

# **EBA Engineering Consultants Ltd.**

February 23, 1994

Government of Yukon  
Box 2703  
Whitehorse, Yukon  
Y1A 2C6

EBA File: 0201-11730

Attention: Mr. Rob Conrad, Manager, Land Development  
Engineering And Development Branch

Dear Sir:

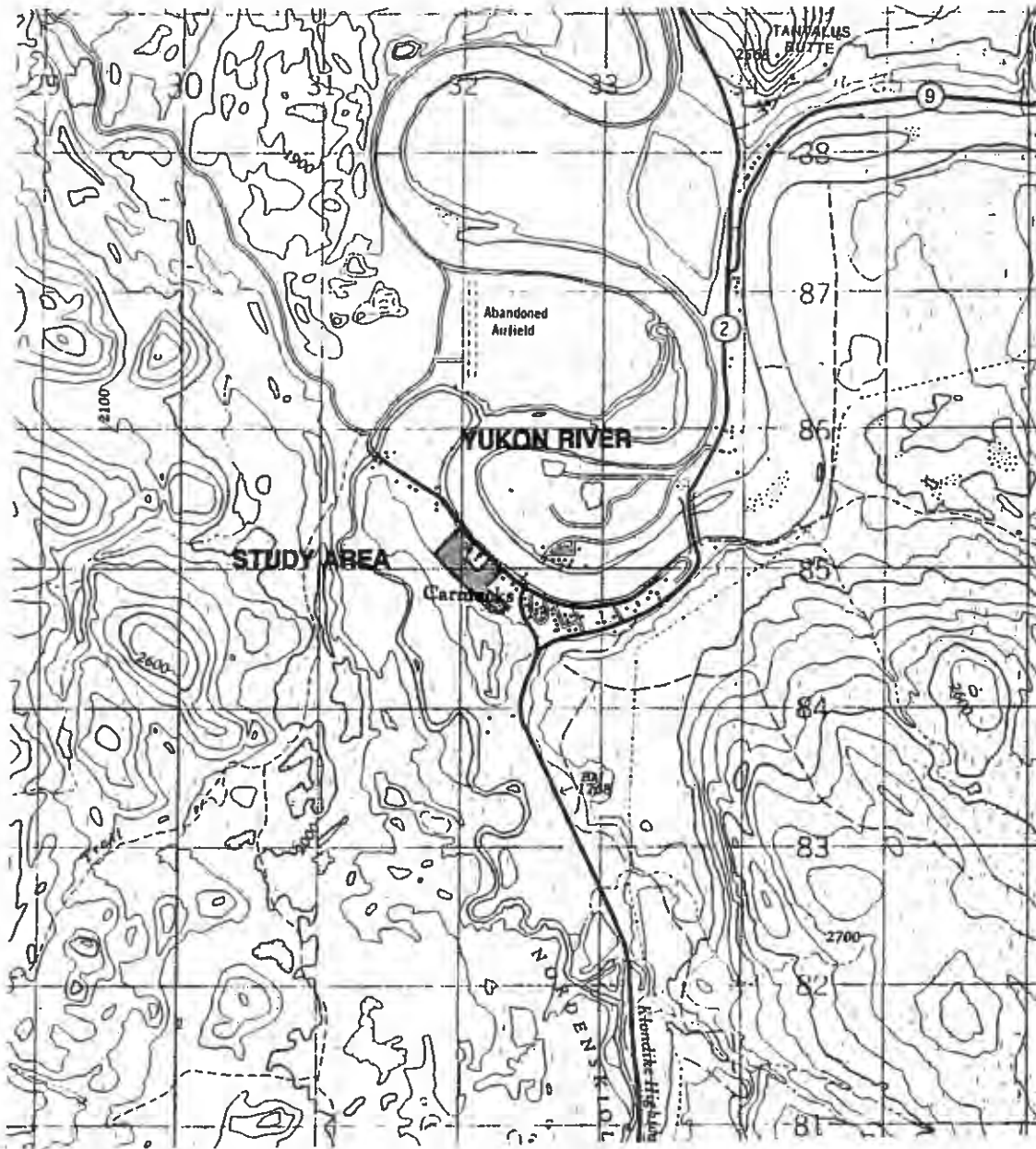
Subject: Geotechnical Evaluation  
Residential Expansion-Carmacks, Yukon

## **1.0 INTRODUCTION**

In a December 9, 1994 memorandum to YTG, Engineering and Development Branch, Mr. Ian Robertson of Inukshuk Planning & Development conveyed the wishes of the Carmacks town council to have a geotechnical investigation of the area west of Rawlinson Road along River Road completed to confirm the suitability of the area for residential expansion. The study area is presented on Figure 1, following.

EBA Engineering Consultants Ltd. (EBA) was retained to complete the geotechnical evaluation of the subject site under the authorization of Mr. Rob Conrad, Manager, Land Development, Engineering and Development Branch, YTG.

This letter report summarizes the results of this investigation, discusses the residential expansion potential of the area and presents development recommendations.



<b>EBA Engineering Consultants Ltd.</b>			PROJECT	<b>RESIDENTIAL EXPANSION CARMACKS, YUKON</b>
CLIENT	<b>GOVERNMENT OF YUKON ENGINEERING AND DEVELOPMENT</b>		TITLE	<b>GENERAL LOCATION MAP</b>
DATE	<b>95-02-23</b>	DWN	MCP	CHKD
DWG NO.	<b>FIGURE 1</b>	<b>0201-11730</b>		

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## 2.0 SITE INVESTIGATION

On February 6, 1995, six testpits were excavated throughout the subject site. The testpits were excavated to depths ranging from 3.2 m to 4.2 m. A CAT 225 tracked excavator was contracted from Kando Enterprises of Carmacks to advance the testpits. Mr. M.C. Plaunt, C.E.T. was EBA's site representative. Testpits were located within each of the various terrain features encountered within the study area to provide an overview of surface and subsurface conditions.

Figure 2, following, presents the various terrain features noted during air photo interpretation and the site investigation.

## 3.0 EXISTING GEOTECHNICAL CONDITIONS

Detailed soils information is presented on the testpit logs and the location of each of the six testpits is presented on Drawing 11730-A-01, attached to this letter.

Generally, the subject site runs in a northwesterly direction. The physical boundaries of the site are River Road and the Yukon River at the front of the study area and the north facing toe of the ridge separating the Yukon and Nordenskiold Rivers at the back of the study area. The back half of the study area is quite typical of permafrost areas in the Yukon (characterized by the presence of thick moss ground cover and sparse, dwarf black spruce tree cover). Soil conditions in this portion of the subject site consist of up to a metre of ice rich permafrost over unfrozen but wet silts. Granular soils (gravel and sand) were noted below the silt. Groundwater was noted in each of the three testpits (TP's 1, 2 & 3) excavated in this portion of the study area. At the time of the investigation, significant glaciation of the ground surface was also noted. As well, on the airphotos utilized for this study, surface water was noted within the bermed area at the back of the developed portion of lot owned by Carl Scanlon.



<p><b>EBA Engineering Consultants Ltd.</b></p>	<p><b>PROJECT</b></p> <p>RESIDENTIAL EXPANSION - CARMACKS, YUKON</p>
<p><b>CLIENT</b></p> <p>GOVERNMENT OF YUKON ENGINEERING AND DEVELOPMENT</p>	<p><b>TITLE</b></p> <p>SITE PLAN SHOWING TERRAIN FEATURES</p>
<p><b>DATE</b> 95-02-23</p>	<p><b>DWG NO.</b> 0201-11730</p>
<p><b>DWN</b> MCP</p>	<p><b>FIGURE 2</b></p>
<p><b>CHKD</b></p>	

