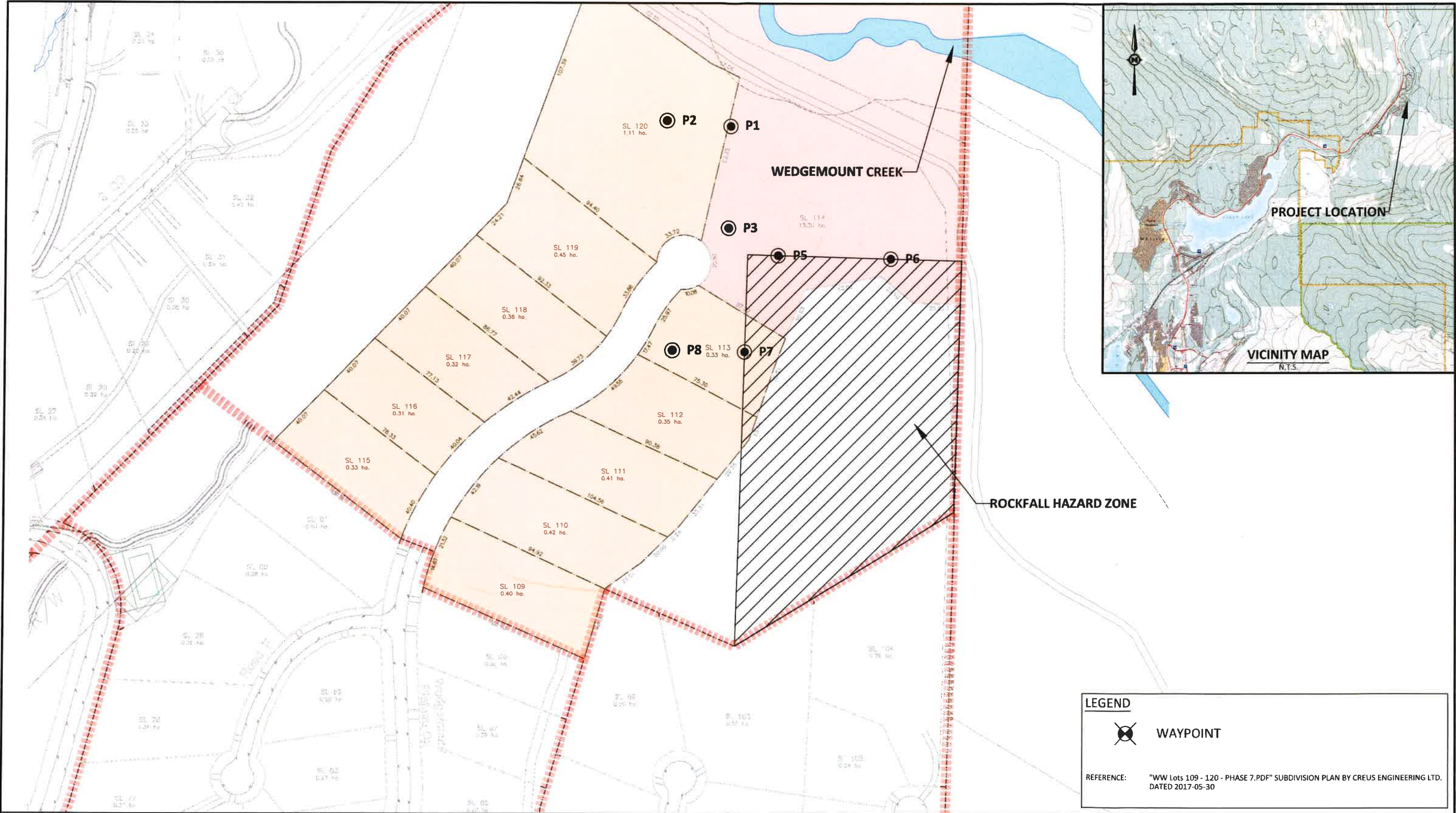
The Client agrees that both electronic file and hard copy versions of KONTUR's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except KONTUR. The Client warrants that KONTUR's instruments of professional service will be used only and exactly as submitted by KONTUR.

The Client recognizes and agrees that electronic files submitted by KONTUR have been prepared and submitted using specific software and hardware systems. KONTUR makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.



March 9, 2020
Project No.: **K-180335-00**
Geotechnical Assessment
Residential Development
Phase 7, Wedge Woods, Whistler, BC

APPENDIX B
Figures



LEGEND

WAYPOINT

REFERENCE:

"WW Lots 109 - 120 - PHASE 7.PDF" SUBDIVISION PLAN BY CREUS ENGINEERING LTD.
DATED 2017-05-30

REVISIONS		
NO	DESCRIPTION	DATE
0	ISSUED FOR REPORT	2020-03-04

TITLE	SITE PLAN
CLIENT	28165 YUKON INC.
PROJECT LOCATION	PHASE 7 WEDGE WOODS, WHISTLER BC

PROJECT NO.:	K-180335-00		
DATE:	2020-03-04	SCALE:	DWG NO.: FIGURE 1
DRAFT:	JL	DESIGN:	CHECK: EGS



March 9, 2020
Project No.: **K-180335-00**
Geotechnical Assessment
Residential Development
Phase 7, Wedge Woods, Whistler, BC

