

PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
LITTLE WHITE RIVER II BRIDGE REPLACEMENT
HIGHWAY 546, DISTRICT OF ALGOMA
G.W.P.512-00-00, W.P. 513-00-01, SITE: 38S-056

Geocres Number: 41J-73

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of the proposed replacement bridge to carry Highway 546 over the Little White River in Algoma, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

A previous investigation was reported in 2004 by Golder Associates Ltd. related to the replacement of the existing temporary modular bridge (TMB). The factual data from that investigation is included in Appendix C and has been considered in the analysis and preparation of recommendations contained in this report.

Thurber carried out the investigation as a sub-consultant to Marshall Macklin Monaghan, under the Ministry of Transportation Ontario (MTO) Agreement Number 5005-E-0042.

2 SITE DESCRIPTION

At the site, the Little White River flows towards the southwest in a channel that parallels Highway 546. Little White River joins the Mississagai River near Wharncliffe, approximately 10 km north of Highway 17. The river level was recorded as Elevation 297.2 in October 2006.

The river flows on a relatively gentle gradient at the site, with poorly developed meanders. The channel is approximately 21 m wide and 3 m deep (in the middle of the channel). The river banks are approximately 2 m high at the site, though higher, actively eroding banks were observed approximately 200 m upstream from the existing crossing, as can be seen in the background of Photo 4 in Appendix E, just below the "Little White River" sign.

Geologically, the site lies within the Canadian Shield, which is characterized by Pre-Cambrian bedrock. Locally, however, the Little White River flow across post-glacial deposits of sand and gravel and the area is comparatively flat and well treed. There are no buildings or other developments in the immediate vicinity of the site. The junction of Highway 546 with Highway 639 lies approximately 1.4 km north of the site.

Photographs of the site are included in Appendix E and show the existing bridge, the approaches and the soil exposure north of the bridge site.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field-testing for this project was carried out during February 19 to March 17, 2007. Six boreholes numbered 07-LW1 to 07-LW6 were drilled at the north and south abutments of possible single-span structures on three alternative alignments. The depths of the boreholes ranged from 23.2 m to 32.3 m. 8 boreholes (07-LW7 to 07-LW14) were drilled along the existing road for the proposed embankment and ranged in depth from 2.9 m to 3.7 m. The Record of Borehole sheets for the boreholes are included in Appendix A. The approximate locations of the 14 boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix F.

Prior to commencing the site investigation, clearance was obtained from utility companies having plant in the area.

A combination of hollow-stem auger drilling and diamond coring techniques were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

Dynamic Cone Penetration Testing (DCPT) was undertaken in boreholes LW1, LW2, LW5 & LW6 from a depth of 1.5 m to refusal, and from 25.5 m to refusal in borehole LW3.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. At each abutment one or more standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen were installed and enclosed in filter sand to permit longer term groundwater level monitoring. The locations and completion details of the piezometers are shown in Table 3.1. Boreholes without piezometer installations were grouted with bentonite upon completion. The borehole completion details are shown in Table 3.1.

A member of Thurber's technical staff supervised drilling and sampling operations on a full time basis. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

Table 3.1 – Borehole Completion Details

Borehole Location	Piezometer Tip Depth/ Elevation (m)	Completion Details
07-LW1 South Abutment	29.9 / 270.0	Piezometer with 1.5 m slotted screen installed with sand filter to 27.8 m, bentonite seal from 27.8 m to ground surface.
07-LW2 North Abutment	22.8 / 275.8	Piezometer with 1.5 m slotted screen installed with sand filter to 21.0 m, bentonite seal from 21.0 m to ground surface.
07-LW3 South Abutment	No Installation	Bentonite grout to ground surface.
07-LW4 North Abutment	No Installation	Bentonite grout to ground surface.
07-LW5 South Abutment	30.5 / 270.2	Piezometer with 1.5 m slotted screen installed with sand filter to 28.4 m, bentonite seal from 28.4 m to ground surface.
07-LW6 North Abutment	24.4 / 273.3	Piezometer with 1.5 m slotted screen installed with sand filter to 22.9 m, bentonite seal from 22.9 m to ground surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A. Selected samples were also subjected to gradation analysis and the results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy along the three alternative alignments are presented in this appendix and on the “Borehole Locations and Soil Strata” drawings in Appendix F. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by granular fill overlying cohesionless deposits of sand and gravel with cobbles and boulders.

5.1 Topsoil

Topsoil was encountered at two abutment borehole locations (LW3 & LW6) ranging from 75 mm to 200 mm in thickness. The topsoil ranged from peaty deposits near the river to sandy topsoil above the riverbank. Topsoil was encountered in Boreholes LW 7 to LW11 inclusively, ranging in thickness from 50 to 100 mm.

5.2 Fill

Boreholes LW4 & LW5, located on the north and south abutments respectively, encountered granular fill consisting of reworked native sand and gravel with cobbles and boulders. The thickness of the fill ranged from 2.4 to 3.0 m and the underside of the fill layer was recorded at elevations between 298.3 m and 297.4 m.

‘N’ values ranging from 11 to greater than 100, derived from Standard Penetration Tests conducted in the sand and gravel fill, indicate a compact to very dense relative density. In some cases, the high SPT values may reflect the presence of cobbles or boulders.

Natural moisture content of samples from the granular fill ranged from approximately 4 to 16 %. A gradation of a sample of the fill is shown in Figure B1 in Appendix B.

Fill material was not encountered in the embankment boreholes.

5.3 Sand and Gravel

The soils encountered in the boreholes drilled for the investigation consisted predominantly of layered sand and gravel deposits. These deposits extended to the depth of exploration, ranging from 23.2 to 32.3 m at the river crossing and 2.9 m to 3.7 m for the embankment boreholes. The soils were generally encountered in a compact state, becoming very dense toward the bottom of the exploratory boreholes. Cobbles and boulders were inferred at depth from SPT refusal. SPT ‘N’ values generally ranged between 17 and greater than 100 blows per 300mm penetration were recorded in this stratum, indicating compact to very dense relative density.

Gravel was encountered more frequently at the south abutment than at the north abutment where sand was the predominant soil type, with sand and gravel occurring at depths of greater than 17 m below ground level. Gravel was not encountered in boreholes LW4 and LW5.

The structural boreholes, with the exception of LW3, terminated in 2 m to greater than 3 m of dense or very dense sand.

The embankment boreholes encountered layers of sand and sand and gravel and predominantly exhibited compact to very dense relative density.

Selected samples from this deposit were subjected to grain size distribution tests and the results are presented in Figures B2 to B9 in Appendix B. Natural moisture content of this material ranged from approximately 4 to 35%.

5.4 Silt

A layer of silt, 0.8 m to 3.7 m thick, was encountered at depths of 4 to 7 m on the north bank (LW2 LW4 & LW6) of the river and also a 0.7 m thick layer at a depth of 0.8 m in LW 2. SPT ‘N’ values between 16 and 45 were recorded in the main stratum, indicating

compact to dense relative density. The upper stratum in LW 2 is loose, based on a SPT 'N' value of 8.

Loose sandy silt was encountered at embankment borehole LW11 from ground level to 2.2 m, coinciding with a high water table of 0.8 m below ground level. Compact silt was also encountered in embankment borehole LW12 from 3 to 3.7 m.

The results of gradation testing undertaken on this deposit are presented in Figures B10 to B12 in Appendix B. Natural moisture content of this material ranged from approximately 16 to 28 %.

5.5 Groundwater Conditions

Standpipe piezometers were installed in selected boreholes and water levels were measured after completion of drilling and prior to demobilization from the site. The water level readings are presented in Tables 5.2 and 5.3.

Based on short-term readings in piezometers installed at the site, the groundwater level ranges from Elevation 295.0 close to the river to Elevation 302.4 in borehole LW13 further from the river. The water table will fluctuate seasonally and will be strongly influenced by the level of the river.

Table 5.2: Water Level Measurements at Bridge Abutments

	BH 07-LW1		BH 07-LW2		BH 07-LW3		BH 07-LW4		BH 07-LW5		BH 07-LW6	
Date (2007)	Depth (m)	Elev.	Depth (m)	Elev.	Depth (m)	Elev.	Depth (m)	Elev.	Depth (m)	Elev.	Depth (m)	Elev.
March 8	-		-		-		-		-		0.8	296.9
March 9	-		-		-		3.7	296.8	-		-	
March 13	4.9	295.0	-		-		-		-		-	
March 15	-		-		-		-		3.7	297.0	-	
March 16	-		1.8	296.8	-		-		-		-	
March 29	-		-		3.1	297.2	-		-		-	

Table 5.3: Water Level Measurements along Embankment Alignment

	BH 07-LW7, LW8, LW9, LW10, LW14		BH 07-LW11		BH 07-LW12		BH 07-LW13	
Date (2007)	Depth (m)	Elev.	Depth (m)	Elev.	Depth (m)	Elev.	Depth (m)	Elev.
March 10	Dry Upon Completion		-		2.1	299.9	2.9	302.4
March 17			0.8	299.8	-		-	

Boreholes LW7, LW8, LW9, LW10, and LW14 did not encounter groundwater at the time of investigation. All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

6 MISCELLANEOUS

Eastern Ontario Diamond Drilling Ltd. of Hawkesbury, Ontario supplied a track mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephane Loranger and Mr. George Azzopardi of Thurber, under the direction of Mr. Alastair E. Gorman, P.Eng.

The coordinates for the boreholes and the ground surface elevations were provided by Marshall Macklin Monaghan.

Mr. Tony Harte, M.Sc., FGS and Mr. Alastair E. Gorman, P.Eng prepared the Foundation Investigation Report.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.

Thurber Engineering Ltd.
Tony Harte, M.Sc., FGS

Tony Harte
MAY 15, 2007



Alastair E. Gorman, P.Eng.,
Senior Foundations Engineer

Report Reviewed by:
P.K. Chatterji, P.Eng.,
Review Principal, Designated MTO Contact



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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This report presents interpretation of the geotechnical data in the factual report and presents preliminary geotechnical design recommendations to assist the design team to select and design a suitable foundation system and approach embankments for the new permanent structure and for a detour structure, if required.

It is understood that Highway 546 will cross the Little White River on a single span structure that may lie on the existing alignment or on a new alignment immediately east or west of the existing. In the case of replacement on the existing alignment, a detour structure will also be required.

It is anticipated that the grade of the highway as it crosses the new structure will be approximately Elevation 300.0. The resulting approach embankments will be approximately 2 m above the original ground level at the south and up to 3.5 m above original ground at the north.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of this investigation.

8 STRUCTURE FOUNDATIONS

The stratigraphy identified in the preliminary investigation consisted primarily of a deep deposit of sands and gravels, with some silt layers, extending to depths greater than the maximum depth of exploration of 32 m. On and adjacent to the existing highway alignment, the native soil was overlain by generally dense to very dense cohesionless fill, presumably placed during past road construction activities.

The existing temporary modular bridge (TMB) is supported on timber cribs as shown in Photo 4 in Appendix E. These crib foundations appear to be performing satisfactorily. The approach spans from the ends of the TMB to the river bank are assumed to be supported on shallow footings or sleepers that are not readily visible.

In the preparation of the preliminary geotechnical design recommendations, consideration was given to the following foundation types:

- Spread footings bearing on native soil
- Spread footings on engineered fill
- Steel H-piles driven into the very dense soil
- Drilled shafts founded in the very dense soil

A comparison of the foundation alternatives based on advantages and disadvantages of each is included in Appendix D.

8.1 Spread Footings on Native Soil

Spread footings bearing on native soil generally are the least expensive form of construction.

However, at this site, spread footings are not recommended for the following reasons:

1. The near surface soils are cohesionless and the relative density was found to be highly variable, being very loose in some boreholes. Accordingly, the geotechnical resistance is low and uneven settlement is also anticipated.
2. Shallow foundations placed near the edge of the river would be at risk from erosion during the design life of the structure.
3. Founding spread footings at sufficient depth to resist erosion would require excavation in permeable, cohesionless soils below the water table. Such an excavation would require extensive dewatering and yet would remain at risk of becoming destabilized due to the inflow of unbalanced groundwater heads.

8.2 Spread Footings on Engineered Fill

The available geotechnical resistance could be improved, including improvement of the SLS condition, by founding the footings on a pad of Granular “A” engineered fill. Typically, spread footings on pads of engineered granular fill may be designed for the following geotechnical resistances:

- Factored ULS 900 kPa
- SLS 350 kPa

However, the use of spread footings on engineered fill at this site is not recommended for the following reasons:

1. The engineered fill pad could be subject to erosion or undermining during high river flows.

2. Founding the engineered fill on suitably dense, uniform subgrade soils may require excavation in permeable, cohesionless soils below the water table. Such an excavation would require extensive dewatering and yet would remain at risk of becoming destabilized due to the inflow of unbalanced groundwater heads.

8.3 Steel H-Piles

The soil stratigraphy encountered at this site is considered to be suitable for the support of foundations on driven steel piles.

It is recommended that the H-piles be driven to sufficient depth to embed the pile tips in the very dense sand and gravel soils encountered at the site.

8.3.1 Axial Resistance

For preliminary design, the following geotechnical resistances can be used for piles founded in the very dense native soils:

Pile Section	Geotechnical Resistance (kPa)	
	Factored ULS	SLS (25 mm)
HP 310 X 110	1 600	1 400
HP 360 X 132	1 800	1 600

The structural resistance of the pile must be checked by the structural designer.

The highest recommended tip elevations for the H-piles are as follows:

	Highest Pile Tip Elevation		
	West Alignment	Existing Alignment	East Alignment
North Abutment	278	273	275
South Abutment	271	274	270

These are preliminary recommendations and may change during detail design based on the final alignment, final bridge arrangement and the results of the site investigation and field testing to be completed at that time.

8.3.2 Pile Installation

Pile installation should be in accordance with Special Provision No. 903S01.

The soils encountered consist of sand and gravel that is generally compact in the upper 20 m, becoming very dense at greater depths. The presence of cobbles and boulders has been inferred at depth across the site.

8.4 Drilled Shafts

Initial consideration was given to the use of drilled shafts to support the structure. However, the use of drilled shafts is not recommended for the following reasons:

1. Based on the available information from the investigation, the drilled shaft piles would be founded in cohesionless soils below the water table. Drilling with mud and/or the simultaneous advance of a steel liner would be required in order to maintain stable sides.
2. It would not be possible to unwater the shaft, necessitating placement of concrete by tremie methods, and preferably by pumping.
3. There is a high risk that the geotechnical resistance of the soil would be compromised due to disturbance of the founding soil caused by drilling below the groundwater level.

8.5 Downdrag

Downdrag on the piles is not an issue at this site.

8.6 Abutment Design Considerations

From a geotechnical perspective, the conditions at this site are considered to be suitable for the design of conventional, semi-integral or integral abutments.

Design of the abutment must take account of the CHBDC requirements for scour protection.

8.7 Recommended Foundation

From a geotechnical perspective, the recommended foundation consists of steel H-piles driven into the very dense native soil.

