

February 24, 2022

Government of Yukon  
Community Services  
Land Development  
Box 2703  
Whitehorse, YT Y1A 2N1

ISSUED FOR USE  
FILE: 704-ENG.WARC03938-02  
Via Email: Christine.Lambert@yukon.ca

**Attention:** Christine Lambert, MSc., P.Geo. – Senior Project Manager

**Subject:** Lot Development and Foundation Design Bulletin  
Phase 6 Whistle Bend Subdivision, Whitehorse, Yukon

## 1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Government of Yukon, Department of Community Services Land Development Branch (YG) to provide geotechnical recommendations pertaining to lot development and foundation design for Phase 6 of the Whistle Bend Subdivision, Whitehorse, YT.

## 2.0 SCOPE OF SERVICES

Tetra Tech's scope of services included the following:

- Describing site and soil conditions that may affect surface and subsurface drainage;
- Outlining appropriate methods of controlling surface water flow and disposal;
- Assessing potential for water problems to occur and provide recommendations for mitigation of drainage problems; and
- Providing foundation insulation recommendations for use during residential construction to minimize potential for damage caused by seasonal frost heave.

## 3.0 SITE CONDITIONS

### 3.1 Location and Surficial Features

Whistle Bend Subdivision's Phase 6 is located north of Phase 4 and west of Phase 5. The proposed development in Phase 6 will consist of single-detached, duplex, townhouse, and multi-family residential properties.

In general, Phase 6 is quite flat and the only terrain features noted consisted of a glaciofluvial deposit along the west side of Wyvern Avenue and a smaller feature along Vedder Avenue north of Witch Hazel.

## 3.2 Soil Conditions

The entirety of Phase 6 is underlain by glaciolacustrine silt. A thin layer of surficial sand up to approximately 0.3 m in thickness exists in some areas, overlying the silt. A glaciofluvial landform consisting of several meters of sand was encountered along the west side of Wyvern Avenue. It is assumed much of this sand has been used during deep utilities and surface works construction but may be encountered during lot development.

## 3.3 Groundwater

Groundwater was not encountered in any of the test holes within the Phase 6 area. However, since construction, water has been encountered in various locations throughout the Whistle Bend subdivision where it was not observed during geotechnical evaluations prior to deep utility construction, most commonly during excavations for water and sanitary service connections.

Investigation is ongoing to determine if this groundwater is naturally sourced (e.g., from surface water infiltration) or artificially sourced (e.g., from leaks in buried municipal services). The precise extents and elevations of this groundwater have not been delineated and therefore there is potential it may be encountered during water and sanitary service connection work, or foundation and/or basement excavation.

Developers should be prepared to mitigate if required.

## 4.0 GENERAL SITE GRADING AND DRAINAGE CONSIDERATIONS

There is limited potential for disposal of surface water and roof runoff by infiltration into thin, surficial sand soils due to the underlying fine-grained soils. Rock pits constructed on individual lots for stormwater management are generally not feasible. Discharge over hardscape, onto paved roadways and into the storm sewer system should be considered to direct flow towards the Whistle Bend bio swale system.

Final site grading around all structures must direct water (roof runoff and surface water) away from the foundation elements to minimize potential for water damage and seasonal frost related movement.

## 5.0 FOUNDATION DRAINAGE CONSIDERATIONS

According to the City of Whitehorse Building Advisory October 25, 2010, *Drainage Standards for Building Foundations* (City of Whitehorse, 2010), any new building constructed in Whitehorse with below-grade foundations must adhere to prescribed standards for drainage. The relevant standards referenced in the City of Whitehorse document include the following:

- Permanent Wood Foundations, as outlined in CAN/CSA S-406-92, *Construction of Preserved Wood Foundations* and identified in the 2005 edition of the National Building Code of Canada (NBCC 2005).
- Concrete Foundations, as described in NBCC 2015, Section 9.14, which identifies minimum requirements for foundation drainage, drainage tile and associated piping, granular drainage layers, drainage disposal, and control of surface runoff.

The prescriptive measures are based on CSA and NBCC specifications as summarized in the following sections, as understood from the updated 2015 edition of the National Building Code of Canada (NBCC 2015).

