

February 18, 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:Updated Lot Development and Foundation Design Bulletin<br/>Phase 3E 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 3E 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 and/or commercial construction to minimize potential for damage caused by seasonal frost heave.

### 3.0 SITE CONDITIONS

### 3.1 Location and Development to Date

Whistle Bend Subdivision's Phase 3E runs along the Keno Way corridor between Olive May Way and Casca Boulevard (refer to Figure 1 attached).

The proposed development in 3E will be commercial with a large centrally located public service lot located northwest of the Continuing Care Facility.

Prior to development these areas were utilized as follows:

- During predesign, this area was investigated as a potential non-frost-susceptible borrow area. Throughout the highest point of the aeolian feature (dune) 8.7 m of sand was noted overlying glaciolacustrine silt (refer to Borehole log W14101171-BH15, attached);
- This material was subsequently used for pregrading and subgrade construction during Phases 1 & 2 construction;
- During Phases 1 & 2 construction, significant stockpiles of organic and fine-grained soils were created in the area located directly north of the Continuing Care Facility site;
- A large lay-down area to support subsequent phases of construction was constructed; and
- The area was utilized for stockpiling sub-cut material from the Continuing Care Facility foundation excavation.

### 3.2 Soil Conditions

Soil conditions throughout the Keno Way corridor in Phase 3E (between Olive May Way and west to Casca Boulevard) will be predominantly frost susceptible glaciolacustrine silt (there may be some pockets of fill encountered throughout). Throughout the west end of Phase 3E (in the vicinity of lots 456 to 459 where WARC03380-01 Testpit TP03 was excavated), sand was encountered between 0.4 and 1.6 m; this sand layer was underlain by silt. Tetra Tech understands fill was placed generally according to the Associated Engineering Surface Works Site Grading Plan (Drawing No. 2183-03D-C-4303).

Select borehole and testpit logs have been included in Appendix B. Borehole and Tetspit locations are shown on Figure 1.

### 3.3 Groundwater

In addition to the geotechnical evaluations completed specifically for Phase 3 design and construction, detailed geotechnical evaluations were completed for the Continuing Care Facility (initial work by Tetra Tech including a borehole drilling program and a Cone Penetration Testing (CPT) program. CPT testing is a very useful method of delineating discrete lenses of varying fine-grained soil types, assessing potentially liquefiable soils and can predict possible seepage zones. CPT results of this testing suggested that seepage may occur at a depth of around 4.5 m, however; groundwater monitoring wells installed below 4.5 m were dry during the monitoring period in advance of deep utilities construction.

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

The Surface Works Overland Drainage Plan (Drawing Number 2183-03D-C-4301) prepared by Associated Engineering indicates that site grading supports positive drainage throughout Phase 3E. Surface water travels east along Keno Way to the bio swale located adjacent to the north end of Phase 3A.

There is limited potential for disposal of surface water and roof runoff by infiltration into surficial sand 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 bio swale system.

Final site grading around all commercial and residential 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 impervious glaciolacustrine underlying material. Free draining soil is generally not expected throughout Phase 3E, therefore this requirement will not likely be waived for new developments.

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 beyond the footing plate a minimum of 300 mm. The granular drainage layer shall 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.

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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 3E is not generally expected to be free draining.

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.

For 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, 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 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 frost protection insulation is also discussed in NBCC 2015 Section 9.4.4.4 – Soil Movement.

Typical insulation recommendations are shown on Figure 2, attached. Two foundation scenarios are presented including strip footings to support residential or commercial structures and a pad and pedestal configuration for foundations supporting entrance overhangs or rear decks.

It should be noted that the designs presented in Figure 2 is based on a typical foundation depth of 1.2 m. If different footing burial depths are being considered, Tetra Tech should be contacted to provide specific insulation recommendations.

It is important to limit the infiltration of surface water into foundation soils to minimize frost-related ground movement. Surface water infiltration should be minimized through site grading, functioning eavestroughs, and snow management. Installation of 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.



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PERMIT TO PRACTICE TETRA TECH CANADA INC. SIGNATURE Date PERMIT NUMBER PP003
Engineers of Yukon



### REFERENCES

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National Research Council of Canada (NBCC). (2005). National Building Code of Canada 2005.

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City of Whitehorse. (2020). City of Whitehorse Servicing Standards Manual, 5th Edition.

Canadian Standards Association. (2021). Specification of permanent wood foundations for housing and small buildings. S406-16 (R2021).



# FIGURES

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- Figure 1 Site Plan Showing Phase 3E Borehole and Testpit Locations
- Figure 2 Typical Frost Protection Foundation Insulation Details







# APPENDIX A

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



### GEOTECHNICAL

#### 1.1 USE OF DOCUMENT AND OWNERSHIP

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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 document, 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 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.

#### 1.8 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.

#### **1.9 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.

#### **1.10 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.

#### 1.11 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.

#### 1.12 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.

#### 1.13 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.

#### 1.14 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.

#### 1.15 DRAINAGE SYSTEMS

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. Where temporary or permanent drainage systems are installed within or around a structure, these systems must protect the structure from loss of ground due to mechanisms such as internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design details regarding the geotechnical aspects of such systems (e.g. bedding material, surrounding soil, soil cover, geotextile type) should be reviewed by the geotechnical engineer to confirm the performance of the system is consistent with the conditions used in the geotechnical design.