From a foundations perspective, the three alternative alignments are equal.

9 BRIDGE APPROACHES AND EMBANKMENTS

Based on the total of the six boreholes drilled at the alternative structure locations and eight boreholes drilled along potential realignments, the soils at the site are almost entirely non-cohesive sand and gravel. In general, the soils are described as compact to very dense sand and gravel with cobbles and boulders.

No long term settlement problems are anticipated for approach embankments built at this site. Similarly, the 2 to 3 m high embankments likely to be constructed will be stable at side slopes of 2H:1V and no overall stability issues are expected provided the new embankment does not encroach on the river bank.

10 CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to:

1. Pile Installation

The presence of cobbles and boulders in a very dense matrix of sand and gravel may present difficulties in installing the piles to the specified depth and to the specified tolerances for location and verticality.

2. Excavation

Hydraulic equipment is expected to be capable of excavating to the depths required for abutments on piles. If excavations advance below the existing groundwater level, groundwater control measures may have to be implemented in order to maintain stable sides and base in the excavation.

3. Unwatering

The pervious nature of the soils encountered at this site and the proximity to the river will make unwatering of excavations difficult. Depending on the locations of the abutments, steps may have to be taken to control the river and exclude it from the excavations. Typically, a combination of a sheet pile cutoff and vacuum well-points may be required.

11 INVESTIGATION FOR DETAIL DESIGN

During the detail design phase of the project, additional site investigation and field testing will be required. The following minimum program is recommended:

1. Boreholes for structure foundations.

Two sampled boreholes must be drilled at each foundation element of the new permanent structure and at each foundation element of the detour, if a detour is required.

At each foundation element, one borehole must be sampled to refusal (N=100 blows for 0.3 m of penetration) and the second borehole must be sampled to 3 m below refusal or to the depth to which piles will be driven, whichever is deeper. The preliminary investigation has revealed the presence of cobbles or boulders that might impede the driving of piles. Particular attention must be paid to recording cobbles and boulders during drilling in the detail design phase.

Depending on the final bridge arrangement, it may be possible to incorporate some of the boreholes drilled in the preliminary investigation.

2. Boreholes for approaches.

At each approach to the permanent structure and to the detour structure, one sampled borehole must be drilled. These boreholes must be sampled to depths equal to the height of the embankment at the location of investigation, or to refusal if refusal is encountered at a lesser depth.

3. Reporting.

A Foundation Investigation and Foundation Investigation and Design Report must be prepared in accordance with the Ministry's standards. The topics addressed in the design portion must include:

- Structure foundation design (shallow or deep)
- Associated axial, lateral and sliding resistances
- Founding elevations for the potential foundation options
- Suitability for integral or semi-integral abutment design
- Requirements for pile driving shoes/rock points
- Assumptions for earth pressure diagrams and conceptual shoring alternatives, if required
- Stability analysis and recommendations for slope geometry
- Settlement (preloading/surcharging, soil improvement, wick drains, lightweight fill)
- Frost protection
- Drainage, run-off, erosion protection
- Unwatering
- Staged construction
- Geosynthetic reinforcement and Retained Soil Systems (RSS)
- Seismic considerations

12 CLOSURE

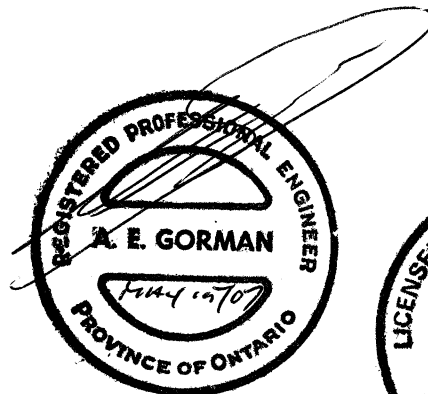
Engineering analysis and preparation of the Foundation Design Report were carried out by Mr. Alastair E. Gorman, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Alastair E. Gorman, P.Eng.,
Senior Foundations Engineer

P. K. Chatterji, P.Eng.,
Review Principal



Appendix A



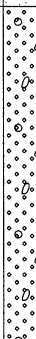

Record of Borehole Sheets

RECORD OF BOREHOLE No 07-LW1

1 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 794.62 E 394 842.35 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.10 - 2007.03.13 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
299.9								20 40 60 80 100						
0.0	SAND AND GRAVEL, trace silt, occasional rootlets Very Dense Brown (SP)		1	SS	59									31 52 17 (SI+CL)
			2	SS	74									
298.4														
1.5	SAND, trace gravel Dense Brown (SP)		3	SS	37									
297.6														
2.4	SAND AND GRAVEL Compact to Dense Brown (SP)		4	SS	45									28 68 4 (SI+CL)
			5	SS	16									
295.3														
4.6	SAND, trace gravel Compact to Dense Brown Wet (SP)		6	SS	15									0 97 3 (SI+CL)
			7	SS	31									8 81 11 (SI+CL)
			8	SS	19									
			9	SS	17									0 96 4 (SI+CL)

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW1

2 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 794.62 E 394 842.35 ORIGINATED BY GA
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SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P W W L				WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
	Continued From Previous Page							20 40 60 80 100						
289.3	SAND, trace gravel Compact to Dense Brown Wet (SP)													
10.7	SAND AND GRAVEL Compact to Dense Brown Wet (SP)		10	SS	21		289						43 53 4 (SI+CL)	
			11	SS	27		288							
			12	SS	30		287							
			13	SS	27		286						43 54 3 (SI+CL)	
			14	SS	17		285							
							284							
			15	SS	30		283							
							282							
							281						29 62 9 (SI+CL)	

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+ 3, × 3: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

METRIC[illegible]

+ ³, × ³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 07-LW1

4 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 794.62 E 394 842.35 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.10 - 2007.03.13 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) W _p W W _L				
	Continued From Previous Page																
269.1	SAND, some gravel Very Dense Brown Wet (SP)		20	SS	101												
30.8	END OF BOREHOLE AT 30.78m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 13/03/07 4.88 295.02						269										

RECORD OF BOREHOLE No 07-LW2

1 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 821.99 E 394 861.84 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.16 - 2007.03.17 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								○ UNCONFINED + FIELD VANE				
								● QUICK TRIAXIAL × LAB VANE				
298.6						20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
0.0	SAND , trace silt, trace to some gravel, occasional cobbles Very Dense Brown (SP)		1	SS	50/ .150		W P	W	W L			
297.8							WATER CONTENT (%)					
0.8	SILT , trace clay, trace sand, occasional cobbles Firm Brown		2	SS	8							
297.1												
1.5	SAND AND GRAVEL Dense Brown Wet (GP)		3	SS	32							
296.3												
2.3	SAND , trace to some gravel Very Dense Brown (SP)		4	SS	55							
			5	SS	50/ .075							
294.5												
4.1	Sandy SILT , trace clay, trace gravel Compact Grey (SM-NP)		6	SS	16							
292.9												
5.6	SAND Compact to Dense Brown (SP)		7	SS	30							
			8	SS	27							
			9	SS	29							

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW2

2 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 821.99 E 394 861.84 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.16 - 2007.03.17 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L	W _P W W _L	W _P W W _L		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)				GR SA SI CL
	SAND Compact to Dense Brown (SP)													
	Very Dense		10	SS	84		288							
							287							
			11	SS	26		286							1 96 3 (SI+CL)
							285							
			12	SS	27		284							0 93 7 (SI+CL)
							283							
	occasional gravel seam 15.85 to 16.46m.		13	SS	23		282							0 100 0 (SI+CL)
							281							
280.7			14	SS	22		280							
17.8	SAND AND GRAVEL , occasional cobbles Very Dense Grey (SP)		15	SS	82		279							

Continued Next Page

+ 3 , × 3 : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW2

3 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 821.99 E 394 861.84 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.16 - 2007.03.17 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
277.2	SAND AND GRAVEL, occasional cobbles Very Dense Grey (SP)		16	SS	102		278							
21.3	SAND, some gravel Very Dense Grey (SP)		17	SS	103		277							17 78 5 (SI+CL)
							276							
275.4			18	SS	108									
23.2	END OF BOREHOLE AT 23.16m. BOREHOLE OPEN TO 22.86m IN CASING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 16/03/07 1.83 296.77													

RECORD OF BOREHOLE No 07-LW3

1 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 786.98 E 394 843.37 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.20 - 2007.02.20 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
300.3							20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
0.0 0.1	TOPSOIL: (75 mm) SAND AND GRAVEL, occasional cobbles Very Dense Brown														
299.2			1	SS	50/ .125										
1.1	SAND, trace gravel Compact Brown Moist														
			2	SS	21										
			3	SS	15										
			4	SS	7										
			5	SS	17										
294.8															
5.5	SAND AND GRAVEL, occasional cobbles Compact Grey Wet														
			6	SS	17										
			7	SS	20										
			8	SS	17										

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Continued Next Page

+ 3, x 3: Numbers refer to 20
Sensitivity 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW3

2 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 786.98 E 394 843.37 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.20 - 2007.02.20 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100	20 40 60	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page						290											
289.8	SAND AND GRAVEL, occasional cobbles Compact																	
10.5	SAND, trace to some silt, trace gravel Compact Grey Wet		9	SS	17										2 94 4 (SI+CL)			
							289											
			10	SS	23		288											
	some gravel, trace silt						287											
			11	SS	21													
							286											
	occasional cobbles		12	SS	21		285											
							284											
			13	SS	12		283											
							282											
			14	SS	20													
							281											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW3

3 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 786.98 E 394 843.37 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.20 - 2007.02.20 CHECKED BY AEG




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
	Continued From Previous Page		15	SS	20		280							1 97 2 (SI+CL)
	SAND, trace to some silt, trace gravel Compact Grey Wet													
	occasion gravel seams loss of water in between 22.86m and 25.91 m						279							
							278							
			16	SS	15		277							
							276							
275.0														
25.3	AUGER REFUSAL AT 25.3m. DCPT REFUSAL AT 27.41m. BOREHOLE BACKFILLED WITH BENTONITE GROUT.													
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/03/07 3.05 297.25													

RECORD OF BOREHOLE No 07-LW4

1 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 821.16 E 394 872.30 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.08 - 2007.03.09 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	W P W W L	20 40 60						
300.5	SAND AND GRAVEL , occasional cobbles Compact to Very Dense Brown (FILL)(SP)		1	SS	84													
0.0																		
			2	SS	78													
			3	SS	100/ .075													
			4	SS	11													
297.4	SAND , trace gravel, trace clay Loose to Very Dense Grey to Brown (SP)		5	SS	5													
3.0																		
			6	SS	12													
			7	SS	50/ .150													
293.5	SILT , some clay, trace gravel, trace sand Hard (ML)																	
7.0																		
			8	SS	41													
			9	SS	45													

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

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15
10

(%) STRAIN AT FAILURE

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w _p — w — w _L				
								20	40	60	80	100	20	40	60		
Continued From Previous Page																	
289.8	SILT, trace clay, trace gravel Hard (ML)						290										
10.7	SAND, trace silt, compact to dense Grey (SP)		10	SS	37		289										
			11	SS	35		288										
			12	SS	15		287										
			13	SS	35		286										
			14	SS	30		285										
			15	SS	17		284										
							283										
							282										
							281										

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 07-LW4

3 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 821.16 E 394 872.30 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.08 - 2007.03.09 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page		16	SS	15									
	SAND, trace silt, compact to dense Grey (SP)						280							
							279							
							278							
	becoming gravelly		17	SS	29									
							277							
							276							
							275							
			18	SS	17									
							274							
							273							
			19	SS	101/ .275									
							272							
271.2 29.3	END OF BOREHOLE AT 29.26m. BOREHOLE BACKFILLED WITH BENTONITE GROUT.		20	SS	122/ .300									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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15 5
10 (%) STRAIN AT FAILURE

ONTMT4S 2333.GPJ 17/05/07

RECORD OF BOREHOLE No 07-LW4

4 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 821.16 E 394 872.30 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.08 - 2007.03.09 CHECKED BY AEG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
							20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page															
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 09/03/07 3.66 296.84															

METRIC

G.W.P.	5321-04-00	LOCATION	Little White River N 5 167 778.62 E 394 853.61	ORIGINATED BY	GA
HWY	129	BOREHOLE TYPE	Hollow Stem Auger / NW Casing	COMPILED BY	MFA
DATUM	Geodetic	DATE	2007.03.14 - 2007.03.15	CHECKED BY	AEG

[illegible]

+ 3, × 3: Numbers refer to Sensitivity

ONTMT4S 2333.GPJ 17/05/07

RECORD OF BOREHOLE No 07-LW5

2 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 778.62 E 394 853.61 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.14 - 2007.03.15 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								20 40 60 80 100										
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W P W W L WATER CONTENT (%)							
							20 40 60 80 100				20 40 60							
	Continued From Previous Page																	
	SAND, some silt, trace gravel Compact Brown (SP) becoming Grey		10	SS	38		290											
							289											
			11	SS	21		288											
							287											
			12	SS	26		286											
							285											
			13	SS	16		284											
							283											
			14	SS	17		282											
							281											
			15	SS	20													

7 75 18
(SI+CL)

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

ONTMT4S 2333.GPJ 17/05/07

METRIC

Continued Next Page



+ 3, × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 07-LW5

4 OF 4

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 778.62 E 394 853.61 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.14 - 2007.03.15 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)	
	Continued From Previous Page							20 40 60 80 100									
	SAND, trace silt, trace gravel Very Dense																
			20	SS	104			270									5 91 4 (SI+CL)
								269									
268.4																	
32.3	END OF BOREHOLE AT 32.31m. BOREHOLE OPEN TO 32.00m IN CASING Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 15/03/07 3.66 297.04																

RECORD OF BOREHOLE No 07-LW6

1 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 811.91 E 394 880.99 ORIGINATED BY SLU/GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.07 - 2007.03.07 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w _p w w _L				
297.7							20 40 60 80 100	20 40 60 80 100	20 40 60					
0.0	ORGANICS, with roots and rootlets													
0.2	SAND, trace gravel, with wood fragments Loose to Dense Brown Wet													
			1	SS	1									
			2	SS	1									
			3	SS	15									
			4	SS	36									
			5	SS	26									
			6	SS	70									
291.0	trace gravel Very Dense Brown/Grey													
6.7	SILT, some clay Hard Grey Moist													
290.2														
7.5	SAND, trace silt, trace to some gravel Loose to Compact Grey Wet (SP)		7	SS	10									
			8	SS	23									
	becoming brown													

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW6

2 OF 3

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 811.91 E 394 880.99 ORIGINATED BY SLU/GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger / NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.07 - 2007.03.07 CHECKED BY AEG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%)						
							20	40	60	80	100		GR SA SI CL
	SAND, trace silt, some gravel Loose to Compact Brown Wet		9	SS	20	287							20 80 0 (SI+CL)
			10	SS	30	286							
			11	SS	22	284							
			12	SS	27	282							0 92 8 (SI+CL)
			13	SS	20	281							
279.4						280							
18.3	SAND AND GRAVEL Compact Grey (SP)		14	SS	23	279							
277.9						278							
19.8	SAND, occasional gravel												

ONTM14S 2333.GPJ 17/05/07

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

METRIC

SOIL PROFILE						SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	20	40			60	80	100	w _p	w			w _L	GR
	Continued From Previous Page																	
	Dense to Very Dense Grey (SP)		15	SS	45													
	gravel layer at 21.3m																	
	some gravel, frequent cobbles, occasional boulders		16	SS	100/.150													
273.1																		
24.6	END OF BOREHOLE AT 24.6m. BOREHOLE OPEN TO 24.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																	
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 08/03/07 0.76 296.94																	

+ 3, × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 07-LW7

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 596.63 E 394 857.60 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.19 - 2007.02.19 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			
301.8													
0.0	TOPSOIL: (50 mm) SAND, trace gravel, occasional cobbles Very Dense Brown Moist		1	AS									
			1	SS	50/ .125		301						
			2	SS	23		300					5 92 3 (SI+CL)	
			3	SS	50/ .150								
			2	AS									
298.7			4	SS	50/ .025		299						
3.1	END OF BOREHOLE AT 3.08 m. BOREHOLE OPEN TO 0.84 m AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.												

