

November 1, 2019

Government of Yukon
Department of Community Services
Rural Land Development – Land Development Branch
Box 2703
Whitehorse, YT Y1A 2C6

ISSUED FOR USE
FILE: 704-ENG.WARC03386-45
Via Email: kevin.fisher@gov.yk.ca

Attention: Mr. Kevin Fisher, Senior Program Manager

Subject: Residential Site Development Suitability
Keno, Yukon

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Kevin Fisher, Program Manager for the Government of Yukon (YG), Community Services, Rural Land Development, Land Development Branch to provide a geotechnical overview of the proposed residential development area(s) in Keno, Yukon.

The first site is Lot 128 which is a 0.7 ha triangular shaped parcel and the second site is located directly west of Lot 128 and is 4.1 ha in size and is un-surveyed commissioner's land.

To meet the objectives of this project, the following tasks have been completed:

- An in-house project file search revealed a project completed in 1985. This Keno Soil Study included the excavation of 7 testpits and the completion of 3 percolation tests. Testpit TP01 and percolation test PT01 were completed close to the east tip of Lot 128.
- Surficial geology mapping of the Keno area was also reviewed. Information presented on the "Surficial Geology of Keno Hill – Central Yukon (105 M/14) Geoscience Map 1998-4" identifies two depositional polygons throughout the Keno townsite suggests that the surficial soil deposition in this area is a silt till veneer that conforms to the underlying bedrock topography and to the west (closer to the commissioner's land), deposition is made up of glaciofluvial channel deposits which include glaciofluvial deposition associated with lateral and interfluvial (elevated part of the landscape that extends between two adjacent valleys) meltwater channels.
- Based on the conditions noted during the site reconnaissance, a summary of terrain and soil conditions is presented.
- Potential for country residential development are discussed and recommendations for roadway construction, conventional foundation construction and on-site sewage disposal system design and construction are presented.

2.0 SITE CONDITIONS

2.1 Location and Current Land Use

The study areas are located west of the Keno town-site along the road that runs out to the landfill site and the mine. Both sites are currently undeveloped but there is roadway access around the entire area.

2.2 Terrain Conditions

In general, the sites slope upward to the north and the slope is moderately steep with occasional benches which have gentle slopes. Terrain conditions may impact access road construction and will limit on-site sewage disposal system design to chamber, deep trench or possibly wide trench systems.

2.3 Geotechnical Conditions

The presence of glaciofluvial soils, as presented on the Yukon Geoscience Map 1998-4 – Keno Hill and confirmed in the 1985 soil study (EBA file: 0201-4405), the two sites are likely underlain with granular soils (till and/or glaciofluvial soils). The near surface soils noted during testpitting were often silty.

Refusal was encountered at 4.0 m in TP03 (possible bedrock), which was excavated on the east side of the townsite. Surficial soil mapping identifies soil cover as a veneer throughout the study areas so minimal soil cover over bedrock is possible.

Permafrost was encountered in TP7 located north of town. Thick moss cover and organic silt was noted at this location, so the presence of permafrost is not surprising. Since the study area is along a south facing slope, permafrost may not be an issue but since the area has not been pre-cleared, there is potential to encounter permafrost.

2.4 Site Grades and Drainage

Since the site is located along a slope, the area should be fairly well drained, but development will have to control surface runoff.

3.0 DEVELOPMENT POTENTIAL AND RECOMMENDATIONS

The development potential for this study area is considered fair. Development considerations related to this site include:

- Development along slopes can be problematic, making roadway construction and driveway access difficult.
- The biggest negative aspect of developing this area is the proximity to the landfill and the mine's tailings. Safe setback distances from industrial sites are often at least 800 m and even Lot 128 is less than that distance from the landfill.
- The soil conditions are considered suitable for roadway and building foundation construction. The percolation rates measured in the various soil types encountered in the 1985 soil study suggest that on-site sewage disposal system construction is feasible.

3.1 Minimum Lot Size

For country residential site development projects completed throughout the Yukon and northern British Columbia by Tetra Tech, a minimum lot size of 1 ha is typically recommended. This preliminary recommendation is considered appropriate for this proposed development as well. However, it is understood that higher density development is preferred for the study area. Based on the anticipated geotechnical conditions, 0.5 ha lot size would be feasible as long as development is limited to residential development (not residential/industrial lot development where space for equipment and shop structures is required).

3.2 Roadway Structure

The subgrade soils are likely to be fairly consistent throughout the study area, comprised of silty soils with sand and gravel.

It is anticipated that access roads will either be a gravel or BST surfaced roadway so the recommended structure over a properly prepared, stable subgrade surface includes 150 mm of Gran A (20 mm crushed basecourse gravel) over 300 mm of Gran D (80 mm pit run sub-base gravel). Imported gravel should meet the gradation specifications presented in Table 1.

Table 1: Recommended Granular Material Specifications

80 mm Pit Run Gravel		20 mm Crushed Basecourse Gravel	
Particle Size (mm)	% Passing by Mass	Particle Size (mm)	% Passing by Mass
80.000	100	-	-
25.000	55-100	20.000	100
12.500	42-84	12.500	64-100
5.000	26-65	5.000	36-72
1.250	11-47	1.250	12-42
0.315	3-30	0.315	4-22
0.080	0-8	0.080	3-6

All imported gravel is to be placed in lifts no thicker than 200 mm, moisture conditioned, and compacted to at least 98% of Standard Proctor Maximum Dry Density (as per ASTM D698).

3.2.1 Borrow Sources

It is anticipated that imported gravel used on this project will come from a Government of Yukon gravel source.