#### **1.16 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.

#### 1.17 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.

# 1.18 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.

# APPENDIX B

### **BOREHOLE AND TESTPIT LOGS**



### **TERMS USED ON BOREHOLE LOGS**

### TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM
Very Loose
Loose
Compact

Dense Very Dense RELATIVE DENSITY

0 TO 20%

20 TO 40%

40 TO 75%

75 TO 90%

90 TO 100%

N (blows per 0.3m)

0 to 4 4 to 10 10 to 30 30 to 50 greater than 50

The number of blows, N, on a 51mm 0.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIF	PTIVE	TERM
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Very Soft Soft Firm Stiff Very Stiff Hard

### UNCONFINED COMPRESSIVE STRENGTH (KPA) Less than 25 25 to 50 50 to 100 100 to 200 200 to 400 Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

### **GENERAL DESCRIPTIVE TERMS**

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying colour and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.;
Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.



					MODIFIED UNIFIEI	O SOIL CLASSIFICATION	
I	MAJO	r Division	I	group Symbol	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
		fraction ieve	RAVELS	GW	Well-graded gravels and gravel- sand mixtures, little or no fines	$\mathbf{C}_{u} = \mathbf{D}_{eo} / \mathbf{D}_{10} \qquad \text{Greater than 4}$ $\mathbf{C}_{e} = \frac{(\mathbf{D}_{eo})^{2}}{\mathbf{D}_{10} \times \mathbf{D}_{e0}} \qquad \text{Between 1 and 3}$	
	sieve*	RAVELS e of coarse t on No. 4 s	CLEAN G	GP	Poorly-graded gravels and gravel- sand mixtures, little or no fines	Up to the second	
S.	75 µm	or mor etained	rels Fr	GM	Silty gravels, gravel-sand-silt mixtures	Bit Solution         Atterberg limits plot below 'A' line or plasticity index less than 4         Atterberg limits plotting in hatched area are	
ED SOII	on No.	20%	GRA WI	GC	Clayey gravels, gravel-sand-clay mixtures	「 愛 る あ 名 空	6
se - grain	% retained	oarse sieve	SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$\begin{array}{c} \overbrace{c}^{0} & C_{u} = D_{eo} / D_{1o} & \text{Greater than 6} \\ \overbrace{gent{array}{c}}^{gent{array}{c}} & \overbrace{e}^{gent{array}{c}} & \overbrace{e}^{gent{array}{c}} \\ \overbrace{c}^{gent{array}{c}} & \overbrace{e}^{gent{array}{c}} & \overbrace{c}^{gent{array}{c}} \\ \overbrace{c}^{gent{array}{c}} & \overbrace{c}^{gent{array}{c}} & \overbrace{c}^{gent{array}{c}} \\ \overbrace$	
COAR More than 50	re than 50	ANDS 1 50% of c 1 sses No. 4	CLEAN	SP	Poorly-graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW	
	Mo	S ore than ction pa	S I S	SM	Silty sands, sand-silt mixtures	B         % 21 d         %           B         % 21 d         %           Image: B         %         1           Image: B         1	
	frac Trac	SAN WI	SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above 'A' line and plasticity index greater than 7 symbols	3	
		δ	d limit <50	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity	60 PLASTICITY CHART For classification of fine-grained	7
	*	SIL	Liquic >50	МН	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	50 soils and fine fraction of coarse- grained soils Equation of 'A' line: PI = 0.73(LL-20)	
ehavior)	µm sieve	on rt content	<30	CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays		
ILS (by be	Isses 75	CLAYS we "A" line asticity cha le organic	iquid limit 30-50	CI	Inorganic clay of medium plasticity, silty clays		
ained so	r more pa	Abo	>50	СН	Inorganic clay of high plasticity, fat clays	10 MH or OH	
FINE-GR/	50% 0	ANIC TS LAYS	l limit <50	0L	Organic silts and organic silty clays of low plasticity		
Ē	ORG SIL AND C	Liquid >50	ОН	Organic clays of medium to high plasticity	U 10 20 30 40 50 60 70 80 90	100	
HIGH	IGHLY ORGANIC SOILS PT Peat, muck and other highly organic soils			PT	Peat, muck and other highly organic soils	<ul> <li>* Based on the material passing the 75 mm sieve</li> <li>1 ASTM Designation D 2487, for identification procedure see D 2488 USC as modified by PFRA</li> </ul>	

### **GROUND ICE DESCRIPTION**

		ICE NOT VISIBLE	
GROUP Symbol	SYMBOL	SUBGROUP DESCRIPTION	
	Nf	Poorly-bonded or friable	
N	Nbn	No excess ice, well-bonded	
	Nbe	Excess ice, well-bonded	NACE OF COMPANY

#### NOTES:

LEGEND:

1. Dual symbols are used to indicate borderline or mixed ice classifications.

Ice

- 2. Visual estimates of ice contents indicated on borehole logs  $\pm$  5%
- This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes.

#### VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP Symbol	SYMBOL	SUBGROUP DESCRIPTION	
	Vx	Individual ice crystals or inclusions	• •
v	Vc	Ice coatings on particles	0 दुर
v	Vr	Random or irregularly oriented ice formations	KVX
	Vs	Stratified or distinctly oriented ice formations	