RECORD OF BOREHOLE No 07-LW8

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 645.13 E 394 850.56 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.20 - 2007.02.20 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100	20	40	60			
301.3	TOPSOIL: (50 mm) SAND AND GRAVEL, occasional cobbles Compact Brown Moist Cobble		1	SS	50/ .100												
299.1			2	SS	25												
297.6	SAND, some silt Dense Brown Moist		3	SS	40												
297.6			4	SS	30												
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE OPEN TO 1.83 m AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.																

RECORD OF BOREHOLE No 07-LW9

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 696.02 E 394 848.00 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.20 - 2007.02.20 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80						100	20
301.0	TOPSOIL: (50 mm) SAND AND GRAVEL, occasional cobbles Loose to Dense Brown Moist Cobble		1	AS														
			1	SS	50/ .100													
			2	SS	8													
			3	SS	19													
			4	SS	36													
297.3	END OF BOREHOLE AT 3.66 m. BOREHOLE OPEN TO 1.60 m AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.																	

ONTMT4S 2333.GPJ 23/04/07

RECORD OF BOREHOLE No 07-LW10

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 744.62 E 394 829.68 ORIGINATED BY SLL
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JHL
 DATUM Geodetic DATE 2007.02.20 - 2007.02.20 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)			
301.2								20	40	60	80	100					
0.0 0.1	TOPSOIL: (75 mm) SAND, trace silt, trace gravel Very Loose to Compact Brown Moist						301										
			1	SS	1												
							300										
			2	SS	6												
			3	SS	20		299										
			4	SS	23		298										
297.5																	
3.7	END OF BOREHOLE AT 3.66 m. BOREHOLE OPEN TO 3.05 m AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.																

ONTM14S 2333.GPJ 23/04/07

RECORD OF BOREHOLE No 07-LW11

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 838.20 E 394 892.09 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.17 - 2007.03.17 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
300.6														
0.0 0.1	TOPSOIL Sandy SILT, trace clay, occasional rootlets and wood fibres Loose Brown (SM)		1	SS	6									
			2	SS	5									0 29 66 5
			3	SS	6									
298.4														
2.2	SAND AND GRAVEL Compact Grey Wet (SP)		4	SS	11									
			5	SS	28									
296.9														
3.7	END OF BOREHOLE AT 3.7m. BOREHOLE OPEN TO 1.2m AND BACKFILLED WITH BENTONITE GROUT TO SURFACE. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 17/03/07 0.76 299.84													

RECORD OF BOREHOLE No 07-LW12

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 854.29 E 394 930.36 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.10 - 2007.03.10 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
302.0								SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20	40	60	80	100		
								WATER CONTENT (%)						
								20	40	60				
								PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				
								W _p	W	W _L				
302.0	SAND, some gravel, occasional rootlets, occasional wood fibers Compact to Dense Brown Dry (SP)		1	SS	50/.125		302							
			2	SS	21		301							
			3	SS	25		300							
			4	SS	43									
299.0														
3.0	SILT, trace sand, trace clay Compact Grey (ML)		5	SS	27		299							
298.3														0 2 90 8
3.7	END OF BOREHOLE AT 3.66m. BOREHOLE OPEN TO 3.0m, BACKFILLED WITH BENTONITE GROUT TO SURFACE.													
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10/03/07 2.13 299.87													

ONTM14S 2333.GPJ 23/04/07

RECORD OF BOREHOLE No 07-LW13

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 889.58 E 394 967.43 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.10 - 2007.03.10 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
305.3														
0.0	SAND, trace to some gravel, occasional rootlets Very Dense Brown (SP)		1	SS	50/ .125		305							
304.5														
0.8	SAND AND GRAVEL, Very Dense Brown (SP)		2	SS	50/ .150		304							
			3	SS	50/ .150									
			4	SS	50/ .150		303							
302.4														
2.9	END OF BOREHOLE AT 2.9m. BOREHOLE OPEN TO 2.9m AND BACKFILLED WITH BENTONITE GROUT TO SURFACE. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10/03/07 2.90 302.40													

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-LW14

1 OF 1

METRIC

G.W.P. 5321-04-00 LOCATION Little White River N 5 167 913.38 E 395 012.85 ORIGINATED BY GA
 HWY 129 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007.03.10 - 2007.03.10 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
307.3								20 40 60 80 100									
0.0	SAND AND GRAVEL , occasional cobbles Very Dense Brown (SP)		1	SS	50/ .150		307										
			2	SS	50/ .100		306										
			3	SS	51												
			4	SS	50/ .150		305										
304.3	Wet																
3.0	SAND , trace gravel Very Dense Brown (SP)		5	SS	78		304										
303.8																	
3.5	END OF BOREHOLE AT 3.5m. BOREHOLE OPEN AND DRY TO 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.																

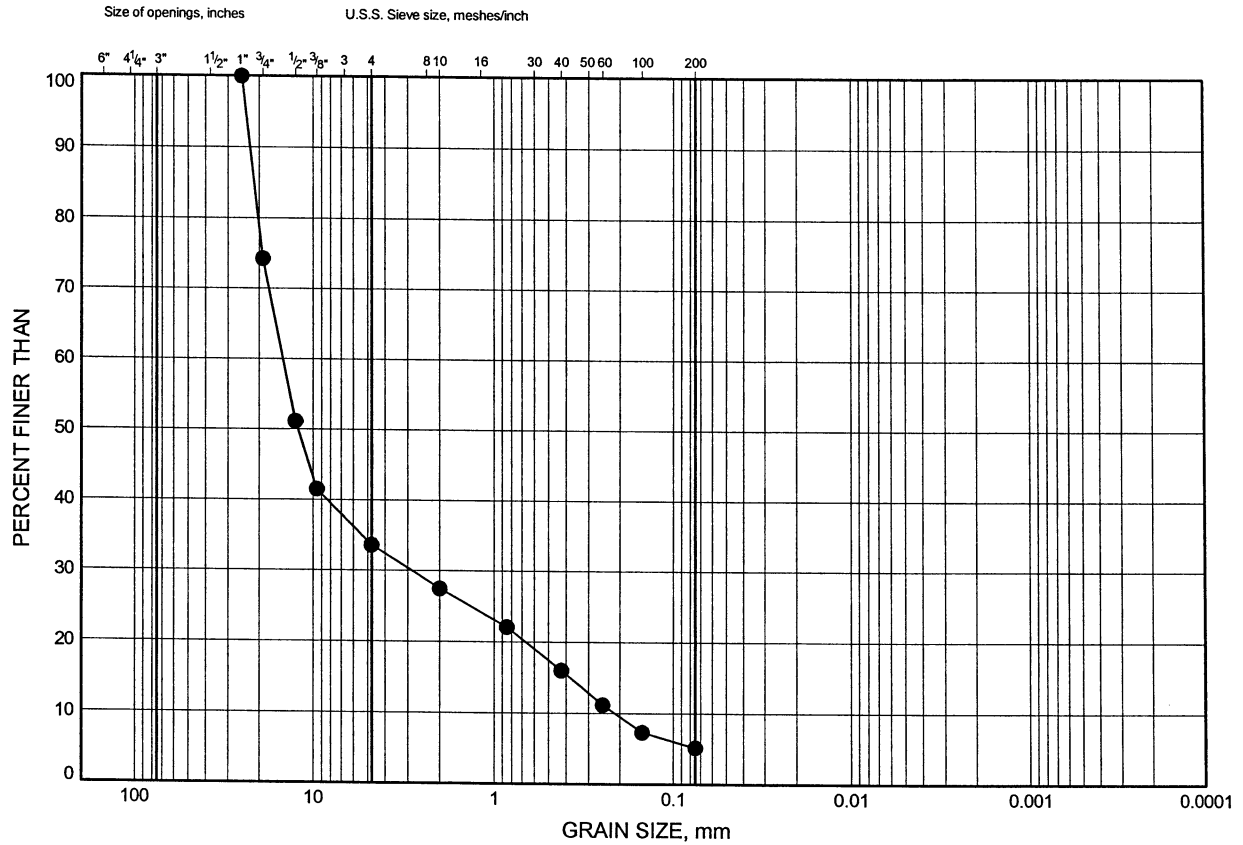
Appendix B

Laboratory Test Results

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B1

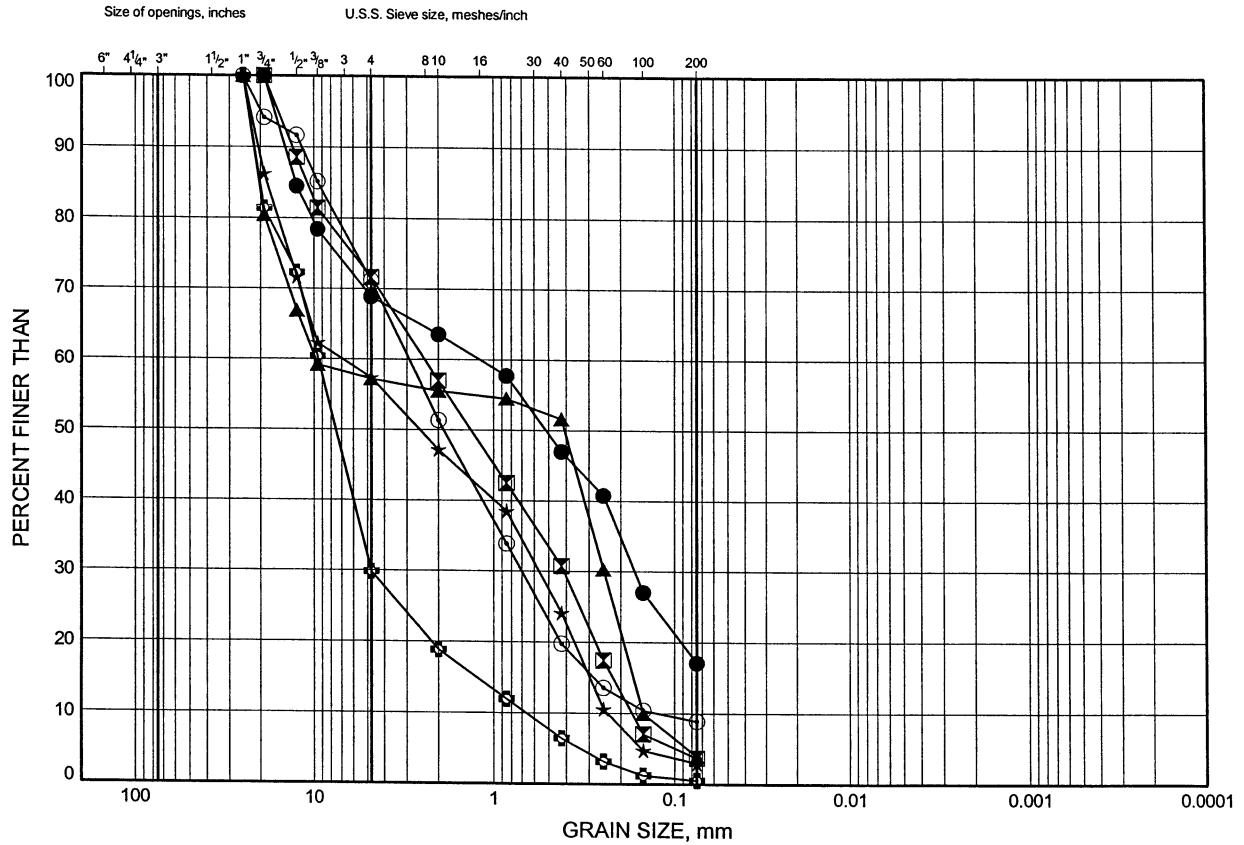
FILL



Little White River GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND AND GRAVEL



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW1	0.30	299.07
⊠	07-LW1	2.59	296.78
▲	07-LW1	10.97	288.40
★	07-LW1	14.02	285.35
⊙	07-LW1	18.59	280.78
⊛	07-LW1	20.12	279.25

Date April 2007

Project 5321-04-00



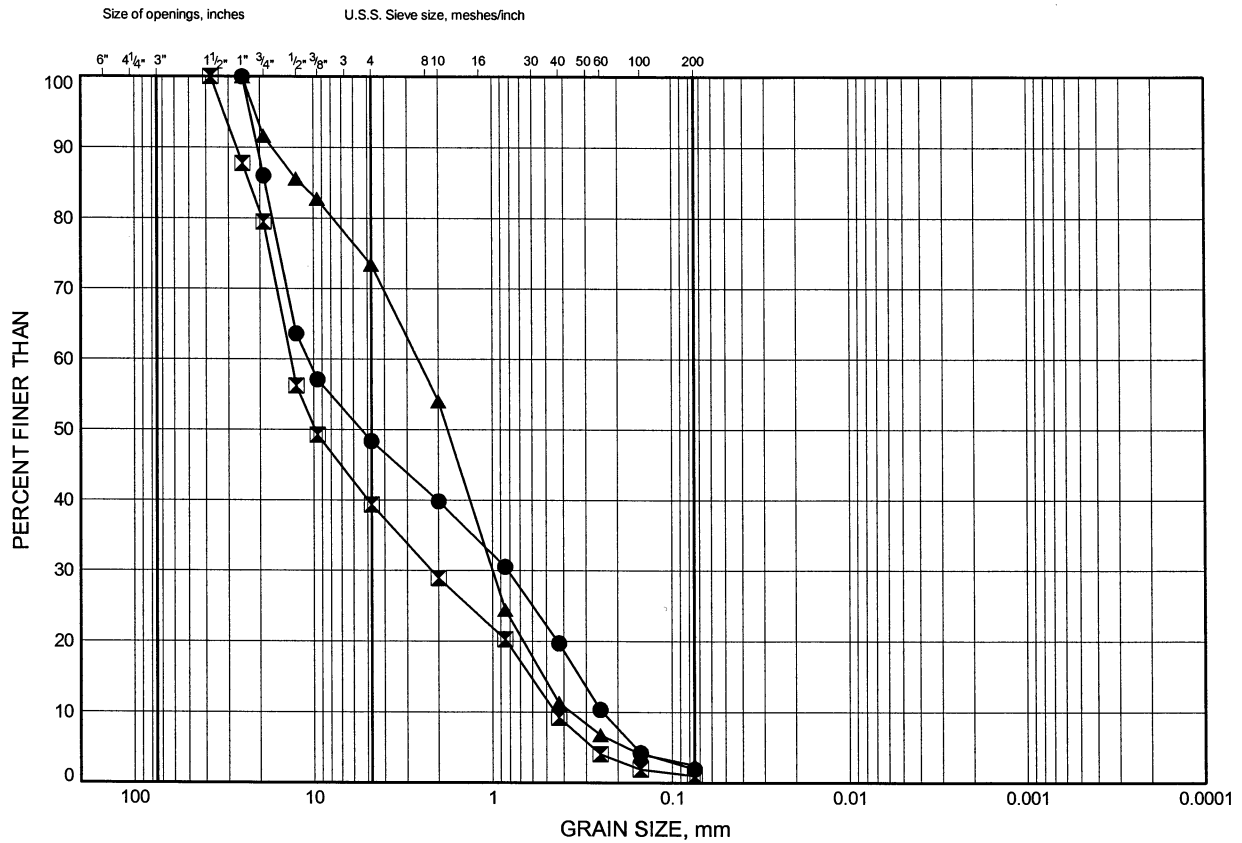
Prep'd MFA

Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND AND GRAVEL



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW1	23.16	276.76
⊠	07-LW2	1.83	296.75
▲	07-LW4	15.54	284.94

