

**FOUNDATION INVESTIGATION AND DESIGN REPORT
MEDIAN SEWER
LATERAL AND CULVERT REPLACEMENTS
HIGHWAY 400
NORTH CANAL ROAD TO INNISFIL ROAD
SIMCOE COUNTY, ONTARIO
G.W.P. 83-00-00**

Geocres Number: 31D-563

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation carried out for the proposed median sewer, sewer outlets (laterals) and culvert replacements, and construction of a number of culvert headwalls along Highway 400 between North Canal Road and Innisfil Road in Simcoe County, Ontario.

The purpose of this investigation was to determine the subsurface conditions at selected locations along the alignment in order to provide borehole location plans and soil strata drawings, records of boreholes, laboratory test results, and a generalized description of the subsurface conditions. A model of the subsurface conditions was developed for locations where adequate data has been obtained from this and previous investigations.

Thurber Engineering Ltd. (Thurber) carried out this investigation as a sub-consultant to McCormick Rankin (MRC), a member of MMM Group Limited under MTO Assignment No. 2010-E-0081.

2 SITE DESCRIPTION AND SCOPE OF FOUNDATION INVESTIGATION

The alignment covered in this report extends along Highway 400 from North Canal Road to Innisfil Road. The general locations of the proposed works are shown on the key plans on the Borehole Locations and Soil Strata drawings in Appendix C.

The project alignment straddles physiographic regions known as Schomberg Clay Plain and Peterborough Drumlin Field. The soils in the clay plain consist of interbedded silty clay and silty clay till with sand. The drumlin field consists of both eskers which are sandy and gravelly ridges, and drumlins which are mounds of silty tills with cobbles and boulders, or silts and fine sands. The surface watercourses have eroded gullies within the native soils and relatively recent fluvial sediments have been deposited in the gullies.

Regional drainage in the vicinities of the project alignment is controlled by the Humber River and its tributaries as well as Lake Simcoe. Localized drainage is facilitated by the creeks flowing within the gullies.

The land use adjacent to this section of Highway 400 is largely rural and agricultural, although there is increasing residential and commercial development in recent years.

The scope of work pertinent to the foundation investigation program consists of the following:

- Replacement of approximately 13.8 km of median sewer
- Replacement of 97 sewer laterals (73 locations, 24 of which run east and west)
- Replacement of 17 culverts
- Headwalls at 3 culvert locations

As directed by MTO, Thurber has conducted a reduced site investigation program to address the proposed works. This foundation investigation program is less than what would normally be required for the detailed design of the project outlined above. Details of this reduced program, other background information and anticipated risks are detailed in our proposal letter dated March 27, 2013. The following highlights the major features of this reduced program.

- Drilling one (1) sampled borehole near the median at each sewer lateral, regardless of whether it extends across the entire highway or in only one direction
- For culvert replacements, drilling only two (2) boreholes, one on each outside shoulder
- Drilling two (2) boreholes for each culvert headwall location
- Eliminating all median sewer boreholes.

The implication of increased risks due to the reduced borehole program will be discussed in Part 2 of this report. Additional borehole and field investigations will be required to fill in the areas where there is limited or no borehole information in order to reduce the risk of encountering unanticipated ground conditions.

3 SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing for the proposed median sewer, lateral and culvert replacements, and new headwalls consisted of drilling and sampling a total of 110 boreholes. For the sewer laterals, there are a total of 73 boreholes designated as either NLAT- or SLAT- advanced to depths typically ranging from 6 to 8 m below highway grade. For the culverts, there is a total of 31 C- series boreholes advanced to depths typically ranging from 8 to 10 m below highway shoulder grade. For the culvert headwalls, two boreholes were advanced at each of the three headwall sites for a total of 6 boreholes each to a depth of about 8 m below existing ground surface. All boreholes were drilled

within the period of May 5, 2013 to June 13, 2013 by simultaneously using two drill rigs and two traffic control crews.

All boreholes for the sewer lateral and culvert replacements on the Highway 400 embankment were drilled during approved lane closure times at night on the left (fast) lanes and the outside shoulders of the northbound and southbound lanes, respectively. Lane closures and traffic control were carefully planned for drilling each borehole. Boreholes for culvert replacement on the cross roads and for headwall construction off the highway were drilled during day time with traffic control as required. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawings in Appendices A to E. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendices A to E. The borehole coordinates were surveyed by the MMM Group and provided to Thurber.

Solid and hollow stem augers were used to advance the boreholes, and soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT). Field vane tests using an MTO 'N' size vane were attempted at locations where cohesive soils of softer consistency were encountered.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. As agreed with MTO, no piezometer was installed within the travelled portion of the highway and at the narrow shoulders due to safety reasons. An exception was that a standpipe piezometer was installed in a few boreholes during the first week of the field work. Standpipe piezometers were installed at selected locations off the highway to permit monitoring of groundwater levels. The piezometers consisted of 19 mm PVC pipes with slotted screens. The locations and completion details of the piezometers are shown in Table A-1 immediately preceding Appendix A. The borehole completion details are also shown in Table A-1.

Members of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The supervisors logged the boreholes, visually examined the recovered soil samples, and transported them to Thurber's laboratory for further examination and testing.

4 LABORATORY TESTING

Visual identification and natural moisture content determination were undertaken on all recovered soil samples returned to the laboratory. At least 25% of the soil samples were subjected to grain size distribution analysis. Selected cohesive soil samples underwent Atterberg Limits tests. The results of this testing program are shown on the Records of Borehole sheets and on the accompanying figures in Appendices A to E.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

This section presents a generalized summary of the subsurface conditions encountered at the borehole locations drilled for the proposed median sewer, laterals, culvert crossings and headwalls. Borehole location plans and stratigraphic profiles for selected portions along the Highway 400 centreline, where boreholes data is available, are presented on the Borehole Locations and Soil Strata Drawings in Appendices A to D, inclusive. These profiles are identified by sections and station numbers in Table 5.1 below. Stratigraphic sections for culvert replacements, borehole location plans for headwalls and other investigated locations along the highway alignment are presented in Appendix E. Records of Borehole sheets and laboratory testing data relevant to each section are also included in the appendices.

It is important to note that the soil strata drawings presented in this report are for illustrative purposes and for providing a general description of the stratigraphy at selected locations along the Highway 400 alignment. These interpretative soil strata have been developed only for areas where spacings between adjacent boreholes are considered suitable for interpolation. The factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

In general, the soil stratigraphy encountered along the subject section of highway consists of pavement structure (asphalt on granular) and embankment fill overlying native, firm to very stiff silty clay, or clayey silt to silty clay till deposits along the southerly section of the alignment. Beyond this section, compact to dense sands and silts and dense to very dense silty sand to sandy silt till become more prominent foundation soils. Silty clay to clayey silt, sand and silt interlayers and lenses are present between and/or within the glacial till deposits. Groundwater levels observed in open boreholes and noted upon completion of drilling typically range between 2 and 6 m depths below existing grade. It is noted that these observations are very short term and subject to seasonal fluctuations, and therefore do not necessarily represent the stabilized groundwater conditions.

Table 5.1
Longitudinal and Cross Sections

Identification	Reference Alignment	Hwy. 400 Station No.	Reference Boreholes
Longitudinal Profiles – Median Sewer			
West Gwillimbury Township (South of Highway 89)			
Section 1	Hwy. 400 Centreline	11+600 to 12+250	C1-01,C1-02,C2-01,C2-02,SLAT47W-01
Section 2	Hwy. 400 Centreline	13+000 to 13+600	C4-01,C4-02,SLAT51E-01,SLAT53W-01
Section 3	Hwy. 400 Centreline	13+700 to 14+100	C3,C4, SLAT57W-01,SLAT58W-01
Section 4	Hwy. 400 Centreline	14+600 to 15+400	SLAT62-01,SLAT63W-01,SLAT65-01, SLAT67-01,C8-01,C8-02

Section 5	Hwy. 400 Centreline	17+800 to 18+600	C14-01,C14-02,SLAT18-01,SLAT23W-01
Section 6	Hwy. 400 Centreline	18+900 to 19+450	C17-01,C17-02,SLAT30W-01,SLAT31E-01, SLAT32E-01
Section 7	Hwy. 400 Centreline	21+700 to 22+210	SLAT59-01,SLAT64-01,SLAT68-01, SLAT72-01
Innisfil Township (North of Highway 89)			
Section 8	Hwy. 400 Centreline	11+400 to 12+050	NLAT51E-01,NLAT07E-01,NLAT06-01, C47-01,C47-02, NLAT11E-01
Section 9	Hwy. 400 Centreline	12+100 to 12+600	NLAT20E-01,NLAT18W-01,NLAT15-01
Section 10	Hwy. 400 Centreline	12+850 to 13+400	NLAT23AW-01,NLAT28E-01,NLAT32E-01, NLAT54-01
Section 11	Hwy. 400 Centreline	13+500 to 14+000	NLAT50W-01,NLAT46-01,NLAT41-01, NLAT37-01
Section 12	Hwy. 400 Centreline	14+100 to 14+600	C51-01,C51-02,NLAT60-01,NLAT65W-01
Section 13	Hwy. 400 Centreline	14+750 to 14+450	NLAT68W-01,NLAT70W-01,NLAT72W-01, NLAT79E-01,NLAT78-01,NLAT75-01
Section 14	Hwy. 400 Centreline	16+400 to 17+000	NLAT96W-01,NLAT99W-01,NLAT100E-01, NLAT104W-01,NLAT106W-01
Section 15	Hwy. 400 Centreline	18+350 to 19+000	NLAT124E-01,NLAT131-01,NLAT128W-01, NLAT127-01,NLAT08-01,NLAT04-01
Section 16	Hwy. 400 Centreline	19+200 to 19+800	NLAT12W-01,NLAT13E-01,NLAT14W-01, NLAT18W-01,NLAT25W-01
Cross-Sections – Culverts			
West Gwillimbury Township (South of Highway 89)			
1	Crossing Hwy.400	11+641	C1-01, C1-02
2	Crossing Hwy.400	12+031	C2-01, C2-02
4	Crossing Hwy.400	13+121	C4-01, C4-02
7	Crossing Hwy.400	14+874	C7-01, C7-02
8	Crossing Hwy.400	15+364	C8-01, C8-02
14	Crossing Hwy.400	17+818	C14-01, C14-02
17	Crossing Hwy.400	18+952	C17-01, C17-02
32	Crossing Hwy.400	24+613	C32-01, C32-02
Innisfil Township (North of Highway 89)			
HR107	Crossing	10+100	C107-01, C107-02
HR108	Crossing Hwy. 89 N-E/S Ramp	10+126	C108-01, C108-02

47	Crossing Hwy.400	12+000	C47-01, C47-02
SR102	Crossing Concession Rd. 5	13+300	C102-01, C102-02
SR103	Crossing Concession Rd. 5	13+300	C103-01, C103-02
51	Crossing Hwy.400	14+125	C51-01, C51-02
SR112	Crossing 4 th Line	14+150	C112-01, C112-02
SR113	Crossing 4 th Line	14+150	C113-01, C113-02

More detailed descriptions of the stratigraphy within these sections are presented below.

5.1 Sections 1, 2, 3 and 4 (Stations 11+600 to 15+400 West Gwillimbury)

Stratigraphic profiles, records of boreholes and laboratory test results along this portion of the highway are presented in Appendix A.

5.1.1 Pavement Structure

Pavement structure consisting of asphalt overlying granular materials was encountered in Boreholes SLAT47W-01, SLAT51E-01, SLAT53W-01, SLAT57W-01, SLAT58W-01, SLAT62-01, SLAT63W-01, SLAT65-01, SLAT67-01, SLAT18-01 and SLAT23W-01 located on the median lanes, and Boreholes C1-01, C1-02, C2-01, C2-02, C4-01, C4-02, C7-01, C7-02, C8-01 and C8-02 located on the outside shoulders.

The asphalt thickness ranged from 125 to 350 mm (most values between 200 and 350 mm) on the median lanes and ranged from 75 to 375 mm (most values between 75 and 200 mm) on the shoulders. The granular fill materials generally consisted of sand to sand and gravel ranging between 0.2 and 1.8 m in thickness. Where measured, the granulars were in a compact state as indicated by SPT 'N' values ranging from 7 to 29 blows per 0.3 m of penetration, with most values lying between 12 and 23 blows indicating a typically compact state. The moisture contents ranged from approximately 1% to 12%.

The thickness of the pavement structure may vary between and beyond the borehole locations.

Grain size distribution curves for the sand to sand and gravel fill samples tested are presented on the Record of Borehole sheets and on Figures A1 to A2 of Appendix A.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	5 to 49
Sand	42 to 90
Silt and Clay	3 to 14

5.1.2 Clayey Silt to Silty Clay Fill

Fill was encountered in Borehole SLAT67-01, SLAT18-01, C1-02, C2-01, C2-02 and C4-01 below the pavement granular materials. The fill consisted of clayey silt to silty clay with some silt layers, trace gravel with occasional cobbles, wood fibres, organics and was typically brown in colour. Where encountered, the thickness of this fill ranged from 0.8 m to 2.6 m, with base elevations between 223.5 and 260.0 m.

Recorded SPT N-values in the fill ranged from 6 to 37 blows per 0.3 m penetration indicating a firm to hard consistency.

The natural moisture contents of fill samples obtained generally ranged from approximately 3% to 23%.

Grain size distribution curves for cohesive fill samples tested are presented on the Record of Borehole sheets and on Figure A3 of Appendix A. Atterberg Limit test results are presented on Figure A12 of Appendix A.

The results of the laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 10
Sand	0 to 37
Silt	47 to 74
Clay	21 to 26

Index Property	(%)
Liquid Limit	30 to 35
Plasticity Index	13 to 18

The above results show that the clayey silt to silty clay fill is of low plasticity with group symbol of CL.