#### **VISIBLE ICE GREATER THAN 50% BY VOLUME**

#### 

Tt\_Modified Unified Soil Classification\_Arctic.cdr

Soil



			Borehole No	D: BH18-0	2						
			Project: 2018 Geotechnical Serv	ces	Project No: ENG.WARC03380-01						
		<b>Associated</b> GLOBAL PERSPECTIVE. Engineering LOCAL FOCUS.	Location: Whistle Bend Phase 3	) and 3E							
			Whiteharse Vuken								
	1		Whitehorse, Tukon			49407	Z E, 073020	U IN, Z O			
Depth (m)	Method	Soil Description	n	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic M Limit C 20 4	loisture Liquid Content Limit 0 60 80	o Depth (ft)		
E		SILT - some organic debris at surface, trace sand, (200	mm thick)	Seasonally frozen							
	Solid stem auger	SAND - trace to some silt, brown, fine sand, medium sa SILT (GLACIOLACUSTRINE) - some clay, soft to firm, o - moist to wet	nd with depth	Unfrozen		10.3 3.4 29 30.5	•		1 1 2 2 3 4 5 6 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
		- dark grey				31.1	•		110		
	_	<b>~</b>	Contractor: Donjeck Drilling		Comp	letion	Depth: 6 m				
			Drilling Rig Type: Truck Mounted	CME 75	Start I	Date: 2	018 March 2	20			
	U		Logged By: MP		Comp	letion	Date: 2018 N	/larch 20			
	_		Reviewed By: CC		Page	1 of 1					

			Borehole	No: BH18-	-0	3						
			Project: 2018 Geotechnica	al Services		Projec	t No: EN	G.WARC03	380-01			
		Engineering LOCAL FOCUS.	Location: Whistle Bend Ph	ase 3D and 3E								
			Whitehorse, Yukon			UTM:	494071 E	; 6738120	N; Z 8			
					Τ							
Depth (m)	Method	Soil Description		Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit 20	Moisture Content	Liquid Limit <b>I</b> 80	Monitoring Well	Depth (ft)	
-		SILT (FILL FROM CONTINUING CARE SUBEXCAVAT	ION) - trace clay, grey	Seasonally frozen	+					<u>م م</u>		
	Solid stem auger	SAND - trace to some silt, brown, fine to medium sand SILT (GLACIOLACUSTRINE) - some clay, moist to wet - trace to some sand, increased dilatancy, wet, soft, fi - firm END OF BOREHOLE (6.00 metres) 50 mm diameter Monitoring well installed to 5.70 metre	, soft to firm, olive brown ne sand	Verasionally trozen		15.4 6.6 30 30.7	•	•			1	
- - - - 7.5			Contractor: Donjeck Drillin	g		Comp	letion De	pth: 6 m			23-	
		TETRA TECH	Drilling Rig Type: Truck Mounted CME 75			Start Date: 2018 March 20						
	U		Logged By: MP			Comp	letion Dat	te: 2018 Ma	arch 20			
J			Reviewed By: CC			Page	1 of 1					

			Borehole No	D: BH18-0	4							
			Proiect: 2018 Geotechnical Servi	ces	Proie	ct No: I	ENG.WAR	C03380-0 <sup>-</sup>	1			
		Engineering GLUBAL PERSPECTIVE.	Location: Whistle Bend Phase 3	) and 3E								
	_		Whitehorse Yukon		⊔тм∙	49420	8 E· 67380	27 N· 7 8				
					101111.	10120	.0 E, 07000	2111,20				
o Depth (m)	Method	Soil Description	ו	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit 20	Moisture Content 40 60	Liquid Limit –1 80	o Depth (ff)		
-		THIN GRAVEL VENEER - (from construction traffic), (10	00 mm thick)	Seasonally frozen			-	: :				
	Solid stem auger	SAND - trace silt, brown, fine to medium sand SILT (GLACIOLACUSTRINE) - some clay, moist, firm, o - moist to wet	Jive brown	Unfrozen		4.6 15.5 31.4 30.7	•			$ \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 10 \\ 10 \\ 11 \\ 12 \\ 13 \\ 14 \\ 15 \\ 16 \\ 17 \\ 18 \\ 19 \\ 19 \\ 10 \\ 17 \\ 18 \\ 19 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10$		
F						1				21-		
E						1						
F										22-		
- 7										23-		
F												
75										24-		
			Contractor: Donjeck Drilling		Comp	oletion	Depth: 6 m					
			Drilling Rig Type: Truck Mounted	CME 75	Start	Date: 2	2018 March	20				
	lt		Logged By: MP		Comp	oletion	Date: 2018	March 20	)			
			Reviewed By: CC		Page	1 of 1						

	•		Testpit No: TF	<b>P</b> 01					
Ŀ	<b>0</b> 0	vernment of Yukon -	Project: Geotechnical Evaluation Se	ervices	Project No	: W1410356	57-18.004		
	C	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground Ele	ev: 676 m			
			Whitehorse, Yukon		UTM: 4943	323 E; 6738	033 N; Z 8		
Depth (m)	Method	Soil Descriptic	on	Ground Ic Descriptio	u a Ire Content (%)				Elevation (m)
					Moistu	Plastic Limit	Moisture Content	Liquid Limit I	
0		SAND (FILL) - some silt to silty, uniformly graded, brow	n, fine sand, (150 mm thick)	Seasonally frozen		20	40 60	<u>00</u>	676
-								:	-
_		ORGANIC ROOT MAT - black, (50 mm thick)						:	_
_		SILT (GLACIOLACUS I RINE) - trace to some clay, olive	e grey and brown						-
							· · ·	:	
								:	
_		- moist		Unfrozen			· · ·		_
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_		END OF TESTFIT (1.5 meties)							_
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3									672
		۲	Contractor: Arctic Backhoe Services			n Depth: 1.5	m		013
		TETRA TECH	Drilling Rig Type: CAT Rubber Tired	d Backhoe	Start Date:	2016 Dece	mber 05		
"	U		Logged By: MCP		Completion	n Date: 201	6 Decemb	er 05	
			Reviewed By: CPC		Page 1 of	1			

