

GR-999-014

Drawer # 17



**HOGGAN ENGINEERING & TESTING
(1980) LTD.**



An Affiliate of J. R. Paine & Associates Ltd

EDMONTON ● GRANDE PRAIRIE ● PEACE RIVER ● WHITEHORSE

HOGGAN ENGINEERING & TESTING (1980) LTD.

**GEOTECHNICAL SERVICES
NORDENSKIOLD RIVER CROSSING
CARMACKS, YUKON
1998-1999**

HOGGAN ENGINEERING & TESTING (1980) LTD.

REPORT NO.: 8002-254

**GEOTECHNICAL SERVICES
NORDENSKIOLD RIVER CROSSING
CARMACKS, YUKON
1998-1999**

December 8, 1998

HOGGAN ENGINEERING
& TESTING (1980) LTD.
14 BURNS ROAD
WHITEHORSE, YUKON
Y1A 4Y9

HOGGAN ENGINEERING & TESTING (1980) LTD.

REPORT # 8002-254

**GEOTECHNICAL SERVICES
NORDENSKIOLD RIVER CROSSING
CARMACKS, YUKON
1998-1999**

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>PAGE</u>
1.0 INTRODUCTION	1
2.0 GEOTECHNICAL INVESTIGATION	2
2.1 Drilling Program	2
2.2 Sampling Program	4
2.3 Laboratory Program	5
3.0 SUBSURFACE SOIL CONDITIONS	6
4.0 RECOMMENDATIONS & EVALUATIONS	7
4.1 Spread Footing/Shallow Raft Foundation	7
4.2 Deep Pile Foundation	10
5.0 CONCLUSIONS	12
5.1 Spread Footing/Shallow Raft Foundation	12
5.2 Deep Pile Foundation	14
6.0 CLOSURE	16

HOGGAN ENGINEERING & TESTING (1980) LTD.

APPENDICES

Appendix A- Testhole Locations

Appendix B- Testhole Soil Logs

Appendix C- Individual Test Summary Sheets

Appendix D- Photographic Documentation

Appendix E – Pile Evaluation

Appendix F – Recommended Grainsize Distribution

HOGGAN ENGINEERING & TESTING (1980) LTD.

PROJECT: Geotechnical Services
Bridge Foundation Evaluation

LOCATION: Nordenskiold River Crossing
Near Carmacks, Yukon

CLIENT: Government of Yukon
Community & Transportation Services
Transportation Engineering Branch
Box 2703
Whitehorse, Yukon
Y1A 2C6

ATTENTION: Mr. Bruce Fulcher, Geotechnical Services Manager

1.0 INTRODUCTION

The following report details the results of the geotechnical investigation our firm conducted at the proposed Nordenskiold River Crossing, Carmacks, Yukon Territories. The proposed crossing will include the construction of a single span two-lane bridge located upstream of the Yukon River confluence south of Carmacks, Yukon. The bridge site is located approximately between 600 meters and 700 meters west of kilometer 355 of the Klondike Highway.

The investigation was conducted at two locations, one on either side of the Nordenskiold River, along the existing cleared right-of-way between the Mt. Nansen Rd. and the Klondike Highway. The objective of the investigation was to determine the subsurface soil conditions at the locations of the two proposed bridge abutments to provide foundation recommendations for bridge abutment design and construction.

Hoggan Engineering & Testing (1980) Ltd. was retained for this study with authorization to proceed granted by Mr. Dick Stilwell of the Y.T.G. Transportation Engineering Branch on October 26, 1998.

The field investigation was conducted between October 27, 1998 and Nov 3, 1998.

HOGGAN ENGINEERING & TESTING (1980) LTD.

HOGGAN ENGINEERING & TESTING (1980) LTD.

HOGGAN ENGINEERING & TESTING (1980) LTD.

The scope of work undertaken by our firm is outlined in detail in our October 22, 1998 *Geotechnical Services Proposal*.

2.0 GEOTECHNICAL INVESTIGATION

The methodology for the geotechnical investigation consisted of conducting a drilling, sampling and laboratory program. A detailed description of each facet of the investigation conducted is described below.

2.1 Drilling Program

The field program included drilling a total of four testholes at predetermined locations within the existing cleared right-of-way (please see Appendix A- Site Sketch). Specifically, the testholes were located on the proposed centerline, 10 meters from the existing river bank. Testhole locations were determined relative to existing benchmarks and centerline stakes as shown in Appendix A –Testhole Locations.

Drilling at each abutment location consisted of first advancing 150 mm. continuous flight solid stem augers to delineate the general underlying soil profile. Following this, 200 mm. continuous flight hollow stem auger were advanced to facilitate standard penetration testing (SPT) and sampling to more accurately characterize the soil strata. These drilling methods were utilized to obtain representative disturbed and undisturbed samples of the underlying unconsolidated materials to assess suitability for founding the two proposed bridge abutments.

The drilling program was conducted between October 27, 1998 and November 3, 1998 utilizing a CME 75 drill mounted on an FN 60 Flextrak Nodwell supplied and operated by *15317 Yukon Inc.*

HOGGAN ENGINEERING & TESTING (1980) LTD.

Testholes drilled include the following;

T.H. # 1-98, T.H. # 1A-98, T.H. # 9-98, T.H. # 9A-98

Testholes were advanced to the following depths;

T.H.# 1-98 19.51 meters Solid Stem
T.H.# 1A-98 9.60 meters Hollow Stem
T.H. # 9-98 19.05 meters Solid Stem
T.H. # 9A-98 15.69 meters Hollow Stem

It should be noted the required depths (20 meters) for drilling at the locations of both hollow stem testholes were not obtained. This was due to the influx of fines and sands into the lead hollow stem auger during drilling operations. This influx of material into the lead auger prevented the proper seating of the inner plug and therefore terminated drilling operations. Considerable effort was employed in an effort to maintain a positive head during drilling operations by pouring water down the interior portion of the hollow stem augers, as noted in photograph # 2-98. This method was utilized until subsurface conditions terminated drilling operations.

The specific soil conditions at each testhole location are described in detail on the individual testhole soil logs provided in Appendix B-Testhole Soil Logs.

Each testhole soil log contains the following information.

- i). Soil description for each stratum encountered
- ii). USC/NRC classification
- iii). Depths at which changes in soil stratigraphy occurs
- iv). Sample depths and types
- v). Physical laboratory test results
- vi). Watertable and seepage zones encountered

HOGGAN ENGINEERING & TESTING (1980) LTD.

2.2 Sampling Program

During sampling, all samples were visually classified in the field with continuous field soil logs maintained. A total of 49 soil samples were retrieved during the sampling program. Disturbed hand samples were retrieved from off the solid stem auger at regular intervals or at significant changes within the soil stratum.

Standard Penetration Test (SPT) Program

During hollow stem drilling, standard penetration testing (SPT) and sampling was generally performed at regular intervals.

The standard penetration test is a dynamic testing and sampling method which involves driving a split barrel sampler in the soil with a 63.5 kg weight having a free fall of 760 millimeters. The blows required to drive the sampler 300 millimeters, after an initial penetration of 150 millimeters is referred to as the SPT "N" value. The SPT is useful in providing a guide to the in-situ engineering properties and in providing a sample of the soil for classification purposes. The SPT is best suited for sands for the ability to obtain reliable samples and to apply the "N" value to allowable bearing capacity determination.

It should be noted that because standard penetration testing was conducted below the groundwater table, it is possible that higher N values were obtained in the field due to the influence of hydrostatic pressure. Both drilled testholes were terminated due to excessive wash in of sands into the lead auger, causing a blockage in the testhole and preventing drilling operations from continuing.

In T.H. # 1A-98, a total of six SPT's were conducted, one of which resulted in refusal (50 blows - 7.5 cm.). Values for blow counts obtained varied from 21 to 63, indicating soil density ranging from medium-dense to very dense granular materials. The average N value for T.H. # 1A-98 is 33, representative of a dense material.

HOGGAN ENGINEERING & TESTING (1980) LTD.

In T.H. # 9A-98, a total of eight SPT's were conducted, one of which resulted in refusal (40 blows – 2.5 cm.). Values for blow counts obtained varied from 13 to 67, indicating soil density ranging from medium-dense to very dense granular materials. The average N value for T.H. # 9A-98 is 34, representative of a dense material. It should be noted however that in an effort to obtain samples at depth, the sampling interval for the last two samples in T.H.# 9A-98 was doubled.

A total of 15 samples were obtained during the SPT program. All samples obtained were subsequently bagged for further classification and analysis in the laboratory.

2.3 Laboratory Program

All unconsolidated soil samples were visually classified in *Hoggan Engineering & Testing (1980) Ltd.*, Whitehorse laboratory facility to confirm field testhole logs.

Laboratory testing conducted in our Whitehorse facilities consisted of moisture content determination and visual soil classification on all 49 samples obtained. Selected samples were then chosen for either sieve analysis or Atterberg limit testing in order to provide an indication of the soil types encountered at the project and their engineering properties, or when such testing would help classify marginal samples.

Grainsize analysis was conducted on 37 selected samples while 1 sample exhibiting a presence of clay was analyzed for Atterberg limits.

Result of the Atterberg limit analysis indicated a plastic limit of 20.2, a liquid limit of 23.1 and a plasticity index of 2.9.

Laboratory test results are included in Appendix B – Testhole Soil Logs and on the individual test summary sheets enclosed in Appendix C.

3.0 SUBSURFACE SOIL CONDITIONS

Based upon field observations, the subsurface soil conditions appear to be dominated by alluvial deposits and similar fluvial derived material. Materials encountered during the subsurface drilling program varied between Silty Sandy Gravel with a trace to some clay to Sandy Gravel and Gravelly Sand with cobbles in size to 10 cm, however, in general, granular materials were encountered at depth.

It should be noted that considerable variation in material type between T.H.# 1-98 and T.H. # 1A-98 was noted to depths of 7.32 meters, even though the two testholes were within 1.5 meters of one another. This material varied from a silty sandy gravel with a trace to some clay to sands and gravelly sands showing the wide variation in material types which may be encountered within the active alluvial deposits.

Groundwater was encountered in all four testholes drilled. A standpipe was installed at each abutment location to more accurately delineate groundwater levels. During drilling operations, groundwater levels were noted as follows;

T.H.# 1-98 2.13 meters below original ground

T.H.# 9-98 0.56 meters below original ground

Note that these groundwater levels may not accurately define static groundwater conditions due to the disturbance of drilling operations.

No indication of permanently frozen materials was encountered.

No indication of bedrock was encountered.

Detailed subsurface soil conditions encountered at each testhole location are presented in detail in Appendix B – Testhole Soil Logs.

HOGGAN ENGINEERING & TESTING (1980) LTD.

Photographic documentation of the site is located in Appendix D.

4.0 RECOMMENDATIONS & EVALUATIONS

As requested by YTG, C&TS, our firm has prepared recommendations regarding both shallow and deep foundation options, in particular this includes the possibility of founding the bridge on one of the following two options;

Spread Footing/Shallow Raft Foundation

Deep Pile Foundation

4.1 Spread Footing/Shallow Raft Foundation

A spread footing or shallow raft foundation can be integrated into the underlying material, however, careful consideration should be given due to the variability of the material encountered and the close proximity of the Nordenskiold River.

1. The proposed bridge may be founded on a spread footing or “raft” system placed at a depth of at least 1 meter below the bottom of the existing Nordenskiold River. This founding depth has been estimated as approximately 2.5 meters on the west side and 4.0 meters on the east side. Verification of these estimates should be conducted prior to construction. This depth of founding is considered a critical component in providing adequate protection from potential river erosion.
2. In no instance should the spread footing or “raft” system be placed closer than 2.0 meters of the original ground surface. This depth is measured from the contact surface of the footing to the existing ground elevation and is purposed to provide frost protection for the foundation base materials and underlying native materials.

HOGGAN ENGINEERING & TESTING (1980) LTD.

3. Allowable soil bearing values should not exceed 100 kilopascals for footings placed within the underlying native materials. This figure includes the total of all live and dead loads. This value is given assuming the above noted 2.0 meter depth of soil cover.
4. The footings base material must be placed on undisturbed native material only. No loose, disturbed, remolded or slough material should be allowed to remain in the open footing excavations. Hand cleaning is advisable if an acceptable surface cannot be prepared by mechanical equipment. The excavation should be inspected by qualified personnel to ensure suitability of the exposed material.
5. A filter cloth should be installed within the excavation and covered with a minimum of 0.5 meters of an approved clean granular material. Fill required to bring the subgrade to the desired elevation should be an approved inorganic material of 75mm maximum size. Depending on availability and price, either a sand or sand-gravel mixture may be used. All fill should be placed in 150 millimeter lifts (as measured after compaction) and should be compacted to an equivalent of at least 100 percent of the corresponding standard proctor density at optimum moisture content. Recommended grainsize distributions for fill materials are provided in Appendix F.
6. A minimum of 100 mm. of 20 mm. crushed gravel should be used as a leveling coarse prior to placement of the concrete footings. This material should likewise be compacted to an equivalent of at least 100 percent of the corresponding standard proctor density at optimum moisture content. Recommended grainsize distributions for the 20 mm. crushed gravel are provided in Appendix F.
7. Grades adjacent to the foundation footing must not exceed a 2:1 (horizontal to vertical) grade, with the recommended 2 meter cover (both lateral and vertical)

HOGGAN ENGINEERING & TESTING (1980) LTD.

maintained. If this is not possible, a restraining structure such as a cantilever or counterfort must be integrated into the footing system.

8. The slopes adjacent to the river should be safeguarded from erosion by placing rip-rap, filter cloth or alternate protective measures.
9. Due to the presence of the near surface groundwater table, de-watering of construction excavations will be required.
10. Footing excavations must be protected from rain, snow, and the ingress of surface water or groundwater at all times during construction

Concrete

There is a danger of sulphate attack from the native soils and groundwater on this site. It is recommended that C.S.A. Type 50, Sulphate Resistant Portland cement be used in all concrete work. The concrete should have a minimum 28 day compressive strength of 25 megapascals and have 4 to 6 percent air entrainment. Where concrete is exposed to de-icing chemicals and or frequent freeze-thaw cycles, compressive strength, water/cement ratio and air content should be in accordance with CSA A23.1-94.

Settlement

Settlements (total) for a shallow spread footing are estimated at up to 50 mm. with differential movements of up to 30 mm. expected (Cernica 1982). These movements are based on estimated footing loads (net 77 kPa) and footing size (length/width ratio = 4 and width of 2.5 meters). Given the range of movements which can be expected with variations in loading and footing size, re-evaluation of settlements following preliminary design of structures is recommended.

HOGGAN ENGINEERING & TESTING (1980) LTD.

4.2 Deep Pile Foundation

The proposed bridge may be supported by a deep pile foundation extending into the underlying granular materials at depth. However, given that such stratum may be discontinuous both in composition and thickness, the allowable load for the piers would be limited.

Analysis for pile evaluation utilized two methods, firstly, the single pile-static analysis (CFEM, 3rd Edition, 1992), and secondly, single pile-standard penetration test analysis (Meyerhof, 1976). Both methods determined the axial bearing capacity of a pile relative to its penetration and pile diameters. The results of the two analyses have been presented in graphical and tabular form in Appendix E.

The major assumptions that were made in undertaking the analysis were as follows;

The pile utilized was assumed to be a thick wall pipe pile with varying diameters.

The analysis were based on a soil stratigraphy consisting of loose to medium dense sand with an average Standard Penetration Test (SPT) N value of 33 and a toe N value of 13. This stratigraphy would be consistent with the soils encountered in T.H# 1A-98 and T.H. # 9A-98.

Static groundwater table was placed at 1.0 meter below the ground surface.

A linear increase in vertical effective stress with depth below the ground surface.

Note: For the static analysis this assumption may lead to an over estimation of axial bearing capacity with pile lengths greater than 20 pile diameters.

A factor of safety of 4 would be suitable for both analyses.

The sand stratum is laterally continuous over the length of the shaft.

HOGGAN ENGINEERING & TESTING (1980) LTD.

The calculated axial capacities of the two methodologies give varying results. Below 10 meters in depth, the static analysis gives the lower axial capacity while above 10 meters in depth the SPT analysis gives the lower capacity.

1. For the purposes of this project, it is recommended that the values obtained in the SPT analysis be utilized for design purposes and that a minimum pile length of 10 meters be driven. The minimum length of pile of 10 meters will assure a suitable depth of pile seating to compensate for disturbance of the surface soil stratigraphy. In using the axial capacities obtained by the SPT analysis, the design would be based on the conservative values.
2. Should bearing capacities greater than those outlined in the SPT analysis be required, it may be prudent to undertake an insitu pile load test.
3. The pile group capacity for driven piles in cohesionless soils may be considered to be equal to the sum of the individual pile capacities.
4. The slopes adjacent to the river should be safeguarded from erosion by placing rip-rap, filter cloth or alternate protective measures.

Pile Settlements

For load levels given in the SPT analysis the settlement of pile can be calculated using an imperial formula (Vesic, 1970, 1977).

$$S = (b/100) + (QL)/(AE) \approx 0.009 \text{ meters}$$

Where b = pile diameter	(meters)	0.9
Q = applied load	(kN)	1760
L = pile length	(meters)	20

A = pile cross-sectional area (meters ²)	0.636
E = Elastic Modulus (MPa)	200,000

The settlement estimated would be up to 15 millimeters.

Installation

Given the variable nature of the deposit encountered during the drilling program, it would be prudent to utilize a specially designed pile shoe and pile cap to protect the pile toe and head during installation.

In addition to utilizing the pile shoe to protect the pile from damage, an open pile will allow for inspection of pile integrity and straightness.

5.0 CONCLUSIONS

It appears that the study area is characteristic of an alluvial valley bottom deposit. The variable silt, sand and gravel is indicative of an active environment of deposition, possibly of glacial origin.

5.1 Spread Footing/Shallow Raft Foundation

1. A spread footing or shallow raft foundation system, placed on the sand and gravel alluvial materials may support the proposed bridge abutments. However, careful consideration should be given due to the variability of the material encountered and the close proximity of the Nordenskiold River.
2. The foundation should be placed a minimum of 1.0 meter below the bottom elevation of the Nordenskiold River with a minimum of 2.0 meters of soil cover.

HOGGAN ENGINEERING & TESTING (1980) LTD.

3. It is recommended that all excavations be inspected by a qualified geotechnical engineer prior to installation of the foundation components to ensure the suitability of the exposed material.
4. De-watering of the excavations below the near surface groundwater table will be required.
5. A filter cloth should be installed within the excavation prior to backfill operations.
6. A minimum of 0.5 meters of approved granular material should be utilized to bring the subgrade to the desired elevation. Recommended grainsize distributions for fill materials are provided in Appendix F.
7. A minimum of 100 mm. of 20 mm. crushed gravel should be utilized as a leveling coarse prior to placement of the concrete footings. Recommended grainsize distributions for the 20 mm. crushed gravel are provided in Appendix F.
8. All fill should be placed in 150 millimeter lifts (as measured after compaction) and should be compacted to an equivalent of at least 100 percent of the corresponding standard proctor density at optimum moisture content, unless otherwise specified.
9. Allowable soil bearing values should not exceed 100 kilopascals for footings placed within the underlying native materials. This figure includes the total of all live and dead loads.
10. Movements, including total settlement up to 50 mm. and differential movements of up to 30 millimetres, have been estimated.
11. If winter construction is being considered, it is critical that all fill and load bearing materials be frost free.

HOGGAN ENGINEERING & TESTING (1980) LTD.

12. Care must be taken during the installation of the foundation system to ensure that no deleterious or disturbed material remains under or within the structure.
13. It is essential that all surface drainage be directed away from the structure due to the possible frost susceptibility of any underlying fine grained materials.
14. The slopes adjacent to the river should be safeguarded from erosion by placing rip-rap, filter cloth or alternate protective measures.
15. There is a danger of sulphate attack from the native soils and groundwater on this site. It is recommended that C.S.A. Type 50, Sulphate Resistant Portland cement be used in all concrete work. The concrete should have a minimum 28 day compressive strength of 25 megapascals and have 4 to 6 percent air entrainment. Where concrete is exposed to de-icing chemicals and or frequent freeze-thaw cycles, compressive strength, water/cement ratio and air content should be in accordance with CSA A23.1-94.

5.2 Deep Pile Foundation

A range of pile axial capacities have been given which vary due to pile length and pile diameter.

For the purposes of this analysis a range of diameters and lengths have been chosen. Should the actual chosen pile size or depth not conform to the table of values given, the undersigned should be contacted for re-evaluation of the chosen pile.

Given the variable nature of the soils encountered on this site, it is recommended to closely monitor all pile installations to ensure suitable driving resistance is attained. Evaluating driving resistance may encompass utilizing driving formulae such as the Hiley or Engineering News or Modified Engineering News.

HOGGAN ENGINEERING & TESTING (1980) LTD.

1. For the purposes of this project, it is recommended that the values obtained in the SPT analysis be utilized for design purposes and that a minimum pile length of 10 meters be driven. The minimum length of pile of 10 meters will assure a suitable depth of pile seating to compensate for disturbance of the surface soil stratigraphy. In using the axial capacities obtained by the SPT analysis, the design would be based on the conservative values.
2. Should bearing capacities greater than those outlined in the SPT analysis be required, it may be prudent to undertake an insitu pile load test.
3. The pile group capacity for driven piles in cohesionless soils may be considered to be equal to the sum of the individual pile capacities.
4. The slopes adjacent to the river should be safeguarded from erosion by placing rip-rap, filter cloth or alternate protective measures.
5. The settlement estimated would be up to 15 millimeters.
6. Given the variable nature of the deposit encountered during the drilling program, it would be prudent to utilize a specially designed pile shoe and pile cap to protect the pile toe and head during installation.
7. In addition to utilizing the pile shoe to protect the pile from damage, an open pile will allow for inspection of pile integrity and straightness.

HOGGAN ENGINEERING & TESTING (1980) LTD.**6.0 CLOSURE**

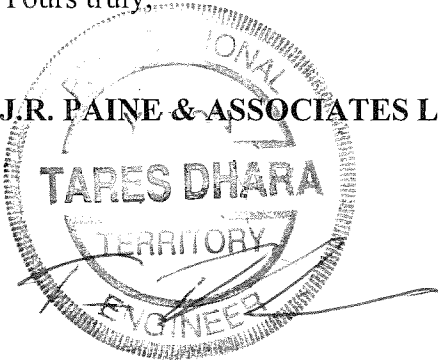
This report has been prepared for the exclusive and confidential use of the Government of Yukon and applies only to the geotechnical investigation performed at the study area described above. The recommendations provided herein are based on the information collected during the investigation, subsurface soil conditions encountered during the field work program, current investigative techniques, and generally accepted engineering practices. Due to the geological randomness of many soil formations, no interpolation of soil conditions between testholes has been made or implied. Soil conditions are known only at testhole locations. Should other soils be encountered at any time or other pertinent information become available, the recommendations may be altered or modified in writing by the undersigned.

HOGGAN ENGINEERING & TESTING (1980) LTD.

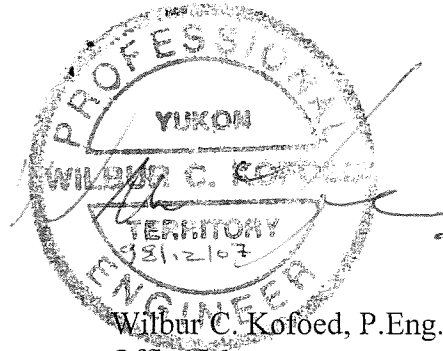
Thank you for the opportunity to provide this service to your organization. If you should have any questions or comments, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

J.R. PAINE & ASSOCIATES LTD.