5.1.3 Silty Clay to Clayey Silt

Silty clay to clayey silt deposits were encountered in all but Borehole C1-02, C2-01 and C4-01 advanced within this section. These cohesive deposits consisted of brown becoming grey with depth, silty clay to clayey silt with trace to some sand and gravel, and were encountered below the fill or pavement granulars. Where fully penetrated, the deposits were 1.1 m to 7.0m thick with base elevations varying between 217.4 and 226.3 m.

Based on SPT N-values ranging from 5 to 47 blows for 0.3 m of penetration, these cohesive soils have a firm to hard consistency.

The natural moisture contents of the samples recovered from these cohesive deposits ranged from 9 to 30%, but typically between 11% and 23%.

Grain size distribution results for the cohesive till samples tested are presented on the Record of Borehole sheets and on Figures A4 to A8 of Appendix A. Atterberg Limit test results are presented on Figures A13 to A16 of Appendix A.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Silty Clay

Soil Particles	(%)
Gravel	0 to 7
Sand	0 to 37
Silt	38 to 66
Clay	23 to 50

Index Property	(%)
Liquid Limit	25 to 46
Plasticity Index	10 to 25

The above results show that the silty clay has low to occasional medium plasticity with a group symbol of CL and occasionally CI.

Clayey Silt

Soil Particles	(%)
Gravel	2 to 13
Sand	27 to 38
Silt	42 to 44
Clay	16 to 18

Index Property	(%)
Liquid Limit	15 to 30
Plasticity Index	5 to 15

The above results show that the clayey silt has low plasticity with a group symbol of CL.

5.1.4 Clayey Silt to Silty Clay Till

Clayey silt till was encountered in Boreholes C1-01, C1-02, C2-01, C2-02, C4-01, C4-02 and C7-01 advanced within this section. Silty clay till was encountered in Borehole SLAT47W-01 and SLAT63W-01. These tills are typically brown to grey in colour with trace to some sand and gravel, and were encountered below the fill or silty clay to clayey silt deposits.

Except in Borehole C2-01 where the till was fully penetrated with a thickness of 4.9 m and base elevation 219.6 m, the other boreholes were terminated within the till.

Based on SPT N-values typically ranging from 9 to 17 blows for 0.3 m of penetration, these cohesive soils have a stiff to very stiff consistency. Occasional values of 7 and 31 blows indicate the presence of firm and hard zones.

The natural moisture contents of the till samples ranged from 10% to 22%.

Grain size distribution results for the cohesive till samples tested are presented on the Record of Borehole sheets and on Figures A9 and A10 of Appendix A. Atterberg Limit test results are presented on Figures A17 to A18 of Appendix A.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Silty Clay Till

Soil Particles	(%)
Gravel	0 to 4
Sand	14 to 26
Silt	45 to 49
Clay	31 to 39

Index Property	(%)
Liquid Limit	19 to 38
Plasticity Index	8 to 20

Clayey Silt Till

Soil Particles	(%)
Gravel	0 to 7
Sand	31 to 39
Silt	36 to 49
Clay	19 to 21

Index Property	(%)
Liquid Limit	18 to 21
Plasticity Index	8 to 9

The above results show that the tills have low plasticity with a group symbol of CL.

Glacial tills inherently contain cobbles and boulders.

5.1.5 Sand and Silt

In Boreholes SLAT62-01 and SLAT63W-01, a layer of grey sand and silt with trace to some gravel and clay was encountered within the silty clay to clayey silt deposits. Where encountered, these cohesionless layers were 0.8 to 1.1 m thick with base elevations varying between 223.9 and 224.6 m.

The SPT N-values recorded in the cohesionless deposits were 7 and 9 blows for 0.3 m of penetration indicating a loose condition.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 10% and 12%

Grain size distribution curves for samples tested from the sand deposits are presented on the Record of Borehole sheets and on Figure A11 of Appendix A.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	6 to 13
Sand	41 to 43
Silt	37 to 40
Clay	9 to 11

5.1.6 Water Levels

The groundwater level was observed in the boreholes during and upon completion of drilling. No piezometer was installed in the SLAT- (except for SLAT62-01, SLAT65-01, SLAT67-01 where piezometer were installed and decommissioned several days later) and C- series of boreholes located on the median lane and shoulder of the highway, respectively, as explained previously. The water levels observed in the open boreholes upon completion of drilling are summarized in Table 5.2 except otherwise noted. It is noted that boreholes not shown in the table below were dry (did not have free water level inside the borehole) upon completion.

Table 5.2 – Observed Groundwater Levels

Approx. Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
West Gwillimbury				
11+641	C1-01	May 13, 2013	4.5	226.4
	C1-02	May 14, 2013	5.7	225.4
12+031	C2-01	May 13, 2013	4.9	223.4
	C2-02	May 14, 2013	4.7	223.3
13+121	C4-01	May 13, 2013	5.0	221.4
	C4-02	May 14, 2013	5.6	220.9
13+930	SLAT57W-01	May 8, 2013	3.9	224.3
14+640	SLAT62-01 (piezometer)	May 5, 2013	2.5	227.0
14+980	SLAT65-01 (piezometer)	May 5, 2013	2.5	228.3
15+150	SLAT67-01 (piezometer)	May 5, 2013	1.8	230.7
15+364	C8-01	May 15, 2013	5.9	228.5
	C8-02	May 14, 2013	8.5	225.8

The above values are very short term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5.2 Sections 5, 6, 7, 8 and 9 (Stations 17+800 West Gwillimbury to 12+600 Innisfil)

Stratigraphic profiles, records of boreholes and laboratory test results along this portion of the highway are presented in Appendix B.

5.2.1 Pavement Structure

Pavement structure consisting of asphalt overlying granular materials was encountered in Boreholes SLAT18-01, SLAT23W-01, SLAT30W-01, SLAT31E-01, SLAT32E-01, SLAT59-01, SLAT64-01, SLAT68-01, SLAT72-01, NLAT51E-01, NLAT07E-01, NLAT06-01, NLAT11E-01, NLAT20E-01, NLAT18W-01 and NLAT15-01 located on the median lanes, and Boreholes C14-01, C14-02, C17-01, C17-02, C47-01 and C47-02 located on the outside shoulders.

The asphalt thickness ranged from 150 to 450 mm with most values lying between 200 and 350 mm. The granular fill materials generally consisted of sand to gravelly sand with some silt ranging between 0.4 and 3.0 m in thickness, with most values lying between 0.4 and 1.5 m. The measured SPT 'N' values ranged from 17 to 45 blows per 0.3 m of penetration with most values lying between 12 and 24 blows indicating a typically compact state. The

moisture contents ranged from approximately 2% to 18% with most values lying between 2% and 8%.

The thickness of the pavement structure may vary between and beyond the borehole locations.

Grain size distribution curves for the sand to gravelly sand fill samples tested are presented on the Record of Borehole sheets and on Figures B1 and B2 of Appendix B.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	5 to 40
Sand	52 to 90
Silt and Clay	3 to 29

5.2.2 Sand and Silt Fill

Fill was encountered in Borehole SLAT18-01, NLAT07E-01, NLAT11E-01, C47-02 and NLAT20E-01 below the pavement granular materials. The fill consisted of silty sand to sand and silt with trace gravel and was typically brown in colour. Where encountered, the thickness of this fill ranged from 0.6 m to 2.2 m, with base elevations between 230.7 and 260.0 m.

Recorded SPT N-values in the fill ranged from 6 to 17 blows per 0.3 m penetration indicating a loose to compact state.

The natural moisture contents of fill samples obtained ranged from approximately 6% to 18%.

Grain size distribution curves for cohesionless fill samples tested are presented on the Record of Borehole sheets and on Figure B3 of Appendix B.

The results of the laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	(%)
Gravel	1 to 8
Sand	48 to 61
Silt	24 to 30
Clay	10 to 14

5.2.3 Silty Clay to Clayey Silt

Silty clay to clayey silt deposits were encountered in Boreholes C14-01, C14-02, SLAT18-01, C17-01, SLAT30W-01, NLAT51E-01, NLAT07E-01, C47-01, NLAT11E-01, NLAT20E-01 and NLAT18W-01 advanced within this section. These cohesive deposits consisted of brown becoming grey with depth, silty clay to clayey silt with trace to some sand

and gravel, and were typically encountered below the fill or pavement granulars. Where fully penetrated, the deposits were 0.6 m to 2.3 m thick with base elevations varying between 221.6 and 273.5 m. Borehole NLAT51E-01 was terminated within the silty clay which is at least 8.3 m thick and extends below Elevation 221.6 m.

Based on SPT N-values typically ranging from 7 to 26 blows for 0.3 m of penetration, these cohesive soils have a stiff to very stiff consistency. Occasional values of 5 to 6 blows and 32 blows indicated firm and hard zones.

The natural moisture contents of the samples recovered from these cohesive deposits typically ranged from 10 to 25%, with occasional values up to 38%.

Grain size distribution results for the cohesive samples tested are presented on the Record of Borehole sheets and on Figures B4 to B6 of Appendix B. Atterberg Limit test results are presented on Figures B12 to B14 of Appendix B.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Silty Clay

Soil Particles	(%)
Gravel	0 to 2
Sand	4 to 31
Silt	31 to 65
Clay	28 to 51

Index Property	(%)
Liquid Limit	22 to 35
Plasticity Index	10 to 18

Clayey Silt

Soil Particles	(%)
Gravel	0 to 1
Sand	21 to 48
Silt	33 to 60
Clay	17 to 19

Index Property	(%)
Liquid Limit	18 to 34
Plasticity Index	8 to 13

The above results show that the silty clay and clayey silt have low plasticity with a group symbol of CL.

5.2.4 Sands and Silts

In all but Boreholes SLAT30W-01, SLAT59-01, SLAT64-01, SLAT68-01, SLAT72-01, NLAT51E-01 and NLAT06-01, deposits of sand and silt, sandy silt to silty sand with trace to some gravel was encountered interlayering with the silty clay to clayey silt deposits. Where fully penetrated, these cohesionless soils were 0.7 to 3.1 m thick with base elevations varying between 231.0 and 280.1 m. Where not fully penetrated in Boreholes SLAT23W-01, C17-02, SLAT31E-01, NLAT07E-01, and NLAT-15-01, these deposits have minimum thicknesses varying from 2.2 m to 6.9 m and extend below a base elevation of 223.2 m.

The SPT N-values recorded in these soils were between 4 and 39 blows for 0.3 m of penetration indicating a loose to dense state. Occasional values of greater than 50 blows indicate the presence of very dense zones.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 5% and 28%.

Grain size distribution curves for samples of the sand deposits are presented on the Record of Borehole sheets and on Figures B7 to B9 of Appendix B.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 8
Sand	36 to 71
Silt	23 to 47
Clay	8 to 16

5.2.5 Sandy Silt to Silty Sand Till

Boreholes SLAT32E-01, SLAT59-01, SLAT64-01, SLAT68-01, SLAT72-01, NLAT06-01, C47-01, C47-02 and NLAT11E-01 encountered glacial till deposits consisting of brown to grey sandy silt to silty sand with trace to some gravel and trace clay. All of these boreholes terminated within the till. The minimum thicknesses of these till deposits, where encountered, varied between 2.1 and 5.2 m.

The SPT N-values recorded in these soils varied widely between 15 blows for 0.3 m of penetration to greater than 100 blows for less than 0.3 m penetration, indicating a compact to very dense state. Most N-values ranged between 30 and 100 blows indicating a dense to very dense state. The higher blow counts may indicate the presence of cobbles and boulders.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 6% and 15%.

Grain size distribution curves for samples tested from the sand deposits are presented on the Record of Borehole sheets and on Figure B10 of Appendix B.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 3
Sand	13 to 63
Silt	24 to 76
Clay	9 to 16

Glacial tills inherently contain cobbles and boulders.

5.2.6 Clayey Silt Till

Clayey silt till was encountered in Boreholes SLAT32E-01 and C47-01. This till is typically brown to grey in colour with sand and trace gravel, and were encountered below the sands and silts, or silty clay to clayey silt deposits.

The till was fully penetrated in both boreholes with thickness between 1.5 and 2.2 m, and base elevations of 277.9 and 230.7 m.

Based on SPT N-values ranging from 37 to 80 blows for 0.3 m of penetration, this till in Borehole SLAT32E-01 has a hard consistency. This till in Borehole C47-01 has a very stiff consistency as indicated by an N-value of 16 blows per 0.3 m penetration.

The natural moisture contents of the till samples ranged from 7% to 10%.

Grain size distribution results for a clayey silt till sample is presented on the Record of Borehole sheets and on Figure B11 of Appendix B.

The results of laboratory gradation test are summarized below:

Clayey Silt Till

Soil Particles	(%)
Gravel	2
Sand	51
Silt	28
Clay	19

5.2.7 Water Levels

The groundwater level was observed in the boreholes during and upon completion of drilling. No piezometer was installed in the SLAT-, NLAT- and C- series of boreholes located on the median lane and shoulder of the highway, respectively, as explained previously. The water levels observed in the open boreholes upon completion of drilling are summarized in Table

5.3. It is noted that boreholes not shown in the table below were dry (did not have free water level inside the borehole) upon completion.

Table 5.3 – Observed Groundwater Levels

Approx. Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
West Gwillimbury				
17+818	C14-02	May 13, 2013	3.6	251.7
18+600	SLAT23W-01	May 9, 2013	6.1	264.4
18+952	C17-01	May 12, 2013	6.0	272.0
	C17-02	May 13, 2013	5.9	272.3
Innisfil				
11+440	NLAT51E-01	May 26, 2013	8.5	222.9
11+770	NLAT07E-01	May 27, 2013	3.3	229.7
12+000	C47-01	May 31, 2013	4.3	232.5
12+000	C47-02	May 31, 2013	3.3	233.3
12+100	NLAT11E-01	May 27, 2013	3.4	235.7
12+280	NLAT20E-01	May 27, 2013	2.7	239.1
12+430	NLAT18W-01	May 28, 2013	2.5	241.7

The above values are very short term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5.3 Sections 10, 11, 12, 13 and 14 (Stations 12+850 to 17+000 Innisfil)

Stratigraphic profiles, records of boreholes and laboratory test results along this portion of the highway are presented in Appendix C.

