TETRA TECH

Pavement Rehabilitation Assessment
East Porpoise Bay Road/Sechelt Inlet Road

PRESENTED TO

British Columbia Ministry of Transportation and Infrastructure

SEPTEMBER 16, 2022
ISSUED FOR USE
FILE: 704-TRN.PAVE03225-08

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of British Columbia Ministry of Transportation and Infrastructure (MoTI) and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than British Columbia Ministry of Transportation and Infrastructure (the Ministry), or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

1.1 Purpose

Tetra Tech Canada Inc. (Tetra Tech) was retained by the British Columbia Ministry of Transportation and Infrastructure (MoTI) to undertake a pavement rehabilitation assessment of approximately 700 m long section of East Porpoise Bay Road / Sechelt Inlet Road.

This report provides the findings of Tetra Tech's field exploration, data review and rehabilitation recommendations. A Site Plan showing the borehole location and general location of the project roadway segment is included as Figure 1.

1.2 Scope of Work

The scope of service for this assignment was provided in a Work Plan and Cost Estimate submitted to the MoTI on October 22, 2021 and included the following:

- Completion of a field reconnaissance to assess the pavement surface condition;
- Review of traffic data, pavement age, historical rehabilitation information and any other data provided by the MoTI or available from other sources;
- Asphalt pavement coring to determine the thickness of the asphalt pavement within the project limits;
- Analysis of the collected and analyzed data and development of pavement rehabilitation options;
- Geotechnical exploration program consisting of the following:
  - Completion of BC Onecall notifications and hiring an independent utility locating contractor to clear proposed borehole locations of underground utilities
  - Auger drilling within the roadway segment to determine existing subgrade soil conditions
  - Completion of laboratory testing on select samples from the drilling program
  - Preparation of a summary of geotechnical borehole exploration in the report
- Meeting with the MoTI to discuss the findings of the analyzed and collected data and pavement structure designs; and
- Preparation of a Pavement Evaluation report as per Tetra Tech proposal 704-PTRN.PAVE03225-01.

Geotechnical drilling scope wasn't included in the original project scope and was later added to gather additional information about the thickness of the granular pavement layers underneath the asphalt pavement.

1.3 Authorization to Proceed

Authorization to proceed with this assignment was provided by Mr. Salem Bahamdun on October 25, 2021, and the pavement rehabilitation designs were completed under MoTI "As and When" Contract No. 860CS1115. This work is subject to the Limitations on the Use of this Document contained in Appendix A.

2.0 REVIEW OF BACKGROUND INFORMATION

2.1 Roadway Description

The project section of East Porpoise Bay Road / Sechelt Inlet Road extends from Xenichen Avenue to Delta Road for a total project length of approximately 700 m. Review of the Google Street View images indicate that the project segment is generally flat. The project roadway has a general north-south alignment. The project section of the roadway has one travel lane in each direction. An additional bike lane accompanies the southbound travel lane. Review of the satellite imagery indicate concrete plant / gravel pits on east of the project site generating heavy truck traffic.

2.2 Climate Data Review

A climate data review was completed as part of this assignment. Local climate information including average daily high and low temperatures and average monthly rainfall are used for the selection of an appropriate asphalt binder and the suitable construction window.

The closest Environment Canada weather recording station with weather data was located at Merry Island Lightstation (Climate ID #1045100) located approximately 11.0 km west of the project limits at an elevation of 7.2 m above mean sea level. This weather station reports Canadian Climate Normals from 1981 to 2010. The climate data from this weather station is summarized in Table 1.

Table 1: Climate Data

Weather Station	Average Annual Precipitation (mm)	Mean Annual Temperature (ºC)	Winter[1] and Summer[2] Mean Monthly Temperature (°C)	Extreme Temperature (°C)
Merry Island Lightstation (#1045100)	1029	11.0	6.0 to 17.5	-11.7 to 32.2

[1]The Winter Average Monthly Temperature is based on the daily average temperatures in December, January and February.
[2] The Summer Average Monthly Temperature is based on the daily average temperatures in June, July and August.

The weather data from this station indicated that the area receives an annual precipitation of 1029 mm, which included 1006 mm of rainfall and 23 cm of snowfall. According to the C-SHRP Environmental Zones plan, the roadway is located in a Wet-No-Freeze environmental zone.

3.0 FIELD EXPLORATION

3.1 Site Reconnaissance

A site visit was completed by Vipin Sharma (Tetra Tech) with Mr. Salem Bahamdun of MoTI on November 1, 2021 as part of scope development for work plan to evaluate the suitable rehabilitation strategies for the roadway segment. Few photographs showing the general conditions of the roadway were also taken.

Photo 1: General Condition of the Roadway showing Fatigue Cracks

The pavement surface was generally observed to be in poor condition with excessive fatigue cracking in the wheelpaths at several locations. The pavement surface was also observed to be ravelled. The ride quality was determined to be very poor during the site reconnaissance.

3.2 Asphalt Pavement Coring

Asphalt pavement coring was completed on December 3, 2021. A total of nine 100 mm diameter cores were extracted along the roadway segment within the project limits. The core holes were backfilled with high strength concrete.

The measured ACP core thicknesses at each core location are presented below in Table 2.

Table 2: ACP Core Summary

Core No.	Lane	Station	Offset / Location	Asphalt Thickness (mm)	Lift Thicknesses (Top/Middle/Bottom)
1	SB	101+10	2.5 m left off C/L	190	(55/70/65)
2	NB	102+00	1.8 m right off C/L	140	(50/90)
3	SB	103+00	0.6 m left off C/L	150	(80/70)
4	NB	103+50	2.0 m right off C/L	150	(45/55/50)
5	NB	104+30	1.8 m right off C/L	175	(45/65/65)
6	SB	105+10	1.0 m left off C/L	130	(65/65)
7	NB	106+20	1.8 m right off C/L	145	(45/45/55)
8	SB	107+40	1.8 left off C/L	110	(70/40)
9	SB	100+60	4 m left off C/L	45	(45)

Review of the measured asphalt concrete pavement (ACP) thicknesses from the coring program indicated that the ACP thickness in the travel lanes vary significantly and range from 110 mm to 190 mm. One of the cores extracted from the shoulder indicated that the ACP thickness was 40 mm.

As it is the intent of the MoTI to realign / widen the existing roadway to include a bike lane on either side of the road, it was determined that further investigations including borehole drilling were required to determine the total pavement structure (including ACP and granular materials) to develop the pavement rehabilitation options and new pavement structure designs.