	• -		Testpit No: T	<b>2</b> 02						
G	j0	vernment of Yukon -	Project: Geotechnical Evaluation Se	ervices	Project N	o: W14	103567	7-18.004		
	C	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground E	lev: 67	7.5 m			
			Whitehorse, Yukon		UTM: 494	4135 E:	67380	09 N; Z 8	}	
o Depth (m)	Method	Soil Descriptio	bn	Ground Ic Descriptio	Maisture Contract (%)		astic I imit 20 4	Moisture Content 40 60	Liquid Limit -1 80	Elevation (m)
- - - - - - - - -	Excavated	SILI (FILL) - reworked by construction traffic, some sar	ια, trace gravel, trace clay, olive brown	Unfrozen						- - - 677 - - - - - - - -
-		SAND - some silt, uniformly graded, moist, brown, fine sand SILT (GLACIOLACUSTRINE) - trace to some clay, moist, olive brown END OF TESTPIT (1.7 metres)								
- 2 - - - - - - - - - - - -										- - - - - - - - - -
	-	-	Contractor: Arctic Backhoe Services	3	Completi	on Dept	th: 1.7	m		•
			Drilling Rig Type: CAT Rubber Tire	d Backhoe	Start Date	e: 2016	Decen	nber 05		
	t		Logged By: MCP		Completi	on Date	e: 2016 December 05			
			Reviewed By: CPC		Page 1 o	f 1				

			Testpit No: TF	203						
ŀ	j0	vernment of Yukon -	Project: Geotechnical Evaluation Se	ervices	Project No	o: W	141035	67-18.004		
	C	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground E	nd Elev: 678 m				
		-	Whitehorse, Yukon		UTM: 494	022	F: 5738	012 N: 7	8	
							, 0.00	<u>, , , , , , , , , , , , , , , , , , , </u>	•	
o Depth (m)	Method	Soil Descriptio	n	Ground Ic Descriptio	Woisture Content (%)		Plastic Limit 20	Moisture Content 40 60	Liquid Limit <b>I</b> 80	Elevation (m)
		SILT (FILL) - some fine sand, olive brown		Seasonally frozen						
-		- trace organics in silt matrix SAND - some silt, uniformly graded, brown, fine sand								-
-		- damp		Unfrozen						-
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<u> </u> 1	cav							•••••••••••••••••••••••••••••••••••••••		677—
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		SILT (GLACIOLACUSTRINE) - trace to some clay, mon	st, olive brown							
										_
-										-
-							:			-
- 2										676-
		I LINU OF IESTPIL (2.0 METRES)								
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F										
-										
L										-
3										675
		<b></b>	Contractor: Arctic Backhoe Services	3	Completic	on D	epth: 2 r	n		075
		TETRA TECH	Drilling Rig Type: CAT Rubber Tire	d Backhoe	Start Date	e: 20	16 Dece	mber 05		
	U		Logged By: MCP		Completic	on D	ate: 201	6 Decem	per 05	
			Reviewed By: CPC		Page 1 of	1				

	•		Testpit No: TF	<b>&gt;</b> 04						
Ģ	0¢	vernment of Yukon -	Project: Geotechnical Evaluation Se	ervices	Project N	No: V	V14103567	-18.004		
	С	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground	Elev	: 676.5 m			
			Whitehorse, Yukon		UTM: 49	9436	2 E; 67380	36 N; Z 8	;	
o (m)	Method	Soil Descriptic	on	Ground Ic Descriptio	e n	Moisture Content (%)	Plastic M Limit ( 20 4	loisture Content	Liquid Limit 80	Elevation (m)
		ORGANICS - black, (150 mm thick)		Seasonally frozen					:	
-		SILT (GLACIOLACUSTRINE) - trace to some clay, olive	e brown							-
-	Excavated	- moist		Unfrozen						- 676 - - -
- 1 - -		END OF TESTPIT (1.5 metres)								- - - 675-
- - - - 2										-
										- - - 674 - - - -
		2	Contractor: Arctic Backhoe Services	3	Complet	tion [	Depth: 1.5 r	n		
			Drilling Rig Type: CAT Rubber Tire	d Backhoe	Start Da	te: 2	016 Decem	ber 05		
	U		Logged By: MCP		Complet	tion [	Date: 2016	Decemb	er 05	
			Reviewed By: CPC		Page 1 c	of 1				

	<b>`</b> ~	vernment of Vulken	Testpit No: TF	<b>P05</b>						
U U	) (		Project: Geotechnical Evaluation Se	ervices	Project N	No: V	V1410356	67-18.004		
	C	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground E	Elev	: 676.5 m			
			Whitehorse, Yukon		UTM: 49	426	4 E; 6738	079 N; Z 8		
Depth (m)	Method	Soil Descriptio	วท	Ground Ic Descriptio	e o	Moisture Content (%)	Plastic Limit 20	Moisture Content 40 60	Liquid Limit 80	Elevation (m)
		ORGANICS - black, (150 mm thick)		Seasonally frozen			:	· · ·	:	
-		SAND - some silt, uniformly graded, brown								-
-		- damp	st olive brown	Unfrozen						-
- - - -	Excavated									676— - - -
		END OF TESTPIT (1.2 metres)								- - - 675- - - - -
		2	Contractor: Arctic Backhoe Services	3	Completi	ion [	Depth: 1.2	2 m		1
			Drilling Rig Type: CAT Rubber Tired	d Backhoe	Start Dat	te: 2	016 Dece	mber 05		
	lt		Logged By: MCP		Completi	ion [	Date: 201	6 Decemb	er 05	
	_		Reviewed By: CPC		Page 1 o	of 1				