5.3.1 Pavement Structure

Pavement structure consisting of asphalt overlying granular materials was encountered in Boreholes NLAT23AW-01, NLAT28E-01, NLAT32E-01, NLAT54-01, NLAT50W-01, NLAT546-01, NLAT41-01, NLAT37-01, NLAT60-01, NLAT65W-01, NLAT68W-01, NLAT70W-01, NLAT72W-01, NLAT79E-01, NLAT78-01, NLAT75-01, NLAT96W-01, NLAT99W-01, NLAT100E-01, NLAT104W-01 and NLAT106W-01 located on the median lanes, and Boreholes C51-01 and C51-02 located on the outside shoulders.

The asphalt thickness typically ranged from 200 to 350 mm with occasional values lying of 175 and 188 mm. The granular fill materials generally consisted of sand, gravelly sand to sand and gravel, occasional cobbles, trace to some fines, trace organics, and ranging between 0.4 and 1.5 m in thickness with some values greater than 2 m and occasionally up to 4.5. The measured SPT 'N' values ranged from 10 blows per 0.3 m of penetration to greater than 100 blows for less than 0.3 m penetration, with most values lying between 10 and 25 blows

indicating a typically compact state. The moisture contents ranged from approximately 1% to 18% with most values lying between 1% and 10%.

The thickness of the pavement structure may vary between and beyond the borehole locations.

Grain size distribution curves for selected fill samples tested are presented on the Record of Borehole sheets and on Figures C1 to C3 of Appendix C.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	4 to 48
Sand	47 to 88
Silt and Clay	3 to 22

5.3.2 Sand and Silt Fill

Fill was encountered in Borehole NLAT23AW-01, NLAT37-01, C51-02, NLAT96W-01 and NLAT100E-01 below the pavement granular materials. The fill consisted typically of sands and silts, trace gravel, occasional cobbles, and occasional clayey silt and was typically brown in colour. Where encountered, the thickness of this fill ranged from 0.6 m to 2.1 m, with base elevations between 251.5 and 297.8 m.

Recorded SPT N-values in the sand and silt fill ranged from 11 to 52 blows per 0.3 m penetration indicating a compact to very dense state. An occasional value of 8 blows indicates a loose zone. The clayey silt in Borehole C51-02 has a firm consistency as indicated by an N-value of 6 blows.

The natural moisture contents of sand and silt fill samples obtained ranged from approximately 3% to 13%. The clayey silt fill has a measured moisture content of 36%.

Grain size distribution curves for cohesionless fill samples tested are presented on the Record of Borehole sheets and on Figure C4 of Appendix C.

The results of the laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	(%)
Gravel	2 to 3
Sand	54 to 60
Silt	24 to 32
Clay	11 to 14

5.3.3 Sands and Silts

Below the fill and some cohesive tills, Boreholes NLAT23AW-01, NLAT28E-01, NLAT32E-01, NLAT41-01, C51-02, NLAT60-01, NLAT68W-01, NLAT72W-01,

NLAT79E-01, NLAT100E-01, NLAT104W-01 and NLAT106W-01 encountered deposits of sands and silts with trace to some gravel. Where fully penetrated, these cohesionless soils were 1.1 to 2.5 m thick with base elevations varying between 254.8 and 294.5 m. Where not fully penetrated, these deposits have minimum thicknesses varying between 1.1 and 7.4 m and extend below base elevations of 247.9 to 289.9 m.

The SPT N-values recorded in these soils were between 3 and 84 blows for 0.3 m of penetration, with most values ranging from 10 to 48 blows indicating a compact to dense state. Occasional values of greater than 50 blows and less than 10 blows indicate the presence of very dense and loose zones, respectively.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 5% to 22%.

Grain size distribution curves for samples tested from the sand deposits are presented on the Record of Borehole sheets and on Figures C5 to C7 of Appendix C.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 20
Sand	49 to 87
Silt	15 to 32
Clay	2 to 14

5.3.4 Sandy Silt to Silty Sand Till

With the exception of Boreholes NLAT 100E-01, NLAT23AW-01, NLAT41-01, NLAT60-01, NLAT68W-01, NLAT70W-01, NLAT72W-01 and NLAT104W-01, and underlying the sands, silts and cohesive soils, boreholes advanced within these sections were terminated in glacial till deposits consisting of sandy silt, sand and silt to silty sand with trace to some gravel and trace to some clay. In Borehole NLAT32E-01, the upper 1.5 m of silty sand till with a base elevation at 258.9 m grades into a sandy silt till with depth. In the boreholes that were terminated in the cohesionless till, the minimum thickness of the till ranges between 2.2 and 5.8 m and extend below elevations 251.2 to 293.4 m.

The SPT N-values recorded in these soils were typically between 50 blows for 0.3 m of penetration to greater than 100 blows for less than 0.3 m penetration indicating a very dense state. Occasional values of less than 50 blows indicate the presence of compact to dense zones. The high blow counts may represent the presence of cobbles and boulders.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 5% to 15%.

Grain size distribution curves for samples tested from the sand deposits are presented on the Record of Borehole sheets and on Figures C8 and C9 of Appendix C.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 10
Sand	54 to 65
Silt	20 to 35
Clay	8 to 21

Glacial tills inherently contain cobbles and boulders.

5.3.5 Silty Clay/Clayey Silt and Silty Clay/Clayey Silt Till

Silty clay to clayey silt and silty clay to clayey silt till deposits were encountered in Boreholes NLAT41-01, NLAT37-01, C51-01, C51-02, NLAT65W-01, NLAT70W-01, NLAT79E-01, NLAT78-01 and NLAT106W-01 advanced within this section. These cohesive deposits consisted of brown becoming grey with depth, silty clay to clayey silt with trace to some sand and gravel, and were typically interlayered with the sands and silts. Where fully penetrated, the deposits were 0.5 m to 3.4 m thick with base elevations varying between 276.3 and 292.2m. Borehole NLAT41-01 was terminated within the clayey silt till at Elevation 276.3 m.

Based on SPT N-values ranging from 5 to 36 blows for 0.3 m of penetration, the silty clay to clayey silt has a firm to hard consistency. The clayey silt till in Boreholes NLAT41-01 is hard throughout as indicated by 'N' values ranging from 54 blows per 0.3 m penetration to greater than 80 blows for less than 0.3 m penetration.

The natural moisture contents of the silty clay to clayey silt samples ranged from 10 to 30%. The moisture contents measured for the clayey silt till were 5% and 10%.

Grain size distribution results for the cohesive samples tested are presented on the Record of Borehole sheets and on Figures C10 to C12 of Appendix C. Atterberg Limit test results are presented on Figures C13 and C14 of Appendix C.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Clayey Silt to Silty Clay Till

Soil Particles	(%)
Gravel	1
Sand	38 to 41
Silt	28 to 38
Clay	23 to 30

Index Property	(%)
Liquid Limit	22
Plasticity Index	11

The above results show that the silty clay till has low plasticity with a group symbol of CL.

Silty Clay to Clayey Silt

Soil Particles	(%)
Gravel	0
Sand	5 to 43
Silt	26 to 44
Clay	18 to 69

Index Property	(%)
Liquid Limit	21 to 50
Plasticity Index	11 to 28

The above results show that the silty clay and clayey silt have low to intermediate plasticity with a group symbol of CL-CI.

5.3.6 Water Levels

The groundwater level was observed in the boreholes during and upon completion of drilling. No piezometer was installed in the NLAT- and C- series of boreholes located on the median lane and shoulder of the highway, respectively, as explained previously. The water levels observed in the open boreholes upon completion of drilling are summarized in Table 5.3. It is noted that boreholes not shown in the table below were dry (did not have free water level inside the borehole) upon completion.

Table 5.3 – Observed Groundwater Levels

Approx. Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
Innisfil				
12+900	NLAT23AW-01	May 28, 2013	4.1	250.5
13+100	NLAT32E-01	May 29, 2013	6.1	255.1
13+350	NLAT54-01	May 29, 2013	0.9	268.1
13+810	NLAT41-01	May 28, 2013	4.4	278.1
13+970	NLAT37-01	May 31, 2013	2.4	282.9
14+125	C51-01	May 31, 2013	1.5	284.2
14+125	C51-02	May 31, 2013	2.9	282.8
14+400	NLAT60-01	May 27, 2013	3.0	284.4
14+550	NLAT65W-01	May 27, 2013	3.6	284.6
14+910	NLAT70W-01	May 17, 2013	5.2	284.9
15+030	NLAT72W-01	May 17, 2013	5.3	285.4
15+170	NLAT79E-01	May 30, 2013	4.5	286.9
15+280	NLAT78-01	May 30, 2013	5.1	287.5
16+560	NLAT99W-01	May 16, 2013	5.9	292.4
16+790	NLAT104W-01	May 16, 2013	6.4	289.5
16+980	NLAT106W-01	May 16, 2013	5.4	291.3

The above values are very short term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5.4 Sections 15 and 16 (Stations 18+350 to 19+800 Innisfil)

Stratigraphic profiles, records of boreholes and laboratory test results along this portion of the highway are presented in Appendix D.

5.4.1 Pavement Structure and Topsoil

Pavement structure consisting of asphalt overlying granular materials was encountered in Boreholes NLAT124E-01, NLAT131-01, NLAT128W-01, NLAT127-01, NLAT08-01, NLAT04-01, NLAT12W-01, NLAT13E-01, NLAT14W-01, NLAT118W-01 drilled through the highway embankment.

The asphalt thickness ranged from 188 to 350 mm in the boreholes. The granular fill materials generally consisted of sand, gravelly sand to sand and gravel with occasional cobbles generally ranging between 0.4 and 2.0 m in thickness. The measured SPT 'N' values ranged from 7 to 35 blows per 0.3 m of penetration indicating a loose to dense state. The moisture contents ranged from approximately 1% to 10% with most values lying between 1% and 3%.

The thickness of the pavement structure may vary between and beyond the borehole locations.

Grain size distribution curves for selected fill samples tested are presented on the Record of Borehole sheets and on Figure D1 of Appendix D.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	6 to 64
Sand	34 to 78
Silt and Clay	2 to 25

Topsoil of about 25 mm in thickness was encountered at ground surface in Borehole NLAT25W-01 located off the embankment. The thickness of the topsoil may vary between and beyond the borehole locations.

5.4.2 Silty Sand and Silty Clay Fill

Fill was encountered in Borehole NLAT131-01 and NLAT04-01 below the pavement granular materials. The fill consisted of silty sand, some clay, trace gravel and silty clay with sand, trace gravel, and was typically brown in colour. Where encountered, the thickness of this fill varied from 1.3 m to 1.5 m, with base elevations between 295.1 and 301.8 m. In Borehole NLAT25W-01, sand and silt fill was encountered below the topsoil to 2.2 m depth or to Elevation 305.0 m.

Recorded SPT N-values in the silty sand fill varied from 8 to 10 blows per 0.3 m penetration indicating a loose to compact state. The silty clay fill in Borehole NLAT04-01 has a very stiff consistency as indicated by an N-value of 17 blows per 0.3 m penetration. SPT N-values measured in the sand and silt fill ranged between 7 and 9 blows per 0.3 m penetration indicating a loose state.

The measured moisture contents of the silty sand fill samples ranged from approximately 8% to 10%. Measured values for the sand and silt fill were between 14% and 17%. The silty clay fill has a measured moisture content of 15%.

Grain size distribution curves for cohesionless fill samples tested are presented on the Record of Borehole sheets and on Figure D2 of Appendix D.

The results of the laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	(%)
Gravel	1 to 10
Sand	54 to 70
Silt	20 to 34
Clay	11 to 12

A grain size distribution curve for the silty clay fill sample are presented on the Record of Borehole sheets and on Figure D3 of Appendix D. Atterberg limits results are plotted on Figure D8.

The results of the laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	(%)
Gravel	1
Sand	39
Silt	31
Clay	29

Index Property	(%)
Liquid Limit	24
Plasticity Index	11

The above results show that the silty clay fill has low plasticity with a group symbol of CL.

5.4.3 Sands and Silts

Boreholes advanced within these sections, except for Boreholes NLAT08-01 and NLAT14W-01, encountered deposits of brown sand, sandy silt to silty sand with trace to some gravel and trace clay. These cohesionless deposits were encountered below the pavement structure or the underlying fill. Where fully penetrated in Boreholes NLAT124E-01, NLAT127-01, NLAT128W-01, NLAT12W-01 and NLAT118W-01, the thickness of the till ranges from 0.7 to 3.0 m with base elevations ranging between 293.4 and 305.5 m. In other boreholes terminating within the sands and silts, the minimum thickness of these deposits varies between 4.4 and 4.7 m and extend below elevations 290.4 to 300.5 m.

The SPT N-values recorded in these soils were ranged between 4 and 96 blows for 0.3 m of penetration with most values lying between 16 and 59 blows indicating a compact to very dense state.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 5% to 18%.

Grain size distribution curves for tested samples are presented on the Record of Borehole sheets and on Figure D4 of Appendix D.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	2 to 8
Sand	46 to 63
Silt	21 to 38
Clay	8 to 14

5.4.4 Sandy Silt to Silty Sand Till

Underlying the pavement structure or the native sand and silts, Boreholes NLAT128W-01, NLAT127-01, NLAT08-01, NLAT12W-01, NLAT13E-01 and NLAT14W-01 encountered glacial till deposits consisting of sandy silt to silty sand with trace to some gravel and cobbles, and trace to some clay. These boreholes terminated within the till with minimum thickness ranging between 2.5 and 6.0 m and extend below elevations 293.4 to 300.1 m.