3.3 Geotechnical Exploration Methods

3.3.1 Utility Locate

Prior to drilling activities, Tetra Tech completed ground disturbance notifications (i.e., BC One Call) for the site. Proposed borehole locations were cleared on-site by Western Locates.

3.3.2 Drilling

Borehole drilling was completed on May 4th, 2022, using a truck mounted Drill Rig provided by Omega Drilling Inc. A total of 9 boreholes were completed within the project limits to determine thickness of pavement layers and classification of subgrade soil. The boreholes were completed to depths of 1.52 m depth, three boreholes were advanced to 3.05 m, one borehole was advanced to 4.57 m depth, and two boreholes were advanced to 5.33 m depth. All of the boreholes were completed in the center of the respective travel lane. Three boreholes were located in the northbound lane and five boreholes were located in the southbound lane. Standard Penetration Tests (SPTs) were completed congruently with drilling. Note that the additional location (BH22-09) was completed adjacent to

BH22-04 for the purpose of collecting additional SPT data since extra time was available after completing BH22-01 through to BH22-08. Borehole locations along the roadway segment are presented in Figure 1. The measured thicknesses of ACP and granular base layers from the borehole drilling are summarized in Table 3 in section 4.1.

3.3.3 Laboratory Testing

Select samples retained during the geotechnical borehole drilling program were tested in Tetra Tech's materials testing laboratory in Nanaimo to determine the index properties of the samples. The tests were completed to determine moisture content, and gradation.

Review of the lab test reports indicate that the granular material / fill material directly underneath the ACP layer does not meet the gradation requirements of MoTI's Well Graded Base material. Testing completed on the subgrade samples indicated that the subgrade material consists primarily of sand with varying amounts of gravel.

The detailed laboratory test reports are included in Appendix D.

4.0 GEOTECHNICAL DESCRIPTION OF THE SITE

4.1 Soil Conditions

Table 3: Summary of Pavement Layer Thicknesses from Borehole Drilling

Soil/Material Type	BH22-01	BH22-02	BH22-03	BH22-04	BH22-05	BH22-06	BH22-07	BH22-08	BH22-09
Asphalt Pavement	100 mm	100 mm	130 mm	130 mm	200 mm	130 mm	130 mm	130 mm	130 mm
SAND and GRAVEL, trace silt. (Base)	0.13 m	0.10 m	0.13 m	0.13 m	0.10 m	0.10 m	0.12 m	0.10 m	0.12 m
SAND and GRAVEL, or SAND, gravelly to some gravel, trace silt. (Subbase)	1.29 m	1.32 m	1.27 m	2.19 m	1.22 m	0.99 m	1.27 m	1.29 m	2.19 m
SAND, some gravel to gravelly, trace silt, compact to loose. (Inferred Native)	N/E	1.53 m	N/E	2.13 m	N/E	1.83 m	1.53 m	3.81 m	2.89 m

Borehole Logs showing the thickness of various pavements layers and classification of the soils are included in Appendix B.

4.2 Groundwater Conditions

No groundwater was observed in any of the boreholes during this geotechnical exploration. If required, seasonal fluctuation of groundwater levels at the Site would need to be determined through additional geotechnical exploration.

4.3 Liquefaction Potential

Liquefaction occurs when pressures increase in the soil-air-liquid matrix that causes the matrix to lose internal stability and behave as a liquid. Liquefaction can occur due to seismic forces or from rapid changes to pore water pressures. For liquefaction to occur, the soil needs to be saturated, have a high void ratio, and have a particular grain size distribution. Generally, liquefaction occurs in loose granular or fine-grained soils below groundwater level.

Groundwater was not observed during the drilling program. However, loose granular soils were observed, and the total thickness of these soils was not determined. The loose granular soils may extend beyond the depth of the groundwater level and the seasonal fluctuation of groundwater levels is not known at this time. Therefore, liquefaction is considered to be a potential risk at the Site.

5.0 TRAFFIC ANALYSIS

Design traffic in terms of Equivalent Single Axle Loads (ESALs) were calculated based on the traffic information provided by the MoTI.

Based on the information provided by Mr. Salem Bahamdun, the following inputs were used:

- Design period: 20-Years
- Traffic growth factor: 2.0%
- Direction factor: 50%
- Total number of light trucks: 682
- Total number of heavy trucks: 32
- Total number of buses: 13

Based on these assumptions, design traffic was calculated for a 20-year analysis period and the calculated design ESALs are presented in Table 4.

Table 4: Design Traffic Loading Summary

ESAL Factor			Growth Rate	Direction Factor	20-Year Design ESALs ($x10^6$)
Light Truck	**Heavy Truck**	**Bus**	2.0%	50%	3.43
1.0	2.0	2.0			

6.0 PAVEMENT REHABILITATION

The design input values required by the AASHTO methodology and as outlined in Technical Circular were used for the pavement structure design. The input parameters required by the AASHTO methodology and used in the pavement structure designs are summarized below:

Table 5: AASHTO Pavement Design Inputs

Criteria	Value	Rationale
Reliability	85%	Based on engineering judgment, Traffic type, and MoTI's Pavement Structure Design Guidelines (Technical Circular T-01/15).
Serviceability:		In accordance with the MoTI's Pavement Structure Design Guidelines (Technical Circular T-01/15).
Initial Serviceability Index (Pi)	4.2	
Terminal Serviceability Index (Pt)	2.5	
Serviceability Loss (ΔPSI)	1.7	
Overall Standard Deviation	0.45	
Subgrade Modulus	45	Based on the review of the geotechnical data and soil classification.

Based on the review of the geotechnical data, observation made during the field reconnaissance and engineering judgement, the following pavement structure and structural layer coefficients, summarized in the table below, were used in the calculation of existing Structural Number (S_N).

Table 6: Existing Pavement Structure and Layer Coefficient

Pavement Structure	Layer Thickness (mm)	Layer Coefficient
Existing ACP	100	0.25
Existing Base	200	0.12
Existing Sub-Base	600	0.09

6.1 Rehabilitation Treatments

Observations made during the field reconnaissance indicated that majority of the roadway is in poor condition in terms of exhibited distress.

Pavement strength test data was not available for the roadway segment. However, based on the past performance of the existing pavement surface, observations made during the field reconnaissance and discussions with the MoTI staff, it is understood that the existing pavement surface is (older than 12-15 years). The primary exhibited distresses are pavement edge cracking, wheel path cracking and raveling.

Considering varying ACP thickness and proposed realignment, it is concluded that the pavement will need to be reconstructed as part of the proposed widening.