## Permanent (Preserved) Wood Foundation Recommendations

If the use of permanent (preserved) wood foundations (PWF) is desired, a granular drainage layer should be installed beneath all footings and basement slabs, in accordance with CAN-CSA S406, because of the low permeability of the underlying glaciolacustrine material. Free draining soil is generally not expected throughout Phase 6, therefore this requirement will not likely be waived for new developments, however this can be reviewed on a case-by-case basis by a geotechnical engineer if required.

The granular drainage layer should be constructed using a clean crushed stone or screened drain rock material of maximum particle size 40 mm and having less than 10% sand (passing the 5 mm sieve). This layer shall be at least 125 mm thick and shall extend at least 300 mm beyond the footing plate. The granular drainage layer shall be graded to drain to a sump which, in turn, shall drain to a point of final disposal beyond the building's footprint. It is common to use bedding stone that is produced to satisfy the City of Whitehorse 25 mm Bedding Stone specification as described in the City of Whitehorse's Servicing Standards Manual (City of Whitehorse 2020). If alternative granular materials are considered, testing should be completed to confirm suitability.

In accordance with CAN-CSA S406, the use of perimeter drainage tile or pipe is not recommended with PWF.

All backfill material placed within 600 mm of the foundation walls should be free of deleterious debris, frozen materials, and boulders larger than 150 mm in diameter.

Existing site soils can be used as backfill around foundations and in service trenches. All backfill materials should be moisture conditioned and compacted to at least 95% of standard Proctor maximum dry density.

## Concrete Foundation Recommendations

If the use of concrete foundations is desired, the drainage tile and pipe, granular drainage layers, drainage disposal, and surface drainage specifications outlined in NBCC 2015, Section 9.14 "Drainage" must be followed. As mentioned above, soil throughout Phase 6 is not generally expected to be free draining, however this can be reviewed on a case-by-case basis by a geotechnical engineer if required.

Concrete footing and foundation wall systems are required to have perimeter drainage tile which terminates in a sump pit. A sump pit shall be installed to assist in the removal of water from the foundation area (should water accumulation in the sump pit warrant it).

All backfill material placed within 600 mm of the foundation walls shall be free of deleterious debris, frozen materials, and boulders larger than 150 mm in diameter.

Existing site soils can be used as backfill around foundations and in service trenches. All backfill materials should be moisture conditioned and compacted to at least 95% of standard Proctor maximum dry density.

## 6.0 SEASONAL FROST CONSIDERATIONS

### 6.1 Seasonal Frost Related Movement

Seasonal frost-related movement is common in cold climates when three conditions have been satisfied:

- The ground temperature is below freezing;
- Frost susceptible soils (i.e., soils tending to grow ice lenses and heave during freezing) are present; and

- Soil pore space is near 100% saturation.

Considering a seasonal frost depth of 2.4 m (typical for Whitehorse), frost-susceptible foundation soils, and the presence or potential presence of water within these soils, there is potential for frost-related ground movement, and additional protection is required wherever building foundations, floor slabs, or other elements are installed within the depth of seasonal frost penetration.

## 6.2 Foundation Insulation Recommendations

---

Current local codes now dictate the use of insulation around all foundations as under Section 86 of City of Whitehorse's Building and Plumbing Bylaw 99-50 (City of Whitehorse, 2016). However, this insulation is intended for energy efficiency, and not considered adequate for season frost protection. Tetra Tech recommends installing additional perimeter insulation around foundations constructed on frost susceptible soils to mitigate potential for seasonal frost-heave damage. This requirement for seasonal frost protection insulation is also discussed in NBCC 2015 Section 9.4.4.4 – Soil Movement.

Typical insulation recommendations are shown on Figure 1, attached. Two foundation scenarios are presented including strip footings to support residential structures and a pad and pedestal configuration for foundations supporting entrance overhangs or rear decks.

It should be noted that the schematics presented in Figure 1 are based on a typical foundation depth of 1.2 m. If different footing burial depths are being considered, a geotechnical engineer should be contacted to provide specific insulation recommendations.

It is important to limit the infiltration of surface water into foundation soils to minimize seasonal frost-related ground movement. Surface water infiltration should be minimized through site grading, functioning eavestroughs, and snow management. Installation of seasonal frost protection insulation will aid in directing water that has infiltrated away from foundation elements.

