APPENDIX I

STEEP SLOPE

Addendum Note:
Updated to Steep Slope and Rockfall Hazard Assessment Final Sealed (May 5, 2021)

Visit the website for any updates or addendums
www.shuswapnorthokanaganrailtrail.ca/development-plan

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May 5, 2021

Sicamous to Armstrong Rail Trail Technical Operational Committee,
c/o Urban Systems Ltd.,
#500 - 1708 Dolphin Avenue,
Kelowna, BC
V1Y 9S4

Attention: Mr. Thomas Simkins, P.Eng.
Project Manager

Dear Mr. Simkins,

Steep Slope and Rockfall Hazard Assessment
Sicamous-to-Armstrong Rail Trail

1.0 INTRODUCTION

1.1 Authorization

The work reported upon in this document was authorized by yourself on behalf of the Sicamous to Armstrong Rail-Trail Technical Operational Committee in June 2020.

1.2 Qualifications

Use of this report is subject to the Statement of Qualifications and General Conditions, which is attached. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

1.3 Terms of Engagement

The terms under which our services are provided are attached.

2.0 SCOPE OF THE REPORT

This document is related to that portion of the Sicamous-to-Armstrong Rail Trail (SART) that extends from Station 0+000 in Sicamous, BC, just south of the Sicamous Narrows Bridge, to Station 49+500 which is located at the junction of Highway 97 and Landsdowne Road just north and east of Armstrong, BC.

The rail trail is to function as a public multi-use pathway, especially for walking and cycling. This report is intended to provide a preliminary assessment of potential steep slope hazards, specifically; the document considers risks associated with rockfall and debris slides that may impact public safety along the trail. Preliminary recommendations are made with the intent of reducing risk to the travelling public.

On the basis of an in-house review of aerial photography, the only potential rockfall and debris slide hazards exist between Stations 0+000 and 23+000.

3.0 SURFICIAL GEOLOGY

Available surficial geology mapping indicates that the first 23 km of the rail trail is predominantly underlain by bedrock and modern alluvium consisting of sand, gravel, silt and minor muck and peat. The materials on site are consistent with that description.

4.0 FIELD RECONNAISSANCE

Subsequent to a desktop aerial photography review of the alignment to locate over-steep and rock sections of interest, a field reconnaissance was carried out to observe pertinent sections of the rail trail by Terry Eddy, P.Eng., and Ryan Stearns, P.Eng., of Fletcher Paine Associates Ltd. on July 17, 2020.

It was determined in the field that the trail is not subject to any rockfall or debris slide hazards located south of Station 14+460.

Although there were a few exceptions, ditching along the alignment was typically narrow and shallow such that rockfall and debris slides would not be contained within them. Furthermore, the trail is very rarely of sufficient width to allow the construction of a sufficiently large ditch for rock catchment purposes.

This document does not discuss the embankment underlying the trail but it was noted that there are some locations where the embankment is eroding and/or slipping along Mara Lake.

5.0 ASSESSMENT

5.1 General

For the purposes of this report, the assignment of a rockfall or debris slide as a hazard implies that there is a risk of harm to people using the trail from those phenomena. The hazard risk is estimated by the writer based on consideration of estimated frequency, volume of falling/sliding materials, and consequence.

5.2 Levels of Risk

- Low Risk - This category implies that the hazard risk to public safety is minimal and no mitigative action is recommended. This does not mean "no" risk and the public should be provided some information along the trail as discussed elsewhere in this report.
- Moderate Risk - A moderate risk implies that there is a hazardous condition that requires heightened attention by trail users and some mitigation is recommended.
- High Risk - A high hazard risk indicates that the trail should not be opened prior to carrying out mitigative measures to reduce risk of harm to the public.

5.3 Observed Conditions and Recommendations

The table below summarizes observations. Photographs are attached as Appendix A.

Stationing	Level of Risk	Hazard	Recommended Mitigation
3+680 to 4+200	Low to Moderate	Rockfall	Scale the rock face
4+450 to 4+560	Low to Moderate	Rockfall	Scale the rock face
4+560 to 4+660	High	Rockfall	Scale to reduce to Moderate Risk
4+760 to 4+835	Moderate	Rockfall	Scale to reduce to Low to Moderate Risk
5+600	Low	Earth/Talus	Clean Ditch
5+930 to 5+960	Moderate	Rockfall	Scale the rock face
12+700 to 12+710	Low	Rockfall	None
13+600 to 13+900	Low to Moderate	Rockfall	Scale the rock Face
13+900 to 14+100	Moderate to High	Rockfall	Heavy Scaling

6.0 DISCUSSION

6.1 Mitigation

Mitigative measures recommended in the above table are intended to reduce the public exposure to risk but do not remove risk in its entirety. Typically a low to moderate risk will be improved to a low risk when scaling is complete. In order to remove all risk, significant works would be required such as blasting, bolting and/or draping. Additional works could include catchment ditches, however; there is seldom room available at this project site to provide wide ditching.