Based on the review of the collected and analyzed data and in discussions with the project team, following pavement rehabilitation options are considered feasible and appropriate for the roadway segment:

6.1.1 Option 1: Remove 125 mm of Pavement and replace with 125 mm of ACP

This option is considered simple to construct and will include complete removal of the existing ACP (and granular materials) to a target depth of 125 mm, regrading of the exposed base material, localized base repairs of the failed areas followed by placement of 125 mm of ACP. In the areas where the existing ACP layer is thicker than 125 mm, entire ACP layer should be removed followed by the addition of the Crushed Base Course (CBC) prior to the placement of the new ACP layer.

Based on the review of the borehole logs, the rehabilitated pavement structure will comprise of:

- Asphalt Concrete Pavement - 125 mm
- Granular Base (existing) - 175 mm
- Select Granular Sub-Base (existing) - 600 mm

The pavement structure for new construction as included in section 6.1.4 should be used for the widening areas.

6.1.2 Option 2: Full Depth Reclamation (FDR)

FDR could be considered as feasible rehabilitation option. It is recommended that the existing pavement structure be reclaimed to a target depth of 300 mm. The reclaimed material should be spread and regraded for the entire proposed width of the roadway, followed by placement of 200 mm of new CBC and 100 mm of new ACP.

This option will result in the following pavement structure:

- Asphalt Concrete Pavement - 100 mm
- Crushed Base Course - 200 mm
- Reclaimed Material - 200 mm (estimated)
- Select Granular Sub-Base - 600 mm

This option, if selected by the ministry, will raise the road profile by approximately 200 mm.

6.1.3 Option 3: Partial Reconstruction

Rehabilitation of the pavement could also be undertaken by removing existing ACP followed by placement of 200 mm of CBC and 100 mm of ACP overlay.

Inspection and proof roll of the exposed base surface following the removal of the asphalt pavement shall be completed by a geotechnical / pavement engineer prior to placement of new ACP. If the exposed base layer is determined to be unsuitable, it should be sub-excavated and replaced with new CBC. Any areas showing higher deflections will need to be repaired prior to the placement of the new asphalt concrete pavement layers.

6.1.4 Widening Section

Based on the review of the proposed geometry of the roadway, design traffic, sub-surface conditions (inferred from review of borehole logs), engineering judgement and discussions with the project team, following pavement structure is recommended for the construction of the widening section:

- Asphalt Concrete Pavement - 100 mm
- Crushed Base Course - 300 mm
- Select Granular Sub-Base - 300 mm

6.2 Asphalt Binder and Asphalt Mix Type

Based on the climate, roadway characteristics, current pavement surface condition and calculated design traffic volumes, use of Performance Grade (PG) 64-22 (equivalent to 80-100 Group A asphalt cement) is recommended for the project. This binder provides a reliability of 99% for the high temperature and 99% for the low temperature and include a grade bump for high temperature.

It is also recommended that BC MoTI's 16 mm Class 1 Medium Mix asphalt be used for the project.

7.0 OTHER CONSIDERATION

7.1 General

It is recommended that the exposed granular base layer should be compacted, and proof rolled prior to the placement of the new ACP layers. Any weak/soft spots observed during the proof roll should be sub-excavated to a minimum depth of 300 mm and replaced with new CBC material prior to the placement of the ACP.

7.2 Seismic Data and Site Classification

Unfactored peak ground and selected spectral accelerations for selected frequencies (in units of gravitational acceleration, g) at the Site are shown in Table 7 below. Accelerations are calculated by Natural Resources Canada (NR Can) Seismic Hazard Calculator and are interpolated from NR Canada Seismic Hazard Maps.

Table 7: Selected Ground and Spectral Accelerations at Intersection of Tsulich Dr

Seismic Event	PGA (g)	Sa (0.05 s)	Sa (0.1 s)	Sa (0.2 s)	Sa (0.3 s)	Sa (0.5 s)	Sa (1.0 s)	Sa (2.0 s)
1 in 2,475	0.354	0.430	0.654	0.810	0.818	0.730	0.424	0.260
1 in 475	0.178	0.211	0.324	0.407	0.413	0.359	0.195	0.113

Because ground accelerations from an earthquake will differ on a site-specific basis due to ground conditions, the BCBC requires the use of modification factors based on expected in-ground shear wave velocity. Based on the results of the geotechnical exploration and anticipated shallow foundations, site class F is considered applicable.

7.3 Retaining Walls

Tetra Tech understands that retaining walls may be required for road widening purposes. The precise location, construction methods, and dimensions of the retaining wall are unknown at the time of writing this report. Regarding the potential use of retaining walls, Tetra Tech can make the following general comments:

Topsoil or organic material should not be present within the footprint of the retaining wall, before the placement of the granular materials. Any soft areas identified during proof roll should be reworked, or sub-excavated to a minimum depth of 300 mm and backfilled with imported fill material and compacted to a minimum of 95% of Modified Proctor Maximum Dry Density (MPMDD) per ASTM D1557;The following parameters are considered acceptable for preliminary retaining wall design at the Site:

- Subgrade soil unit weight: 18 kN/m^3;
- Friction Angle: 30 degrees;
- At-rest Earth Pressure Coefficient: 0.5 (the At-Rest Earth Coefficient is the ratio between vertical effective stress and horizontal effective stress that will occur naturally in a soil. As the At-Rest Earth Coefficient is unfactored. Soil forces calculated using this factor should have the geotechnical resistance factor applied);
- Bearing Capacity of Foundation (assuming excavation to underlying competent soil): 75 kPa;
- Any retaining wall design using these parameters should be reviewed by a qualified geotechnical engineer and may require additional site exploration to validate the parameters; and
- Note that the parameters presented are unfactored (i.e., characteristic values). Suitable geotechnical resistance (scaling) factors should be applied for Load Resistance Factored Design (LRFD), or the results should be compared to an appropriate Factor of Safety (FoS) for working stress-based design (WSD).

The Engineers and Geoscientists of British Columbia (EGBC) Professional Practice Guidelines for Civil and Transportation Infrastructure Retaining Wall Design (EGBC, 2020) specifies that any retaining walls higher than 1.2 m require detailed geotechnical design unless failure would have the potential to impact life safety. Detailed design is outside of the scope of this document; however, Tetra Tech is available to provide detailed geotechnical design services if required.

8.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
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September 16, 2022

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PERMIT TO PRACTICE
TETRA TECH CANADA INC.
PERMIT NUMBER: 1001972

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

DESIGN REPORT

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

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1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless so stipulated in the Design Report, TETRA TECH was not retained to explore, address or consider, and has not explored, addressed or considered any environmental or regulatory issues associated with the project specific design.

