MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

FINAL
FOUNDATION INVESTIGATION REPORT

ROADWAY PROTECTION AT KENOGAMI LAKE BRIDGE
STATIONS 10+104 TO 10+132– TWP. of Grenfell
GWP 162-98-00 – Site No. 47-009
MEL Site E

Highway 11, From 0.3 km South of the Highway 11/66 Intersection
Northerly 11.7 km to 3.5 km South of Highway 570

MEL Ref. No.: 09/10/09181E January 14, 2011

Submitted to:

AECOM Canada Ltd.
189 Wyld Street
North Bay, Ontario
P1B 1Z2

Geocres No. 42A-83

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1.0 INTRODUCTION

Merlex Engineering Ltd. (MEL) has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation for the purpose of roadway protection at the Kenogami Lake Bridge located between Stations 10+104 to 10+132, Township of Grenfell. The GWP 162-98-00 on Highway 11 passes through parts of the Townships of Eby and Grenfell and the location is described as: from 0.3 km South of the Highway 11/66 intersection Northerly 11.7 km to 3.5 km South of Highway 570. This project involves foundation investigation for roadway protection to allow conversion of the Kenogami Lake Bridge abutment to a semi-integral configuration.

The foundation investigation location was specified by the MTO in their email dated June 23, 2010 and in Change Order No. 1. The terms of reference for the scope of work are outlined in MEL's proposal 09/10/09181, dated June 30, 2010. MEL investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The Kenogami Lake Bridge is located on Highway 11, between Stations 10+104 and 10+132, Township of Grenfell. The topography at the site is generally of moderate relief. Kenogami Lake flow easterly in the river at the bridge location. The existing highway, at the bridge location, supports two undivided lanes of traffic, running in a north south direction. A visual review of the highway, at the north and south approaches, indicates in general that the embankment appears to have performed well, however there was evidence of minor slab settlement along the east edge of the north approach slab. It is understood that the existing expansion joints are in fair

condition, however they are 27 years old and are at the end of their expected service life and will be removed to allow for conversion to semi-integral abutment construction.

The existing 28 m single span bridge was constructed in 1984 under Contract No. 84-212, on the original highway alignment. This bridge replaced the original multi span bridge which was greater in length. The original abutments were left in place, however the contract drawings indicated they were to be cut down to elevation 304.0 m.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-provinces known as the Eastern Sandy Uplands. The topography on this section of Highway 11 is generally rolling. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed.

Bedrock in the area, as indicated on OGS Map 2440, is of the Early Precambrian Era. In the area of the bridge site the bedrock comprises of Metasediments including conglomerate, sandstone, mudstone, marble, chert, iron formation, and related migmatites.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out between September 7 and 14, 2010, during which time four sampled boreholes were advanced. Two boreholes were advanced at either of end of the bridge, one through the existing approach slab and the second a short distance beyond the end of the approach slab.

The field investigation was carried out using a track mounted CME 55 drilling rig equipped with hollow stem augers, standard augers, routine geotechnical sampling equipment, and NQ size

diamond drill coring equipment. Soil samples were obtained at regular intervals of depth at the borehole locations, where possible, using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D-1586). The SPT method involves advancing a 50 mm diameter split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm mounted in a trip (automatic) hammer. The number of blows per 300 mm penetration was recorded as the "N" value. At select boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. When cohesive deposits were encountered, the in-situ strength was measured using an "N" size field vane, vane collar, and calibrated torque meter. All samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing. The NQ size core samples were also transported to our North Bay laboratory for visual examination and for Rock Quality Designation (RQD) analysis. The RQD is a method of estimating the quality of a rock mass, from diamond drill cores. The RQD is calculated (as a percentage) of the length of core pieces over 100 mm in length relative to the total core run length.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following completion of the individual boreholes. All open boreholes were backfilled upon completion with compacted auger cuttings, in the general order they were removed and, where necessary, bentonite pellet backfill was added to the boreholes. The upper part of the borehole was backfilled with compacted cold patch asphalt.

The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the

boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Figures Nos. L-1 to L-3, Appendix C.

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. E-1 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT and Dynamic Cone Penetration Test (DCPT), plus field observations. Typically such boundaries represent transitions from one zone to another and are generally not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings as a conceptual model for design purposes only. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4 were recorded at 307.3, 307.3, 307.1, and 307.0 m respectively.

4.1 Kenogami Lake Bridge, Stations 10+104 to 10+132, Township of Grenfell

A plan and profile showing the borehole locations and stratigraphic sequences is shown on Figure No. E-1, Appendix C. During the course of the exploration program, four (4) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced at the south end of the existing bridge, to the right of the centerline, while Borehole Nos. 3 and 4 were advanced at north end of the bridge, to the left of the centerline.

4.1.1 Pavement Structure

At the surface of each borehole, a layer of asphalt some 100 mm in thickness was penetrated. Underlying the asphalt, at Borehole Nos. 1 and 4, a layer of crushed gravel some 200 mm in thickness was penetrated. Underlying the asphalt at Borehole Nos. 2 and 3, the concrete approach slab some 225 mm in thickness was penetrated.

