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<b>To:</b>	Gerry Fleming, P.Eng. R.F. Binnie & Associates Ltd.	<b>Date:</b>	October 7, 2016
<b>c:</b>		<b>Memo No.:</b>	5_A
<b>From:</b>	(Uthaya) M. Uthayakumar, P. Eng.	<b>File:</b>	704-V13103464-01
<b>Subject:</b>	Geotechnical Design Recommendations for the Proposed Sound Wall Along 216 Street Highway 1 at 216 Street Interchange and Highway Widening Project		

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*This 'Issued for Review' document is provided solely for the purpose of client review and presents our interim findings and recommendations to date. Our usable findings and recommendations are provided only through an 'Issued for Use' document, which will be issued subsequent to this review. Final design should not be undertaken based on the interim recommendations made herein. Once our report is issued for use, the 'Issued for Review' document should be either returned to Tetra Tech EBA or destroyed.*

## 1.0 INTRODUCTION

The British Columbia Ministry of Transportation and Infrastructure (MoTI) has awarded a contract for the design of a roadway interchange at Highway 1 and 216 Street and widening of Highway 1 from 202 Street to 216 Street in Langley, BC. The Project will follow a traditional design-bid-build delivery model, administered by the MoTI.

R.F. Binnie & Associates Ltd. (Binnie) is the lead consultant for this project. Tetra Tech EBA Inc. (Tetra Tech EBA) has been retained by Binnie to provide geotechnical engineering consulting services.

The purpose of this memorandum is to provide Geotechnical recommendations for the design of the proposed Sound Wall along 216 Street on the north side of Highway 1. The wall is proposed to be 3 m high above the ground surface as shown in the drawings, prepared by Binnie and dated October 01, 2016 (Plan, Elevation, and Sections, No. R1-818-809 to 812) and September 26, 2016 (Option A).

The Sound Wall will be designed and supplied by proprietary wall suppliers. The geotechnical parameters given in this memorandum may be used for the design of the Sound Walls.

Our June 28, 2016 Geotechnical report provides information on subsurface soil conditions, groundwater and geotechnical recommendations for the design of the proposed Interchange and Highway Widening project.

## 2.0 SITE DESCRIPTION AND SURFICIAL GEOLOGY

The site is located within the Township of Langley, BC. Highway 1 runs nearly in the east-west direction and 216 Street is aligned nearly along the north-south direction at the site. Currently there is no direct connection or crossing across Highway 1 along 216 Street.

The site setting is generally rural farmland and residential. Drainage ditches, water courses and culverts are located within the project site. Underground and overhead utility lines such as gas, water, sewer, electrical and communication lines are located along 216 Street.

The Surficial Geology Map, published by the Geological Survey of Canada (GSC Map No. 1484A New Westminster, 1980), identifies probable subsurface soil types as: "Capilano Sediments (Cd) – marine and glaciomarine stony (including till-like deposits) to stoneless silt loam to clay loam with minor silt and sand usually 3 m thick, but up to

30 m thick”. The Surficial Geology Map also shows presence of “Vashon Drift (Va) – Till, glaciofluvial, glaciolacustrine and ice contact deposits” along the northern half of the proposed Sound Wall site, between Telegraph Trail and 88 Avenue. The till deposit may also contain gravel cobbles and occasional boulders.

We have utilized the above information, the test holes drilled for the Interchange and Highway Widening project and the laboratory test results (provided in our June 28, 2016 Geotechnical report) for developing subsurface soil conditions and soil parameters described in the following sections.

### 3.0 SUBSURFACE SOIL CONDITIONS AND DESIGN PARAMETERS

Expected subsurface conditions along the proposed Sound Wall locations are shown in Tables 1 and 2 below. Estimated design parameters are also given in the Tables.

The groundwater level was estimated to be about 2 to 3 m below the existing ground surface for the section north of Highway 1 and south of Telegraph Trail, and expected to be present at depths greater than 6 m for the section north of Telegraph Trail.

**Table 1: Interpreted Subsurface Soil Conditions along 216 Street between Highway 1 and Telegraph Trail**

Soil Description	Depth Below Existing Ground Surface (m)	Total Unit Weight (kN/m <sup>3</sup> )	Friction Angle (degree)	Undrained Shear Strength (kPa)
<b>Topsoil</b> - Dark brown damp gravelly silty sand with trace rootlets (outside the paved areas)	0 to 1	18	28	0
<b>CLAY with some silt</b> - Damp to moist, stiff to very stiff, low plasticity grey/brown silty clay.	1 to 15	18	0	70

**Table 2: Interpreted Subsurface Soil Conditions along 216 Street between Telegraph Trail and 88 Avenue**

Soil Description	Depth Below Existing Ground Surface (m)	Total Unit Weight (kN/m <sup>3</sup> )	Friction Angle (degree)	Undrained Shear Strength (kPa)	
<b>Topsoil</b> - Dark brown damp gravelly silty sand with trace rootlets (outside the paved areas)	0 to 1	18	28	0	
<b>Till-like soils (glaciofluvial, glaciolacustrine and ice contact deposits)</b>	very stiff, low plasticity grey brown silty clay	>1	18	0	150
	silty sand to sandy silt with gravel, cobbles and boulders	>1	20	35	0

## 4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of R.F. Binnie & Associates Ltd. and their agents. Tetra Tech EBA Inc. 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 R.F. Binnie & Associates Ltd., 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. Tetra Tech EBA's General Conditions are attached to this memo.

## 5.0 CLOSURE

We trust that the information provided in this memorandum meets your present requirements. Should you have any questions or comments, please contact the undersigned.

Respectfully submitted,  
Tetra Tech EBA Inc.

**ISSUED FOR REVIEW**

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# APPENDIX A

## TETRA TECH EBA'S GENERAL CONDITIONS

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# GENERAL CONDITIONS

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## GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

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### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

### 2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

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

### 3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

## 7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

## 8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

## 9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

## 10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

## 11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

## 12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

## 13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

## 14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.