Tares Dhara, P.Eng.
Project Engineer



Wilbur C. Kofoed, P.Eng.
Office Manager

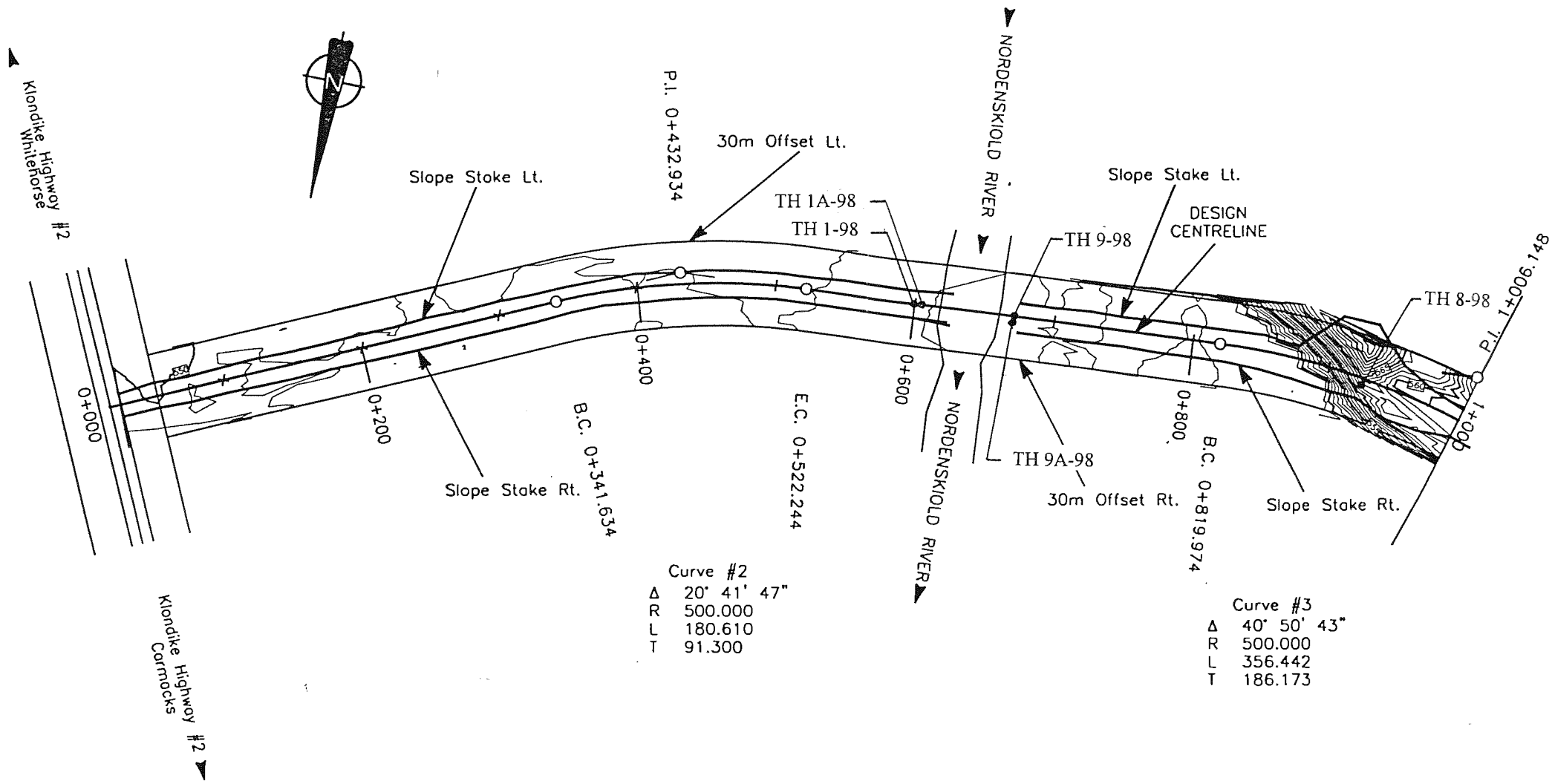
Attached: Appendices A-F

TD/td

c:\JRPAIN\GOV\8002-254\NordRiverCrossing

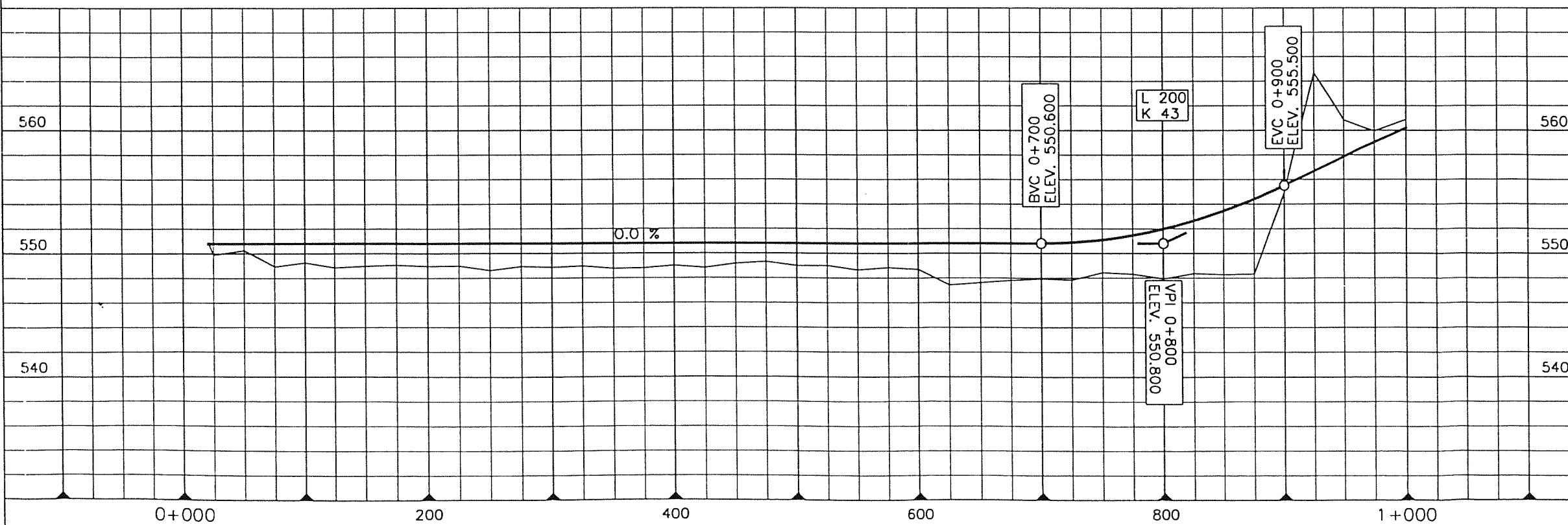
Appendix A – Testhole Locations

- NOTES:
 1. CONTOUR INTERVAL 1m
 2. DESIGN GRADELINE SHOWN IS TOP OF SUBGRADE



Curve #2
 Δ 20° 41' 47"
 R 500.000
 L 180.610
 T 91.300

Curve #3
 Δ 40° 50' 43"
 R 500.000
 L 356.442
 T 186.173



PROJECT:
 PROPOSED CARMACKS BYPASS
 km 0.0 – km 5.3

DRAWING TITLE:
 0+021 – 1+000

DATE: _____ HORIZONTAL SCALE: 1:4,000
 DRAWN: _____ VERTICAL SCALE: 1:400

DRAFT

DESIGN: _____
 CHECKED: _____
 APPROVED: _____

Appendix B – Testhole Soil Logs

Geotechnical Services		YTG, Transportation Engineering		TEST HOLE NO: 1-98								
CME75 150 mm Solid Stem Auger		Nordenskiold River Crossing		PROJECT NO: 8002-254								
FN60 Flextrak Nodwell		Sta 0 + 600 CL		ELEVATION:								
SAMPLE TYPE		<input checked="" type="checkbox"/> TUBE	<input type="checkbox"/> LOST	<input checked="" type="checkbox"/> AUGER	<input type="checkbox"/> DISTURBED	<input type="checkbox"/> SPT	<input type="checkbox"/> CORE					
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	Soil Description		LIQUID		CLAY		USC	SOIL SYMBOL	ELEVATION(m)
						20	40	60	80			
						PLASTIC		SILT				
						M.C.		SAND				
						LIQUID		GRAVEL				
						20	40	60	80			
						20	40	60	80			
						20	40	60	80			
						20	40	60	80			
0.0	X	1		SANDY SILT -dry to moist, loose, fine grained brown/black, some organics and rootlets								0.0
1.0	X	2		SILT 0.75 M -some sand -damp to moist, loose, fine grained brown/black, trace organics and rootlets						ML		-1.0
2.0	X	3		SILTY SAND 1.52 M -moist to wet, medium dense, fine grained, reddish-brown						SM		-2.0
	X	4		GROUNDWATER ENCOUNTERED 2.13 M SILTY SANDY GRAVEL -wet, loose, poorly graded, fine grained, brown, gravels to 7 cm.						GM		-3.0
4.0	X	5		-as above								-4.0
5.0	X	6		SANDY SILTY GRAVEL 4.57 M -trace to some clay -wet, firm, plastic, grey -some medium to coarse grained sand in seams						GM-GC		-5.0
7.0	X	7		-as above Plastic Limit 20.2 Liquid Limit 23.1 Plasticity Index 2.9								-7.0
8.0	X	8		SAND 7.32 M -some silt, trace gravel -wet, loose, poorly graded, grey						SP-SM		-8.0
9.0	X	9		-as above								-9.0
10.0	X											-10.0

J. R. Paine & Associates Ltd.
Whitehorse, Yukon

LOGGED BY: TD
REVIEWED BY: WCK
Fig. No:

COMPLETION DEPTH: 19.51 m
COMPLETE: 10/29/98

Geotechnical Services		YTG, Transportation Engineering		TEST HOLE NO: 1-98											
CME75 150 mm Solid Stem Auger		Nordenskiold River Crossing		PROJECT NO: 8002-254											
FN60 Flextrak Nodwell		Sta 0 + 600 CL		ELEVATION:											
SAMPLE TYPE		<input checked="" type="checkbox"/> TUBE	<input type="checkbox"/> LOST	<input checked="" type="checkbox"/> AUGER	<input type="checkbox"/> DISTURBED	<input type="checkbox"/> SPT	<input type="checkbox"/> CORE								
DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SPT (N)	Soil Description	LIQUID			CLAY			USC	SOIL SYMBOL	ELEVATION (m)		
					20	40	60	80	20	40				60	80
					PLASTIC			SILT							
					M.C.			GRAVEL							
					20	40	60	80	20	40	60	80			
10.0	X	10		SAND -trace silt, trace gravel -wet, loose, well graded, grey	●				●				SP-SM		-10.0
11.0	X	11		SAND -trace silt, some gravel -wet, loose, well graded, grey	●				▲	◆			SW-SM		-11.0
12.0	X	12		GRAVELLY SAND 11.58 M -trace silt -wet, loose, well graded, grey	●				▲	◆			GW		-12.0
13.0	X	13		SANDY GRAVEL 12.50 M -wet, loose, well graded, grey	●				▲	◆			GW		-13.0
14.0	X	14		SAND 13.00 M -trace silt, some gravel -wet, loose, well graded, grey	●				▲	◆			SW-SM		-14.0
15.0	X	15		GRAVELLY SAND 14.00 M -wet, loose, well graded, grey	●				▲	◆			SW		-15.0
16.0	X	16		GRAVELLY SAND -trace silt -wet, loose, well graded, grey	●				▲	◆			SW-SM		-16.0
17.0	X	17		-as above	●				▲	◆			SW-SM		-17.0
18.0	X	18		SANDY GRAVEL to GRAVELLY SAND 17.37 M -trace silt -wet, loose, well graded, grey -grindy drilling, possible cobbles -Note: Sample # 18 & 19 based on auger action due to poor sample recovery	●				▲	◆			GW-GM		-18.0
19.0	X	19			●										-19.0
20.0				End of Hole @ 19.51 meters -Standpipe Installed											-20.0

J. R. Paine & Associates Ltd.
Whitehorse, Yukon

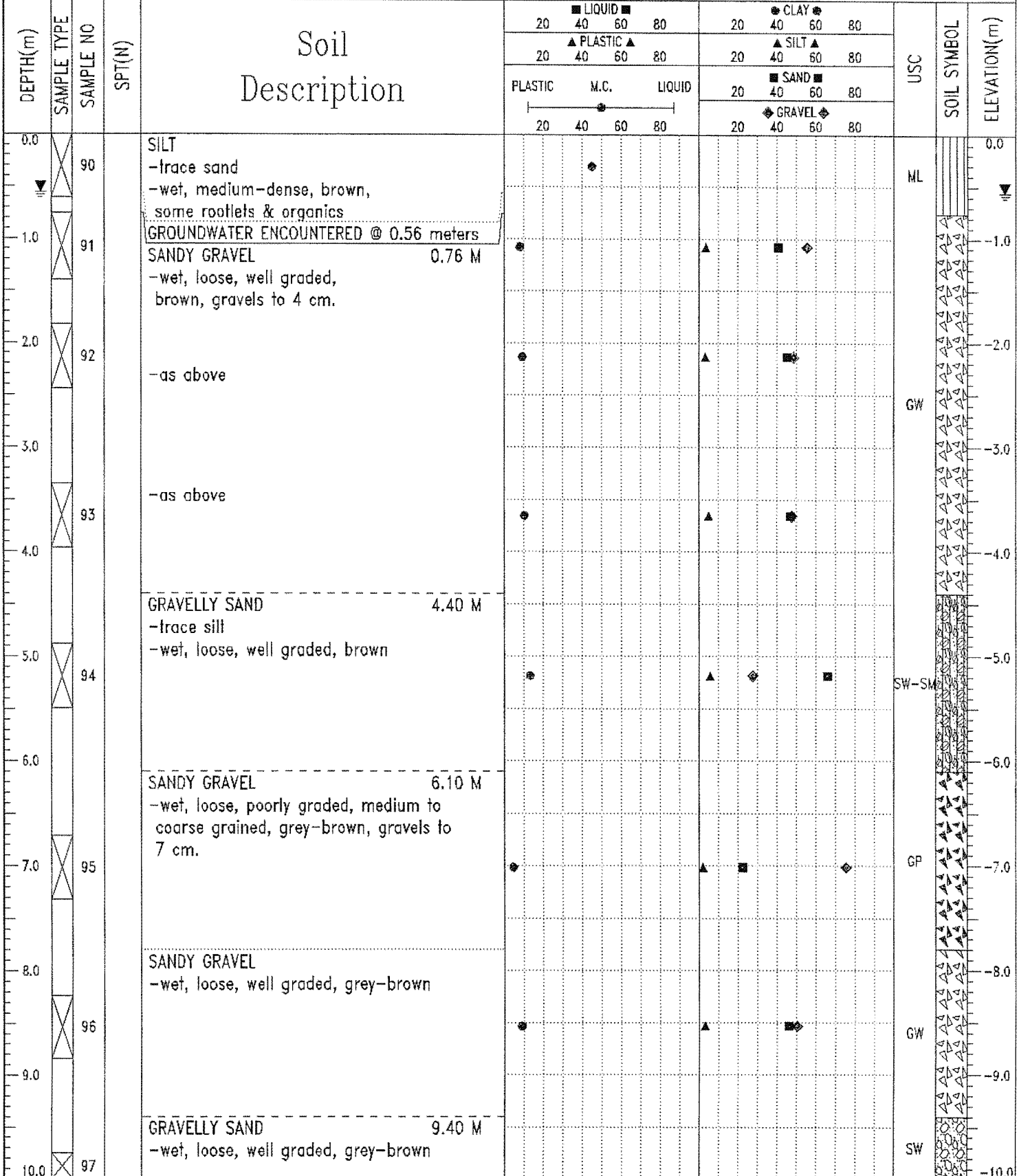
LOGGED BY: TD
REVIEWED BY: WCK
Fig. No:

COMPLETION DEPTH: 19.51 m
COMPLETE: 10/29/98

Geotechnical Services		YTG, Transportation Engineering		TEST HOLE NO: 1A-98								
CME75 200 mm Hollow Stem Auger		Nordenskiold River Crossing		PROJECT NO: 8002-254								
FN60 Flextrak Nodwell		Sta 0 + 599 CL		ELEVATION:								
SAMPLE TYPE		<input checked="" type="checkbox"/> TUBE	<input type="checkbox"/> LOST	<input checked="" type="checkbox"/> AUGER	<input type="checkbox"/> DISTURBED	<input type="checkbox"/> SPT	<input type="checkbox"/> CORE					
DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SPT (N)	Soil Description	LIQUID		CLAY		USC	SOIL SYMBOL	ELEVATION (m)	
					20	40	60	80				20
					PLASTIC		SILT					
					M.C.		GRAVEL					
					20	40	60	80	20	40	60	80
0.0				-No sample obtained due to drilling operations/methodology, however, auger action indicated material granular in nature.								0.0
3.0	II	20		SAND 2.20 M -trace silt, trace gravel -wet, medium-dense, well graded, brown 7 cm. in 50 blows - Refusal SPT blows/6 inches (12, 50 blows-3 inches) refusal due to possible cobble	●				■			-3.0
4.0	III	21	63	GRAVELLY SAND -trace silt -wet, medium-dense, well graded, brown SPT blows/6 inches (3, 26, 37)	●		▲	◆	■			-4.0
5.0	III	22	28	SAND -trace gravel, trace silt -wet, medium-dense, well graded, brown SPT blows/6 inches (5, 13, 15)	●		▲		■			-5.0
6.0	III	23	33	GRAVELLY SAND -trace silt -wet, medium-dense, well graded, brown-grey SPT blows/6 inches (9, 13, 20)	●		▲	◆	■			-6.0
8.0	III	24	21	SAND -some silt -wet, medium-dense, well graded, brown SPT blows/6 inches (10, 10, 11)	●		▲	◆	■			-8.0
9.0	III	25	21	SAND -trace silt -wet, medium-dense, well graded, brown-grey SPT blows/6 inches (9, 11, 10)	●		▲	◆	■			-9.0
10.0				END OF HOLE @ 9.57 meters -Testhole terminated due to excessive								-10.0
J. R. Paine & Associates Ltd. Whitehorse, Yukon					LOGGED BY: TD		COMPLETION DEPTH: 9.57 m					
					REVIEWED BY: WCK		COMPLETE: 10/31/98					
					Fig. No:		Page 1 of 1					

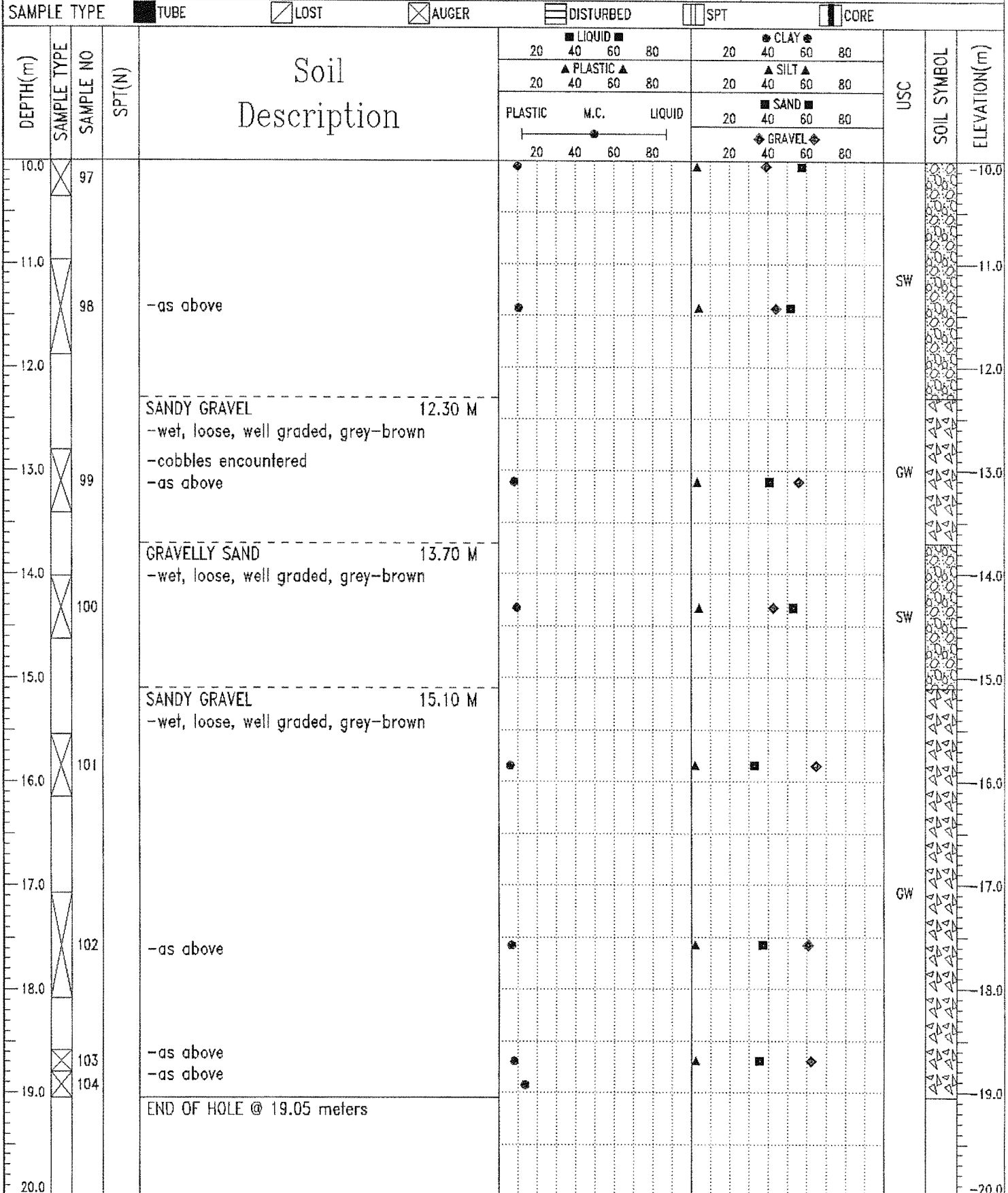
Geotechnical Services	YTG, Transportation Engineering	TEST HOLE NO: 9-98
CME75 150 mm Solid Stem Auger	Nordenskiold River Crossing	PROJECT NO: 8002-254
FN60 Flextrak Nodwell	Sta 0 + 670 CL	ELEVATION:

SAMPLE TYPE TUBE LOST AUGER DISTURBED SPT CORE



J. R. Paine & Associates Ltd. Whitehorse, Yukon	LOGGED BY: TD	COMPLETION DEPTH: 19.05 m
	REVIEWED BY: WCK	COMPLETE: 11/01/98
	Fig. No:	Page 1 of 2

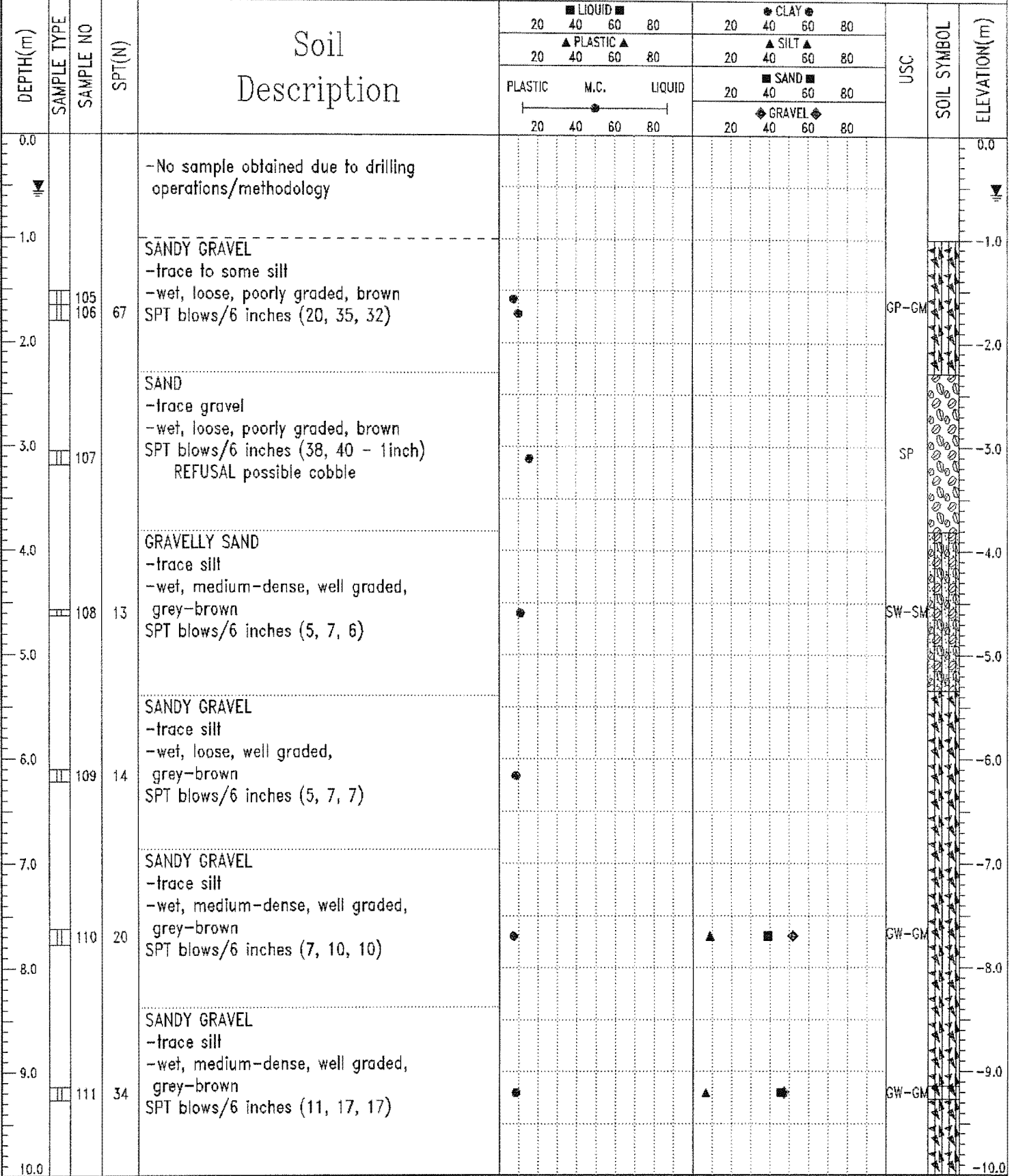
Geotechnical Services	YTG, Transportation Engineering	TEST HOLE NO: 9-98
CME75 150 mm Solid Stem Auger	Nordenskiold River Crossing	PROJECT NO: 8002-254
FN60 Flextrak Nodwell	Sta 0 + 670 CL	ELEVATION:



J. R. Paine & Associates Ltd. Whitehorse, Yukon	LOGGED BY: TD	COMPLETION DEPTH: 19.05 m
	REVIEWED BY: WCK	COMPLETE: 11/01/98
	Fig. No:	Page 2 of 2

Geotechnical Services	YTG, Transportation Engineering	TEST HOLE NO: 9A-98
CME75 200 mm Hollow Stem Auger	Nordenskiold River Crossing	PROJECT NO: 8002-254
FN60 Flextrak Nodwell	Sta 0 + 670 1 M Rt. CL	ELEVATION:

SAMPLE TYPE TUBE LOST AUGER DISTURBED SPT CORE



J. R. Paine & Associates Ltd.
Whitehorse, Yukon

LOGGED BY: TD

REVIEWED BY: WCK

Fig. No:

COMPLETION DEPTH: 15.69 m

COMPLETE: 11/03/98

Page 1 of 2

Geotechnical Services		YTG, Transportation Engineering		TEST HOLE NO: 9A-98											
CME75 200 mm Hollow Stem Auger		Nardenskiold River Crossing		PROJECT NO: 8002-254											
FN60 Flextrak Nodwell		Sta 0 + 670 1 M Rt. CL		ELEVATION:											
SAMPLE TYPE		<input type="checkbox"/> TUBE	<input type="checkbox"/> LOST	<input checked="" type="checkbox"/> AUGER	<input type="checkbox"/> DISTURBED	<input type="checkbox"/> SPT	<input type="checkbox"/> CORE								
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	Soil Description		LIQUID			CLAY			USC	SOIL SYMBOL	ELEVATION(m)	
						20	40	60	80	20	40				60
						PLASTIC			SILT						
						20	40	60	80	20	40	60	80		
						M.C.			SAND						
						20	40	60	80	20	40	60	80		
						GRAVEL			GRAVEL						
						20	40	60	80	20	40	60	80		
10.0															-10.0
11.0				GRAVELLY SAND -some silt -wet, medium-dense, well graded, grey-brown SPT blows/6 inches (11, 20, 22)											-11.0
12.0		112	42												-12.0
13.0															-13.0
14.0				GRAVELLY SAND - 0 cm. -trace silt -wet, medium-dense, well graded, grey-brown SPT blows/6 inches (6, 7, 5, 11, 21) Note that due to the influx of medium to coarse grained sands into the drill stem, seating of the SPT sampler was approximately 2 feet. SPT 'N' number was extrapolated using the blows required for the final 6 inches											-14.0
15.0		113	42												-15.0
16.0															-16.0
17.0				END OF HOLE @ 15.36 meters -Testhole terminated due to excessive wash-in of sands into plug -Standpipe Installed											-17.0
18.0															-18.0
19.0															-19.0
20.0															-20.0
J. R. Paine & Associates Ltd. Whitehorse, Yukon						LOGGED BY: TD REVIEWED BY: WCK Fig. No:			COMPLETION DEPTH: 15.69 m COMPLETE: 11/03/98			Page 2 of 2			