	Government of Yukon -	Testpit No: TI	<b>&gt;</b> 06						
Ŀ.	00 0	vernment of Yukon -	Project: Geotechnical Evaluation Se	ervices	Project No:	W14103567	-18.004		
	C	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground Ele	v: 677 m			
			Whitehorse, Yukon		UTM: 49409	92 E; 673811	10 N; Z 8		
o Depth (m)	Method	Soil Descriptio	DN	Ground Ic Descriptio	U a Moisture Content (%)	Plastic M Limit C 20 4	loisture Content 0 60	Liquid Limit 1 80	Elevation (m)
- - - - - - - - - - -	Excavated	SILT (FILL) - trace to some clay, trace fine sand (from c - wet SAND - some silt, uniformly graded, moist at interface v	vith surficial silt, brown	Unfrozen					
- - - - - - - - - - - - -		- damp \$ILT (GLACIOLACUSTRINE) - trace to some clay, moi END OF TESTPIT (1.6 metres) Note: Excavated where Norcope's Continuing Care s	st, olive brown						- - - - - - - - - - - - - - - - - - -
- - -	Ą	TETRA TECH	Contractor: Arctic Backhoe Service: Drilling Rig Type: CAT Rubber Tire Logged By: MCP Reviewed By: CPC	s d Backhoe	Completion Start Date: 2 Completion	Depth: 1.6 n 2016 Decem Date: 2016 I	n ber 05 Decembe	r 05	

	Government of Yukon -	Testpit No: TF	<b>P07</b>				
G	0	vernment of Yukon -	Project: Geotechnical Evaluation Se	ervices	Project No:	W14103567-18.004	
	С	ommunity Services	Location: Whistle Bend Subdivision	- Phase 3	Ground Ele	v: 678.5 m	
			Whitehorse, Yukon		UTM: 4940	21 E: 6738213 N: Z 8	
o Depth (m)	Method	Soil Descriptio	n	Ground Ic Descriptio	U O Moisture Content (%)	Plastic Moisture Liquic Limit Content Limit 20 40 60 80	Elevation (m)
		ORGANICS - very thin veneer, black, (50 mm thick)		Seasonally frozen			
-		SAND - some silt, becoming trace silt with depth, browr - damp	1	Unfrozen			
- 1 - - - - - - - - - - - - - - - - - -	Excavated	END OF TESTPIT (2.5 metres)					
-							-
3	1	1	Contractor: Arctic Backhoe Services	3	Completion	Depth: 2.5 m	I
			Drilling Rig Type: CAT Pubber Tiro	, 1 Backhoe	Start Date:	2016 December 05	
17	R	I I E I KA TECH			Completies	Date: 2016 December 05	
Ľ						Date. 2010 December 05	
			Reviewed By: CPC		rage 1 of 1		

			Testpit No: <b>TF</b>	208				
C	<b>)</b> 0	vernment of Yukon -	Project: Controbuical Evaluation Sc		Project No:	W11103567 18	004	
	C	ommunity Services	Floject. Geolectifical Evaluation Se	Dhase 2	Cround Ele	. VV 14 103007-10.	.004	
		· · · · · · · · · · · · · · · · · · ·	Whitehorse Yukon	- Flidse 5		50. 070.5 m IGN E: 6738321 N	l· 7 8	
					01101.4340	00 L, 0730321 N	1, 2 0	
Depth (m)	Method	Soil Descriptio	on	Ground Ic Descriptio	U O Moisture Content (%)	Plastic Moist Limit Cont 20 40	ure Liquid ent Limit 60 80	Elevation (m)
		SILT AND SAND - brown, fine sand		Seasonally frozen			· · · · · · · · · · · · · · · · · · ·	
-		SAND - some silt, damp, brown, fine to medium sand		Unfrozen				- - - 678 - - - -
- 1 - - - - - - - - - - - - - - - - - -	Excavated	SII T (LACLISTRINE) - trace to some clay, moist, olive b	ΣΓΩΨΩ					677
-		END OF TESTPIT (2.5 metres)	prown					- 676-
3								
		<b>_</b>	Contractor: Arctic Backhoe Services	;	Completion	n Depth: 2.5 m		
		TETRA TECH	Drilling Rig Type: CAT Rubber Tired	d Backhoe	Start Date:	2016 December	05	
	U		Logged By: MCP		Completion	n Date: 2016 Dec	ember 05	
			Reviewed By: CPC		Page 1 of 1			

Whist	e Bend Subdivision	CLIENT: Associa	ated E	Inginee	ring		BOREHO	E NO: BH02	
Detail	ed Geotechnical Design	DRILL: Nodwell	Moun	ted CM	E 75		PROJECT	: W14101372.002	
Sanita	ry Lift Station, Whitehorse, YT								
SAMF	PLE TYPE DISTURBED NO RECOVE	RY 🔀 SPT			A-CASING	SHEL	BY TUBE	CORE	
BACK	FILL TYPE 🗾 BENTONITE 🚺 PEA GRAVE	L IIII SLOUGH	1		GROUT		L CUTTINGS	SAND	
Depth (m)	SOIL DESCRIPTION		SAMPLE TYPE	SPT (N)	GROUND ICE DESCRIPTION AND COMMENTS	□ BULK DE 1400 160 ■ S 20 40 PLASTIC I 	INSITY (kg/m³) □ 00 1800 2000 PT (N) ■ 0 60 80 M.C. LIQUIE ● 1 0 60 80		Depth (ft)
= 0	TEA GROUND COVER and ORGANICS - damp, black	/	SA	v06					0
E	SILT - trace clay, trace fine sand, damp, firm to dense, lig	ght to medium							
Ē		Gitt							
<u> </u>									
E									
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E_ 2			$\square^{\circ}$	0/ 13					
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L_ 3 E			$\square$						10_=
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E_ 4	very maint by 4.5 m becoming wet with donth								
Ē	- very moist by 4.5 m, becoming wet with depth								
F			$ \forall $						15_
E 5			X s≉	09 9					
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E_ 6	- last 150 mm of 6.0-6.5 m SPT is wet. soft and dark	arev	$ \vdash $						20_
Ē		5 - 5	X s≉	10 7					
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<u> </u>									
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E-	- very soft increased clay content and plasticity		$ \vdash $						25_
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E 9			$\mathbb{H}$						30_
F			X s≉	12 4				•	
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E 10									
F									
F	- colder with depth maybe close to 0°C @ 10.5 m		$\mathbb{H}$						35
È 11			X s≄	13 3					
E''	END OF BOREHOLE @ 11.0 m		M						
Ē.									
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- 12						1 : : : : :			<u>  39</u> = m
	<b>TETRA TECH</b> EBA			REVIE				LETTON DEPTH. 11	111
				DRAV	VING NO:		Page	l of 1	
WHITEHOP	RSE ZONE8 GPJ EBA GDT 16/11/22								