4.1.2 Fill

Underlying the pavement structure at each borehole, a deposit of granular fill, consisting of brown sand and gravel to sand with gravel, trace to some silt, occasional to numerous cobble and boulder size rock was penetrated. The frequency of cobble and boulder size rock increases with depth, with auger refusal on boulder size rock encountered between depths of 1.0 and 3.1 m below ground surface (elevations 306.3 and 304.0 m), at which point diamond core drilling was commenced. The silt content, of the granular fill, increases with depth in the deposit at Borehole No. 1, becoming sandy silt at a depth of some 4.6 m (elevation 302.7 m). The original contract drawings (Contract No. 84-212) state that the native material, in the area between the old and new abutments, was to have been excavated to elevation 299.5 m (at the south abutment) and elevation 300.5 m (at the north abutment). The old abutments were to be removed down to elevation 304.0 m. The area between the old and new abutments was to

have been backfilled with rock fill. At Borehole No. 2 wood pieces, possibly old formwork, were encountered at a depth of some 3 m in the fill deposit. The natural moisture content from samples of this fill deposit was in the order of 2 to 22%. Gradation analyses were carried out on twelve (12) samples from this deposit, which were retained in the split spoon sampler (37 mm inside diameter), the results of which indicated 5 to 56% gravel size particles, 40 to 69% sand size particles, and 3 to 51% silt and clay size particles (see Figure Nos. L-1 and L-2, Appendix C). Based on SPT values of between 4 and 98 blows per 300 mm penetration, the compactness of this deposit was described as loose to very dense, generally dense. Several attempts of the SPT resulted in over 100 blows per 300 mm penetration, indicating SPT refusal, likely on cobble/boulder sizes. Bedrock was encountered underlying this deposit at depths of 6.2 and 7.0 m at Borehole Nos. 1 and 2 (elevations 301.1 and 300.3 m). However, diamond core drilling was commenced at depths of 2.0 and 1.0 m below grade at Borehole No. 1 and 2 respectively due to the presence of cobble/boulder size rock fill. At Borehole No. 3, auger refusal was encountered on boulder size rock at a depth of some 3.0 m below ground surface (elevation 304.1 m). Diamond core drilling was continued through boulders in a granular fill at this borehole to depth of 6.1 m below ground surface (elevation 301.0 m). Sampling was resumed in this rock fill deposit at a depth 6.1 m. Bedrock was then encountered at a depth of 7.6 m below ground surface at Borehole No. 3 (elevation 299.5 m). Concrete (old abutment) was encountered underlying the fill deposit at a depth of 3.1 m below ground surface at Borehole No. 4 (elevation 303.9 m).

Although not encountered during the advancement of the four (4) foundation boreholes, it is reported that past maintenance work, consisting of grouting voids under the approach slab(s), had been carried out by district forces. It is further reported that this work was carried out below only the north approach slab and involved grouting voids which were estimated at 300 to 500

mm deep and mostly in the north east area of the north approach slab. During the geotechnical investigation, also carried out by MEL, all four corners of the approach slab were drilled and grout was only identified in one borehole, which was located to the north east of the north slab. The type of grout reportedly used was 0.4 MPa with a high slump.

4.1.3 Concrete

At Borehole No. 4, auger refusal was met at a depth of 3.1 m (elevation 303.9 m) where diamond core drilling was commenced, through concrete. Three runs of core were obtained with a recovery of between 80 and 100%. The concrete was encountered to a depth of 6.6 m below ground surface (elevation 300.4 m). Based on a review of available data it appears that this concrete is from the south portion of the original north bridge abutment.

4.1.4 Gravel

Underlying the concrete at Borehole No. 4, a 1.3 m thick deposit of grey sandy gravel some silt was penetrated. The natural moisture content from a sample of this deposit was in the order of 11%. A gradation analysis was carried out on one sample of this deposit, the results of which indicated 51% gravel size particles, 34% sand size particles, and 15% silt and clay size particles (see Figure No. L-3, Appendix C). Based on the STP value of 30 blows per 300 mm penetration, the compactness of this deposit was described as dense. Auger refusal was encountered in this deposit at a depth of 7.9 m below ground surface (elevation 299.1 m).

4.1.5 Bedrock

Bedrock was encountered at depths of 6.2, 7.0, 7.6, and 7.9 m (elevations 301.1, 300.3, 299.5, and 299.1 m) at Borehole Nos. 1 to 4 respectively. Two core runs were retrieved from Borehole Nos. 1, 2, and 4, and three runs were retrieved from Borehole No. 3, with a recovery of between

92 and 100% at all boreholes. The bedrock is described as a grey to black conglomerate with a fined grained matrix. The RQD of the bedrock varied between 69 to 100%, indicating a fair to excellent quality, generally good quality. The diamond core drilling was terminated at a depths of 9.1, 10.1, 10.8 and 11.1 m below ground surface at Boreholes Nos. 1 to 4, respectively (elevations 298.2, 297.2, 296.3, and 295.9 m, respectively).

4.2 Groundwater Conditions

Groundwater and cave-in levels in the open boreholes were taken during the advance of the individual borings and upon completion. These levels were recorded on the individual Record of Borehole Log Sheets (Appendix B). The water level was measured at a depth of some 2.8, 4.1, and 2.2 m at Boreholes Nos. 1, 3, and 4 respectively (elevations 304.5, 303.0, and 304.8 m, respectively). Borehole No. 2 was dry at the time of completion. These groundwater levels will fluctuate seasonally. The water level in the Blanche River, at the time of this investigation, was at elevation 303.5 m.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
Principal