The SPT N-values recorded in these soils were typically from 52 blows for 0.3 m of penetration to greater than 50 blows for less than 0.3 m penetration indicating a dense to very dense state. Occasional values of less than 50 blows indicate the presence of compact to dense zones. The high N-values may represent the presence of cobbles and boulders.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured at 5% to 15%.

The grain size distribution curve for a sample of the silty sand till is presented on the Record of Borehole sheets and on Figure D5 of Appendix D.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	1 to 12
Sand	46 to 61
Silt	25 to 29
Clay	11 to 13

Glacial tills inherently contain cobbles and boulders.

5.4.5 Clayey Silt/silty clay to Clayey Silt Till

Underlying the fill or native sands and silts, clayey silt/silty clay to clayey silt till deposits were encountered in Boreholes NLAT124E-01, NLAT13E-01, NLAT14W-01 and NLAT118W-01 advanced within this section. These cohesive deposits consisted of brown becoming grey with depth, clayey silt to silty clay with trace to some sand and gravel, and were typically interlayered with the sands and silts. Where fully penetrated, the deposits were 1.5 m thick with base elevations at 302.9 and 303.6m. Boreholes NLAT124E-01 and NLAT118W-01 were terminated within the clayey silt or clayey silt till, which have minimum thicknesses of 2.9 to 4.4 m and extends below Elevations 290.5 and 301.1 m, respectively.

Based on SPT N-values ranging from 4 to 21 blows for 0.3 m of penetration, the clayey silt to silty clay has a firm to very stiff consistency. The clayey silt till in Boreholes NLAT118W-

01 is very stiff to hard as indicated by 'N' values ranging from 21 to 46 blows per 0.3 m penetration.

The natural moisture contents of these clayey silt to silty clay samples typically ranged from 10 to 21%. The moisture contents measured for the clayey silt till were between 8% and 16%.

Grain size distribution results for the cohesive samples tested are presented on the Record of Borehole sheets and on Figures D6 and D7 of Appendix C. Atterberg Limit test results are presented on Figures D9 and D10 of Appendix C.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Clayey Silt/Silty Clay

Soil Particles	(%)
Gravel	1 to 6
Sand	40 to 42
Silt	32 to 39
Clay	16 to 25

Index Property	(%)
Liquid Limit	19 to 28
Plasticity Index	8 to 14

The above results show that the silty clay till has low plasticity with a group symbol of CL.

Clayey Silt Till

Soil Particles	(%)
Gravel	2
Sand	46
Silt	32
Clay	20

Index Property	(%)
Liquid Limit	21
Plasticity Index	9

The above results show that these cohesive soils have low plasticity with a group symbol of CL.

Glacial tills inherently contain cobbles and boulders.

5.4.6 Water Levels

The groundwater level was observed in the boreholes during and upon completion of drilling. No piezometer was installed in the NLAT- series of boreholes located on the median lane as explained previously. The water levels observed in the open boreholes upon completion of

drilling are summarized in Table 5.4. It is noted that boreholes not shown in the table below were dry (did not have free water level inside the borehole) upon completion.

Table 5.4 – Observed Groundwater Levels

Approx. Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
Innisfil				
18+500	NLAT131-01	May 16, 2013	6.6	292.0
19+000	NLAT04-01	May 15, 2013	6.1	298.0
19+400	NLAT14W-01	June 3, 2013	9.5	297.9

The above values are very short term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5.5 Culverts, Headwalls and Other Sewer Lateral Locations

The C- series boreholes have been drilled at selected locations near the proposed culvert replacement alignments. Boreholes located on the highway shoulders, with the exception of C32-01 and C32-02, have been incorporated in the previous Sections 5.1 to 5.4.

Stratigraphic sections along the culvert centrelines are presented in Appendix E. Records of boreholes and geotechnical laboratory test results associated with the culvert replacement, headwall construction, and at locations along the highway median not covered in the previous Sections 5.1 to 5.4, are included in Appendix E.

5.5.1 Pavement Structure and Topsoil

Pavement structure consisting of asphalt overlying granular materials was encountered in the SLAT- and NLAT- series boreholes, except for NLAT90-01, on the highway embankment. The asphalt thickness on the highway ranged from 150 to 450 mm in the boreholes. On the sideroads, asphalt ranging between 175 and 450 in thickness was encountered in Boreholes C102-02, C103-01, C114-01 and C116-01.

Below the asphalt, the granular fill materials consisted of sand, gravelly sand to sand and gravel generally ranging between 0.2 and 1.5 m in thickness, with occasional values up to the range of 2.2 to 2.7 m. The fill contains occasional cobbles, trace gravel, and trace to some silt. The measured SPT 'N' values typically ranged from 12 to 28 blows per 0.3 m of penetration indicating a compact state. Occasional dense to very dense zones were present as indicated by 'N' values varying from 37 to 98 blows. The moisture contents ranged from 2% to 15% with most values lying between 2% and 5%.

The thickness of the pavement structure may vary between and beyond the borehole locations.

Grain size distribution curves for selected granular samples are presented on the Record of Borehole sheets and on Figures E1 to E2 in Appendix E.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 41
Sand	46 to 95
Silt and Clay	3 to 17

Topsoil of ranging between 50 and 200 mm in thickness was encountered at ground surface in Borehole NLAT90-01 and in the C100- series boreholes except for Boreholes C112-01 and C112-02. The thickness of the topsoil may vary between and beyond the borehole locations.

5.5.2 Peat

Fibrous peat was encountered in Boreholes C39-01HW and C39-02HW drilled for the headwalls of Culvert #39 off the highway. This material consisted of organics, roots and rootlets. The thickness varied from 2.1 to 2.2 m with base elevations varying at 224.8 to 224.9 m. The measured SPT 'N' values ranged from 1 to 7 blows per 0.3 m penetration indicating a very loose to loose state. Measured moistures contents ranged from 120% to 348%.

5.5.3 Sand, Silt and Clay Fill

Fill was encountered in Borehole SLAT83W-01, SLAT19W-01, C32-02, NLAT91W-01, NLAT108W-01, NLAT110W-01, NLAT114E-01, NLAT119E-01 below the pavement granular materials on the highway. Off the highway, fill was encountered in Boreholes C102-02, C103-01, C107-01, C107-02, C108-01, C108-02, C112-01, C112-02, C113-01, C113-02, C18-01HW, C27-01HW and C27-02HW. The fill consisted of a range of materials including silty sands, sandy to clayey silts with trace gravel, and silty clay. The cohesive fill contains roots and organic inclusions. Occasional cobbles are also noted in the cohesionless fill.

Where encountered on the highway, the thickness of this fill ranged from 0.6 m to 3.1 m, with base elevations between 232.0 and 295.7 m. Recorded SPT N-values in the sand and silt fill ranged from 7 to 31 blows per 0.3 m penetration indicating a loose to dense state. Clayey silt fill has a firm to very stiff consistency as indicated by 'N' value between 6 and 26 blows. The natural moisture contents of these fill samples from the highway embankment ranged from approximately 2% to 24%.

Where encountered off the highway, the thickness of this fill ranged from 0.4 to 4.9 m, with base elevations between 225.1 and 283.7 m. Recorded SPT N-values in the sand and silt fill ranged from 3 to 26 blows per 0.3 m penetration indicating a very loose to compact state. Clayey silt to silty clay fill has a firm to stiff consistency as indicated by 'N' value between 5 and 15 blows. The natural moisture contents of these fill samples off the highway typically ranged from 10% to 22% with occasional values up to 40%.

Grain size distribution curves for selected fill samples tested are presented on the Record of Borehole sheets and on Figures E3 to E5 of Appendix E. Atterberg Limits test results of the cohesive fills are presented on Figures E17 in Appendix E.

The results of the laboratory gradation and Atterberg Limits tests are summarized as follows:

Sand and silt fill

Soil Particles	(%)
Gravel	0 to 19
Sand	0 to 80
Silt	21 to 93
Clay	5 to 13

Clayey silt to silty clay fill

Soil Particles	(%)
Gravel	0 to 3
Sand	4 to 52
Silt	31 to 54
Clay	14 to 55

Index Property	(%)
Liquid Limit	27 to 39
Plasticity Index	12 to 19

The above results show that the silty clay fill has low to occasionally medium plasticity with a group symbol of CL to CI.

5.5.4 Clayey Silt to Silty Clay

Silty clay to clayey silt deposits were encountered in Boreholes SLAT41-01, SLAT44-01, SLAT06E-01, C32-01, C32-02, SLAT109W-01, NLAT40W-01, NLAT110W-01, NLAT119E-01, C102-01, C102-02, C103-01, C107-02, C112-01, C112-02 and C27-02HW. These cohesive deposits consisted of brown becoming grey with depth, silty clay to clayey silt with trace to some sand and gravel, and occasional cobbles and were encountered below the pavement and fill interlayering with the fills and sands and silts. Where fully penetrated, these deposits were 0.2 m to 3.5 m thick with base elevations varying between 224.9 and

294.3 m. Where the boreholes terminated within these deposits, the minimum thickness varied between 2.6 and 8.1 m and the base elevation ranging below 218.4 to 282.8 m.

Measured SPT N-values for these soils typically ranged from 4 to 30 blows for 0.3 m of penetration indicating a firm to very stiff consistency. Occasional hard zones were present as indicated by 'N' values of 40 and 49 blows.

The natural moisture contents of the samples recovered from these cohesive deposits ranged from 10 to 30%.

Grain size distribution results for the cohesive samples tested are presented on the Record of Borehole sheets and on Figures E6 to E8 of Appendix E. Atterberg Limit test results are presented on Figures E18 to E20 of Appendix E.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Clayey Silt to Silty Clay

Soil Particles	(%)
Gravel	0 to 6
Sand	0 to 53
Silt	26 to 56
Clay	15 to 61
Index Property	(%)
Liquid Limit	15 to 45
Plasticity Index	5 to 23

The above results show that the clayey silt to silty clay has low to occasionally medium plasticity with a group symbol of CL to CI.

5.5.5 Sands and Silts

Boreholes SLAT41-01, SLAT06E-01, SLAT19W-01, C32-01, C32-02, SLAT109W-01, NLAT37E-01, NLAT40W-01, NLAT90-01, NLAT108W-01, NLAT110W-01, NLAT114E-01, NLAT119E-01, C107-01, C107-02, C108-01, C108-02, C112-02, C113-01, C113-02, C114-01, C116-01, C18-01HW, C18-02HW, C27-01HW, C27-02HW, C39-01HW and C39-02HW encountered deposits of sandy silts, sands and silts to silty sands with trace to some gravel, and occasional cobbles. These deposits were encountered below the fill or the silty clay layer. Where fully penetrated, these cohesionless soils were 0.6 to 4.6 m thick with base elevations varying between 234.0 and 296.6 m. Where not fully penetrated, these deposits have minimum thicknesses varying between 0.1 and 9.3 m and extend below base elevations of 216.9 to 293.1 m.

The SPT N-values recorded in these soils were typically between 10 and 47 blows for 0.3 m of penetration indicating a compact to dense state. A number of N-values of greater than 50 blows for less than 0.3 m penetration and less than 10 blows of 0.3 m penetration indicate the presence of very dense and loose zones, respectively.

These deposits were observed to be moist to wet with natural moisture contents of recovered samples measured typically at 8% to 22%, with occasional values of 2%, 4% and 36%.

Grain size distribution curves for samples tested from the sand deposits are presented on the Record of Borehole sheets and on Figures E9 to E12 of Appendix E.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 13
Sand	18 to 90
Silt	24 to 72
Clay	4 to 25

5.5.6 Sand and Gravel

Sand and gravel to gravelly sand with trace to some silt and occasional cobbles, interlayered with the silty clay to clayey silt deposits, were encountered in Boreholes C32-01 and C32-02. The thickness of these layers ranged between 0.4 to 1.4 m with base elevations varying from 229.3 to 231.9 m. The measured SPT 'N' values ranged from 10 to 41 blows per 0.3 m penetration indicating a compact to dense state. Measured moisture contents ranged from 5% to 15%.

The grain size distribution curve for a sand and gravel sample is presented on the Record of Borehole sheet and on Figure E13 of Appendix E.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	37
Sand	50
Silt and Clay	13

5.5.7 Clayey Silt to Silty Clay Till

Underlying the fill or sands and silts, clayey silt to silty clay till deposits were encountered in Boreholes SLAT83W-01, SLAT41-01, C113-01 and C113-02. These cohesive deposits consisted of brown becoming grey with depth, clayey silt to silty clay with trace to some sand and gravel. All four boreholes terminated within the cohesive till having minimum thicknesses of 0.2 to 3.0 m and extending below Elevations 241.7 and 280.4 m.

Based on SPT N-values ranging from 14 blows for 0.3 m of penetration to greater than 50 blows for less than 0.3 m penetration, the clayey silt to silty clay till has a stiff to hard consistency. The “refusal” blow counts infer the presence of cobbles or boulders.

The natural moisture contents of these cohesive till samples ranged from 8 to 24%.

Grain size distribution results for samples of the silty clay till are presented on the Record of Borehole sheets and on Figure E14 of Appendix E. Atterberg Limit test results are presented on Figure E21 of Appendix E.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Clayey Silt to Silty Clay Till

Soil Particles	(%)
Gravel	0 to 3
Sand	19 to 23
Silt	40 to 49
Clay	28 to 38

Index Property	(%)
Liquid Limit	19
Plasticity Index	8

The above results show that the silty clay till has low plasticity with a group symbol of CL.

Glacial tills inherently contain cobbles and boulders.

