Fletcher Paine Associates Ltd.

Consulting Geotechnical and Materials Engineers

Vernon Office
2250 11 Avenue
Vernon, B.C. V1T 7X8

Kelowna Office
544 Bernard Avenue
Kelowna, B.C. V1Y 6P1

File 6671

May 17, 2021

Allnorth Consultants Ltd.
206 - 3200 Richter Street
Kelowna, B.C.
V1W 5K9

Attention: Simon Davis, NZCE
Municipal Project Manager

Dear Mr. Davis,

Geotechnical Investigation and Report
Summerland Watermain Replacement Projects
District of Summerland, B.C.

1.0 INTRODUCTION

1.1 Authorization

The work reported upon in this document was authorized by Brad Colvey, Eng.L. of Allnorth Consultants Ltd. (The Client) on December 2, 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.

1.4 Report Usage Limitations

This report has been prepared exclusively for the use of the client listed above, for the use of others on their design team, and for those responsible for the permitting process.

1.5 Scope of the Report

The contents of this report are intended to provide preliminary geotechnical recommendations related to the proposed watermain replacement projects in Summerland, B.C., at the following locations, which are shown on the attached Site Location Plan, Figure 6671-1:

a) Dale Meadows Road between Walton Street and Haddrell Avenue, approximately 1200 m in length. The proposed improvements for this section include full width road upgrades and shoulder bikeways.

b) Canyon View Road alignment that includes Canyon View Road, Paradise Road, McGee Street and Mountain Avenue; approximately 1000 m in length. An alternative watermain alignment is proposed that would extend along a currently unsecured right of way extending from Simpson Road to the north ends of Sherk Street and Mountain Avenue; approximately 1000 m in length. The proposed improvements for this section include full width road upgrades and shoulder bikeways.

The contents of this report will address the following specific items:

a) Surficial geology at the project locations

b) Geotechnical field and laboratory investigations carried out for the project

c) The engineering properties and characteristics of the subsoils at the site

d) Potential reuse of existing materials within proposed constructions

e) Recommendations for trench excavations and backfill procedures

f) Recommended pavement structure design, construction methods and procedures

g) Preliminary retaining wall considerations

2.0 SURFICIAL GEOLOGY

2.1 Dale Meadows Road

The site is described on available surficial geological maps as glacial lake sediments consisting of sand, gravel and silt. The materials encountered during this field

investigation were consistent with available surficial geological mapping. In addition, post glacial sediments consisting of muck, mucky peat, marl and peat were encountered at the west and lower elevation areas of the roadway.

2.2 Canyon View Road Alignment

The site is described on available surficial geological maps as glacial outwash terrace deposits consisting of a silt, sand, and gravel. The materials encountered during this field investigation were consistent with available surficial geological mapping.

3.0 INVESTIGATIONS

3.1 Field Investigation

The field investigation consisted of drilling seventeen exploratory boreholes (BH) on January 19, 2021 using a truck-mounted drill rig owned and operated by Mud Bay Drilling Ltd. The boreholes were made for the purposes of identifying the subsoil stratigraphy at the exploration locations and recovering disturbed samples of the encountered soils for further classification and testing in the laboratory. Standpipe piezometers were installed at select borehole locations so that static groundwater levels could be monitored within the investigation depths.

Detailed borehole logs are provided on the attached Records of Exploration and the borehole locations are shown on the attached Borehole Location Plans A and B, Figures 6671-2 and 6671-3 respectively.

3.1.1 Dale Meadows Road (BH 1 through BH 8)

The boreholes were made through an asphalt surface ranging between 50 mm and 100 mm in thickness. The road structure fill encountered beneath the asphalt consisted of compact sands and gravels, gravelly sands, and silty, gravelly sands that extended to depths ranging between 0.2 m and 1.5 m below the existing surface. At the locations of BH 7 a second fill layer was encountered below the asphalt and road structure fill that consisted of a loose to compact mixture of sand, gravel, silt with some topsoil that extended to a depth of 2.1 m below the existing surface. Peat was encountered below the asphalt and fill soils at the locations of BH 1, BH 2 and BH 3 that extended to depths ranging between 3.0 m and 3.7 m below the ground surface. At the location of BH 3 peaty sands and silts, and peaty, clayey silts were interlayered within the peat.

The native soils underlying the fill and peat at the locations of BH 1, BH 2, and BH 3 were medium plastic, soft to stiff clayey silts. The boreholes ended at a depth of 4.6 m below the existing ground surface.

The native soils underlying the fill at the locations of BH 4 through BH 8 were compact to dense gravelly sands, silty sands, and silts and sands. BH 4 through BH 7 ended at a depth of 3.0 m below the existing ground surface. BH 8 ended at 1.5 m due to drilling refusal in possible bedrock.

Standpipe piezometers were installed at the locations of BH 1, BH 3 and BH 7 to monitor static groundwater levels within the investigated depth. When measured on February 4, 2021 the groundwater level at the locations of BH 1, BH 3 and BH 7 was 0.4 m, 1.0 m, and 1.6 m below the existing ground surface, respectively.

3.1.2 Canyon View Road Alignment (BH 9 to BH 17)

The boreholes at the locations of BH 9 through 12, BH 14, and BH 15 were made through an asphalt surface ranging between 40 mm and 50 mm in thickness. The road structure fill encountered beneath the asphalt consisted of compact sand and gravel, gravelly sand, and sand that extended to depths ranging between 0.15 m and 0.3 m below the existing surface. At the locations of BH 13, BH 16 and BH 17 were made through a fill surface consisting of compact silty, gravelly sand, and sand and silt that extended to 0.1 m to 0.8 m below the existing ground surface.

The boreholes at the locations of BH 13, BH 16 and BH 17 were made through a fill surface consisting of compact silty, gravelly sand, and sand and silt that extended to depths ranging between 0.1 m and 0.8 m below the existing ground surface.

The native soils underlying the fill at the borehole locations were loose to compact sands, gravelly sands, and silty, gravelly sands to the terminus of the boreholes, at 3.0 m below the existing ground surface.

Standpipe piezometers were installed at the locations of BH 11 and BH 16 to monitor static groundwater levels within the investigated depth. When measured on February 4, 2021 the standpipes were dry.

3.2 Asphalt Surface Conditions

3.2.1 Dale Meadows Road

The condition of the investigated asphalt surface on Dale Meadows Road was assessed visually on January 19, 2021 and is characterized as very poor. The surface exhibited extensive cracking, fatigue cracking, and ravelling along its length. Subsidence at the outside edges of the roadway was observed from Haddrell Avenue to Gould Avenue Crack tar seal maintenance and asphalt patch repair work were also observed.

A 200 m length of road at the east end of the Dale Meadows Road from the Walton Street intersection was in moderate condition. Minor cracking, ravelling, and utility repair patching was observed.

3.2.2 Canyon View Road Alignment

The condition of the investigated asphalt surfaces on Canyon View Road, Paradise Avenue, McGee Street and Mountain Avenue was assessed visually on January 19, 2021 and is characterized as very poor. The surfaces exhibited extensive cracking, fatigue cracking, and ravelling along their lengths. Severe subsidence was observed on Canyon View Road due to a perpetual slope instability. Patching from utility repairs and base failures were observed.

3.3 Laboratory Investigation

Natural moisture contents were determined for all recovered samples and are reported on the attached Record of Exploration. An Atterberg liquid and plastic limit determination test was performed on a select fine-grained sample from BH 1 and seven grain size distribution tests were performed on select samples of the in situ native soils and road structure fill soils and the test results are attached to this report. The Atterberg liquid and plastic limit determination and grain size distribution test results are attached to this report.

4.0 SUBSOIL ENGINEERING PROPERTIES AND CHARACTERISTICS

4.1 Fill, Topsoil and Peat

Due to the non-homogeneous and organic nature of the fill materials, topsoil, and peat encountered at the borehole locations, no engineering properties can be reasonably assigned to them.

4.2 Plasticity and Swelling Potential

Based on the Atterberg limit test results, the in situ undisturbed medium plastic clayey silts encountered during the investigation have a low potential for volume change (shrink/swell) with changes in moisture contents.

4.3 Estimated CBR Values of the In Situ Soils

An estimated California Bearing Ratio (CBR) value of 15 can be used for design where the subgrade will consist of the undisturbed native gravelly sands, and silty, gravelly sands.

An estimated CBR value of 6 can be used for design where the subgrade will consist of the undisturbed native sands, silty sands, and silts and sands.

An estimated CBR value of 3 can be used for design where the subgrade will consist of the undisturbed native clayey silts.

4.4 Frost Susceptibility

The following table summarizes the test results from the grain size distribution tests related to the percent passing the 0.075 mm diameter sieve. Soils with more than 7 percent passing the 0.075 mm diameter sieve are frost susceptible to some degree. Clay, silt, and organic soils are highly susceptible to frost.

Sample Description and Depth	Material	Percent Passing 0.075 mm Sieve
BH 1-1 at 0.6 m	Fill – Sand, silty, gravelly	31.1 %
BH 5-2 at 0.9 m	Silt and Sand, trace gravel	47.1 %
BH 6-1 at 0.5 m	Sand and Gravel, silty	21.4 %
BH 7-1 at 0.3 m	Fill – Gravel and Sand, trace silt	8.0 %
BH 11-1 at 0.6 m	Sand, trace silt, trace gravel	6.2 %
BH 13-1 at 0.9 m	Sand, gravelly, trace silt	7.8 %
BH 16-1 at 0.2 m	Fill - Sand, silty, gravelly	23.9 %

5.0 SALVAGEABLE MATERIALS

It is understood that gradation and compaction specifications for subgrade fill and trench backfill materials should satisfy District of Summerland Subdivision and Development Servicing Bylaw No. 99-004 (DoS Bylaw) which references Master Municipal Construction Documents (MMCD) specifications for trench backfill and road structure materials. However, additional recommendations are provided below without regard to MMCD in the event that alternate design and specification options are requested. Approval for reuse of materials should be obtained by the client representative.