Date May 2007
Project 5321-04-00

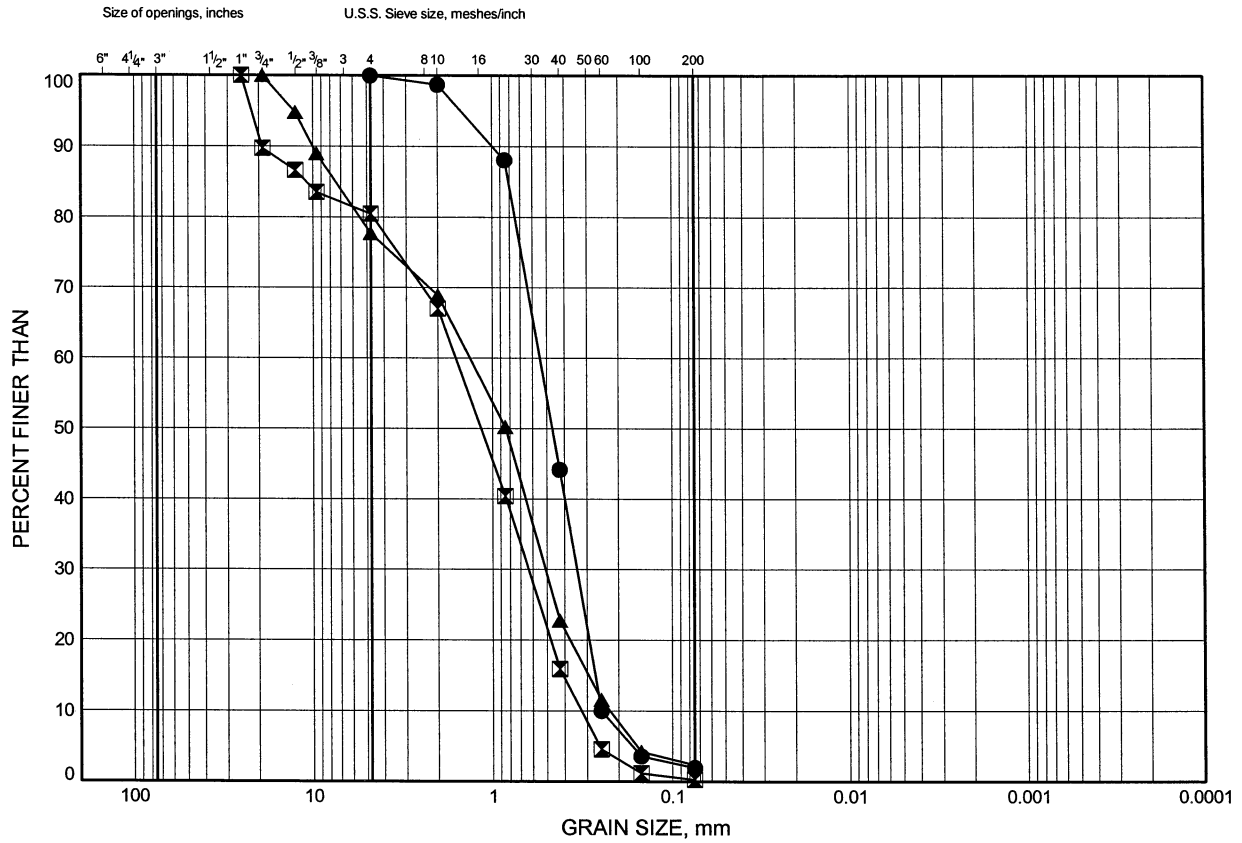


Prep'd MFA
Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B4

SAND



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW4	18.59	281.89
⊠	07-LW6	10.97	286.70
▲	07-LW9	2.59	298.41

Date May 2007
Project 5321-04-00

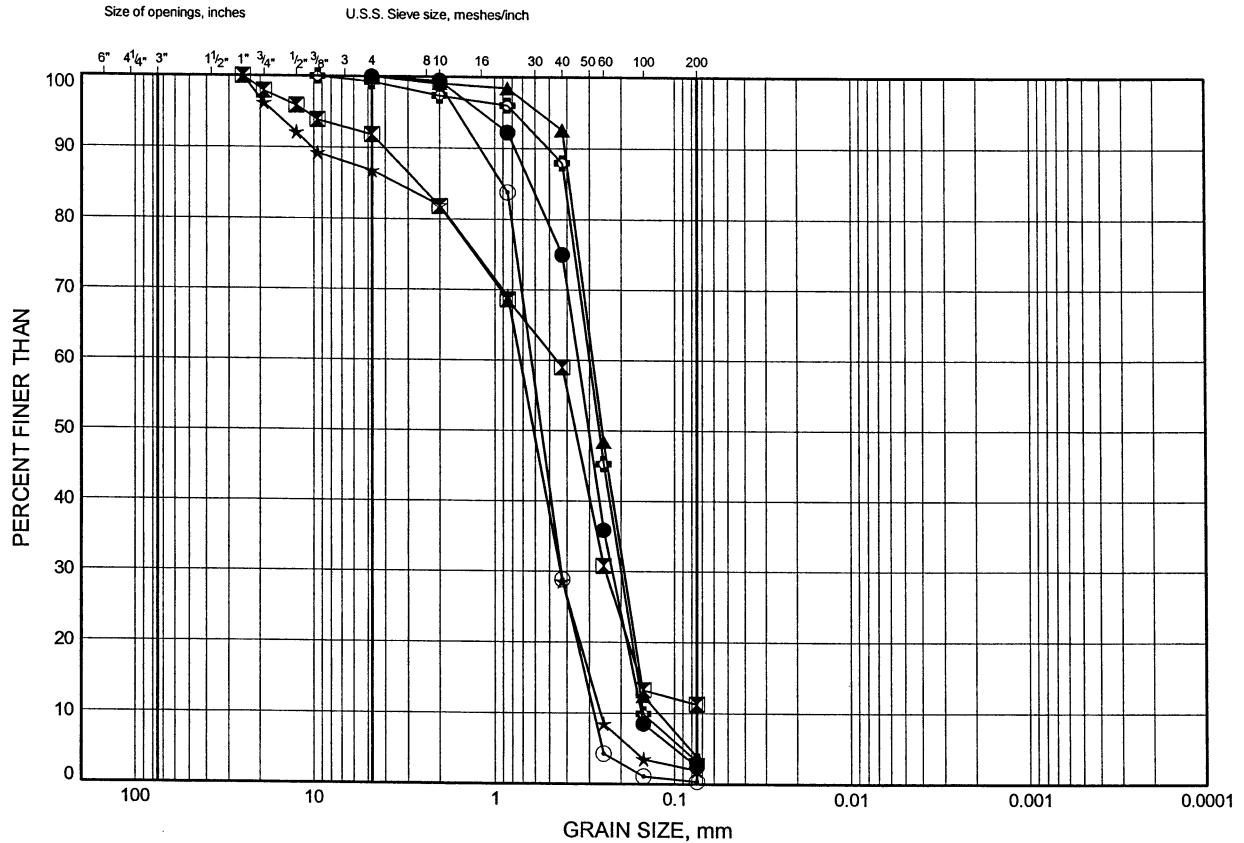


Prep'd MFA
Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B5

SAND



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW1	4.88	294.49
⊠	07-LW1	6.40	292.97
▲	07-LW1	9.45	289.92
★	07-LW1	29.26	270.11
⊙	07-LW2	9.45	287.24
⊞	07-LW2	12.50	284.19

Date April 2007

Project 5321-04-00



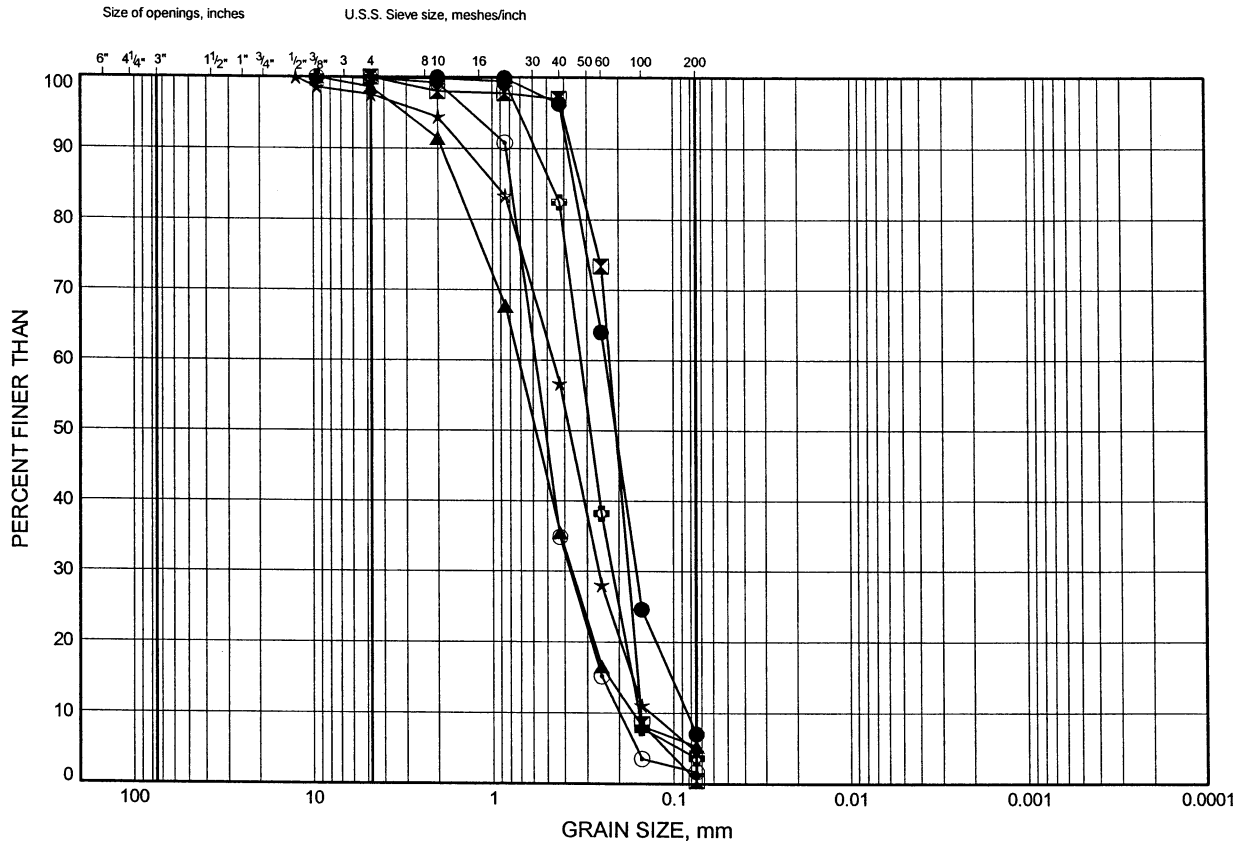
Prep'd MFA

Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B6

SAND



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW2	14.02	282.67
⊠	07-LW2	15.54	281.15
▲	07-LW3	2.59	297.00
★	07-LW3	10.97	288.62
⊙	07-LW5	2.59	298.08
⊗	07-LW5	6.40	294.27

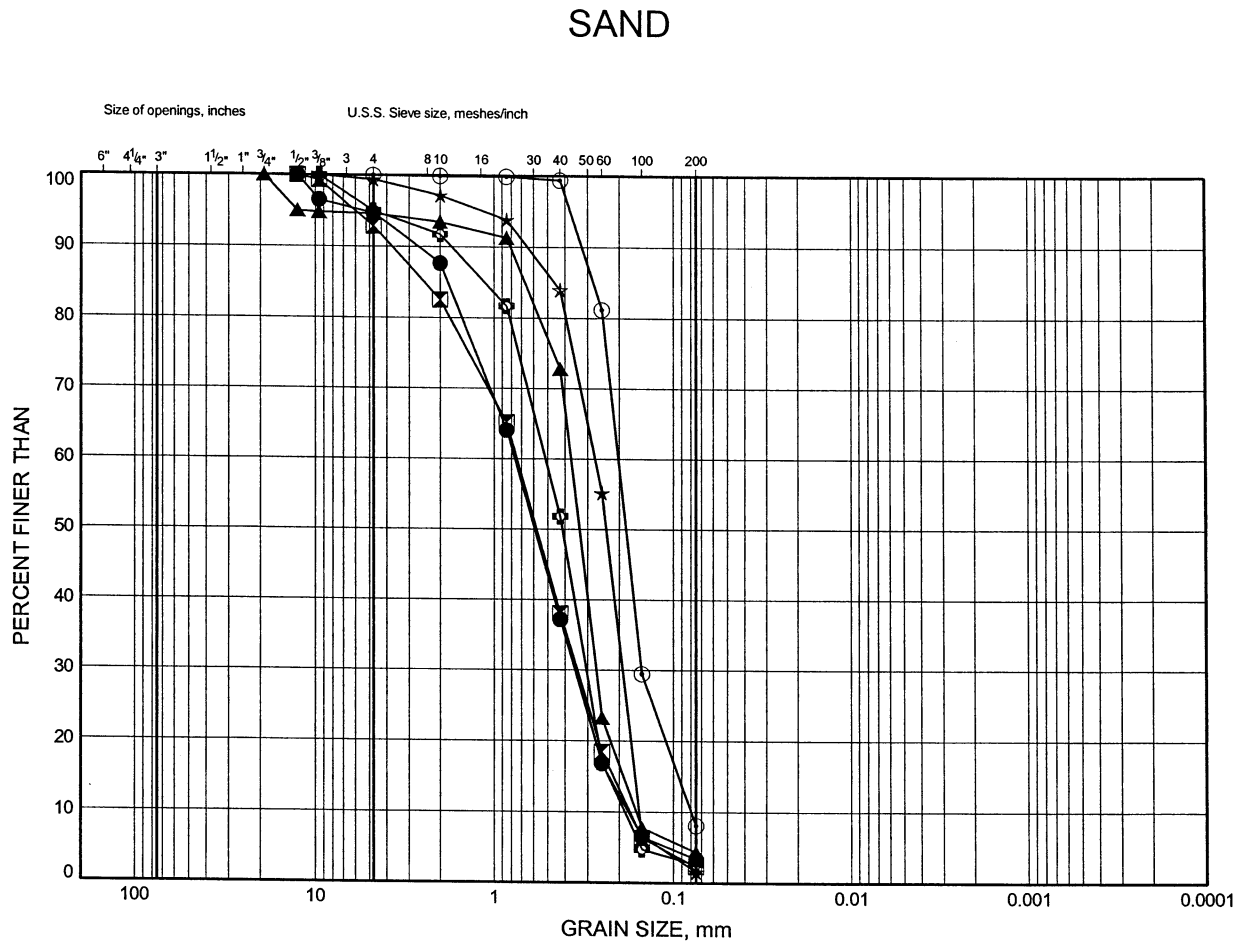
Date April 2007
Project 5321-04-00



Prep'd MFA
Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B7



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW5	9.45	291.22
⊠	07-LW5	20.12	280.55
▲	07-LW5	30.63	270.04
★	07-LW6	4.88	295.59
⊙	07-LW6	15.54	284.93
⊕	07-LW7	1.83	299.97