## 6.3 Foundation Construction and Frozen Ground

---

During foundation construction, it is critical that footings not be constructed on or over frozen ground. If foundations are constructed on soils experiencing frost heave, there will likely be settlement as the soil thaws in the spring or summer. Once the foundation is in place, the underlying frost susceptible soils must be protected and not allowed to freeze during the remaining construction period.

## 7.0 LIMITATIONS OF REPORT

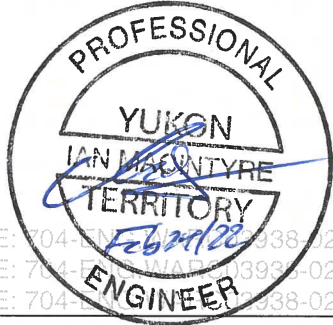
---

This report and its contents are intended for the sole use of Government of Yukon, Department of Community Services Land Development Branch (YG) and their agents. Tetra Tech Canada Inc. (operating as 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 Government of Yukon, Department of Community Services Land Development Branch (YG), 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.

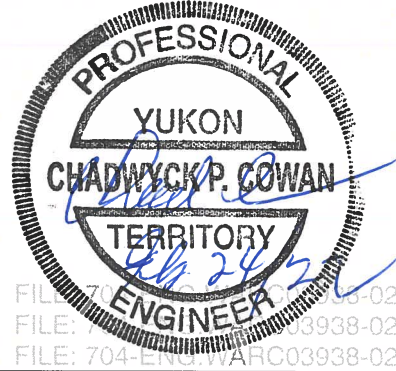
## 8.0 CLOSURE

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

Respectfully submitted,  
Tetra Tech Canada Inc.



Prepared by:  
Ian MacIntyre, P.Eng.  
Geotechnical Engineer, Arctic Region  
Direct Line: 867.668.9240  
ian.macintyre@tetrattech.com



Reviewed by:  
Chad Cowan, P.Eng.  
Geotechnical Manager, Yukon - Arctic Region  
Direct Line: 867.668.9214  
Chad.Cowan@tetrattech.com

<b>PERMIT TO PRACTICE TETRA TECH CANADA INC.</b>	
SIGNATURE	<i>[Signature]</i>
Date	<i>Feb 24/22</i>
<b>PERMIT NUMBER PP003</b> Association of Professional Engineers of Yukon	