5.1 Clayey Silt, Peat, and Fill Soils with Topsoil

The clayey silt, peat, and fill soils with appreciable amounts of topsoil should not be used for subgrade fill and/or trench backfill purposes.

5.2 In Situ Granular Soils and Granular Fill Soils

The in situ granular soils and granular fill soils encountered at the site are suitable for reuse as subgrade fill and trench backfill above pipe zones. The salvaged soils should be placed in loose lifts not exceeding 300 mm in thickness that are moisture conditioned within 2 percent of optimum and compacted, and in accordance with this report.

5.3 Existing Asphaltic Concrete Roadway Surface

The existing asphalt pavement can be salvaged for reuse as subgrade and trench backfill to subgrade levels above pipe zones provided it is prepared as discussed below.

The existing asphalt surface can be milled to a 25 mm (-) condition and blended with the existing granular fill and road structure base materials at the site, or with imported pit-run sands and gravels (150mm maximum grain size). The blend should be such that there are at least three volumes of granular soil for every one of asphaltic concrete (3G:1A). This Reclaimed Asphalt Pavement (RAP) material can then be moisture conditioned, spread in trenches or below subgrade levels, and compacted to the satisfaction of the geotechnical engineer.

6.0 TRENCH EXCAVATIONS AND FILLS

It is understood that complete removal of peat soils below water lines for the purposes of pipe support may not be economically feasible on Dale Meadows Road. If peat soils are left in place, civil design for water mains and services should take into consideration the potential for differential movement. Engineering assurances for pipe support where peat soils are left in place cannot be provided; however, reasonable performance can be expected provided the recommendations in this report are adhered to.

Trench considerations related to the perpetual slope instability at Canyon View Road is outside the scope of this report and it is understood that the District of Summerland has completed a preliminary geotechnical slope stability assessment. Water mains should take into consideration the potential movement associated with this slope.

6.1 Dale Meadows Road Groundwater and Dewatering

Groundwater was measured on Dale Meadows Road in the standpipes and is expected to impact trenching activities for typical trench depths of 1.5 m to 1.8 m.

The recommended slope gradients provided in Section 6.3 are dependent on a dewatering program specific to the work site. It is envisaged that drain rock pipe bedding and sumps will be suitable for Dale Meadows Road; however, the finalized method of dewatering will depend on the elevation of the base of the excavation, groundwater levels at the time of construction and construction methodology.

The contractors geotechnical engineer, retained to satisfy Worksafe BC guidelines, should recommend the final dewatering and slope stability design parameters for the excavation, since one is dependent on the other. The recommendations made in this report are guidelines and are not intended to provide assurances of excavation safety during construction.

6.2 Temporary Excavations Above Groundwater Table

Temporary excavated slopes can be made as steep as they can be safely maintained by the contractor provided that they are in compliance with the current WorkSafe BC regulations and the project requirements. If unsure of the stability of the excavation side slopes, the contractor should engage the services of a geotechnical engineer to assure compliance with the WorkSafe BC guidelines. The recommendations made in this report are guidelines and are not intended to provide assurances of excavation safety during construction.

Specifications and methods related to trench excavation should conform with the most recent version of the DoS Bylaw and this report.

6.3 Temporary Excavations Below Groundwater Table

For preliminary design purposes the following unsupported temporary excavated slope configurations can be used for the proposed sanitary alignments. Hydraulic head is the height of the static groundwater table above excavation base and trench geometry is based on anticipated dewatering recommendations provided by a qualified geotechnical engineer at the time of construction. Ranges of hydraulic head are based on measured groundwater levels and a typical water line install depth of 1.5 m to 1.8 m below ground surface and pipe support excavation depths.

The following geometries assume that the excavations are made at a rate that allows pore pressures to dissipate as the excavation and trench pumping proceed.

Clayey Silts and Peat

1.) Hydraulic head 0 m to 1.0 m – 1.25H:1.0V
2.) Hydraulic head 1.0 m to 3.0 m – 2.0H:1.0V

Granular Materials – Sands, Gravels, Silty Sands, Sands and Silts

1.) Hydraulic head 0 m to 1.0 m – 1.0H:1.0V
2.) Hydraulic head 1.0 m to 2.0 m – 1.5H:1.0V

We estimate that the above carefully excavated and dewatered unsupported side slope gradients will be stable on a temporary basis. The actual stable gradients would be dependent on groundwater elevations, dewatering efforts, precipitation, surcharge loads, and methods and procedures applied at the time of construction.

Excavation support that includes trench boxes or cage support should be used at locations where steeper side slope gradients are needed, provided that support and excavation configurations are in compliance with WorkSafe BC guidelines.

6.4 Trench Backfills, Pipe Foundation Soil Preparation, and Pipe Zone Materials

Specifications and methods related to pipe zone and trench backfill materials, construction methods and procedures, and quality assurance and control should conform with this report and the applicable specifications of the most recent version of the DoS Bylaw and MMCD.

In the event that the base of excavation consists of soft, weak, loose, deleterious or organic soils they should be removed until competent soils are encountered, as determined by the geotechnical engineer. An exception to this is on Dale Meadows Road in peat soils; excavation at these locations should be limited to 600 mm below pipe invert. If required, and if natural moisture and groundwater conditions permit, backfill to pipe invert elevations should consist of clean, well graded 150 mm (minus) sands and gravels, or approved salvage materials, that are moisture conditioned to within 2 percent of optimum, compacted to at least 95 percent of Modified Proctor dry density (MPD) in accordance with ASTM D1557. Loose lifts should not exceed a thickness of 300 mm prior to being compacted.

The following specific procedures are recommended to address dewatering and compaction requirements at locations where the base of trench conditions are wet and in peat:

a) All existing uncontrolled fill, disturbed soils, and all other soft and/or loose materials should be removed to expose the natural and undisturbed in situ soils, or to an elevation at least 300 mm below the pipe invert, whichever is deeper, and to allow sump and pump operations. At locations where the base of trench is in peat the excavation should extend at least 600 mm below pipe invert. The trench base should be observed by the geotechnical engineer prior to proceeding to the backfill stage.

b) As the excavation proceeds, the exposed undisturbed base of excavation should be immediately covered with non-woven geotextile (Nilex 4545 or an approved equivalent) overlapped by at least 300 mm at seams. The geotextile should be placed on the base and sides of the excavation such that it extends to a distance of at least 600 mm above the proposed top of pipe installation, or at least 600 mm above the groundwater surface levels during pipe installation and backfilling operations, whichever is higher.

c) Once the geotextile is in place, the trench base should be backfilled using 12 mm to 50 mm clear drain rock to the underside of pipe elevations and pumping operations should be maintained to keep the water levels below these levels. The surface of the drain rock should be provided with nominal compaction using a light plate tamper, and placed in lifts where drain rock thickness exceeds 450 mm.

d) The drain rock should continue to be used for pipe zone and trench backfill purposes until the surface of the drain rock is above the existing groundwater levels. The surface of the drain rock backfill should be completely covered by geotextile fabric that overlaps the existing geotextile fabric.

e) The groundwater level can be controlled and maintained with the drain rock and geotextile preparation using sumps from which the water can be pumped and directed to safe and approved outlets.

7.0 PAVEMENT STRUCTURE DESIGN

7.1 Discussion

It is understood that full width road re-construction is proposed for Dale Meadows Road and Canyon View Road Alignments consisting of Mountain Avenue, McGee Street, Paradise Road and Canyon View Road. Road widening for bikeways is proposed for both locations.

The proposed Dale Meadows Road pavement structure design and subgrade preparation is recommended with the understanding that excessive removal of the peat soils is not economically feasible and some differential settlement could be expected.

7.2 Design Qualification

Engineering assurances cannot be provided for road structures that are placed above non engineered fill, topsoil or peat. If full engineering assurances are required, all fill, organic and other deleterious materials would need to be removed in conjunction with incorporating a structurally adequate pavement structure.

Engineering assurances cannot be provided for road structures built over the Canyon View Road slope instability location until remedial stabilization works have been completed.

The road structure designs provided below will satisfy the strength requirements for the specified traffic loads but will not address frost susceptibility in its entirety. Full frost protection for a 15 year design life at this site would require a road structure consisting of at least 750 mm of non-frost susceptible granular soils, or its equivalent in insulating value.

The road structure design life assumes that a road maintenance program exists such that cracks are filled before the underlying road structure is damaged due to the introduction of excess moisture.

7.3 Pavement Structure Design Criteria

The pavement structure design provided in this report are based on the DoS Bylaw and in accordance with the methodologies presented in "AASHTO Guide of Pavement Structures", (1993) for a 15-year design life. The District of Summerland Transportation Master Plan map identifies that the Dale Meadows Road and Canyon View Road Alignment roadways should be based on the local road classification.

The DoS Bylaw specifies that projected Equivalent Single Axle Loads (ESAL) be applied

in the design of municipal roads. The bylaw specifies that an ESAL value of $2.8x10^4$ should be used for a 15 year design for local roadways design, where 1 ESAL equals 8165 kg. No traffic data was available for these roadways.