Whistl	e Bend Sub	division		CLIENT: Associated Er	ngineerir	ng		TESTPI	T NO: T	-03		
Detaile	ed Geotech	nical Design		EXCAVATOR: Hitachi I	FX200L	C Tracked Exc	avator	PROJE	CT: W14	101372.0	002	
Sewer	r Force Mai	n Route, Whitehorse,	ΥT									
SAMP	PLE TYPE	DISTURBED		RY 🔀 SPT	A	CASING	SHEL	BY TUBE	C	ORE		
BACK	FILL TYPE	BENTONITE	PEA GRAVEL	SLOUGH	ن G	ROUT			iS 🟥 Si	AND		
					Щ		BULK DEI 1400 160	NSITY (kg/m <sup>3</sup> ) 0 1800 2000	$\begin{vmatrix} \Box \\ 0 \end{vmatrix} = 20$	CLAY (%)	♦ 80	
(E)					Ĕ	GROUND ICE	■ SF	PT (N)		SILT (%)	•	(ft)
pth					L L	AND	20 40	0 60 80	20	40 60 SAND (%)	80	spth
ď					AMI	COMMENTS		M.C. LIQ	JID <u>20</u>		80	ð
					S		20 40	) 60 80	20	40 60	80	
- 0	ORGANIC	VENEER - mostly black	ootlets throughout, da	mn_compact (est )_midium						· · · · ·		0 -
	brow	n		mp, compact (cst.), midiam			•			· · · · ·		-
-	- sand b	ecomes cleaner and fediu	m to fine grained day	nn to dry light grevish brown								
	Sund B		in to fine grained, da	np to dry, light groyion brown				• • • • • • • • • •				-
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L												-
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-												5 -
-	- some	sidewall sloughing										-
E												-
F							•					-
<u> </u>	- occasi	onal thin lenses of coarse	r black sand at depth									
F												-
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-	SILT - trac	e clay, trace fine sand, da	mp, firm, light olive bi	own								15
E												
F_							•					
	END OF T	ESTPIT @ 5.0 m						• • • • • • • • • • •				
F	NOTE SA	ND/SILT INTERFACF diff	icult to determine due	to sloughing soils						· · · · ·		
E										· · · · ·		-
5.5											1. 6	18_
	ь) тет	RA TECH EB	Ą	ŀ	LUGGE	U BY: MCP			/IPLETIC	<u>10/00/0</u>	<u>H: 5m</u> 9	
	<b>_</b>			ŀ	DRAWI	NG NO:		Pag	e 1 of 1	10/03/0	5	

Whistl	e Bend Subdivision	CLIENT: Associated Er	ngineeri	ing		TESTPIT	NO: TP15	
Detail	ed Geotechnical Design	EXCAVATOR: Komats	u Rubb	er Tired Backho	e	PROJECT	: W14101372.002	
Casca	& Phases I and II, Whitehorse, YT							
SAMF	LE TYPE 📃 DISTURBED 🗌 NO RECOV	ERY 🔀 SPT	ļ	A-CASING	SHEL	BY TUBE	CORE	
BACK	FILL TYPE 📃 BENTONITE 🚺 PEA GRAVE	EL I SLOUGH	· • • (	GROUT	🛛 drili	L CUTTINGS	SAND	
			Ц	L	BULK DE	NSITY (kg/m³)□ 0 1800 2000	◆ CLAY (%) ◆ 20 40 60 80	
(E)	SOIL		Ĭ			PT (N)	● SILT (%) ●	( <del>ft</del> )
epth	DESCRIPTION	J			20 40	00 00	20 40 60 80 ▲ SAND (%) ▲	epth
ă		•	MAR	COMMENTS		M.C. LIQUIE	20 40 60 80 ■ GRAVEL (%) ■	
0	OPCANIC POOT MAT - seasonally frozen black				20 40	0 60 80	20 40 60 80	0
	ORGANIC ROOT WAT - seasonally hozen, black							°-
-	SAND - some silt to silty between 0.2 and 1.0 m, cleane	r with trace of silt from 1.0 m to	) prk					-
F	brown below 1.0 m							_
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L	END OF TESTPIT @ 2.3 m							_
	NOTE: Testpit excavated at intersection of Casca Blvd (	north leg) and Keno						
								-
F								-
F								_
╞								-
Ļ								-
3								10
		ŀ	LOGG	ED BY: MCP			LETION DEPTH: 2.3	m
		ł		<u>ING NO'</u>		Page 2	LETE: 10/10/18	