APPENDIX C
Photographs



PHOTO 1 – Bedrock Knoll, South End of Property (P1)



PHOTO 2 – Bedrock Knoll, South End of Property (P2)



PHOTO 3 – Gully Down to Access Road, North End Property (P3)



PHOTO 4 – Flat lying Ground Surface – Central Portion of Property (P4)



PHOTO 5 – Talus Slope Eastern Portion of Property (P5)



PHOTO 6 – Access Road South Portion of Property (P6)



PHOTO 7 – Talus Slope Behind Trees, Eastern Portion of Property (P7)



PHOTO 8 – Gravelled Surface over Bedrock, South End of Property (P8)



March 9, 2020
Project No.: **K-180335-00**
Geotechnical Assessment
Residential Development
Phase 7, Wedge Woods, Whistler, BC

APPENDIX D
Appendix D : Landslide Assessment Assurance Statement

APPENDIX D: LANDSLIDE ASSESSMENT ASSURANCE STATEMENT

Note: This Statement is to be read and completed in conjunction with the "APEGBC Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia", March 2006/Revised September 2008 ("APEGBC Guidelines") and the "2006 BC Building Code (BCBC 2006)" and is to be provided for *landslide assessments* (not floods or flood controls) for the purposes of the Land Title Act, Community Charter or the Local Government Act. Italicized words are defined in the APEGBC Guidelines.

To: The Approving Authority

Date: March 2, 2020

Squamish Lillooet Regional District

PO Box 219, 1350 Aster St, Pemberton, BC, V0N 2L0

Jurisdiction and address

With reference to (check one):

- ☒ Land Title Act (Section 86) – Subdivision Approval
- ☐ Local Government Act (Sections 919.1 and 920) – Development Permit
- ☐ Community Charter (Section 56) – Building Permit
- ☐ Local Government Act (Section 910) – Flood Plain Bylaw Variance
- ☐ Local Government Act (Section 910) – Flood Plain Bylaw Exemption
- ☐ British Columbia Building Code 2006 sentences 4.1.8.16 (8) and 9.4 4.4.(2) (Refer to BC Building and Safety Policy Branch Information Bulletin B10-01 issued January 18, 2010)

For the Property:

Lot A, DL 2247, Gp 1, NWD, Plan BCP39086 except Strata Plan BCS3916 (Phase 1-5)

Legal description and civic address of the Property

The undersigned hereby gives assurance that he/she is a *Qualified Professional* and is a *Professional Engineer or Professional Geoscientist*.

I have signed, sealed and dated, and thereby certified, the attached *landslide assessment* report on the Property in accordance with the *APEGBC Guidelines*. That report must be read in conjunction with this Statement. In preparing that report I have:

Check to the left of applicable items

- x 1. Collected and reviewed appropriate background information
- x 2. Reviewed the proposed *residential development* on the Property
- x 3. Conducted field work on and, if required, beyond the Property
- x 4. Reported on the results of the field work on and, if required, beyond the Property
- x 5. Considered any changed conditions on and, if required, beyond the Property
- 6. For a *landslide hazard analysis* or *landslide risk analysis* I have:
 - x 6.1 reviewed and characterized, if appropriate, any *landslide* that may affect the Property
 - x 6.2 estimated the *landslide hazard*
 - x 6.3 identified existing and anticipated future *elements at risk* on and, if required, beyond the Property
 - x 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*
- 8. Where the Approving Authority has **not** adopted a *level of landslide safety* 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 this guideline 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)

I hereby give my assurance that, based on the conditions^[1] contained in the attached *landslide assessment* report,

Check one

- ☒ for subdivision approval, as required by the Land Title Act (Section 86), "that the land may be used safely for the use intended"

Check one

- ☒ with one or more recommended registered covenants.
- ☐ without any registered covenant.

- ☐ for a development permit, as required by the Local Government Act (Sections 919.1 and 920), my report will "assist the local government in determining what conditions or requirements under [Section 920] subsection (7.1) it will impose in the 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 registered covenants.
- ☐ without any registered covenant.

- ☐ for flood plain bylaw variance, as required by the "Flood Hazard Area Land Use Management Guidelines" associated with the Local Government Act (Section 910), "the development may occur safely".

- ☐ for flood plain bylaw exemption, as required by the Local Government Act (Section 910), "the land may be used safely for the use intended".

Evan Sykes, P.Eng.

Name (print)

March 2, 2020

Date

Signature

^[1] When seismic slope stability assessments are involved, *level of landslide safety* is considered to be a "life safety" criteria as described in the National Building Code of Canada (NBCC 2005), Commentary on Design for Seismic Effects in the User's Guide, Structural Commentaries, 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".

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Port Coquitlam, BC, V3C 6G5

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Telephone

(Affix Professional seal here)

If the *Qualified Professional* is a member of a firm, complete the following.

I am a member of the firm Kontur Geotechnical Consultants Inc.

and I sign this letter on behalf of the firm.

(Print name of firm)