Date April 2007
Project 5321-04-00

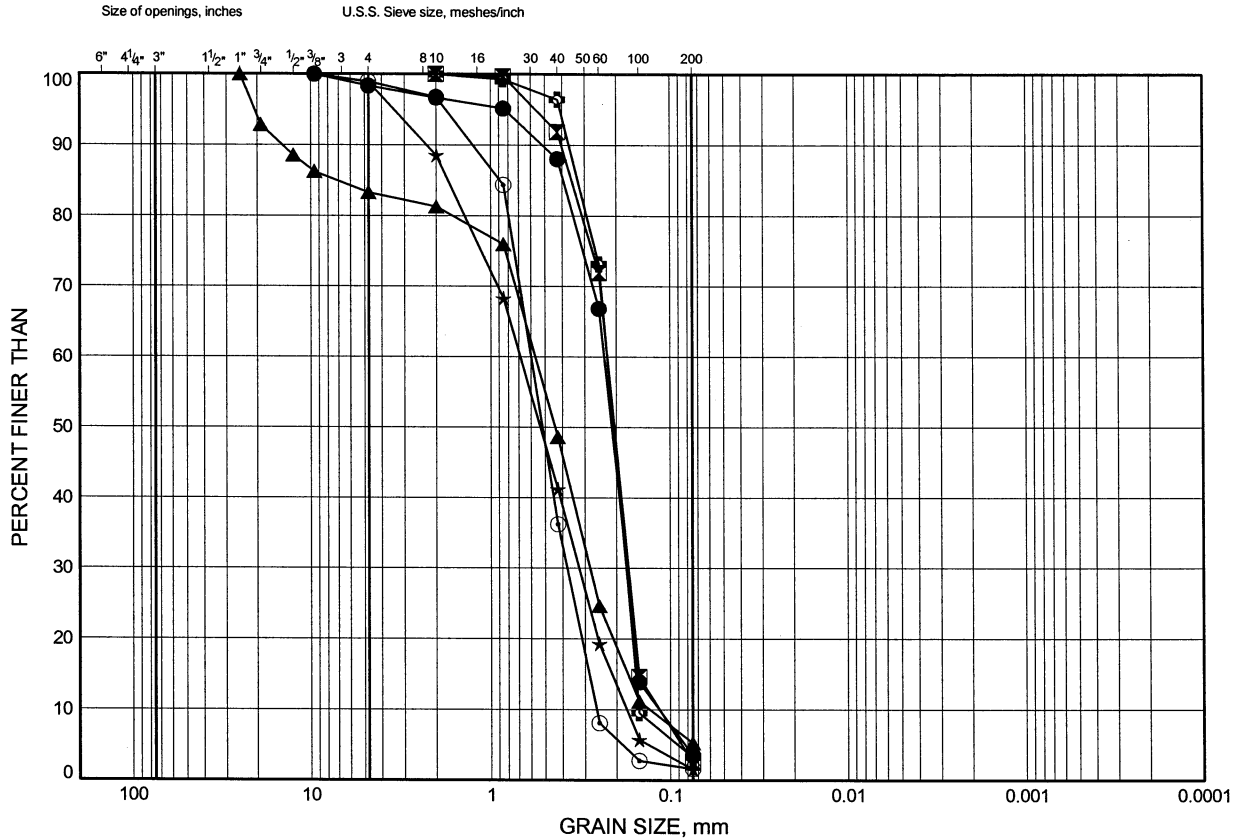


Prep'd MFA
Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B8

SAND



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
▲	07-LW2	21.64	276.94
★	07-LW3	20.12	280.21
⊙	07-LW4	4.88	295.60
⊠	07-LW8	2.59	298.71
●	07-LW10	1.83	299.37
⊞	07-LW10	3.35	297.85

Date May 2007
Project 5321-04-00

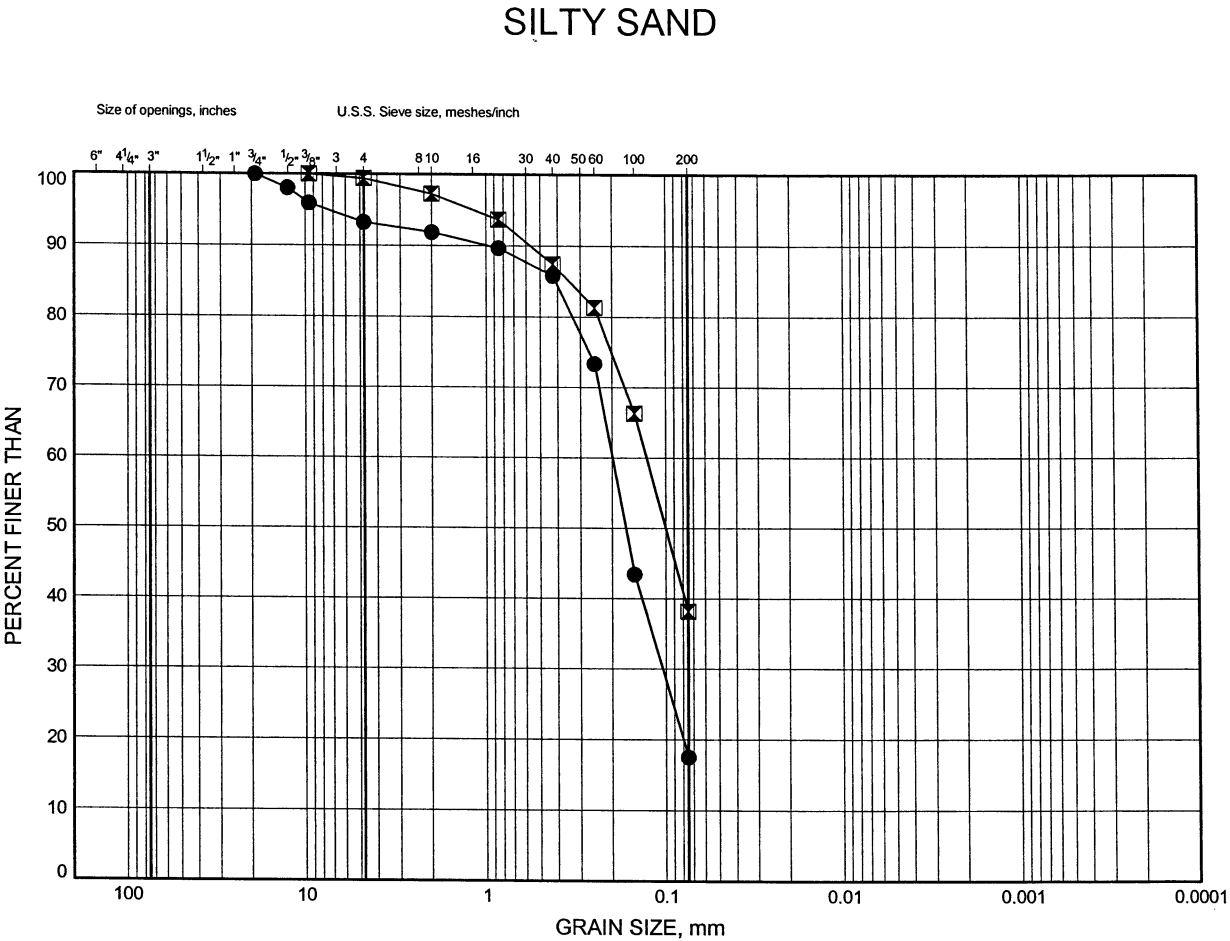


Prep'd MFA
Chkd. TJH

Little White River

GRAIN SIZE DISTRIBUTION

FIGURE B9



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

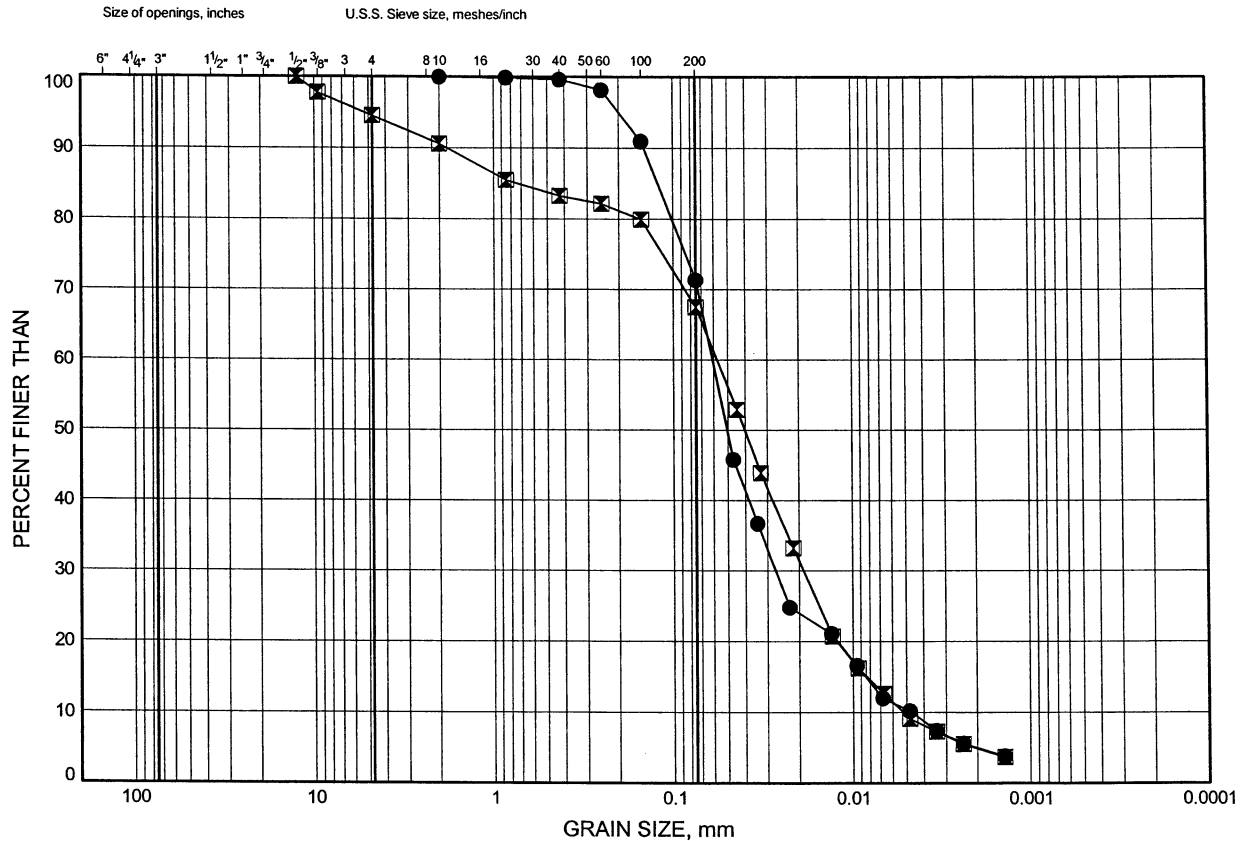
SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-LW5	14.02	286.65
⊠	07-LW5	23.16	277.51



Little White River GRAIN SIZE DISTRIBUTION

FIGURE B10

SANDY SILT



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
☒	07-LW2	4.88	291.81
●	07-LW11	1.07	299.53