J. R. Berghamer, P. Eng.
Project Engineer

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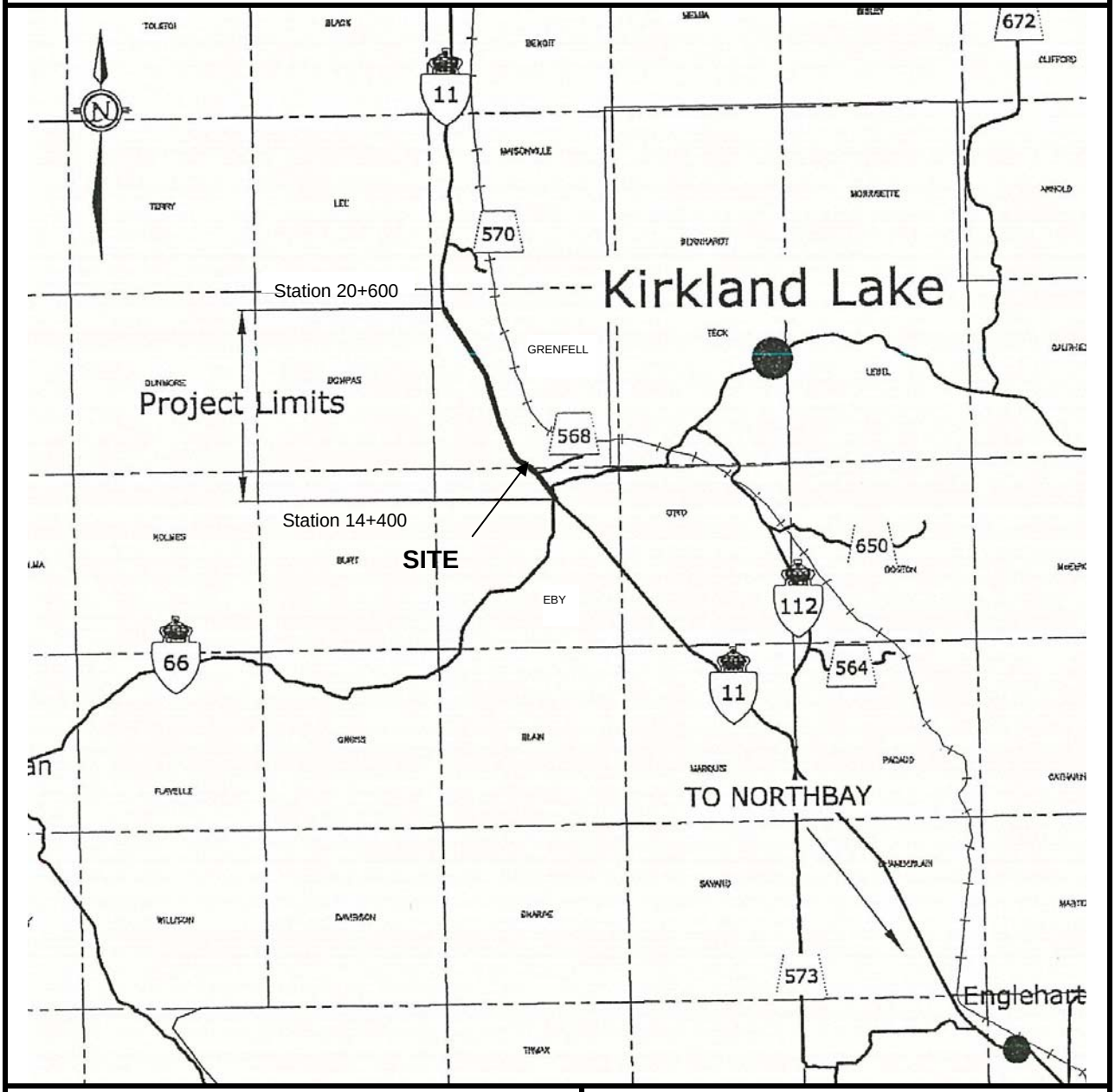
APPENDIX A

Figure No. 1: Key Plan

KEY PLAN

Figure No. 1

NOT TO SCALE



FINAL
FOUNDATION INVESTIGATION REPORT
GWP 162-98-00

Highway 11, From 0.3 km South
of Highway 66, Northerly 11.7 km to
3.5 km South of Highway 570

MEL Ref. No.: 09/10/09181E January 2011

MERLEX ENGINEERING LTD.

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APPENDIX B

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure Nos. 2 to 5: Record of Borehole Sheets

LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS Auger Sample
CS Chunk Sample
DS Denison type sample
FS Foil Sample
HB Hammer Bouncing
NFP No Further Progress
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
RC Rock core with size & percentage of recovery
SS Split Spoon
ST Slotted Tube
TO Thin-walled, open
TP Thin-walled, piston
WH Sampler Advanced by static weight (weight of hammer and/or rods)
WS Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 90° point cone driven by a 63 kg hammer falling 760 mm.

Plotted as —•—•—•—•

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*Relative Density*
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	*Consistency*
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole. The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

¨ - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P Standard Proctor Test
A Atterberg Limit Test
GS Grain Size Analysis
H Hydrometer Analysis
C Consolidation

SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.

2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.

3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.