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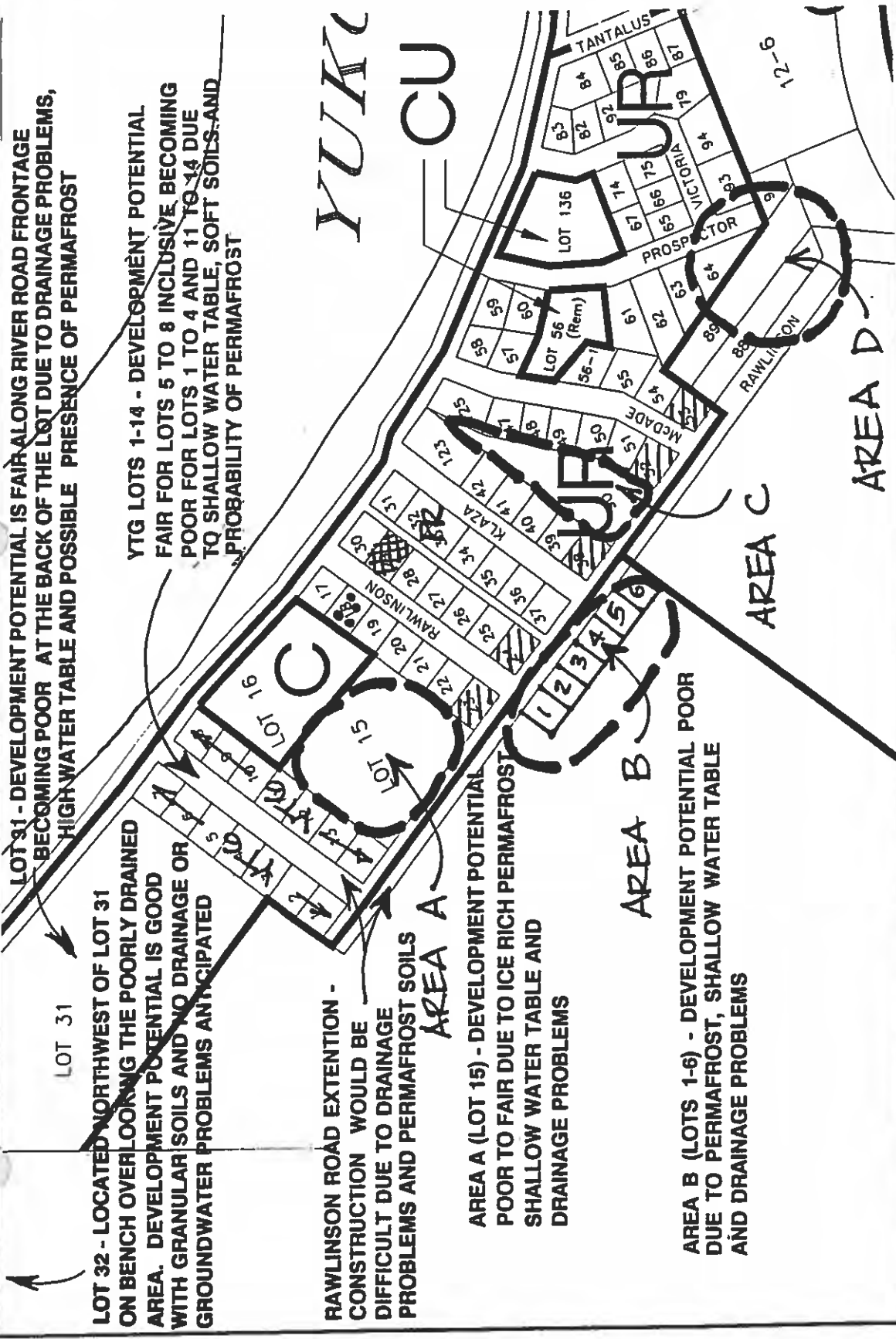
The northwest end of the study area (numbered as Lot 32 on the Zoning Map included in the Inukshuk planning report) is an elevated bench. Soil conditions in this area are comprised of up to 1.0 m of silt over granular soils. This area is covered with mature spruce and poplars and appears to be well drained.

#### **4.0 DISCUSSION AND RECOMMENDATIONS**

The Inukshuk Development Infill Needs Assessment report provided planning options for three sites within the study area contingent upon additional geotechnical information. The three areas are noted as Area A, Area B, and the YTG lots 1 to 14 as presented on Figure 3, following. The portions of these areas which are located in the wet, permafrost areas along the back of the study area will be difficult and expensive (but not impossible) to develop while available land along River Road and the upper bench located at the northwest end of the study area (Lots 31 & 32) are considered to be more conducive to development through conventional means. Recommendations for specific aspects of site development are presented below.

##### **4.1 Area A (Lot 15)**

Development of Lot 15 will require the subcut and removal of all ice rich permafrost soils and the subsequent backfill to design grade with granular materials. The silts found below the ice rich permafrost are fairly wet and soft so construction of the gravelled portions of the site will have to be completed with a minimum of disturbance to the subgrade. Utilization of a geotextile may be warranted. It is the opinion of the undersigned that the suggested trailer park option would be easier to construct but with considerable cost. The geotextile placement and gravel pad construction could be limited to the access road and trailer areas to minimize development costs. Another advantage to trailers as opposed to residential structures is that adjustments can be made to offset any movement caused by settlement or frost heave.



LOT 31 - DEVELOPMENT POTENTIAL IS FAIR ALONG RIVER ROAD FRONTAGE BECOMING POOR AT THE BACK OF THE LOT DUE TO DRAINAGE PROBLEMS, HIGH WATER TABLE AND POSSIBLE PRESENCE OF PERMAFROST

LOT 32 - LOCATED NORTHWEST OF LOT 31 ON BENCH OVERLOOKING THE POORLY DRAINED AREA. DEVELOPMENT POTENTIAL IS GOOD WITH GRANULAR SOILS AND NO DRAINAGE OR GROUNDWATER PROBLEMS ANTICIPATED

YTG LOTS 1-14 - DEVELOPMENT POTENTIAL FAIR FOR LOTS 5 TO 8 INCLUSIVE BECOMING POOR FOR LOTS 1 TO 4 AND 11 TO 14 DUE TO SHALLOW WATER TABLE, SOFT SOILS AND PROBABILITY OF PERMAFROST

RAWLINSON ROAD EXTENSION - CONSTRUCTION WOULD BE DIFFICULT DUE TO DRAINAGE PROBLEMS AND PERMAFROST SOILS

AREA A (LOT 15) - DEVELOPMENT POTENTIAL POOR TO FAIR DUE TO ICE RICH PERMAFROST, SHALLOW WATER TABLE AND DRAINAGE PROBLEMS

AREA B (LOTS 1-6) - DEVELOPMENT POTENTIAL POOR DUE TO PERMAFROST, SHALLOW WATER TABLE AND DRAINAGE PROBLEMS

CLIENT	EBA Engineering Consultants Ltd.		
PROJECT	RESIDENTIAL EXPANSION - CARMACKS, YUKON		
TITLE	SITE PLAN DELINEATING DEVELOPMENT POTENTIAL		
DATE	95-02-23	DWN	MCP
DWG NO.	FIGURE 3		0201-11730

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**4.2 Area B (Lots 1 to 6)**

Of the six lots making up Area B on Figure 1 of the Inukshuk report, residential construction will probably be feasible for Lots 5 & 6 which are located on higher ground but permafrost, soft underlying soils and shallow groundwater make development of Lots 1 to 4 very difficult. Anecdotal information has indicated that shallow and fluctuating groundwater elevations have been a problem in the basements of a number of houses along Rawlinson and Klaza Roads.

**4.3 YTG Lots 1 To 14**

As stated in the Inukshuk report, the six lots closest to River Road (Lots 5 to 10) are founded on higher ground and vegetation patterns indicate that the area has some drainage. Along with the soil conditions noted for Testpit 11730-03, two boreholes drilled for YTG, Transportation Engineering Branch indicate that soil conditions along the front of the area are comprised of silts over sands or gravels below 2.0 m. An option which may be considered is the construction of a cul de sac from River Road into the site. The lots would have to be resurveyed but this would decrease the length of road required and minimize the amount of permafrost encountered during construction. The houses constructed along the bulb of the cul de sac would have to be placed on a foundation system which is comprised of the excavation of all permafrost soils and the construction of an engineered gravel pad.

**4.4 Lot 31**

The majority of lot 31 is being utilized as an equipment storage compound by Mr. Carl Scanlon of Carmacks. However, a small section located between Mr. Scanlon's lot and the creek located at the west edge of lot 31 could possibly be considered for infill along River Road if future truck traffic can be routed away from the area.

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At the back of Mr. Scanlon's property is a berm which ties into a finger of higher land. This has created a bit of a barrier which may be one of the reasons that the south edge of the study area becomes glaciated in the winter.