Date April 2007
Project 5321-04-00

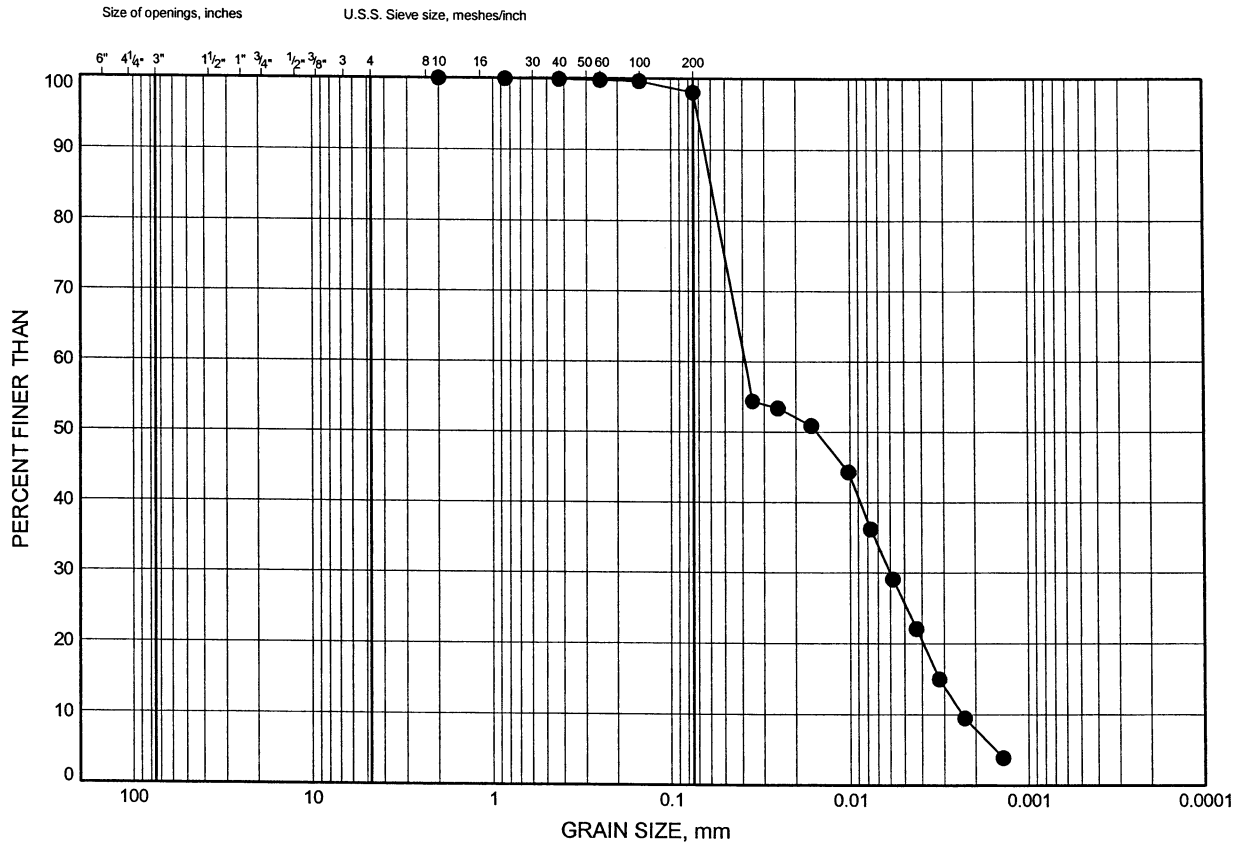


Prep'd MFA
Chkd. TJH

Little White River GRAIN SIZE DISTRIBUTION

FIGURE B11

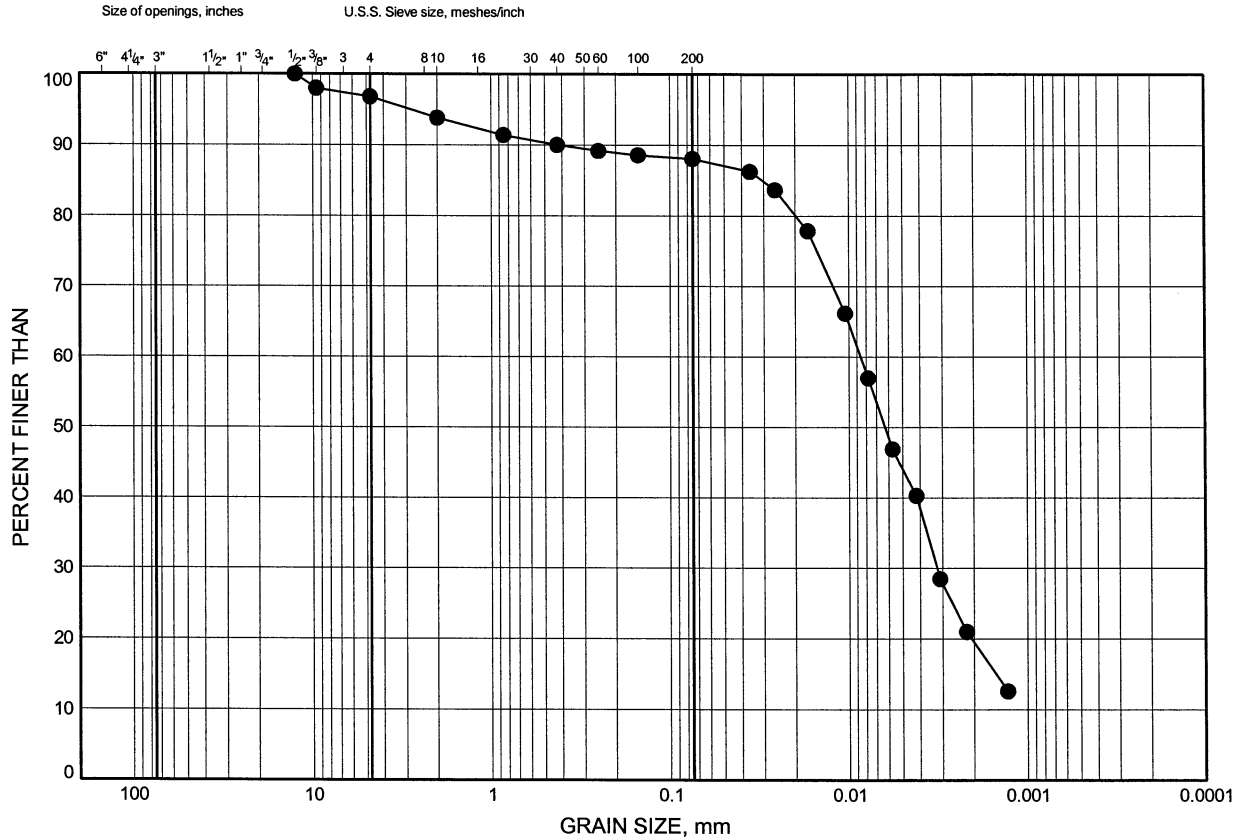
SILT



Little White River GRAIN SIZE DISTRIBUTION

FIGURE B12

SILT, SOME CLAY



Appendix C

Factual Information from the Golder Report

PROJECT <u>03-1111-029</u>		RECORD OF BOREHOLE No LW2-1		1 OF 3	METRIC
W.P. <u>513-00-01</u>		LOCATION <u>N 199995.9 :E 100009.8</u>		ORIGINATED BY <u>GB</u>	
DIST <u>62</u> HWY <u>546</u>		BOREHOLE TYPE <u>CME 55 POWER AUGER AND WET ROTARY WITH NQ CORE BARREL</u>		COMPILED BY <u>KG</u>	
DATUM <u>Local</u>		DATE <u>October 31, 2003</u>		CHECKED BY <u>JPD</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
100.7	GROUND SURFACE													
0.0	Silty Sand, some gravel and rootlets, occasional cobbles Loose Brown Moist (Fill)		1	SS	5									
99.3			2	SS	7									
1.4	Sand and Gravel, trace silt, occasional cobbles Compact Brown Moist (Fill)		3	SS	19									
97.7														
3.0	Sand and Gravel, trace silt, occasional cobbles Loose to compact Brown Wet		4	SS	11									
			5	SS	7									
			6	SS	12									
			7	SS	22									
91.0	End of Borehole													
9.8	Notes: 1. Borehole was advanced to a depth of 1.8 m using 108 mm I.D. hollow stem augers, beyond which, further boring to 9.75 m depth was carried out using 'N' size casing and 'NQ' size core barrel. 2. Difficulties were experienced with sand blowing into the casing during drilling and sampling operations. 3. Dynamic Cone Penetration Test (DCPT) was carried out between depths of 9.75 m to 30.2 m.													

MISS_MTO 03-1111-029-BA-MTO.GPJ ON_MOT_GDT 9/2/04

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MISS_MTO 03-1111-029-BA-MTO.GPJ ON_MOT.GDT 9/2/04

+³, ×³: Numbers refer to Sensitivity O^{3%} STRAIN AT FAILURE



+³, ×³: Numbers refer to Sensitivity O^{3%} STRAIN AT FAILURE

MISS_MTO 03-1111-029-BA-MTO.GPJ. ON_MOT.GDT 9/2/04



+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MISS_MTO 03-1111-029-BA-MTO.GPJ ON_MOT.GDT 9/2/04

DIST. 62 HWY. 546		
CONT No.		
WP No. 513-00-01		SHEET
LITTLE WHITE RIVER #2 AND HWY 546		
BOREHOLE LOCATIONS		

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

KEY PLAN

LEGEND	
	Borehole - Current Investigation
	Dynamic Cone Penetration Test
	Borehole and Cone
CO-ORDINATES	
No.	ELEVATION
LW2-1	100.7
LW2-2	100.6
CO-ORDINATES	
NORTHING	EASTING
199985.9	100009.8
200022.7	100037.1

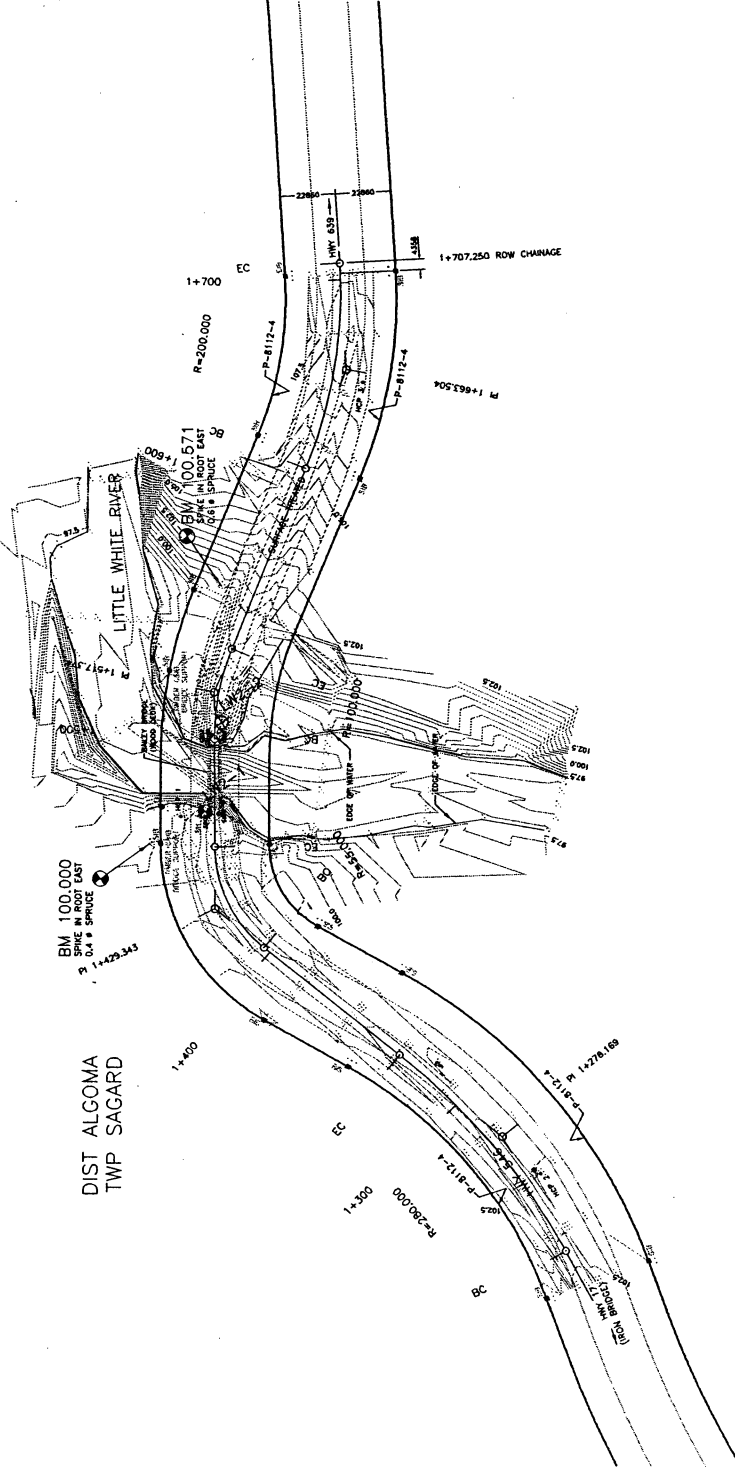
NOTE

1. Northings and Eastings presented on this drawing are as presented by Northing Engineering and are not in UTM coordinate system, but are based on a local metric grid.

REFERENCE

Base plans provided in digital format by Northing Engineering (1997) and Northing Engineering, meeting the req. Unit # 2 (February, revised November 25, 2003).

NO.	DATE	BY	REVISION
1			
Create No. PROJECT NO. 03-1111-029 DIST. 62 HWY. 546 CMC, JPD DATE JAN. 2004 SITE 365-56 SUBM. CMC, JPD DRAWN: JPD			



PLAN

Appendix D

Foundation Comparison

COMPARISON OF FOUNDATION ALTERNATIVES FOR EACH FOUNDATION ELEMENT

Foundation Element	Spread Footings	Spread Footings on Engineered Fill	Driven Piles	Drilled Shafts
Abutments	<p>Advantages:</p> <ul style="list-style-type: none"> i. Generally less costly construction than deep foundation elements. <p>Disadvantages:</p> <ul style="list-style-type: none"> i. Low geotechnical resistance available due to variable and very loose soils at the surface. ii. Shallow foundations near the edge of the river may be subject to scour. iii. Deeper excavations required as a result of scour protection will be difficult to dewater and maintain in an undisturbed condition. 	<p>Advantages:</p> <ul style="list-style-type: none"> i. Generally less costly construction than deep foundation elements. <p>Disadvantages:</p> <ul style="list-style-type: none"> i. Better geotechnical resistance than spread footings on native, but still influenced by the variable and very loose soils at the surface. ii. Shallow foundations or engineered fill pads near the edge of the river may be subject to scour. iii. Deeper excavations required as a result of scour protection will be difficult to dewater and maintain in an undisturbed condition. 	<p>Advantages:</p> <ul style="list-style-type: none"> i. High geotechnical resistance may be developed by driving the piles into very dense soil. ii. Comparatively short abutment stem possible iii. Permits integral abutment design iv. Readily permits founding below the scour depth <p>Disadvantages:</p> <ul style="list-style-type: none"> i. Higher unit cost compared to footings. 	<p>Advantages:</p> <ul style="list-style-type: none"> i. High geotechnical resistance is potentially available using deep shafts <p>Disadvantages:</p> <ul style="list-style-type: none"> i. Higher costs compared to spread footings. Probably higher costs compared to driven piles. ii. Difficulties advancing through very dense sand and gravel containing cobbles and boulders. iii. High risk of not being able to maintain undisturbed shaft walls and base below the groundwater level. iv. An integral abutment design is not an available option v. It may be necessary to place concrete by tremie methods.
	NOT RECOMMENDED	NOT RECOMMENDED	RECOMMENDED	NOT RECOMMENDED