7.4 Pavement Structure Design

Based on the gathered information, the subgrade preparation specified in Sections 7.5 and the qualifications noted above, the following minimum pavement structure is recommended for the subject roads:

Canyon View Road Alignment

THICKNESS (mm)	MATERIAL
50	MMCD Upper Course #1 Hot Mix Asphalt (placed in one lift)
100	DoS 19 mm (-) Crushed Granular Base Course
300	DoS 75 mm (-) Crushed Granular Subbase Course
	For Prepared Subgrade (See Section 7.5)

Dale Meadows Road

THICKNESS (mm)	MATERIAL
50	MMCD Upper Course #1 Hot Mix Asphalt
100	DoS 19 mm (-) Crushed Granular Base Course
300	DoS 75 mm (-) Crushed Granular Subbase Course
	For Prepared Subgrade (See Section 7.5)

Dale Meadows Road with peat subgrade

THICKNESS (mm)	MATERIAL
50	MMCD Upper Course #1 Hot Mix Asphalt
100	DoS 19 mm (-) Crushed Granular Base Course
300	DoS 75 mm (-) Crushed Granular Subbase Course
n/a	Naue Combigrid 30/30 (or an approved equivalent)
	For Prepared Subgrade (See Section 7.5)

7.5 Subgrade Preparation

a) Subgrade preparation should include the removal of all soils to the top of subgrade design elevation. The excavation should be extended outside the edges of the pavement by a distance that is equal to the fill thickness that is to be placed beneath the paved surface. The exposed subgrade surface should be observed by the geotechnical engineer to confirm that all obvious deleterious materials have been removed before proceeding with construction.

At Dale Meadows Road, where subgrade soils consist of peat or wet soils, the excavation should extend to at least 400 mm below design subgrade elevation. For drainage purposes, the sub-excavation should be provided with positive drainage and extend to at least one edge of the roadway, or be provided with trenching, allowing any accumulated water within the low point of the subgrade soils to drain outside of the roadway.

At locations where a road embankment must be constructed, the horizontal extents of the base of the excavation should be further extended for a horizontal distance defined by an imaginary line extending outside the roadway at a 2H:1V slope gradient, until it intersects the competent materials as described above.

b) Where excavation to levels that exceeds the pavement structure thickness requirements are needed, backfill materials used to elevate the subgrade to the design elevation should consist of clean (less than 7 percent passing the 0.075 mm sieve) and well graded 150 mm (-) sands and gravels, or approved salvage materials as discussed in Section 5.0 of this document, that are moisture conditioned within 2 percent of optimum and compacted to at least 95 percent of MPD. Loose lifts should not exceed a thickness of 300 mm prior to being compacted.

At Dale Meadows Road, where subgrade soils consist of peat or wet soils, a Nilex 4545 non-woven geotextile, or an approved equivalent, should be placed on the base and sides of the excavation. 50 mm to 75 mm diameter fractured clear rock should be placed on the geotextile to subgrade elevation and nominally compacted.

c) The finished subgrade surface should be provided with a crown or cross fall gradient of at least two percent to allow efficient drainage toward the outer edges of the roadway of any moisture that may accumulate within the finished road structure.

d) It is recommended that the finished subgrade surface be inspected, and possibly proof rolled, in its entirety in the presence of the geotechnical engineer in order to identify any soft or weak areas before placing subbase materials. Soft or weak areas should be excavated and replaced with pitrun sand and gravel and compacted to 100 percent of SPD.

e) Construction traffic should not continue to travel on any surfaces that appear to be rolling due to pumping actions at the subgrade levels, and vibratory compaction should not continue in areas where pumping of the soils is occurring. The geotechnical engineer should be contacted immediately for advice if any of these phenomena become apparent.

7.8 Subbase, Base, Asphalt and Concrete Constructions

Specifications and methods related to the pavement structure and concrete materials, construction procedures, and quality assurance and control should conform with this report and the current DoS Bylaw and MMCD specifications. If there is a conflict with MMCD and DoS Bylaw specifications the most stringent specification should be used.

7.9 Granular Materials Quality Control / Assurance Testing

The materials testing agency should be provided an opportunity to sample the proposed road and trench construction materials for specification conformance at least two weeks in advance of their use on the project.

7.10 Drainage

Good drainage is of paramount importance to the long-term performance of any roadway. The proposed road upgrade should have permanent drainage provided in the forms of adequate grading, ditching, and/or piping. The bottom of road ditching should be at least 200 mm below subgrade surface levels.

During construction, the site should be maintained in a well-drained condition throughout all phases to reduce the potential for damage to wet subgrade soils by construction traffic due to pumping actions in the native subsoils. Any ditching required during construction should be designed to keep any intermediate or long term flow water surfaces at levels that are below top of subgrade surfaces.

8.0 PRELIMINARY RETAINING WALL CONSIDERATIONS

Preliminary civil design drawings provided by Allnorth Consulting Ltd. propose retaining walls to support proposed road widenings on Dale Meadows Road with wall heights ranging between 0.8 m and 1.5 m. A supplementary investigation is recommended to identify the extent of the peat deposits at proposed retaining wall locations as these deposits may limit the potential options of soil retention at the required locations. In general, most modular block faced mechanically stabilized earth (MSE) retaining wall systems require foundation soils to be free of organic materials.

If the complete removal of peat is not economically feasible, the following MSE retention options have minimal ground preparation requirements and can somewhat tolerate differential foundation soil settlement as a result from leaving peat in place:

a) Flex MSE – front face batter ranging from 35 degrees to 85 degrees, vegetated face required.

b) Tensar Sierra Slope – front face batter 45 degrees and 70 degrees, erosion control or vegetated face required.

The retaining wall options have limitations when constructed on peat and steeper wall batters require more rigorous the foundation soils preparation. In addition, the settlement tolerances that may be satisfactory for the retaining walls may have adverse effects on the asphalt paved road widenings.

9.0 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that, from a geotechnical point of view, the proposed constructions can safely proceed provided the recommendations made in this report are followed.

It is recommended that:

a) The items contained in Section 5.0 through 8.0 of this report be followed.

b) The geotechnical engineer inspect all soils, and soils related work on the project to assure that:

i) all soils conditions are as good or better than those inferred in this report, and that

ii) all soils and soils related construction conforms to this report, designs provided, and the appropriate specifications for the work.

c) Any design(s) or other work for soils or for soils related structures connected with this project and prepared by others be submitted to the geotechnical engineer for review regarding conformity to the requirements and intent of this report.

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

Yours truly,
Fletcher Paine Associates Ltd.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
R. C. STEARNS
35573
17 May 2021

Ryan C. Stearns, P.Eng.
Project Engineer

Reviewed By:

Robert M. Scherz
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.

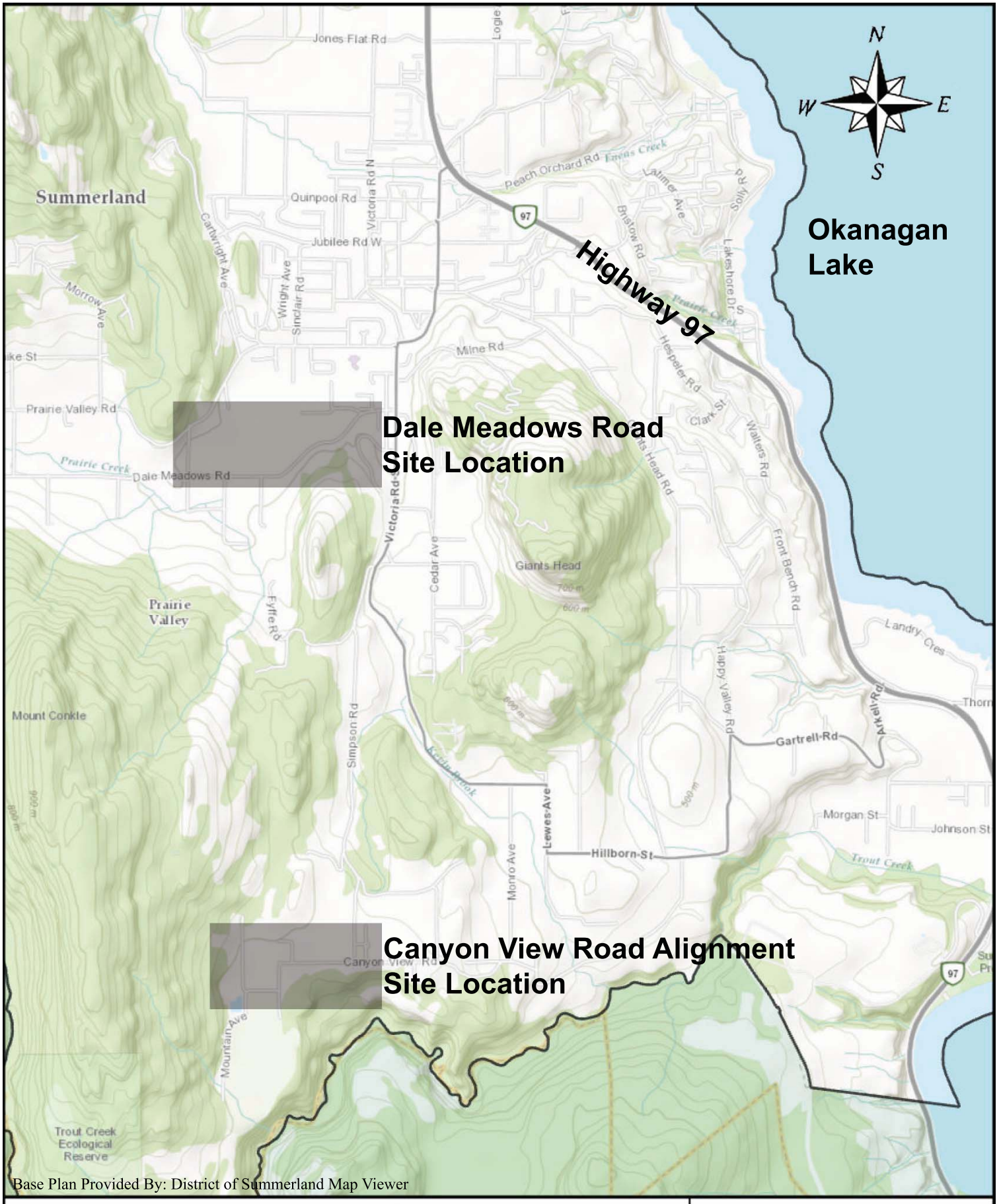
6. Observations during Construction

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.