#### **4.5            Lot 32**

This area has acceptable soil conditions and is definitely conducive to residential expansion. Further input should be sought from Mr. Ian Robertson of Inukshuk Planning And Development regarding design concepts and safety implications of accessing the area off of River Road.

Roadway construction in the area would require the stripping of at least 0.6 m of surficial soils which are very silty and may contain organics or volcanic ash and the subsequent construction of a 500 mm sub-base and 150 mm basecourse embankment.

#### **4.6            Site Drainage**

The problem of site drainage will have to be addressed if the study area is to be developed. The source and direction of groundwater flow in the area has not been determined as part of this investigation but it appears that steps will have to be taken to provide a channel for additional surface water to leave the area. A properly constructed ditch (with shallow sideslopes due to soil conditions and proper armouring to provide erosion protection) will have to be constructed along the base of the slope which defines the south boundary of the study site. As well, it will have to run unimpeded to the creek located adjacent to Carl Scanlon's property and subsequently into the Yukon River.

#### **4.7            Construction Of New Road West Of Rawlinson**

To be as cost effective as possible, it may be best to minimize the length of the new road to access Lot 15 only. Construction will require the subcut of all ice rich permafrost, the

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placement of geotextile over the wet subgrade silts and the construction of a 500 mm sub-base and 150 mm basecourse embankment. Backslopes along the ditches should be constructed at a maximum of 3:1 (horizontal:vertical) to ensure slope stability.

#### 4.8            **Underground Utilities Installation**

It is understood that the main reason for considering this area for development is its proximity to the sewage treatment facility. All sewer and service lines being installed will likely be founded below the groundwater table. Prospective contractors should be prepared to pump water, utilize drain rock for pipe bedding and deal with sloughing trench walls during construction. It may also be a good idea to perform a thermal analysis for the proposed system to determine adequate depth of burial and/or insulation requirements.

#### 5.0            **CLOSURE**

It is hoped that this report satisfies your present requirements. If this area does undergo residential development in the future, EBA would be pleased to assist in the geotechnical implications of the detailed design. Terms and conditions for the use of this report are attached and if you have questions regarding the information presented here-in, please contact the undersigned.

Yours truly,  
EBA Engineering Consultants Ltd.



M.C. Plaunt, C.E.T.  
Engineering Technologist

MCP/mcp

**EBA ENGINEERING CONSULTANTS LTD.  
GEOTECHNICAL REPORT  
GENERAL CONDITIONS**

**A.1 USE OF REPORT AND OWNERSHIP**

This geotechnical report pertains to a specific site and development. It is not applicable to adjacent sites nor is it valid for types of development other than that to which it refers. Any variation from the site, or development, necessitates a geotechnical review in order to determine the validity of the design concepts evolved herein.

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**A.2 NATURE AND EXACTNESS OF SOIL DESCRIPTION**

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

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

**A.3 LOGS OF BORINGS**

The boring logs are a compilation of conditions and classification of soils as obtained from field observations and laboratory testing of selected samples. Soil zones have been interpreted. Change from one geologic zone to the other, indicated on the logs as a distinct line, is in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil zone transition elevations may require special evaluation.

**A.4 STRATIGRAPHIC AND GEOLOGIC SECTIONS**

The stratigraphic and geologic sections indicated on drawings contained in this report are evolved from logs of borings. Stratigraphy is known precisely only at the locations of the borings. Actual geology and stratigraphy between borings may vary from that shown on these drawings. Natural variations in geologic conditions are inherent and a function of historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of exact locations of geologic units is necessary, it is cautioned that such determination requires special attention.

**A.5 GROUNDWATER CONDITIONS**

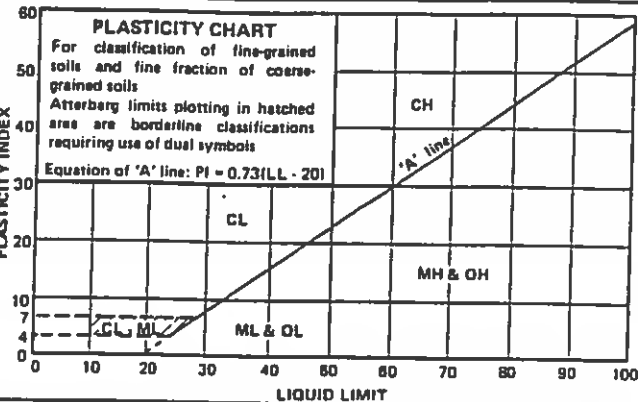
Groundwater conditions represented in this report refer only to those observed at the times recorded on logs of borings, and/or within the text of this report. These conditions vary with geologic detail between borings; annual, seasonal and special meteorologic conditions; and with construction activity. Where instruments have been established to record groundwater variations on an ongoing basis, the records will be specifically referred to. Interpretation of groundwater conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and construction activity. Deviations from these observations, may occur. No other warranty, express, or implied, is made by EBA.

**A.6 PROTECTION OF EXPOSED GROUND**

Excavation and construction operations expose geologic materials to meteorological elements. Many geologic materials deteriorate rapidly upon exposure to climatic elements. Severe deterioration of materials may be caused by precipitation and/or the action of frost on exposures. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from elements, particularly all forms of moisture, desiccation from arid conditions and frost action.

# UNIFIED SOIL CLASSIFICATION †

MAJOR DIVISIONS		GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS	More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP More than 12% pass No. 200 sieve 5% to 12% pass No. 200 sieve Borderline classification requiring use of dual symbols
			GRAVELS WITH FINES	GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines	
			SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	
		SANDS WITH FINES		SP	Poorly-graded sands and gravelly sands, little or no fines	
				SM	Silty sands, sand-silt mixtures	
		FINE-GRAINED SOILS	50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less	ML	
	CL				Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	OL				Organic silts and organic silty clays of low plasticity	
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
		CH	Inorganic clay of high plasticity, fat clays			
OH		Organic clays of medium to high plasticity				
PT		Peat, muck and other highly organic soils				



## GROUND ICE DESCRIPTION

### ICE NOT VISIBLE

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
N	NI	Poorly-bonded or friable	
	Nbn	No excess ice, well-bonded	
	Nbe	Excess ice, well-bonded	

### VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
V	Vx	Individual ice crystals or inclusions	
	Vc	Ice coatings on particles	
	Vr	Random or irregularly oriented ice formations	
	Vs	Stratified or distinctly oriented ice formations	

### VISIBLE ICE GREATER THAN 50% BY VOLUME

ICE	ICE + Soil Type	Ice with soil inclusions	
	ICE	Ice without soil inclusions (greater than 25 mm (1 in.) thick)	

- NOTE**
- Dual symbols are used to indicate borderline or mixed ice classifications
  - Visual estimates of ice contents indicated on borehole logs ± 5%
  - This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes

**LEGEND**  
Soil Ice



**EBA Engineering Consultants Ltd.**

**GOVERNMENT OF YUKON  
ENGINEERING AND DEVELOPMENT**

PROJECT

**RESIDENTIAL EXPANSION - CARMACKS, YUKON**

TITLE

**SITE PLAN SHOWING TESTPIT LOCATIONS**

DWG NO.