Appendix E

Site Photographs

Little White River II Bridge Replacement
Highway 546, Algoma



Photo 1. Looking south along Little White River Bridge

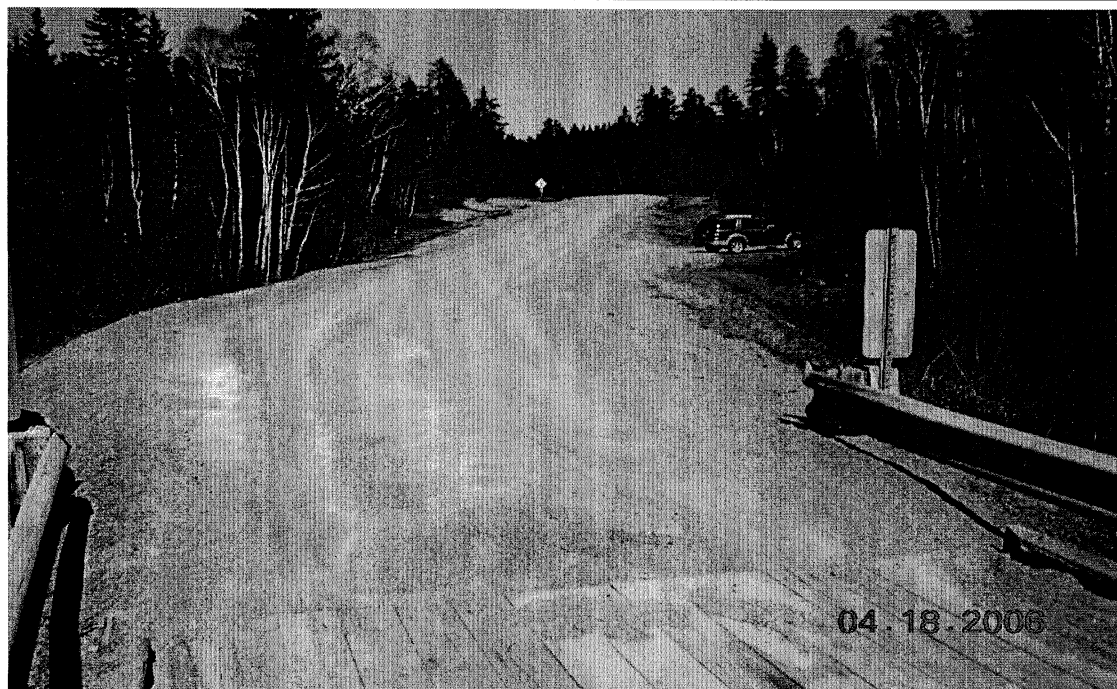


Photo 2. North approach to the Little White River II Bridge

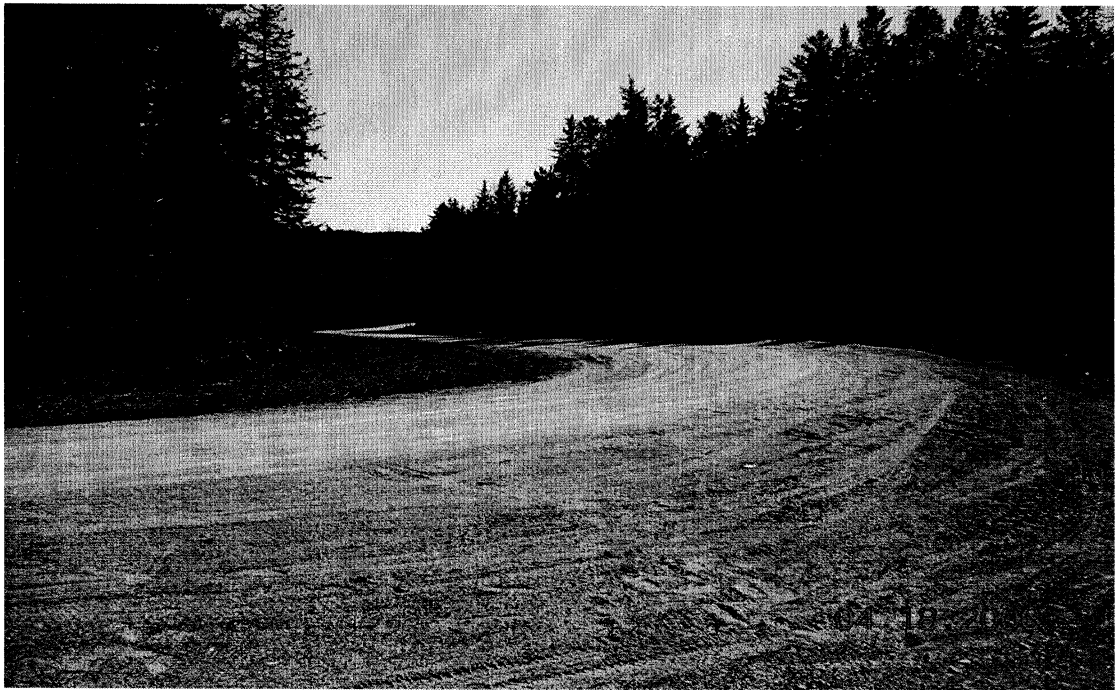


Photo 3. South approach to the Little White River II Bridge.



Photo 4. Little White River II Bridge from the southeast showing timber cribs.

Appendix F

Drawings



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

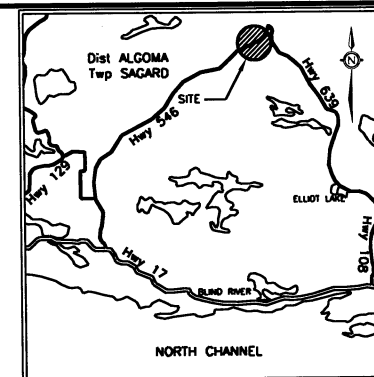
CONT No 512-00-00
GWP No



SHEET








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LEGEND

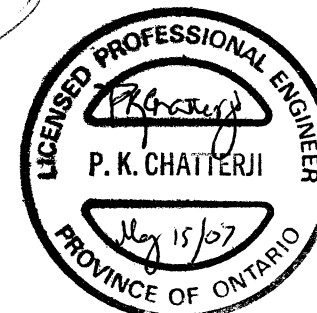
- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

NO	ELEVATION	NORTHING	EASTING
07-LW1	299.92	5 167 794.62	394 842.35
07-LW2	298.58	5 167 821.99	394 861.84
07-LW3	300.33	5 167 786.98	394 843.37
07-LW4	300.48	5 167 821.16	394 872.30
07-LW5	300.70	5 167 778.62	394 853.61
07-LW6	297.67	5 167 811.91	394 880.99
07-LW7	301.80	5 167 596.63	394 857.60
07-LW8	301.30	5 167 645.13	394 850.56
07-LW9	301.00	5 167 696.02	394 848.00
07-LW10	301.20	5 167 744.62	394 829.68
07-LW11	300.60	5 167 838.20	394 892.09
07-LW12	302.00	5 167 854.29	394 930.36
07-LW13	305.30	5 167 889.58	394 967.43
07-LW14	307.30	5 167 913.38	395 012.85

-NOTES-

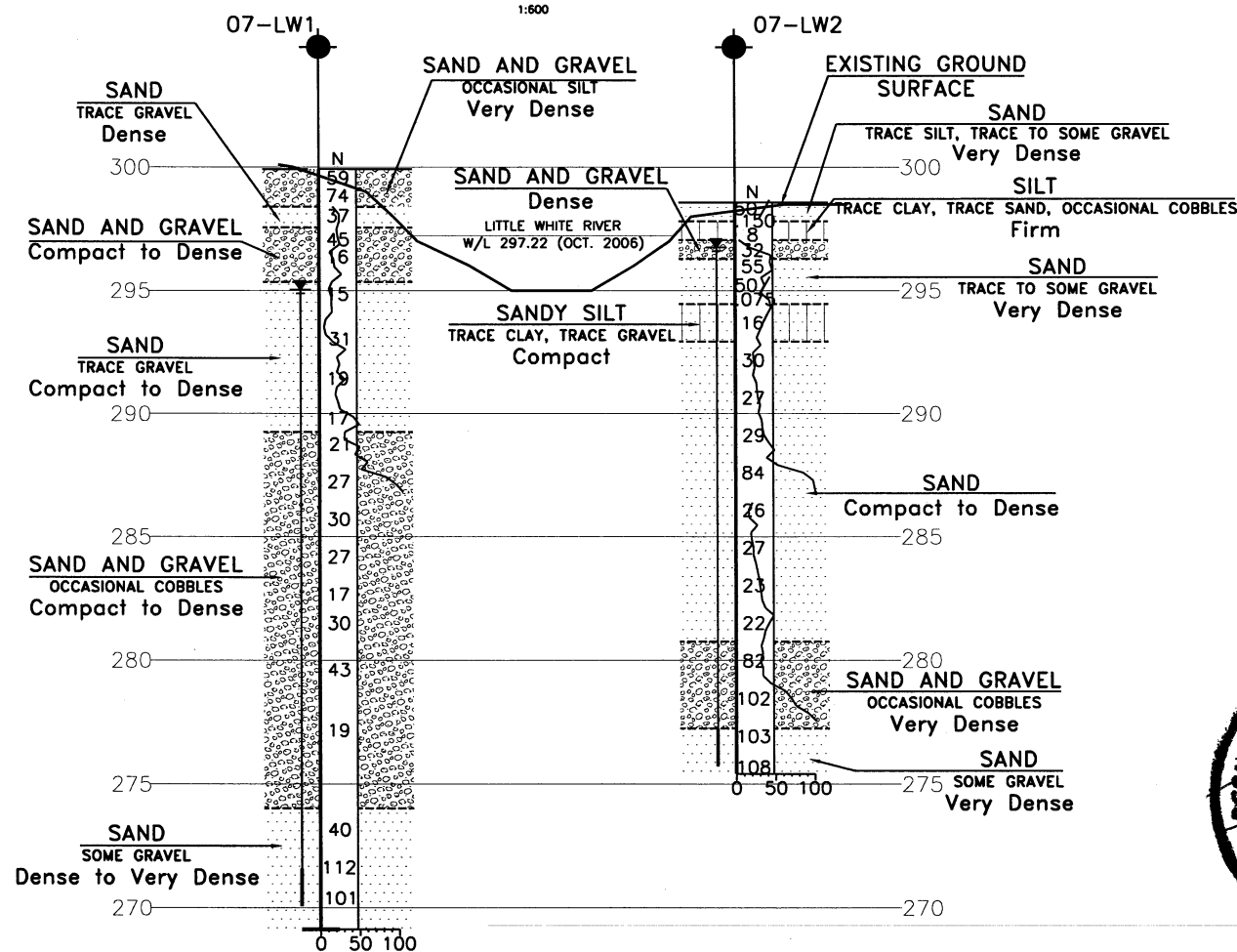
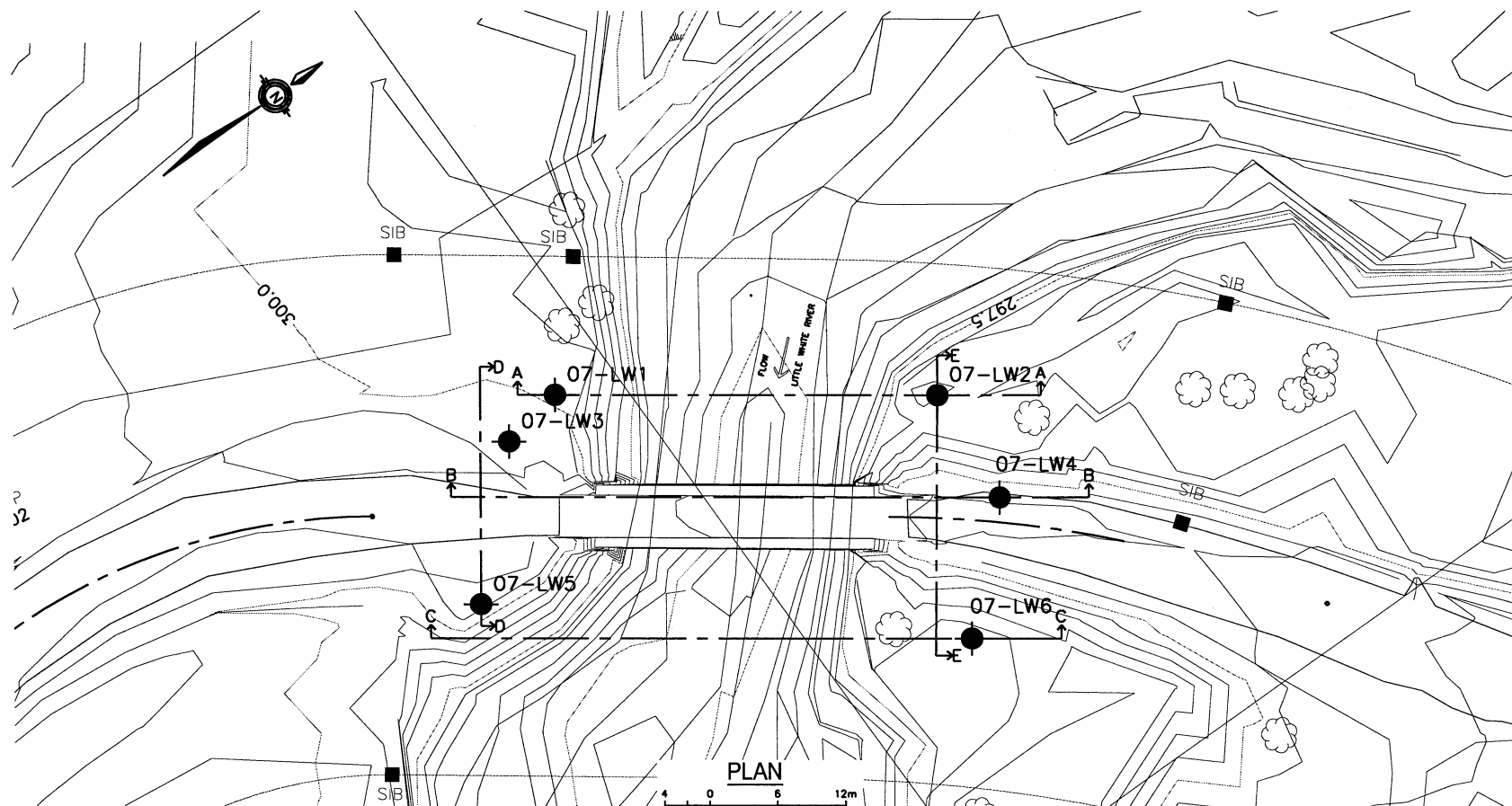
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 41J73

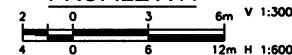


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PROFILE A-A



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AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No 512-00-00
GWP No

LITTLE WHITE RIVER II
BRIDGE REPLACEMENT
BOREHOLE LOCATION PLAN AND SOIL
STRATA

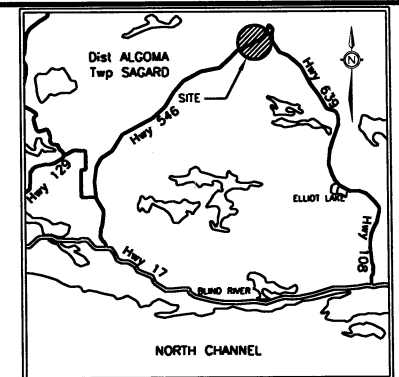


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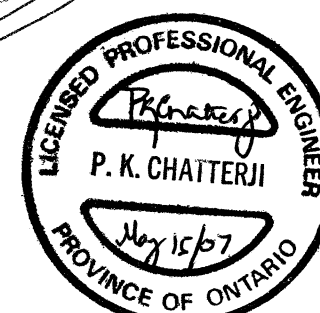
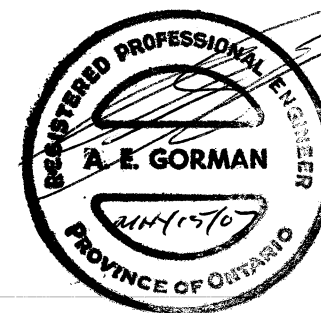
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
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07-LW5	300.70	5 167 778.62	394 853.61
07-LW6	297.67	5 167 811.91	394 880.99