1.8 CALCULATIONS AND DESIGNS

TETRA TECH may have undertaken design calculations and prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, TETRA TECH's client. These designs have been prepared to a standard that is consistent with current industry practice. Notwithstanding, if any error or omission is detected by TETRA TECH's Client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of TETRA TECH.

1.9 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon TETRA TECH's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If a Geotechnical Report was prepared for the project by TETRA TECH, it may be included in the Design Report as appropriate. The Geotechnical Report contains Limitations that should be read in conjunction with these Limitations for the Design Report.

1.10 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This report has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.

APPENDIX B

SITE PLAN SHOWING LOCATION OF BOREHOLES

LEGEND

- Borehole Location
- Main Road
- Local Road

NOTES
Base data source:
Imagery from ESRI; Sunshine Coast (2018)

STATUS
ISSUED FOR USE

EAST PORPOISE BAY ROAD & SECHELT INLET ROAD GEOTECHNICAL SERVICES, SECHELT, BC

Borehole Location Plan

PROJECTION	DATUM
UTM Zone 10	NAD83

Scale: 1:4,000
80 40 0 80
Metres

FILE NO.
PAVE03225-08_Fig01_BoreholePlan.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	DS	MRV	KS	0

DATE	PROJECT NO.
September 16, 2022	TRN.PAVE03225-08

CLIENT
British Columbia — Ministry of Transportation and Infrastructure

TETRA TECH

Figure 1

Q:\Vancouver\GIS\TRANSPORTATION\PAVE\PAVE03225-08\Maps\PAVE03225-08_Fig01_BoreholePlan.mxd modified 2022-06-08 by Darren.Schouls

APPENDIX C

BOREHOLE LOGS

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Borehole No: **BH22-01**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: East Porpoise Bay Road	
Sechelt, BC	UTM: 445552.63 E; 5481270.54 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0	Solid Stem Auger		Asphalt 102 mm.					0
			SAND and GRAVEL (ROAD BASE), trace silt, dry, dense (Inferred), dark brown.			G 1		
			SAND and GRAVEL (SUBBASE), trace silt, damp, dense (Inferred), light brown.			G 2		
1								1 – 5
2			End of Borehole at 1.52 m. - Borehole backfilled with cuttings, bentonite (from 1.22 to 1.52 m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.					6 – 10
3								10 – 15
4								13 – 15
5								16 – 18
6								19

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 1.52 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Borehole No: **BH22-02**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: Sechelt Inlet Road	
Sechelt, BC	UTM: 445585.09 E; 5481463.26 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0	Solid Stem Auger		Asphalt 102 mm.					0
			SAND and GRAVEL (ROAD BASE), trace silt, dry, dense (Inferred), dark brown.			G 1		
			SAND and GRAVEL (SUBBASE), trace silt, damp, dense (Inferred), light brown.					1
1						G 2		2
								3
								4
			SAND (INFERRED NATIVE), some gravel, trace silt, damp, compacted (Inferred), light brown					5
2								6
								7
						G 3	●	8
								9
3								10
			End of Borehole at 3.05 m. - Borehole backfilled with cuttings, bentonite (from 2.74 to 3.05 m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.					11
								12
4								13
								14
								15
5								16
								17
								18
6								19

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 3.05 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

Borehole No: **BH22-03**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: Sechelt Inlet Road	
Sechelt, BC	UTM: 445601.38 E; 5481572.48 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0												0
	Solid Stem Auger		Asphalt 130 mm.									
			SAND and GRAVEL (ROAD BASE), trace silt, dry, dense (Inferred), dark brown.			G 1	36	57.2	6.8		●	
1			SAND and GRAVEL (SUBBASE), trace silt, damp, dense (Inferred), light brown.			G 2					●	1–5
			End of Borehole at 1.52 m. - Borehole backfilled with cuttings, bentonite (from 1.22 to 1.52 m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.									
2												6–10
3												10–15
4												13–19
5												
6												

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 1.52 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

Borehole No: **BH22-04**

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: Sechelt Inlet Road	
Sechelt, BC	UTM: 445629.87 E; 5481777.39 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0			Asphalt 130 mm.									0
			SAND and GRAVEL (ROAD BASE), trace silt, dry, compact (Inferred), dark brown.			G 1						
			SAND (SUBBASE), some gravel to gravelly, trace silt, damp, compact (Inferred), light brown.									1
1						G 2	22	74.2	3.8			3
												4
												5
2	Solid Stem Auger											6
												7
			SAND (INFERRED NATIVE), gravelly, trace silt, damp, loose (Inferred), light brown.			G 3						8
												9
3												10
												11
			SAND, some gravel, trace silt, damp, loose (Inferred), light brown to orange-brown; coarse sand									12
												13
4						G 4	15	81.2	3.8			14
												15
			End of Borehole at 4.57 m. - Borehole backfilled with cuttings, bentonite (from 4.27 to 4.57m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.									16
5												17
												18
												19
6												

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 4.57 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Borehole No: **BH22-05**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: Sechelt Inlet Road	
Sechelt, BC	UTM: 445613.59 E; 5481674.4 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0												0
	Solid Stem Auger		Asphalt 200 mm.									
			SAND and GRAVEL (ROAD BASE), some silt, dry, dense (Inferred), dark brown.			G 1	37	52.7	10.3		●	
1			SAND (SUBBASE), some gravel, trace silt, damp, dense (Inferred), light brown.			G 2						1–5
			End of Borehole at 1.52 m. - Borehole backfilled with cuttings, bentonite (from 1.22 to 1.52 m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.									
2												6–10
3												10–15
4												13–19
5												16–19
6												19

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 1.52 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

Borehole No: **BH22-06**

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: Sechelt Inlet Road	
Sechelt, BC	UTM: 445566.99 E; 5481366.96 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0												0
	Solid Stem Auger		Asphalt 130 mm.									
			SAND and GRAVEL (ROAD BASE), trace silt, dry, dense (Inferred), dark brown.			G 1						
			SAND (SUBBASE), some gravel, trace silt, damp, dense (Inferred), light brown.			G 2						
1												1
			SAND (INFERRED NATIVE), some gravel, some wood remnants, trace silt, compact (Inferred), damp, light brown.			G 3						
2												2
			SAND, some gravel to gravelly, trace silt, damp, compact (Inferred), light brown			G 4	26	69.1	4.9			
3												3
			End of Borehole at 3.05 m. - Borehole backfilled with cuttings, bentonite (from 2.74 to 3.05m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.									
4												4
5												5
6												6

