



October 23, 2017

Reference No.: VAN-00241231-A0

Mr. Chris Osborne
City of Campbell River
301 St. Ann's Road
Campbell River, BC
V9W 4C7

Email: chris.osborne@campbellriver.ca

**RE: Third Party Geotechnical Review
Proposed 6-level Residential Development
1430 Island Highway South (Hwy. 19A), Campbell River BC**

Dear Mr. Osborne,

1.0 INTRODUCTION

Further to the Letter dated July 25, 2017, prepared by EXP Services Inc. (EXP) and titled '*Third Party Geotechnical Review*' regarding the above-referenced redevelopment, EXP has prepared this letter. The purposes of this letter are:

- to summarize recent discussions and meetings with the project's Geotechnical Engineer-of-record (Terran Geotechnical Consultants Ltd.); and,
- to provide EXP's most recent comments and opinions with respect to the proposed development and identified geotechnical challenges.

The previously issued letter by EXP is intended to form part of this letter. Review and use of this letter should be completed in accordance with the attached *Interpretation and Use of Study and Report* document. These documents are included as an integral part of this letter and should be read in conjunction with all parts of this letter. This letter does not address any environmental issues related to the proposed project.

It is important to note that the scope of services discussed in this letter are strictly limited to review of the geotechnical aspects of the identified items only and that detailed engineering analysis, calculations, or detailed studies, have not been carried out by EXP as part of this review.

2.0 DISCUSSION

Based on several items identified by EXP as requiring clarification, several meetings and discussions were completed between EXP and Terran Geotechnical Consultants Ltd. (Terran Geo). Terran Geo has subsequently issued the letter '*Clarification Response to Third Party Geotechnical Review*' dated September 18, 2017.

The following comments are provided with respect to Terran Geo's response to EXP's requests for clarification.

- **Clarification Request No. 1**

Terran Geo has provided clarification on the interpreted soil profile. While not stated in their written response, based on conversations between EXP and Terran Geo, it is EXP's understanding that the

site visits by Terran Geo were completed when there was little vegetation cover on the face of the slope which allowed for detailed visual review of the soils exposed along the face of the slope. Visual review was completed in combination with several shallow hand-dug and hand-operated testholes as summarized by Terran Geo.

It is noted by EXP that there are some inconsistencies with respect to terminology in the response, such as the use of 'dense' clay, opposed to 'very stiff' or 'hard' clay. It is also noted that the deep testholes only 'qualitatively' describe the consistency or 'compactness' of the soils at the base of the slope.

Based on this information and discussions with Terran Geo, the methodology used to interpret the soil profile at this site is considered to be reasonable and suitable for this site. Furthermore, while there are some inconsistencies in the descriptive terminology, the soil parameters used by Terran Geo appear to be reasonable; however, are based largely on surficial and/or qualitatively described information.

Therefore, it is considered prudent by EXP that during the detailed design stages (perhaps during the Building Permit process) of the project that more detailed testhole information be obtained, either by Cone Penetration Testing, Standard Penetration Testing, or a suitable alternative, in order to gain more quantitative-based data that can be used for the detailed geotechnical designs and inputs for the project.

Ultimately, while EXP's opinion on the specifically selected parameters may differ, it is the responsibility of the Engineer-of-Record to select these parameters, who also has the added advantage of having completed more thorough site review and/or evaluations.

EXP has no further comment or requests for clarification on this item.

- **Clarification Request No. 2**

Terran Geo has indicated that it '*agrees rapid mudflow forms part of the overall landslide failure mechanisms*' for this site. Terran Geo has proposed to construct an interceptor ditch at the crest of the slope, install horizontal drains into the face of the slope to lower the static groundwater level, and to install a high-tensile steel mesh and soil nail system at the top of the slope to stabilize the soil mass. It is understood that the installation of a high-tensile steel mesh and soil nail/anchor system or equivalent is proposed in place of moving the building to a position that is set back a suitable horizontal distance away from the anticipated mudflow debris runout zone.

Provided these systems are properly designed and constructed, it is EXP's opinion that the recommendations provided by Terran Geo are reasonable and appropriate. Should these measures not be adequately implemented, it is EXP's opinion that a suitable horizontal setback from the toe of the slope be established. The detailed designs should be provided for the building permit application.

EXP has no further comment or requests for clarification on this item.