**Appendix C – Individual Test
Summary Sheets**



J. R. Paine & Associates Ltd.

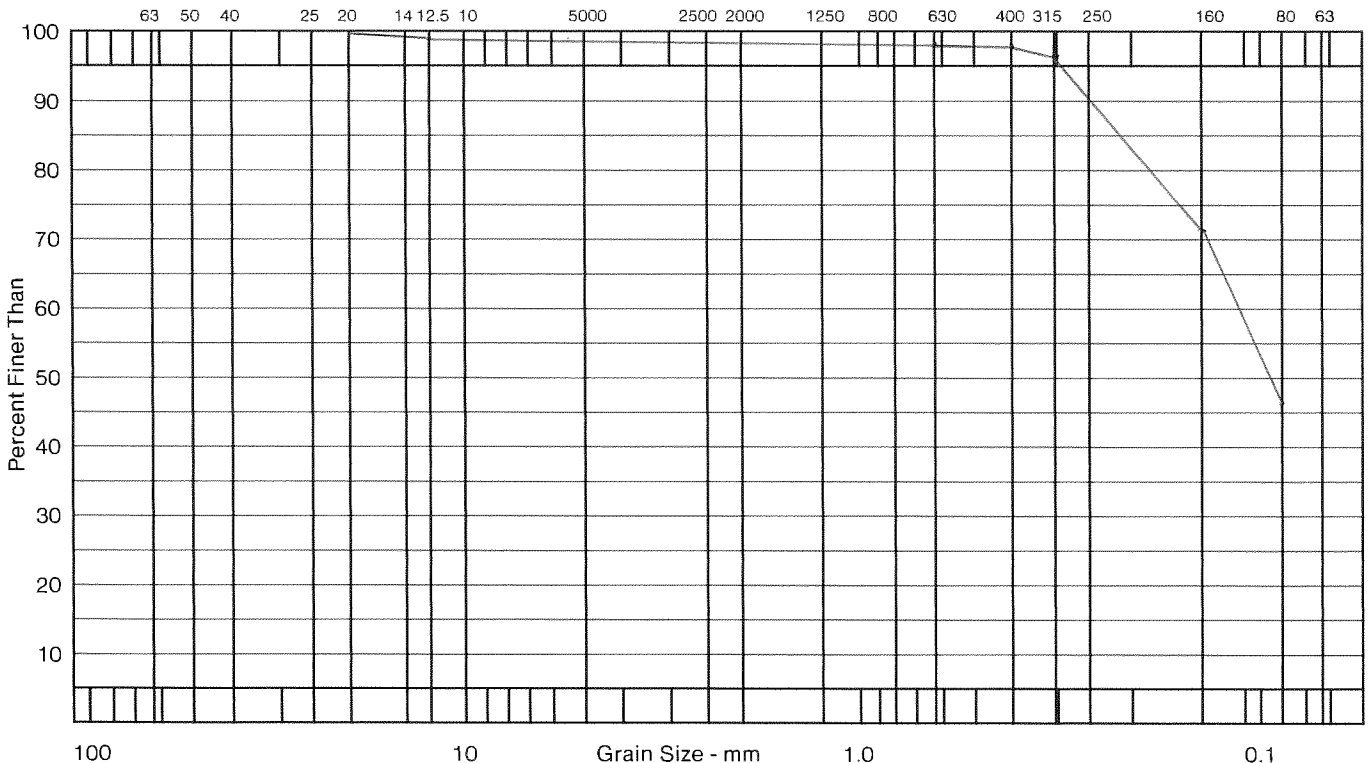
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 3 Depth: 1.83 - 2.13 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 CK'd by: WUC Date: 1998/11/09

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				99.5
10,000	10.0				
5,000	5.0				99.2
2,500	2.5				99.1
2,000	2.0				99.0
1,250	1.25				98.9
800	0.800				98.8
630	0.630				98.7
400	0.400				98.0
315	0.315				96.4
160	0.160				71.0
80	0.080				46.1

Description of Sample _____ Method of Preparation _____ Dry _____ Washed _____
Brown silty sand Remarks _____
USC - SM _____ **Fines: 46.1%** _____
 Time of Sieving _____ Min. 15 _____ **Sand: 53.1%** _____
 _____ **Gravel: 0.8%** _____
 _____ **Moisture: 29.0%** _____





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

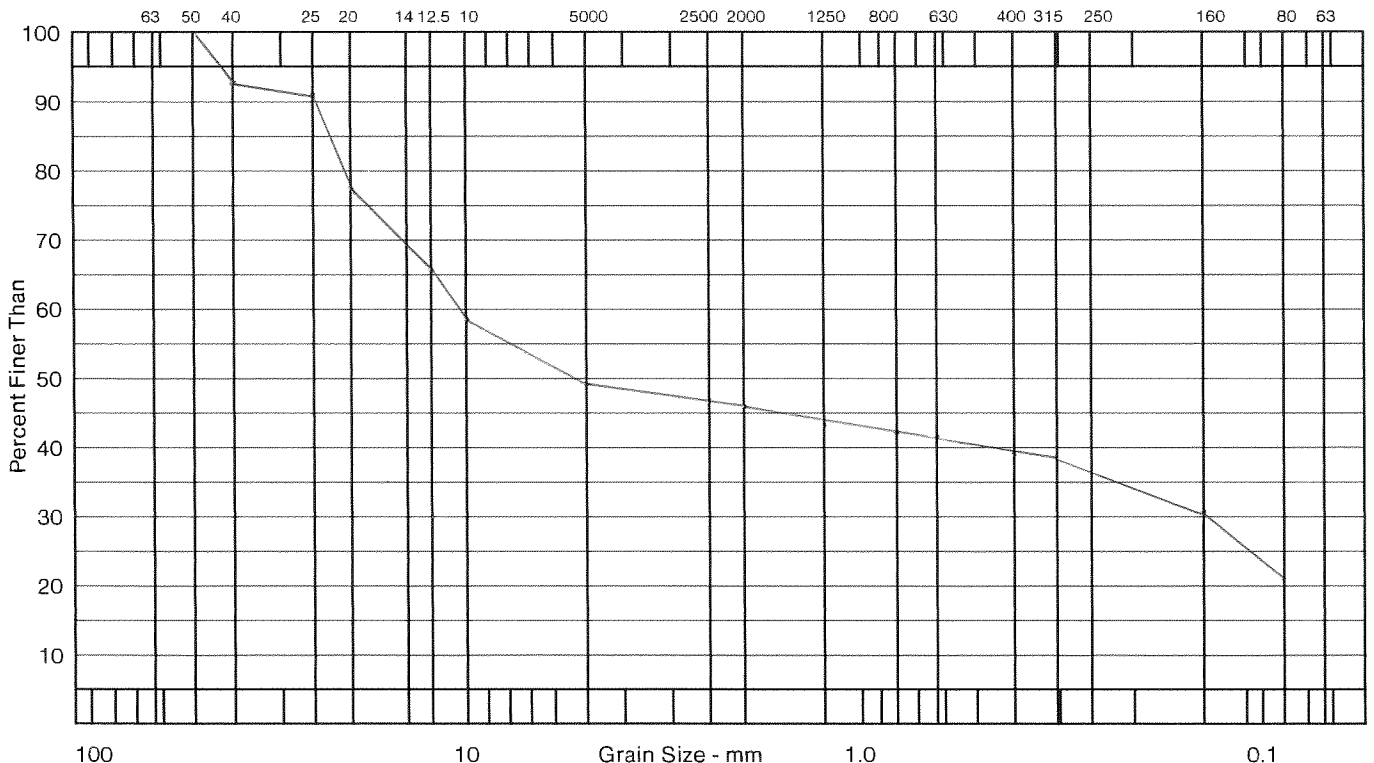
Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 4 Depth: 2.44 - 2.74 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCC Date: 1998/11/09

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				100.0
40,000	40.0				93.4
25,000	25.0				90.7
20,000	20.0				77.2
12,500	12.5				65.2
10,000	10.0				58.4
5,000	5.0				49.7
2,500	2.5				46.5
2,000	2.0				45.6
1,250	1.25				43.8
800	0.800				42.0
630	0.630				41.2
400	0.400				39.6
315	0.315				38.6
160	0.160				30.1
80	0.080				20.6

Description of Sample _____
Brown silty sandy gravel

USC - GM
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 20.6%
Sand: 29.1%
Gravel: 50.3%
Moisture: 15.9%





J. R. Paine & Associates Ltd.

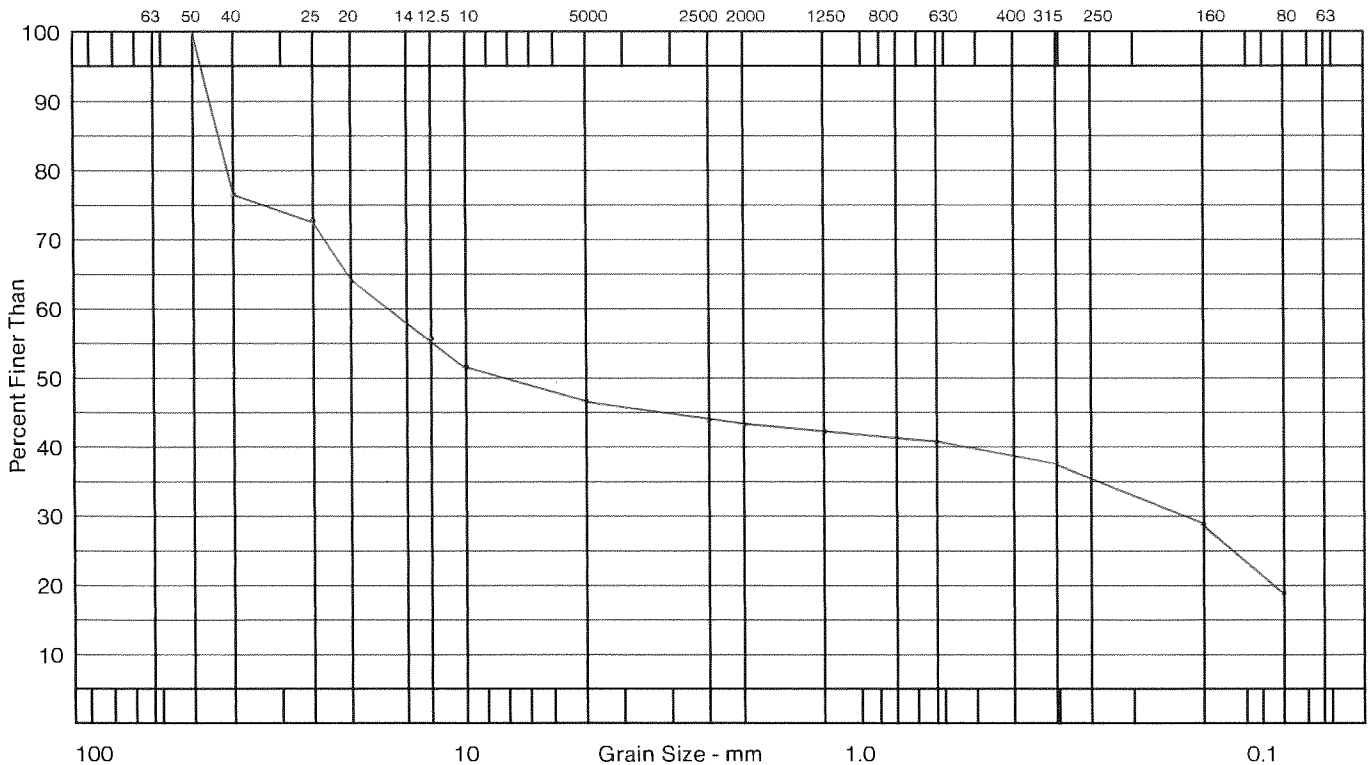
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 5 Depth: 3.66 - 3.96 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 CK'd by: W.C.K. Date: 1998/11/09

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				100.0
40,000	40.0				76.3
25,000	25.0				73.2
20,000	20.0				64.4
12,500	12.5				55.2
10,000	10.0				51.4
5,000	5.0				46.6
2,500	2.5				44.4
2,000	2.0				43.7
1,250	1.25				42.3
800	0.800				41.0
630	0.630				40.3
400	0.400				38.9
315	0.315				37.7
160	0.160				29.4
80	0.080				19.2

Description of Sample _____ Method of Preparation _____ Dry _____ Washed **X**
Brown silty sandy gravel Remarks _____
Usc - GM _____ **Fines: 19.2%**
 Time of Sieving _____ Min. 15 _____ **Sand: 27.4%**
 _____ **Gravel: 53.4%**
 _____ **Moisture: 17.2%**





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

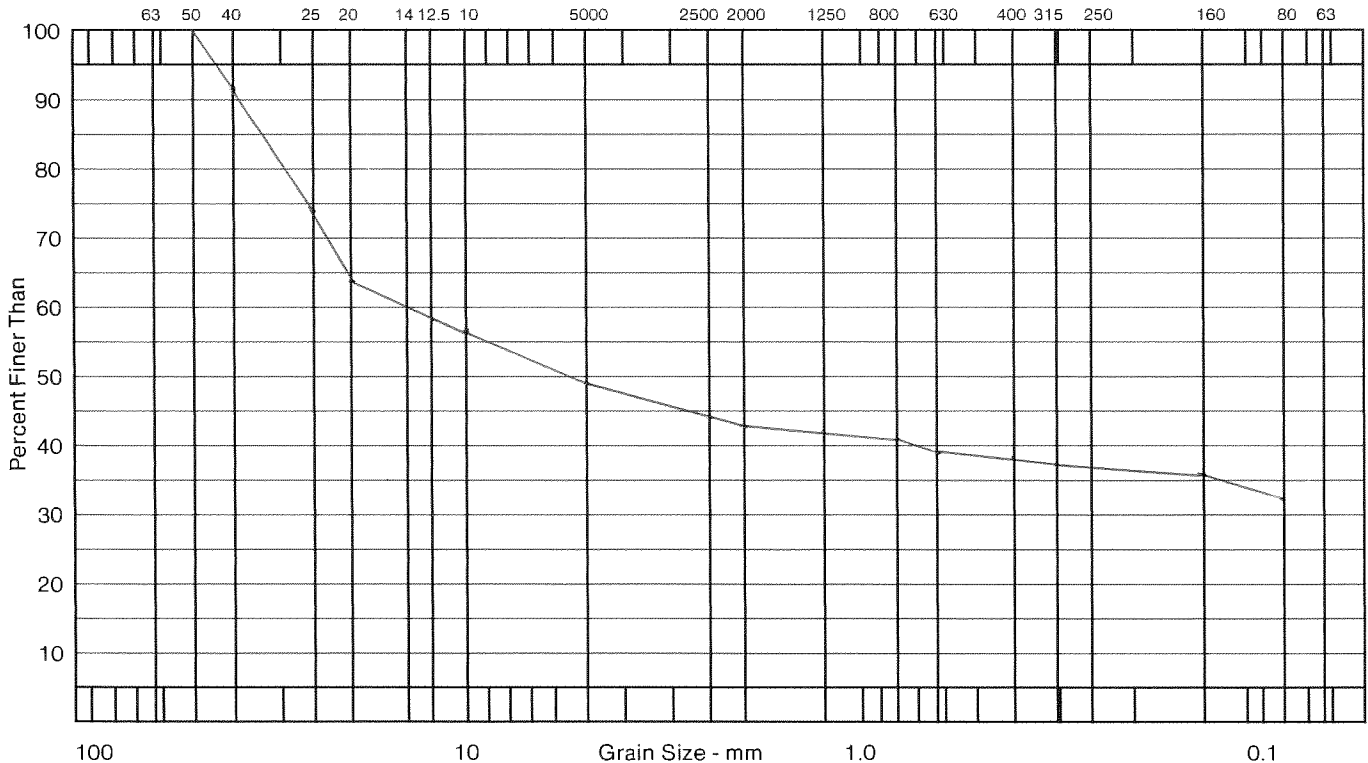
Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 6 Depth: 4.88 - 5.49 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCK Date: 1998/11/09

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				100.0
40,000	40.0				91.9
25,000	25.0				74.2
20,000	20.0				64.0
12,500	12.5				58.5
10,000	10.0				56.5
5,000	5.0				49.2
2,500	2.5				44.7
2,000	2.0				43.6
1,250	1.25				41.9
800	0.800				40.4
630	0.630				39.6
400	0.400				38.2
315	0.315				37.4
160	0.160				35.4
80	0.080				32.6

Description of Sample _____

Trace of some clay
Sandy silty gravel
USC - GM GC
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 32.6%
Sand: 16.6%
Gravel: 50.8%
Moisture: 14.3%





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

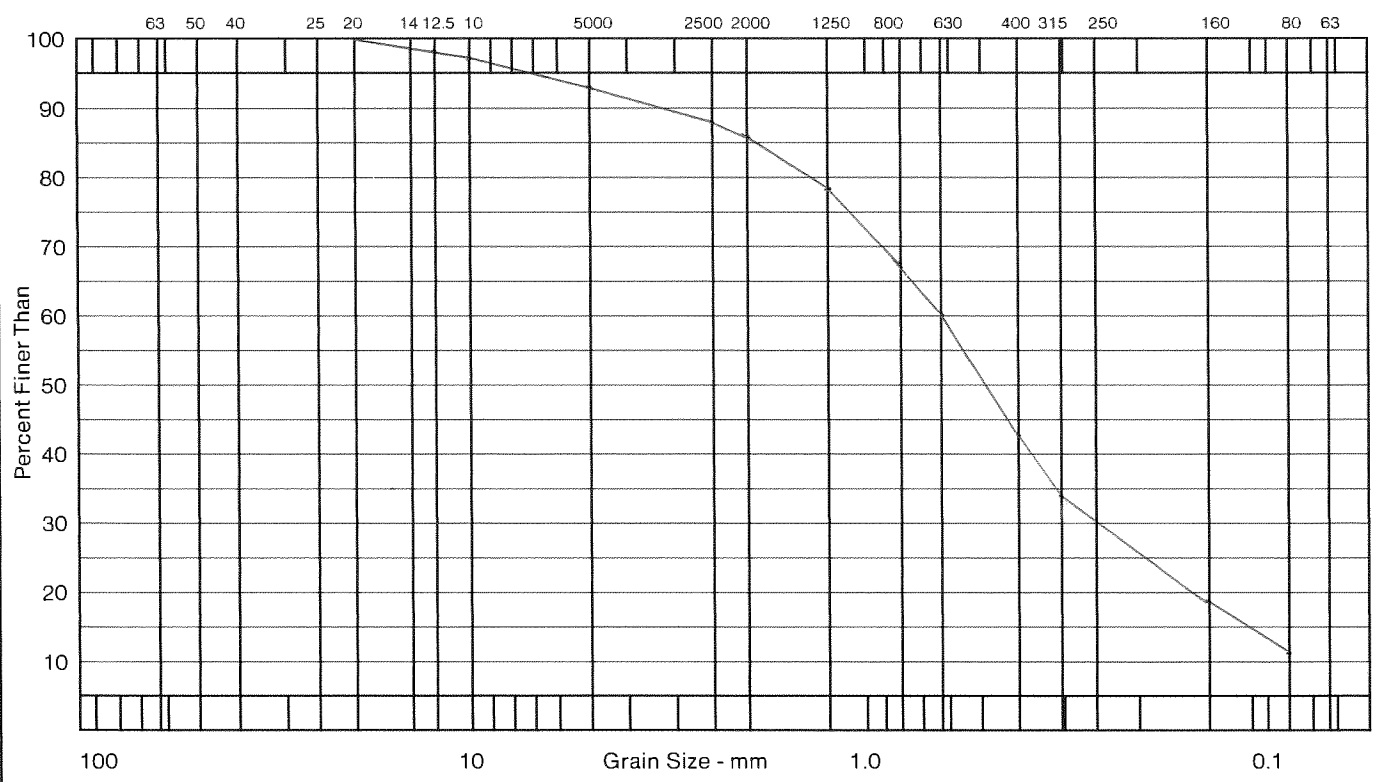
SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 8 Depth: 7.92 - 8.84 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCK Date: 1998/11/10

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				98.6
10,000	10.0				97.3
5,000	5.0				93.8
2,500	2.5				88.2
2,000	2.0				85.5
1,250	1.25				78.1
800	0.800				67.7
630	0.630				60.0
400	0.400				43.0
315	0.315				34.6
160	0.160				18.2
80	0.080				11.3

Description of Sample _____
Trace of gravel
Some silt, sand
USC - SP SM
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 11.3%
Sand: 82.5%
Gravel: 6.2%
Moisture: 17.8%





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

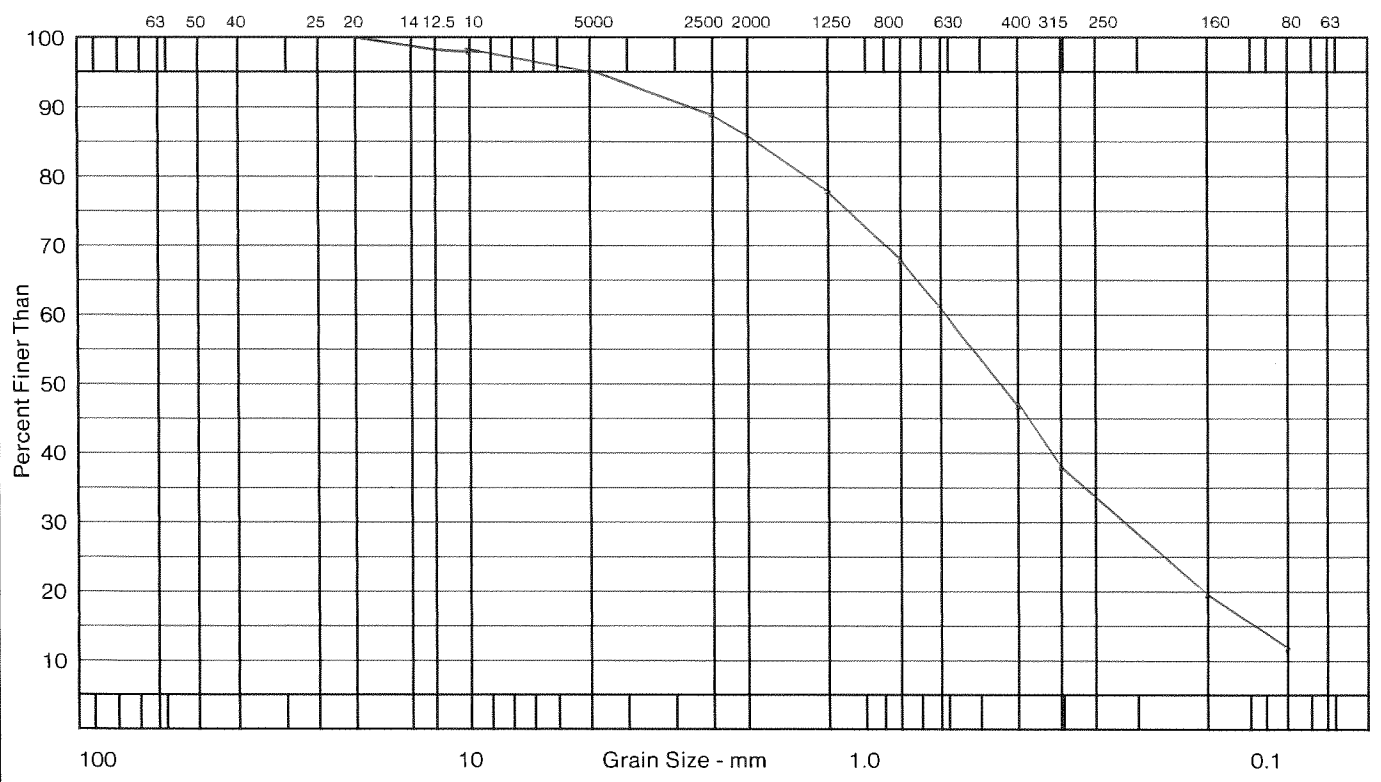
Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 9 Depth: 9.14 - 9.75 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCK Date: 1998/11/10

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				98.7
10,000	10.0				98.0
5,000	5.0				95.0
2,500	2.5				89.0
2,000	2.0				85.6
1,250	1.25				77.6
800	0.800				67.9
630	0.630				61.2
400	0.400				46.5
315	0.315				37.8
160	0.160				19.9
80	0.080				11.5

Description of Sample _____

Trace of gravel
Some silt, sand
USC - SP SM
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 11.5%
Sand: 83.5%
Gravel: 5.0%
Moisture: 18.0%