4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

ENCLOSURE NO.:2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5329363.6 E 364408.4 - Grenfell Twp. ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 - MEL Site E BOREHOLE TYPE CME 55 - Hollow Stem Augers and Core Drill COMPILED BY AT

CLIENT AECOM Inc. DATE (Started/Completed) 10/9/7 - 10/9/7 TIME 6:30:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
307.3	Ground Surface										
0.0	±100 mm asphalt ±200 mm crushed gravel FILL - brown sand and gravel to sand some gravel trace to some silt		1	AS	N/A		307				
			2	SS	50/100 mm			DCPT Refusal			36 59 (5)
							306				
			3	SS	50/50 mm						
305.3											
2.0	Occasional cobble/boulder size rock Start of diamond core drilling		4	SS	98		305				42 44 (14)
						▽					
			5	SS	14		304				19 62 (14)
			6	SS	24						47 45 (8)
			7	SS	7		303				5 44 (51)
	Higher silt content (Sandy Silt)										
301.1			8	SS	10/50 mm		302				
6.2	BEDROCK - grey to black conglomerate		9	RC	Rec 92% RQD 93%		301				
			10	RC	Rec 100% RQD 88%		300				
298.2							299				
9.1	End of Coring End of Borehole										

COMMENTS

River water surface was at elevation 303.5 m at the time of this investigation. Auger refusal at 2.0m depth. Relocated hole 1 m south, auger refusal 2.0 m. Commenced diamond core drilling.

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/9/7 6:35:00 PM	2.8 ▽	5 ▣
2)	- ▽	-
3)	- ▼	-

MEL-GEO 09181 - KENOGAMI BRIDGE - BOREHOLE LOGS.GPJ MEL-GEO.GDT 11/1/14

MERLEX ENGINEERING LTD.
2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.:3 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 2

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5329640.9 E 364403.9 - Grenfell Twp. ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 - MEL Site E BOREHOLE TYPE CME 55 - Hollow Stem Augers and Core Drill COMPILED BY AT

CLIENT AECOM Inc. DATE (Started/Completed) 10/9/14 - 10/9/14 TIME 6:05:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
307.3	Ground Surface						
0.0	±100 mm asphalt ±225 mm concrete FILL - sand and gravel to sand with gravel trace to some silt		1	AS	N/A		307
306.3							
1.0	Occasional cobbles Start of diamond core drilling						306
			2	SS	57		
	350 mm rock						305
			3	SS	8		
	trace wood 250 mm rock numerous cobble/boulder size rock unable to advance split spoon sampler to retrieve samples bewteen 3 to 5 m depth 550 mm rock						304
	350mm rock		4	SS	4		303
	grey fine sand some silt (fill)		5	SS	39		302
300.3							301
7.0	BEDROCK - grey to black conglomerate		6	RC	Rec 100% RQD 69%		300
			7	RC	Rec 100% RQD 100%		299
297.2							298
10.1	End of Coring End of Borehole						

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

COMMENTS
River water surface was at elevation 303.5 m at the time of this investigation.

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

$\circ$ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/9/14 6:05:00 PM	DRY	2.5
2)	-	-
3)	-	-

MEL-GEO 09181 - KENOGAMI BRIDGE - BOREHOLE LOGS.GPJ MEL-GEO.GDT 11/1/14

MERLEX ENGINEERING LTD.
2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.:4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5329663.6 E 364375.7 - Grenfell Twp. ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 - MEL Site E BOREHOLE TYPE CME 55 - Hollow Stem Augers and Core Drill COMPILED BY AT

CLIENT AECOM Inc. DATE (Started/Completed) 10/9/8 - 10/9/9 TIME 2:05:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
307.1	Ground Surface						307				
0.0	±100 mm asphalt ±225 mm concrete FILL - sand and grave lto sand with gravel trace silt		1	AS	N/A				○		
	occasional cobble size rock		2	SS	40		306		○		30 61 (9)
			3	SS	49				○		29 66 (5)
			4	SS	17		305		○		56 40 (4)
304.0			5	SS	50/25 mm				○		
3.1	Start of diamond core drilling cobble/boulder size rock 300 mm rock					▽	304				
	400 mm rock						303				
	grey gravelly sand trace silt occasional cobble/boulder size rock		6	SS	39		302		○		35 56 (9)
	600 mm rock						301				
299.5							300				
7.6	BEDROCK - grey to black conglomerate		7	RC	Rec 100% RQD 100%		299				
			8	RC	Rec 100% RQD 90%		298				
			9	RC	Rec 100% RQD 100%		297				
296.3											
10.8	End of Coring End of Borehole										

COMMENTS

River water surface was at elevation 303.5 m at the time of this investigation. Water level in borehole probably not stabilized prior to backfilling.

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, × 3 : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/9/9 2:20:00 PM	4.1 ▽	5.6 ▨
2)	- ▽	-
3)	- ▼	-

MEL-GEO 09181 - KENOGAMI BRIDGE - BOREHOLE LOGS.GPJ MEL-GEO.GDT 11/1/14

MERLEX ENGINEERING LTD.
2-120 Progress Court, P1B-8G4 Phone: 1-705-476-2550 Fax: 1-705-476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 09/10/09181 DATUM Geodetic LOCATION N 5329667.4 E 364371.8 - Grenfell Twp. ORIGINATED BY JL

PROJECT GWP 162-98-00, Highway 11 - MEL Site E BOREHOLE TYPE CME 55 - Hollow Stem Augers and Core Drill COMPILED BY AT

CLIENT AECOM Inc. DATE (Started/Completed) 10/9/9 - 10/9/13 TIME 5:00:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
307.0	Ground Surface										
0.0	±100 mm asphalt ± mm crushed gravel FILL - sand and gravel to sand with gravel trace silt		1	AS	N/A						
			2	SS	33		306				50 47 (3)
			3	SS	27		305	DCPT Refusal			22 69 (9)
			4	SS	61						49 48 (3)
303.9			5	SS	25/25 mm		304				
3.1	Auger Refusal Start of Diamond Core Driling Concrete - old abutment		6	RC	Rec 100%		303				
			7	RC	Rec 100%		302				
			8	RC	Rec 80%		301				
300.4											
6.6	GRAVEL - grey sandy gravel some silt		9	SS	30		300				51 34 (15)
299.1											
7.9	BEDROCK - grey to black conglomerate		10	RC	Rec 100% RQD 83%		299				
			11	RC	Rec 100% RQD 100%		298				
295.9							297				
							296				
11.1	End of Coring End of Borehole										

COMMENTS

River water surface was at elevation 303.5 m at the time of this investigation.