**11730-A-01**

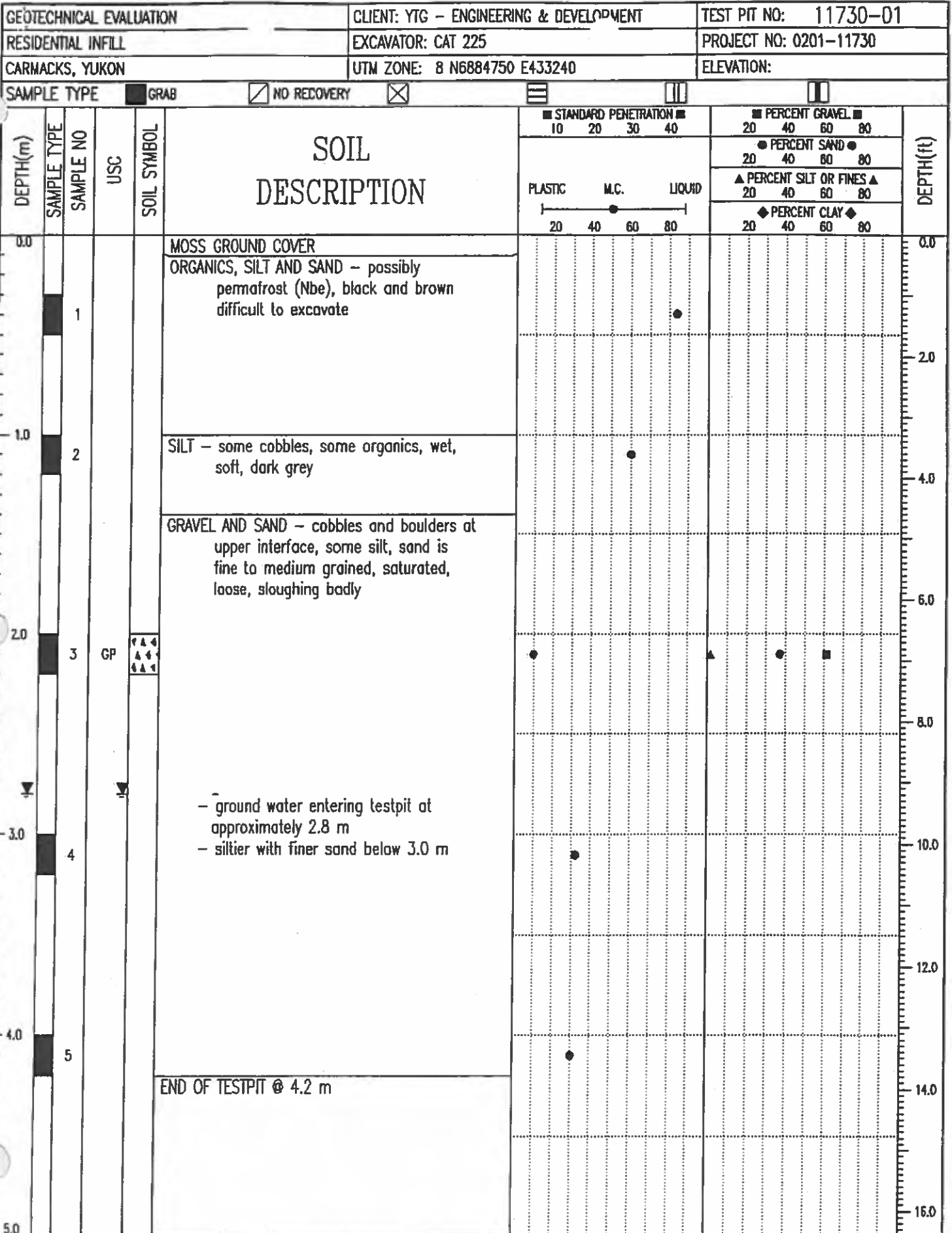
**0201-11730**

DATE **95-02-23**

DWN

**MCP**

CHKD



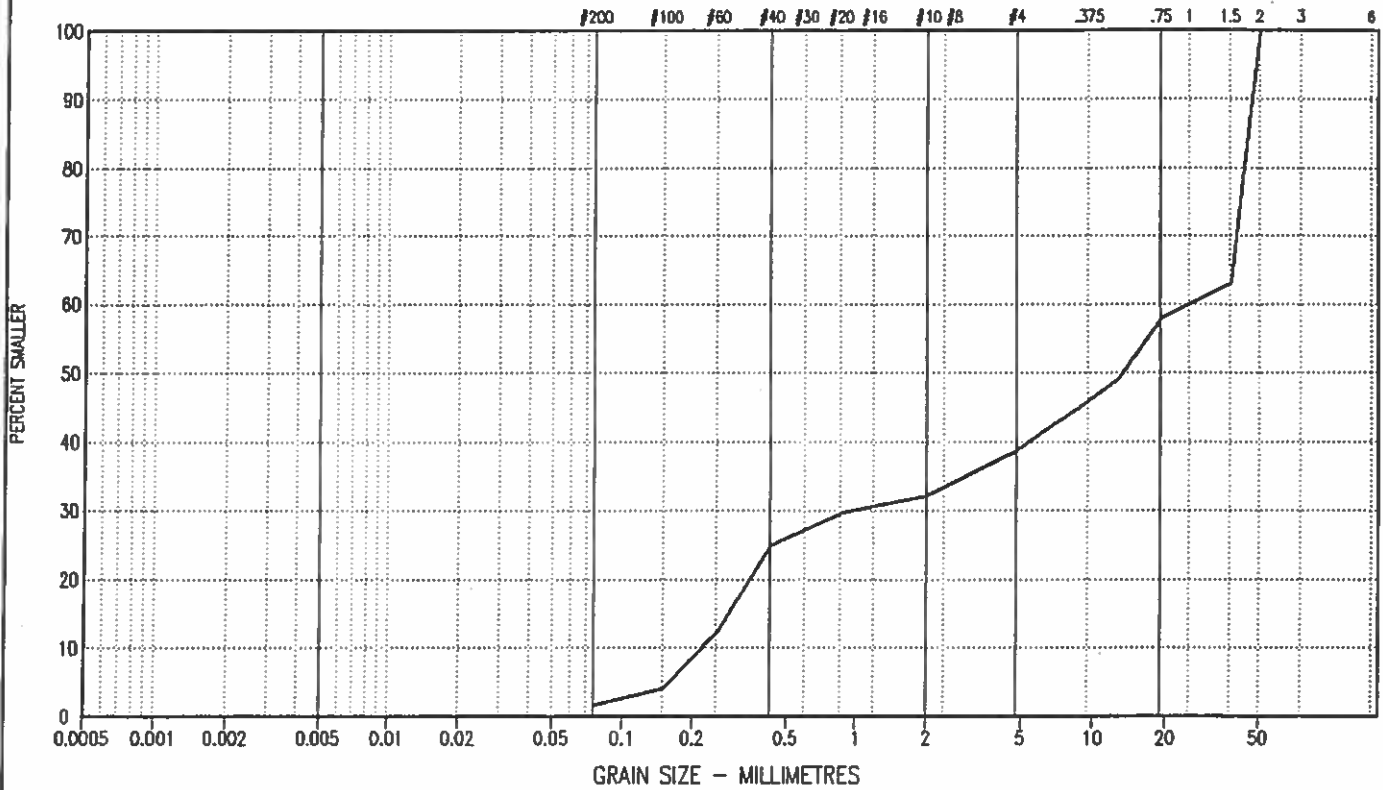
EBA Engineering Consultants Ltd.  
Whitehorse, Yukon

LOGGED BY: MCP	COMPLETION DEPTH: 4.2 m
REVIEWED BY: MCP	COMPLETE: 06/02/95
Fig. No:	Page 1 of 1

## PARTICLE SIZE - ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

U.S. STANDARD SIEVE SIZES



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
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Project: 0201-11730