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

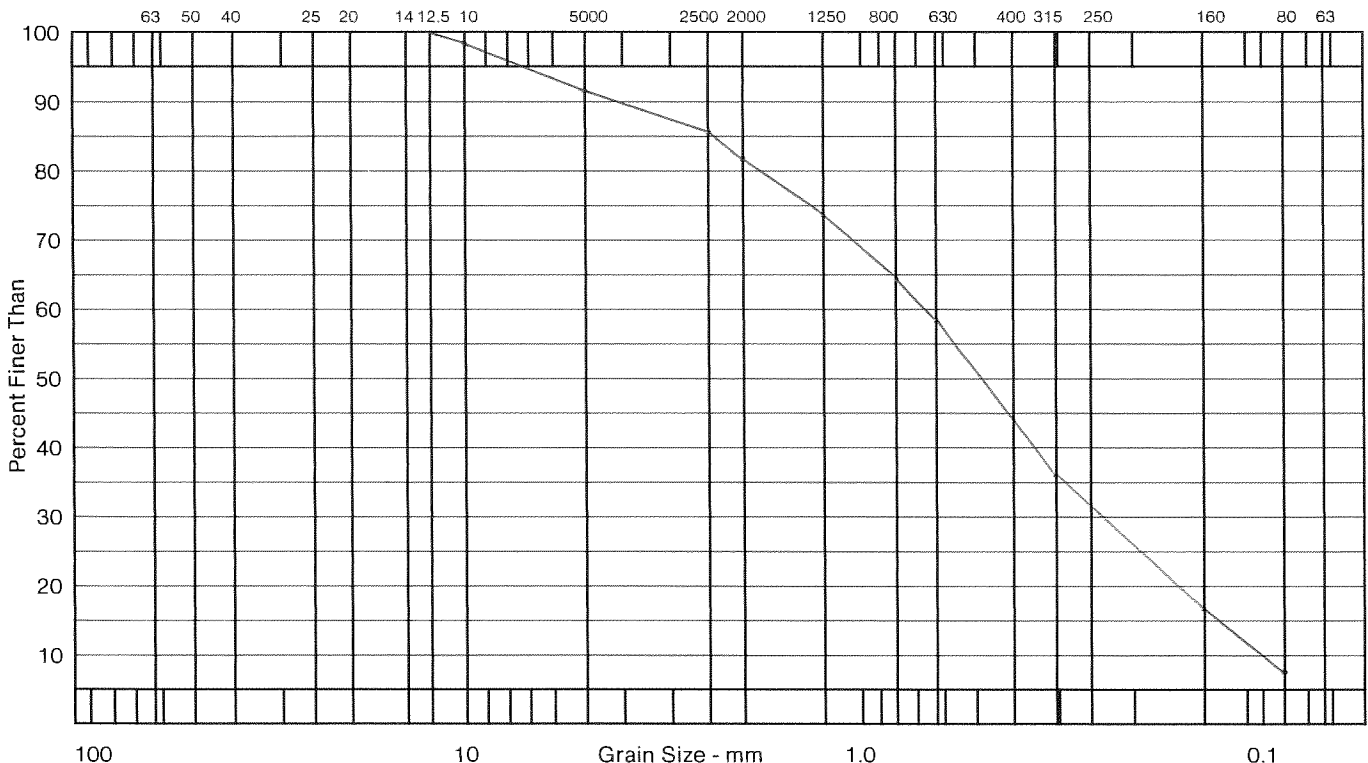
Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 10 Depth: 10.06 - 10.36 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCL Date: 1998/11/10

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				
12,500	12.5				100.0
10,000	10.0				98.6
5,000	5.0				91.9
2,500	2.5				85.1
2,000	2.0				81.8
1,250	1.25				74.0
800	0.800				64.9
630	0.630				58.8
400	0.400				44.6
315	0.315				35.7
160	0.160				16.6
80	0.080				7.7

Description of Sample _____
Trace silt and gravel, sand

USC - SW SM
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 7.7%
Sand: 84.2%
Gravel: 8.1%
Moisture: 17.0%





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

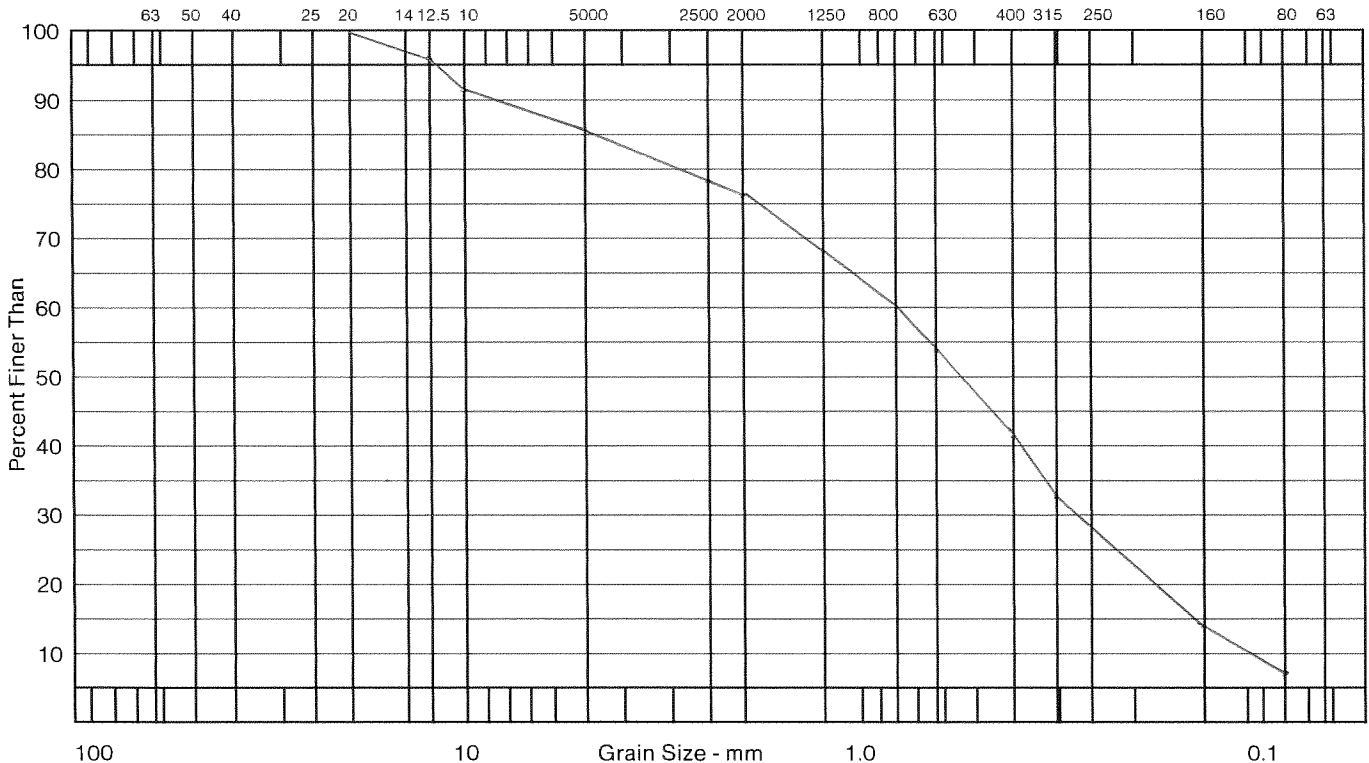
Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 11 Depth: 10.97 - 11.43 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: [Signature] Date: 1998/11/10

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				95.4
10,000	10.0				91.7
5,000	5.0				85.5
2,500	2.5				78.8
2,000	2.0				75.7
1,250	1.25				68.4
800	0.800				60.0
630	0.630				54.3
400	0.400				40.9
315	0.315				32.7
160	0.160				14.4
80	0.080				6.5

Description of Sample _____
Trace silt, some gravel, sand

USC - SW SM
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 6.5%
Sand: 79.0%
Gravel: 14.5%
Moisture: 16.4%





J. R. Paine & Associates Ltd.

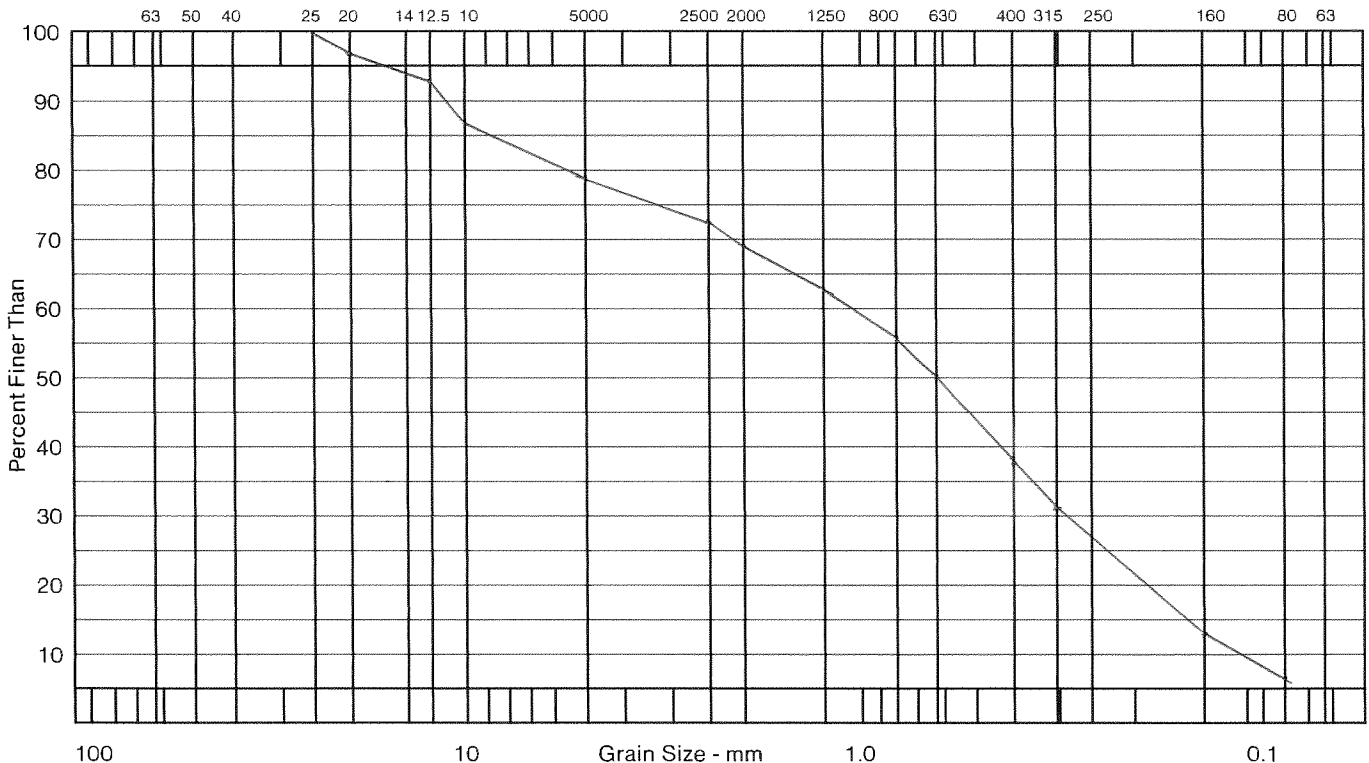
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 12 Depth: 11.58 - 12.04 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WC Date: 1998/11/10

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				100.0
20,000	20.0				96.6
12,500	12.5				93.0
10,000	10.0				86.8
5,000	5.0				79.2
2,500	2.5				72.8
2,000	2.0				69.7
1,250	1.25				62.9
800	0.800				55.1
630	0.630				50.0
400	0.400				38.1
315	0.315				30.7
160	0.160				13.5
80	0.080				6.1

Description of Sample _____ Method of Preparation _____ Dry _____ Washed _____
 Remarks _____
Trace silt gravelly sand **Fines: 6.1%**
Sand: 73.1%
USC - SW SM **Gravel: 20.8%**
 Time of Sieving _____ Min. 15 **Moisture: 15.5%**





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

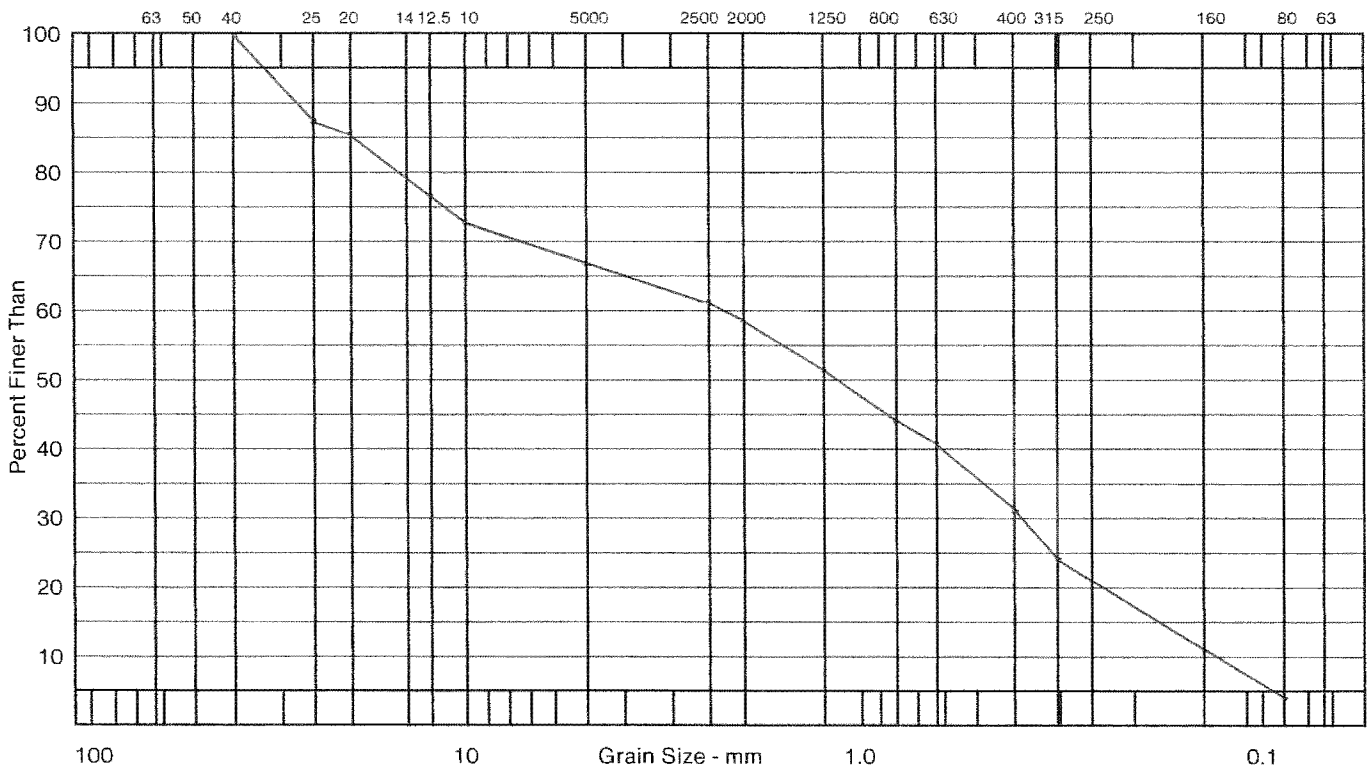
Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 13 Depth: 12.50 - 12.80 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 CK'd by: [Signature] Date: 1998/11/10

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				87.6
20,000	20.0				85.1
12,500	12.5				76.4
10,000	10.0				73.0
5,000	5.0				66.7
2,500	2.5				60.7
2,000	2.0				58.2
1,250	1.25				51.9
800	0.800				44.8
630	0.630				40.5
400	0.400				30.7
315	0.315				24.6
160	0.160				10.5
80	0.080				4.7

Description of Sample _____
Sandy gravel

USC - GW
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Fines: 4.7%
Sand: 62.0%
Gravel: 33.3%
Moisture: 12.6%





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 14 Depth: 13.11 - 13.56 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCL Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				98.8
10,000	10.0				95.1
5,000	5.0				87.0
2,500	2.5				78.7
2,000	2.0				75.0
1,250	1.25				66.3
800	0.800				57.0
630	0.630				51.3
400	0.400				38.6
315	0.315				31.2
160	0.160				12.9
80	0.080				5.7

Description of Sample _____
Trace silt, some gravel, sand
USC - SW SM

Method of Preparation _____ Dry _____ Washed X

Remarks _____

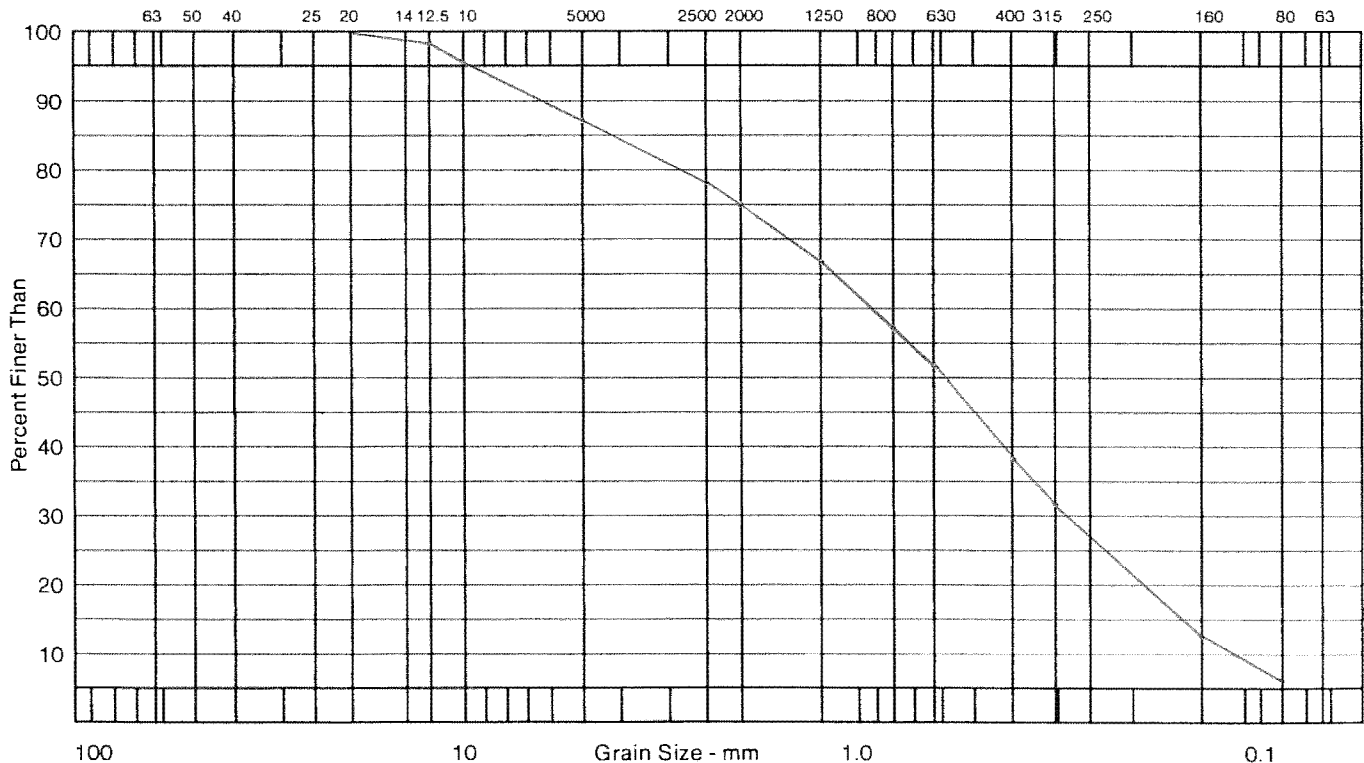
%Fines: 5.7

%Sand: 81.3

%Gravel: 13.0

%Moisture: 15.6

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 15 Depth: 14.02 - 14.33 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1-98 Ck'd by: WCR Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				93.1
20,000	20.0				
12,500	12.5				85.1
10,000	10.0				82.8
5,000	5.0				73.7
2,500	2.5				64.6
2,000	2.0				61.1
1,250	1.25				52.6
800	0.800				44.2
630	0.630				39.4
400	0.400				29.2
315	0.315				23.2
160	0.160				9.4
80	0.080				4.6

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X

Gravelly sand
USC - SW

Remarks _____

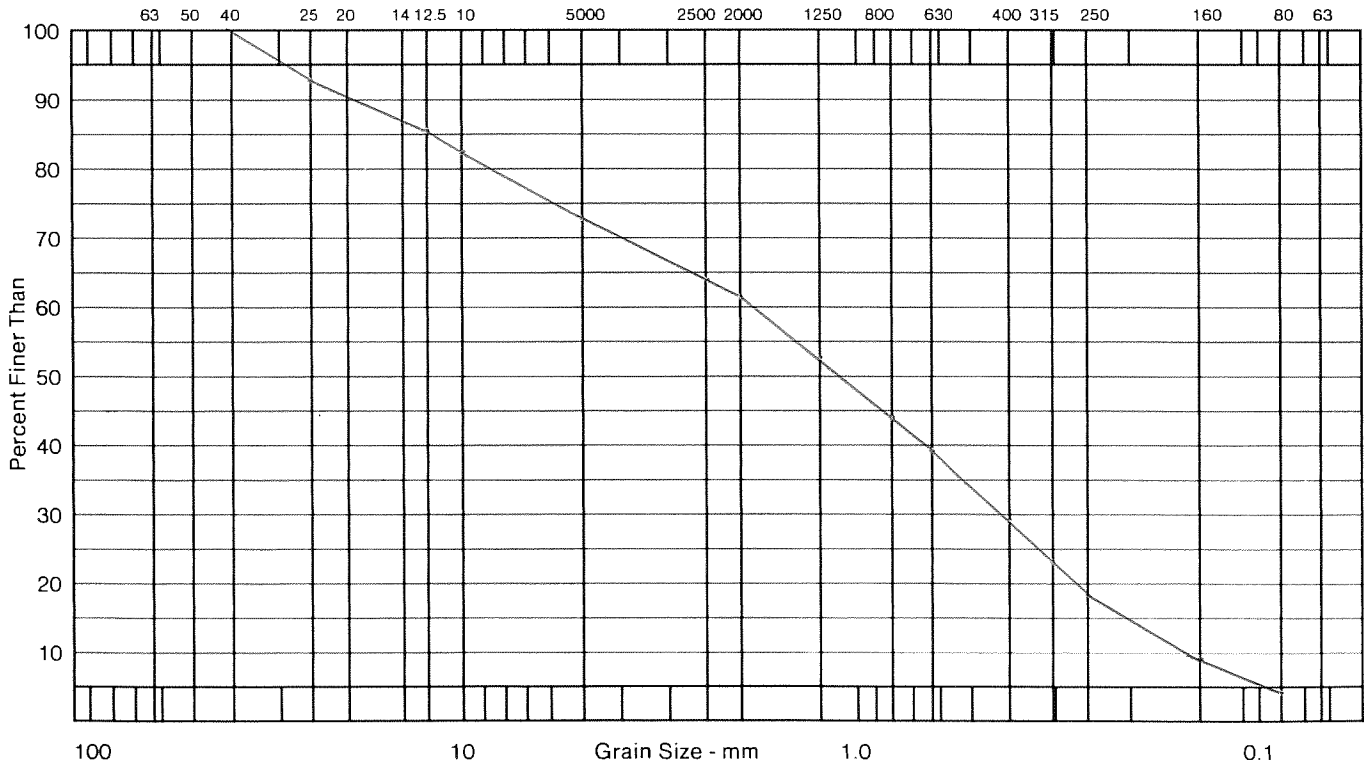
%Fines: 4.6

%Sand: 69.1

%Gravel: 26.3

%Moisture: 11.9

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

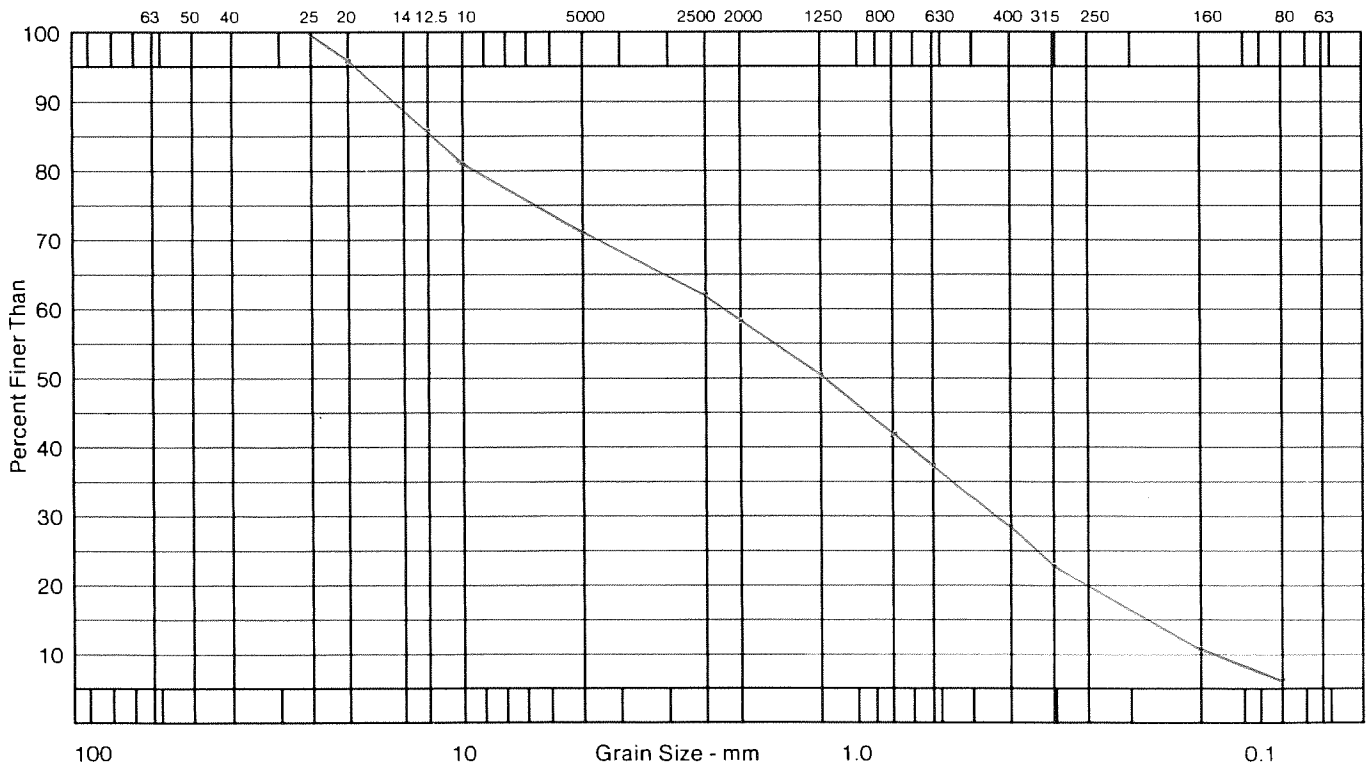
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 16 Depth: 14.45 - 14.94 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH# 1-98 Ck'd by: WCL Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				100.0
20,000	20.0				95.3
12,500	12.5				85.7
10,000	10.0				80.8
5,000	5.0				70.8
2,500	2.5				62.0
2,000	2.0				58.2
1,250	1.25				50.1
800	0.800				41.8
630	0.630				37.4
400	0.400				28.5
315	0.315				23.3
160	0.160				10.5
80	0.080				5.9

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Trace silt, gravelly sand
USC - SW SM
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 5.9
%Sand: 64.9
%Gravel: 29.2
%Moisture: 9.7