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 3.05 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Borehole No: **BH22-07**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: East Porpoise Bay Road	
Sechelt, BC	UTM: 445490.17 E; 5481193.7 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Depth (ft)
0	Solid Stem Auger		Asphalt 130 mm.				0
			SAND and GRAVEL (ROAD BASE), trace silt, dry, very dense, dark brown.				
			SPT at 0.13 m: 29/42/52/38/17 (N=94) - 100% Recovery - Sample collected from depth range 0.25 - 0.91 m - Gravel clast stuck in spoon			SPT 1	
			SAND (SUBBASE), some gravel, trace silt, damp, dense, light brown.			G 1	
1							3
			SPT at 1.52 m: 29/7/5/5/5 (N=12) - 100% Recovery - Sample collected from depth range 1.52 - 2.28 m				
			SAND (INFERRED NATIVE), some gravel, some silt, compact, damp, light brown.			SPT 2	
2							7
						G 2	
3							10
			End of Borehole at 3.05 m. - Borehole backfilled with cuttings, bentonite (from 2.74 to 3.05m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.				
4							13
5							16
6							19

Field Blowcount (blows/300 mm) — SPT: 20 40 60 80

Plastic Limit — Moisture Content — Liquid Limit: 20 40 60 80

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 3.05 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Borehole No: **BH22-08**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: East Porpoise Bay Road	
Sechelt, BC	UTM: 445431.31 E; 5481119.43 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Field Blowcount (blows/300 mm) □ SPT (20 40 60 80)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0			Asphalt 130 mm.						0
			SPT at 0.13 m: 11/11/10/9/7 (N=21) - 100% Recovery - Sample collected from depth range 0.13 - 0.91 m			SPT 1			
			SAND and GRAVEL (ROAD BASE), trace silt, dry, compact, dark brown.						
			SAND (SUBBASE), some gravel, some silt, damp, compact, light brown.			G 1			
1									1
									2
									3
									4
			SAND (INFERRED NATIVE), some gravel, trace silt, damp, loose to compact, light brown. SPT at 1.52 m: 1/4/6/6/7 (N=10) - 100% Recovery - Sample collected from depth range 1.52 - 2.28 m			SPT 2			5
2	Solid Stem Auger								6
						G 2			7
									8
									9
3			SAND, silty, some gravel, damp, dense, light brown. SPT at 3.05 m: 0/5/19/24/26 (N=24) - 100% Recovery - Sample collected from depth range 3.05 - 3.81 m			SPT 3			10
									11
						G 3			12
4									13
									14
	SPT		SPT at 4.57 m: 5/15/20/23/25 (N=35) - 100% Recovery - Sample collected from depth range 4.57 - 5.33 m			SPT 4			15
5									16
									17
			End of Borehole at 5.33 m. - Borehole backfilled with cuttings, bentonite (from 4.27 to 4.57m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.						18
6									19

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 5.33 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure

Borehole No: **BH22-09**

Project: Geotechnical Investigation	Project No: 704-TRN.PAVE03225-08
Location: Sechelt Inlet Road	
Sechelt, BC	UTM: 445629.28 E; 5481776.06 N; Z 10

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Field Blowcount (blows/300 mm) □ SPT (20 40 60 80)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Depth (ft)
0			Asphalt 130 mm.						0
			SPT at 0.13 m: 9/13/15/13/12 (N=28) - 100% Recovery - Sample collected from depth range 0.13 - 0.91 m			SPT 1	□		
			SAND and GRAVEL (ROAD BASE), trace silt, dry, compact, dark brown.						
			SAND (SUBBASE), some gravel, trace silt, damp, compact, light brown.			G 1			
1									3
									4
			SPT at 1.52 m: 6/8/12/13/12 (N=20) - 100% Recovery - Sample collected from depth range 1.52 - 2.28 m			SPT 2	□	●	5
2	Solid Stem Auger								6
									7
			SAND (INFERRED NATIVE), gravelly, trace silt, damp, loose, light brown.						8
						G 2			9
3									10
			SPT at 3.05 m: 2/3/6/5/5 (N=9) - 100% Recovery - Sample collected from depth range 3.05 - 3.81 m			SPT 3	□	●	11
			SAND, trace gravel, trace silt, damp, loose, orange-brown; coarse sand.						12
						G 3			13
4									14
									15
	SPT		SPT at 4.57 m: 3/6/7/9/7 (N=13) - 100% Recovery - Sample collected from depth range 4.57 - 5.33 m			SPT 4	□	●	16
5									17
			End of Borehole at 5.33 m. - Borehole backfilled with cuttings, bentonite (from 4.27 to 4.57m), and patched with cold mix asphalt. - No groundwater observed upon completion. - Borehole location measured using handheld GPS. Locations considered accurate to +/- 5 m horizontal.						18
6									19

TETRA TECH

Contractor: Omega Drilling	Completion Depth: 5.33 m
Drilling Rig Type: B54 Auger Truck	Start Date: 2022 May 4
Logged By: EE	Completion Date: 2022 May 4
Reviewed By: KS	Page 1 of 1

APPENDIX D

LABORATORY TEST RESULTS

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project: Geotechnical Investigation, Sechelt Inlet Road
Project No.: 704-TRN.PAVE03225-08
Client: MoTI
Project Engineer: Vipin Sharma

Sample No.: 110
Date Tested: May 18, 2022
Tested By: EE
Page: 1 of 1

B.H. Number	Sample Number Depth (m)	Moisture Content (%)	Visual Description of Soil
BH22-01	G2 @ 0.6 - 0.9	1.2	GRAVEL and SAND, trace silt, dry, brown
BH22-02	G3 @ 2.4 - 2.7	3.0	SAND, trace gravel, trace silt, damp, light brown
BH22-03	G2 @ 0.9 - 1.2	2.5	SAND and GRAVEL, trace silt, damp, light brown
BH22-06	G1 @ 0.1 - 0.3	3.3	SAND and GRAVEL, trace silt, damp, brown
BH22-07	SPT2 @ 1.5 - 2.3	1.9	SAND, trace gravel, trace silt, dry, light brown
BH22-08	SPT2 @ 1.5 - 2.3	3.4	SAND, trace gravel, damp, light brown; coarse
BH22-08	G3 @ 3.7 - 4.0	3.4	SAND, some silt, trace gravel, damp, light brown
BH22-08	SPT4 @ 4.6 - 5.3	2.8	SAND, trace silt, damp, light brown
BH22-09	SPT2 @ 1.5 - 2.3	2.8	SAND, trace gravel, trace silt, damp, light brown; medium to coarse
BH22-09	SPT3 @ 3.0 - 3.8	3.3	SAND, some gravel, trace silt, damp, light brown; coarse
BH22-09	SPT4 @ 4.6 - 5.3	2.3	SAND, some gravel, trace silt, damp, orange brown; coarse

Reviewed By: _____ ASc.T.