Date Tested: 95/02/08

BY: MCP

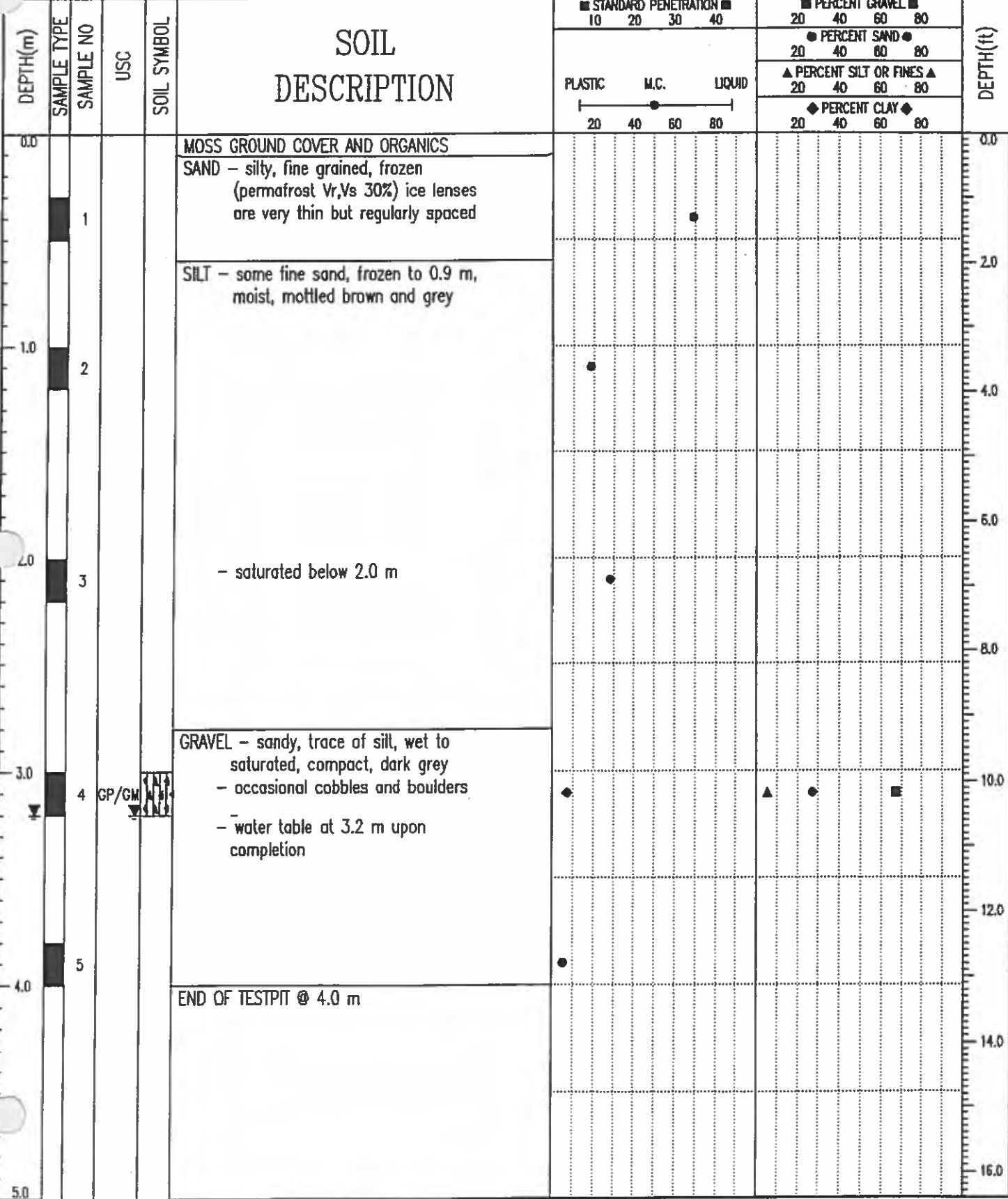
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SAMPLE TYPE:  GRAB     NO RECOVERY     [Symbol]     [Symbol]     [Symbol]



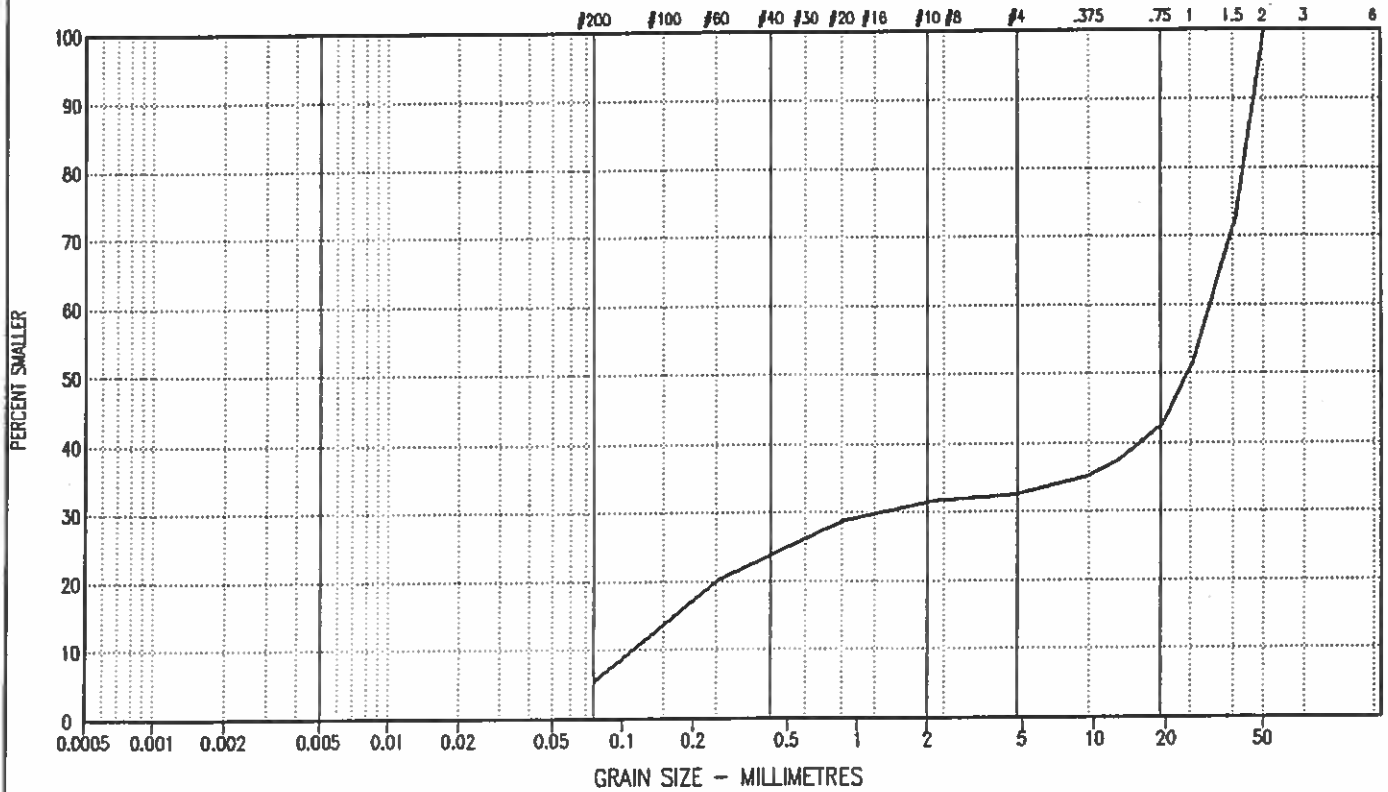
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Whitehorse, Yukon

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REVIEWED BY: MCP	COMPLETE: 06/02/95
Fig. No:	Page 1 of 1

## PARTICLE SIZE - ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

U.S. STANDARD SIEVE SIZES



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
—	11730-02	3.00 - 3.20	5.3	27.2	67.5	260.2	0.6	GP-GM