3.3 Foundations

The till and/or glaciofluvial soils underlying the site are considered appropriate for supporting conventional shallow foundation systems including strip & spread footing and thickened monolithic slab-on-grade construction.

Typically, residential housing construction relies on NBCC requirements. For non-conventional foundations, Tetra Tech can provide bearing resistances (ULS and SLS) and an appropriate seismic site classification for foundation design.

3.3.1 Seasonal Frost Heave Potential & Foundation Insulation Recommendations

The till and glaciofluvial soils are considered frost susceptible. Current local codes typically dictate the use of insulation around all foundations. However, the minimum insulation thickness and distance out from the foundation elements are often considered to be insufficient when dealing with frost susceptible soils. Tetra Tech always recommends insulating foundations constructed on frost susceptible soils to mitigate potential for seasonal frost-heave damage and it should be noted that Tetra Tech recommendations for insulation thickness and distance out from the perimeter foundation system are not generic. The frost susceptibility of soils supporting building foundations must be considered along with footing burial depth and the amount of protective soil cover over the footings. Tetra Tech or qualified geotechnical personnel should be contacted to provide site specific foundation insulation recommendations.

4.0 ON SITE SEWAGE DISPOSAL SYSTEM POTENTIAL

The percolation rates measured during the 1985 soil study suggest that there will be suitable accepting soils for on-site sewage disposal system design and construction. However, the following should be considered:

- As mentioned above, a 1 ha minimum lot size is preferable. This will ensure sufficient space for establishing a back-up soil absorption system in case the original field fails.
- Absorption fields will not likely be possible along the sloping terrain of the study area, but deep trench, shallow absorption trench, and chamber systems are all considered appropriate.
- All systems must be designed and installed in accordance with the Yukon Government's Environmental Health Guidelines. This includes site specific permitting, percolation testing, design and construction, as well as the as-built documentation to support approval.

5.0 RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL WORK

Potential for development from a geotechnical aspect has been established but this project would benefit from a final design stage geotechnical evaluation that would include a series of testpits along roadways and additional testpits on lots to establish preferable on-site sewage disposal system solutions. Ideally, this work would be completed after the roadways have been cleared of trees to ensure easy access.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Government of Yukon, 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's General Conditions are provided in Appendix A of this report.

7.0 CLOSURE

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

Respectfully submitted,
Tetra Tech Canada Inc.

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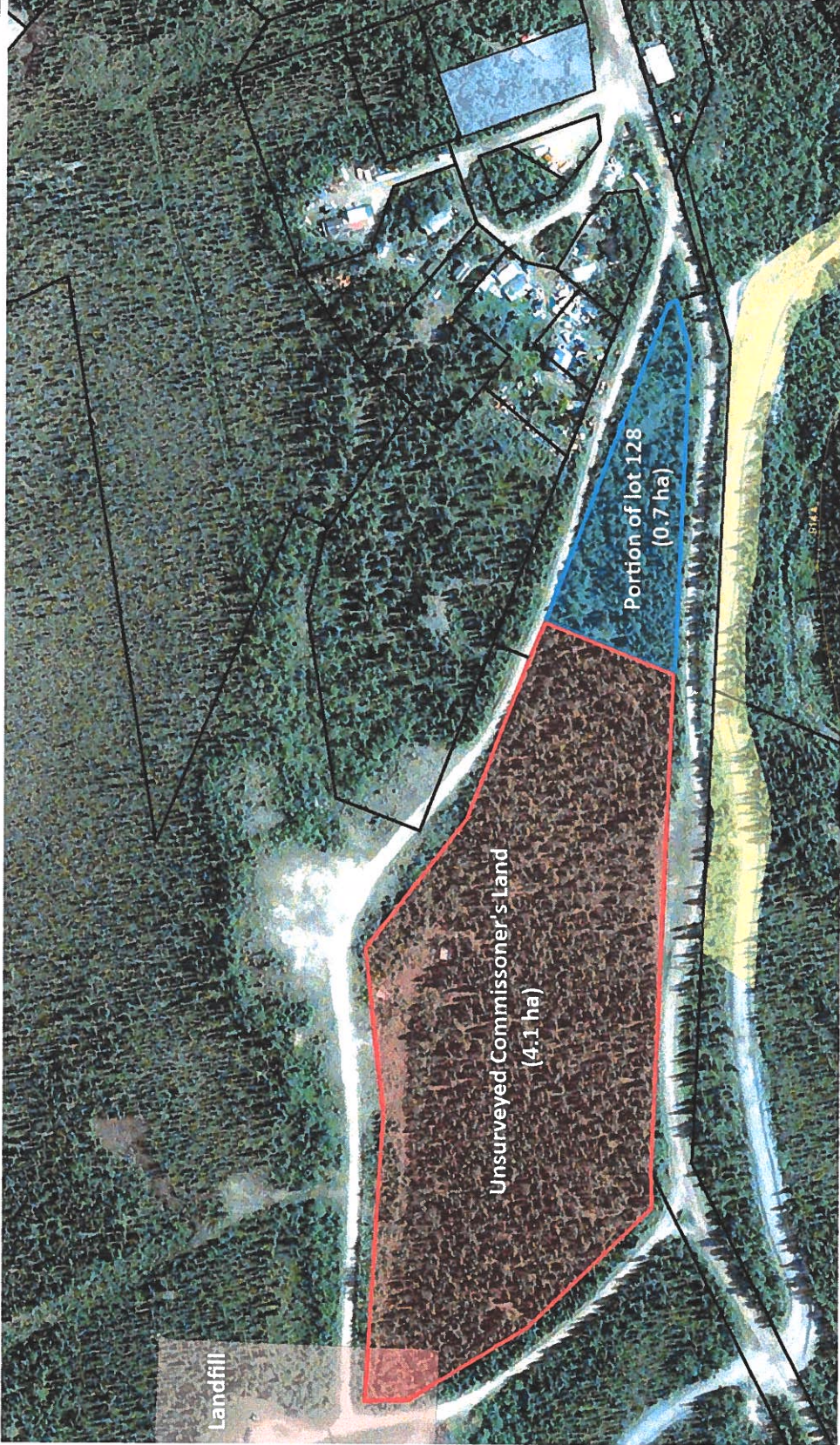
/cr