6.2 Signage

Signage should be installed at public access points with advisories related to the rockfall hazards. With the exception of low risk areas, signage should also be installed at each section where moderate and/or high risk rockfall hazards are allow to remain. The moderate to high risk signage should advise the public to move through and do not pause between specific stations.

6.3 Monitoring

It is recommended that a qualified engineer carry out a follow-up hazard assessment to the site during spring freshet each year for the first three years to confirm that the frequency and volume of any rockfall meets with expectations and to provide additional recommendations if necessary. The writer envisages a reduced frequency of monitoring after three years of observation such that one site visit every five years should suffice over the long term.

7.0 CONCLUSIONS

1) Some rockfall hazards were encountered during the site reconnaissance that should be subjected to scaling such that the level of public safety is improved.

2) Alternative means of addressing the hazard conditions are available that would require engineering design recommendations but do not form a part of the scope of work for this document.

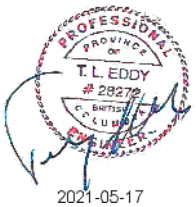
3) A qualified engineer should monitor the rock slope conditions over time.

4) The rail trail can be relatively safely used by the public provided that the recommendations made in the report are adhered to.

We trust that the contents of this document are appropriate for your needs. If you should have any queries please call our office.

Yours truly,

Fletcher Paine Associates Ltd.



Terry Eddy, P.Eng.

Sr. Geotechnical Engineer

STATEMENT OF QUALIFICATIONS AND GENERAL CONDITIONS

1. Standard of Care

This report has been prepared in accordance with generally accepted geotechnical engineering practices in this area. No other warranty, expressed or implied, is made.

2. Basis of the Report

This report has been prepared for the specific site, design objective, development and purpose that was described to Fletcher Paine Associates Ltd. (FPA) by the client and summarized in this letter. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the report are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to FPA, unless FPA was specifically requested by the Client to review and revise the report in light of such alteration or variation.

3. Uses of the Report

The information and opinions expressed in this report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THIS REPORT OR ANY PORTION THEREOF WITHOUT FPA's EXPRESS WRITTEN CONSENT. FPA WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS APPROVED USERS. The ownership and copyright of this report remain the property of FPA, who authorizes only the Client and Approved Users to make copies of the report and 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 available the report or any portion thereof, or any copy of the report or portion thereof, to any other party without the express written permission of FPA.

4. Complete Report

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to FPA by the Client, communications between FPA and the Client, and to any other reports prepared by FPA for the Client relative to the specific site described in the report.

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

5. Interpretation of the Report

a) Nature and Exactness of Soil Description: Classification and identification of soils, rocks, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from these systems have been used they are specifically mentioned. Classification and identification of the type and condition of soils, rocks and geologic units are judgmental in nature. Accordingly, FPA cannot warrant or guarantee the exactness of the descriptions of in situ ground conditions set forth in the Report.

b) Logs of Test Holes, Pits, Trenches, etc.: The test hole logs are a record of information obtained from field observations and laboratory testing of selected samples as well as an interpretation of the likely subsurface stratigraphy at the test holes sites. In some instances normal sampling procedures do not recover a complete or any sample. Soil, rock or geologic zones have been interpreted from the available data. The change from one zone to another, indicated on the logs as a distinct line, may be transitional. The same limitations apply to test pit and other logs.

c) Stratigraphic and Geologic Sections: The stratigraphic and geologic sections indicated on drawings contained in this report are interpreted from logs of test holes, test pits or other available information. Stratigraphy is inferred only at the locations of the test holes or pits to the extent indicated by items 5. a) and b) above. The actual geology and stratigraphy, particularly between these locations, may vary considerably from that shown on the drawings. Since natural variations in geologic conditions are inherent and a function of the historic site environment, FPA does not represent or warrant that the conditions illustrated are exact and the user of the report should recognize that variations may exist.

d) Groundwater Conditions: Groundwater conditions shown on logs of test holes and test pits, and/or given within the text of this report, record the observed conditions at the time of their measurement. Groundwater conditions may vary between test hole and test pit locations and can be affected by annual, seasonal, and special meteorological conditions, or by tidal conditions for sites near the seas. Groundwater conditions can also be altered by construction activity. These types of variation need to be considered in design and construction.

e) Changes of Exposed Ground: Many geologic materials deteriorate rapidly upon exposure to climatic elements. Deterioration may be caused by precipitation, sunshine and/or the action of frost. Therefore, site conditions may vary considerably from the time of the making of the tests performed for preparation of the report and the time of actual construction.

f) Influence of Construction Activity: Construction activities can alter and damage the in situ ground conditions. The influence of all anticipated construction activities on the geologic environment should be considered in formulating and implementing the final design and construction techniques.

Wherever changes in the site occur after the preparation of the report or conditions are observed which indicate results clearly incompatible with the test results on which the report is based, the client and any other users of this report should notify FPA as soon as possible so that FPA will be able to provide necessary revisions to its report prior to any commencement of or alteration in design and construction.

6. Observations during Construction

Observations of geologic conditions should be carried out during the site preparation, excavation and construction to verify the conditions predicted by the report. Such observations should be communicated to FPA to allow for confirmation and/or alteration of the geotechnical recommendations or design guidelines presented in the report.

