

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, Program Manager

Subject: Site Development Suitability
Mayo, 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 complete a geotechnical assessment of eight sites within the Village of Mayo and a single site located in the Airport Subdivision located north of the village. The sites include:

- Lot 5; Block 2; 21592 LTO;
- Lot 22; Block 9; 21592 LTO;
- Lots 3 to 7; Block 11; 21592 LTO;
- Lot 16; Block 12; 21592 LTO;
- Lots 27 to 30; Block 12; 21592 LTO;
- Lot 31; Block 25; 62158 LTO;
- Lot 4; Block 33; 24315 LTO;
- Lots 4 to 8; Block 25; 24315 LTO; and
- Lot 1004, Quad 105 M/12; 64596 LTO (Airport Subdivision).

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

- In-house project files were recovered and reviewed to establish geotechnical conditions throughout the Village of Mayo and the Airport Subdivision area.
- The depositional history of the Mayo area was established using the map entitled “Surficial Geology of the Village of Mayo – NTS 105 M/12, Yukon – File 2011-3”.
- Based in-house information, a summary of geotechnical conditions is presented.
- Potential for residential development is discussed along with constraints for foundation construction and on-site sewage disposal system design and construction (specifically for Lot 1004 in the Airport Subdivision).

2.0 SITE CONDITIONS

2.1 Surficial Geology

The surficial geology of the Mayo area is quite complex. The area has been affected by a combination of valley glaciation and fluvial action related to the Mayo and Stewart River channels. Glacial sediments have been found to extend to depths in excess of two hundred metres (as determined by water well drilling throughout the Village of Mayo).

Near the surface, glacial melt water deposited glaciolacustrine silt and clay in temporary pro-glacial lakes. Fluvial deposition of coarse granular outwash deposits is also common. Adjacent to the Mayo and Stewart River channels, soil deposition is further complicated by erosion of glacial sediments and deposition of river gravels throughout post-glacial river floodplains.

For additional information that details the depositional history and surficial geology of the Mayo area, refer to the “*Northern Climate Exchange, March 2011. Mayo Landscape Hazards: Geological Mapping for Climate Change Adaptation Planning*” which is available from Northern Climate Exchange c/o Yukon Research Centre, Yukon College, Whitehorse.

2.2 Soil Conditions

The soil stratigraphy is relatively consistent throughout the Mayo town site with silty surficial soils overlying granular sediments which are underlain by fine grained glaciolacustrine soils. However, the thickness of each of the soil units is extremely variable.

2.3 Bedrock

No bedrock has been encountered during the completion of any of the current and historic geotechnical evaluations completed within the Mayo town site. As mentioned above, the community water well was developed just above the bedrock surface at approximately 240 m (800’).

2.4 Groundwater

The presence and depth to groundwater was quite random during the evaluations completed throughout Mayo. The presence of groundwater may be related to seasonal water level fluctuations in areas close to the Mayo and Stewart

Rivers; the depth to the underlying permafrost where ice rich soils have melted out, leaving groundwater perched on frozen glaciolacustrine soils; or it may be encountered at shallow depths in channels within the floodplain deposits.

2.5 Permafrost

Also documented in the Mayo Landscape Hazards document is a good overview of the permafrost conditions within the Mayo town site and throughout the Mayo area. The testhole logs presented in the separately submitted Mayo Testhole Database detail the permafrost conditions at specific locations spanning the last 45 years.

In general, if the root mat and tree cover are undisturbed, permafrost can be expected at shallow depths in the coarse-grained sediments that define the floodplains deposits. The permafrost extends into the fine grained glaciolacustrine soils that continue to significant depth. The permafrost encountered in the coarse-grained sediments are typically not ice rich while significant visible ice contents (stratified ice contents of more than 70%) have been noted in the underlying fine-grained soils.

Throughout the Mayo town site and the Airport Subdivision where development has included building site construction, roadway construction, deep utilities construction and on-site sewage disposal system installation much of the permafrost that existed within the coarse-grained soils has melted but it is generally accepted that there is still potential for ice rich permafrost to exist in the underlying fine-grained soils.

Determining the rate of permafrost degradation beneath roadways in Mayo has not been addressed as it would entail the drilling of numerous deep boreholes, the recovery of permafrost core to assess ice content, and the installation of thermistors to monitor ground temperatures. This program would be quite expensive and to be successful, on-going data collection and interpretation would be necessary.

2.6 Site Specific Geotechnical Conditions

The locations of all testholes advanced throughout Mayo are presented on the Mayo Site Plan (accompanying this report). Attached to this report are the testhole logs used to complete this evaluation. The following sections present a list of testholes considered indicative of conditions throughout the various sites and a summary of the anticipated conditions in the vicinity of the lots that are being considered for residential development.

2.6.1 Lot 5; Block 2

Testhole logs reviewed include 1200073-TP05 and 10506-BH02. In this area of Mayo, the surficial silts are quite thick, ranging from 3.0 m to 3.5 m. No permafrost was noted in the top 4.0 m (Lot 5 in uncleared so there is potential that permafrost exists on that site). Groundwater was encountered at 3.2 m to 3.5 m.

2.6.2 Lot 22; Block 9

Testhole logs reviewed include ENG.WARC03340-TP17-01 and TP17-02; 1200073-TP-04 and 10605-BH01 and BH02. Throughout this area, silty sands are interbedded with sand and gravel. No permafrost was encountered in the near surface soils in any of the five testholes. Groundwater was encountered at 4.6 m and 2.7 m at 2nd Avenue and Center Street (Binet House Restoration) respectively.

2.6.3 Lots 3 to 7; Block 11, Lot 16; Block 12, Lot 27 to 30; Block 12 & Lot 31; Block 25

Four potential development areas are located in the First Avenue and Duncan Street area of Mayo. Testhole logs reviewed included 10506-BH01; W14103567-24-BH17-01, BH17-02 & BH17-05; and E-1021-BH7. Gravel fill was noted along roadways and was underlain by silty sand interbedded with silt or gravel. Groundwater was only encountered in the force main wet well borehole drilled on the dyke in 1991 (at a depth of 5.6 m). It is interesting to note that no permafrost was encountered in the recent testholes advanced along roadways but in borehole E-1021-BH7 (drilled in 1975), ice rich permafrost was encountered in the granular surficial sediments.