FIGURES

- Figure 1 General Location Map (Yukon Lands Viewer)
- Figure 2 1985 Soil Study Report With Site Plan, Testpit Logs and accompanying Laboratory Test Result Report Forms

Keno Vacant Land Development 2019 Assessment Boundary



Legend

- Land Applications - Active**
- Land Dispositions**
 - Transfer Request
 - Agreement for Sale
 - Easement
 - Lease
 - Reservation
- Land Licences**
- Lots for Sale**
- Notations**
- Development Hold Areas**
- Agricultural Planned Land App**
- Agricultural Land Applications**
 - Agricultural
 - Grazing
- Agricultural Land Dispositions**
 - Agricultural
 - Grazing
- Surveyed Land Parcels (<80k)**
- Settlement Lands (Surveyed)**
 - A: Surface and Subsurface Rights
 - B: Surface Rights
 - FS: Fee Simple
 - 4.1.1 Retained Reserve
- Settlement Lands (Unsurveyed)**
 - A: Surface and Subsurface Rights
 - B: Surface Rights

Notes

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.
Date Printed: 25-Jul-2019

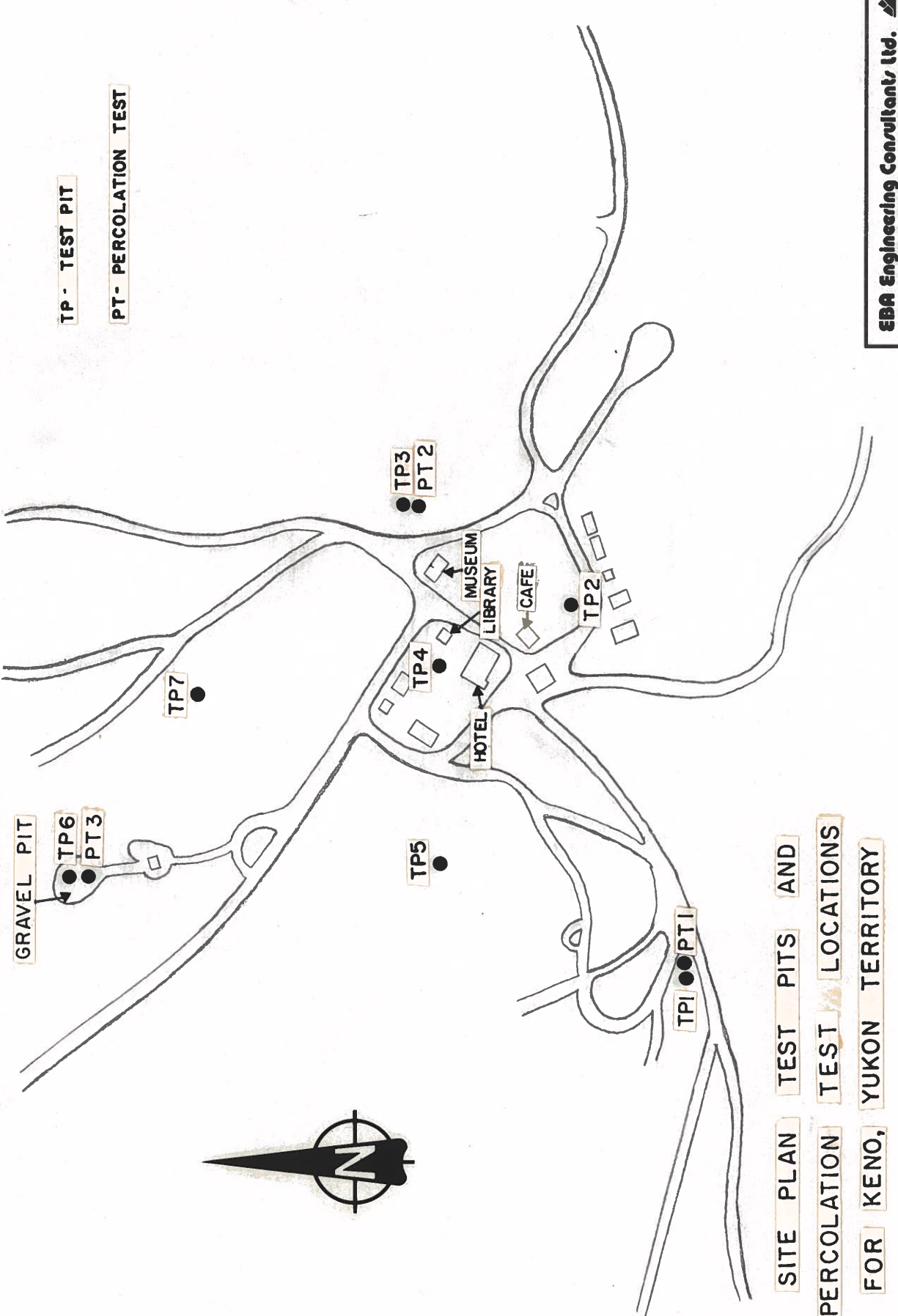


Scale: 1: 2,500

0.1 Kilometers



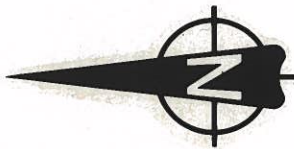
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Yukon Albers
Produced from: Yukon Lands Viewer