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/9/13 11:00:00 AM	3.1	-
2) 10/9/13 5:00:00 PM	2.2	5.5
3)	-	-

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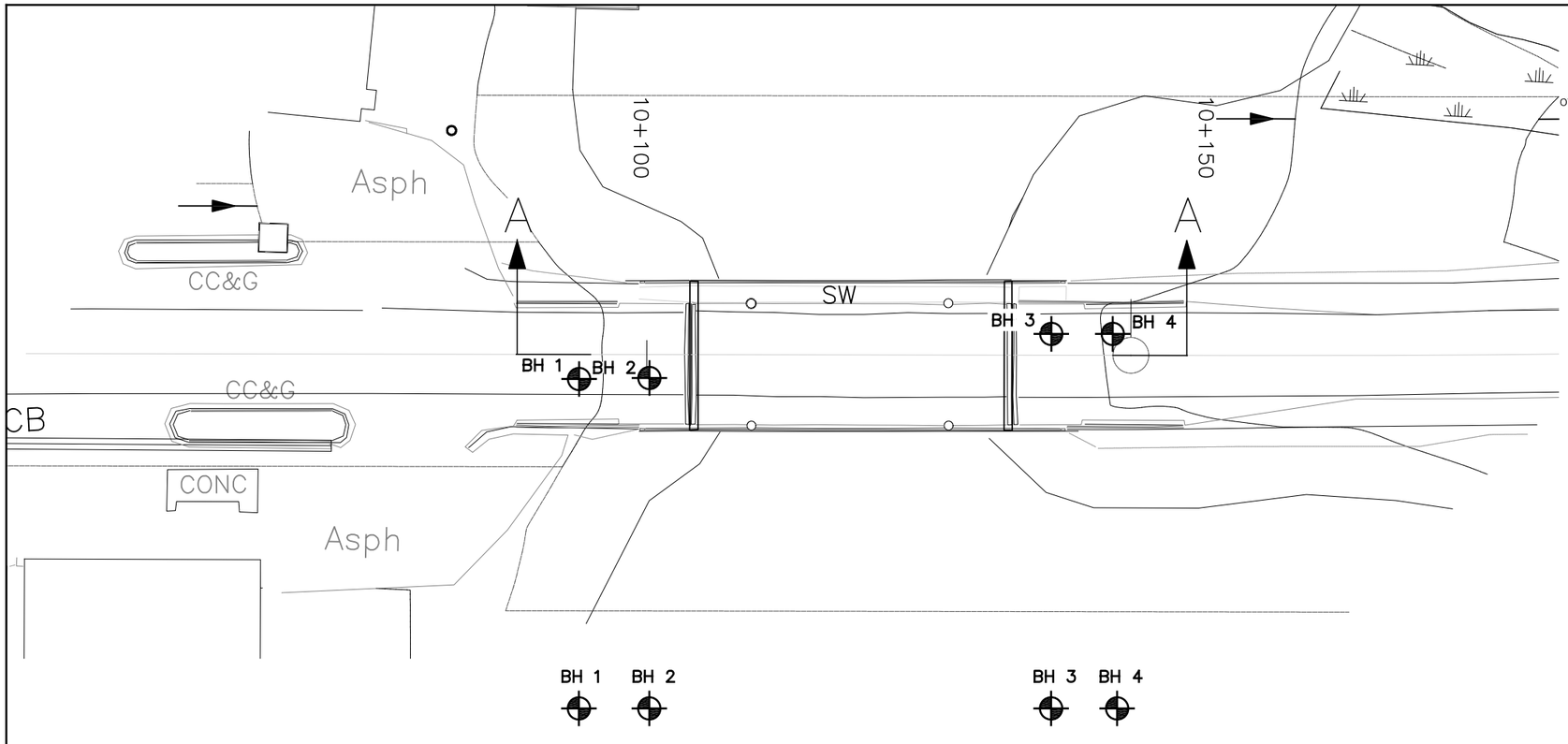
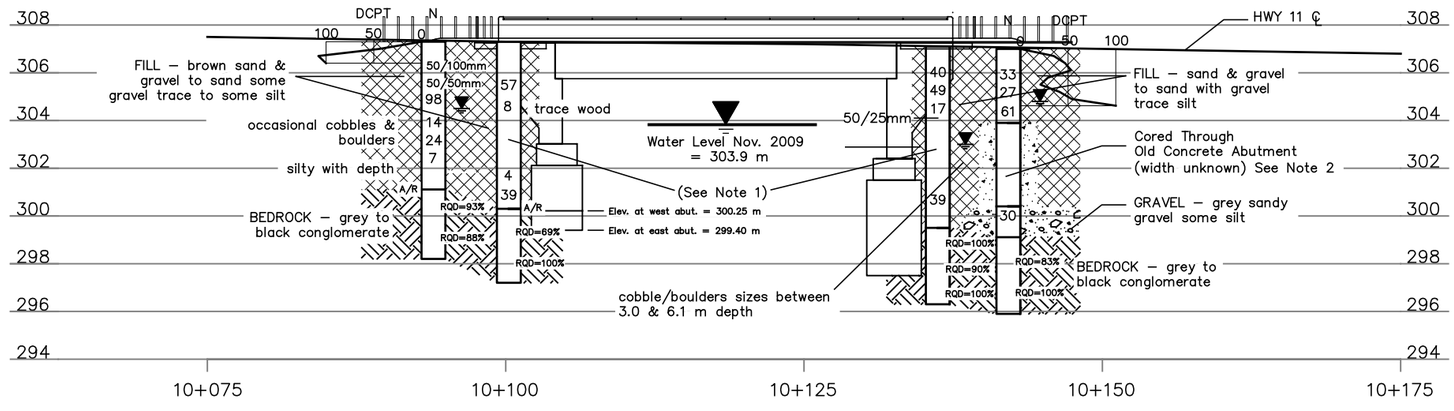
APPENDIX C