2.6.4 Lot 4; Block 33

Borehole logs E-1021-BH4 and -BH5 were reviewed for this lot. Below the organic root mat, granular surficial soils were noted with siltier sediments below 4.5 m and 5.5 m. No groundwater was encountered, and permafrost was observed below 4.2 m in both boreholes. These boreholes were drilled in 1975 at the site of the Mayo curling rink and the site was not cleared at the time of drilling.

2.6.5 Lot 4 to 8; Block 25

Three testholes logs were reviewed for this site. E-1021-BH4 and -BH5 were drilled in 1975 (at the Mayo Curling Rink site) and W14101489-TP04 was excavated in 2010 for Phase 2 of the Urban Infill Project. Below the fine-grained surficial soils, granular soils were noted to between 4.0 m and 5.0 m. No groundwater was encountered but permafrost was encountered in all three testholes at depths ranging from 2.5 m to 4.0 m.

2.6.6 Lot 1004; Quad 105 M/12

To evaluate this lot, testholes 10626-BH01 and -BH02; 14107-TP01; 1200104-TP01, -TP02 and -TP03 were reviewed. The Airport Subdivision is located along a plain with glaciofluvial sediments below the near surface silts and organics. These granular soils extend to at least 3.5 m. No permafrost was encountered in any of the testholes included in this evaluation but anecdotal information and personal knowledge amongst personnel in this office confirm that foundations issues due to permafrost degradation has been documented.

Shallow groundwater was noted in 4 of the 6 testholes. Recent photos of an environmental excavation along the highway at the west end of the subdivision had groundwater seepage at approximately 1.5 m.

3.0 DEVELOPMENT FEASIBILITY AND FOUNDATION CONSTRUCTION

It is acknowledged that problems with foundations affected by the degradation of ice-rich permafrost has been encountered throughout both the Village of Mayo and the Airport Subdivision. It can be assumed that the construction of residential structures is feasible for all sites being considered, but steps must be taken to minimize the potential for and the effects of melting permafrost.

3.1.1 Preferred Foundation System

Engineers and scientists are now of the opinion that the degradation of permafrost, especially in the “discontinuous permafrost portion of northern regions”, is inevitable. Therefore, specific to the Mayo town site and the Airport Subdivision, this office is of the opinion that in areas where deep utilities and foundations have been in place for numerous years, the potential for settlement from permafrost degradation will become minimal but in areas that have been recently cleared; the potential for settlement is much greater. Keep in mind, the rate of permafrost thaw at depth has not been determined (as mentioned in Section 2.5).

The challenge for residential; housing on undeveloped lots is to minimize differential settlement while the near surface permafrost melts out. It is recommended that all foundation construction follow the following steps:

- Preclearing of the building sites is key but better yet, clearing the entire lot would be preferable since any tree cover may shade the building site and slow permafrost degradation. If this can be accomplished one or even two years in advance of foundation construction, there is a better chance that all near surface, ice rich permafrost will have degraded.
- In most cases, there will be fine grained surficial soils which are very frost susceptible. It is recommended that these soils be excavated down to thaw stable granular soils. Once exposed, the construction of an engineered fill can bring the building site back to grade. The depth to the granular soils is variable throughout the Village of Mayo so it is recommended that a test pit or two be excavated to determine what the sub-cut depth will be.
- The engineered fill should be non-frost susceptible granular material(s) placed in 200 mm thick lifts, moisture conditioned and compacted to 98% of standard proctor maximum dry density. The engineered fill should extend at least 0.2 m above existing ground elevations so that surface water and roof run-off is directed away from the foundation. Granular soils for engineered fill construction should meet the gradation limits presented in Table 1, below.
- Even with the engineered fill, builders have to be respectful of the fine-grained permafrost soils at depth. Therefore, it is recommended that an adjustable foundation system be constructed to support the residential structures. There are a few options such as space frame foundations but for ease of construction and maintenance, a timber crib foundation supported by PWF pads works well in areas such as Mayo and Dawson City. Below the flooring system, there should be a clear crawlspace and it is very important to ensure that air flow is not interrupted. Skirting around the elevated foundation is acceptable to keep animals out the clear crawlspace, but the skirting must ensure a minimum of 50% air flow.

Table 1: Recommended Granular Material Specifications

80 mm Pit Run Gravel		20 mm Crushed Surface Course	
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

4.0 LOT 1004 LOT DEVELOPMENT

4.1 On-Site Sewage Disposal System Potential

The glaciofluvial soils underlying this site are considered acceptable for on-site sewage disposal system design and construction. However, the following should be considered:

- The underlying glaciofluvial soils may have a percolation rate of less than 5 minutes/25 mm. This will necessitate the requirement to install a 600 mm thick sand filter in order to ensure treatment along with disposal.

- The presence of shallow groundwater throughout much of this subdivision may result in the construction of a shallow absorption field and possibly a pump-up system.
- Absorption field, shallow absorption trench, and chamber systems are all considered appropriate for the study area.
- 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. Due to possible shallow groundwater issues, it may be preferable to have this system engineered by a consultant such as Tetra Tech.

4.2 Lot 1004 Foundations

The presence of shallow groundwater and permafrost will somewhat limit foundation options. However, if lots are pre-cleared; the surficial silty soils are removed, and an engineered fill is constructed to support a timber crib foundation that can be levelled as necessary, long term settlements can be controlled.

5.0 RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL WORK

After clearing of the infill lots has been completed, it is advisable that testpits be excavated to assess permafrost conditions and determine acceptable subexcavation depths.