GRAVEL PIT

TP - TEST PIT



PT - PERCOLATION TEST





SITE PLAN TEST PITS AND
 PERCOLATION TEST LOCATIONS
 FOR KENO, YUKON TERRITORY

SCALE: 1:5000
 (TRACED FROM AIRPHOTO)

EBA Engineering Consultants Ltd.	
JOB NO.: 0201-4405	DATE: 1985-09-18
DRAWN BY: WAS	DRAWING NO.: 4405-01
REVIEWED BY: <i>[Signature]</i>	

PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 1 & Perc Test 1		PROJECT NO.: 0201-4405												
LOCATION: Keno, Yukon		SURFACE ELEVATION: 938 m		DRILL: Koering Bantam Backhoe												
SAMPLE TYPE: <input checked="" type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER																
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS.	SAMPLE DEPTH (ft.)	WATER CONTENT-% : ●				COMPRESSIVE STRENGTH								
				PLASTIC LIMIT (W _p)	LIQUID LIMIT (W _L)	Unconfined..... ▲			Pocket Penetrometer..... Δ							
				20	40	60	80	TSF 1	2	3	4	5	kPa 100	200	300	400
1	SILT - gravelly, sandy, trace of clay, occasional cobble and boulder, dark olive, moist, and cobbles sub-rounded to sub-angular	GM	1 2 3 4 5													
2	- Depth of fill material in area 2.3 m		6 7													
3	SILT - sandy, trace of gravel, occasional cobble medium brown, moist	ML	8 9 10 11													
4	- Percolation Test Number 1 was performed in this soil layer		12 13													
5	GRAVEL - sandy, trace of silt, cobbles & boulders throughout, sub-rounded to sub-angular, dark brownish grey, damp	GW	14 15 16													
6	- less silt with depth		17 18 19 20													
	END OF TEST PIT															
 DEPTH TO WATER:  NO WATER UPON COMPLETION DEPTH TO SLOUGH: — NOT MEASURED		WET UNIT $\frac{kN}{m^3}$		16	18	20	22	20		40	60	80	STANDARD PENETRATION: N- <input checked="" type="checkbox"/>			
		COMPLETION DEPTH: 5.0 m		DATE DRILLED: 85-09-11		LOGGED BY: MCP		DRAWING NO.:								

This log is a compilation of subsurface conditions and soil or rock classification obtained from the field as well as from laboratory testing of samples from the borehole. Soil zones have been interpreted according to commonly accepted practice. The change from one zone to another, as indicated on the log, may be transitional and approximate in nature. Groundwater conditions refer only to those observed at the times and places indicated and they may vary with time, geologic conditions, and construction activity.

PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 2		PROJECT NO.: 0201-4405											
LOCATION: Keno, Yukon		SURFACE ELEVATION: 940m													
		DRILL: Koering Bantam Backhoe													
SAMPLE TYPE: <input type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER															
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS.	SAMPLE DEPTH (ft.)	WATER CONTENT-% : ●				COMPRESSIVE STRENGTH							
				PLASTIC LIMIT (W _p)	LIQUID LIMIT (W _L)		Unconfined..... ▲ Pocket Penetrometer..... Δ TSF 1 2 3 4 5 kPa 100 200 300 400								
	GRAVEL - Silty, sandy, cobbles throughout, dark olive grey, moist	GM													
	- depth of fill material 0.7 m in area														
1	ORGANIC SILT LAYER - black over greyish black, moist, roots and stumps throughout	OL													
	SILT - Sandy, trace of gravel and occasional cobble, medium brown, moist	ML													
2	GRAVEL - Sandy, trace of silt, cobbles and boulders up to 800 mm in size present, sub-angular to sub-rounded, dark greyish brown, damp	GW													
	- Rusty brown in colour below 2.4 m														
3															
4															
	- Excavation quite difficult due to number of large boulders														
5															
	END OF TEST PIT														
6															
		DEPTH TO WATER:  NO WATER UPON COMPLETION DEPTH TO SLOUGH: — NOT MEASURED		WET UNIT $\frac{kN}{m^3}$ 16 18 20 22 WEIGHT-O P.C.F. 100 110 120 130 140 150		STANDARD PENETRATION: N- <input checked="" type="checkbox"/>									
				COMPLETION DEPTH: 5.0 m		DATE DRILLED: 85 09 11									
				LOGGED BY: MCP		DRAWING NO.:									

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EBA Engineering Consultants Ltd.