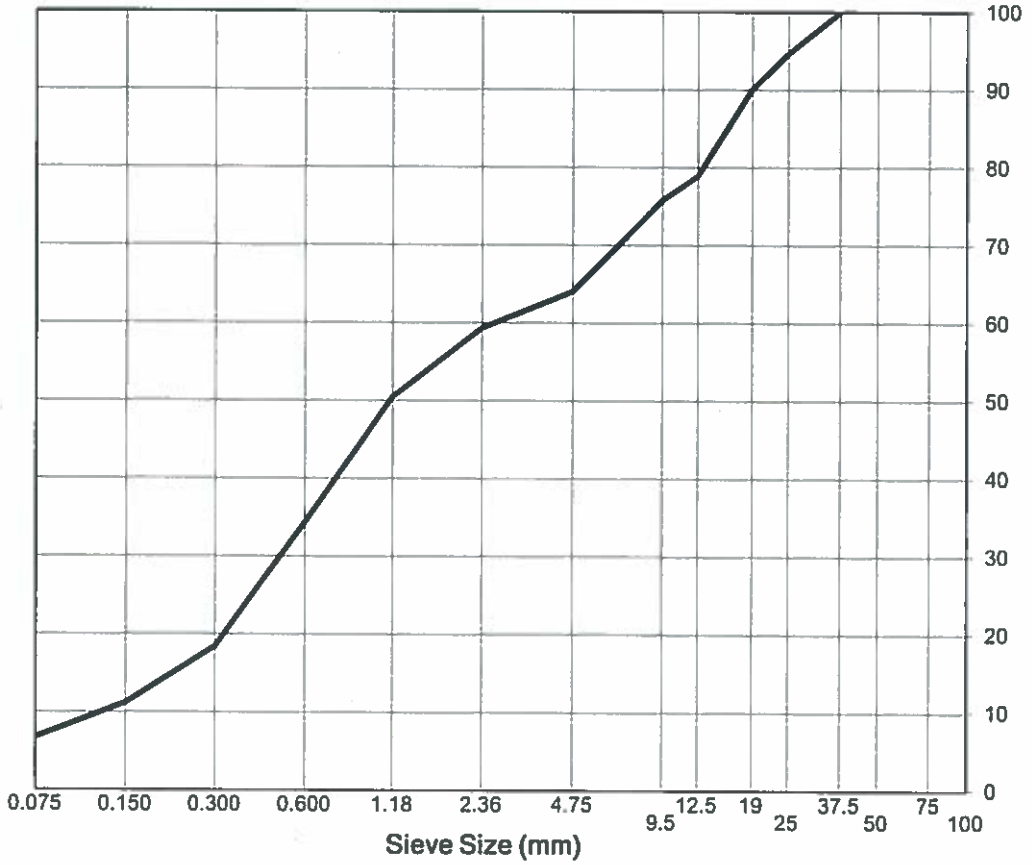
TETRA TECH

SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.:	704-TRN.PAVE03225-08	Sample No.:	111
Project:	Geotechnical Investigation, Sechelt Inlet Road	Date Sampled:	May 4, 2022
Client:	MoTI	Sampled by:	EE
Attention:		Date Tested:	May 18, 2022
Email:		Tested by:	EE Office: Nanaimo
Description:	SAND and GRAVEL, trace silt, damp, brown	Moisture Content (as received):	4.9%
		No. Crushed Faces:	Two (2) or Three (3)
Source:	BH22-03	By particle mass:	
Supplier:	N/A		
Sample Location:	G1 @ 0.1 - 0.2 m		
Specification:	N/A		

Sieve Size	Percent Passing
37.5	100
25	95
19	90
12.5	79
9.5	76
4.75	64
2.36	59
1.18	50
0.600	34
0.300	18
0.150	11
0.075	6.8



Remarks:

Reviewed By: ASc.T.