As mentioned above, it would also be preferable to have the septic system for Lot 1004 designed by an engineering firm familiar with on-site sewage disposal system design. This design work will require testpitting and percolation testing at the proposed absorption field location.

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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ATTACHMENTS

General Location Maps (Yukon Lands Viewer)

Testhole Logs Used For Geotechnical Evaluation Purposes



- Legend**
- Land Applications - Active
 - Land Licences
 - Lots for Sale
 - Notations
 - Development Hold Areas

Notes

0.1 0 0.06 0.1 Kilometers

Yukon Albers Projection
Produced from: Yukon Lands Viewer

Scale: 1:2,500

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



LDB Mayo Vacant Lot Development Airport Subdivision



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

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Date Printed: 25-Jul-2019

0.3 0 0.13 0.3 Kilometers

Yukon Albers
Produced from: Yukon Lands Viewer

LOT 5; BLOCK 2 TESTHOLES

Stanley Associates Engineering

Borehole No: 02

Project: Sewage Forcemain/wet Well Construction

Project No: 0201-10506

Location: Between Dyke And Roadway

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0								20	40	60	80
0		SILT - some fine sand, frequent root fibres, dark brown, wet, soft	Unfrozen								0
1		SILT (ML) - sandy, trace of clay, wet, soft (est.), grey			1		40.2				2
2											4
3					2		23.1				6
4											8
5											10
6											12
7											14
8											16
9											18
10											20
11											22
12											24
13											26
14											28
15											30
16											32
17											34
18											36
19											38
20											40
21											42
22											44
23											46
24											48
25											50
26											52
27											54
28											56
29											58
30											60
31											62
32											64
33											66
34											68
35											70
36											72
37											74
38											76
39											78
40											80
41											82
42											84
43											86
44											88
45											90
46											92
47											94
48											96
49											98
50											100

(Gravel - 0%; Sand - 23%; Silt - 65%; Clay - 12%)

SAND - gravelly, some to trace silt, subrounded to angular gravel, coarse to medium sand, light brown, saturated, compact
- water table at 3.3 m

END OF BOREHOLE 4.1 m



TETRA TECH

Contractor:

Drilling Rig Type: CME 75

Logged By: CRH

Reviewed By: JRT MCP

Completion Depth: 4.1 m

Start Date: 1991 May 8

Completion Date: 1991 May 8

Page 1 of 1

Na-Cho Nyak Dun First Nation

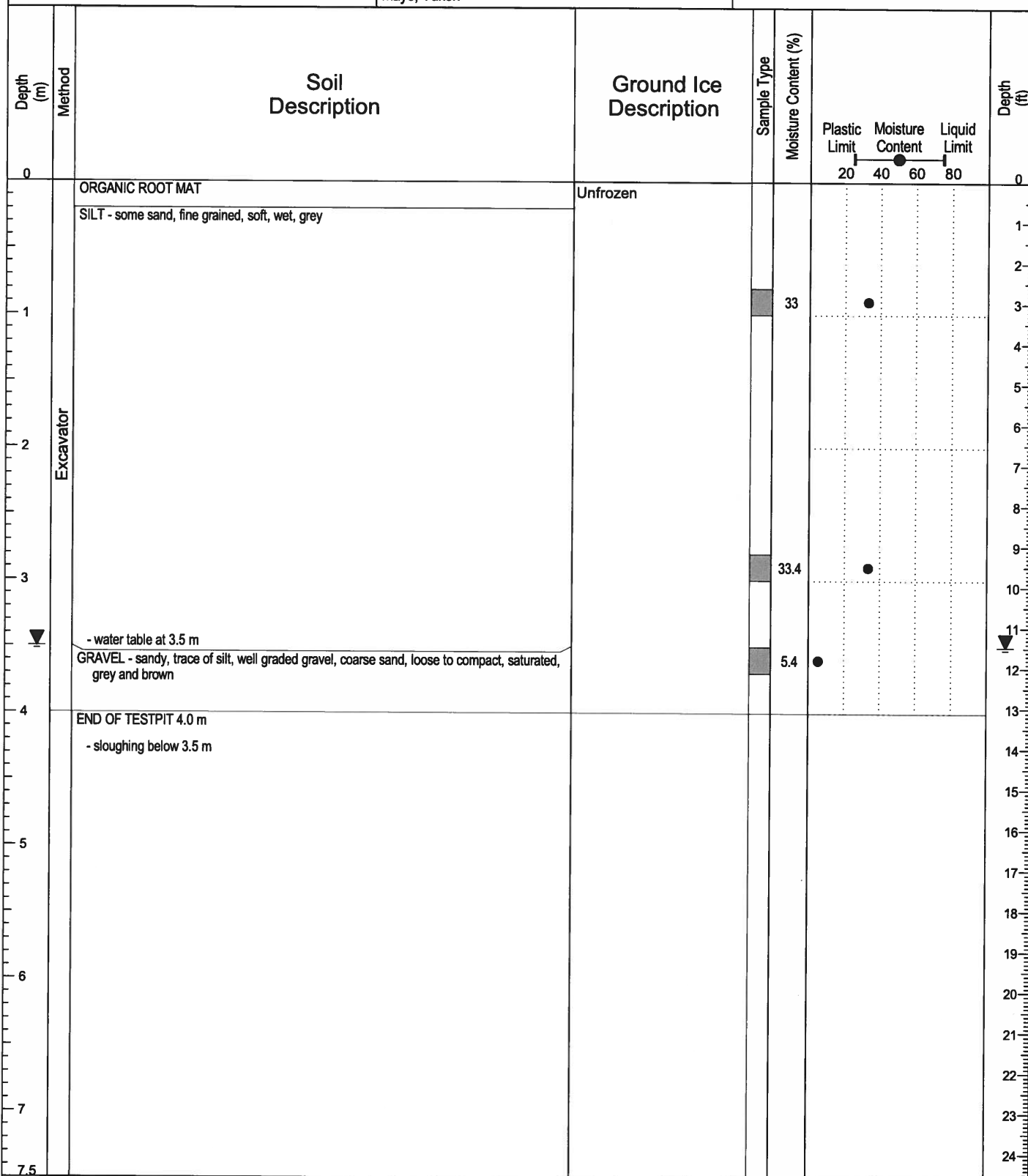
Testpit No: TP05

Project: Geotechnical Site Evaluations

Project No: 1200073

Location: Proposed Admin. Building NND C-22B

Mayo, Yukon



TETRA TECH

Contractor:

Drilling Rig Type: CAT 325 L

Logged By: JSB

Reviewed By: JRT

Completion Depth: 4 m

Start Date: 2004 January 14

Completion Date: 2004 January 14

Page 1 of 1

LOT 22; BLOCK 9 TESTHOLES

N.A. Jacobsen Civil Engineering Consultants		Testpit No: TP17-01				
		Project: Mayo Legion Wash House Geotechnical Evaluation		Project No: ENG.WARC03340-01		
		Location: 1st Avenue				
		Mayo, Yukon		UTM: 455592 E; 7051760 N; Z 8		
Depth (m)	Method	Soil Description	Ground Ice Description	Moisture Content (%)	Plastic Limit Moisture Content Liquid Limit	Depth (ft)
0	Excavation	ORGANIC ROOT MAT - grass covered, (150 mm thick)	Unfrozen			0
		SAND - silty, moist, compact (estimated), medium to dark grey, fine sand				
1						
						2
						3
						4
						5
						6
2						7
						8
						9
						10
3		END OF TESTPIT (3.0 metres)				11
						12
						13
						14
						15
						16
5						
TETRA TECH		Contractor: Walters Construction & Industrial Corp.		Completion Depth: 3 m		
		Drilling Rig Type: CAT 425 Rubber Tired Backhoe		Start Date: 2017 September 19		
		Logged By: JB		Completion Date: 2017 September 19		
		Reviewed By: MCP		Page 1 of 1		

Na-Cho Nyak Dun First Nation

Testpit No: TP-4

Project: Geotechnical Evaluation

Project No: 1200073

Location: New NNDFN Admin. Building

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0						20	40	60	0
0		GRAVEL AND SAND - trace of silt, rootlets throughout, well graded subrounded gravel, medium to coarse sand, compact, damp, reddish brown - trace of silt below 0.3 m - colour changes to medium grey	Unfrozen		2.6				0
1		SAND - trace of gravel, trace of silt, medium to coarse grained, compact, damp, medium grey			3.5				3
2	Excavator	GRAVEL - sandy, trace of silt, well graded gravel, coarse sand, compact, dry, medium grey							7
3									10
4		- (Gravel - 60%; Sand - 39%; Silt & Clay - 2%)			3.2				12
4		END OF TESTPIT 4.0 m - major sloughing throughout							13
5									16
6									19
7									22
7.5									24



TETRA TECH

Contractor:

Drilling Rig Type: CAT 320 L

Logged By: JSB

Reviewed By: JRT

Completion Depth: 4 m

Start Date: 2004 October 7

Completion Date: 2004 October 7

Page 1 of 1

N.A. Jacobsen		Borehole No: 01							
		Project: Binet House Restoration			Project No: 0201-10625				
		Location: Second Ave. And Centre St.							
		Mayo, Yukon							
Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	SPT (N)	Depth (ft)
0		SILT - some fine sand, occasional roots, moist, dark brown, loose	Unfrozen						0
1		SAND - silty, fine grained, uniform, light brown, compact - (Gravel - 0%; Sand - 77.3%; Silt & Clay - 22.7%) - dry to damp to 1.2 m - damp to moist below 1.2 m		X	1	21	5.8	●	2
2		SAND - some gravel, trace of silt, fine and coarse subrounded gravel, damp to moist, compact to loose, light brown		■	2		3.1	●	4
3		- becomes more gravelly with depth		X	3	37	3.6	●	6
4				■	4		2.3	●	8
5	Hollow stem auger	- very easy smooth drilling from 4.6 m - less gravel below 4.6 m		X	5	40	12.9	●	10
6				X	6	12	14.3	■	12
7		- trace of gravel from 7.6 to 9.1 m		X	7	21	18.9	■	14
8		SILT - some fine sand, occasional silty sand seams, occasional rounded fine gravel, dark grey, soft, saturated - non plastic - smooth, easy to moderate drilling below 8.7 m		X	8	35	9	●	16
9		SAND - gravelly, trace silt, angular fine gravel, coarse and medium grained sand, grey, saturated, dense to compact		X	8	35	9	■	18
10				X	8	35	9	■	20
11		END OF BOREHOLE 10.7 m - water table at 4.6 m - no permafrost encountered							22
12									24

TETRA TECH

Contractor:	Completion Depth: 10.7 m
Drilling Rig Type: CME 75	Start Date: 1991 May 8
Logged By: CRH	Completion Date: 1991 May 8
Reviewed By: JRT MCP	Page 1 of 1

N.A. Jacobsen		Borehole No: 02							
		Project: Binet House Restoration				Project No: 0201-10625			
		Location: Second Avenue And Centre Street							
		Mayo, Yukon							

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	20406080 Plastic LimitMoisture ContentLiquid Limit 20406080	Depth (ft)
0		SILT - some fine sand, some organics, frequent roots, wet, dark brown, soft	Unfrozen						0
1		SILT AND SAND - fine, soft, moist, grey with rusty brown mottling		X	1	8	29.8	■ ●	2
2	Hollow stem auger 	GRAVEL - sandy, some silt, rounded, coarse and fine gravel, fine grained sand, moist, brown, loose to compact - (Gravel - 59.9%; Sand - 24.1%; Silt & Clay - 16%) - less silt with depth - water at 2.7 m		■	2		5.4	●	6
3			X	3	23	7.6	● ■	8	
4		- sand becomes coarse with depth		■	4		7.8	●	12
5		- trace silt, trace gravel by 4.0 m - easy drilling with some rough sections		X	5		15	●	14
6		END OF BOREHOLE 4.6 m							16
7									22
8									26
9									30
10									34
11									36
12									38