Whistle	/histle Bend Subdivision CLIENT: Associat						rin	g				TES	STPI	T N	D: TP	16			
Detaile	ed Geotechni	cal Design		EXCAV	ATOR: Komat	su Rubb	bei	r Tired Backho	be			PR	OJE	CT:	W141	0137	72.0	)2	
Casca	& Phases I a	and II, Whitehorse,	YT							-				_	_				
SAMP	LE TYPE	DISTURBED	NO RECOVE	RY 🔀	SPT		A-(	CASING	Ш	SF	HELE	BY TI	UBE			RE			
BACK	FILL TYPE	BENTONITE	PEA GRAVEI	- Ш	SLOUGH	• • •	GF	ROUT	$\mathbb{N}$	DF	RILL	CUT	TING	iS 🚉	SA	ND			
						Ц	비			BULK 1400	DEN ( 1600	ISITY ) 180	(kg/m³) 0 2000		• 20	CLAY 40	(%)◀ 60	► 80	
E			SOIL			Ž	=	GROUND ICE			SP	T (N	)			SILT	(%) <b>(</b>		(#)
spth		DE	SCRIPTION				빌	AND	'	20	40	00	00		20	40 SAND	(%)	<u>60</u>	epth
ŏ								COMMENTS	PL	AST I	IC N	I.C. ●	LIQU	JID	20 ■ G	40 RAVF	60 1 (%)	80	
			france black			0	<i>''</i>			20	40	60	80		20	40	60	80	0
		OUT MAT - seasonally	Trozen, Diack																- 1
	SAND - some season	e silt to silty to 0.8 m, c ally frozen to 0.3 m. m	leaner with trace of sil edium brown	t from 0.8	m to 1.2 m,														-
-		- <b>,</b> ,																	-
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										-									-
	SILT (GLACI	OLACUSTRINE) - trac	e clay, trace fine sand	, damp to	moist, medium oli	ive													
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-																			_
-														:					5_
-																			-
-																			
										÷									_
- <sup>2</sup>	END OF TES	STPIT @ 2.0 m									· · · · ·		• • • • •			•••••••		••••••	-
-	NOTE: Testp	it excavated at intersed	ction of Casca Blvd (n	orth leg) a	t the sanitary force	e													_
-	main c	rossing	,	0,															_
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3																			10
			Δ			LOGG	E	D BY: MCP				$\square$	CON	<b>APL</b>	ETIO	N DE	PTH	l: 2m	1
[ "	ייינס						-W	<u>VED BY: CPC</u>				$\neg$	CON	//PL	<u>ETE:</u> of 1	10/1	0/18		
WHITEHOR	SE ZONE8 GP.I EBA	GDT 16/11/22				URAV	VII	NG INU.					гау	<del>८</del> । (	ווע				

Whistl	histle Bend Infiltration Testing				: Morrison H	ershfie	eld Li	d.		1	rest		10: T	P03			
Whistl	e Bend Subdi	vision		EXCAV	ATOR: Koma	atsu 42	20 Ri	ubber Tire Bac	khoe	F	PRO	JECT	: W14	4101	545.0	01	
White	horse, YT									E	ELEV	ATIC	N: 6	77.6	n		
SAMP	LE TYPE	DISTURBED	NO RECOVE	RY 📐	SPT	E	A A	CASING	III SH	ELB	Y TUB	BE		ORE			
BACK	FILL TYPE	BENTONITE	PEA GRAVEI	L []]]	SLOUGH		ۍ G	ROUT		ILL C	CUTTI	NGS		SAND			
Depth (m)		DES	SOIL CRIPTION			AMPLE TYPE	APLE NUMBEF	GROUND ICE DESCRIPTION AND COMMENTS	1400 20	DENS 1600 ISPT 40 C M.0	60 C. L	J/m²)∐ 2000 80 .IQUID	20 20 20	<ul> <li>CLA</li> <li>40</li> <li>SIL<sup>-</sup></li> <li>40</li> <li>SAN</li> <li>40</li> </ul>	Y (%) <u>60</u> F (%) <u>60</u> D (%) <u>60</u>	80 80 80 80	Elevation (m)
						S	SAN		20	40	60	80	20	GRAV ) 40	EL (% 60	80	
0	ORGANIC CO	DVER						FROZEN TO			: :			: :		:::	_
-	SAND - trace	silt, poorly graded, fin	e to medium sand, lig	ht brown				0.0 m									-
-	- dry, loose							UNFROZEN									677.0
_																· · · · · · · · · · · · · · · · · · ·	-
- 1																	-
-																· · · · · · · · · · · · · · · · · · ·	-
-							6401									· · · · · · · · · · · · · · · · · · ·	-
-							SAUT										676.0
-	SILT - trace c	lay, moist, firm, non pl	astic, olive brown														-
2 																	-
-																	-
																	- 675.0
-							\$402										-
3	END OF TES	TPIT @ 3.0 m (Machin	ne Extent)				SAUZ										-
-																	-
-																	- 674 0
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4													· · · · · · · · · · · · · · · · · · ·			1, 2-	-
	L TETR	A TECH EB	A			RE	VIEV	VED BY: CPC			0 C			<u>UN L</u> E: 11/	<u>י⊏P11</u> 11/29	1. 311	I
						DF	AWI	NG NO: Figure	e 1		P	age 1	of 1	,			