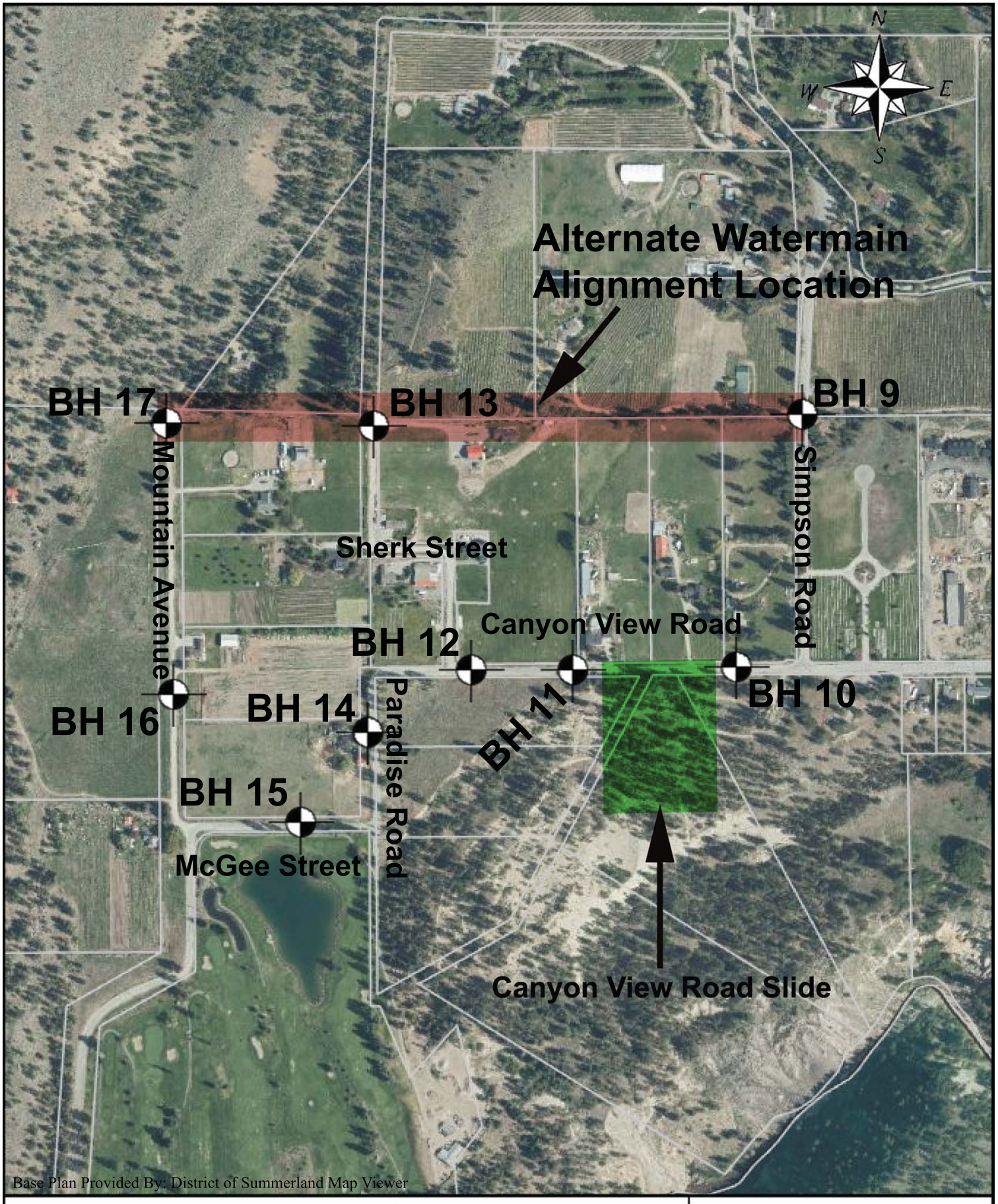
Base Plan Provided By: District of Summerland Map Viewer

Site Location Plan	Figure: 6671 - 1	
	Date: February 1, 2021	Scale: nts

Borehole Location Plan A

Figure: 6671 - 2

Date: February 1, 2021 | Scale: nts



Borehole Location Plan B

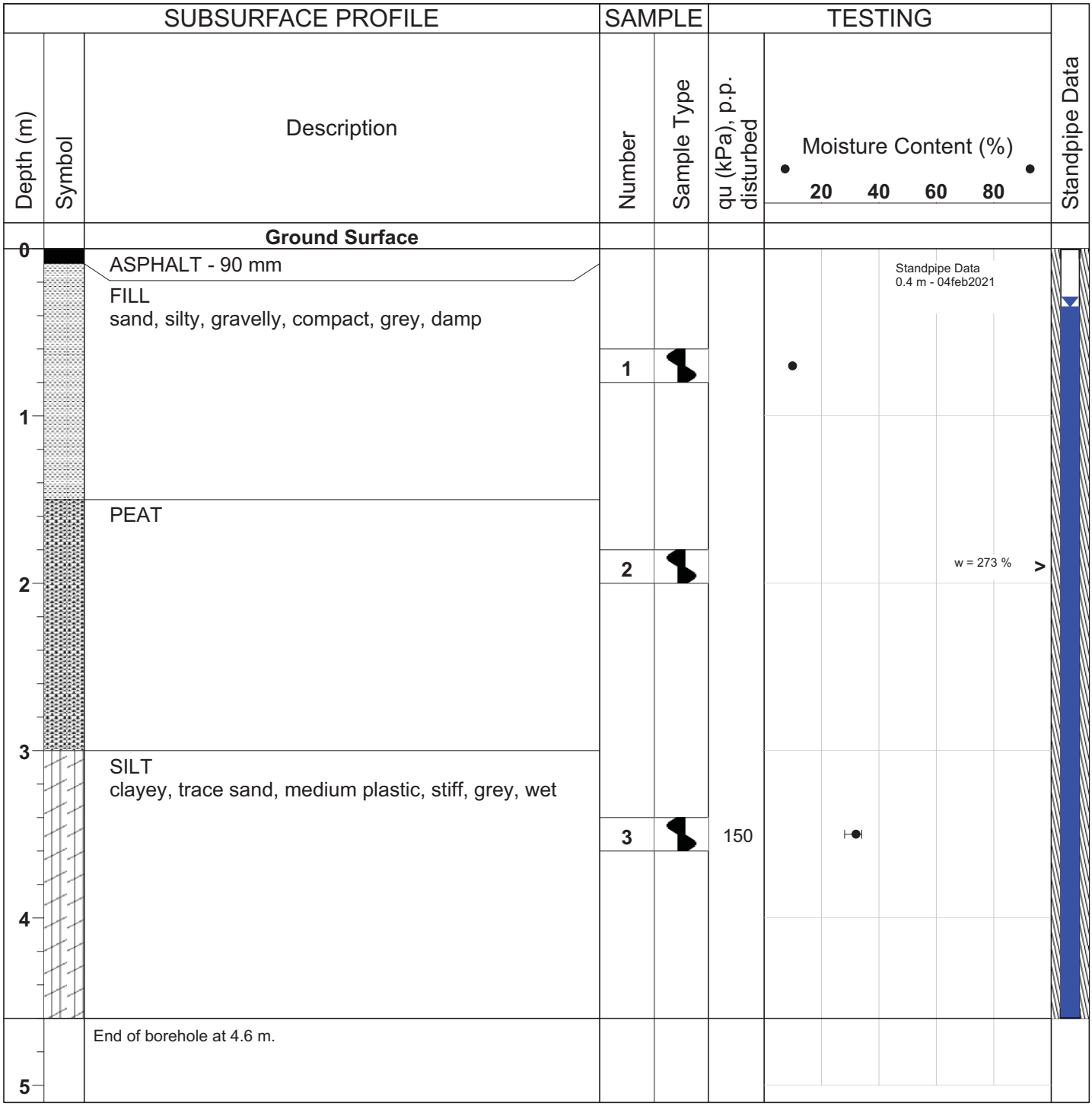
Figure: 6671 - 3

Date: February 1, 2021 | Scale: nts

Record of Exploration - Borehole No. 1

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, 0.5 m north of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem



Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 2

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, on centre line
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 90 mm					
		FILL sand, gravelly, some silt, compact, grey, damp	1			•	
1		PEAT some silt, some sand between 0.6 m and 1.5 m					
2			2			w = 251 % >	
3		SILT clayey, trace sand, medium plastic, firm, grey, wet 300 mm peat seam at 3.6 m	3		80	•	
4							
5		End of borehole at 4.6 m. Groundwater seepage observed at 1.0 m.					