TETRA TECH	Contractor:		Completion Depth: 4.6 m	
	Drilling Rig Type: CME 75		Start Date: 1991 May 8	
	Logged By: CRH		Completion Date: 1991 May 8	
	Reviewed By: JRT MCP		Page 1 of 1	

LOTS 3 TO 7; BLOCK 9...LOT 16; BLOCK 12 LOTS 27 TO 30; BLOCK 12 AND LOT 31; BLOCK 25 TESTHOLES

Stanley Associates Engineering

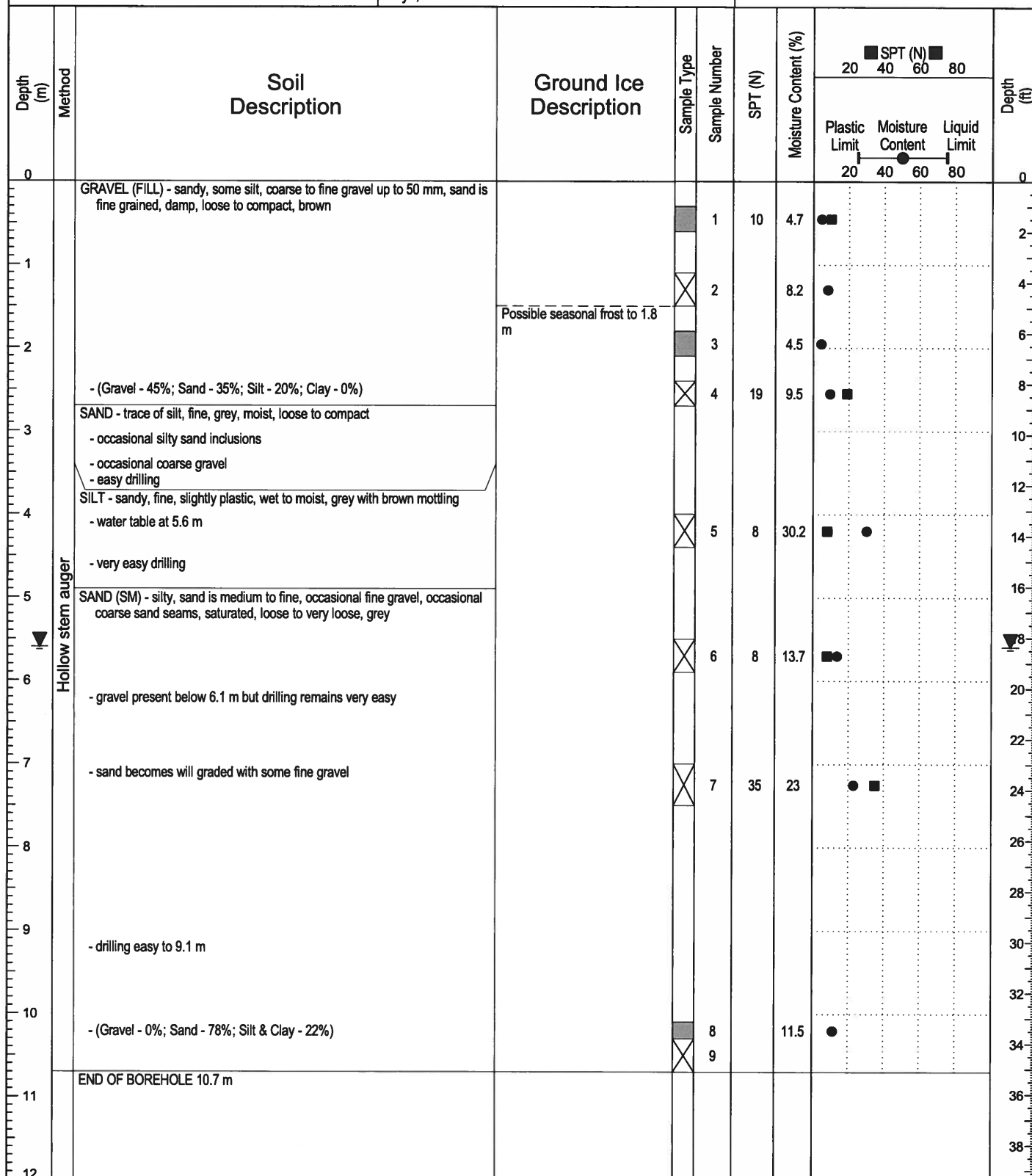
Borehole No: 01

Project: Sewage Forcemain/wet Well Construction

Project No: 0201-10506

Location: Lift Station On Dyke

Mayo, Yukon



TETRA TECH

Contractor:

Drilling Rig Type: CME 75

Logged By: CRH

Reviewed By: JRT MCP

Completion Depth: 10.7 m

Start Date: 1991 May 8

Completion Date: 1991 May 8

Page 1 of 1

Yukon Government

Borehole No: BH17-01

Project: Mayo Underground Utility Upgrades

Project No: W14103567-24

Location: First Ave. and Duncan Ave.

Mayo, YT

UTM: 455654 E; 7051771 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0							20	40	60	0
		SAND and GRAVEL (FILL) - trace silt, well graded, frozen, greyish brown	Seasonally Frozen							1
		SILT - some clay, some sand, trace gravel, frozen, dark greyish brown - no visible gravel								2
1										3
				SA01	31.2					4
										5
2		- firm (est.), damp, brown	Unfrozen							6
				SA02	21.9					7
										8
		- moist, soft (est.), medium plastic, dark grey								9
3				SA03	32.9					10
										11
		GRAVEL - sandy, well graded, sub rounded, moist, loose (est.), reddish brown								12
4				SA04	2.5					13
		- 10 cm silt layer								14
										15
5										16
		- some silt								17
				SA05	9.4					18
6										19
		END of BOREHOLE at 6.1 m (Target Depth).								20
										21
										22
7										23
										24
										25
8										26
										27
										28
9										29
										30
										31
10										32



TETRA TECH

Contractor: Donjeck Drilling

Completion Depth: 6.1 m

Drilling Rig Type: Truck Mounted CME75

Start Date: 20 January 2017

Logged By: TM

Completion Date: 20 January 2017

Reviewed By: JTP

Page 1 of 1

Yukon Government

Borehole No: BH17-02

Project: Mayo Underground Utility Upgrades

Project No: W14103567-24

Location: First Ave. and Montreal St.