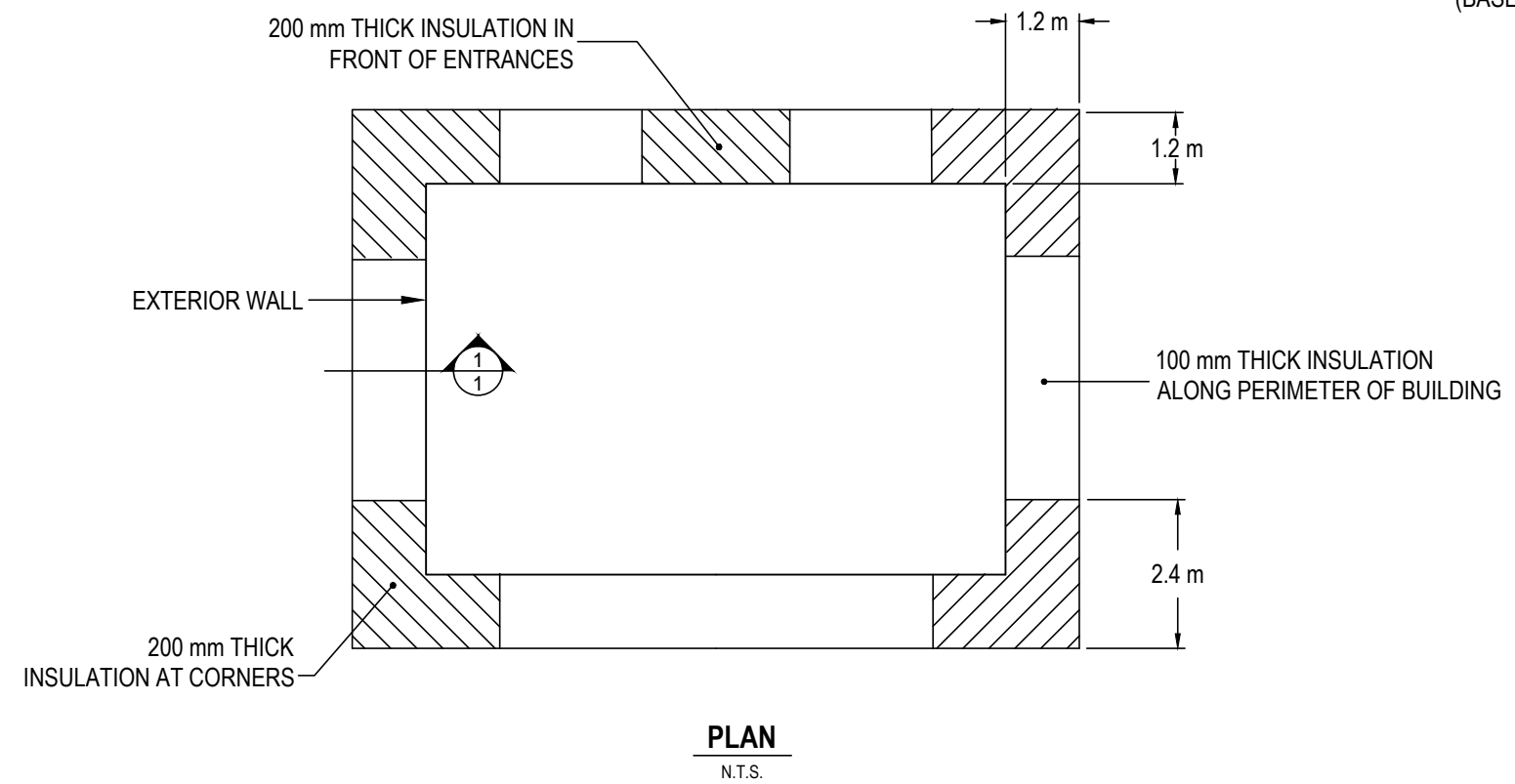
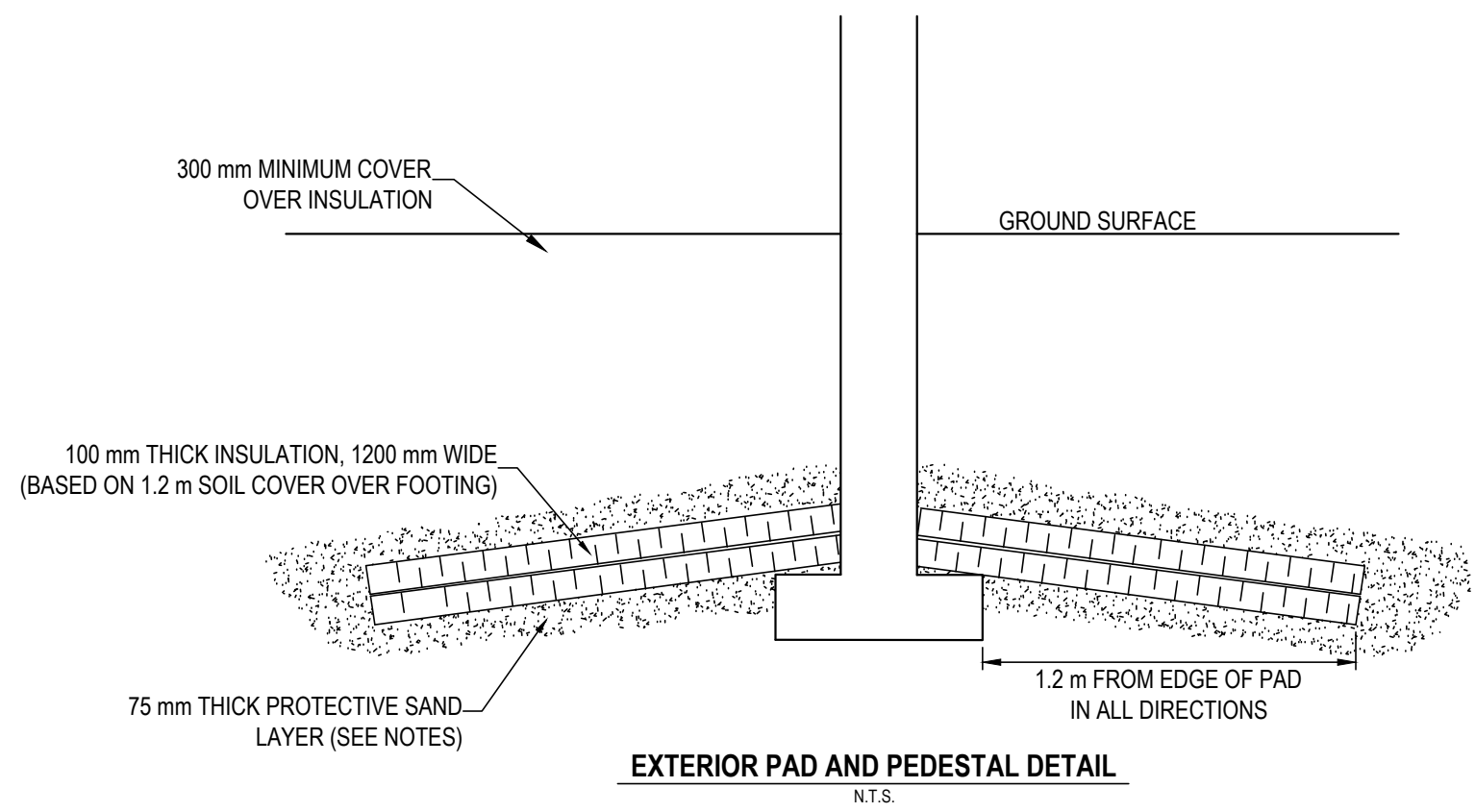