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 3

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, on centre line
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 100 mm					
		FILL sand, gravelly, some silt, compact, brown, damp	1				
		SAND AND SILT peaty, loose, grey, dark brown, wet	2				
1		PEAT					
		SILT clayey, peaty, medium plastic, soft, dark grey, wet	3				
2		PEAT					
3		SILT clayey, trace sand, trace organics, medium plastic, soft, grey, wet	4		40		
4							
		End of borehole at 4.6 m.					
5							

Standpipe Data
1.0 m - 04feb2021

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 4

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, 1.2 m south of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 80 mm					
		FILL sand and gravel, some silt, compact, brown, damp	1			•	
1							
		SAND gravelly, trace silt, compact, grey, wet	2			•	
2							
3		End of borehole at 3.0 m. Groundwater seepage observed at 1.5 m.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 5

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, 1.2 m south of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 50 mm					
		FILL sand and gravel, some silt, compact, brown, damp	1			•	
		SILT AND SAND trace gravel, compact, brown, damp	2			•	
1							
		SAND gravelly, some silt, compact, brown, damp	3			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 6

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, 1.5 m south of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 60 mm					
		FILL sand and gravel, some silt, compact, brown, damp					
		SAND AND GRAVEL silty, compact to dense, grey, damp	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 7

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, 1.2 m south of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 80 mm					
		FILL sand and gravel, trace silt, compact, brown, damp	1				
1		FILL mixture of sand, gravel, silt, some topsoil, loose to compact, brown and dark grey, damp to wet					
2		SAND silty, some gravel, compact, brown, wet	2				
3		End of borehole at 3.0 m.					
4							
5							

Standpipe Data
1.6 m - 04feb2021

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 8

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Dale Meadows Road, Summerland, B.C.

Borehole Location: Figure 6671-2, 1.2 m south of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 60 mm					
		FILL sand and gravel, some silt, compact, brown, damp	1			•	
1		SAND gravelly, some silt, dense, brown, damp					
		End of borehole at 1.5 m due to drilling refusal on bedrock.					
2							
3							
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 9

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Simpson Road, Summerland, B.C.

Borehole Location: Figure 6671-3, 1.2 m west of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 40 mm					
		FILL sand and gravel, some silt, compact, brown, damp					
		SAND medium grained, trace silt, trace gravel, compact, brown, dry to damp	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 10

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Canyon View Road, Summerland, B.C.

Borehole Location: Figure 6671-3, on centre line
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 40 mm					
		FILL sand, some silt, trace gravel, trace topsoil, compact, brown, damp					
		SAND medium grained, trace silt, trace gravel, compact, brown, dry to damp	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 11

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Canyon View Road, Summerland, B.C.

Borehole Location: Figure 6671-3, 1.0 m north of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 50 mm					
		FILL sand, gravelly, trace silt, compact, brown, damp					
		SAND medium grained, trace silt, trace gravel, loose to compact, brown, damp	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m.					
4							
5							

Standpipe Data
Dry - 04feb2021

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 12

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Canyon View Road, Summerland, B.C.

Borehole Location: Figure 6671-3, 1.0 m north of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 50 mm					
		FILL sand, gravelly, trace silt, compact, brown, damp					
		SAND medium grained, trace silt, trace gravel, compact, brown, dry to damp	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 13

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Sherk Street, Summerland, B.C.

Borehole Location: Figure 6671-3, 1.0 m east of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		FILL sand and silt, some gravel, compact, brown, damp topsoil encountered upper 150 mm					
1		SAND gravelly, trace silt, compact, brown, damp	1			•	
2			2			•	
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 14

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Paradise Road, Summerland, B.C.

Borehole Location: Figure 6671-3, on centre line
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 50 mm					
		FILL sand, gravelly, some silt, compact, brown, damp					
		SAND medium grained, trace silt, trace gravel, compact, brown, dry	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 15

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: McGee Street, Summerland, B.C.

Borehole Location: Figure 6671-3, 2.0 m south of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		ASPHALT - 40 mm					
		FILL sand, gravelly, some silt, compact, brown, damp					
		SAND medium grained, trace silt, trace gravel, compact, brown, dry to damp	1			•	
1							
			2			•	
2							
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 16

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Mountain Avenue, Summerland, B.C.

Borehole Location: Figure 6671-3, 1.0 m east of c.l.
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		FILL sand, silty, gravelly, compact, brown, damp	1				
		SAND silty, gravelly, compact, brown, damp					
1			2				
2			3				
3		End of borehole at 3.0 m.					
4							
5							

Standpipe Data
Dry - 04feb2021

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

Record of Exploration - Borehole No. 17

Project No: 6671
Project: Summerland Watermain Replacement Projects
Client: Allnorth Consultants Ltd.
Project Location: Mountain Avenue, Summerland, B.C.

Borehole Location: Figure 6671-3, on centre line
Drilling Contractor: Mud Bay Drilling Ltd.
Drilling Date: January 19, 2020
Sampler Size: 150 mm diameter solid stem

SUBSURFACE PROFILE			SAMPLE		TESTING		
Depth (m)	Symbol	Description	Number	Sample Type	qu (kPa), p.p. disturbed	Moisture Content (%) 20 40 60 80	Standpipe Data
		Ground Surface					
0		FILL sand, silty, gravelly, trace topsoil, compact, brown, damp	1			•	
1		SAND silty, gravelly, compact, brown, damp					
		SAND gravelly, trace silt, compact, brown, dry	2			•	
3		End of borehole at 3.0 m. No groundwater seepage observed.					
4							
5							

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
Email: fletcherpaine@shawlink.ca

FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, B.C. V1T 7X8

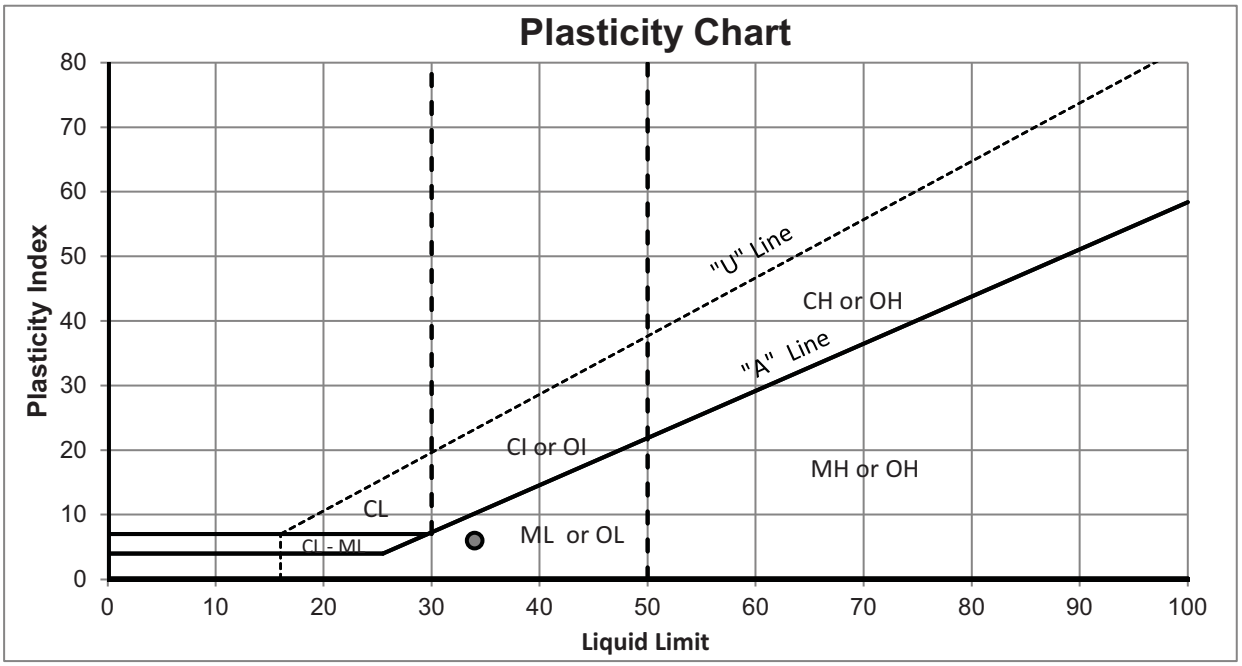
ATTERBERG LIQUID LIMIT AND PLASTIC LIMIT DETERMINATION

ASTM D 4318

Project: Summerland Watermain Replacement Project
Project No: 6671
Client: Allnorth Consultants Ltd.
Date Sampled: 19-Jan-2021
Location: Dale Meadows Road, Summerland, B.C.
Sampled By: RCS
Sample: Borehole 1, Sample 3, Depth 3.4 m

Sample Preparation: Wet preparation method
Test Equipment: Liquid Limit - mechanical device, multi-point method, plastic grooving tool
Plastic Limit - hand rolled

Natural Moisture Content:	**32%**	
Estimated % retained on 0.425 mm sieve:	**0%**	
Liquid Limit:	**34**	
Plastic Limit:	**28**	
Plasticity Index:	**6**	
USCS Classification:	**ML**	inorganic medium plastic clayey silts