Mayo, YT

UTM: 455845 E; 7051742 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0							20	40	60	0
0		SAND - silty, trace gravel, poorly graded, frozen, light greyish brown	Seasonally Frozen							0
1					SA06	19.8				1
1		- dry, loose (est.)	Unfrozen							2
2		- gravelly, some silt, well graded			SA07	3.3				3
2										4
3										5
3										6
4					SA08	2.6				7
4		- moist								8
5										9
5										10
6										11
6										12
6		END of BOREHOLE at 6.1 m (Target Depth).								13
7										14
7										15
8										16
8										17
9										18
9										19
10										20
10										21
10										22
10										23
10										24
10										25
10										26
10										27
10										28
10										29
10										30
10										31
10										32



TETRA TECH

Contractor: Donjeck Drilling

Completion Depth: 6.1 m

Drilling Rig Type: Truck Mounted CME75

Start Date: 20 January 2017

Logged By: TM

Completion Date: 20 January 2017

Reviewed By: JTP

Page 1 of 1

Yukon Government

Borehole No: BH17-05

Project: Mayo Underground Utility Upgrades

Project No: W14103567-24

Location: Duncan Ave. and Montreal St.

Mayo, YT

UTM: 455833 E; 7051662 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0							20	40	60	0
0		SAND and GRAVEL (FILL) - some silt, well graded, frozen, greyish brown	Seasonally Frozen							0
1					SA22	23.5				1
2		SILT - sandy, frozen, greyish brown								2
3		- dry, soft (est.)	Unfrozen		SA23	10.3				3
4		- firm (est.)								4
5		SAND - trace silt, well graded, dry, compact (est.), greyish brown								5
6		- 10 cm silt layer								6
7		- some gravel			SA24	2				7
8		- gravelly								8
9		- silty			SA25	6.7				9
10		END of BOREHOLE at 6.1 m (Target Depth).								10



TETRA TECH

Contractor: Donjeck Drilling

Completion Depth: 6.1 m

Drilling Rig Type: Truck Mounted CME75

Start Date: 21 January 2017

Logged By: TM

Completion Date: 21 January 2017

Reviewed By: JTP

Page 1 of 1

Government of Yukon

Borehole No: 7

Project: Mayo Sewer and Water

Project No: E-1021

Location: Sewer and Water Installation

Ground Elev: 490.7 m

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Elevation (m)
0											
1		HARD PACKED SNOW	Seasonal frost								490
2		GRAVEL (FILL) - sandy, fine to medium grained, medium brown									489
3		SAND - some thin silt laminations, uniform, fine, medium brown	Nf								488
4		GRAVEL - fine to medium sandy, gap graded, medium brown	Unfrozen	X	1	25					487
5		SAND - fine uniform, silty to 3.4 m, medium grained, trace of silt, medium brown	Frozen, Nbn-Nbe	X	2	20	32				486
6		GRAVEL - sandy, fine grained, medium grey brown	Nbn-Nbe	X	3	8					485
7		- fine to medium, very little fines	Nbn-Nbe	X	4	19					484
8		SILT - some organics, dark grey									483
9		END OF BOREHOLE AT 6.6 m									482
10											481
11											480
12											479
13											478
14											477
15											476
16											475
17											474
18											473
19											472
20											471



TETRA TECH

Contractor:

Completion Depth: 6.6 m

Drilling Rig Type:

Start Date: 1975 February 24

Logged By: JK

Completion Date: 1975 February 24

Reviewed By: JK

Page 1 of 1

LOT 4; BLOCK 33 TESTHOLES

Government of Yukon

Borehole No: 4

Project: Mayo Sporting Complex

Project No: E-1021

Location: Mayo Curling Arena

Ground Elev: 489.8 m

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Temperature (°C)	SPT (N)	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Elevation (m)
0												
1		PEAT - fibrous, roots, silty, dark brown CLAY - trace of sand, low plastic, medium brown	Seasonal frost, Nbn									489
2		GRAVEL - sandy, fine to medium grained, some coarse, trace of silt, some oxides, cobbly and coarse from 2.0 m down, medium brown	Nf		1		9					488
3		SAND - very silty, very fine, uniform, medium to dark grey	Unfrozen		2		50					487
4			Frozen									486
5		SILT - dark grey			3		26					485
6					4	0.11	27					484
7			Nbn		5	0	24					483
8					6		25					482
9		- thinly laminated with black organics										481
10		SILT - dark grey										480
11												479
12												478
13												477
14		- no organics			7		28					476
15												475
16												474
17												473
18		- thinly laminated with black organics			8		28					472
19		END OF BOREHOLE AT 18.7 m										471
20												470



TETRA TECH

Contractor:

Completion Depth: 18.8 m

Drilling Rig Type:

Start Date: 1975 February 24

Logged By: JK

Completion Date: 1975 February 24

Reviewed By: JK

Page 1 of 1

Government of Yukon		Borehole No: 5								
		Project: Mayo Sporting Complex		Project No: E-1021						
		Location: Mayo Curling Arena		Ground Elev: 489.9 m						
		Mayo, Yukon								
Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Moisture Content (%)	Plastic Limit 20	Moisture Content 40	Liquid Limit 80	Elevation (m)
0		CLAY - silty, low plastic, medium brown	Nbn							
1		GRAVEL - fine to medium grained, gap graded, dry, trace of silt, medium brown	Nf							489
2		- seasonal frost to 2.4 m	Unfrozen	⊗	1	8	●			488
3		- SPT refusal		▬	2					487
4		- coarser		▬	3					486
5		- SPT refusal	Frozen	▬	4					485
6		SAND - some fine gravel, medium brown, grey at 5.0 m	Nbe-Nbn							484
7		SILT - trace of fine gravel and clay, sandy, dark grey, pieces of wood	Nbe-Vs 0-5%	▬	5	43		●		483
8		END OF BOREHOLE AT 6.7 m								482
9										481
10										480
11										479
12										478
13										477
14										476
15										475
16										474
17										473
18										472
19										471
20										470