PARTICLE - SIZE ANALYSIS OF SOILS

Project: Keno Soil Study
Keno, Yukon

Project Number: 0201-4405

Date Tested: 85 09 06

Borehole Number: TP2

Depth: 3.0 m

Soil Description: Gravel and sand, trace of silt, rusty brown damp

Cu: _____

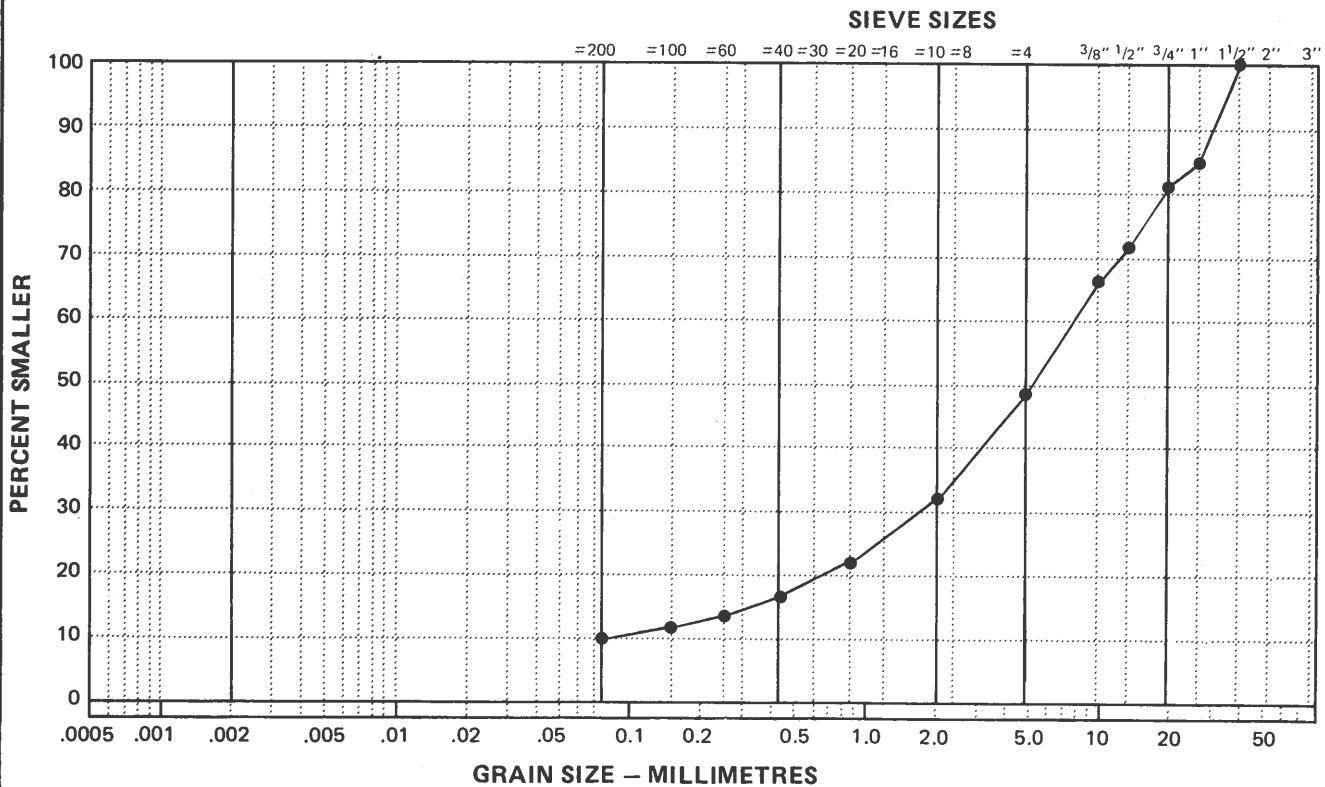
Cc: _____

Natural Moisture Content: 5.3 %



Remarks: _____

SIEVE	PERCENTAGE PASSING
3"	
1 1/2"	100
1"	85
3/4"	81
1/2"	72
3/8"	66
No. 4	49
No. 10	33
No. 20	22
No. 40	17
No. 60	14
No. 100	12
No. 200	10



CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Tested in accordance with ASTM D422 unless otherwise noted.

PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 3 & Perc. Test 2		PROJECT NO.: 0201-4405													
LOCATION: Keno, Yukon		SURFACE ELEVATION: 945 m		DRILL: Koering Bantam Backhoe													
SAMPLE TYPE: <input type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER																	
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS.	SAMPLE DEPTH (ft.)	WATER CONTENT-% : ●				COMPRESSIVE STRENGTH									
				PLASTIC LIMIT (W _p)	LIQUID LIMIT (W _L)		Pocket Penetrometer..... ▲										
				20	40	60	80	TSF	2	3	4	5	kPa	100	200	300	400
1	ORGANIC SILT - Black over dark grey, moist	OL	1														
	SILT - Sandy, dark grey to medium brown, moist	ML	2														
	GRAVEL - Sandy, silty, cobbles and boulders up to 800 mm is size, medium to rusty brown, damp	GW	3														
	- Gravel is dark brownish grey below 1.2 m		4														
2	- not quite as many large boulders between 2.0 and 3.5 m		5														
	- Percolation Test Number 2 performed in this soil layer		6														
			7														
			8														
3	- concentrated layer of large boulders from 3.5 to 4.0 m	GP	9														
			10														
			11														
4	Backhoe refusal at 4.0 m		12														
	END OF TEST PIT		13														
			14														
			15														
5			16														
			17														
			18														
			19														
6			20														
		DEPTH TO WATER:  NO WATER UPON COMPLETION DEPTH TO SLOUGH: — NOT MEASURED		WET UNIT $\frac{KN}{m^3}$ 16 18 20 22 WEIGHT-O P.C.F. 100 110 120 130 140 150				STANDARD PENETRATION: N- ■ COMPLETION DEPTH: 4.0 m DATE DRILLED: 85 09 11									
		LOGGED BY: MCP		DRAWING NO.:													