5.5.8 Sandy Silt to Silty Sand Till

Boreholes SLAT44-01, NLAT191W-01, NLAT90-01, NLAT87-01, NLAT108W-01, C112-01, C112-02, C114-01, C116-01, C18-01HW, C18-02HW, C27-01HW and C27-02HW encountered glacial till deposits consisting of sandy silt, sand and silt to silty sand with trace to some gravel and trace to some clay, and occasional cobbles and boulders. All but Boreholes SLAT44-01 and C114-01 terminated within the till with minimum thickness ranging between 1.7 and 6.4 m and the till extends below elevations 250.6 to 293.6 m.

The SPT N-values recorded in these soils ranged typically from 50 blows for 0.3 m of penetration to greater than 100 blows for less than 0.3 m penetration indicating a very dense state. The “refusal” blow counts infer the presence of cobbles or boulders. Some values of between 15 and 48 blows indicate the presence of compact to dense zones.

These deposits were observed to be moist with natural moisture contents of recovered samples measured between 6% and 10%.

Grain size distribution curves for samples tested from the sand deposits are presented on the Record of Borehole sheets and on Figures E15 to E16 of Appendix E.

The results of the laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 6
Sand	45 to 76
Silt	21 to 44
Clay	5 to 15

Glacial tills inherently contain cobbles and boulders.

5.5.9 Water Levels

The groundwater level was observed in the boreholes during and upon completion of drilling. No piezometer was installed in the NLAT-, SLAT- and some C- series of boreholes located on the median lane and shoulder of the highway, respectively, as explained previously. Standpipe piezometers were installed in selected C- series boreholes off the highway. The water levels observed in the open boreholes upon completion of drilling and those measured in the standpipes are summarized in Table 5.5. It is noted that boreholes not shown in the table below were dry (did not have free water level inside the borehole) upon completion.

Table 5.5 – Observed Groundwater Levels

Approx. Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
West Gwillimbury (South of Highway 89)				
On Conc. Rd. 5	C102-01 (piezometer)	August 7, 2013	0.5	224.0
		November 1, 2013	0.2	224.3
On Conc. Rd. 5	C102-02 (piezometer)	August 7, 2013	0.2	231.0
		November 1, 2013	2.0	229.2
On Conc. Rd. 5	C103-01 (piezometer)	August 7, 2013	0.9	230.3
		November 1, 2013	0.9	230.3
16+400	SLAT83W-01	May 6, 2013	5.2	243.2
19+480	C18-01HW	August 7, 2013	0.1	279.7
		November 1, 2013	0.3	279.5
20+350	C27-01HW	June 6, 2013	4.4	254.4
20+350	C27-02HW (piezometer)	August 8, 2013	1.4	257.0
		November 1, 2013	1.3	257.1
24+650	C32-02	May 15, 2013	3.7	232.1
26+550	C39-01HW (piezometer)	August 8, 2013	0.5	227.4
		November 1, 2013	0.7	227.2
26+550	C39-02HW	August 8, 2013	0.5	226.6
Innisfil (North of Highway 89)				
At Hwy. 89	C107-01	June 13, 2013	3.6	224.4
At Hwy. 89	C107-02 (piezometer)	August 7, 2013	1.8	227.0
		November 1, 2013	1.7	227.1
10+100 o/s 200 w	C108-01	May 13, 2013	3.9	223.4
10+100 o/s 200 w	C108-02 (piezometer)	August 7, 2013	0.9	225.8
		November 1, 2013	1.0	
10+200	NLAT37E-01	May 26, 2013	6.1	223.0
On 4 th Line	C112-01 (piezometer)	June 5, 2013	2.5	282.3
		August 8, 2013	0.3	284.5
		November 1, 2013	0.4	284.4
On 4 th Line	C112-02 (piezometer)	June 5, 2013	2.9	281.6
		August 8, 2013	0.0	284.5
		November 1, 2013	-0.5*	285.0
On 4 th Line	C113-01 (piezometer)	June 6, 2013	2.5	283.0
		August 7, 2013	0.8	284.7
		November 1, 2013	0.6	284.9
On 4 th Line	C113-02 (piezometer)	June 6, 2013	3.4	282.2
		August 8, 2013	0.5	285.1
		November 1, 2013	0.4	285.2
17+200	NLAT108W-01	May 16, 2013	2.1	295.8
17+400	NLAT110W-01	May 16, 2013	5.9	293.1
17+800	NLAT114E-01	May 30, 2013	3.5	294.8
18+050	NLAT119E-01	May 30, 2013	4.2	292.5

* Above ground surface

The above values in the open boreholes are very short term readings and seasonal fluctuations of the groundwater level are to be expected. The piezometric readings obtained to date likely do not represent stabilized groundwater levels. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

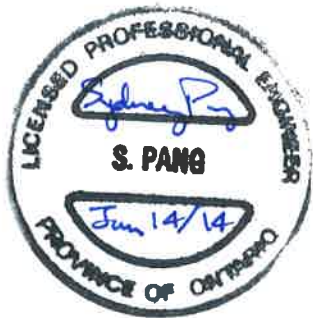
6 MISCELLANEOUS

The drilling and sampling equipment was supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. Traffic control was provided by On Track Safety of Thornhill Hill, Ontario. The field work was supervised on a full time basis by Mr. L. Gilarski, Mr. J. Gurzanski and Ms. E. Siu of Thurber Engineering Ltd. Laboratory testing was carried out at Thurber's Laboratory in Oakville, Ontario.

Interpretation of the field data and preparation of the investigation report was conducted by Dr. Sydney Pang, P.Eng.

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

THURBER ENGINEERING LTD.



Sydney Pang, P.Eng.
Associate, Senior Foundations Engineer



P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact

**FOUNDATION INVESTIGATION AND DESIGN REPORT
MEDIAN SEWER
LATERAL AND CULVERT REPLACEMENTS
HIGHWAY 400
NORTH CANAL ROAD TO INNISFIL ROAD
SIMCOE COUNTY, ONTARIO
G.W.P. 83-00-00**

Geocres Number: 31D-563

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This section of the report presents foundation recommendations and comments for the design and installation of sections of the median sewer, sewer outlets (laterals), culvert replacements and the new headwalls along Highway 400 from North Canal Road to Innisfil Road in Simcoe County, Ontario. Details of the existing and proposed works are contained in a Draft Drainage and Stormwater Management Report, dated June 2013 prepared by MRC. It is understood that redesign of the works is currently underway. For the purpose of this preliminary draft report, relevant information on the proposed works available to Thurber is summarized below.

As pointed out previously, the recently completed foundation investigation program for this project is much smaller in scope than what would typically be carried out under standard MTO terms of reference for foundation investigation for detailed design. This reduced program carries increased design risk, and increased risk of unexpected soil or groundwater conditions being encountered during construction. Factors influencing the increased risks include, though are not necessarily limited to, the following:

- Lack of subsurface information along the median sewer between the locations of sewer laterals and culverts; there are locations where there is no borehole information for several hundred metres
- Reduced subsurface information at the sewer laterals where there is no information at the outer end of the lateral, neither in the shoulder nor in the ditch at the inlet/outlet.
- Subsurface information for the culvert replacements have been obtained only through the embankment and not at the inlet/outlet.

As a result, foundation recommendations and comments for the proposed works provided herein are based on limited subsurface information. In view of the fact that this is a CMGC project and in order

to provide assistance in coping with the risks associated with the limited stratigraphic information, a comparative risk assessment is presented along with the foundation assessment for feasible design and construction options.

Some of the risks that are foreseen at this stage are listed below:

- Trenchless installations for sewer lateral replacement under a major highway pose risk. These laterals are proposed to be installed under shallow cover under the Highway 400. With only one borehole near the median end, this risk is increased due to unknown or unexpected subsurface conditions that could result in unanticipated loss of ground around the casing which can develop a chimney, or cone of settlement. The settlement can be manifested in the pavement as a depression or in some cases a sinkhole. Random development of a sinkhole is a major safety risk to the motorists.
- Replacement of sections of the median sewer with limited subsurface information carries risk of lateral ground movements along the installation trench. This may result in distress to the highway embankment posing safety risk to the motorists. The risk is increased particularly along sections located mainly to the south of Highway 89 where there is no subsurface information for several hundred metres.

Additional field investigation will be required to reduce the above risks.

As agreed with MTO, no piezometer was installed within the travelled portion of the highway or at narrow shoulders due to safety reasons. An exception was that a piezometer was installed in a few boreholes during the first week of the field work. These piezometers were read during subsequent weeks and decommissioned in accordance with O.Reg. 903.

For preliminary considerations, the following criteria agreed with MTO should be followed.

- In an embankment situation, the groundwater should be assumed coinciding with the base of the embankment fill, or typically at the surrounding native ground surface.
- In a flat terrain or low embankment (≤ 1 m) situation, the groundwater should be assumed at the base of the pavement structure, or at subgrade level.
- In a cut situation, the groundwater should be assumed at 1 m depth below the top of pavement.

The above criteria are generally applicable in cases where field information is insufficient or inconclusive. Should borehole information at specific site locations be considered adequate, changes to the above may be made and will be noted in the following sections of this report.

8 MEDIAN SEWER

The existing concrete sewer pipe diameters range from 300 to 900 mm, with most values lying between 300 and 600 mm. Their invert depths range from 1.5 m to 3 m with most values in the order of 2 to 2.5 m below the highway grade. It is understood that the replacement pipes would likely be of similar sizes, type and invert depths.

Replacement of the various sections of the median sewer is anticipated to be carried out by trenching. In general, shallow, vertically sided excavations equal to or less than 2.5 m deep may be carried out within roadway protection systems (temporary shoring) or steel trench boxes where suitable. For deeper excavations, or where water seepage is a concern, or where adjacent ground movement is to be minimized, temporary shoring such as interlocking sheetpiles may be considered. Soldier pile and lagging may be considered in situations where water seepage is not an issue. Sloped open cuts to certain depths may be possible if there is sufficient available space adjacent to the trench. Groundwater control in the form of sump pumping or dewatering (e.g. localized groundwater lowering using well points or eductors) will be required in conjunction with various forms of earth support and excavation outlined above.

For excavations 2.5 m deep or less through surficial fill overlying clayey silt/silty clay or clayey silt/silty clay till, trench box with conventional sump pumping may be considered. It is noted that a trench box is primarily used to enhance the safety of workers inside trenches and is not effective in minimizing water seepage or limiting adjacent ground movements.

For excavations 2.5 m deep or less through surficial fill overlying sandy silt/silty sand or sandy silt/silty sand till, sloughing of the trench sidewalls should be expected especially in cases where the groundwater level is high. At these locations, trench box in conjunction with localized effective dewatering or sheetpiles may need to be used.

In deeper excavations through sands and silts, or where more permeable sands and gravels are anticipated, sheetpiles and/or localized dewatering (e.g. well points or eductors) may be required. Surface runoff should be diverted away from all excavations where practicable.

Table 8.1 below presents specific conceptual protection system alternatives and relative risks associated with the various soils types along the subject Highway 400 median sewer alignment. For the purpose of comparison, the various relative risk levels are defined as follows:

- Very High Risk – No subsurface information for extended lengths along the alignment
- High Risk – 1) Cohesionless soils below the groundwater table requiring sheeting and/or dewatering; 2) where boreholes are too widely spaced (say > 200 m) for meaningful

- interpolation; 3) adjacent ground movements may result in major distress to the highway beyond tolerable limits
- Medium Risk – 1) Mixed soil conditions involving cohesive and cohesionless soils; 2) adjacent ground movements may result in some distress to the highway
 - Low Risk – 1) Cohesive soils; 2) limited to no adjacent ground movement with generally negligible impact to the highway.

Table 8.1 Median Sewer Replacement

Approx. Stations Hwy. 400	Simplified Subsurface Conditions (strata generally in sequence)	Feasible Road Protection System	Groundwater Control	Relative Risk	Comments
West Gwillimbury (South of Highway 89)					
11+600 to 11+700	Sand Fill / Clayey Silt Fill / Silty Clay / Clayey Silt Till	Trench boxes (≤ 2.5 m)	Sump pumping	Medium to Low	Low potential of adjacent ground movement
11+700 to 12+000	No information			High	Additional borehole investigation *
12+000 to 12+250	Sand Fill / Clayey Fill / Silty Clay / Silty Clay Till			Medium to Low	Low potential of adjacent ground movement
12+250 to 13+050	No information	-	-	Very high	Additional borehole investigation *
13+050 to 13+150	Sand Fill / Silty Clay / Clayey Silt Till	Trench boxes (≤ 2.5 m)	Sump pumping	Medium to Low	Low potential of adjacent ground movement
13+250 to 13+500	Sand Fill / Silty Clay			Low	
13+500 to 13+700	No information			High	Additional borehole investigation *
13+700 to 14+100	Sand Fill / Silty Clay			Low	Low potential of adjacent ground movement
14+100 to 14+600	No information	-	-	Very high	Additional borehole investigation *