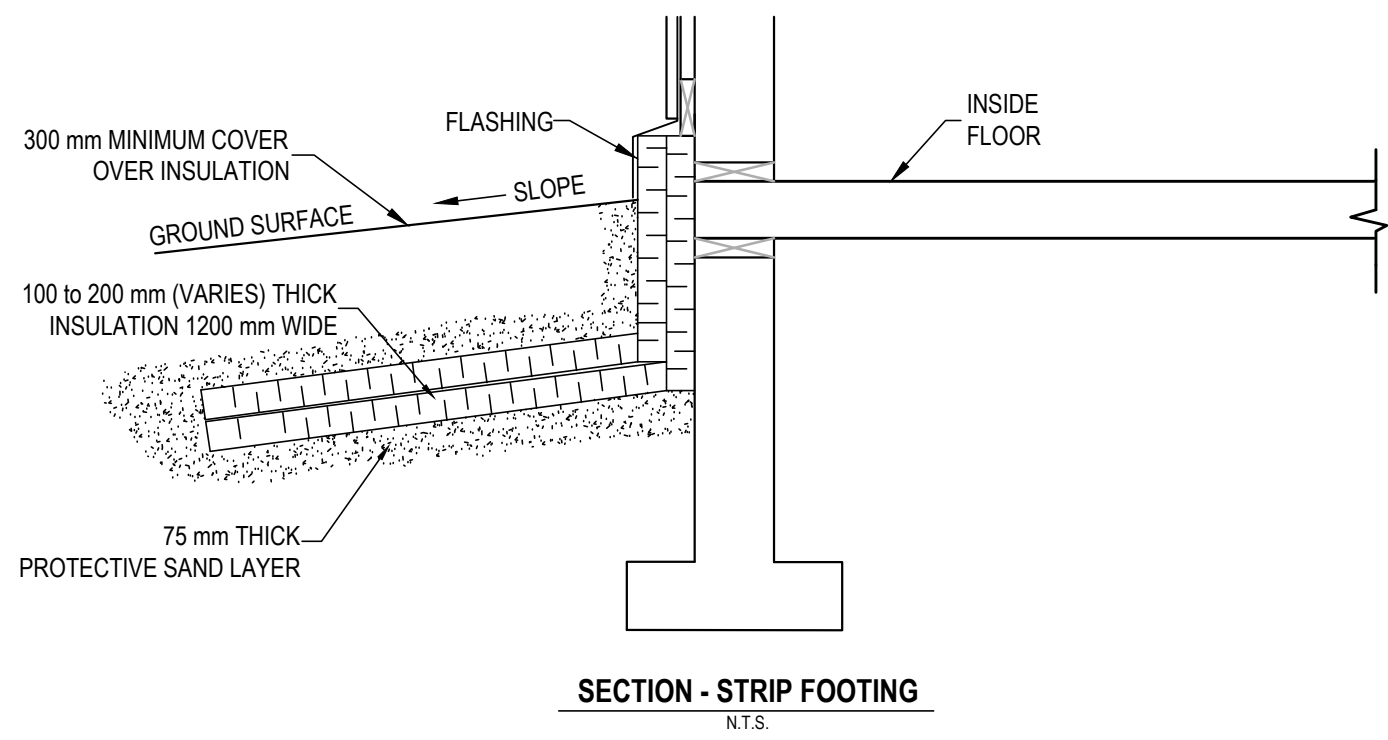
## REFERENCES