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

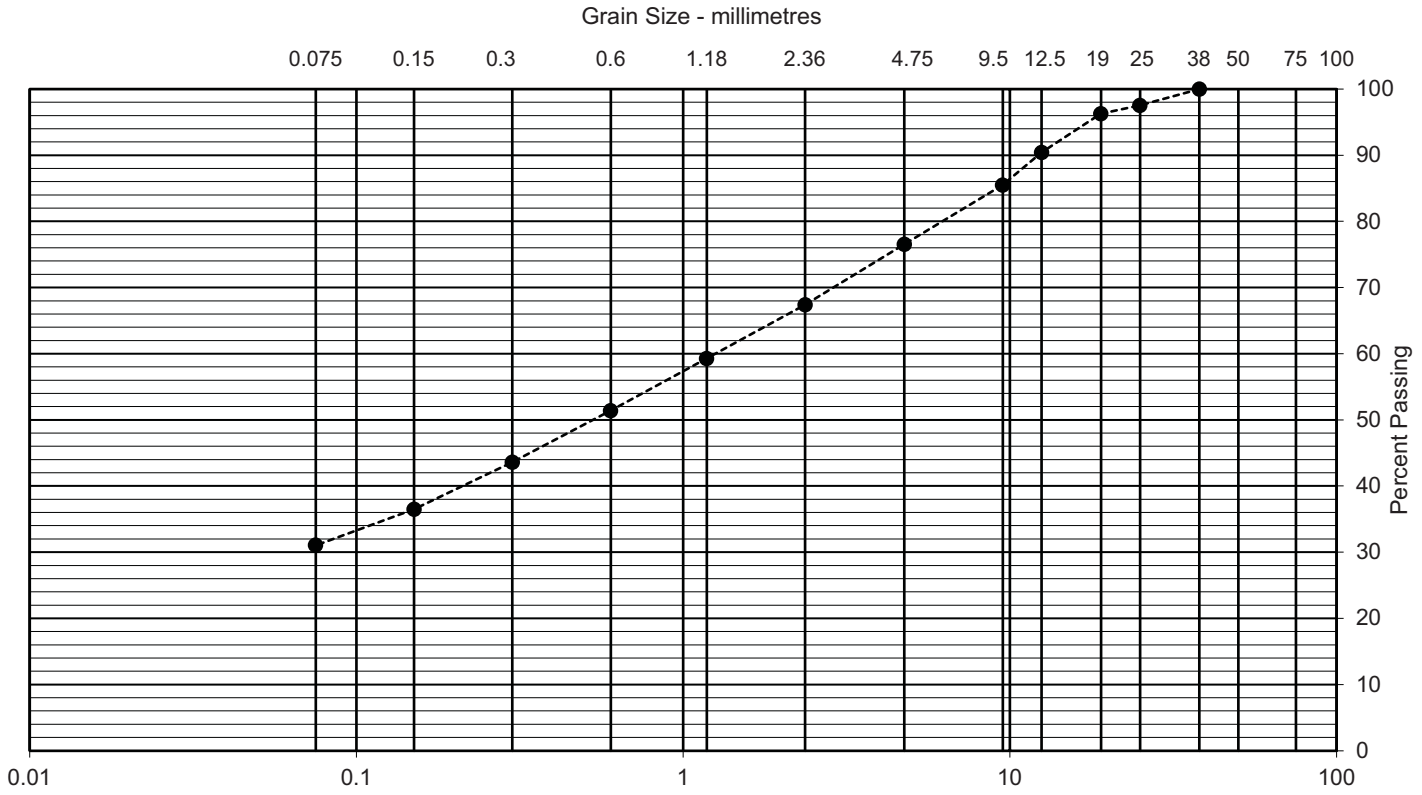
Location: Dale Meadows Road, Summerland, B.C.

Sampled By: RCS

Material: Fill - Sand, silty, gravelly

Sample: Borehole 1, Sample 1, Depth 0.6 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	85.5
100		4.75	76.6
75		2.36	67.4
50		1.18	59.3
38.0	100	0.600	51.4
25.0	97.5	0.300	43.6
19.0	96.3	0.150	36.5
12.5	90.4	0.075	31.1



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

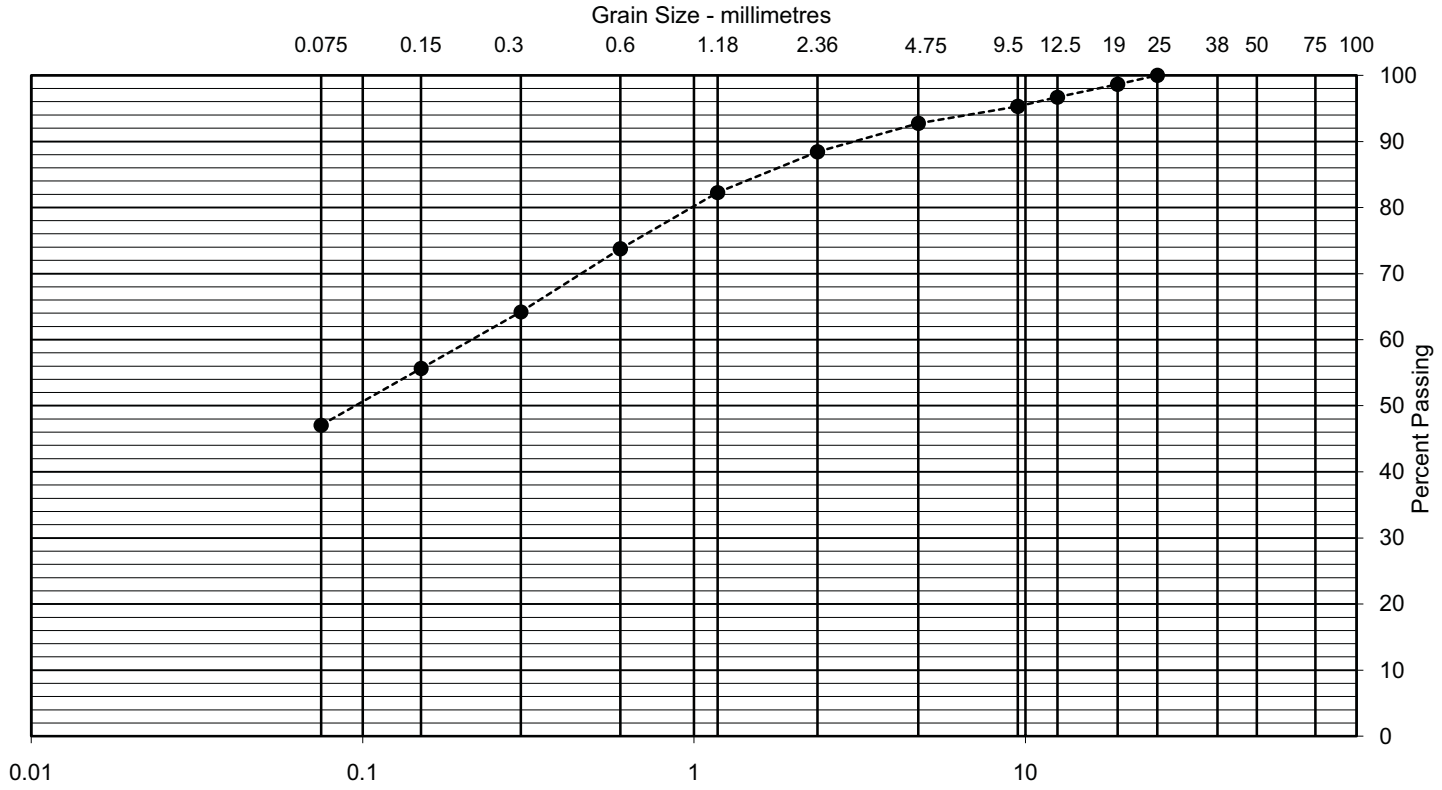
Location: Dale Meadows Road, Summerland, B.C.

Sampled By: RCS

Material: Silt and Sand, trace gravel

Sample: Borehole 5, Sample 2, Depth 0.9 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	95.3
100		4.75	92.7
75		2.36	88.4
50		1.18	82.3
38.0		0.600	73.8
25.0	100	0.300	64.2
19.0	98.7	0.150	55.6
12.5	96.7	0.075	47.1



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

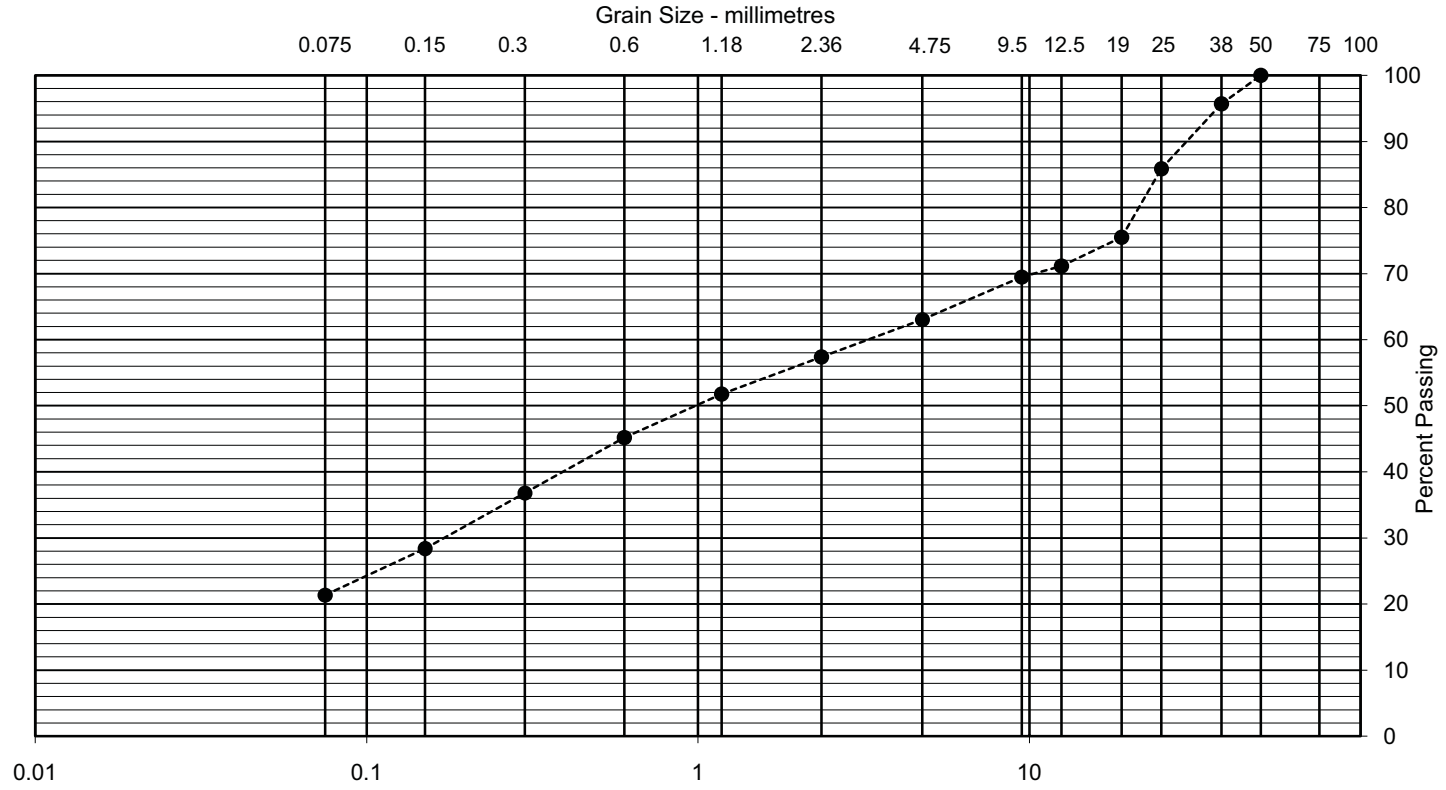
Location: Dale Meadows Road, Summerland, B.C.