14+600 to 15+400	Sand Fill / Silty Clay to Clayey Silt (occ. sand & silt layers)	Trench boxes (≤ 2.5 m) / sheetpiles as required	Sump pumping / dewatering as required	Medium	Sloughing and adjacent ground movement
15+400 to 16+400	No information	-	-	Very high	Additional borehole investigation *; may require sheetpiles and dewatering
16+400 to 16+500	Sand Fill / Cohesive Fill	Trench boxes (≤ 2.5 m) / sheetpiling as required	Sump pumping / dewatering as required	Medium	Adjacent ground movement
16+500 to 17+750	No information	-	-	Very high	Additional borehole investigation *; may require sheetpiles and dewatering
17+750 to 17+900	Sand Fill / Sands and Silts / Silty Clay to Clayey Silt	Trench boxes (≤ 2.5 m) / sheetpiles as required	Sump pumping / dewatering as required	Medium	Sloughing and adjacent ground movement
17+900 to 18+250	No information	-	-	Very high	Investigation such as test pitting *
18+250 to 18+650	Sand Fill / Silt Fill / Sands and Silts	Trench boxes (≤ 2.5 m)	Dewatering / sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
18+650 to 18+850	No information	-	-	Very high	Additional borehole investigation *; may require sheetpiles and dewatering
18+850 to 19+500	Sand Fill / Sands and Silts (some clayey zones)	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
19+500 to 20+100	No information	-	-	Very high	Additional borehole investigation *; may require

					sheetpiles and dewatering
20+100 to 20+400	Sand Fill / Sands and Silts	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
20+400 to 21+700	No information	-	-	Very high	Additional borehole investigation *; may require sheetpiles and dewatering
21+700 to 22+300	Sand Fill / Silty Sand to Sandy Silt Till	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	Medium	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
22+300 to 23+000	No information	-	-	Very high	Investigation such as test pitting *
23+000 to 24+450	No information except at $\approx 23+070$ Sand & Gravel Fill / Clayey Silt to Silty Clay / Silty Sand	Sheetpiles / Trench boxes	Dewatering and/or sump pumping as required	High	Additional borehole investigation *
24+450 to 24+750	Gravelly Sand to Sand Fill Sand Silt / Clayey Silt	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	Medium	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
24+750 to 27+500	No information	-	-	Very high	Additional borehole investigation *
<u>Innisfil (North of Highway 89)</u>					
10+000 to 11+400	No information except at $\approx 10+020$ and $10+650$ Sand and Gravel Fill / Sand & Silt and Silty Sand	Sheetpiles / Trench boxes	Dewatering and/or sump pumping as required	Very high	Additional borehole investigation *
11+400 to 12+600	Sand to Gravelly Sand Fill / Sand & Silt, Sandy Silt to Silty Sand / Silty Sand Till	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	High	Sloughing and adjacent ground movement

	(some silty clay to clayey silt layers)	Sheetpiles		Low	-
12+600 to 12+850	No information	-	-	High	Provision for sheetpiles and dewatering
12+850 to 14+000	Sand to Sand & Silt Fill / Silty Sand to Sandy Silt Till (some clayey silt till and silty clay layers)	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	Medium	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
14+000 to 14+750	Sand, Sand & Gravel Fill / Silty Clay, Clayey Silt, Silty Sand, Sandy Silty layers / Silty Sand to Sand & Silt Till	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
14+750 to 15+500	Sand, Sand & Gravel Fill / Sand, Silt and Silty Clay layers / Sandy Silt to Sand & Silt Till	Trench boxes (≤ 2.5 m)	Dewatering and/or sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
15+500 to 16+400	No information except at $\approx 15+850$, $15+950$ and $16+050$ Sand and Gravel Fill / Silty Sand to Sand / Silty Sand to Sand Till	Sheetpiles / Trench boxes	Dewatering / sump pumping as required	Very high	Additional borehole investigation *
16+400 to 17+000	Sand & Gravel, Silty Sand Fill / Silty Sand to Sandy Silt / Silty Sand to Sandy Silt Till	Trench boxes (≤ 2.5 m)	Dewatering / sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-
17+000 to 19+800	Sand to Silty Sand Fill / Silty Sand, Sandy Silt / Sandy Silt to Silty Sand Till (some silty clay/clayey silt till layers)	Trench boxes (≤ 2.5 m)	Dewatering / sump pumping as required	High	Sloughing and adjacent ground movement
		Sheetpiles		Low	-

* To be carried out prior to construction at the subject section.

Prior to placement of the pipe bedding, the base of the trench excavation must be properly dewatered and dry, and free of disturbed or loose soil. In order to confirm uniformity along the alignment, the exposed subgrade must be inspected and approved prior to placing and compacting the bedding. Any identified disturbed/wet soils should be sub-excavated and replaced with compacted granular

materials. It is critical that the pipe be supported on well compacted bedding overlying a competent and uniform subgrade in order to minimize the potential for differential settlement.

It is recommended that sewer pipe installation, trenching, backfilling and compacting be carried out in accordance with OPSS 401, OPSS 410 and OPSD 802.030, OPSD 802.031, OPSD 802.032 as appropriate. Care must be exercised when compacting the fill immediately above the crown of the pipe in order not to damage the pipe.

9 SEWER OUTLET (LATERALS)

The existing concrete outlet pipe diameters range from 300 to 825 mm, with most values lying between 300 and 450 mm. Their invert depths range from 1.5 to 3 m with most values in the order of 2 to 2.5 m below the highway grade. It is understood that the replacement pipes would likely be of similar sizes and the same type.

A crown cover of 3.0 m between the top of pavement and top of the outer liner (or 2.0 m from the underside of the pavement structure) has typically been adopted to minimize the potential for disturbance of the highway pavement structure. For this project, crown cover above the pipe laterals is in the order of 1.5 to 2.5 m measured from the top of pavement, and in the order of 0.5 to 1.5 m measured from the underside of the pavement structure.

Staged open cutting is technically feasible and carries lesser risk than the trenchless methods in terms of causing ground settlement. However, open cut construction would result in certain degree of disruption to traffic flow amongst other logistics issues. Protection Systems (temporary shoring) and groundwater control will be required. MTO approval of this approach will be required.

In general, shallow, vertically sided trenches equal to or less than 2.5 m deep may be carried out within roadway protection systems or steel trench boxes where suitable. For deeper excavations, or where water seepage is a concern, or where adjacent ground movement is to be minimized, temporary shoring such as interlocking sheetpiles may be considered. Groundwater control in the form of sump pumping will be required in conjunction with various forms of earth support and excavation outlined above.

Sloped open cuts and dewatering involving localized groundwater lowering are not considered feasible for transverse trenches across the highway.

For excavations 2.5 m deep or less through surficial fill overlying clayey silt/silty clay or clayey silt/silty clay till, trench box with conventional sump pumping may be considered. It is noted that a trench box is primarily used to enhance the safety of workers inside trenches and is not effective in minimizing water seepage or limiting adjacent ground movements.

For excavations 2.5 m deep or less through surficial fill overlying sandy silt/silty sand or sandy silt/silty sand till, sloughing of the trench sidewalls should be expected especially in cases where the groundwater level is high. At these locations, trench box in conjunction with sump pumping and/or sheetpiles may need to be used. Surface runoff should be diverted away from all excavations where practicable.

In deeper excavations through silts, sands and gravel, where sump pumping is ineffective in controlling the groundwater, and where it is not feasible to use sheetpiles, trenchless methods will have to be used to install the sewer laterals.

All trenchless installation work should be carried out in general accordance with the requirements of the Non-Standard Special Provision (NSSP) “Pipe Installation by Trenchless Methods”. A copy of this NSSP is attached in Appendix G.

Trenchless installation methods that are typically considered to install pipes under highways include:

- Jack and bore
- Pipe Ramming
- Micro-Tunnelling (MTBM)
- Hand Mining
- Horizontal Directional Drilling

Selection of an appropriate trenchless method should be the responsibility of the Contractor and will depend upon the relative costs and risks associated with each method. The experience of the Contractor is of primary importance for trenchless installation. Amongst the important issues discussed in the NSSP are maintenance of alignment, handling of oversized obstructions and disposal of cuttings.

Hand-mining is not possible for these laterals due to the small diameters. Micro-tunnelling is technically feasible but may not be cost effective due to the relatively short pipe lengths. Horizontal directional drilling procedures are not suitable for these crossings since this method will have difficulties maintaining the required invert elevations of the sewer pipes.

Both pipe ramming and jack-and-bore techniques may be considered for this project. Depending on the ground conditions and construction methods, either of these trenchless techniques carries a certain degree of risk including the potential of highway settlement due to the relatively shallow soil crown cover. Instrumentation and monitoring for potential settlements on the highway will be required for these trenchless construction methods.

The suitability of the two trenchless techniques depends on factors including soil types, groundwater conditions, equipment availability, contractor’s expertise and experience. General comments on the relative technical advantages and disadvantages of these methods are outlined below.

Trenchless Method	Advantages	Disadvantages
Jack-and-Bore	<ul style="list-style-type: none"> • No uncased bore at any time • Equipment and crew readily available locally • Generally more suitable for clayey silt to silty clay soils with minimal water seepage 	<ul style="list-style-type: none"> • Subject to misalignment due to oversized obstructions, although specialized equipment allows for alignment adjustments • Generally less suitable for sands and gravels with water seepage problems, and locations of high groundwater table where dewatering would be required
Pipe Ramming	<ul style="list-style-type: none"> • Versatility in accommodating various subsurface conditions • Generally suitable for soils with water seepage problems • Dewatering is usually not required 	<ul style="list-style-type: none"> • Minimal alignment control especially if oversized obstructions are encountered • May only advance steel casing/sleeve within which concrete pipe is threaded through and grouted
Micro-tunnelling	<ul style="list-style-type: none"> • High precision alignment control is possible • Versatility in accommodating various subsurface conditions • Dewatering is usually not required • Concrete pipe (with appropriate reinforcement) may be installed as part of the tunnelling operation. 	<ul style="list-style-type: none"> • If oversized obstructions are anticipated, cutter heads on the MTBM must be designed to accommodate the situation • Wet spoil management requires adequate space and access

Pipe ramming involves advancing a liner (typically steel casing or sleeve) along the proposed alignment. Once the liner is in place, the new concrete sewer pipe may then be threaded through the liner and grouted in place. Conventional jack and bore involves augering and jacking a steel liner in place, although direct jacking of concrete pipes is possible in some situations. Micro-tunnelling involves using a pressure balance machine to advance the bore after which the concrete sewer pipe can be directly installed.

Table 9.1 below discusses the applicability and relative risks of the trenchless methods associated with the various soil types along the subject Highway 400 alignment. For the purpose of comparison, the various relative risk levels are defined as follows:

- Very High Risk – 1) No subsurface information for extended lengths along the alignment; 2) high potential for loss of tunnel face causing highway settlement and possibly sinkhole
- High Risk – 1) Cohesionless soils below the groundwater table leading to unstable tunnel faces that could result in highway settlements and possibly sinkholes; 2) presence of cobbles and boulders in glacial tills as well as other oversized obstructions in fills that could result in mis-alignment of the pipe/casing/sleeve if alignment is not adjustable

- Medium Risk – 1) Predominantly cohesive and dense to very dense sandy till soils that have sufficiently long stand-up time if left temporarily unsupported; 2) highway settlement is still possible.

Given the relatively shallow crown cover and with reference to MTO's Guidelines for Foundation Engineering - Tunnelling Specialty for Corridor Encroachment Permit Application, there is no "low risk" option with respect to tunnelling for this project.

Table 9.1 Sewer Lateral Replacement

Sewer Lateral Nos. (Stations)	Simplified Subsurface Conditions (strata generally in sequence)	Trenchless Methods (technical feasibility)	Groundwater Control	Relative Risk	Comments
West Gwillimbury (South of Highway 89)					
47, 51, 53, 57, 58, 62, 63, 65, 67 (Stations ≈12+200 to 15+200)	Sand Fill / Clayey Fill / Silty Clay / Clayey Silt to Silty Clay Till	Jack-and-bore (feasible)	Sump pumping at pits	High	Low potential of highway settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium	-
83 (Station ≈16+430)	Gravelly Sand Fill / Clayey Fill / Silty Clay Till	Jack-and-bore (feasible)	Sump pumping at pits	High	Low potential highway settlement
		Pipe ramming (feasible)	Sump pumping at pits	Medium	-
18, 23, 30, 31, 32 (Stations ≈18+200 to 19+450)	Sand to Gravelly Sand Fill / Silt Fill / Sands and Silts (some clayey silt to silty clay zones)	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement /sinkhole
		Pipe ramming (feasible)	-	Medium to High	Potential highway settlement
41, 44 (Stations ≈20+150 to 20+350)	Sand to Gravelly Sand Fill / Sand and Silt Till (interlayered with clayey silt)	Jack-and-bore (possible but risky)	Sump pumping and dewatering as required at pits	High	Potential highway settlement
		Pipe ramming (possible but risky)	Sump pumping as required	Medium to High	Potential for mis-alignment due to cobbles and boulders

59, 64, 68, 72 (Stations ≈21+700 to 22+300)	Sand to Gravelly Sand Fill / Silty Sand to Sandy Silt Till	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement /sinkhole
		Pipe ramming (possible but risky)	Sump pumping as required	Medium to High	Potential for mis-alignment due to cobbles and boulders
6 (Station ≈23+070)	Sand & Gravel Fill / Clayey Silt to Silty Clay / Silty Sand to Sandy Silt	Jack-and-bore (feasible)	Sump pumping at pits	Medium to High	Potential highway settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium	
19, 109 (Stations ≈24+450 to 24+520)	Gravelly to Silty Sand Fill / Sandy Silt (interlayered with clayey silt and sand & gravel)	Jack-and-bore (not feasible)	Sump pumping at pits	Very High	Potential loss of tunnel face and highway settlement /sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
Innisfil (North of Highway 89)					
37 (Station ≈10+180)	Sand & Gravel Fill / Silty Sand / Sand & Silt	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
51 (Station ≈11+430)	Sand Fill / Silty Clay	Jack-and-bore (feasible)	Sump pumping and dewatering as required at pits	Medium to High	Low potential for highway settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium	
7, 6, 11, 20, 18, 15 (Stations ≈11+750 to 12+600)	Sand to Gravelly Sand Fill / Sandy Silt to Silty Sand / (silty clay, clayey silt, sand & gravel layers) Silty Sand to Sandy Silt Till	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement

23, 28, 32 (Stations ≈12+850 to 13+150)	Sand Fill / Sand to Silty Sand / Silty Sand to Sandy Silt Till	Jack-and- bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
54, 50, 46, 41 (Stations ≈13+350 to 13+850)	Sand to Gravelly Sand Fill / Silty Sand to Sand & Silt Till (inferred cobbles and/or boulders)	Jack-and- bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (possible but risky)	Sump pumping as required	Medium to High	Potential for mis-alignment due to cobbles and boulders
37, 60 (Stations ≈13+980, 14+400)	Sand Fill / Sand & Silt Fill / Silty Sand / (with silty clay layers) Sandy Silt Till	Jack-and- bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
65, 68, 70, 72, 79 (Stations ≈14+500 to 15+160)	Sand Fill / Sand, Silty Sand, Sand & Silt / Silty Sand to Sand & Silt Till (inferred cobbles and/or boulders)	Jack-and- bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (possible but risky)	Sump pumping as required	Medium to High	Potential highway settlement
78, 75, 87, 90, 91, 96, 99 (Stations ≈15+250 to 16+600)	Sand, Sand & Gravel Fill / Sandy Silt to Silty Sand Till (inferred cobbles and/or boulders)	Jack-and- bore (possible but risky)	Sump pumping and dewatering as required at pits	High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (possible)	Sump pumping as required	Medium to High	Potential for mis-alignment due to cobbles and boulders
100, 104, 106, 108, 110, 114, 119, 124, 131	Sand to Sand & Gravel Fill / Silty Sand, Clayey Silt Fill / Silty Sand to Sandy	Jack-and- bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole

(Stations ≈16+650 to 18+550)	Silt / (clayey silt layers) / Sandy Silt to Sand & Silt Till	Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
128, 127, 8, 4, 12, 13, 14, 118 (Stations ≈18+600 to 19+600)	Sand to Sand & Gravel Fill / Silty Sand (with clayey silt to silty clay layers) / Silty Sand Till or Clayey Silt Till	Jack-and- bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential for mis-alignment due to cobbles and boulders

Bedding requirements for the sewer lateral pipes are similar to those for the median sewer outlined in Section 8 above.