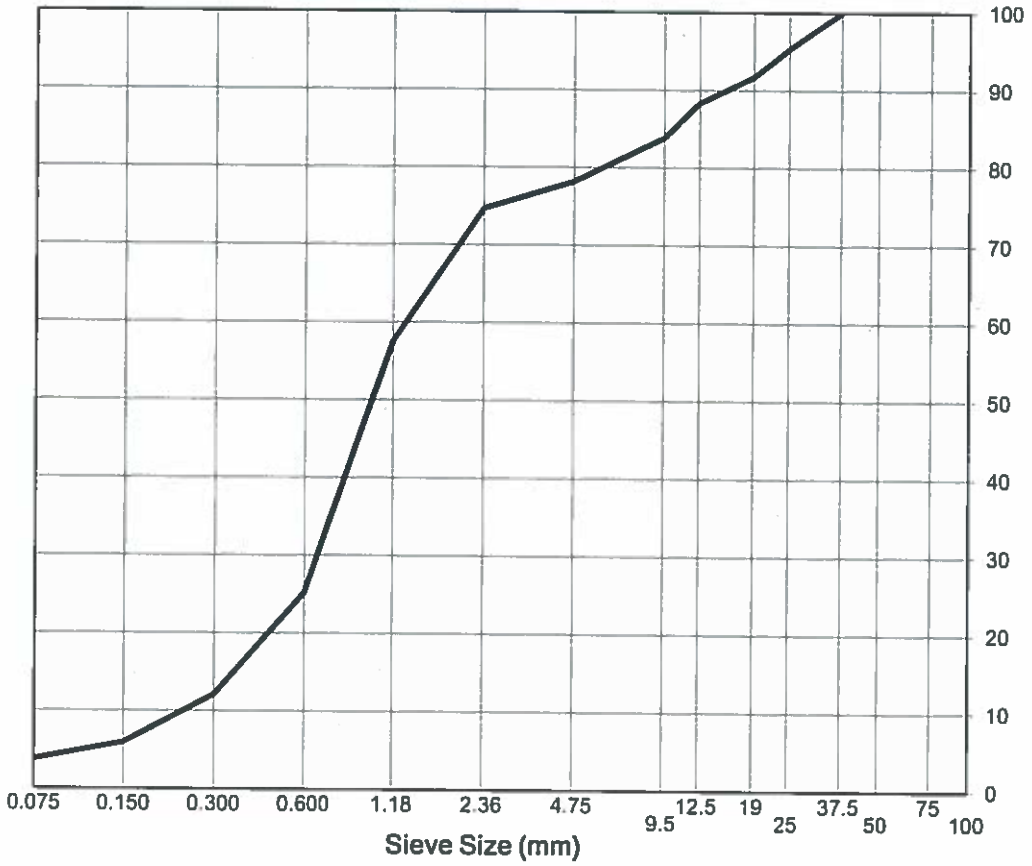
TETRA TECH

SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.:	704-TRN.PAVE03225-08	Sample No.:	112
Project:	Geotechnical Investigation, Sechelt Inlet Road	Date Sampled:	May 4, 2022
Client:	MoTI	Sampled by:	EE
Attention:		Date Tested:	May 18, 2022
Email:		Tested by:	EE Office: Nanaimo
Description:	SAND, gravelly, trace silt, damp, light brown	Moisture Content (as received):	3.0%
		No. Crushed Faces:	Two (2) or Three (3)
Source:	BH22-04	By particle mass:	
Supplier:	N/A		
Sample Location:	G2 @ 0.9 - 1.2 m		
Specification:	N/A		

Sieve Size	Percent Passing
37.5	100
25	95
19	92
12.5	88
9.5	84
4.75	78
2.36	75
1.18	58
0.600	25
0.300	12
0.150	6
0.075	3.8



Remarks:

Reviewed By: _____ ASc.T.

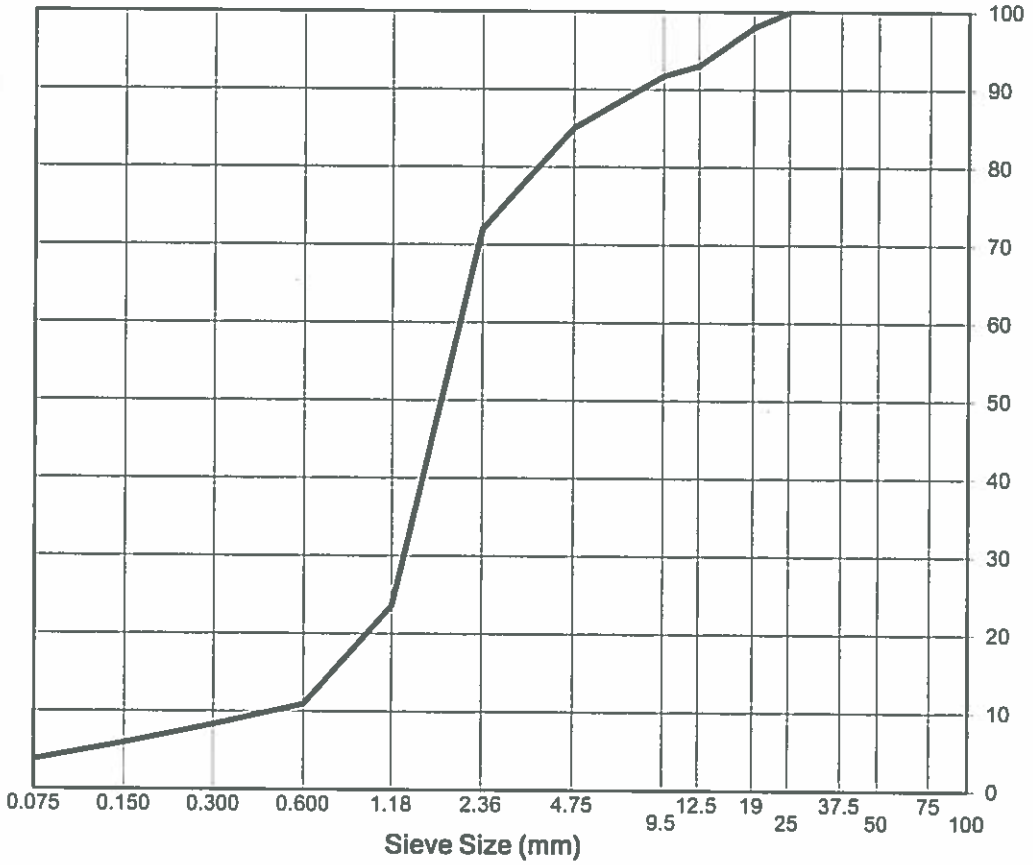
TETRA TECH

SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.:	704-TRN.PAVE03225-08	Sample No.:	113
Project:	Geotechnical Investigation, Sechelt Inlet Road	Date Sampled:	May 4, 2022
Client:	MoTI	Sampled by:	EE
Attention:		Date Tested:	May 18, 2022
Email:		Tested by:	EE Office: Nanaimo
Description:	SAND, some gravel, trace silt, damp, light brown	Moisture Content (as received):	4.1%
		No. Crushed Faces:	Two (2) or Three (3)
Source:	BH22-04	By particle mass:	
Supplier:	N/A		
Sample Location:	G4 @ 4.0 - 4.3 m		
Specification:	N/A		

Sieve Size	Percent Passing
25	100
19	98
12.5	93
9.5	92
4.75	85
2.36	72
1.18	24
0.600	11
0.300	8
0.150	6
0.075	3.8



Remarks:

Reviewed By: ASc.T.