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

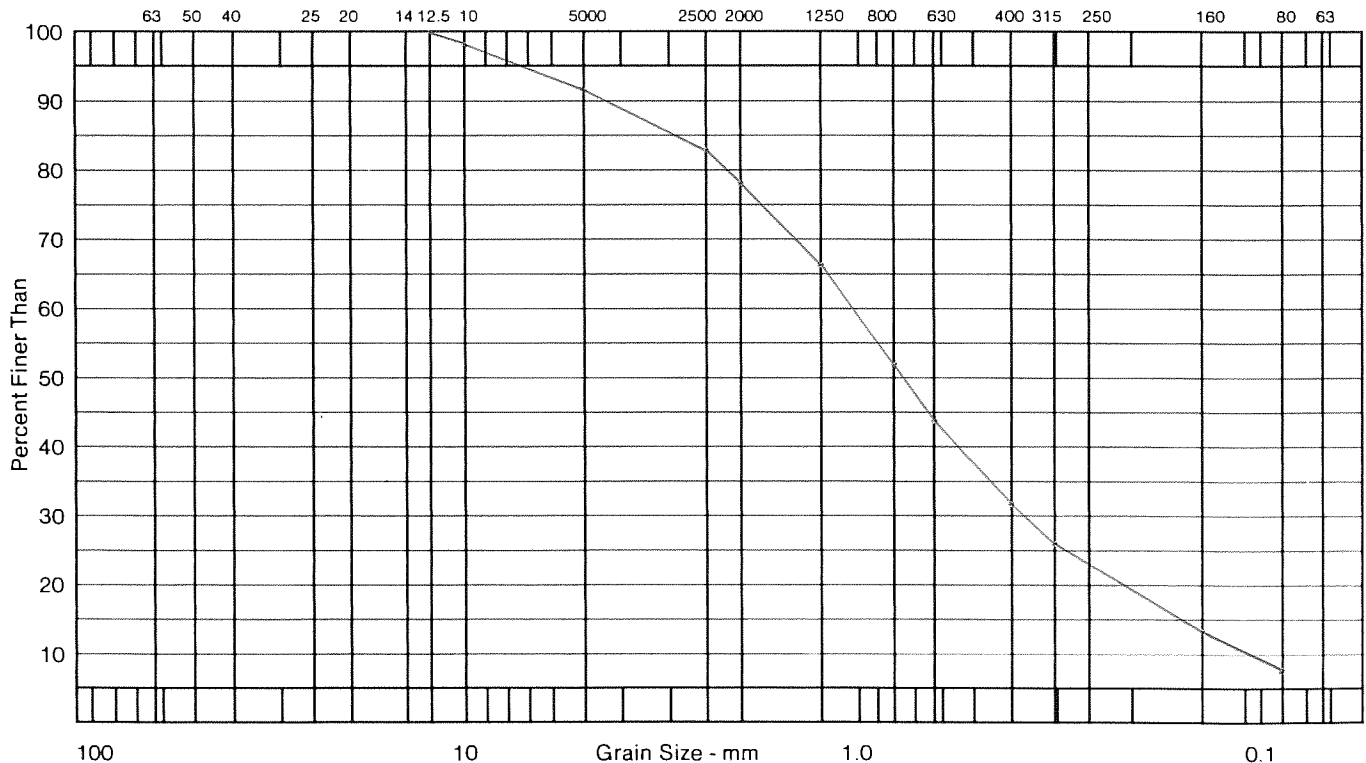
SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 20 Depth: 2.90 - 2.98 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1A-98 Ck'd by: _____ Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				
12,500	12.5				100.0
10,000	10.0				98.0
5,000	5.0				91.8
2,500	2.5				83.0
2,000	2.0				78.2
1,250	1.25				66.0
800	0.800				51.8
630	0.630				44.4
400	0.400				31.3
315	0.315				25.5
160	0.160				13.8
80	0.080				7.5

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X

 Remarks _____
Trace silt and gravel, sand %Fines: 7.5
USC - SW SM %Sand: 84.3
 _____ %Gravel: 8.2
 _____ %Moisture: 12.9
 Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

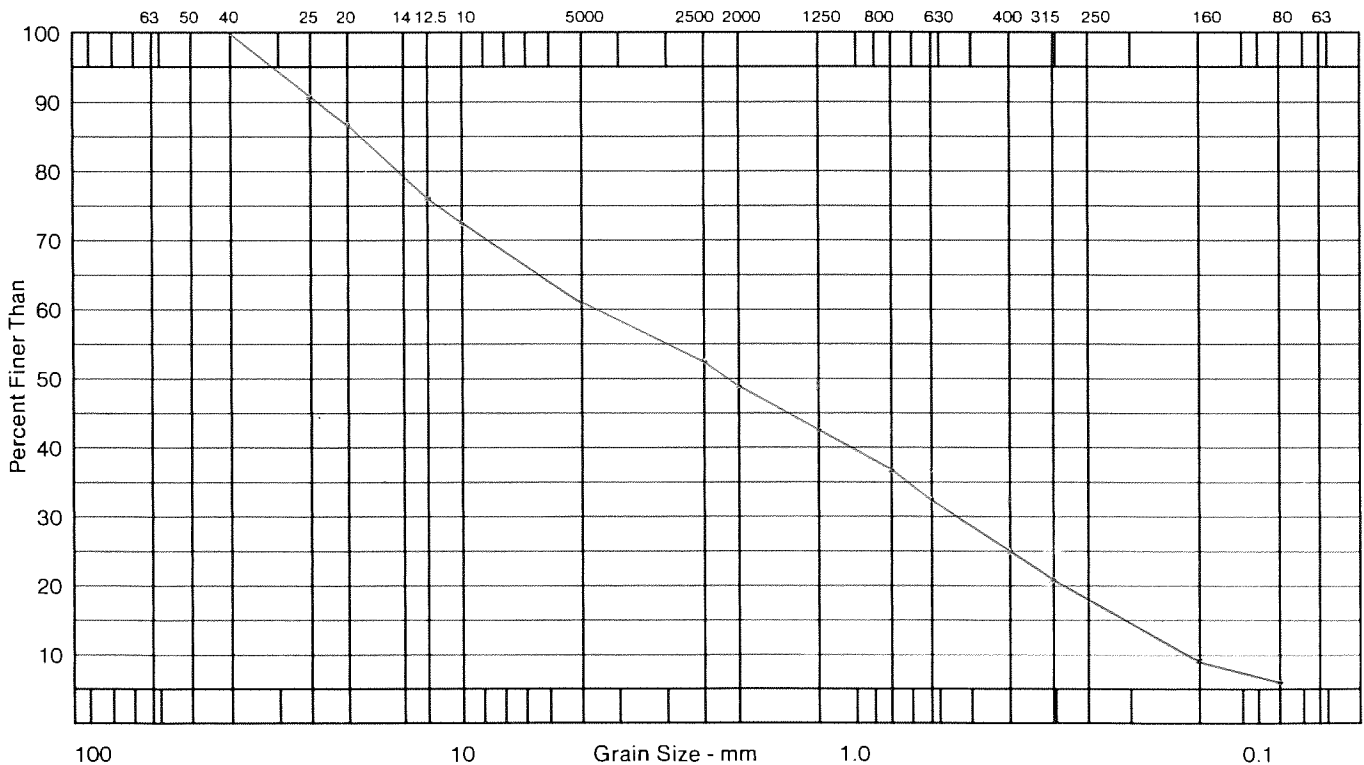
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 21 Depth: 3.81 - 4.03 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH# 1A-98 Ck'd by: _____ Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				90.1
20,000	20.0				86.4
12,500	12.5				75.6
10,000	10.0				72.6
5,000	5.0				60.2
2,500	2.5				52.4
2,000	2.0				49.4
1,250	1.25				42.5
800	0.800				36.1
630	0.630				32.6
400	0.400				25.0
315	0.315				20.2
160	0.160				9.7
80	0.080				5.4

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Trace silt, gravelly sand _____
USC - SW SM _____
 Time of Sieving _____ Min. 15 _____
 Remarks _____
%Fines: 5.4
%Sand: 54.8
%Gravel: 39.8
%Moisture: 9.8





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 22 Depth: 4.57 - 4.71 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
 TH# 1A-98 CK'd by: _____ Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				
12,500	12.5				100.0
10,000	10.0				97.7
5,000	5.0				93.2
2,500	2.5				83.3
2,000	2.0				79.4
1,250	1.25				63.2
800	0.800				51.4
630	0.630				41.5
400	0.400				30.2
315	0.315				24.0
160	0.160				12.9
80	0.080				6.7

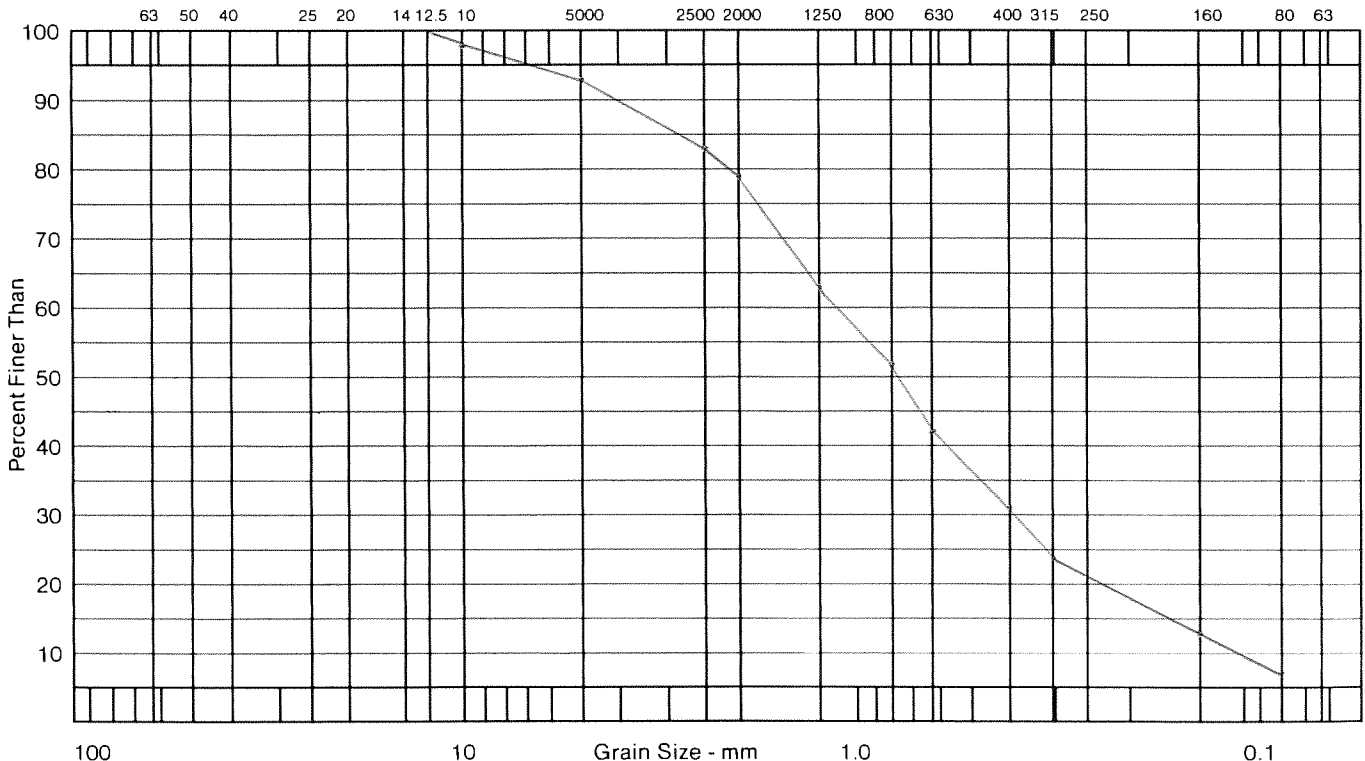
Description of Sample _____

Trace silt and gravel, sand
USC - SW SM

Method of Preparation _____ Dry _____ Washed X
 Remarks _____

%Fines: 6.7
%Sand: 86.5
%Gravel: 6.8
%Moisture: 12.7

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

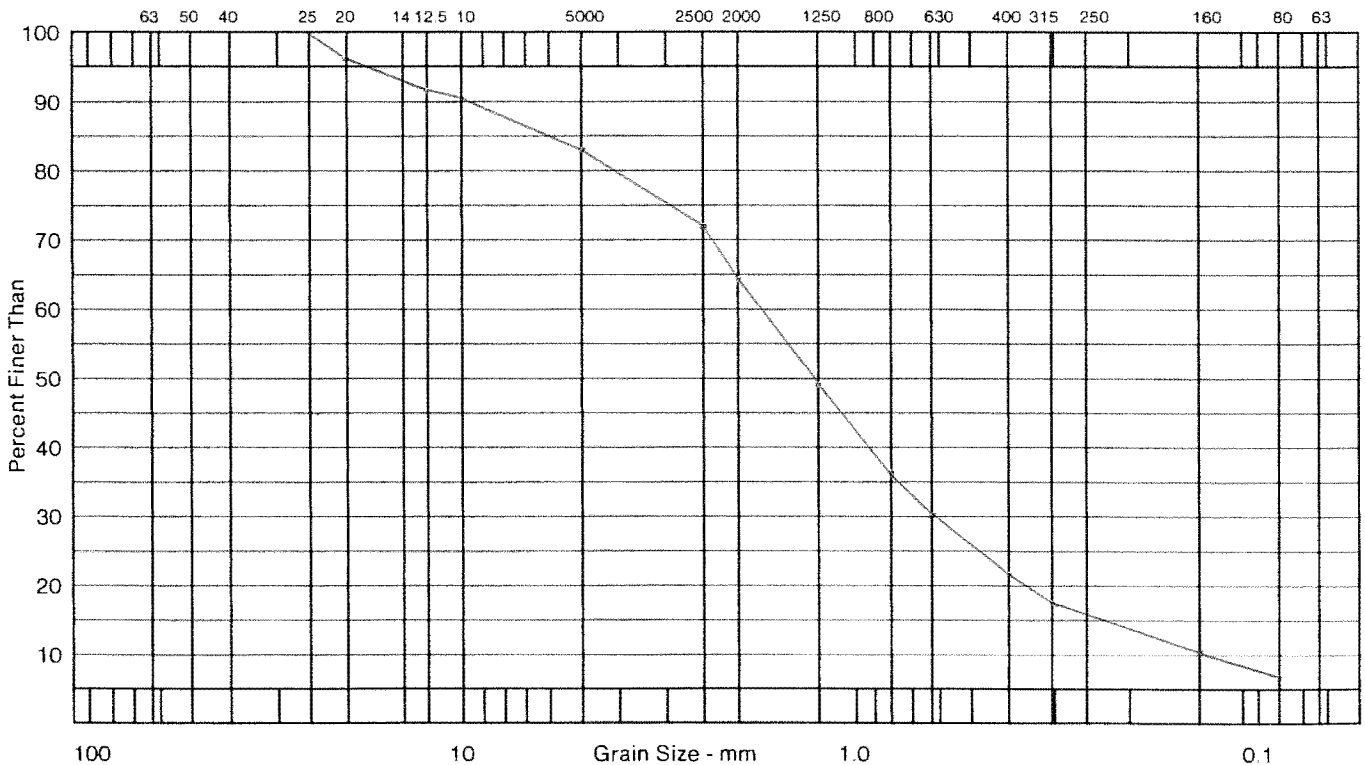
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 23 Depth: 6.10 - 6.48 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#1A-98 CK'd by: _____ Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				100.0
20,000	20.0				95.6
12,500	12.5				91.4
10,000	10.0				90.1
5,000	5.0				83.2
2,500	2.5				71.5
2,000	2.0				64.9
1,250	1.25				49.5
800	0.800				36.0
630	0.630				30.0
400	0.400				21.3
315	0.315				17.6
160	0.160				10.1
80	0.080				6.2

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
 Remarks _____
Trace silt, gravelly sand %Fines: 6.2
USC - SW SM %Sand: 77.0
 %Gravel: 16.8
 %Moisture: 12.3
 Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

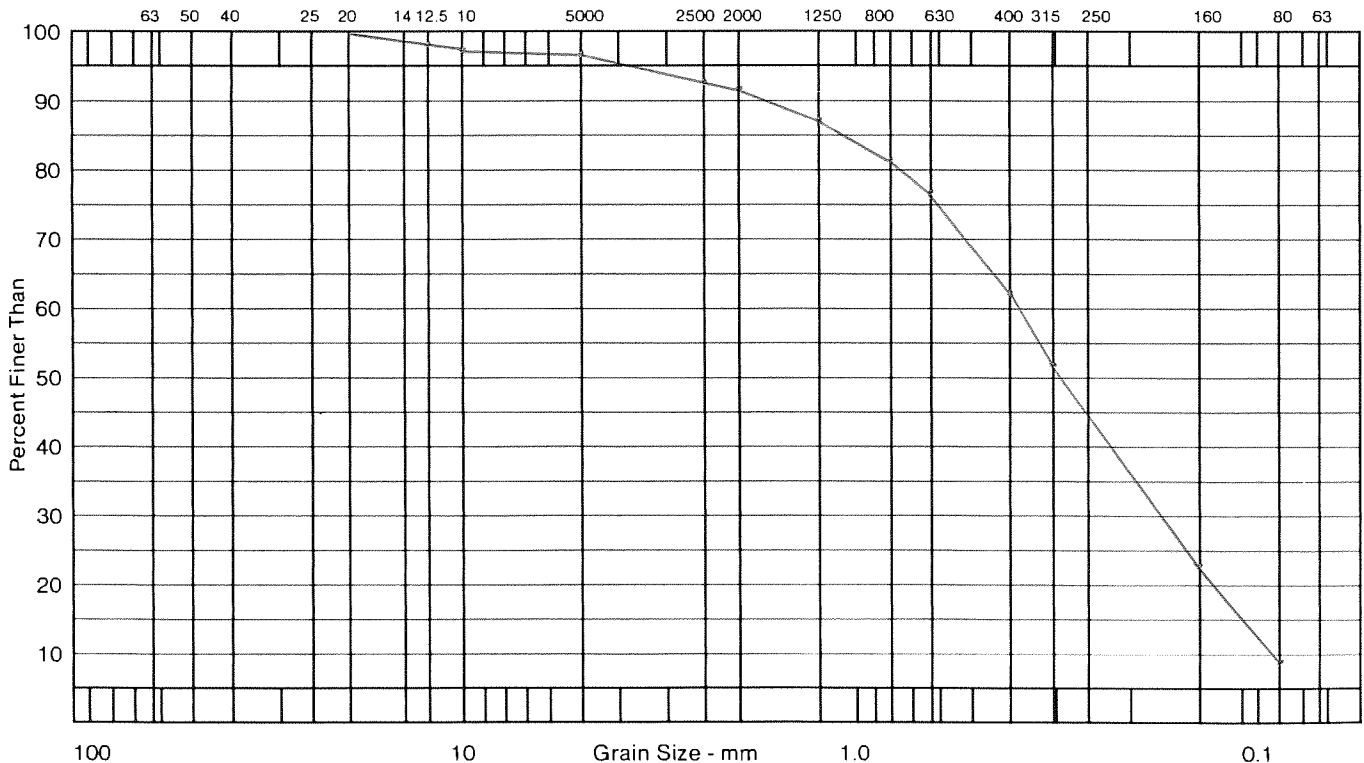
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Sample: 25 Depth: 9.14 - 9.27 Client: YTG, TRANSPORTATION ENGINEERING
Location: Nordenskiold River Crossing Project: Carmacks Bypass Route & Nordenskiold
TH#1A-98 Made by: LK Job No.: 8002-254
CK'd by: _____ Date: 1998/11/12

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				98.7
10,000	10.0				97.6
5,000	5.0				96.1
2,500	2.5				93.6
2,000	2.0				91.8
1,250	1.25				87.2
800	0.800				81.0
630	0.630				76.2
400	0.400				62.5
315	0.315				51.8
160	0.160				23.1
80	0.080				9.4

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Remarks _____
Trace silt, sand %Fines: 9.4
USC - SW SM %Sand: 86.7
%Gravel: 3.9
%Moisture: 16.8
Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

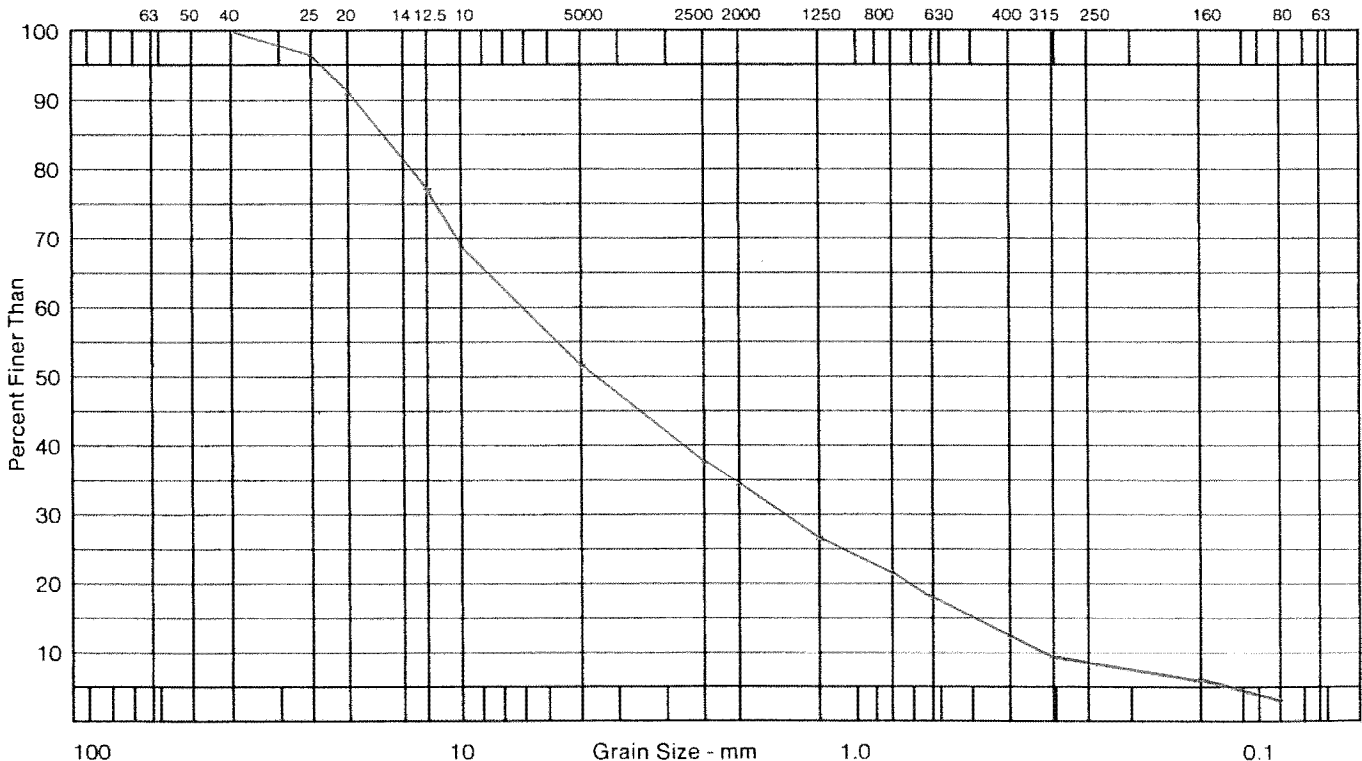
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 92 Depth: 1.83 - 2.44 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 CK'd by: WCK Date: 1998/11/17

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				96.3
20,000	20.0				90.4
12,500	12.5				77.1
10,000	10.0				69.0
5,000	5.0				51.4
2,500	2.5				37.6
2,000	2.0				34.9
1,250	1.25				26.4
800	0.800				21.3
630	0.630				18.4
400	0.400				12.6
315	0.315				9.8
160	0.160				5.6
80	0.080				3.4

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Sandy gravel
USC - GW
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 3.4
%Sand: 45.2
%Gravel: 48.6
%Moisture: 9.5





J. R. Paine & Associates Ltd.

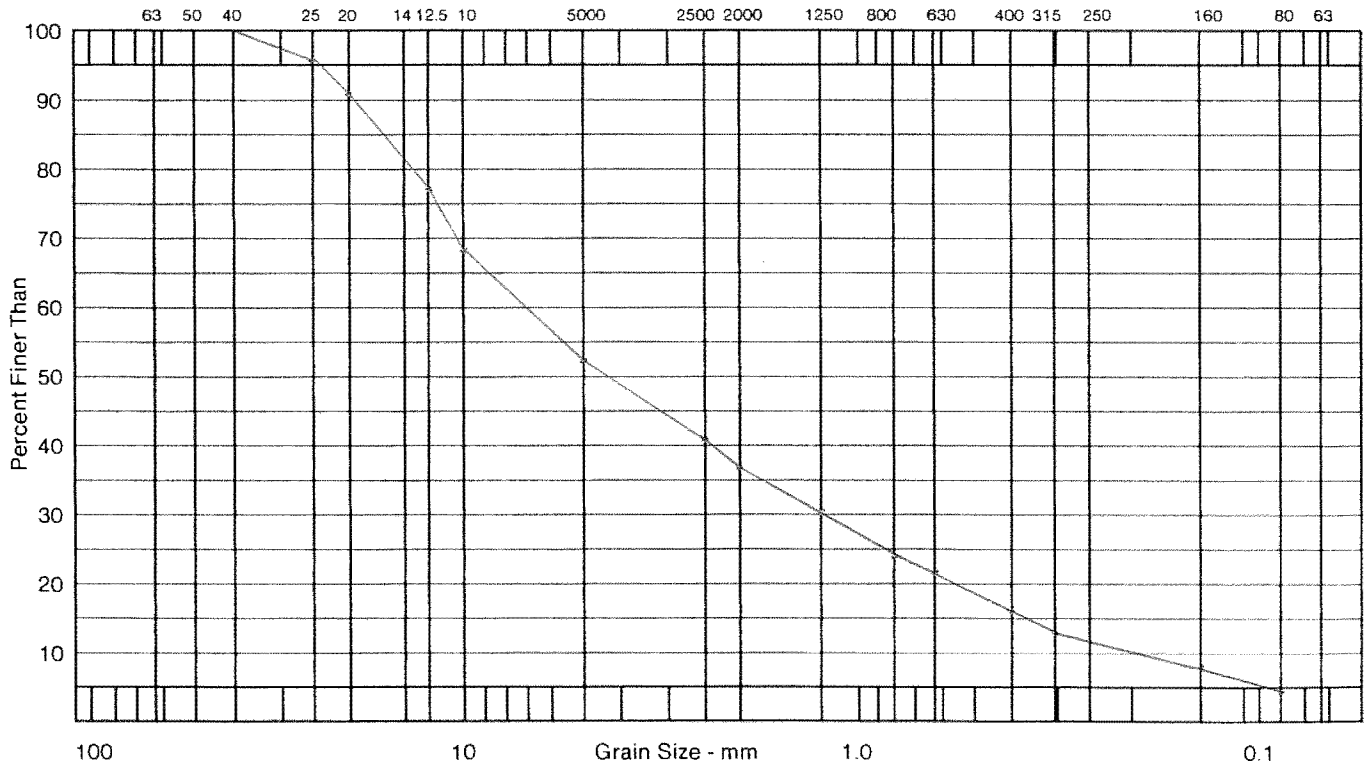
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 93 Depth: 3.35 - 3.96 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: WCP Date: 1998/11/17