Sampled By: RCS

Material: Sand and Gravel, silty

Sample: Borehole 6, Sample 1, Depth 0.5 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	69.5
100		4.75	63.1
75		2.36	57.4
50	100	1.18	51.8
38.0	95.7	0.600	45.2
25.0	85.9	0.300	36.8
19.0	75.5	0.150	28.4
12.5	71.1	0.075	21.4



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

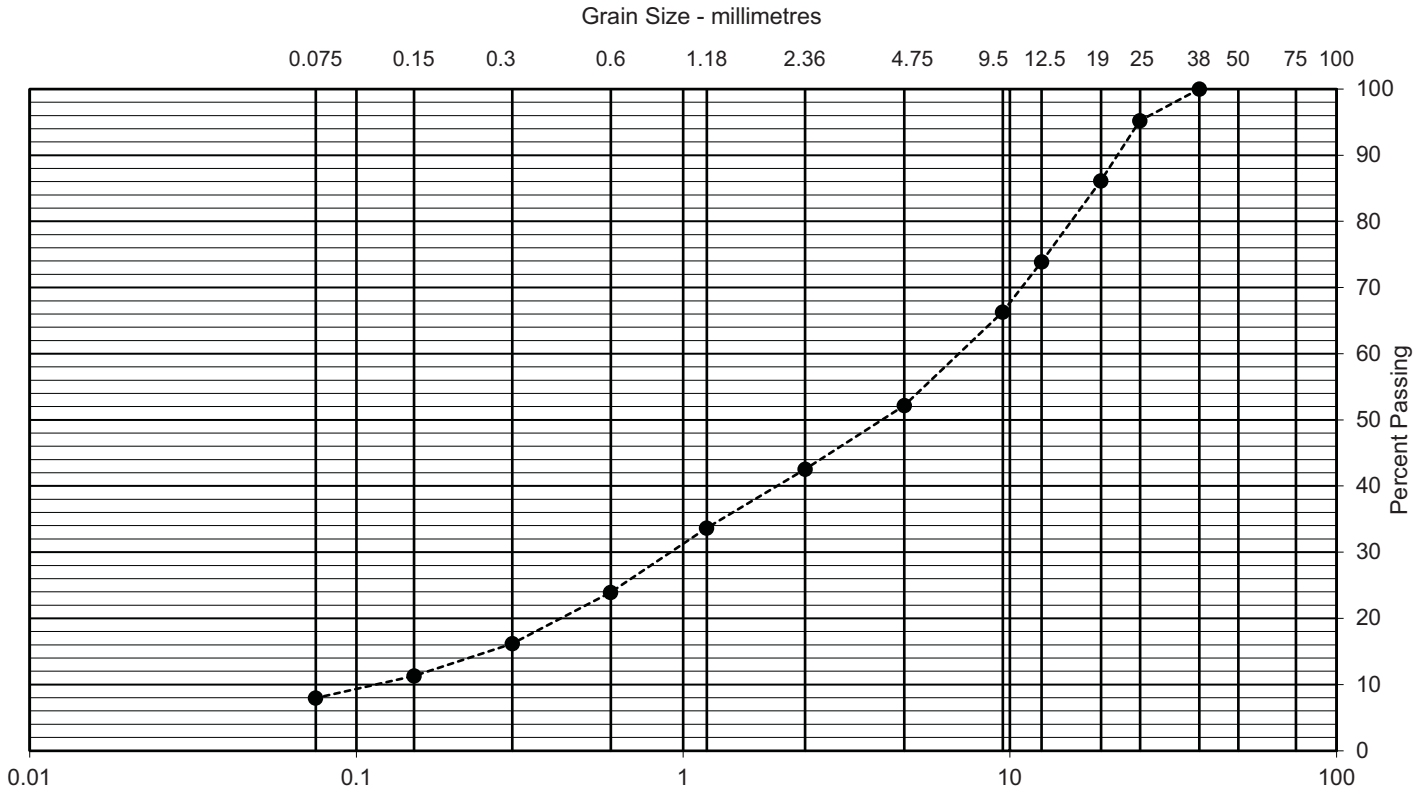
Location: Dale Meadows Road, Summerland, B.C.

Sampled By: RCS

Material: Fill - Sand and Gravel, trace silt

Sample: Borehole 7, Sample 1, Depth 0.3 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	66.3
100		4.75	52.2
75		2.36	42.5
50		1.18	33.6
38.0	100	0.600	23.9
25.0	95.2	0.300	16.2
19.0	86.1	0.150	11.3
12.5	73.9	0.075	8.0



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

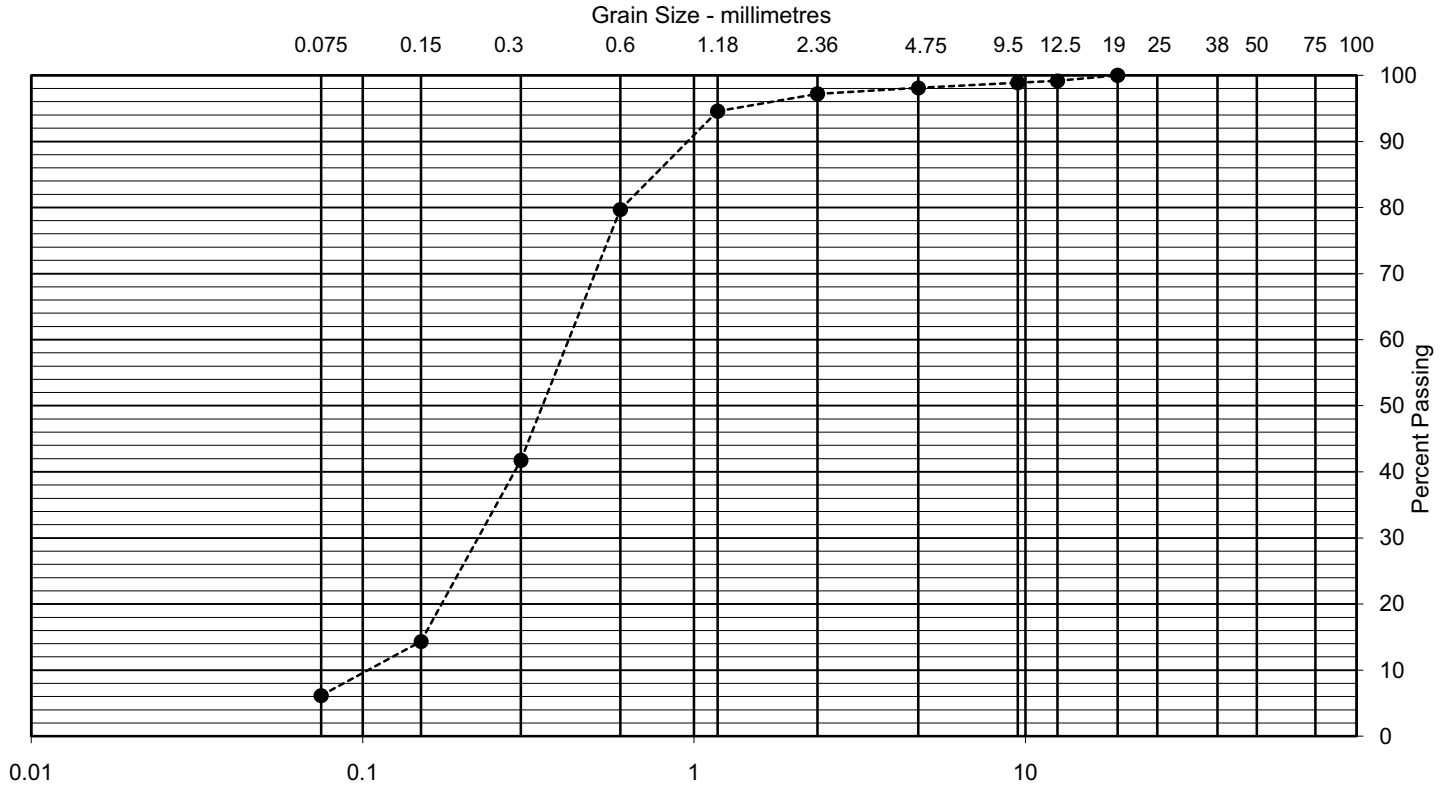
Location: Canyon View Road, Summerland, B.C.