- **Clarification Request No. 3**

Terran Geo has now shown that under existing conditions, the Factor of Safety against sliding is estimated to be about 1.1 (static). Terran Geo previously showed that under seismic conditions, the Factor of Safety against sliding was less than 1, which does not meet the acceptability criteria used by Terran Geo. No updated section was provided in the response related to seismic slope stability conditions.

A Factor of Safety against sliding under static conditions of about 1.7 was shown by Terran Geo when the installation of a soil nail/anchor and wire mesh system and associated drainage measures are installed/constructed. This meets the minimum criteria under static conditions of 1.5 that was identified by Terran Geo.

It is EXP's opinion that seismic slope stability analysis should be presented to show if the recommended mitigation measures meet or do not meet the criteria being compared by Terran Geo (i.e. is the Factor of Safety under seismic conditions greater or equal to 1.1).

Provided it is shown that the seismic slope stability criteria is achieved, EXP has no further comment or requests for clarification on this item.

- **Clarification Request No. 4**

While the response by Terran Geo to this request does not specifically answer or provide any additional information or clarification, EXP has no comment with respect 'risk' or 'risk of fatality'. EXP is experienced and qualified to identify and assess geological hazards and the potential occurrence or frequency of these hazards. This is discussed as part of the previous item (Clarification Request No. 3). EXP is not experienced or qualified to assess risk or 'risk of fatality'. The risk should be evaluated by a Qualified Professional in risk assessments and/or the City of Campbell River.

On this basis, no further comment is provided by EXP on this item.

3.0 GEOTECHNICAL OPINION

Within the limits of this review, it is EXP's opinion that provided the recommended mitigation measures are properly designed and constructed, that the site can be re-developed as proposed. Mitigation measures should include, but are not limited to the items proposed by Terran Geo which include:

1. Provisions to effectively control and convey surface water runoff away from the slope and/or proposed buildings;
2. Provisions to lower the static groundwater level in the slope by installing horizontal drains into the slope; and,
3. Provision to stabilize the crest of the slope by installing a system of soil anchors (or nails) and suitable facing (wire mesh).

As previously discussed by EXP, it is EXP's opinion that wherever possible, avoidance of the hazard should be considered by positioning the building away from the hazard zone. Where this is not practical, the above-listed mitigation measures are considered to be appropriate.

Constructability issues should be addressed in more detail for the Building Permit stage of the project. This should include discussion on temporary surface and groundwater control, excavation, and excavation support. Temporary excavation into the slope should be avoided or minimized. Where excavation is required into the slope, temporary support measures in the form of shotcrete panels and soil anchor tie-backs and/or soldier pile systems are likely to be required.

4.0 CLOSURE

The comments and recommendations presented in this letter are based on the referenced information and EXP's understanding of the project as described herein. If subsurface conditions or project parameters differ from those described in this report, EXP should be notified promptly in order to review the geotechnical aspects of the project and modify them if necessary.

exp Services Inc.

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This letter has been prepared for the exclusive use of *City of Campbell River* and/or their designated consultants or agents. Any use of the materials contained in this letter for other than its intended purpose or by any other party must first be verified in writing by EXP Services Inc. EXP does not accept any responsibility or damages as a result of any other party relying on or using the information and recommendations contained in this letter.

EXP trusts that this meets your current requirements. Should you have any concerns or questions, please do not hesitate to contact the undersigned.

Sincerely,

EXP Services Inc.



Matthew Yip, P.Eng., M.Eng.
Project Manager | Geotechnical Engineer

Reviewed by:

A handwritten signature in blue ink, appearing to be "E. Sykes".

Evan Sykes, P.Eng.
Senior Geotechnical Engineer

Enclosed: Interpretation and Use of Study and Report



INTERPRETATION & USE OF STUDY AND REPORT

1. 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 consulting unless specifically stated in the engineering report.

2. 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. 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. 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. INTERPRETATION OF THE REPORT

- a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelope 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.
- b. 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.
- c. To avoid misunderstandings, **exp Services Inc. (exp)** 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 **exp**. Further, **exp** 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 **exp's** recommendations. Any reduction from the level of services normally recommended will result in **exp** providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When **exp** submits both electronic file and hard copies of reports, drawings and other documents and deliverables (**exp'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 **exp** 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 **exp** shall be deemed to be the overall original for the Project.

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

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