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				95.2
20,000	20.0				90.5
12,500	12.5				77.0
10,000	10.0				68.9
5,000	5.0				52.0
2,500	2.5				40.3
2,000	2.0				36.7
1,250	1.25				30.1
800	0.800				24.3
630	0.630				21.3
400	0.400				15.8
315	0.315				13.1
160	0.160				7.9
80	0.080				4.9

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Sandy gravel
USC - GW
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 4.9
%Sand: 47.1
%Gravel: 48.0
%Moisture: 10.4





J. R. Paine & Associates Ltd.

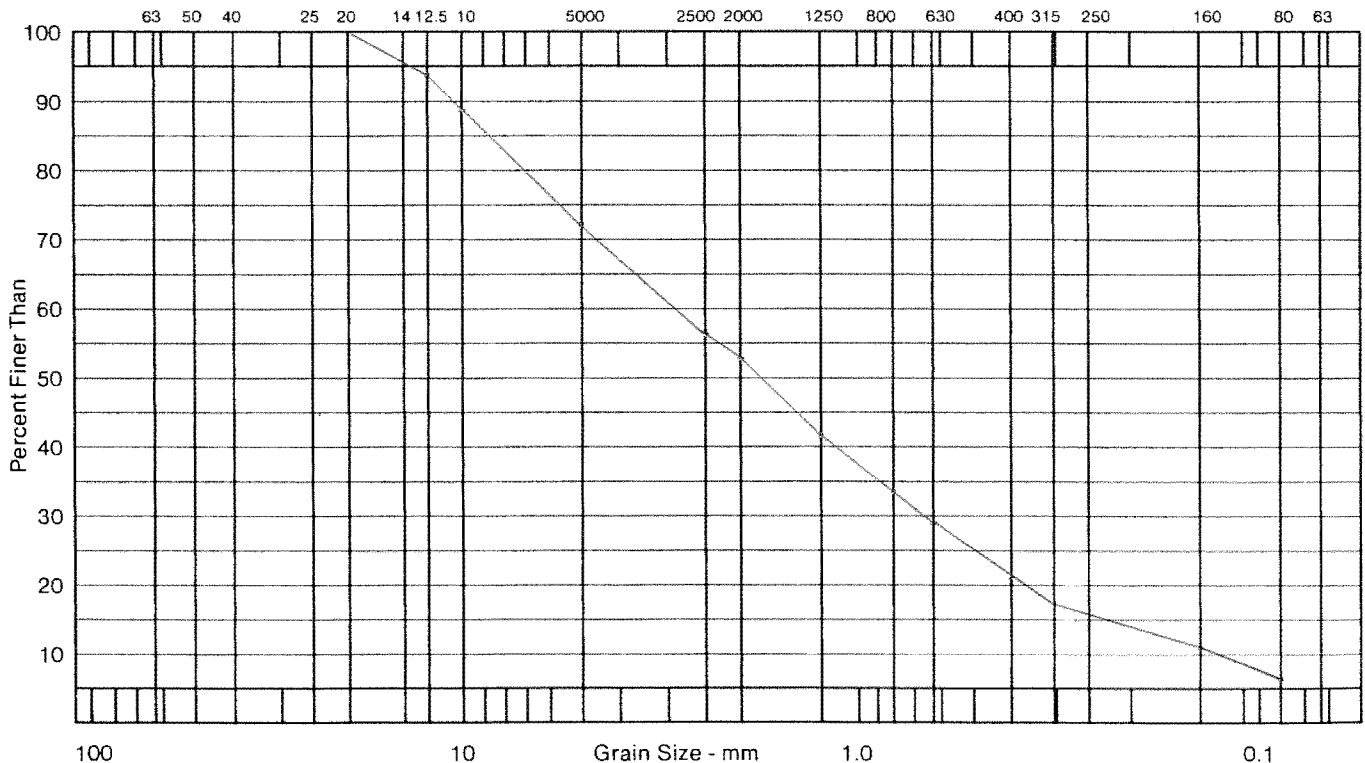
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
Sample: 94 Depth: 4.88 - 5.49 Project: Carmacks Bypass Route & Nordenskiold
Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: WCK Date: 1998/11/17

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				94.3
10,000	10.0				89.0
5,000	5.0				72.1
2,500	2.5				56.5
2,000	2.0				53.0
1,250	1.25				41.7
800	0.800				34.0
630	0.630				29.4
400	0.400				20.9
315	0.315				17.3
160	0.160				10.6
80	0.080				6.0

Description of Sample Trace silt, gravelly sand Method of Preparation Dry Washed X
USC - SW SM
Remarks %Fines: 6.0
%Sand: 66.1
%Gravel: 27.9
%Moisture: 13.4
Time of Sieving 15 Min.





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 95 Depth: 6.71 - 7.32 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: WCK Date: 1998/11/17

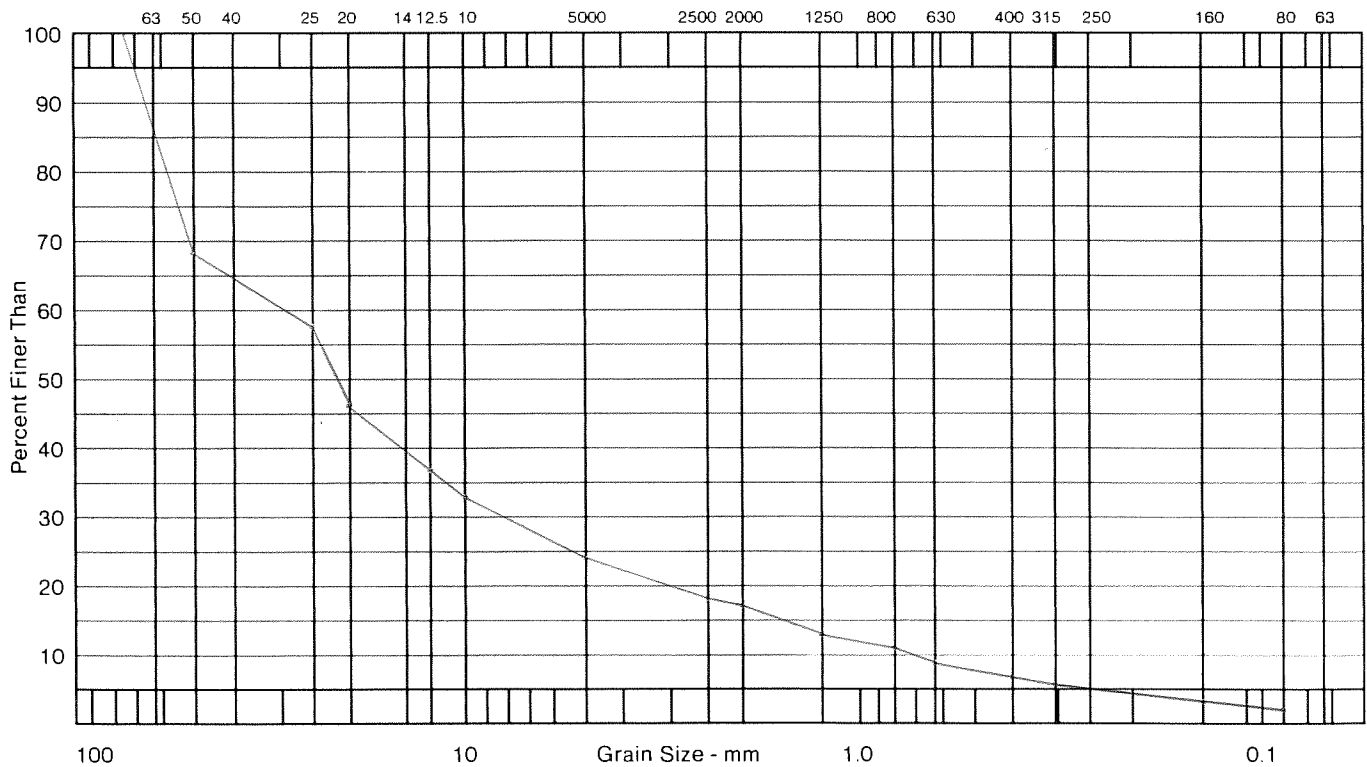
Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				68.3
40,000	40.0				
25,000	25.0				57.6
20,000	20.0				45.8
12,500	12.5				36.9
10,000	10.0				33.7
5,000	5.0				24.5
2,500	2.5				18.6
2,000	2.0				17.2
1,250	1.25				13.4
800	0.800				10.8
630	0.630				9.2
400	0.400				6.3
315	0.315				5.1
160	0.160				3.1
80	0.080				2.0

Description of Sample _____

Sandy gravel
USC - GP

Method of Preparation _____ Dry _____ Washed X
 Remarks 100% passing 75.0mm
%Fines: 2.0
%Sand: 22.5
%Gravel: 75.5
%Moisture: 4.8

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

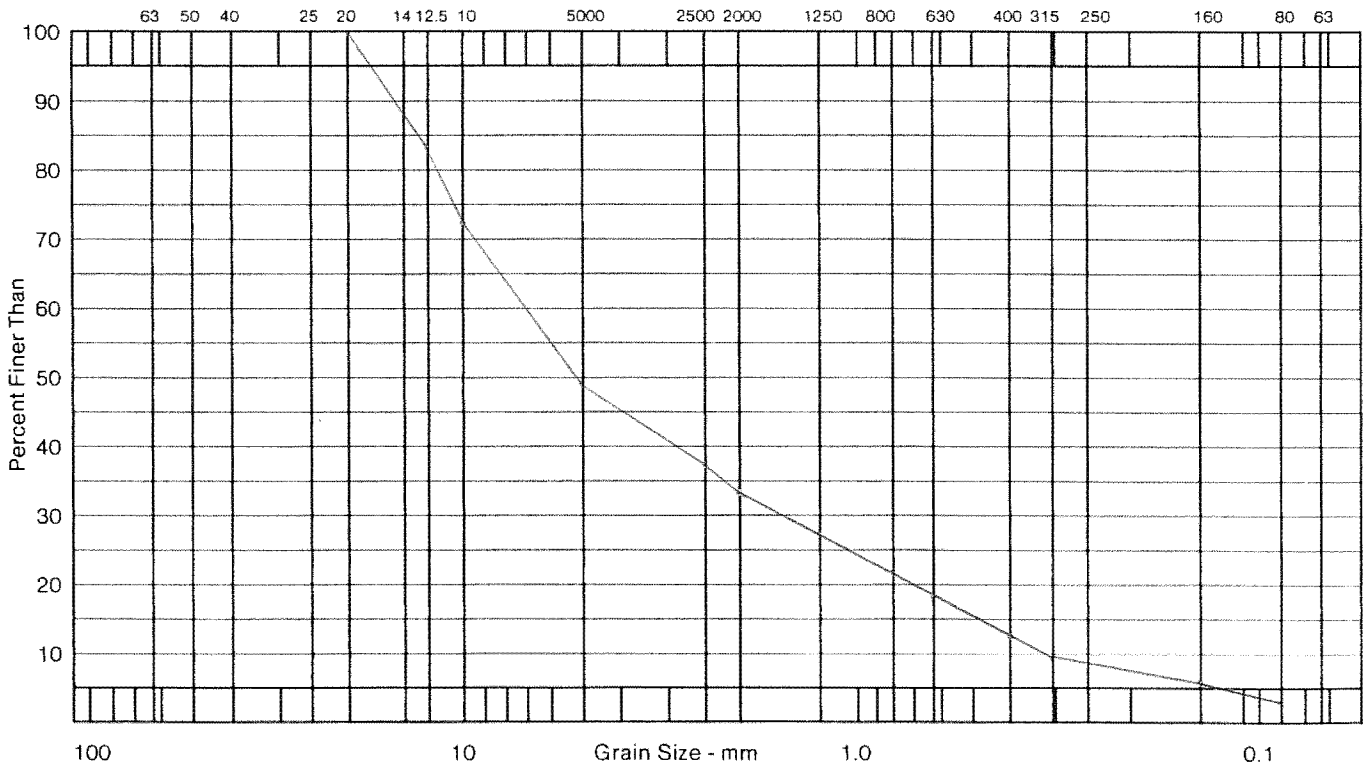
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 96 Depth: 8.23 - 8.84 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: WCL Date: 1998/11/17

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				83.6
10,000	10.0				72.5
5,000	5.0				49.5
2,500	2.5				37.5
2,000	2.0				33.7
1,250	1.25				27.0
800	0.800				21.3
630	0.630				18.3
400	0.400				12.7
315	0.315				9.9
160	0.160				5.2
80	0.080				3.1

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Sandy gravel
USC - GW
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 3.1
%Sand: 46.4
%Gravel: 50.5
%Moisture: 9.1





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 97 Depth: 9.75 - 10.36 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
Th#9-98 CK'd by: Wck Date: 1998/11/17

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				94.6
20,000	20.0				
12,500	12.5				87.9
10,000	10.0				79.1
5,000	5.0				60.7
2,500	2.5				44.2
2,000	2.0				39.7
1,250	1.25				31.5
800	0.800				24.3
630	0.630				20.6
400	0.400				13.8
315	0.315				10.5
160	0.160				5.3
80	0.080				3.2

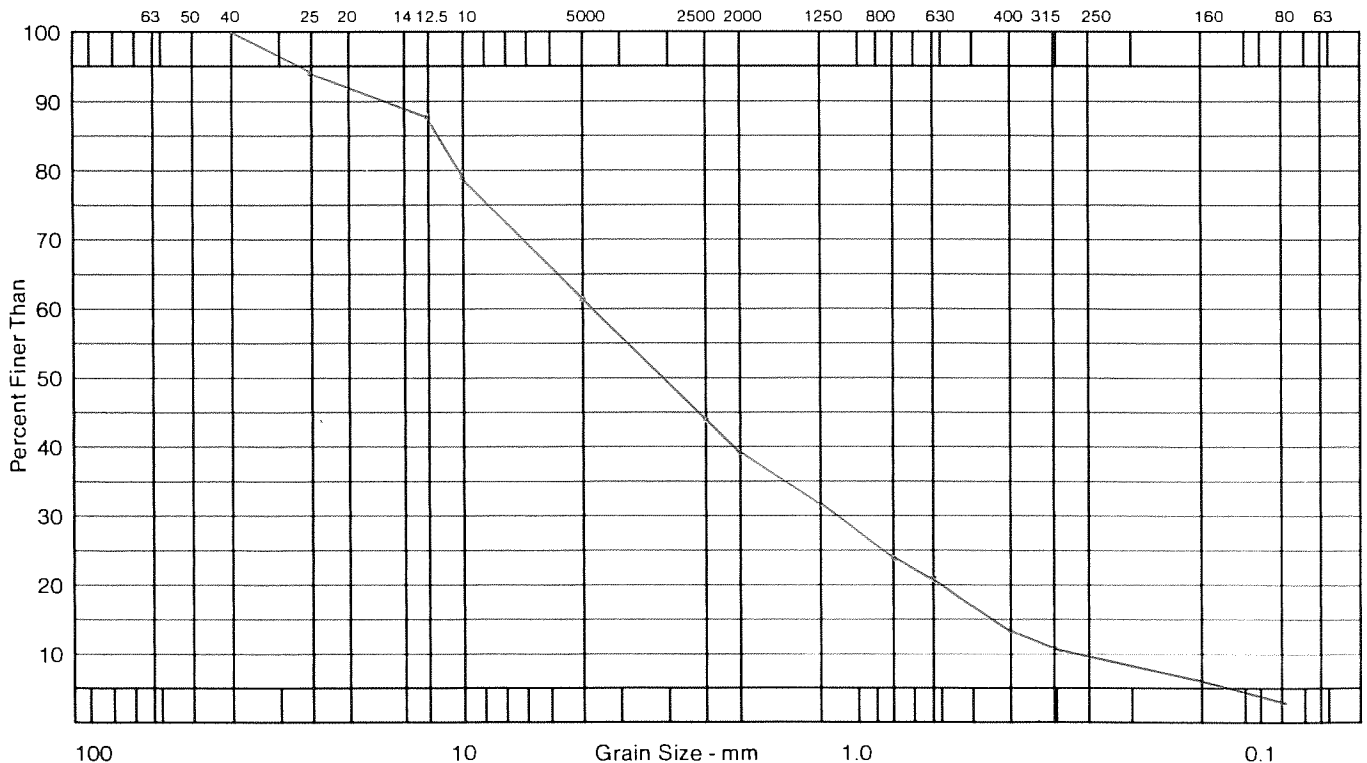
Description of Sample _____

Gravelly sand
USC - SW

Method of Preparation _____ Dry _____ Washed X

Remarks _____
%Fines: 3.2
%Sand: 57.5
%Gravel: 39.3
%Moisture: 10.1

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING

Sample: 98 Depth: 10.97 - 11.89 Project: Carmacks Bypass Route & Nordenskiold

Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254

TH#9-98 Ck'd by: WCL Date: 1998/11/18

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				93.6
20,000	20.0				85.3
12,500	12.5				76.6
10,000	10.0				71.1
5,000	5.0				56.0
2,500	2.5				44.1
2,000	2.0				41.5
1,250	1.25				32.7
800	0.800				26.1
630	0.630				22.0
400	0.400				14.9
315	0.315				11.8
160	0.160				6.8
80	0.080				4.1

Description of Sample _____

Method of Preparation _____ Dry _____ Washed X

Gravelly sand

Remarks _____

USC - SW

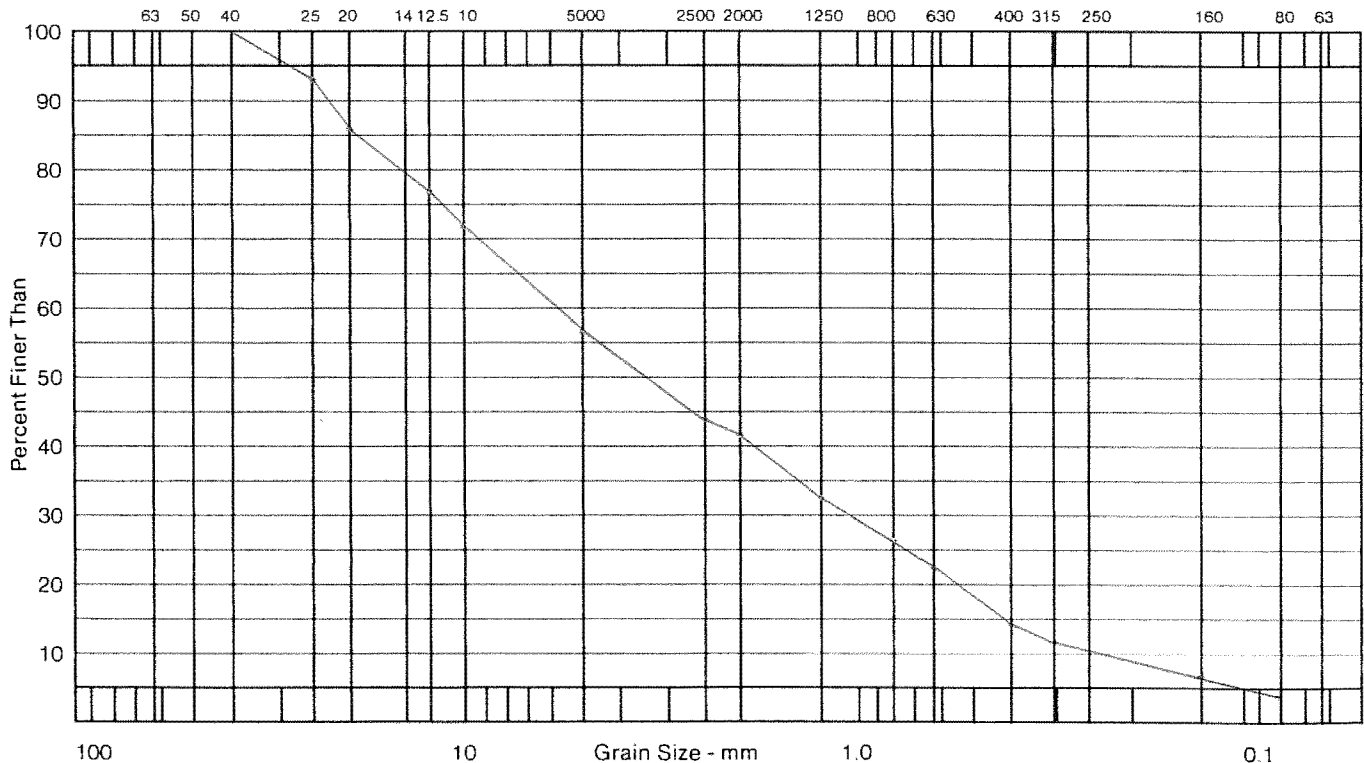
%Fines: 4.1

%Sand: 51.9

%Gravel: 44.0

Time of Sieving _____ Min. 15

%Moisture: 10.7





J. R. Paine & Associates Ltd.

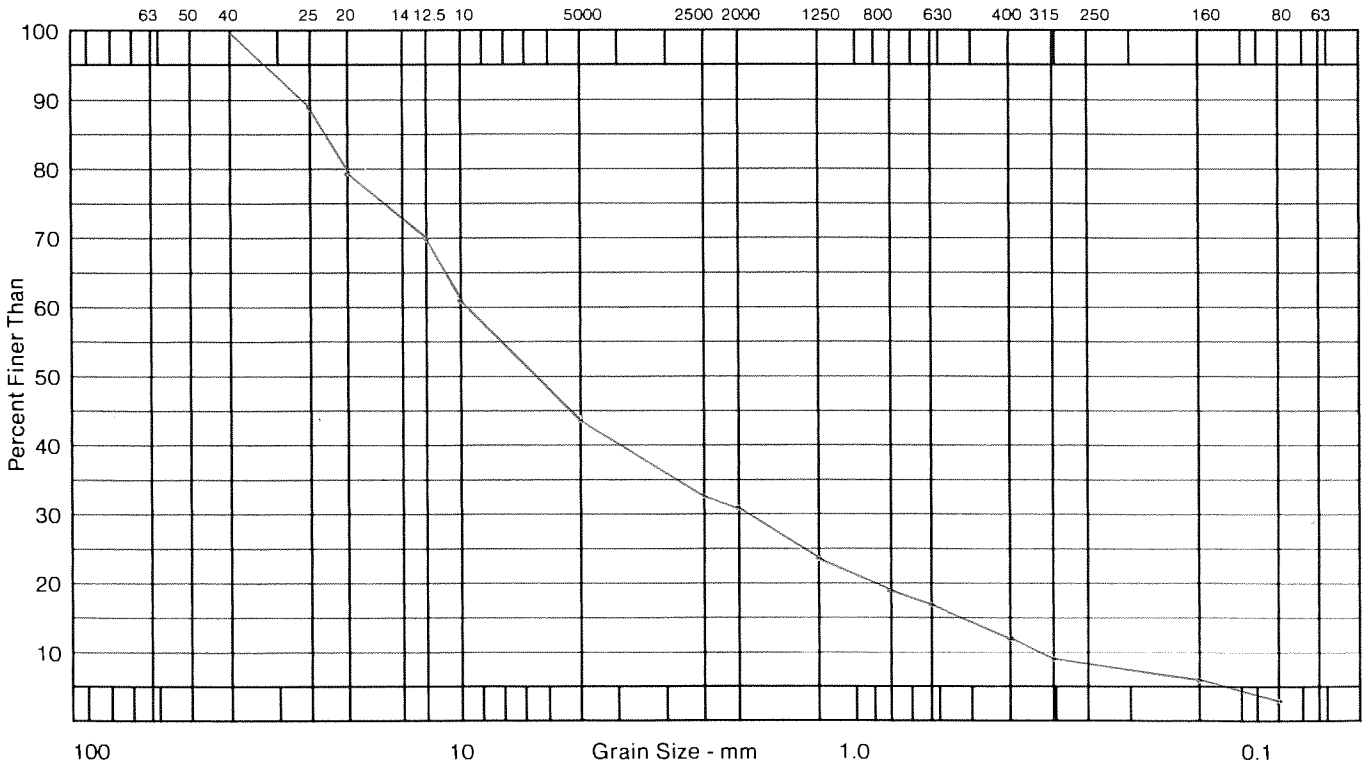
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 99 Depth: 12.8 - 13.41 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: W.C.K. Date: 1998/11/18

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				89.6
20,000	20.0				79.9
12,500	12.5				70.0
10,000	10.0				60.6
5,000	5.0				44.1
2,500	2.5				32.8
2,000	2.0				30.4
1,250	1.25				24.0
800	0.800				19.6
630	0.630				16.9
400	0.400				11.9
315	0.315				9.6
160	0.160				5.5
80	0.080				3.2

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Sandy gravel
USC - GW
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 3.2
%Sand: 40.9
%Gravel: 55.9
%Moisture: 8.2