- Canadian Standards Association. (1992). *Construction of Preserved Wood Foundations*. CAN/CSA-S406-92.
- Canadian Standards Association. (2021). *Specification of permanent wood foundations for housing and small buildings*. S406-16 (R2021).
- City of Whitehorse. (2010). *Building Advisory October 25, 2010 – Drainage Standards for Building Foundations*. City of Whitehorse document ID 9858.
- City of Whitehorse. (2016). *Building and Plumbing Bylaw 99-50*.
- City of Whitehorse. (2020). *City of Whitehorse Servicing Standards Manual, 5<sup>th</sup> Edition*.
- National Research Council of Canada (NBCC). (2005). *National Building Code of Canada 2005*.
- National Research Council of Canada (NBCC). (2015). *National Building Code of Canada 2015*.

## FIGURES

Figure 1 – Typical Insulation Details

Q:\Whitehorse\Drawings\Whitehorse\ENG-WARC\ENGIN\WARC03386-25 Whistle Bend Phase 6 Geotech Services\ENG-WARC03386-25 Fig.2-RO.dwg [FIGURE 2] November 07, 2018 - 7:28:29 pm (BY: BUCHAN, CAMERON)



**NOTES :**

- INSULATION THICKNESS IS SITE SPECIFIC AND BASED ON SOIL CONDITIONS AND AMOUNT OF SOIL COVER ABOVE FOOTINGS.
- THE INSULATION (DOW CHEMICAL HI SERIES STYROFOAM OR POLYURETHANE OR APPROVED EQUIVALENT) SHOULD BE MOISTURE RESISTANT AND SUITABLE FOR BURIAL UNDER VEHICULAR TRAFFIC AREAS.
- A MINIMUM BEDDING THICKNESS OF 75 mm OF FINE TO MEDIUM GRAINED SAND SHOULD BE PLACED ABOVE AND BELOW THE INSULATION FOR PROTECTION.
- THIS PLAN IS NOT TO SCALE

CLIENT



**2018 GEOTECHNICAL SERVICES  
WHISTLE BEND PHASE 6**

**COMMERCIAL AND RESIDENTIAL  
FOUNDATION INSULATION DETAILS**



PROJECT NO. ENG.WARC03386-25	DWN CB	CKD MCP	REV 0
OFFICE EBA-WHSE	DATE November 7, 2018		

**Figure 2**



## APPENDIX A

### TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

# LIMITATIONS ON USE OF THIS DOCUMENT

## GEOTECHNICAL – YUKON GOVERNMENT

### 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").

The Professional Document is intended for the use of TETRA TECH's Client, its officers, employees, agents, representatives, successors and assigns (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH. Any changes to the conclusions, opinions, and recommendations presented in TETRA TECH's Professional Document must be authorized by TETRA TECH.

### 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.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems, as per agreed project deliverable formats. TETRA TECH makes no representation about the compatibility of these files with the Client's 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.

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

### 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.

### 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, and subject to the standard of care herein, 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, except where TETRA TECH has subcontracted for such information.

### 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 make, 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 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the Client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

### 1.8 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to explore, address or consider and has not explored, addressed or considered any environmental or regulatory issues associated with development on the subject site.

## 1.9 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards 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 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.

### 1.10 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.

### 1.11 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 historical environment. TETRA TECH 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 exploration and review may be necessary.

### 1.12 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.

### 1.13 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.

### 1.14 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact 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, and construction sequence are known.

## 1.15 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and 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.

### 1.16 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 satisfactory 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.

### 1.17 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters 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 used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

### 1.18 SAMPLES

TETRA TECH 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.

### 1.19 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document 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.