 TETRA TECH	Contractor:	Completion Depth: 6.7 m
	Drilling Rig Type:	Start Date: 1975 February 24
	Logged By: JK	Completion Date: 1975 February 24
	Reviewed By: JK	Page 1 of 1

LOTS 4 TO 8; BLOCK 25 TESTHOLES

Government of Yukon

Borehole No: 4

Project: Mayo Sporting Complex

Project No: E-1021

Location: Mayo Curling Arena

Ground Elev: 489.8 m

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Temperature (°C)	SPT (N)	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Elevation (m)
0												
1		PEAT - fibrous, roots, silty, dark brown CLAY - trace of sand, low plastic, medium brown GRAVEL - sandy, fine to medium grained, some coarse, trace of silt, some oxides, cobbly and coarse from 2.0 m down, medium brown	Seasonal frost, Nbn Nf		1		9					489
2		SAND - very silty, very fine, uniform, medium to dark grey	Unfrozen		2		50					488
3			Frozen		3		26					487
4					4	0.11	27					486
5		SILT - dark grey	Nbn		5		24					485
6					6		25					484
7					7		28					483
8		- thinly laminated with black organics			8		28					482
9												481
10		SILT - dark grey										480
11												479
12												478
13												477
14		- no organics										476
15												475
16												474
17												473
18		- thinly laminated with black organics										472
19		END OF BOREHOLE AT 18.7 m										471
20												470



TETRA TECH

Contractor:

Completion Depth: 18.8 m

Drilling Rig Type:

Start Date: 1975 February 24

Logged By: JK

Completion Date: 1975 February 24

Reviewed By: JK

Page 1 of 1

Government of Yukon		Borehole No: 5						
		Project: Mayo Sporting Complex			Project No: E-1021			
		Location: Mayo Curling Arena			Ground Elev: 489.9 m			
		Mayo, Yukon						
Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Moisture Content (%)	Plastic Limit 20 40 60 80	Elevation (m)
0								
1		CLAY - silty, low plastic, medium brown	Nbn					489
2		GRAVEL - fine to medium grained, gap graded, dry, trace of silt, medium brown	Nf	⊗	1	8	●	488
3		- seasonal frost to 2.4 m	Unfrozen	▴	2			487
4		- SPT refusal		▴	3			486
5		- coarser						485
6		- SPT refusal	Frozen	▴	4			484
7		SAND - some fine gravel, medium brown, grey at 5.0 m	Nbe-Nbn					483
8		SILT - trace of fine gravel and clay, sandy, dark grey, pieces of wood	Nbe-Vs 0-5%	▴	5	43	●	482
9		END OF BOREHOLE AT 6.7 m						481
10								480
11								479
12								478
13								477
14								476
15								475
16								474
17								473
18								472
19								471
20								470

 TETRA TECH	Contractor:	Completion Depth: 6.7 m
	Drilling Rig Type:	Start Date: 1975 February 24
	Logged By: JK	Completion Date: 1975 February 24
	Reviewed By: JK	Page 1 of 1

**YG - Department of
Community Services**

Testpit No: TP04

Project: Urban Infill Phase 2 - Geotechnical Evaluation

Project No: W14101489

Location: Area "B"

Mayo, YT

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0						20	40	60	0
		ORGANIC ROOT MAT							
		SAND AND SILT - trace clay, fine grained, soft, very moist, medium grey							1
		GRAVEL - sandy, trace silt, well graded gravel, medium to coarse grained sand, loose to compact, damp, grey and brown - cobbles throughout gravel layer							2
1	Excavated								3
									4
									5
2		- becomes moist around 2.0 m							6
									7
		- unable to sample due to slough	Permafrost						8
		END OF TESTPIT @ 2.5 m (Refusal on Permafrost)							9
3		NOTE: Sloughing throughout gravel							10
									11
									12
4									13
									14
									15
5									16



TETRA TECH

Contractor:

Completion Depth: 2.5 m

Drilling Rig Type: CAT 325

Start Date: 2010 October 7

Logged By: JSB

Completion Date: 2010 October 7

Reviewed By: JRT

Page 1 of 1

AIRPORT SUBDIVISION TESTHOLES LOT 1004, QUAD 105 M/12

Stewart Valley Enterprises

Borehole No: 01

Project: Foundation Investigation

Project No: 0201-10626

Location: Bedrock Motel

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0											0
1		GRAVEL AND SAND - trace to some silt, rounded coarse gravel with some fine gravel, fine to medium grained sand, light brown, damp, loose to compact	Unfrozen		1		1.5				2
2		- occasional cobbles (150 mm+)									4
2		- difficult, rough drilling through coarse gravel									6
2		- at 2.1 m, finer gravel			2		3.4				6
3		SAND - gravelly, trace of silt, fine and coarse subangular gravel, well graded sand, brown, saturated, loose to compact			3	8	10.5				10
4											12
5		SAND - trace of gravel, trace of silt, occasional cobbles, medium to fine sand, fine angular gravel, brown, saturated, loose			4	26	6.8				16
6		GRAVEL - some to trace of sand, trace of silt, rounded fine with some coarse gravel, brown, saturated, dense			5		14.3				20
7		- difficult drilling to 7.2 m									22
7		- moderately easy drilling from 7.6 to 9.1 m									24
8		SAND - some gravel, trace of silt, well graded sand, fine gravel, brown, saturated, compact			6						26
9					7	13	9.7				30
10		- becomes dense at 10.4 m									32
10					8	51/213mm	10.3				34
11		END OF BOREHOLE 10.7 m									36
12											38