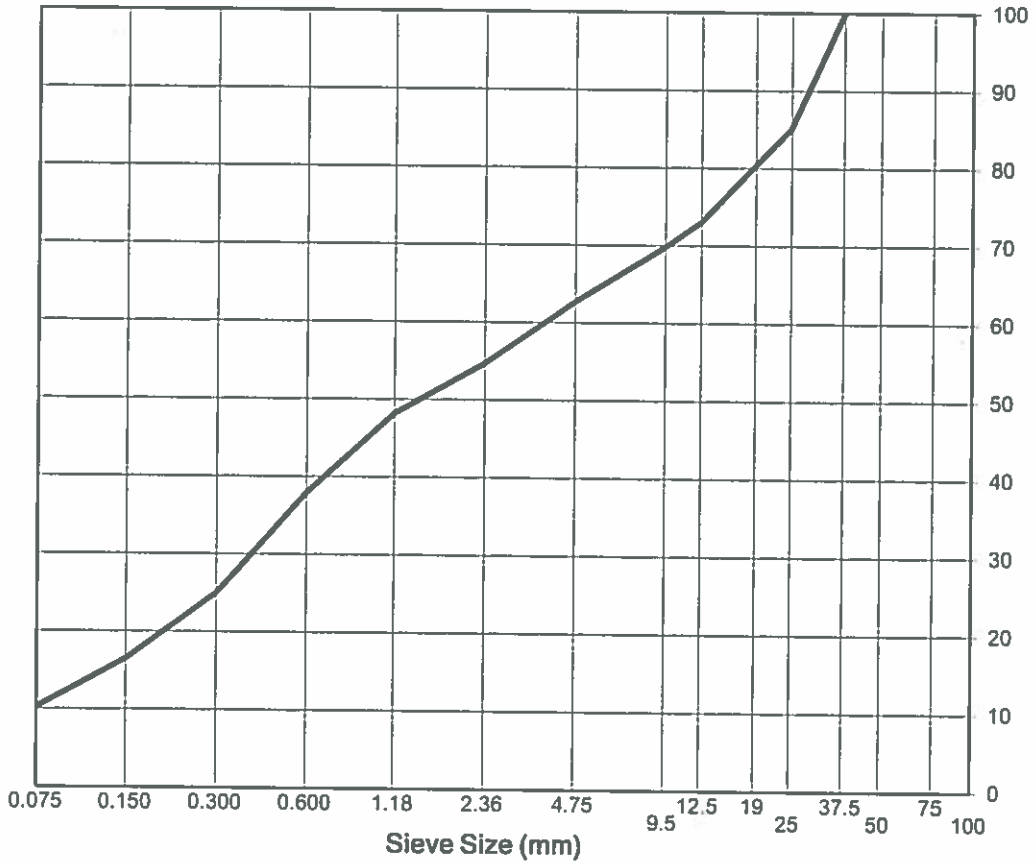
TETRA TECH

SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.:	704-TRN.PAVE03225-08	Sample No.:	114
Project:	Geotechnical Investigation, Sechelt Inlet Road	Date Sampled:	May 4, 2022
Client:	MoTI	Sampled by:	EE
Attention:		Date Tested:	May 18, 2022
Email:		Tested by:	EE Office: Nanaimo
Description:	SAND and GRAVEL, some silt, damp, brown	Moisture Content (as received):	3.7%
		No. Crushed Faces:	Two (2) or Three (3)
Source:	BH22-05	By particle mass:	
Supplier:	N/A		
Sample Location:	G1 @ 0.1 - 0.2 m		
Specification:	N/A		

Sieve Size	Percent Passing
37.5	100
25	85
19	80
12.5	73
9.5	70
4.75	63
2.36	55
1.18	48
0.600	38
0.300	25
0.150	17
0.075	10.3



Remarks:

Reviewed By: ASc.T.

TETRA TECH

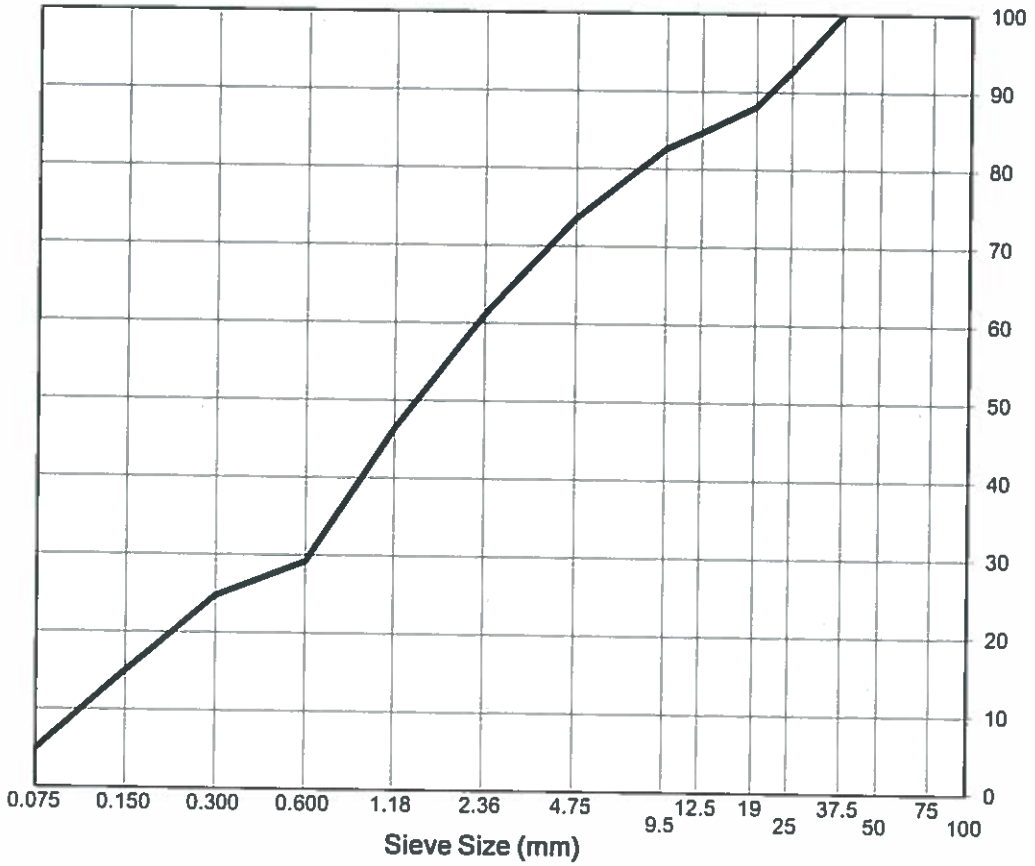
SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.: 704-TRN.PAVE03225-08
Project: Geotechnical Investigation, Sechelt Inlet Road
Client: MoTI
Attention:
Email:
Description: SAND, gravelly, trace silt, damp, light brown
Source: BH22-06
Supplier: N/A
Sample Location: G4 @ 2.4 - 2.7 m
Specification: N/A

Sample No.: 115
Date Sampled: May 4, 2022
Sampled by: EE
Date Tested: May 18, 2022
Tested by: EE Office: Nanaimo
Moisture Content (as received): 3.1%
No. Crushed Faces: Two (2) or Three (3)
By particle mass:

Sieve Size	Percent Passing
37.5	100
25	93
19	88
12.5	85
9.5	83
4.75	74
2.36	61
1.18	46
0.600	29
0.300	25
0.150	15
0.075	4.9



Remarks:

Reviewed By: ASc.T.

TETRA TECH