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

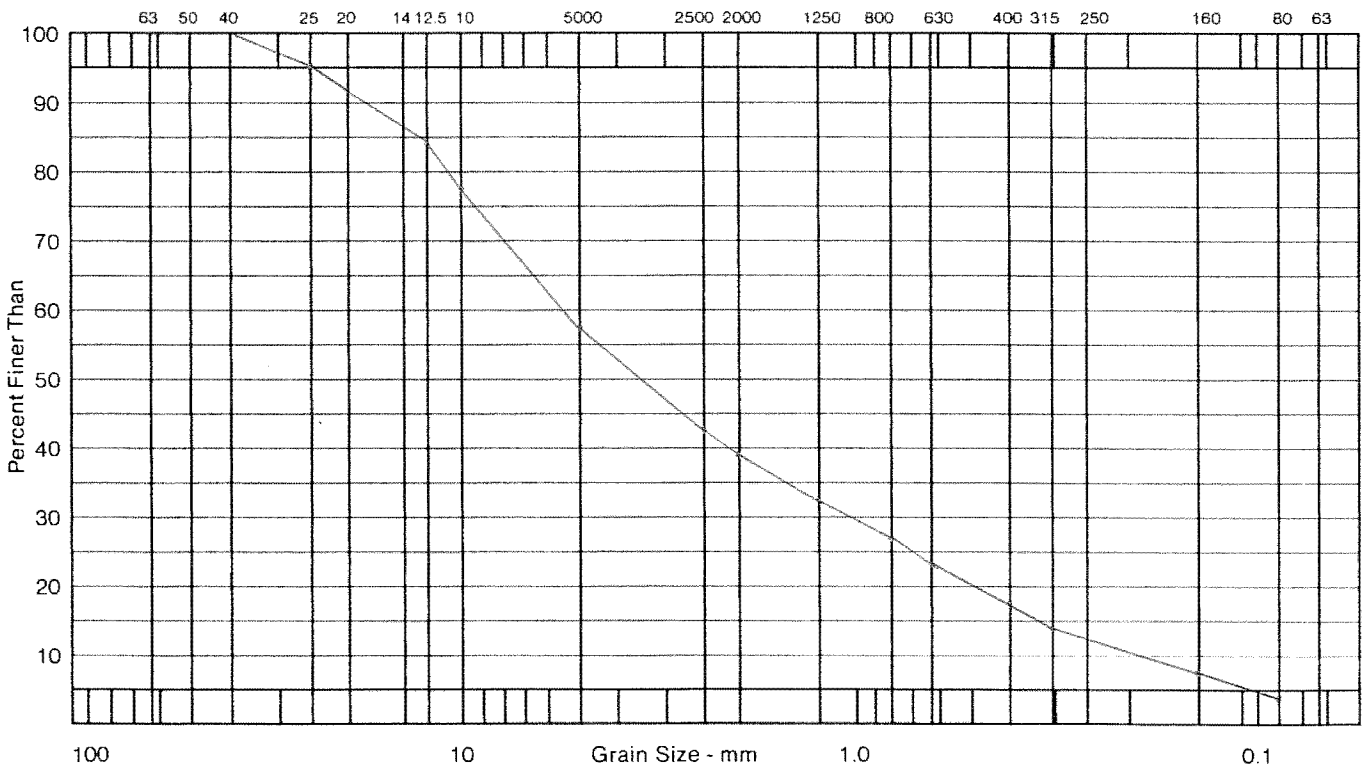
SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 100 Depth: 14.02 - 14.63 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: [Signature] Date: 1998/11/18

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				95.0
20,000	20.0				91.4
12,500	12.5				84.5
10,000	10.0				77.6
5,000	5.0				57.6
2,500	2.5				43.4
2,000	2.0				39.5
1,250	1.25				32.5
800	0.800				26.7
630	0.630				23.6
400	0.400				17.5
315	0.315				14.2
160	0.160				7.3
80	0.080				4.0

Description of Sample _____
Gravelly sand
USC - SW
 Time of Sieving _____ Min. 15

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
%Fines: 4.0
%Sand: 53.2
%Gravel: 42.8
%Moisture: 9.6





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 101 Depth: 15.54 - 16.15 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: WCC Date: 1998/11/18

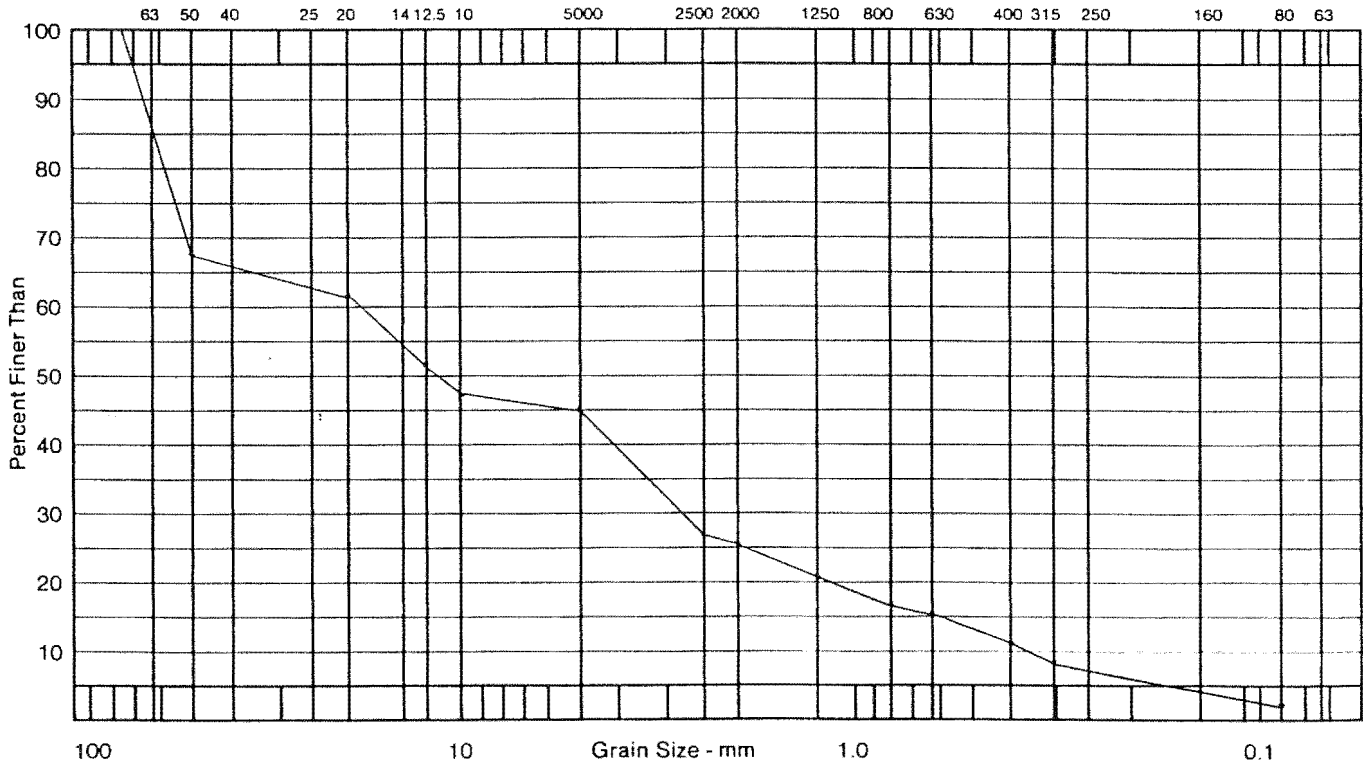
Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				67.7
40,000	40.0				
25,000	25.0				
20,000	20.0				61.0
12,500	12.5				51.7
10,000	10.0				47.3
5,000	5.0				35.0
2,500	2.5				26.7
2,000	2.0				25.2
1,250	1.25				20.2
800	0.800				16.9
630	0.630				15.1
400	0.400				10.9
315	0.315				8.8
160	0.160				4.6
80	0.080				2.1

Description of Sample _____

Sandy gravel
USC - GW

Method of Preparation _____ Dry _____ Washed X
 Remarks 100% passing 75.0mm
%Fines: 2.1
%Sand: 32.9
%Gravel: 65.0
%Moisture: 6.2

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 103 Depth: 18.59 - 18.80 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9-98 Ck'd by: WCL Date: 1998/11/18

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				94.7
20,000	20.0				77.8
12,500	12.5				64.1
10,000	10.0				53.7
5,000	5.0				37.6
2,500	2.5				30.7
2,000	2.0				25.7
1,250	1.25				20.9
800	0.800				16.7
630	0.630				14.6
400	0.400				10.4
315	0.315				8.1
160	0.160				3.9
80	0.080				2.2

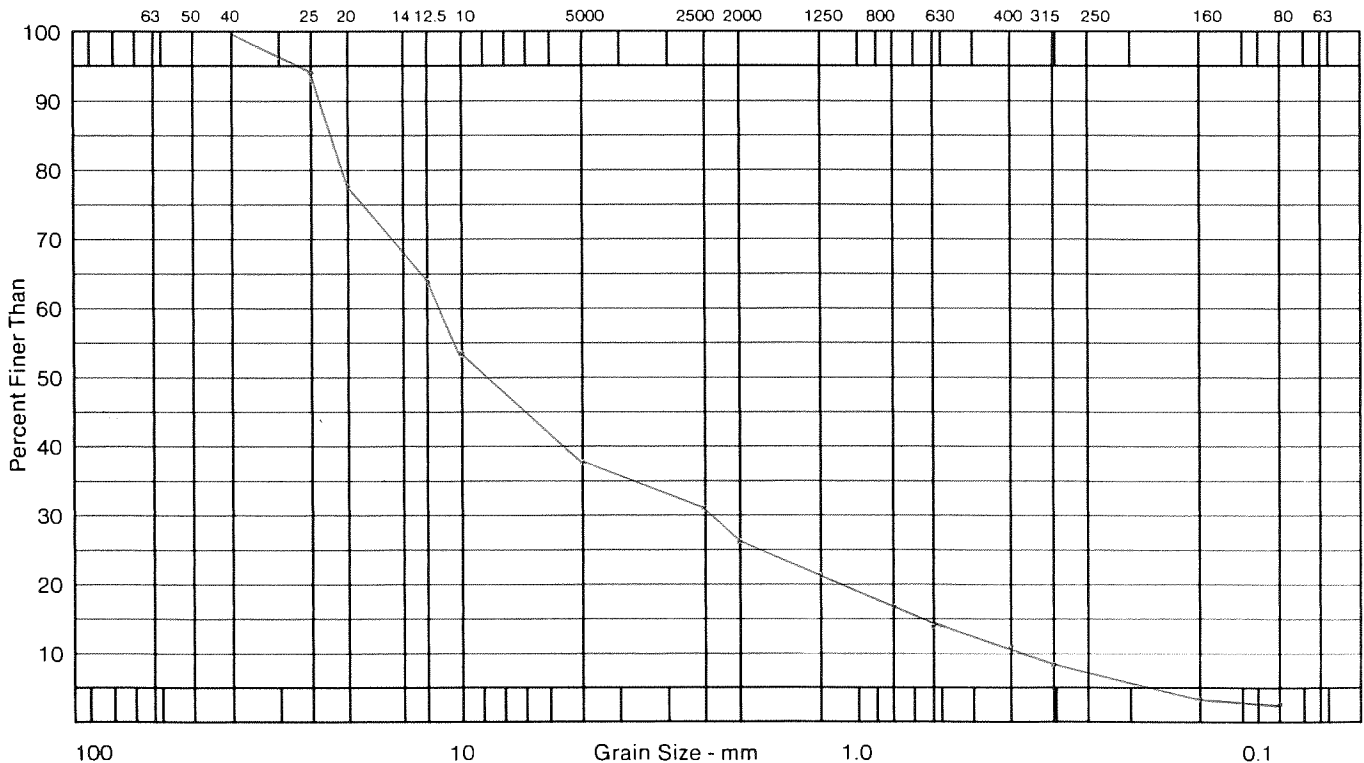
Description of Sample _____

Sandy gravel
USC - GW

Method of Preparation _____ Dry _____ Washed X

Remarks _____
%Fines: 2.2
%Sand: 35.4
%Gravel: 62.4
%Moisture: 8.2

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 110 Depth: 7.62 - 7.77 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9A-98 Ck'd by: WCL Date: 1998/11/18

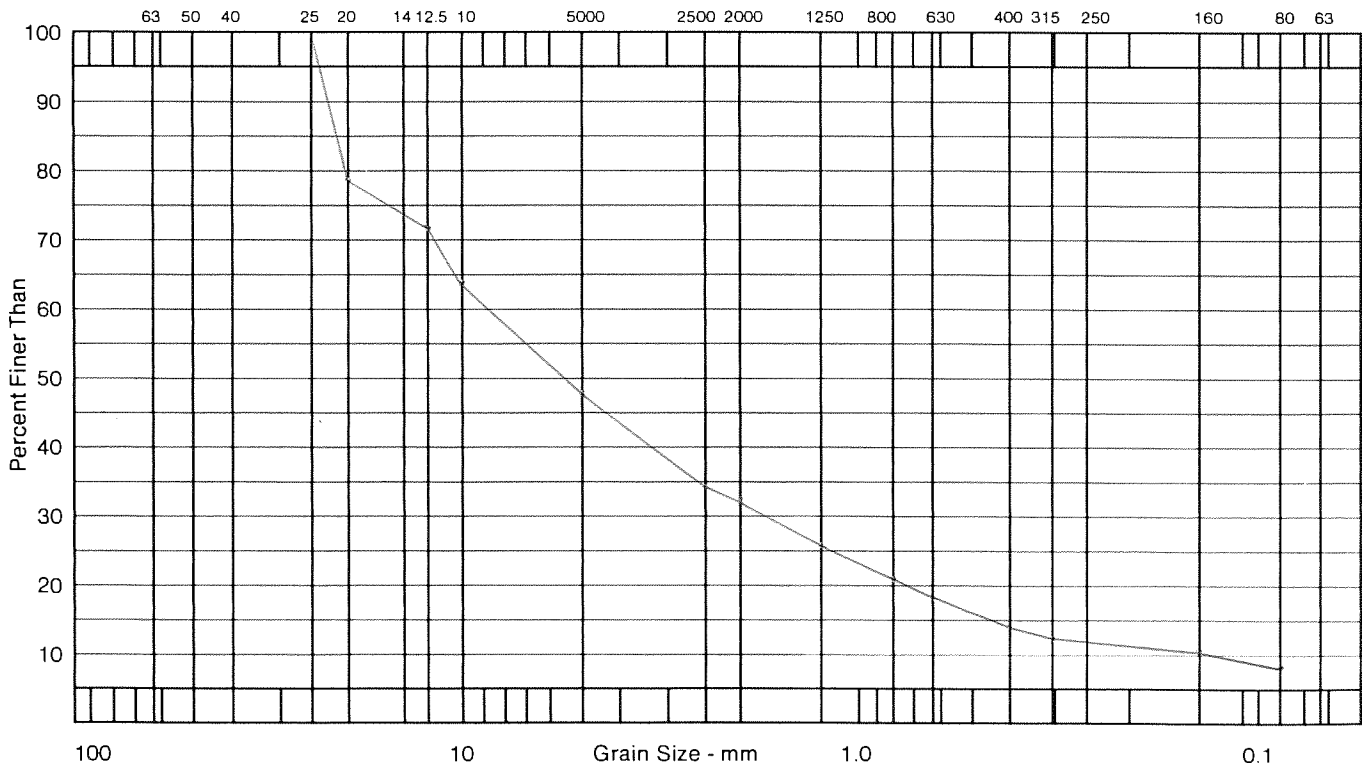
Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				100.0
20,000	20.0				79.0
12,500	12.5				71.9
10,000	10.0				64.1
5,000	5.0				48.0
2,500	2.5				34.8
2,000	2.0				32.4
1,250	1.25				25.3
800	0.800				20.6
630	0.630				18.3
400	0.400				14.3
315	0.315				12.7
160	0.160				10.1
80	0.080				8.8

Description of Sample _____

Trace silt, sandy gravel
USC - GW GM

Method of Preparation _____ Dry _____ Washed X
 Remarks _____
%Fines: 8.8
%Sand: 39.2
%Gravel: 52.0
%Moisture: 7.5

Time of Sieving _____ Min. 15





J. R. Paine & Associates Ltd.

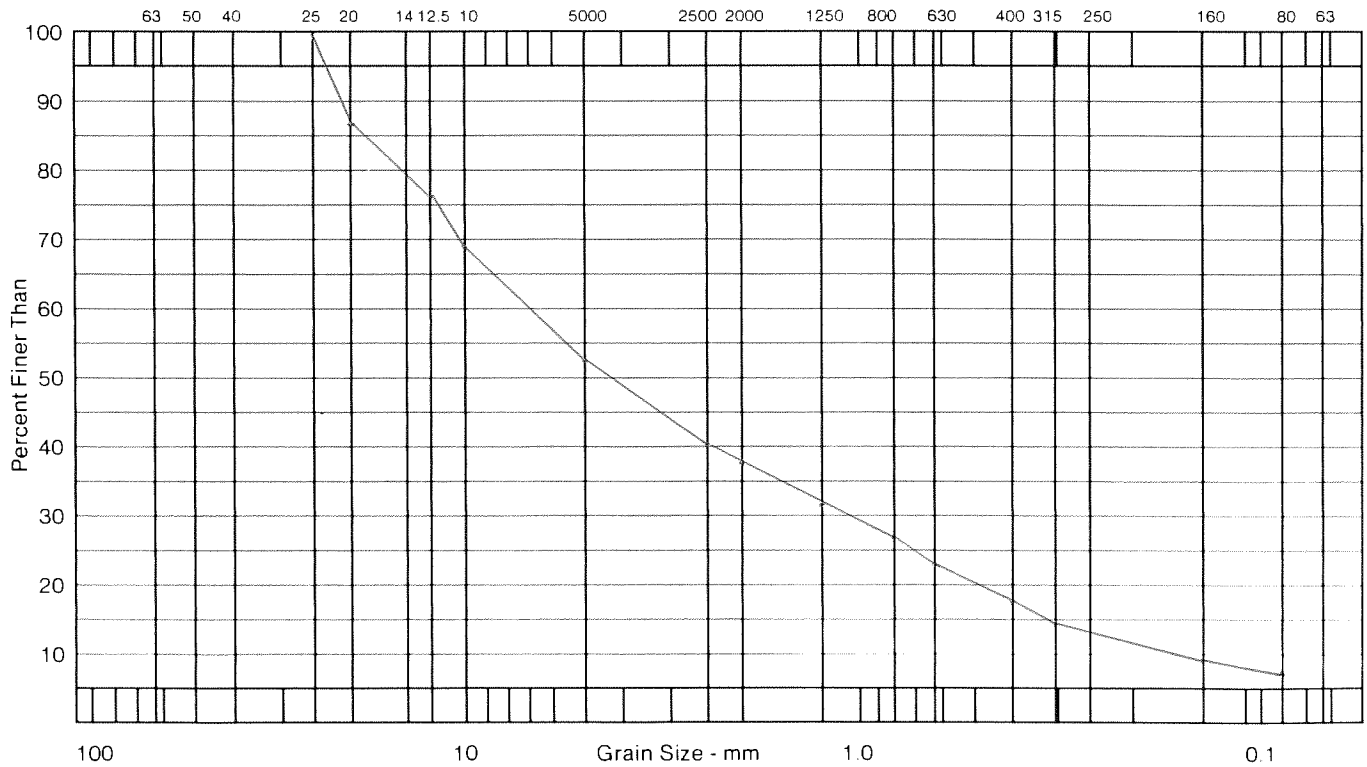
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 111 Depth: 9.14 - 9.27 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9A-98 Ck'd by: WCK Date: 1998/11/18

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				100.0
20,000	20.0				86.6
12,500	12.5				75.8
10,000	10.0				69.2
5,000	5.0				52.7
2,500	2.5				40.0
2,000	2.0				37.8
1,250	1.25				31.3
800	0.800				26.5
630	0.630				23.6
400	0.400				17.7
315	0.315				14.8
160	0.160				9.7
80	0.080				6.9

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Trace silt, sandy gravel Remarks _____
USC - GW GM _____
 _____ %Fines: 6.9
 _____ %Sand: 45.9
 _____ %Gravel: 47.2
 Time of Sieving _____ Min. 15 _____ %Moisture: 8.6





J. R. Paine & Associates Ltd.

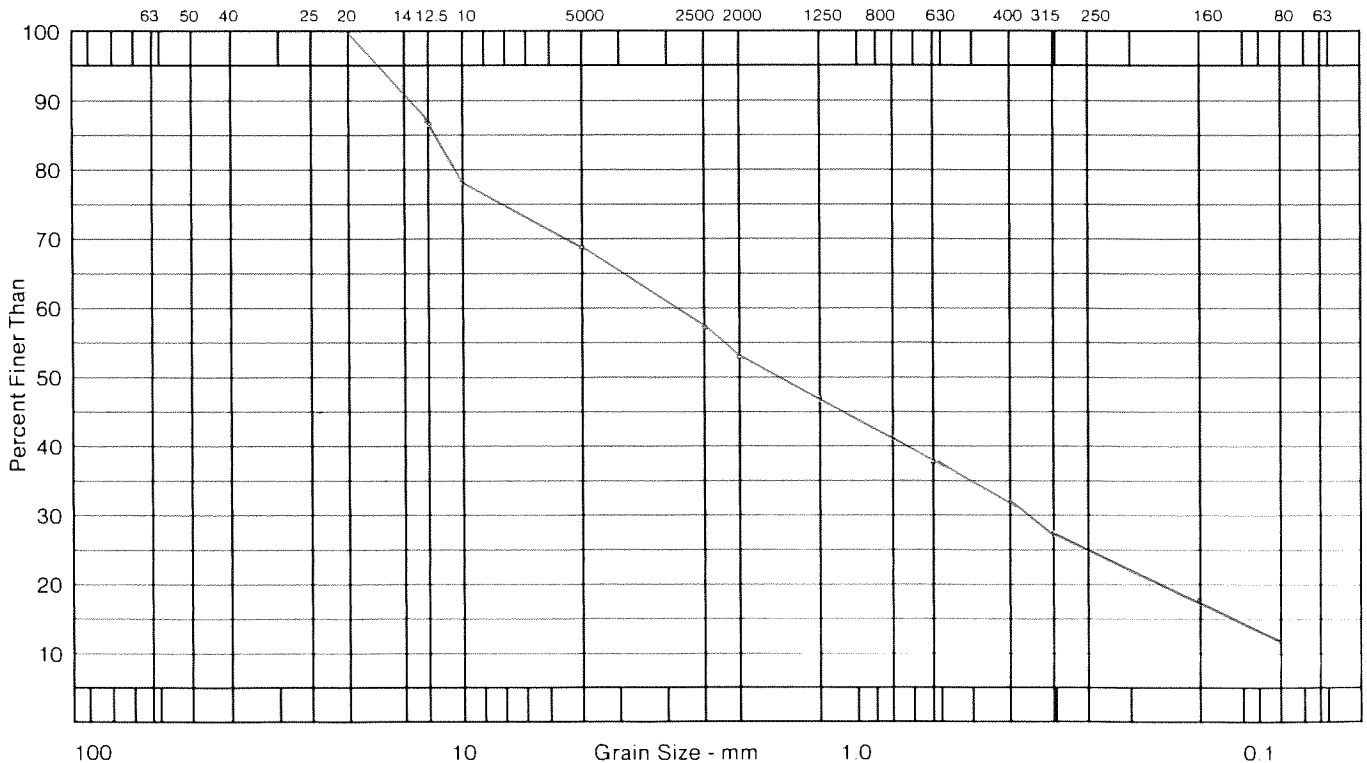
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 112 Depth: 12.19 - 12.37 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH# 9A-98 CK'd by: WIC Date: 1998/11/19

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				100.0
12,500	12.5				86.2
10,000	10.0				78.6
5,000	5.0				69.0
2,500	2.5				57.2
2,000	2.0				53.4
1,250	1.25				46.3
800	0.800				40.6
630	0.630				37.6
400	0.400				31.2
315	0.315				27.3
160	0.160				17.7
80	0.080				11.4

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Some silt, gravelly sand
USC - SW SM
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 11.4
%Sand: 57.6
%Gravel: 31.0
%Moisture: 8.6





J. R. Paine & Associates Ltd.

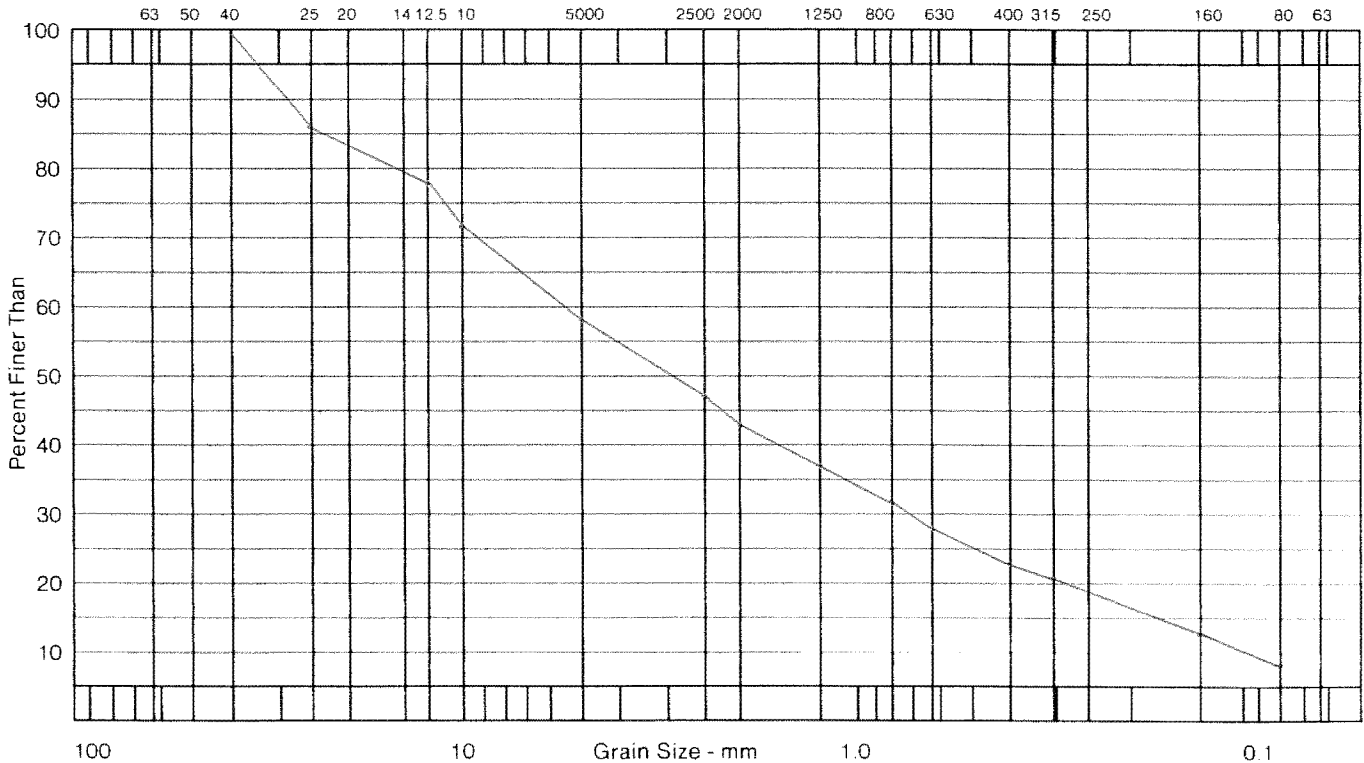
CONSULTING AND TESTING ENGINEERS

SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING
 Sample: 113 Depth: 15.24 - 15.36 Project: Carmacks Bypass Route & Nordenskiold
 Location: Nordenskiold River Crossing Made by: LK Job No.: 8002-254
TH#9A-98 Ck'd by: [Signature] Date: 1998/11/19