Figure No. E-1:	Borehole Locations & Soil Strata
Figure Nos. L-1 to L-3:	Summary Grain Size Analysis Graph





SUBSURFACE PROFILE A – A

Note :
1. Ran NQ Core through nest of cobbles and boulder sizes/rock fill in granular matrix. (See Record of Boreholes)

2. Ran NQ Core through old concrete abutment from elevation 303.9 to 300.4 m (width unknown)

Hort 5m 0 10m
Vert 2.5m 0 5m

METRIC

Dimensions are in meters and/or millimeters unless otherwise shown. Stations are in kilometers + meters.

Geocres No	42A-83
WP No	162-98-00
Site No	47-009

N

HWY 11 - Township of Grenfell
Sta. 10+104 to 10+132 - MEL Site E
Kenogami Lake Bridge
BOREHOLE LOCATIONS & SOIL STRATA

Figure E-1

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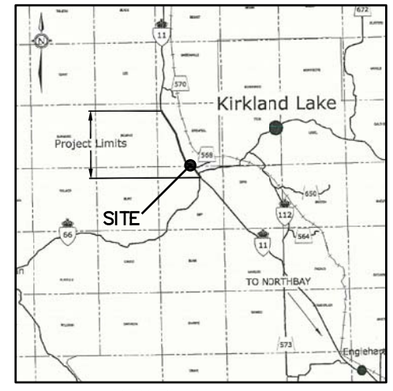
Consulting Geotechnical Engineers



KEY PLAN - NOT TO SCALE

LEGEND

- Borehole
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- DCPT Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation
- E/S End of Sampling
- O/S Offset from centerline

Borehole No.	O/S	Co-ordinates Northerly	Co-ordinates Easterly	Elev.
No. 1	2.2 Rt	5329636.6	364408.4	307.3
No. 2	2.1 Rt	5329640.9	364403.9	307.3
No. 3	1.9 Lt	5329663.6	364375.7	307.1
No. 4	1.9 Lt	5329667.4	364371.8	307.0

NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

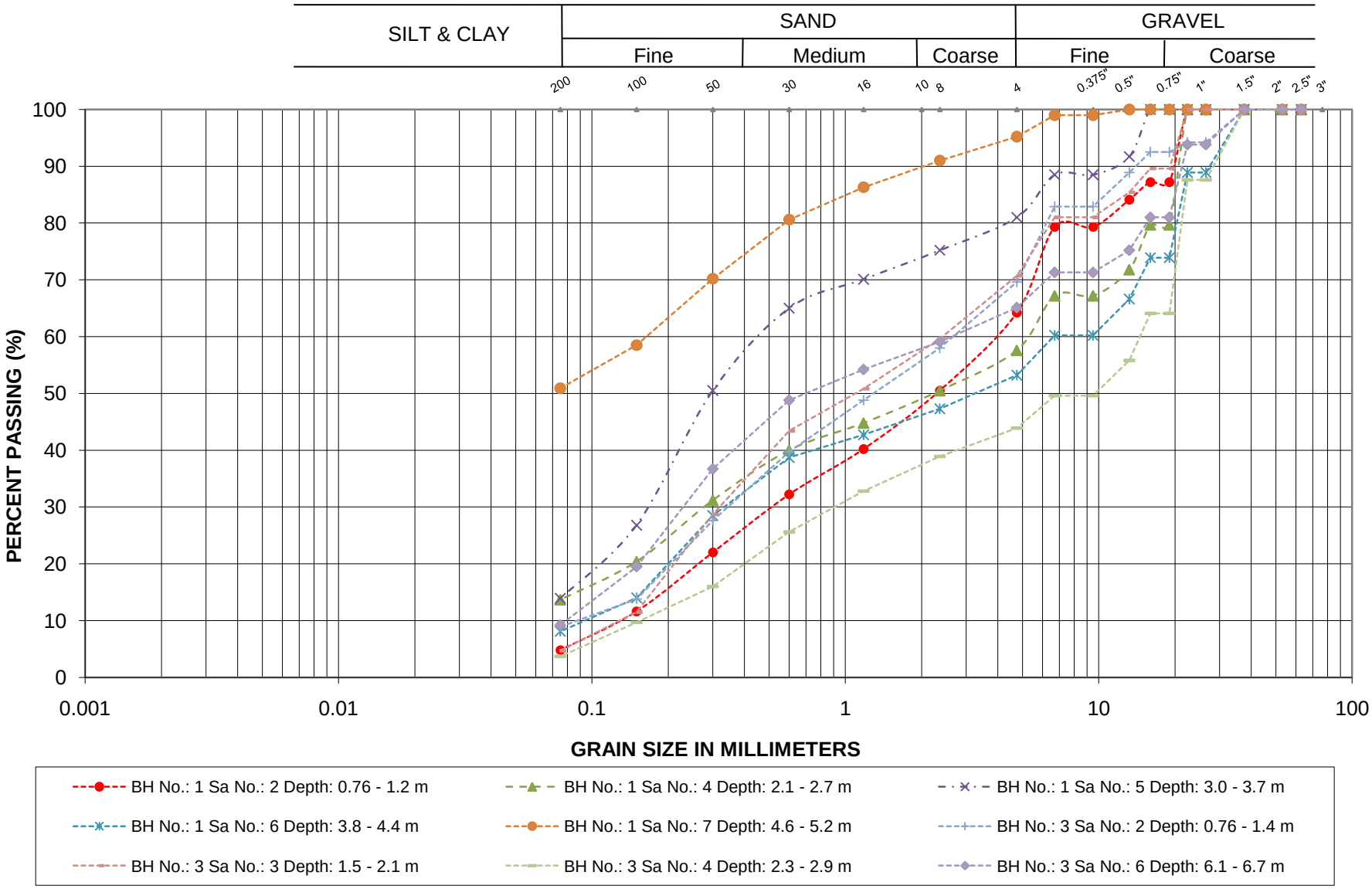
REVISIONS

DATE	BY	DESCRIPTION
Jan 10/11	RG	Modified Notes, added Geocres No.

HWY No. 11 – Kenogami Lake Bridge – Sta. 10+103 to 10+132			REF NO. 09181
SUBM'D			SITE E
DRAWN RG	CHK MAM	DATE November 2010	FIG E-1

Reference No.: 09/10/09181E
Date: January 2011

GRAIN SIZE ANALYSIS



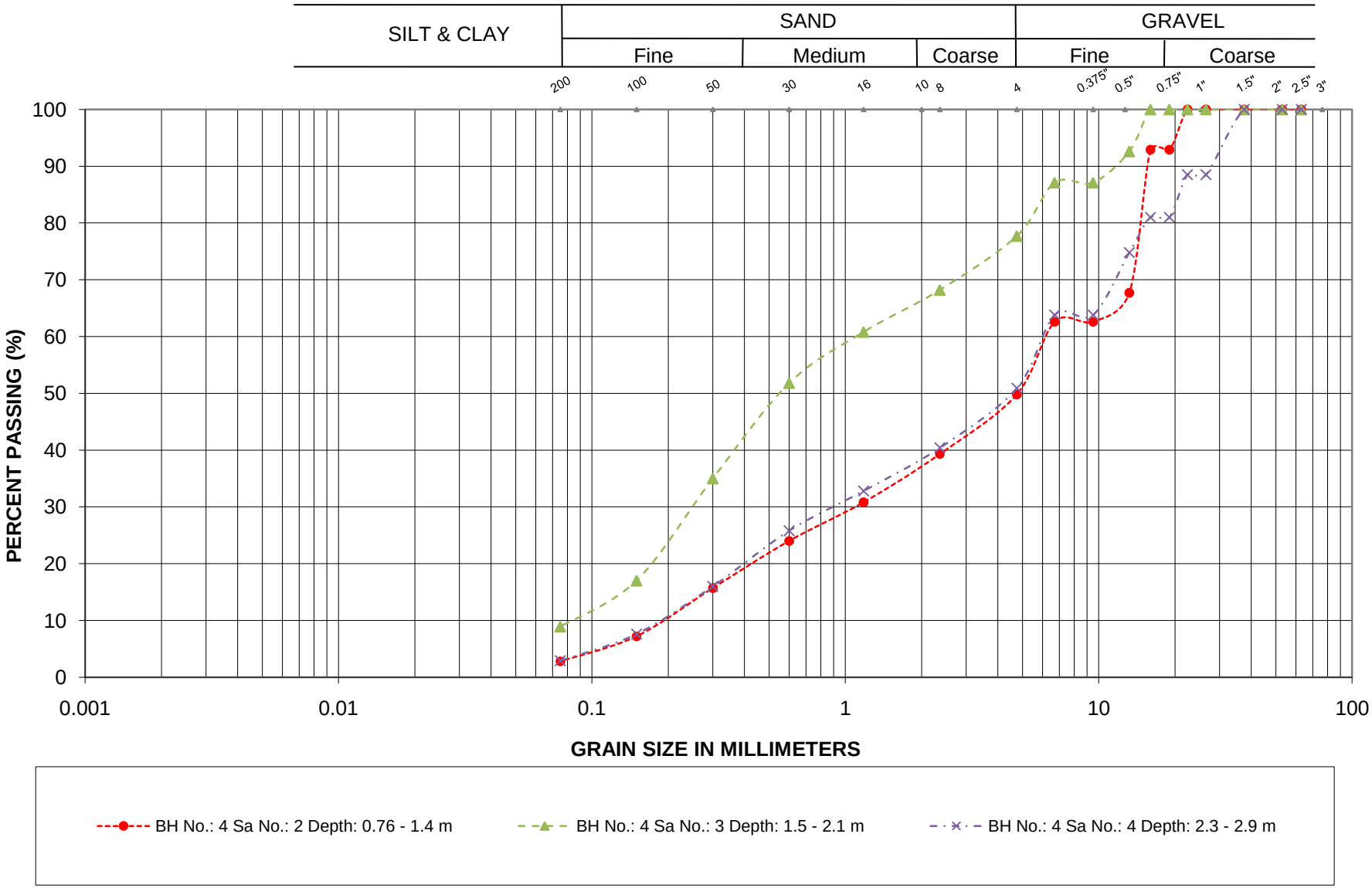
PROJECT: G.W.P. 162-98-00 FILL - Gravel and Sand to Gravelly Sand Trace to Some Silt, to Sandy Silt Trace Gravel
LOCATION: Hwy 11 MEL Kenogami Lake Bridge

MERLEX ENGINEERING LTD.