Sampled By: RCS

Material: Sand, trace silt, trace gravel

Sample: Borehole 11, Sample 1, Depth 0.6 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	98.9
100		4.75	98.1
75		2.36	97.2
50		1.18	94.6
38.0		0.600	79.7
25.0		0.300	41.8
19.0	100.0	0.150	14.4
12.5	99.2	0.075	6.2



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

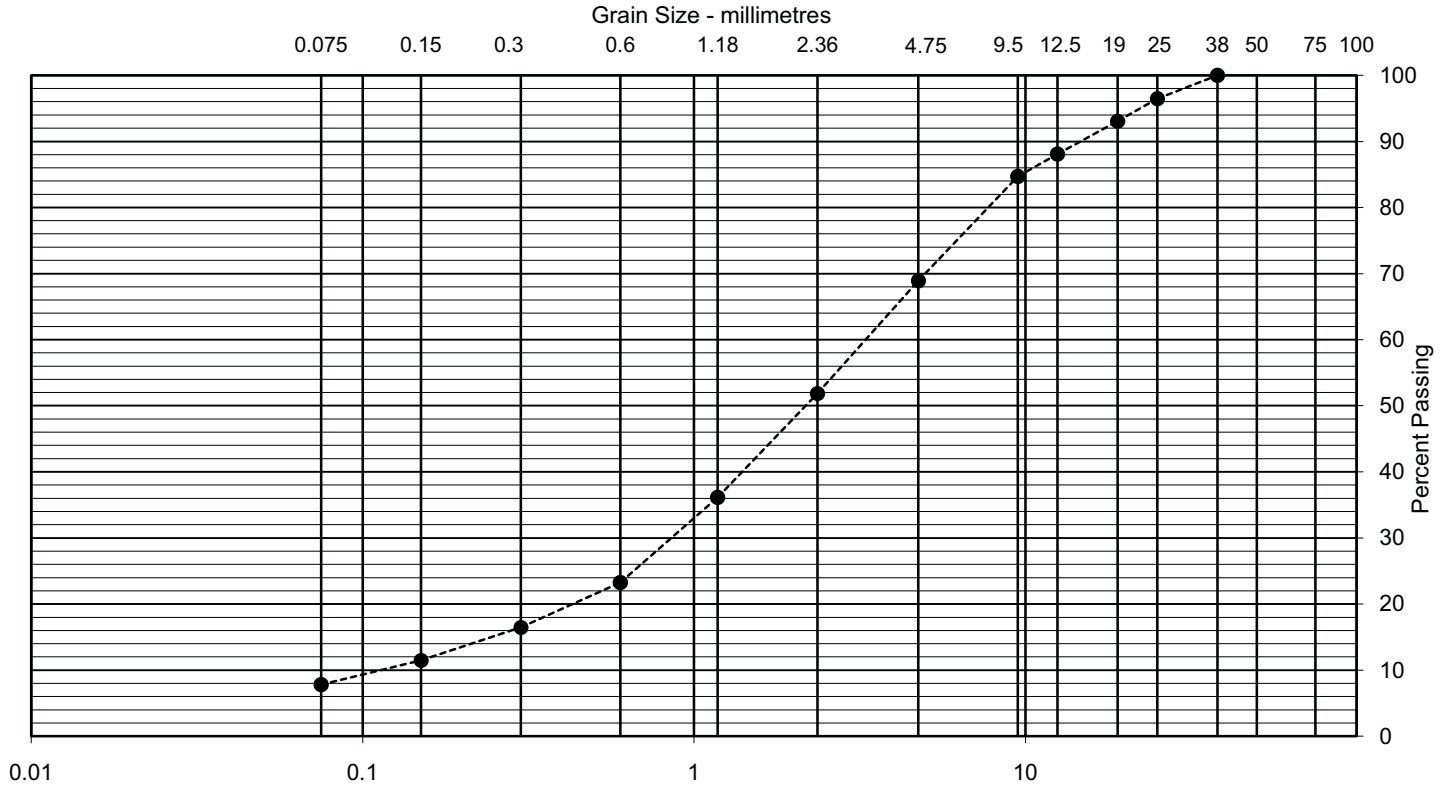
Location: Sherk Street, Summerland, B.C.

Sampled By: RCS

Material: Sand, gravelly, trace silt

Sample: Borehole 13, Sample 1, Depth 0.9 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	84.7
100		4.75	68.9
75		2.36	51.9
50		1.18	36.1
38.0	100	0.600	23.2
25.0	96.5	0.300	16.5
19.0	93.1	0.150	11.5
12.5	88.1	0.075	7.8



FPA Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers
2250 11 Avenue, Vernon, BC, V1T 7X1

GRAIN SIZE DISTRIBUTION

ASTM C136, C117

Project: Summerland Watermain Replacement Project

Project No: 6671

Client: Allnorth Consultants Ltd.

Sample Date: 19-Jan-2021

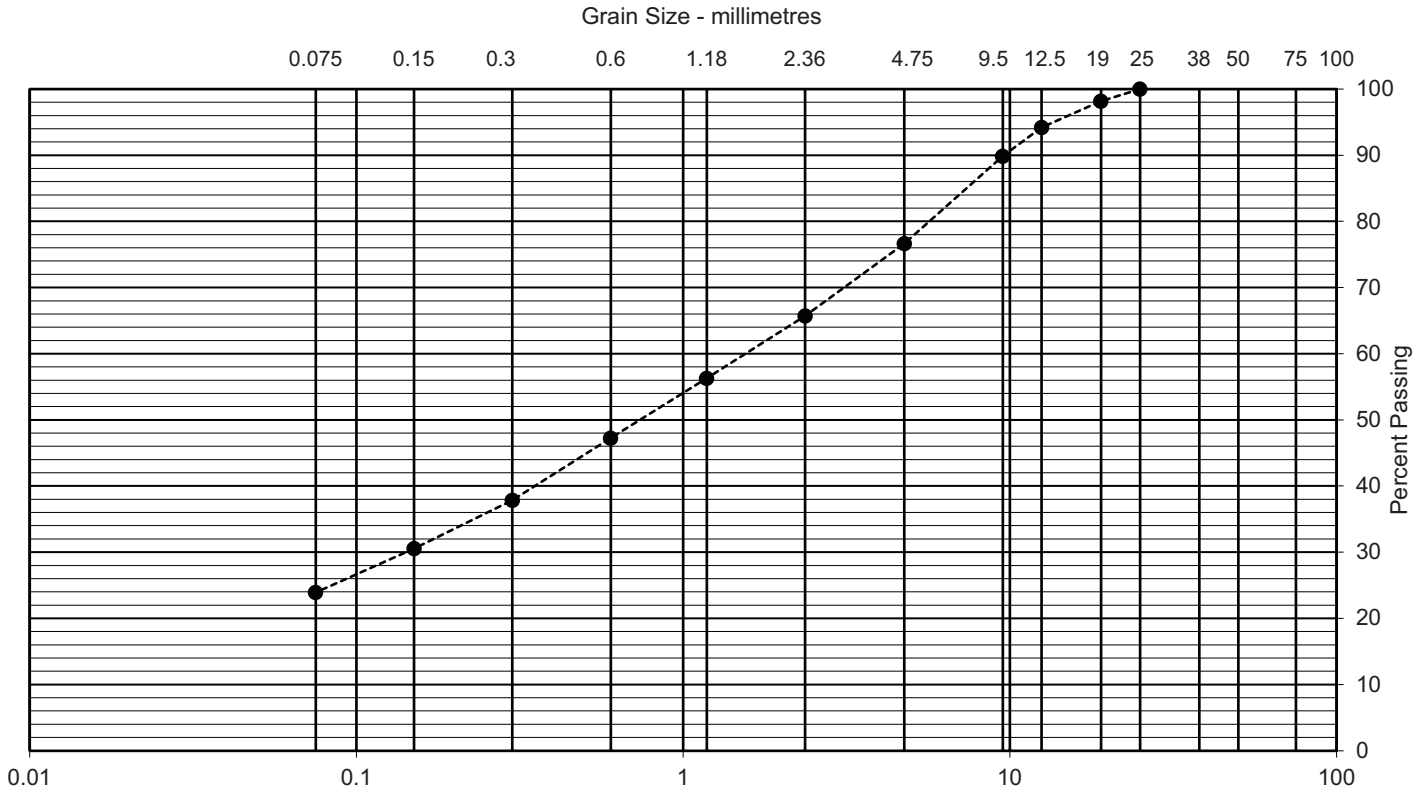
Location: Mountain Avenue, Summerland, B.C.

Sampled By: RCS

Material: Fill - Sand, silty, gravelly

Sample: Borehole 16, Sample 1, Depth 0.2 m

Wash Analysis			
Sieve (mm)	% Passing	Sieve (mm)	% Passing
150		9.50	89.9
100		4.75	76.7
75		2.36	65.7
50		1.18	56.3
38.0		0.600	47.2
25.0	100	0.300	37.8
19.0	98.2	0.150	30.5
12.5	94.2	0.075	23.9



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.
.

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.