TETRA TECH

Contractor:

Drilling Rig Type: CME 75

Logged By: CRH

Reviewed By: JRT MCP

Completion Depth: 10.7 m

Start Date: 1991 May 6

Completion Date: 1991 May 6

Page 1 of 1

Stewart Valley Enterprises

Borehole No: 02

Project: Foundation Investigation

Project No: 0201-10626

Location: Bedrock Motel

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	■ SPT (N) ■ 20 40 60 80 Plastic Limit Moisture Content Liquid Limit 20 40 60 80	Depth (ft)
0		SAND - silty, fine, occasional roots, brown, moist, loose	Unfrozen						0
1		GRAVEL AND SAND - trace of silt, coarse gravel, occasional cobbles, medium to coarse sand, brown, damp, compact							2
2									4
3	Hollow stem auger	- very rough drilling			1				6
4									8
5					2		5.9		10
6		SAND - some fine gravel, occasional coarse gravel and cobbles, trace of silt, well graded sand, brown, saturated, loose							12
7		- easy drilling			3	6	12.9		14
8									16
9		END OF BOREHOLE 4.6 m							18
10									20
11									22
12									24
									26
									28
									30
									32
									34
									36
									38



TETRA TECH

Contractor:

Drilling Rig Type: CME 75

Logged By: CRH

Reviewed By: JRT MCP

Completion Depth: 4.6 m

Start Date: 1991 May 7

Completion Date: 1991 May 7

Page 1 of 1

Na-Cho Nyak Dun First Nation

Testpit No: TP01

Project: Percolation Tests

Project No: 0201-99-14107

Location: Peter Residence

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0							20	40	60	0
		ORGANIC ROOT MAT	Unfrozen							
		SAND & SILT - gravelly, well graded sand, well graded subrounded gravel, compact, damp, light grey brown - no gravel from 0.3 - 0.7 m			1					1
										2
1		GRAVEL & SAND - trace of silt, well graded subrounded gravel, coarse grained sand, compact, damp, mottled grey and brown - cobbly below 1.5 m			2					3
										4
					3					5
										6
										7
										8
										9
3		END OF TESTPIT @ 2.8 m - major slough throughout - water table @ 1.8 m								10
										11
										12
										13
										14
										15
										16



TETRA TECH

Contractor:

Drilling Rig Type: CAT 325 Hoe

Logged By: MCP

Reviewed By: JRT

Completion Depth: 2.8 m

Start Date: 1999 August 26

Completion Date: 1999 August 26

Page 1 of 1

Yukon Energy Corp.

Testpit No: TP01

Project: Geotechnical Evaluation - Lot 1095

Project No: 1200104

Location: YEC House

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0		STRIPPED ORGANIC ROOT MAT	Unfrozen						0
		SAND - gravelly, some silt, fine to medium sand, well graded gravel, compact, damp							1
		GRAVEL AND SAND - trace of silt, well graded gravel, coarse sand, compact, damp, brown			5.8				2
1									3
	Excavator	- water seepage around 1.3 m			2.6				4
2									5
									6
									7
									8
									9
3		- (Gravel - 57%; Sand - 42%; Silt & Clay - 2%)			7.1				10
									11
		SILT - some sand and some clay, trace of gravel, fine grained, dark grey			27.8				12
		- (Gravel - 4%; Sand - 11%; Silt - 77%; Clay - 8.4%)							13
		END OF TESTPIT 3.5 m (REFUSAL)							14
		- water seepage from around 1.3 m depth							15
4									16
5									



TETRA TECH

Contractor:

Drilling Rig Type: CAT 325 L

Logged By: JSB

Reviewed By: JRT

Completion Depth: 3.5 m

Start Date: 2004 July 1

Completion Date: 2004 July 1

Page 1 of 1

Yukon Energy Corp.		Testpit No: TP02						
		Project: Geotechnical Evaluation - Lot 1088			Project No: 1200104			
		Location: YEC House						
		Mayo, Yukon						
Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit Moisture Content Liquid Limit	Depth (ft)	
0						20 40 60 80	0	
	Excavator	STRIPPED ORGANIC ROOT MAT	Unfrozen					
		SAND - some silt to silty, fine grained, soft, moist, light yellowish grey			14.1	●		1
								2
1		GRAVEL AND SAND - trace of silt, well graded gravel, coarse sand, damp, compact, brown - (Gravel - 64%; Sand - 33%; Silt & Clay - 2%)			2.2	●		3
								4
2							5	
							6	
							7	
							8	
							9	
3							10	
		END OF TESTPIT 3.0 (REFUSAL)					11	
							12	
							13	
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4							16	
							17	
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5							21	
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							234	
							235	

Yukon Energy Corp.

Testpit No: TP03

Project: Geotechnical Evaluation - Lot 1088

Project No: 1200104

Location: YEC House

Mayo, Yukon

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Moisture Content (%)	Plastic Limit	Moisture Content	Liquid Limit	Depth (ft)
0		STRIPPED ORGANIC ROOT MAT	Unfrozen			20	40	60	0
		SAND - silty, fine grained, soft, moist, yellowish brown			10.5				1
		GRAVEL AND SAND - trace of silt, well graded gravel, coarse sand, compact, damp, light brown							2
1	Excavator								3
					3				5
2									6
		- colour changes to light grey below 2.5 m			7.2				8
3		END OF TESTPIT 3.0 m (REFUSAL)							10
		- no water table encountered							11
4									13
									14
5									16



TETRA TECH

Contractor:

Drilling Rig Type: CAT 325 L

Logged By: JSB

Reviewed By: JRT

Completion Depth: 3 m

Start Date: 2004 June 1

Completion Date: 2004 June 1

Page 1 of 1

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

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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

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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

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.