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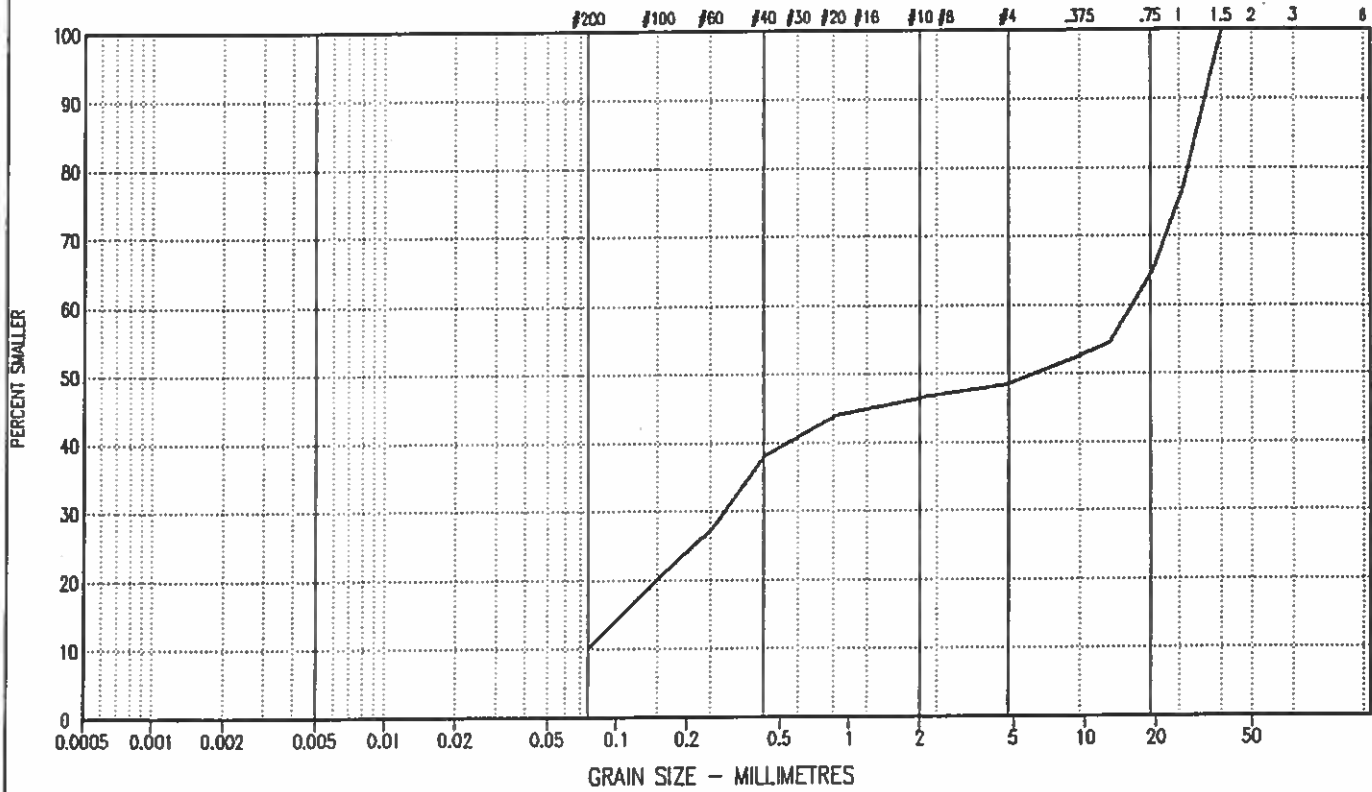




## PARTICLE SIZE - ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

U.S. STANDARD SIEVE SIZES



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
—	11730-03	2.00 - 2.20	10.0	38.3	51.7	216.1	0.1	GP-GM

Project: 0201-11730

Date Tested: 95/02/08

BY: MCP

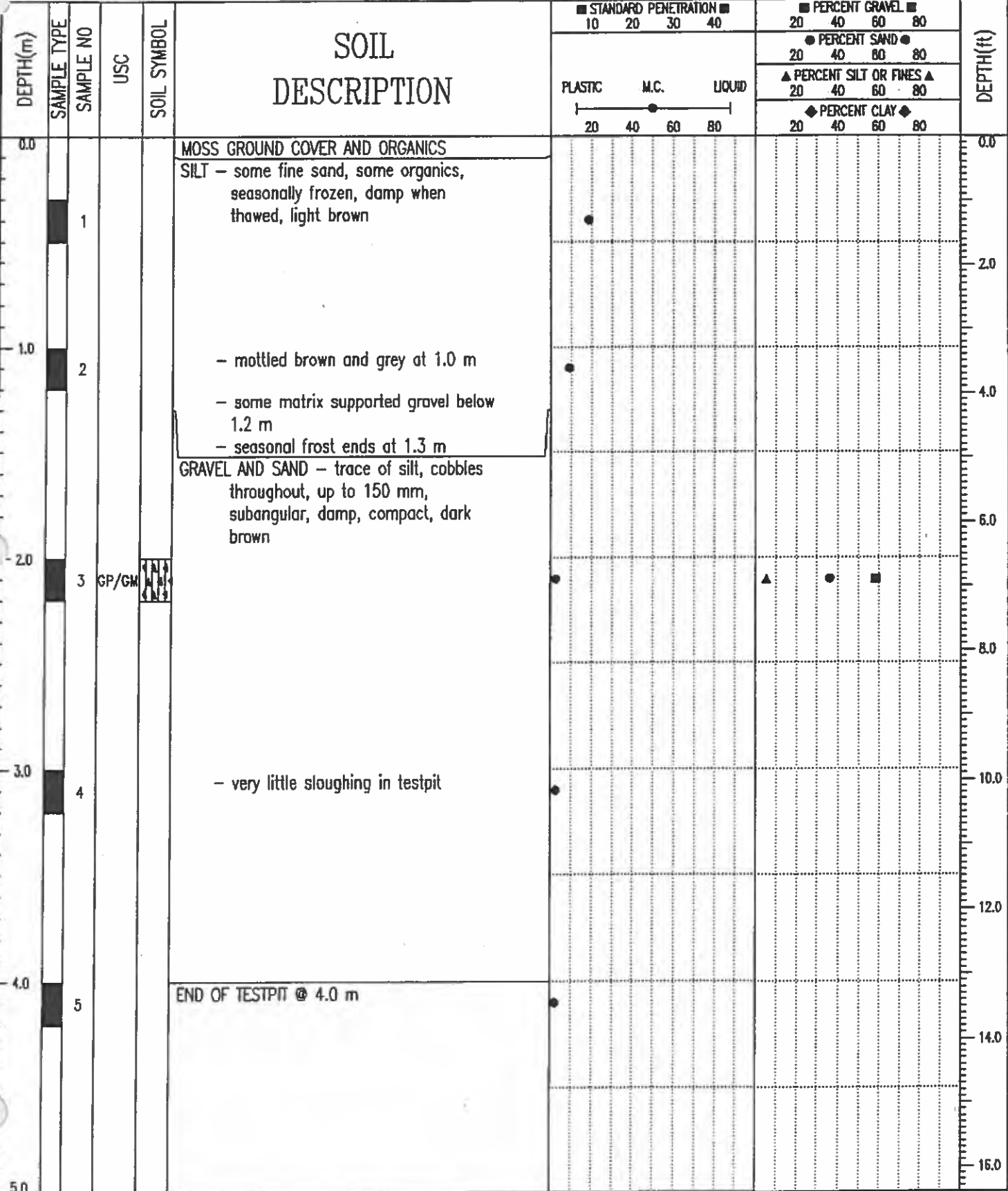
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SAMPLE TYPE  GRAB  NO RECOVERY



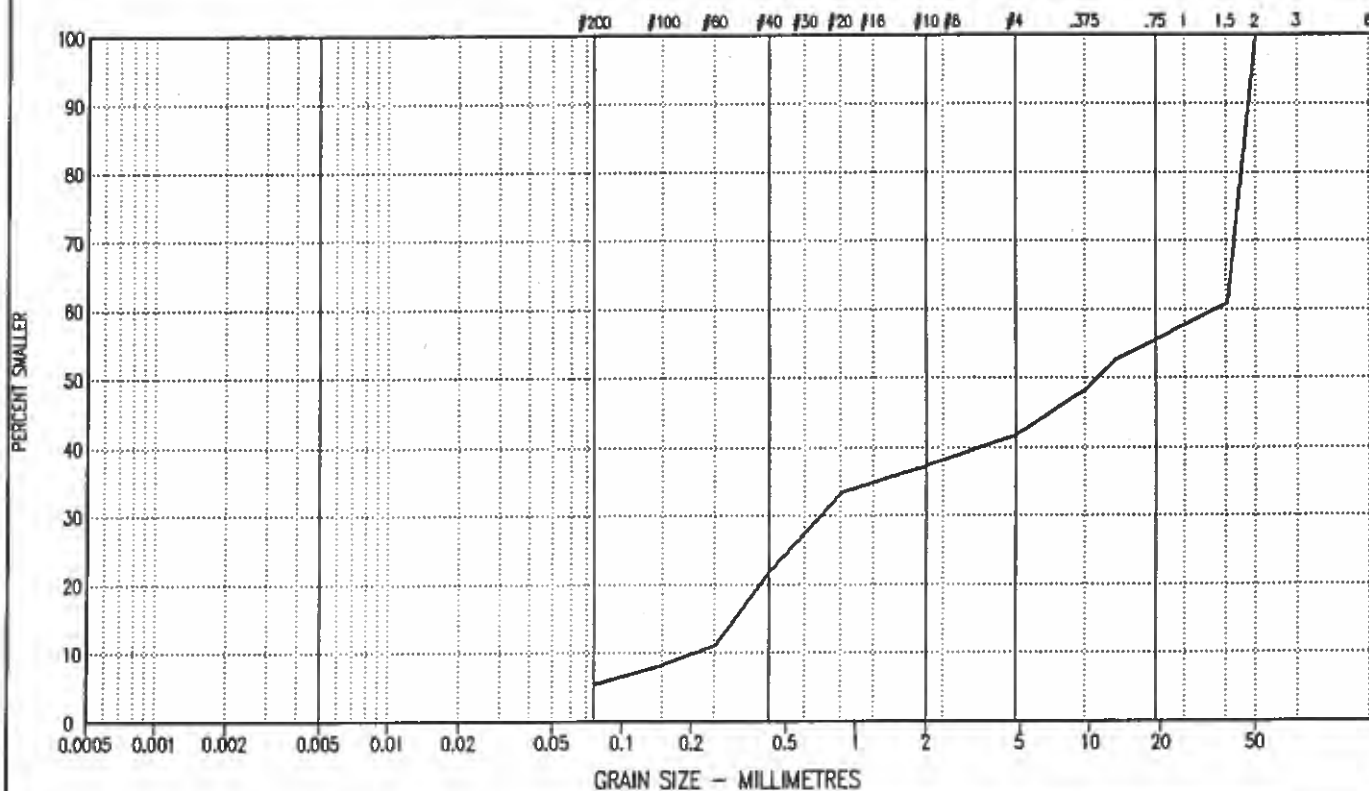
EBA Engineering Consultants Ltd.  
Whitehorse, Yukon