Geote	chnical Evalu	ation	AECOM					BO	REHO	LE NO	BH14			
Whistle	e Bend Subd	ivision		Drilling Method: NOD	WEL	L Mo	unted CME 75		PR	OJECT	: W14	101171		
Whiteh	norse, YT													
SAMP	LE TYPE	DISTURBED	NO RECOVE				-CASING		LBY T	UBE		ORE		
BACK	FILL TYPE	BENTONITE	PEA GRAVEL		Ē	₀ G	ROUT			TINGS	S/		•	
					Ш	BE		1400 1	ENSITY 600 180	(kg/m³)∟ 0 2000	20	40 60	◆ 80	
E			SOII		≥	NUM	GROUND ICE	20	SPT (N	l) <b>■</b>	20	SILT (%)	۰ ۵۵	(#)
spth		DES	CRIPTION		ЫШ	Щ	AND		+0 00	00	20	SAND (%	) 🔺	epth
Õ		020			SAM	MPI	COMMENTS		• M.C.		) <u>20</u> ∎G	<u>40 60</u> RAVEL (%	80 (6)	
			anally frazon block			SA		20	40 60	80	20	40 60	80	0 -
	SILT - some	clay, trace fine sand, s	seasonally frozen, black	8 m, damp below		1		•					•	
	seasor	al frost, firm, medium	olive brown											
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-														
Ē	- moisture co	ontent increases with d	epth, firm, dark olive b	prown		3								
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_ 4														
Ē						4								
	- soft by 4.5	m, turning dark grey as	s moisture content incr	reases between 4.5 and										15_
	6.0 m												· · · ·	
- 0														
-													· · · ·	
-						5							· · · · ·	
E 6														
E	END OF BOI	REHOLE @ 6.0 m											· · · ·	
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Т	E TETE	RA TECH EB	A		RE	VIEV	VED BY:			COMF	LETE:	08/12/1	0	
					DF	RAWI	NG NO:			Page	1 of 1			

Geote	chnical Evalua	ation		AECOM					BOREHO	E NO: BH15		
Whistle	e Bend Subdi	vision		Drilling Method: NOD	WEL	L Mo	unted CME 75		PROJECT	: W1410117		
Whiteh	horse, YT			Drilled on Dune				<u></u>				
SAMP	LE TYPE	DISTURBED	NO RECOVE	RY 🔀 SPT	E		-CASING	SHEL	BY TUBE	CORE		
BACK	FILL TYPE	BENTONITE	PEA GRAVEL	. IIII SLOUGH		۰ C	ROUT			SAND		
					Щ	BER		BULK DE	NSITY (kg/m <sup>3</sup> ) 10 1800 2000	◆ CLAY (9 20 40 6	%)◆ 0 80	
E			SOIL		Ł	NUM	GROUND ICE	■ SI	PT (N)	• SILT (%	6)● 2 80	i (ft)
epth		DES	CRIPTION		ЫШ	ЦЦ	AND	20 40	00 00	▲ SAND (	%) <b>▲</b>	epth
ă		DEC			SAM	MPI	COMMENTS		M.C. LIQUIE	20 40 6 ■ GRAVEL	0 80 (%)∎	Δ
		1. 1				SA		20 40	0 60 80	20 40 6	<u>) 80</u>	0 -
Ē	SAND - some medium	to trace slit, fine grair i brown	ned, uniform, dry to da	mp below seasonal frost,		1		•				0
<u>-</u>	- becomes cl	eaner and greyish bro	wn at 0.3 m									Ē
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E9	SILI - some c	ay, trace fine sand, w	vet, sott, dark olive									
Εl	END OF BOR	EHOLE @ 9.0 m									· · · ·	30
Εl												
Ē,												
- 10						GGF	D BY: MCP	<u>  : : : :</u>	COMP		PTH <sup>.</sup> 9m	33=
	L TETR	A TECH EB	A		RE	VIE	VED BY:		COMP	LETE: 08/12/	<u>/10</u>	
					DF	RAW	NG NO:		Page 2	l of 1		

Geotech	nical Evaluation	AECOM					BOREHOLE NO: W14101171-BH15				
Whistle E	Bend Subdivision	Drilling Method: NODWELL Mounted CME 75					PROJECT NO: W14101171				
Whitehor	rse, YT	6738162N; 494	003	E; Zo	one 8	["]"]		[** <b>16</b> ]*	1 ~-		
SAMPLE										3 CORE	
BACKFIL	LL TYPE BENTONITE										
			ЪË	<b>IBEI</b>			3		20 40	<u>) 60 80</u>	
E	LITHOLOGICAL			NN.	GROUND ICE	Bulk Density(kg/m <sup>°</sup> ) 500 1000 1500 2000			20 40 60 80 _		h (ft)
Jept	DESCRIPTION			Щ	AND COMMENTS				▲ SA	ND (%) ▲	Jept
			SAN	A A		-LASTIC			GRA	VEL (%)	
- 0 3	SAND - some to trace silt, fine grained, uniform, dry to de	amp below		रु		20 4	0 60 80	: :	20 40	) <u>60 80</u>	
	seasonal frost, medium brown			1		•					
-	- becomes cleaner and greyish brown at 0.3 m										-  =
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_ 3	amonth arou drilling throughout donth of harobala										. 10_
	- smooth, easy drining throughout depth of borehole										
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0	SILT - some clay, trace fine sand, wet, soft, dark olive			7		•					
- <sup>3</sup>   E	END OF BOREHOLE @ 9.0 m										30_
-											
10											33
		(			OGGED BY: MCP		CON	<b>NPLE</b>	TION	DEPTH: 9	m
éba	EBA Engineering Con	sultants i	Lto	ם <b>.</b> [ַ	REVIEWED BY:			<b>APLE</b>	TE: 12	2/10/2008	
GP W1410117	71.GPJ EBA.GDT 09/01/30			[	JKAWING NO:		Pag	<u>e 1 o</u>	T 1		