NOTES

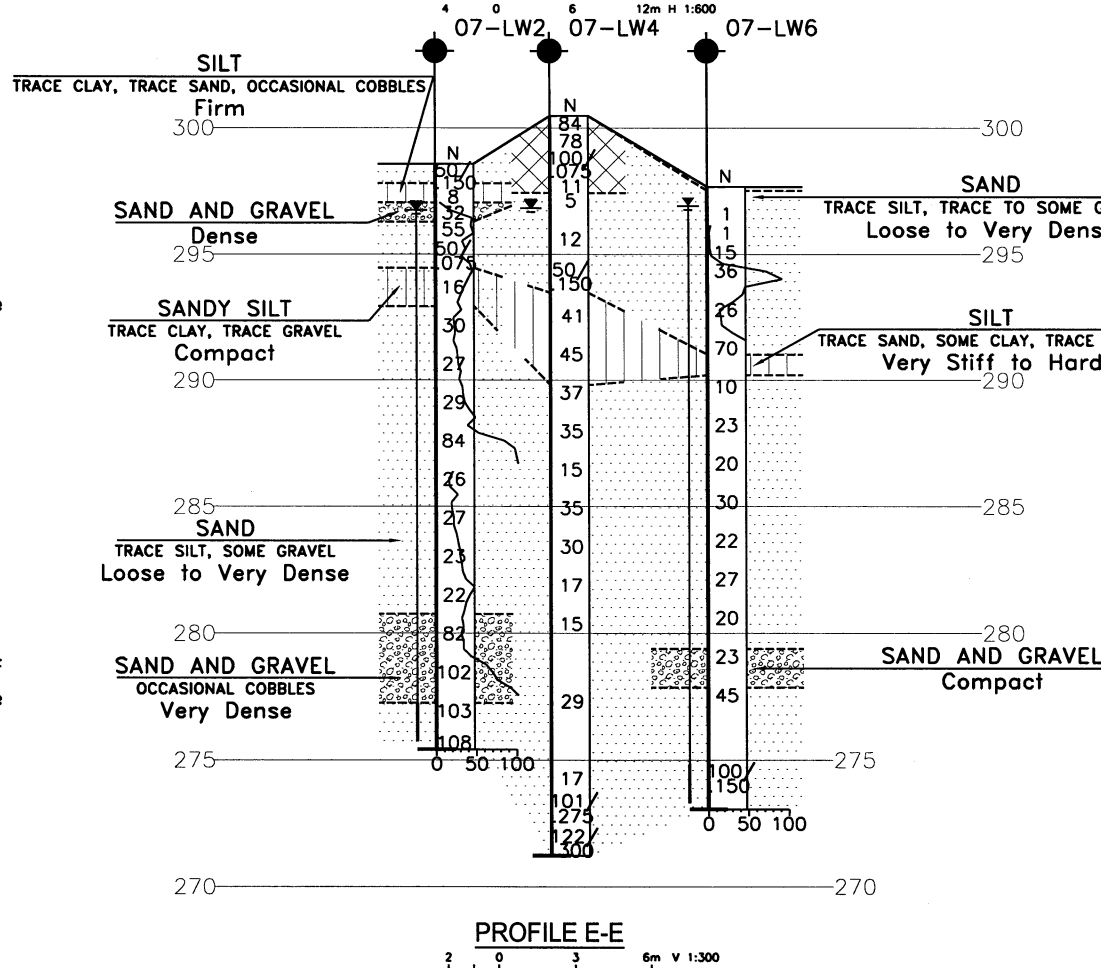
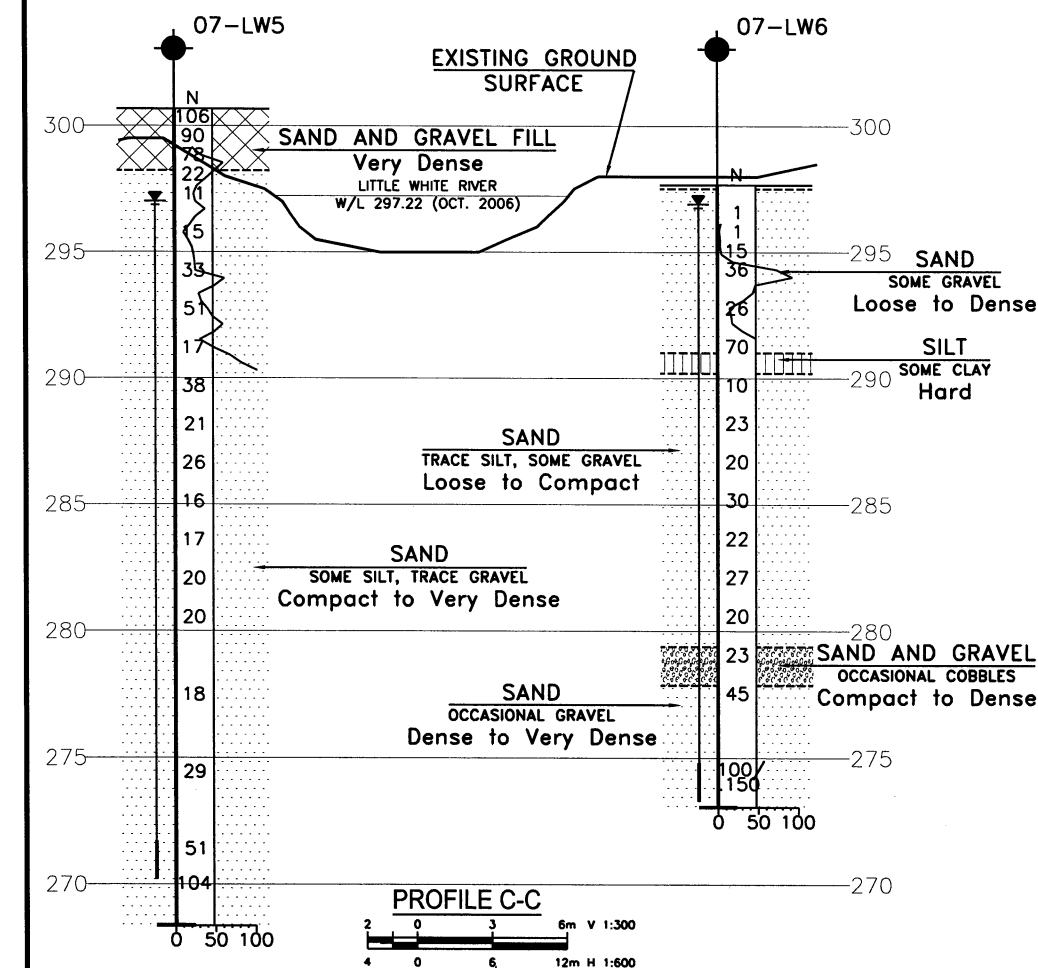
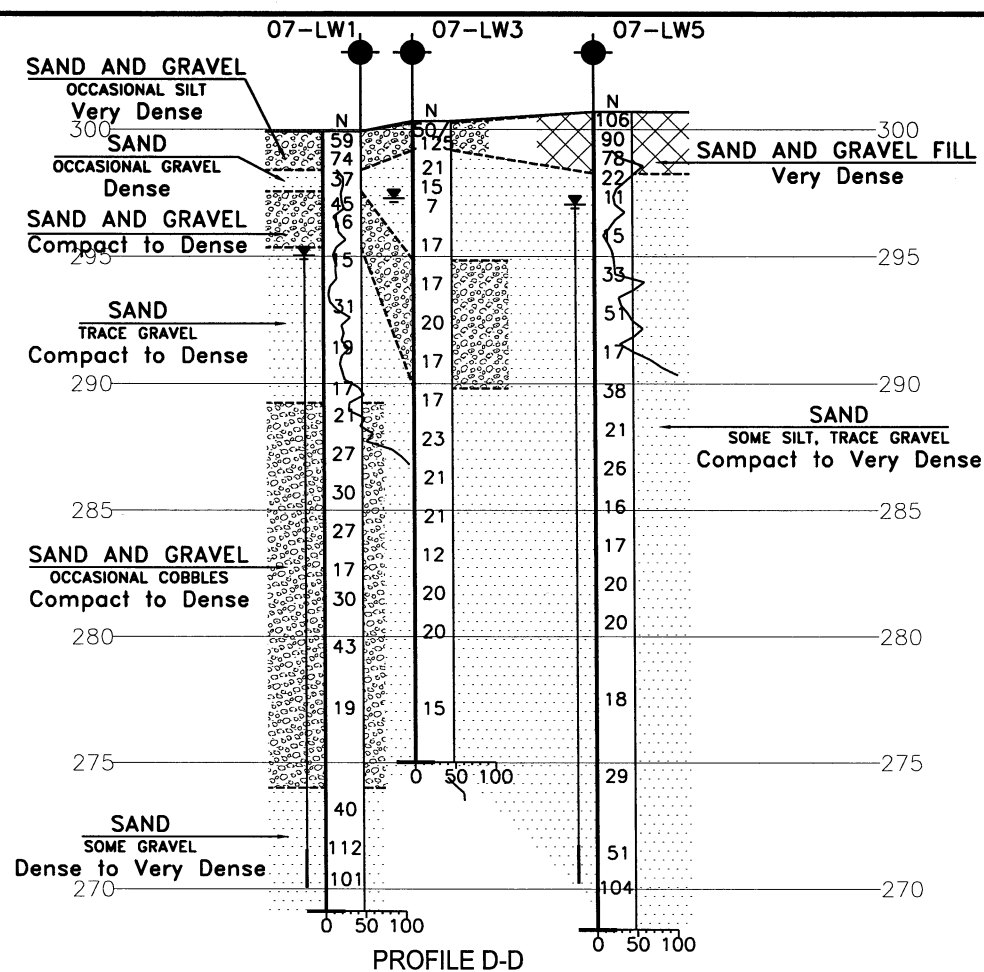
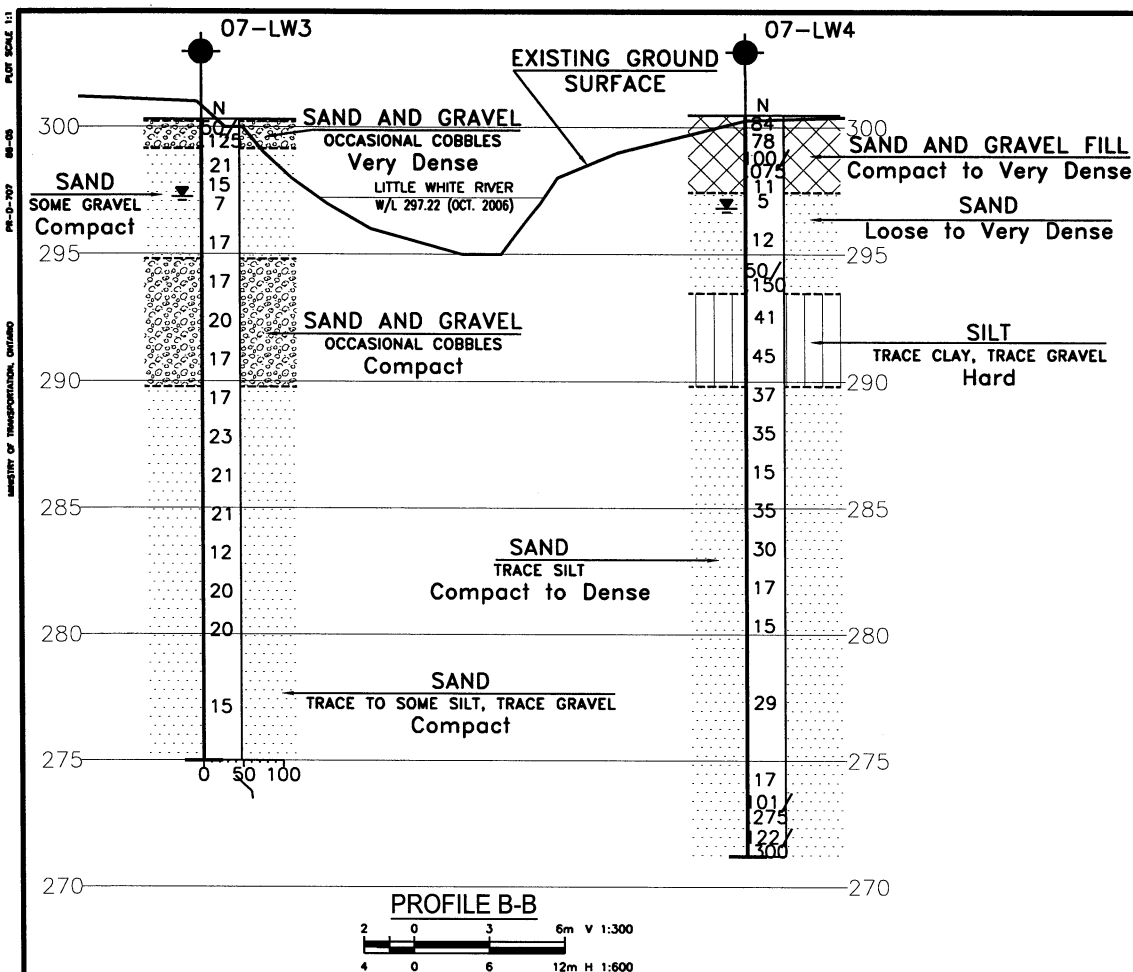
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GEOCRES No. 41J73



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REVISIONS	DATE	BY	DESCRIPTION
DESIGN	AEG	CHK PKC	CODE
DRAWN	MFA	CHK PKC	SITE
			LOAD
			STRUCT
			DWG
			DATE MAY 2007



METRIC

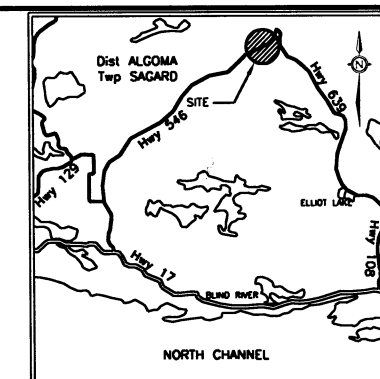
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No 512-00-00






5 | GWP No

LITTLE WHITE RIVER II
BRIDGE REPLACEMENT
SOIL STRATA

SHEET



KEYPLAN
LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
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NO	ELEVATION	NORTHING	EASTING
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07-LW2	298.58	5 167 821.99	394 861.38
07-LW3	300.33	5 167 786.98	394 843.37
07-LW4	300.48	5 167 821.16	394 872.30
07-LW5	300.70	5 167 778.62	394 853.66
07-LW6	297.67	5 167 811.91	394 880.95

-NOTES-

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GEOCRES No. 41J73

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100 mm ON ORIGINAL DRAWING

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