Whenever changes in the site occur after the preparation of the report or conditions are observed which indicate results clearly incompatible with the test results on which the report is based, then the client should notify FPA as soon as possible so that FPA will be able to provide necessary revisions to its report prior to any commencement of or alteration in design and construction.

7. Samples

FPA normally disposes of all unused soil and rock samples after 90 days of completing the testing program for which the samples were obtained. Further storage or transfer of samples can be made at the owner's expense upon written request.

TERMS OF ENGAGEMENT

1. General

Fletcher Paine Associates Ltd. (FPA) shall render its services to the Client for this project with that degree of care, skill and diligence normally provided in the performance of services for projects of a similar nature to that contemplated.

In rendering services to the Client, FPA may, at its discretion and at any stage, engage subconsultants to FPA to carry out its duties and responsibilities as set forth.

2. Compensation

Charges for the services rendered will be made in accordance with our Schedule of Fees in effect at the time the work is performed. All charges will be made in, and will be payable in, Canadian Dollars. Invoices will be due and payable on receipt without holdback. A monthly service charge will be applicable to invoices remaining unpaid after 30 days.

3. Notices

FPA will designate a project manager who shall be responsible for the project. The Client shall designate an authorized representative to act with respect to the project.

4. Termination

Either party may terminate this engagement with cause upon seven (7) days notice in writing. The Client shall forthwith pay for all services performed, including all expenses and other charges payable that are associated with obligations incurred by FPA for this project.

5. Environment and Pollution

The FPA field investigation, laboratory testing and engineering recommendations are not intended to address or evaluate pollution of soil or pollution of groundwater. When practical, FPA will cooperate with the Client's environmental consultant during the field work phase of the investigation.

6. Professional Responsibility

FPA will provide the standards of care, skill and diligence normally provided by a Professional Engineer in the performance of engineering services as contemplated for this project.

7. Limitations of Liability

FPA shall not be responsible for:

a) The failure of a Contractor to perform work in accordance with the relevant contract documents for the Project;

b) The design of, or defects in, equipment provided by or on behalf of the Client by others, for incorporation into the Project;

c) Any damage to subsurface structures or utilities; resulting from subsurface investigations for the Project;

d) Any cross-contamination of ground or groundwater resulting from subsurface investigations for the Project;

e) Any costs incurred for stopping the flow of artesian water from test holes in the event that such conditions are encountered during any field investigation for the Project;

f) Any decisions made by the Client in relation to the Project that are inconsistent with, or contrary to, the advice provided by FPA;

g) Any consequential loss, injury, or damages suffered by the Client, including but not limited to loss of use, loss of earnings, or business interruption;

h) The distribution of any document or report prepared for the Client by or on behalf of FPA for the Project without express authorization by FPA.

Notwithstanding anything to the contrary, the aggregate liability of FPA, including liability for professional negligence and fundamental breach of contract, shall be limited to the amount of Professional Liability insurance carried by FPA.
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The Client's failure to accept the professional recommendations and advice of FPA with respect to the geotechnical conditions at the Project shall relieve FPA of and from any and all legal liability, whether in contract or in tort, to the Client for all manner of loss and damage accruing to the Client, including consequential loss and damage, which may arise out of the FPA services.

8. Personal Liability

The Client agrees that FPA's principals and employees have no personal liability to the Client in respect of a claim whether in contract, tort, and/or any other cause of action in law, and expressly agrees that it will bring no proceedings and take no action in any court of law against any of FPA's principals or employees in their personal capacities.

9. Third Party Liability

This report was prepared by FPA for the Client and the material presented in it reflects the opinions and judgements of FPA as based upon the information available at the time of its preparation. Any use(s) made of this report by a third party is/are the sole responsibility of such third parties. FPA will not accept any responsibility for damages suffered by any third party as a result of decisions made or actions taken that are ostensibly based upon this report. Any use or reliance upon this report by a third party must be authorized in writing by FPA

10. Documents

All of the Documents prepared by FPA in connection with the Project are instruments of service for the execution of the Work. FPA retains the property and copyright in those Documents, whether the Project is executed or not. These Documents may not be used on any other project without prior written agreement and remuneration.

11. Field Services

Where applicable, the field services recommended are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with the intent of our recommendations. Any reduction from the level of services recommended will result in FPA providing qualified opinions regarding the adequacy of the work.

12. Confirmation of Professional Liability Insurance

As required by the Association of Professional Engineers and Geoscientists of British Columbia, it is required that our firm advise whether or not Professional Liability Insurance is held. It is also required that a space for you to acknowledge this information is provided. Accordingly, this notice serves to advise you that FPA carries professional liability insurance. If you wish to acknowledge receipt of this information please sign and return a copy of this form.

APPENDIX A

Station 3 + 850

Station 4 + 180

Station 4 + 100

Station 4 + 200

Station 4 + 460

Station 4 + 560

Station 4 + 540

Station 4 + 620

Station 4 + 820

Station 13 + 680

Station 5 + 660

Station 13 + 840

Station 13 + 620

Station 14 + 020

Station 14 + 000

Station 14 + 050