LOGGED BY: MCP	COMPLETION DEPTH: 4.0 m
REVIEWED BY: MCP	COMPLETE: 06/02/95
Fig. No:	Page 1 of 1

## PARTICLE SIZE - ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

U.S. STANDARD SIEVE SIZES



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
—	11730-04	2.00 - 2.20	5.4	36.1	58.5	165.1	0.1	GP-GM

Project: 0201-11730

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GEOTECHNICAL EVALUATION		CLIENT: YTG - ENGINEERING & DEVELOPMENT		TEST PIT NO: 11730-05											
RESIDENTIAL INFILL		EXCAVATOR: CAT 225		PROJECT NO: 0201-11730											
CARMACKS, YUKON		UTM ZONE: 8 N6885140 E432850		ELEVATION:											
SAMPLE TYPE		<input checked="" type="checkbox"/> GRAB		<input type="checkbox"/> NO RECOVERY											
DEPTH(m)		SAMPLE TYPE		SAMPLE NO		USC		SOIL SYMBOL		SOIL DESCRIPTION				DEPTH(ft)	
										■ STANDARD PENETRATION ■ 10 20 30 40 PLASTIC      M.C.      LIQUID 20 40 60 80				■ PERCENT GRAVEL ■ 20 40 60 80 ● PERCENT SAND ● 20 40 60 80 ▲ PERCENT SILT OR FINES ▲ 20 40 60 80 ◆ PERCENT CLAY ◆ 20 40 60 80	
0.0		1						MOSS AND ORGANICS						0.0	
								SILT - some fine sand, some rootlets throughout, seasonally frozen, light brown							
1.0		2		GM		GM		GRAVEL AND SAND - silty, occasional cobbles and boulders to 300 mm, frozen (may be permafrost Nbn), olive brown, difficult to excavate						4.0	
2.0		3												8.0	
3.0		4						GRAVEL - sandy, trace of silt, gravel up to 200 mm, sand is medium to fine grained, damp, compact, medium brown						12.0	
4.0		5						END OF TESTPIT @ 4.2 m						14.0	
5.0														16.0	

EBA Engineering Consultants Ltd.  
Whitehorse, Yukon

LOGGED BY: MCP

REVIEWED BY: MCP

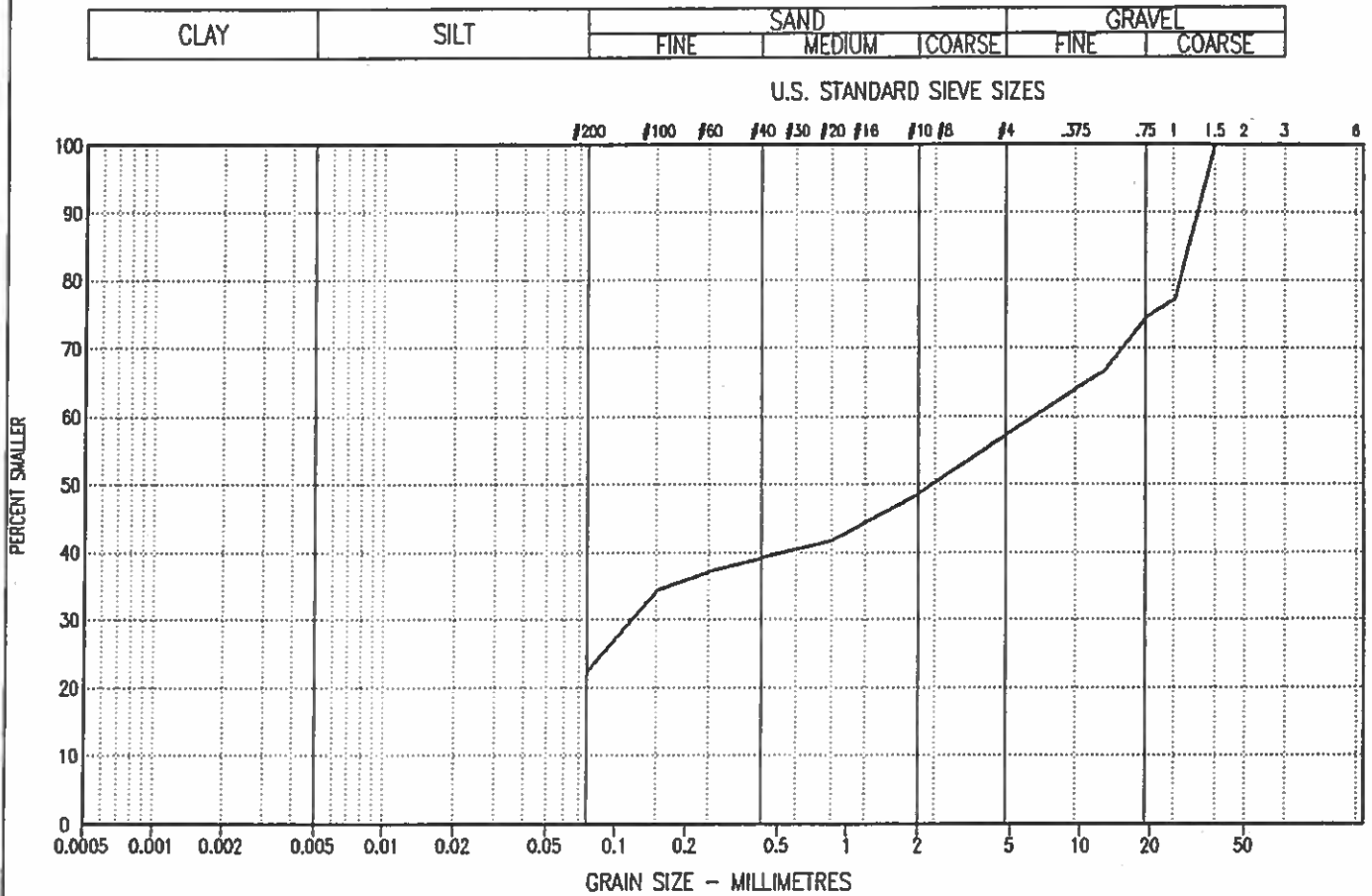
Fig. No:

COMPLETION DEPTH: 4.2 m

COMPLETE: 06/02/95

Page 1 of 1

## PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
—	11730-05	1.00 - 1.20	22.3	34.7	43.0	202.4	0.1	GM

Project: 0201-11730

Date Tested: 95/02/08

BY: MCP

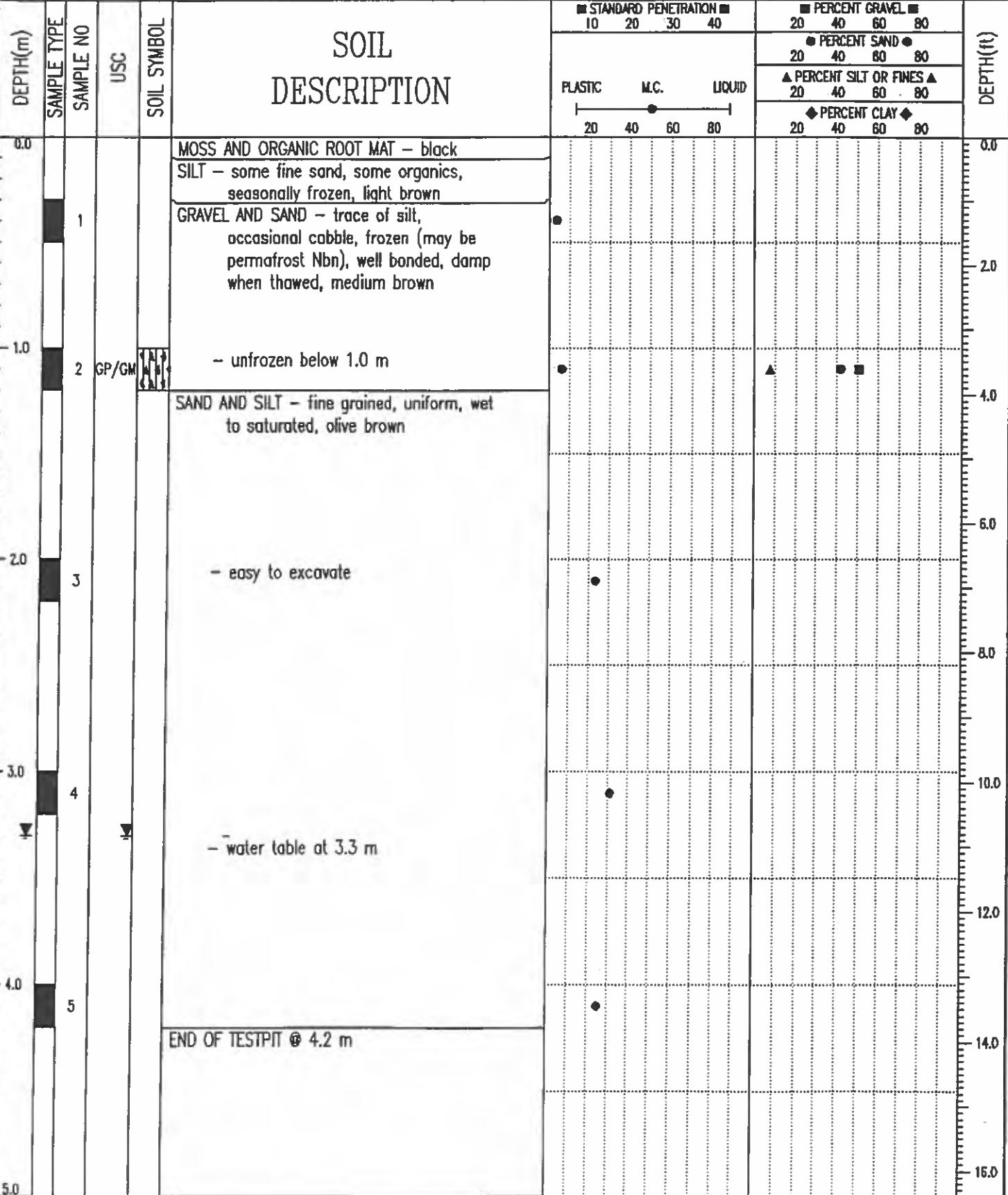
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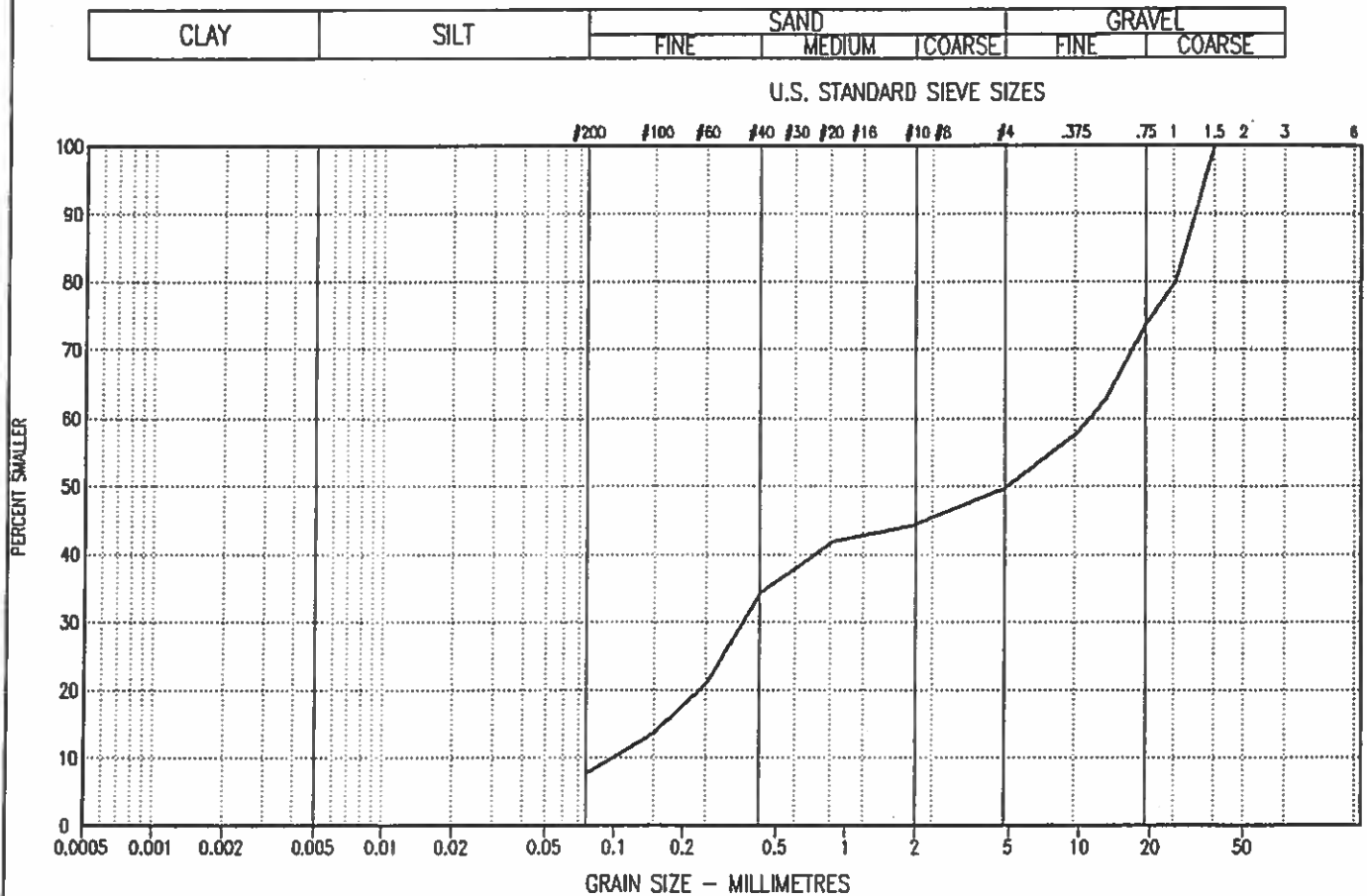


GEOTECHNICAL EVALUATION		CLIENT: YTG - ENGINEERING & DEVELOPMENT	TEST PIT NO: 11730-06
RESIDENTIAL INFILL		EXCAVATOR: CAT 225	PROJECT NO: 0201-11730
CARMACKS, YUKON		UTM ZONE: 8 N6885040 E432850	ELEVATION:
SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/>



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: MCP	COMPLETION DEPTH: 4.2 m
	REVIEWED BY: MCP	COMPLETE: 06/02/95
	Fig. No:	Page 1 of 1

## PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION			Cu	Cc	U.S.C
			CLAY & SILT %	SAND %	GRAVEL %			
—	11730-06	1.00 - 1.20	7.7	41.8	50.5	106.6	0.1	GP-GM

Project: 0201-11730

Date Tested: 95/02/08

BY: MCP

Tested in accordance with ASTM D422 unless otherwise noted.

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