FIGURE L-1

Reference No.: 09/10/09181E
Date: January 2011

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Kenogami Lake Bridge

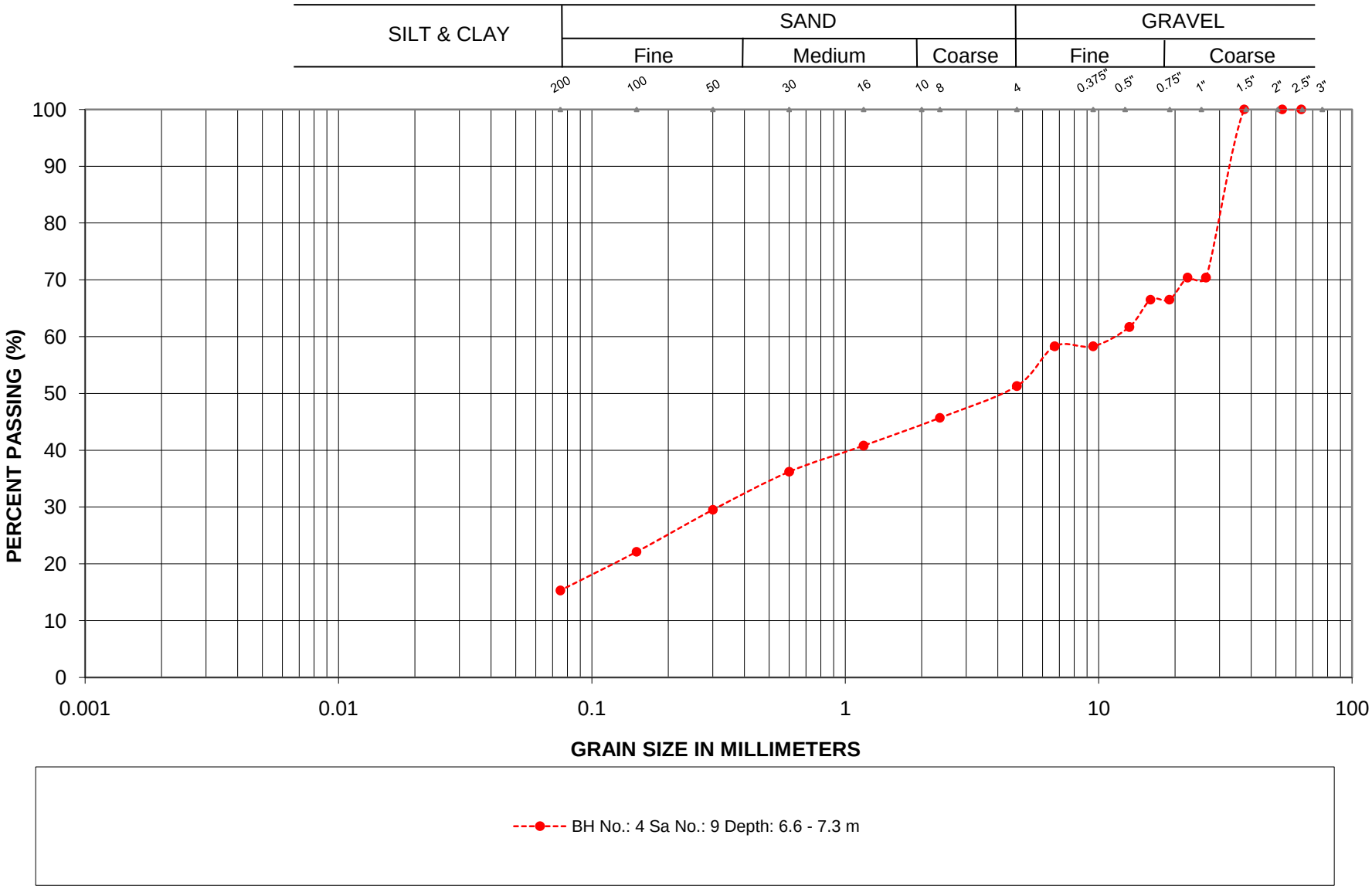
FILL - Gravel and Sand to Sand With Gravel, Trace Silt

MERLEX ENGINEERING LTD.

FIGURE L-2

Reference No.: 09/10/09181E
Date: January 2011

GRAIN SIZE ANALYSIS



PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Kenogami Lake Bridge

GRAVEL - Sandy Gravel, Some Silt

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FIGURE L-3

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CONSULTING GEOTECHNICAL ENGINEERS

MTO Project: GWP 162-98-00
Description: Highway 11, From Highway 0.3 km South of Highway 66, Northerly 11.7 km

MEL Ref.: 09/10/09181
Date: January 11, 2011

NOTICE TO CONTRACTOR

Buried Concrete at Kenogami Lake Bridge

The Contractor is advised that abandoned concrete abutments from a pre-existing structure are present in the approach fills at the Kenogami Lake Bridge. The buried concrete is located approximately 9 m south of the existing south abutment bearings and 9 m north of the existing north abutment bearings. The top of the concrete is approximately elevation 304. The lengths and widths of the abandoned concrete abutments are not known.