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				100.0
25,000	25.0				85.7
20,000	20.0				
12,500	12.5				78.5
10,000	10.0				71.7
5,000	5.0				58.2
2,500	2.5				46.9
2,000	2.0				43.2
1,250	1.25				36.9
800	0.800				31.4
630	0.630				28.6
400	0.400				23.3
315	0.315				20.2
160	0.160				12.9
80	0.080				8.2

Description of Sample _____ Method of Preparation _____ Dry _____ Washed X
Trace silt, gravelly sand
USC - SW SM
 Time of Sieving _____ Min. 15
 Remarks _____
%Fines: 8.2
%Sand: 50.0
%Gravel: 41.8
%Moisture: 8.0



Appendix D – Photographic Documentation



PHOTO # 1 – T.H. # 1A-98



PHOTO # 2 – T.H. # 9A-98

Appendix E – Pile Evaluation

AXIAL BEARING CAPACITY - SPT ANALYSIS for cohesionless soil

Basic Formula $R = mN_t A_t + nN_{avg} D A_s = \text{Pile Bearing Capacity (kN)}$

- Where
- $m = \text{Empirical Coefficient} = 400$
 - $n = \text{Empirical Coefficient} = 2$
 - $N_t = \text{SPT Index At Pile Toe}$
 - $A_t = \text{Pile Toe Area}$
 - $N_{avg} = \text{Average SPT Index Along the pile}$
 - $D = \text{Pile Embedment Length}$
 - $A_s = \text{Pile Unit Shaft Area}$

For Pile Diameter = 0.3 meters with a factor of safety = 4

Depth (meters)	m	N_t (blows)	A_t (m ²)	N_{avg} (blows)	D (meters)	Shaft Area (m ²)	Axial Bearing Capacity (kN)
0	400	13	0.071	33	0	0.0	92
2	400	13	0.071	33	2	1.9	123
4	400	13	0.071	33	4	3.8	154
6	400	13	0.071	33	6	5.7	185
8	400	13	0.071	33	8	7.5	216
10	400	13	0.071	33	10	9.4	247
12	400	13	0.071	33	12	11.3	279
14	400	13	0.071	33	14	13.2	310
16	400	13	0.071	33	16	15.1	341
18	400	13	0.071	33	18	17.0	372
20	400	13	0.071	33	20	18.8	403

For Pile Diameter = 0.6 meters with a factor of safety = 4

Depth (meters)	m	N _t (blows)	A _t (m ²)	N _{avg} (blows)	Shaft Area (m ²)	Axial Bearing Capacity (kN)
0	400	13	0.283	33	0.0	368
2	400	13	0.283	33	3.8	430
4	400	13	0.283	33	7.5	492
6	400	13	0.283	33	11.3	554
8	400	13	0.283	33	15.1	616
10	400	13	0.283	33	18.8	679
12	400	13	0.283	33	22.6	741
14	400	13	0.283	33	26.4	803
16	400	13	0.283	33	30.2	865
18	400	13	0.283	33	33.9	927
20	400	13	0.283	33	37.7	990

For Pile Diameter = 0.9 meters with a factor of safety = 4

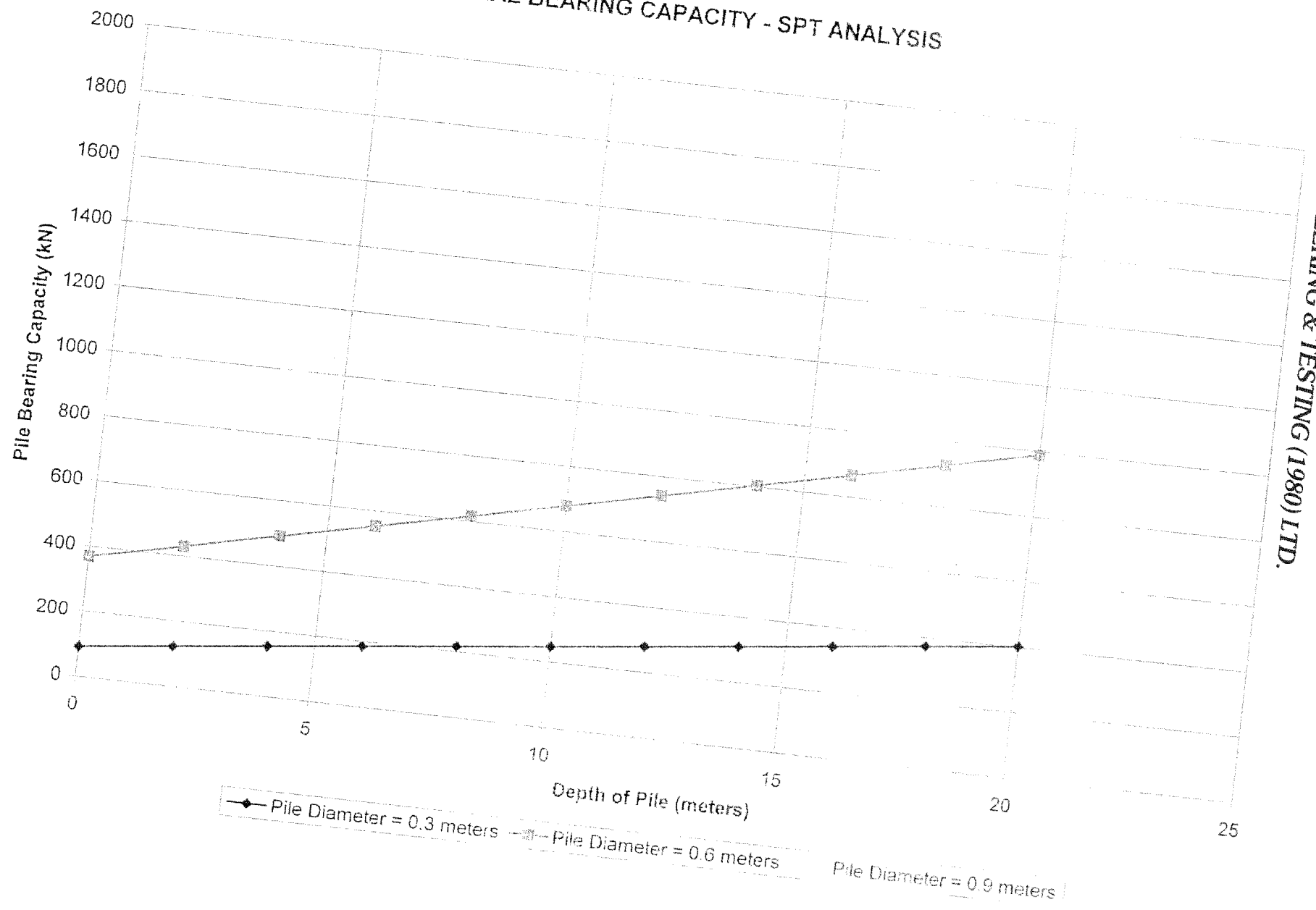
Depth (meters)	m	N _t (blows)	A _t (m ²)	N _{avg} (blows)	Shaft Area (m ²)	Axial Bearing Capacity (kN)
0	400	13	0.636	33	0.0	827
2	400	13	0.636	33	5.7	920
4	400	13	0.636	33	11.3	1014
6	400	13	0.636	33	17.0	1107
8	400	13	0.636	33	22.6	1200
10	400	13	0.636	33	28.3	1294
12	400	13	0.636	33	33.9	1387
14	400	13	0.636	33	39.6	1480
16	400	13	0.636	33	45.2	1573
18	400	13	0.636	33	50.9	1667
20	400	13	0.636	33	56.5	1760

Axial Bearing Capacity - SPT Analysis Summary (with a factor of safety = 4)

Depth (meters)	Pile Diameter (meters)		
	0.3	0.6	0.9
0	92	368	827
2	123	430	920
4	154	492	1014
6	185	554	1107
8	216	616	1200
10	247	679	1294
12	279	741	1387
14	310	803	1480
16	341	865	1573
18	372	927	1667
20	403	990	1760

AXIAL BEARING CAPACITY - SPT ANALYSIS

HOGGAN ENGINEERING & TESTING (1980) LTD.



HOGGAN ENGINEERING & TESTING (1980) LTD.

AXIAL BEARING CAPACITY - STATIC ANALYSIS

Basic Formula

$$R = \sum Cq_s Z + A_t q_b = \text{Axial Bearing Capacity}$$

Where

$$q_s = S'_v k_s M \tan(\text{PHI})' = BS'_v$$

$$q_b = N_t S'_b$$

C = Pile Circumference		variable
L = Embedded Length		variable
Z = Segments of L		variable
A _t = Pile Base Area		3.14*r ²
B = Combined Shaft Resistance Factor (0 to 10 m)		0.6
B = Combined Shaft Resistance Factor (10 to 20 m)		0.8
k _s = Coefficient of Lateral Earth Pressure		-
S' _v = Vertical Effective Stress Adjacent to Pile		variable
M = Pile - Soil Interface Friction Factor		-
N _t = Bearing Capacity Factor (0 to 10 m)		40
N _t = Bearing Capacity Factor (10 to 20 m)		85
S' _b = Vertical Effective Stress At Pile Base		variable

wet unit weight of soil	16.5 kN/m ³	0 to 10 meters
wet unit weight of soil	19.5 kN/m ³	10 to 20 meters
depth of water table	1 meter	

Calculation of q_s

interval	depth	vertical stress	vertical eff. stress	shaft factor	interval shear stress
(meters)	(meters)	(kPa)	(kPa)		(kPa)
0 to 2	1	16.5	16.5	0.6	9.9
2 to 4	3	49.5	29.9	0.6	17.9
4 to 6	5	82.5	43.3	0.6	26.0
6 to 8	7	115.5	56.7	0.6	34.0
8 to 10	9	148.5	70.1	0.6	42.1
10 to 12	11	184.5	86.5	0.8	69.2
12 to 14	13	223.5	105.9	0.8	84.7
14 to 16	15	262.5	125.3	0.8	100.2
16 to 18	17	301.5	144.7	0.8	115.8
18 to 20	19	340.5	164.1	0.8	131.3

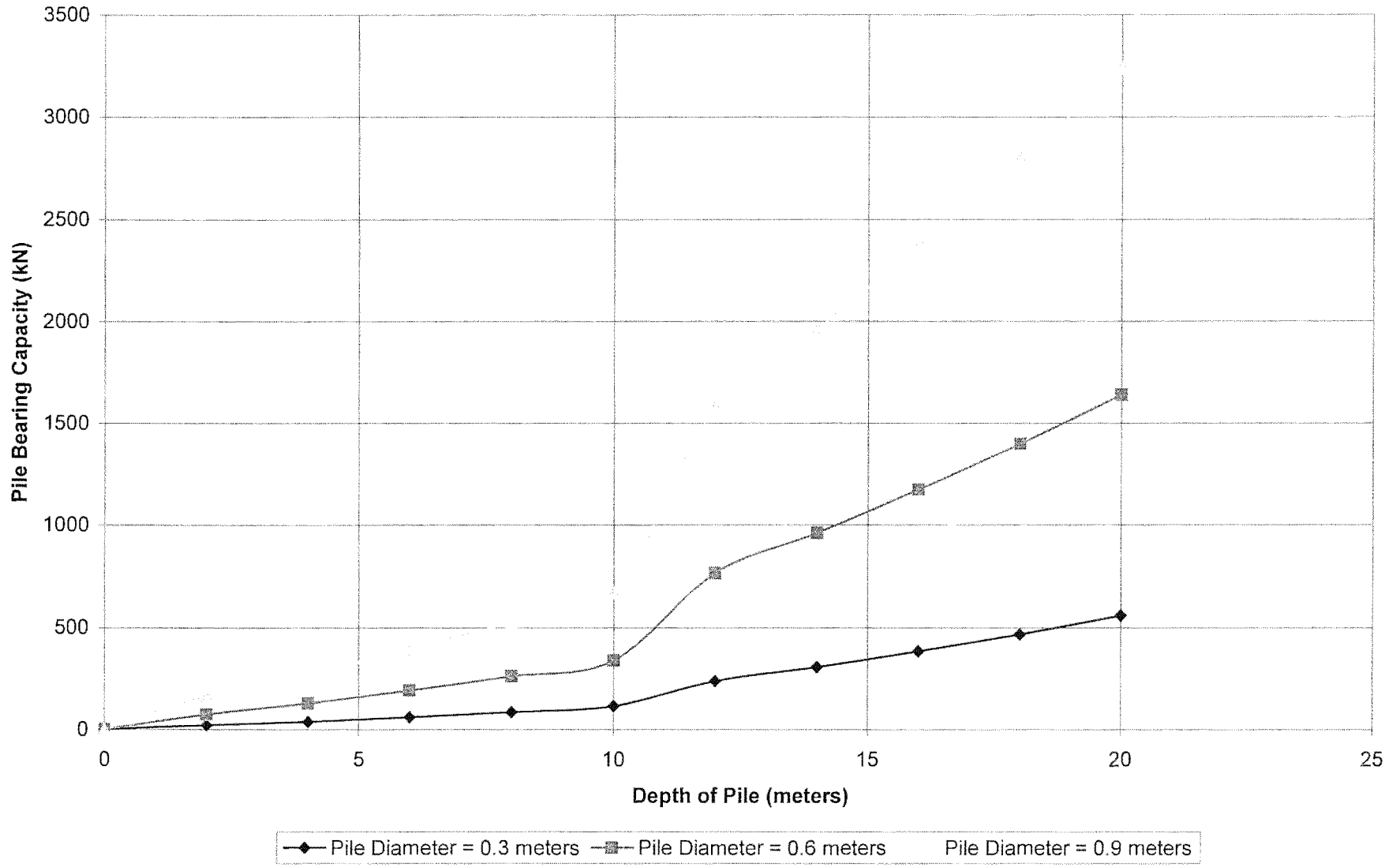
Calculation of q_b

depth	vertical stress	vertical eff. stress	bearing factor	axial bearing capacity (tip)
(meters)	(kPa)	(kPa)		(kPa)
0	0	0	40	0
2	33	23.2	40	928
4	66	36.6	40	1464
6	99	50	40	2000
8	132	63.4	40	2536
10	165	76.8	40	3072
12	204	96.2	85	8177
14	243	115.6	85	9826
16	282	135	85	11475
18	321	154.4	85	13124
20	360	173.8	85	14773

Axial Bearing Capacity for given diameter in (kN) with a factor of safety = 4

Depth (meters)	Pile Diameter (meters)		
	0.3	0.6	0.9
0	0	0	0
2	21	75	162
4	39	130	272
6	61	192	394
8	86	262	528
10	116	340	672
12	238	766	1582
14	307	962	1964
16	384	1173	2368
18	467	1399	2794
20	558	1639	3242

AXIAL BEARING CAPACITY - STATIC ANALYSIS



Appendix F – Recommended Grainsize Distribution

Sheet1

SPT						
b	0.9	0.6	0.3	0.9	0.6	0.3
Q	1760	990	403	1294	679	247
L	20	20	20	10	10	10
A	0.636173	0.282743	0.070686	0.636173	0.282743	0.070686
E	200000	200000	200000	200000	200000	200000
S	0.009277	0.00635	0.00357	0.009102	0.00612	0.003175
STATIC						
b	0.9	0.6	0.3	0.9	0.6	0.3
Q	3242	1639	558	672	340	116
L	20	20	20	10	10	10
A	0.636173	0.282743	0.070686	0.636173	0.282743	0.070686
E	200000	200000	200000	200000	200000	200000
S	0.00951	0.00658	0.003789	0.009053	0.00606	0.003082

$$Q \times L$$

$$kN \quad m$$

$$kN \cdot m$$

$$A \times E$$

$$m^2 \times Mpa$$

$$m^2 \times 10^3 \text{ KN}/m^2$$

$$= 10^3 \text{ KN}$$

$$\frac{kN \cdot m}{10^3 \text{ KN}}$$

$$= \frac{10^{-3}}{m}$$

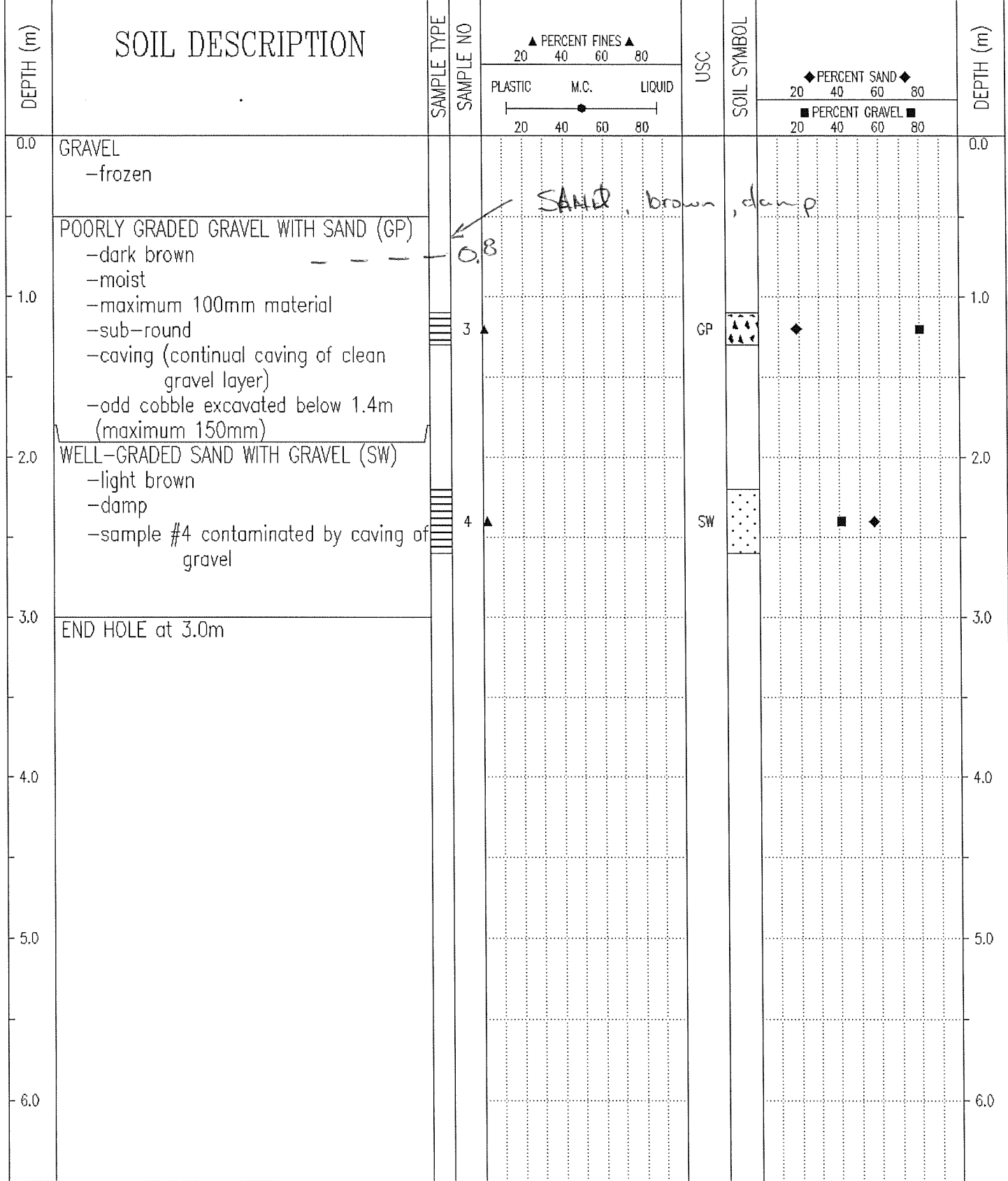


$$1 \text{ pa} = 1 \text{ N}/m^2$$

$$1 \text{ Mpa} = 10^6 \text{ N}/m^2$$

$$= 10^3 \text{ KN}/m^2$$

SUBSURFACE EXPLORATION AND TEST REPORT		KLONDIKE HIGHWAY GRANULAR INVESTIGATION	TEST HOLE NO: 464-02
ENGINEERING CAPITAL		KM 224 RHS	Project No: 092-202002-0201
KOERING 6625 BACKHOE		LOCATION: SEE PLAN	ELEVATION: 0.00 (m)
SAMPLE TYPE	<input checked="" type="checkbox"/> RETURN	<input checked="" type="checkbox"/> S.P.T.	<input checked="" type="checkbox"/> AUGER
		<input type="checkbox"/> BULK	<input type="checkbox"/> TUBE
			<input type="checkbox"/> CORE



Government of Yukon Transportation Engineering	LOGGED BY: K.J.	COMPLETION DEPTH: 3.0 m
	REVIEWED BY:	COMPLETE: 97/10/15
	Fig. No:	Page 1 of 1

$$Q \cdot L \quad / \quad A \cdot E$$

$$1760 \quad 20$$

$$.636 \cdot 200,000$$

$$35200$$

$$127200$$

$$= .2767$$

$$.2767 \times 10^{-3} \text{ m}$$

$$= .00028 \text{ m}$$

$$+ .009$$

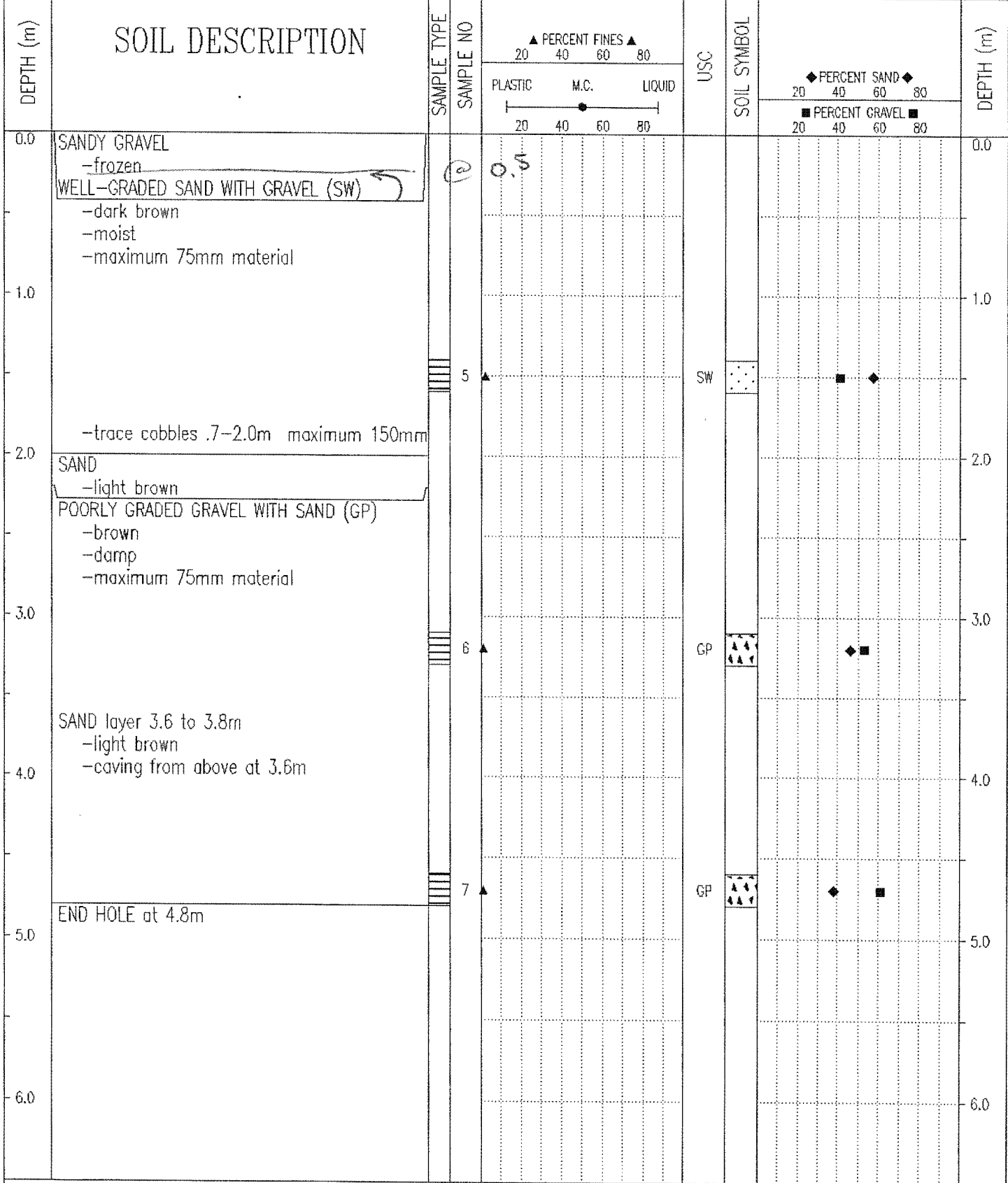
$$=$$

$$.00928 \text{ m}$$

$$=$$

$$9 \text{ mm.}$$

SAMPLE TYPE RETURN S.P.T. AUGER BULK TUBE CORE



Government of Yukon
Transportation Engineering

LOGGED BY: K.J.	COMPLETION DEPTH: 4.8 m
REVIEWED BY:	COMPLETE: 97/10/15
Fig. No:	

**SUMMARY OF RECOMMENDED IMPORTED GRANULAR
CONSTRUCTION MATERIAL GRAINSIZE DISTRIBUTIONS**

IMPORTED FILL

Sieve Number	% Passing By Weight
80,000	100
25,000	60-100
12,500	40-90
5,000	20-65
1,250	9-35
315	3-15
80	0-5

20mm MINUS BASE GRAVEL

Sieve Number	% Passing By Weight
20,000	100
12,500	64-100
5,000	36-72
1,250	12-42
315	4-22
80	3-8



GR-999-014