10 CULVERTS AND HEADWALLS

10.1 Culvert Replacements

The 10 existing culverts crossing under Highway 400 requiring replacement, designated as #1, #2, #4, #7, #8, #14, #17, #32, #47 and #51, are either concrete open footing or box culverts with typical opening dimensions of 1200 mm x 900 mm and 1800 mm x 1200 mm, up to a maximum size of 3850 mm x 1400 mm. It is understood that the replacement culverts will consist of concrete pipes ranging from 900 to 1200 in diameter (twin 1000 mm pipes for the largest culvert). The existing side road culverts off the highway, designated as SR102, SR103, SR112 and SR113, are concrete pipes of 450 to 750 mm in diameter and the replacement pipes are likely to be concrete pipes of greater than 1 m in diameter. The existing highway interchange ramp culverts, designated as HR108 and HR114, are 600 mm diameter CSPs and their replacements are either concrete pipes or CSPs of 825 to 1200 mm in diameter. The proposed pipe invert elevations are similar to the invert elevations of the exist culverts. Selected culvert details are listed in Table 10.1 below.

Table 10.1 Selected Culvert Details

Culvert I.D.	Highway Chainage	Proposed Culvert Type	Diameter (mm)	Upstream Invert Elev. (m)	Downstream Invert Elev. (m)
Highway 400 West Gwillimbury (South of Highway 89)					
1	11+641	Concrete Pipe	1,000	228.78	228.42
2	12+031	Concrete Pipe	1,200	225.19	223.86
4	13+121	Concrete Pipe	1,200	223.80	223.37

7	14+874	Concrete Pipe	1,000	226.92	226.92
8	15+364	Concrete Pipe	1,050	231.82	231.75
14	17+818	Concrete Pipe	Twin 1,000	253.40	252.85
17	18+952	Concrete Pipe	900	276.08	272.84
32	24+613	Concrete Pipe	900	233.56	232.71
Highway 400 Innisfil (North of Highway 89)					
47	12+000	Concrete Pipe	900	234.15	233.67
51	14+125	Concrete Pipe	900	284.24	283.71
Side Road Culverts West Gwillimbury (South of Highway 89)					
SR102	13+300	Concrete Pipe	1,050 or 1,200 or 1,500	224.18	223.68
SR103	13+300	Concrete Pipe	825	223.92	223.92
Side Road Culverts Innisfil (North of Highway 89)					
SR112	14+150	Concrete Pipe	825	283.84	283.60
SR113	14+150	Concrete Pipe	1,050 or 1,200 or 1,800	285.23	284.60
Highway Ramp Culverts Innisfil (North of Highway 89)					
HR108	10+126	Concrete Pipe	825	227.07	226.53
HR114	19+567	Concrete Pipe	825	300.87	300.61

Note: * All chainages refer to Highway 400 centreline.

The new culvert pipes should be designed to resist external loadings including lateral earth pressures, weight of embankment fill, hydrostatic pressure, frost forces, traffic loadings and surcharges due to construction equipment.

10.1.1 Open Cutting

Staged open cutting is technically feasible and carries lesser risk than the trenchless methods in terms of causing ground settlement. However, open cut construction would result in some disruption to traffic flow amongst other logistics issues. Protection Systems (temporary shoring) and groundwater control similar to those discussed previously for the sewer laterals will be required. This approach will require MTO approval.

From a foundation technical perspective, the culverts under the highway may also be replaced with either open footing or box sections within open cuts. Further foundation recommendations and comments will be required if this approach is selected and approved.

10.1.2 Trenchless Methods

Consideration may be given to installing the replacement pipes by trenchless techniques provided that a minimum crown cover of two (2) times the pipe diameter can be maintained. If the current invert elevations do not satisfy this criterion, the following alternative options may be considered:

- 1) Construct the pipe crossings using staged open cutting
- 2) Lower the invert elevations to meet the criterion
- 3) Replace a larger diameter pipe with multiple smaller diameter pipes that would sufficiently increase the crown cover.

Pipe ramming and jack-and-bore may be considered for this project. Due to relatively larger pipe sizes and shallow crown cover of predominantly cohesionless soils, either of these trenchless techniques carries a relatively high degree of risk of causing highway and road settlements. Micro-tunnelling may be considered as an alternative to mitigate these risks and is considered feasible for all soil and groundwater conditions that are to be expected in this project.

Instrumentation and monitoring for potential settlements on the highway and roads will be required for these trenchless construction methods.

Pipe ramming involves advancing a liner (typically steel casing or sleeve) along the proposed alignment. Once the liner is in place, the new concrete sewer pipe may then be threaded through the liner and grouted in place. Conventional jack and bore involves augering and jacking a steel liner in place, although direct jacking of concrete pipes is possible in some situations. Micro-tunnelling involves using a pressure balance machine to advance the bore after which the concrete sewer pipe can be directly installed.

If micro-tunnelling is not selected, the suitability of the other two trenchless techniques depends on factors including soil types, groundwater conditions, equipment availability, contractor's expertise and experience. Table 10.1 below discusses the applicability and relative risks of the trenchless methods associated with the various soil types present at the culvert locations.

Where there is no flow in the culvert, the design invert elevations can be maintained and environmental concerns are satisfied, consideration could be given to threading the new pipe through the existing culvert opening and grouting it in place.

Table 10.1 Culvert Replacement

Culvert I.D. (Hwy. Stations)	Simplified Ground Conditions near Pipe Elevations (strata in sequence)	Trenchless Methods (technical feasibility)	Groundwater Control	Relative Risk	Comments
West Gwillimbury (South of Highway 89)					
Culvert #1 (11+641)	Sand to Sand & Gravel Fill / Clayey Silt Fill / Silty Clay	Jack-and-bore (not feasible)	Sump pumping at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
Culvert #2 (12+031)	Sand Fill / Clayey Silt to Silty Clay Fill / Clayey Silt / Clayey Silt Till	Jack-and-bore (feasible)	Sump pumping at pits	High	Potential highway settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	
Culvert #4 (13+121)	Sand Fill / Silty Clay Fill / Silty Clay / Clayey Silt Till	Jack-and-bore (not feasible)	Sump pumping at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
Culvert #7 (14+874)	Sand & Gravel Fill / Silty Clay	Jack-and-bore (feasible)	Sump pumping at pits	High	Potential highway settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	
Culvert #8 (15+364)	Sand Fill / Clayey Silt / Silty Clay	Jack-and-bore (feasible)	Sump pumping and dewatering as required at pits	High	Potential highway settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	
Culvert #14 (17+818)	Gravelly Sand Fill / Silty Sand / Clayey Silt /	Jack-and-bore (not	Sump pumping at pits	Very High	Potential loss of tunnel face

	Silty Clay	feasible)			and highway settlement / sinkhole
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	Potential highway settlement
Culvert #17 (18+952)	Gravelly Sand Fill / Sand & Silt to Sandy Silt (interlayered with clayey silt)	Jack-and-bore (feasible)	Sump pumping and dewatering as required at pits	High	Potential highway settlement
		Pipe ramming (feasible)	Sump pumping as required	High	
Culvert #32 (24+613)	Silty Sand to Sand Fill / Gravelly Sand to Sand & Gravel	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (possible)	-	Medium to High	Potential highway settlement
Innisfil (North of Highway 89)					
Culvert #47 (12+000)	Gravelly Sand to Sand Fill / Sandy Silt to Silty Sand / Clayey Silt to Silty Clay	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (possible but risky)	Sump pumping as required	High	
Culvert #51 (14+125)	Sand to Silty Sand Fill / Sand & Gravel Fill / Clayey Silt Fill Silty Clay	Jack-and-bore (not feasible)	Sump pumping at pits	Very High	Potential loss of tunnel face and highway settlement / sinkhole
		Pipe ramming (not feasible)	Sump pumping as required	High	
Culvert #SR102 Concession Rd. 5 (13+300)	Sand & Gravel Fill / Silty Clay Fill	Jack-and-bore (feasible)	Sump pumping as required at pits	Medium to High	Potential road settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	

Culvert #SR103 Concession Rd. 5 (13+300)	Sand and Silt Fill / Silty Clay Fill	Jack-and-bore (feasible)	Sump pumping as required at pits	Medium to High	Potential road settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	
Culvert #SR112 4 th Line (14+150)	Silty Sand to Clayey Silt Fill / Clayey Silt to Silty Clay / Silty Sand to Silty Sand Till	Jack-and-bore (feasible)	Sump pumping as required at pits	High	Potential road settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	
Culvert #SR113 4 th Line (14+150)	Sand to Clayey Silt Fill / Sandy Silt Fill / Sandy Silt to Sand	Jack-and-bore (feasible)	Sump pumping as required at pits	High	Potential road settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	
Culvert #HR108 Highway 89 Ramp (10+126)	Sand Fill / Sandy Silt to Sand & Silt	Jack-and-bore (not feasible)	Sump pumping and dewatering as required at pits	Very High	Too little soil cover
		Pipe ramming (not feasible)	Sump pumping as required	Very High	
Culvert #HR114 Innisfil Beach Road (19+567)	Gravelly Sand Fill / Sand & Silt / Sandy Silt /	Jack-and-bore (possible but risky)	Sump pumping and dewatering as required at pits	High	Potential road settlement
		Pipe ramming (feasible)	Sump pumping as required	Medium to High	

Bedding requirements for the culvert pipes are similar to those for the median sewer outlined in Section 8 above.

10.2 Headwalls

Two new headwalls (one on each side of the flow channel) will be constructed near the toe of the highway embankment as part of the rehabilitation/reconstruction of the existing inlet/outlet at Culvert #18 (≈Station 19+500), Culvert #27 (≈Station 23+350) and Culvert #39 (≈Station 26+550). Boreholes C18-01HW, C18-02HW, C27-01HW, C27-02HW, C39-

01HW and C39-02HW were drilled at their respective locations for providing subsurface information.

The culvert headwalls should be founded at the same level as the existing base of culverts in order to avoid undermining of the existing structures and to reduce disturbance of the foundation soils. Table 10.2 below presents the recommended founding depths and elevations at the proposed headwall locations.

Table 10.2
Recommended Highest Founding Elevations and Geotechnical Resistances

Culvert #	Assumed Founding Conditions for Design	Highest Founding Elevations (m)*	Geotechnical Resistance	
			Factored ULS (kPa)	SLS (kPa)
18	Sand and Silt Till (very dense)	277.4 (south)	400	250
		278.2 (north)		
27	Sand and Silt Till (compact to very dense)	255.0 (south)	400	250
		255.0 (north)		
39	Sand and Silt (compact)	224.5 (south)	225	150
		223.5 (north)		

The geotechnical resistances in Table 10.2 above are for vertical, concentric loads only. Effects of load inclination and eccentricity should be taken into account as illustrated in the CHBDC (2006) Clause 6.7.3 and Clause 6.7.4.

The geotechnical resistances at SLS quoted above correspond to 25 mm settlement of an individual culvert footing under the applied load.

Resistance to lateral forces / sliding resistance between concrete and the underlying undisturbed, typically compact to very dense sand and silt till should be evaluated in accordance with the CHBDC (2006) assuming an ultimate coefficient of friction of 0.5. For the compact sand and silt, an ultimate coefficient of friction of 0.45 may be used.

For frost protection purposes, the headwall design should incorporate 1.2 m of earth cover, or its thermal equivalent, to the foundation base.

Roadway protection (temporary shoring) and dewatering will be required for all headwall construction. Further recommendations and comments on these aspects are presented in Section 11 below.

10.3 Lateral Earth Pressures

It is recommended that backfill to the culvert and headwalls consists of free-draining, non-frost susceptible granular materials such as Granular A or B Type II conforming to OPSS

1010. Reference should be made to the backfill arrangements stipulated in OPSD 803 as appropriate. The existing embankment fill is largely comprised of cohesive materials and is therefore not suitable for backfilling adjacent to the culvert walls and headwalls.

All fills should be placed in regular lifts and be compacted in accordance with OPSS 501. The backfill should be placed and compacted in simultaneous lifts on both sides of a culvert, and the top of backfill elevation should be the same on both sides of the culvert at all times. Heavy compaction equipment must not be used adjacent to the walls and roofs of the culverts.