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PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 4		PROJECT NO.: 0201-4405									
LOCATION: Keno, Yukon		SURFACE ELEVATION: 942m											
DRILL: Koering Bantam Backhoe													
SAMPLE TYPE: <input checked="" type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER													
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS.	SAMPLE DEPTH (ft.)	WATER CONTENT-% : ●				COMPRESSIVE STRENGTH					
				PLASTIC LIMIT (W _p)	LIQUID LIMIT (W _L)		Unconfined.....▲ Pocket Penetrometer.....Δ						
				20	40	60	80	TSF	1	2	3	4	5
1	SILT - Sandy, gravelly, dark olive grey, moist - traces of organics indicate extent of fill at 0.5 m - becomes sandy with some gravels and cobbles, medium brown and moist below 0.5 m - colour changes back to dark olive grey below 1.1 m	GM	1 2 3 4 5										
2	GRAVEL AND SILT - some sand, dark olive colour - occasional boulder is present		6 7										
3	- easy digging throughout total depth of Test Pit		8 9 10										
4			11 12 13										
5	- becomes siltier and darker in colour below 4.8 m		14 15 16										
6	END OF TEST PIT		17 18 19 20										
 DEPTH TO WATER:  NO WATER UPON COMPLETION DEPTH TO SLOUGH: — NOT MEASURED		WET UNIT $\frac{KN}{m^3}$ 16 18 20 22 WEIGHT-O P.C.F. 100 110 120 130 140 150		STANDARD PENETRATION: N- <input checked="" type="checkbox"/>									
		COMPLETION DEPTH: 5.0 m		DATE DRILLED: 85 09 11									
		LOGGED BY: MCP		DRAWING NO.:									

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EBA Engineering Consultants Ltd.



PARTICLE - SIZE ANALYSIS OF SOILS

Project: Keno Soil Study
Keno, Yukon

Project Number: 0201-4405

Date Tested: 85 09 16

Borehole Number: TP4

Depth: 2.0 m

Soil Description: Gravel and silt, some sand, dark olive, moist

Cu: _____

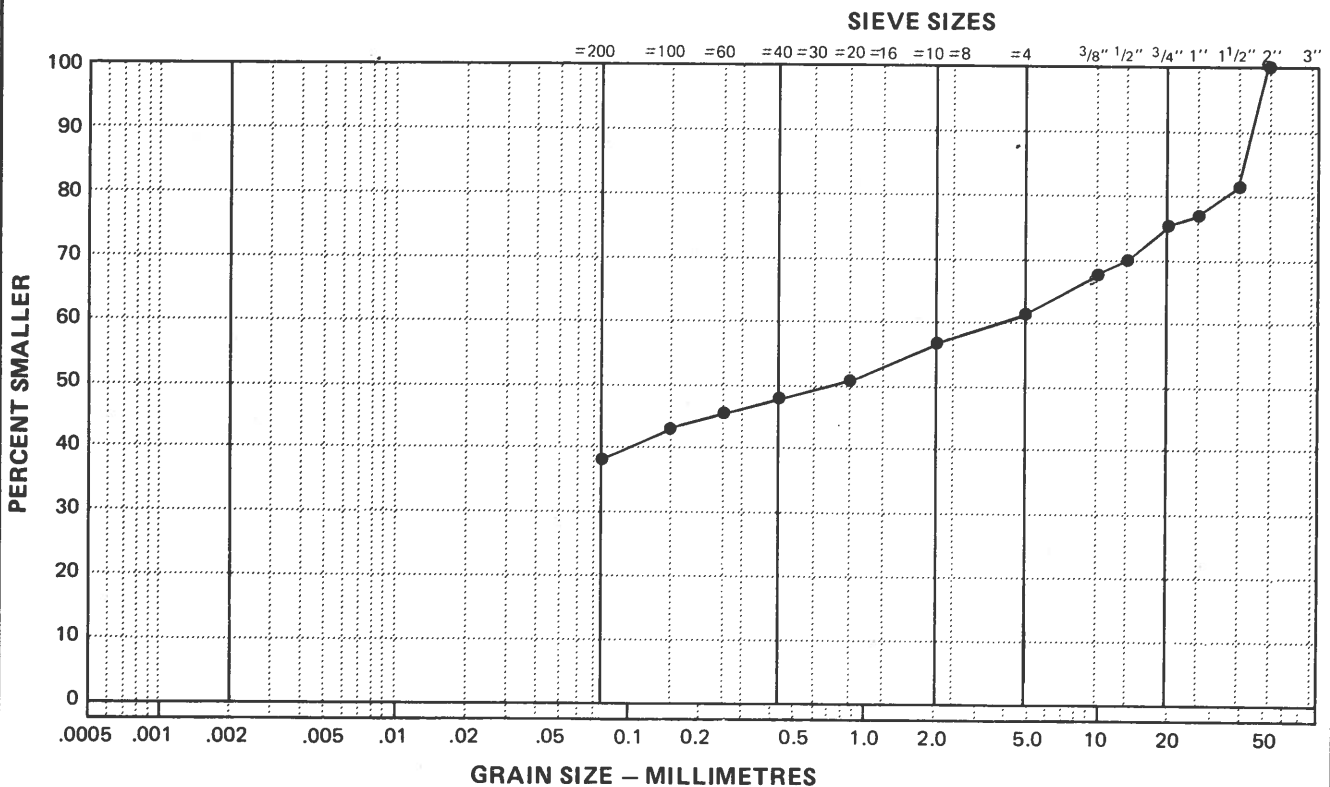
Cc: _____

Natural Moisture Content: 8.5 %



Remarks: _____

SIEVE	PERCENTAGE PASSING
3"	100
1 1/2"	82
1"	77
3/4"	76
1/2"	70
3/8"	68
No. 4	62
No. 10	56
No. 20	51
No. 40	48
No. 60	45
No. 100	43
No. 200	38

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Tested in accordance with ASTM D422 unless otherwise noted.

PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 5	PROJECT NO.: 0201-4405										
LOCATION: Keno, Yukon		SURFACE ELEVATION: 933 m											
DRILL: Koering Bantam Backhoe													
SAMPLE TYPE: <input type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER													
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS. SAMPLE	DEPTH (ft.)	WATER CONTENT-% : ●				COMPRESSIVE STRENGTH					
				PLASTIC LIMIT (W _p)	LIQUID LIMIT (W _L)		Unconfined.....▲ Pocket Penetrometer.....Δ						
				20	40	60	80	TSF	1	2	3	4	5
1	SILT - Sandy, trace of gravel to some gravel, dark olive grey, moist - wood from old buildings present to a depth of 1.5 m	SM	1 2 3 4										
2	GRAVEL - Sandy, some silt, occasional cobble, dark olive grey. - boulders present below 2.3 m - silty, gravelly sand at 2.5 m depth	GM	5 6 7 8 9 10 11 12										
3	- colour changes to rusty brown at 3.0 m		13										
4	- more boulders are present with depth		14 15 16										
5	END OF TEST PIT		17 18 19 20										
 DEPTH TO WATER:  NO WATER UPON COMPLETION DEPTH TO SLOUGH: — NOT MEASURED		WET UNIT $\frac{kN}{m^3}$ 16 18 20 22 WEIGHT-O P.C.F. 100 110 120 130 140 150		STANDARD PENETRATION: N- <input checked="" type="checkbox"/>									
		COMPLETION DEPTH: 5.0 m		DATE DRILLED: 85 09 11									
		LOGGED BY: MCP		DRAWING NO.:									

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EBA Engineering Consultants Ltd.



PARTICLE - SIZE ANALYSIS OF SOILS

Project: Keno Soil Study
Keno, Yukon

Project Number: 0201-4405

Date Tested: 85 09 16

Borehole Number: TP5

Depth: 2.5 m

Soil Description: Sand - silty and gravelly, rusty brown, damp

Cu: _____

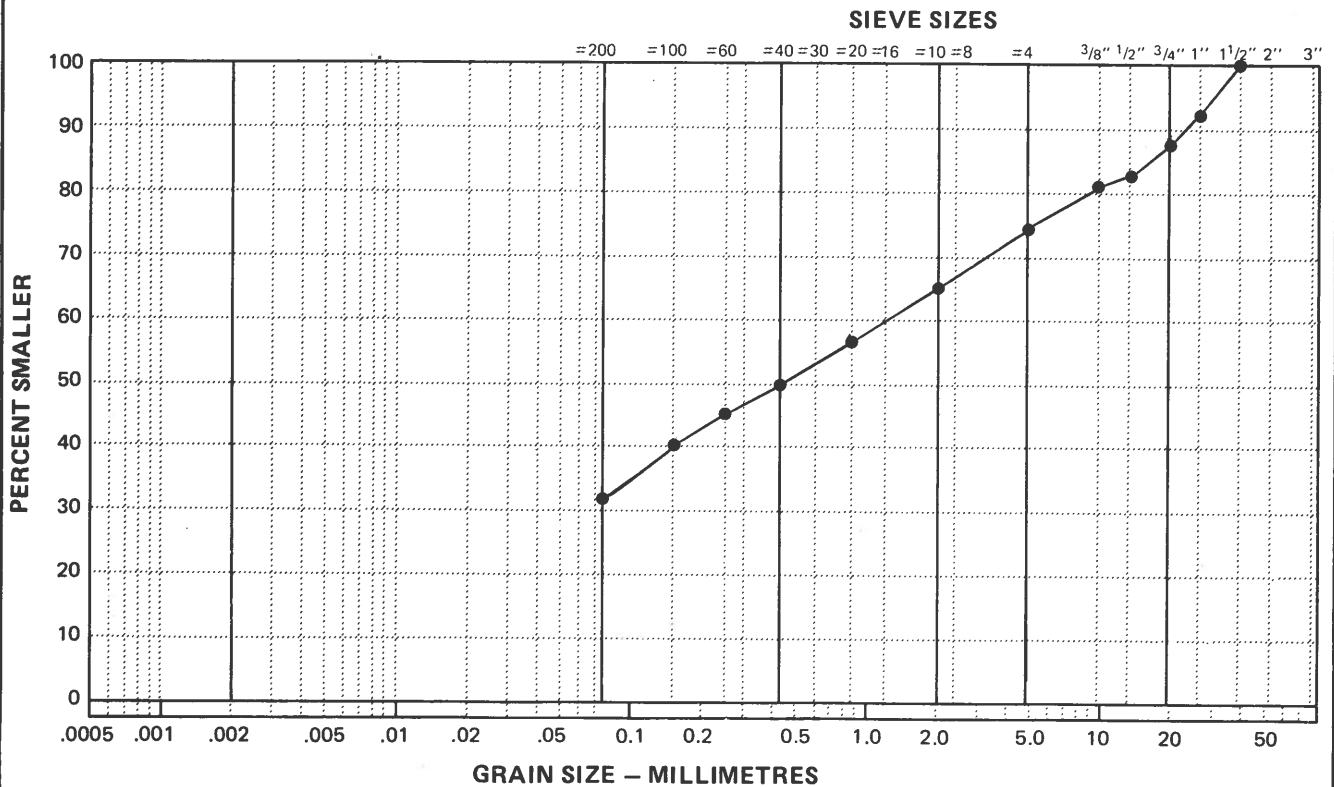
Cc: _____

Natural Moisture Content: 8.9 %


Remarks: _____

SIEVE	PERCENTAGE PASSING
3"	
1 1/2"	100
1"	92
3/4"	87
1/2"	83
3/8"	81
No. 4	74
No. 10	65
No. 20	57
No. 40	50
No. 60	45
No. 100	40
No. 200	32



CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Tested in accordance with ASTM D422 unless otherwise noted.

PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 6 & Perc. Test 3		PROJECT NO.: 0201-4405										
LOCATION: Keno, Yukon		SURFACE ELEVATION: 933m												
		DRILL: Koering Bantam Backhoe												
SAMPLE TYPE: <input checked="" type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER														
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS. SAMPLE	DEPTH (ft.)	WATER CONTENT-% : ●				COMPRESSIVE STRENGTH						
				PLASTIC LIMIT (W _p)	LIQUID LIMIT (W _L)		Unconfined..... ▲ Pocket Penetrometer..... Δ							
				20	40	60	80	TSF	1	2	3	4	5	
								kPa	100	200	300	400		
1	GRAVEL - Sandy, trace of silt, cobbles throughout dark grey, damp	GW	1											
			2											
			3											
	- course gravel layers with no sand - gravel up to 50 mm diameter at depths of 1.0 m and 1.8 m		4											
			5											
			6											
2	- Percolation Test Number 3 performed in this layer of soil		7											
			8											
	- boulders up to 500 mm diameter present below 2.5 m		9											
			10											
3	- becomes slightly siltier below 2.5 m but is still a very clean gravel		11											
			12											
			13											
4	- gravel is larger diameter (up to 40 mm below 2.5 m)		14											
			15											
	- material is very consolidated		16											
	- very little slough from side of Test Pit		17											
5	END OF TEST PIT		18											
			19											
			20											
 DEPTH TO WATER: NO WATER UPON COMPLETION DEPTH TO SLOUGH: NOT MEASURED		WET UNIT $\frac{kN}{m^3}$		16	18	20	22	STANDARD PENETRATION: N- ■						
		WEIGHT-O P.C.F.		100	110	120	130	140	150					
		COMPLETION DEPTH:		5.4 m						DATE DRILLED: 85 09 12				
		LOGGED BY:		MCP						DRAWING NO.:				

This log is a compilation of subsurface conditions and soil or rock classification obtained from the field as well as from laboratory testing of samples from the borehole. Soil zones have been interpreted according to commonly accepted practice. The change from one zone to another, as indicated on the log, may be transitional and approximate in nature. Groundwater conditions refer only to those observed at the times and places indicated and they may vary with time, geologic conditions, and construction activity.

PROJECT: KENO SOIL STUDY		HOLE NO.: Test Pit 7		PROJECT NO.: 0201-4409												
LOCATION: Keno, Yukon		SURFACE ELEVATION: 946 m														
DRILL: Koering Bantam Backhoe																
SAMPLE TYPE: <input type="checkbox"/> THIN WALLED TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE <input type="checkbox"/> OTHER																
DEPTH (m.)	SOIL DESCRIPTION	UNIFIED SOIL CLASS.	SAMPLE DEPTH (ft.)	WATER CONTENT-% : ●					COMPRESSIVE STRENGTH							
				PLASTIC LIMIT (W _p)		LIQUID LIMIT (W _L)			Pocket Penetrometer..... ▲							
				20	40	60	80	TSF 1	2	3	4	5	kPa 100	200	300	400
	200 mm of Moss Cover															
	ORGANIC SILT - greyish black, moist, frozen	OL	1													
	GRAVEL - Sandy, sitly, cobbles, boulders, dary grey, frozen	GM	3													
1	END OF TEST PIT		4													
			5													
			6													
			7													
			8													
			9													
			10													
			11													
			12													
			13													
			14													
			15													
			16													
			17													
			18													
			19													
			20													
 DEPTH TO WATER:  NO WATER UPON COMPLETION DEPTH TO SLOUGH: — NOT MEASURED		WET UNIT $\frac{kN}{m^3}$		16	18	20	22	STANDARD PENETRATION: N- <input type="checkbox"/>								
		WEIGHT-O P.C.F.		100	110	120	130	140	150							
		COMPLETION DEPTH:		0.8 m					DATE DRILLED:		85 09 12					
		LOGGED BY:		MCP					DRAWING NO.:							

This log is a compilation of subsurface conditions and soil or rock classification obtained from the field as well as from laboratory testing of samples from the borehole. Soil zones have been interpreted according to commonly accepted practice. The change from one zone to another, as indicated on the log, may be transitional and approximate in nature. Groundwater conditions refer only to those observed at the times and places indicated and they may vary with time, geologic conditions, and construction activity.

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 sole use of TETRA TECH's Client (**Yukon Government**) 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 unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of the Yukon Government or TETRA TECH. It is acknowledged that the Yukon Government, the Client, may reproduce the report freely for internal usage.

1.2 ALTERNATIVE DOCUMENT FORMAT

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

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

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

1.3 STANDARD OF CARE

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

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

1.4 DISCLOSURE OF INFORMATION BY CLIENT

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

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

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

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

1.6 GENERAL LIMITATIONS OF DOCUMENT

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

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

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this 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

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.

1.16 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.