Earth pressure coefficients for backfill to the culvert and headwalls are dependent on the material used as backfill. The active coefficients should be used for any headwalls or otherwise unrestrained walls.

Earth pressures acting on the structure may be assumed to impose a triangular distribution. For a fully drained backfill, the pressures should be computed in accordance with the CHBDC 2006, but generally are given by the expression:

$$p_h = K (\gamma h + q)$$

where	p_h	=	horizontal pressure on the wall at depth h (kPa)
	K	=	earth pressure coefficient (see Table 10.3 below)
	γ	=	bulk unit weight of retained soil (see Table 10.3 below)
	h	=	depth below top of fill where pressure is computed (m)
	q	=	value of any surcharge (kPa)

In accordance with Clause 6.9.3 of the CHBDC, a compaction surcharge should be added. The magnitude should be 12 kPa at the top of fill and decreasing to 0 kPa at a depth of 2.0 m for Granular B Type I, or at a depth of 1.7 m for Granular A or Granular B Type II.

Earth pressure coefficients for backfill to the culverts, wingwalls and headwalls are dependent on the material used as backfill. Typical unfactored values are shown in the following Table 10.3.

Table 10.3 Earth Pressure Coefficients (K)

Wall Condition	Earth Pressure Coefficient (K)					
	OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ$; $\gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I (modified) $\phi = 32^\circ$; $\gamma = 21.2 \text{ kN/m}^3$		Embankment Fill $\phi = 30^\circ$; $\gamma = 20.0 \text{ kN/m}^3$	
	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)
Active (Unrestrained Wall)	0.27	0.40	0.31	0.48	0.33	0.54
At rest (Restrained Wall)	0.43	0.62	0.47	0.70	0.50	0.76
Passive (Movement Towards Soil Mass)	3.7	-	3.3	-	3.0	-

The factors in the table above are “ultimate” values and require certain movements for the respective conditions to be mobilized. The values to be used in design can be estimated from Figure C6.9.1 (a) in the Commentary to the CHBDC 2010.

10.4 Erosion Control

Erosion protection should be provided at the culvert inlet and outlet areas where the replacement pipes are to be located. Design of the erosion protection measures must consider hydrologic and hydraulic concerns and should be carried out by specialists experienced in this field. As explained previously, boreholes have not been advanced near the inlet and outlet locations where erosion control measures are to be implemented. The following provides general comments on erosion protection measures typically used for MTO projects.

Rip-rap should be provided over all surfaces with which flow through the culvert is likely to be in contact. Treatment at the outlets should be in accordance with OPSD 810.010. A vegetation cover should be established on all other exposed earth surfaces to protect against surficial erosion, in general accordance with OPSS 804.

It is recommended that a clay seal or a concrete cut-off wall be used to minimize the potential for erosion near the inlet areas. The clay seal should extend at least 0.3 m above the high water level and laterally for the width of the granular material, and have a minimum thickness

of 0.5 m. The material requirements should be in accordance with OPSS 1205. A synthetic clay liner may be used as a seal.

11 EXCAVATION AND GROUNDWATER CONTROL

11.1 Excavation

Where open cutting is carried out including the pits for trenchless installations, excavations for median sewer, lateral, culvert replacement and headwall construction will extend through the pavement structure, existing embankment fill and native soils described above.

At locations where there is space restriction prohibiting unsupported, inclined open cutting or where a slope has to be retained, the excavations will need to be carried out in conjunction with a road protection (temporary shoring) system. Any protection system should be designed by licensed Professional Engineers experienced in such designs with consideration of adjacent traffic loads and any sloping retained surfaces. OPSS 539 “Construction Specification for Protection Systems” will have to be included in the contract documents. Typically, a Performance Level 2 as per Clause 539.04.02.01 (maximum horizontal displacement of 25 mm) should be specified for these sites.

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the native clayey silts to silty clays including glacial tills are classified as Type 2 soils above the water table. All existing embankment fills, sands and silts are classified as Type 3 soils. Below the water table, all cohesive soils are classified as Type 3 soils and cohesionless soils as Type 4 soils.

Provision should be made for handling and removal of possible cobbles, boulders, and other obstructions in the fill and glacial tills during excavation.

11.2 Groundwater Control

In addition to the groundwater conditions discussed previously, water perched within the embankment fill will seep into the excavations. Surface runoff will also tend to accumulate in these excavations. Excavations for median sewer, lateral and culvert installations are typically in the order of 2 to 3 m depth. The Contractor must make provisions to control any water seepage, surface runoff and ponding by measures including pumping from filtered sumps to maintain dry excavations during construction. In some cases, localized dewatering including the use of vacuum well points and/or eductors will be required. In general, surface water must be diverted away from any excavation at all times. Temporary water course diversion may be required where feasible.

It is recommended that a Permit To Take Water (PTTW) be obtained on a project wide basis in order to facilitate appropriate discharge of extracted water during construction. In addition

to sump pumping, localized dewatering in the form of groundwater lowering may be required at locations where sands and silts are present. Where borehole information is available, the locations of these sections of highway have been identified above.

12 INSTRUMENTATION AND MONITORING PROGRAM

The impact of the proposed installation on existing nearby structures and underground utilities should be assessed. A pre-construction condition survey should be carried out to document the existing condition of the highway pavement and assess the potential for damage to all facilities and underground services along the alignments of the trenchless crossings. Monitoring of the roadway surface, underground utilities, and any nearby structures should be carried out during construction.

13 CONSTRUCTION CONCERNS

Potential construction concerns that have been identified for this project include the following:

13.1 Loss of ground

Trenchless installations at relatively shallow depth below a highway inherently include some risk of loss of ground into the bore. If it is significant, this loss of ground can result in settlement of the pavement surface and creation of sinkholes. The Contractor's methodology selection must recognize and take into consideration this inherent risk. Contingency plans should be in place to manage any adverse impacts on the highway.

Trenching along the median for sewer replacement will result in some adjacent ground movements depending on the soil and groundwater conditions. Although the risk of causing pavement distress is lower than trenchless methods, the Contractor must recognize that construction sequencing including the implementation of roadway protection (shoring) and groundwater control will be critical to limiting ground movements to within tolerable limits.

13.2 Groundwater Control

Groundwater control will be required for installation of the proposed works. Sump pumping will be required at all locations. Localized groundwater lowering by means of vacuum well points and/or eductors will need to be implemented as required. Surface runoff should be diverted away from excavations at all times.

13.3 Obstructions

Glacial till soils typically contain cobbles and boulders, and fill placed for the highway construction may contain similar and other obstructions. The Contractor's equipment and methodology must be selected to handle such obstructions and successfully remove them

without jeopardizing the highway. The impact of such obstructions on the pipe alignments should be assessed.

13.4 Buried Utilities

The Contractor must accurately establish, in three dimensions, the locations of all buried utilities crossing or closely paralleling the median sewer, laterals and culvert alignments. Any discrepancy from the Contract Drawings must be reported to the Contract Administrator.

14 CLOSURE

Engineering analysis and preparation of the foundation design report was conducted by Dr. Sydney Pang, P.Eng. Dr. P. K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects reviewed the report.

THURBER ENGINEERING LTD.



Sydney Pang, P.Eng.
Associate, Senior Foundations Engineer



P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS


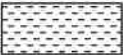



ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	Approximate Uniaxial Compressive Strength (psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

Appendix A

Sections 1, 2, 3 and 4

(Stations 11+600 to 15+400 West Gwillimbury)

RECORD OF BOREHOLE No C1-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 880 121 4 E 295 461 4 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.13 - 2013.05.13 CHECKED BY SKP

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			
230.9												
0.0	ASPHALT: (75mm)											
0.2	SAND and GRAVEL, trace silt and clay Compact Brown Moist (FILL)		1	AS								40 53 7 (SI+CL)
229.6			1	SS	12							
1.3	Silty CLAY, trace sand, trace gravel Very Stiff to Firm Brown to mottled/Grey Moist		2	SS	18							0 0 64 36
			3	SS	8							
			4	SS	6							
			5	SS	10							
226.3												
4.6	Clayey SILT, with sand, trace gravel Stiff Brown Moist (TILL)		6	SS	14							
	Becoming grey		7	SS	14							5 31 43 21
			8	SS	15							
222.7												
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 7.3m AND WATER LEVEL AT 4.5m UPON COMPLETION BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.7m, BENTONITE HOLEPLUG BENTONITE CEMENT TO 0.2m THEN ASPHALT TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/7/13

+ ³, × ³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C1-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 880 102.9 E 295 428.5 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 14 - 2013 05 14 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
231.1	ASPHALT: (75mm)						231					
0.0 0.1	SAND, some to trace gravel Compact Brown Moist (FILL)		1	AS								
229.8			1	SS	28		230					
1.3	Clayey SILT, some sand, trace gravel, occasional cobbles Hard Grey Moist (FILL)		2	SS	37							10 22 47 21
228.9	Stiff		3	SS	9		229					
2.2			4	SS	9		228					
227.3	Clayey SILT, with sand, trace gravel Stiff Brown Moist (TILL)		5	SS	13		227					3 34 42 21
3.8			6	SS	15		226					
			7	SS	13		225					
			8	SS	13		224					
222.9	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 5.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.7m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.						223					
8.2												

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/7/13

RECORD OF BOREHOLE No C2-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 880 436.0 E 295 262.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 13 - 2013 05 13 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
228.3								SHEAR STRENGTH kPa	W P	W	W L	
0.0								○ UNCONFINED + FIELD VANE				
0.1	ASPHALT: (90mm)							● QUICK TRIAXIAL × LAB VANE				
								20 40 60 80 100	20 40 60			GR SA SI CL
	SAND, some to trace gravel Compact Brown Moist (FILL)		1	AS			228					49 48 3 (SI+CL)
			1	SS	20							
226.8							227					
1.5	Silty CLAY, trace sand Very Stiff to Stiff Brown Moist (FILL)		2	SS	20							0 0 74 26
			3	SS	11		226					
225.3												
3.0	Sandy SILT, some clay Compact Brown Moist (FILL)		4	SS	21		225					
224.5												
3.8	Clayey SILT, some sand, trace gravel Stiff Brown Wet (TILL) Grey		5	SS	9		224					Split spoon wet
			6	SS	10		223					
			7	SS	31		222					
							221					
			8	SS	28		220					
	Moist											
219.6												
8.7	Silty CLAY, trace sand Stiff Grey		9	SS	13		219					0 6 66 28
218.5												
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

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

RECORD OF BOREHOLE No C2-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 880 436.0 E 295 262.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 13 - 2013 05 13 CHECKED BY SKP

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								
	Continued From Previous Page BOREHOLE OPEN TO 6.8m AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.												

RECORD OF BOREHOLE No C2-02

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 880 448.9 E 295 213.3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 14 - 2013 05 14 CHECKED BY SKP

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		
228.0	ASPHALT: (90mm)						228							GR SA SI CL
0.0 0.1	SAND, some to trace gravel Compact Brown Moist (FILL)		1	AS										
			1	SS	23		227							
	Some silt and clay													
226.1			2	SS	24		226							16 48 36 (SI+CL)
1.9	Clayey SILT, some sand, trace gravel Very Stiff to Stiff Brown Moist (FILL)													
			3	SS	18		225							0 22 56 22
	Occasional wood fibre Firm Brown to Dark Grey		4	SS	14		224							
223.5			5	SS	6									
4.5	Clayey SILT, some sand, some gravel Firm Brown Moist		6	SS	6		223							13 27 42 18
222.4	Clayey SILT, some sand, trace gravel Stiff Grey Moist (TILL)		7	SS	12		222							Split spoon wet
5.6														
			8	SS	9		221							
							220							
219.3							219							
8.7	Firm		9	SS	7									
218.2	END OF BOREHOLE AT 9.8m													
9.8														

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

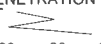
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C2-02

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 880 448.9 E 295 213.3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 14 - 2013 05 14 CHECKED BY SKP

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		w _p	w		
SHEAR STRENGTH kPa									WATER CONTENT (%)				
○ UNCONFINED + FIELD VANE													
● QUICK TRIAXIAL × LAB VANE													
20 40 60 80 100									20 40 60				
	Continued From Previous Page												
	BOREHOLE OPEN TO 8.8m AND WATER LEVEL AT 4.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.7m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.												

RECORD OF BOREHOLE No SLAT47W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 880 589.8 E 295 140.9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 06 - 2013 05 06 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
227.2												
0.0	ASPHALT: (125mm)											
0.1	SAND, some gravel Brown Moist (FILL)		1	AS			227					
	Loose		1	SS	7		226					
225.8												
1.4	Silty CLAY, some sand, trace gravel Very Stiff to Stiff Brown Moist		2	SS	16		225					
225.0												
2.2	Grey		3	SS	11		225					
	Some organics		4	SS	15		224					
223.5												
3.7	Silty CLAY, some sand, trace gravel Stiff Grey Moist (TILL)		5	SS	10		223					
	Inferred cobbles at 5.2m		6	SS	15		222					
			7	SS	14		221					
220.5												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT COLD PATCH TO GROUND SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/25/13

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

RECORD OF BOREHOLE No C4-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 881 454 7 E 294 862 3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.13 - 2013.05.13 CHECKED BY SKP

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		
226.4	ASPHALT: (75mm)													
0.0 0.1	SAND, trace gravel, trace silt and clay Compact Moist (FILL)		1	AS			226							
			1	SS	18		225							5 87 8 (SI+CL)
224.8	Silty CLAY, some sand Stiff Brown (FILL)		2	SS	13		224							
1.6	Trace gravel		3	SS	10		223							
223.6	Clayey SILT, with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		4	SS	12		222							
2.8			5	SS	11		221							
			6	SS	16		220							7 38 36 19 Split spoon wet
			7	SS	17		219							
			8	SS	11									
218.2	END OF BOREHOLE AT 8.2m BOREHOLE OPEN TO 7.3m AND WATER LEVEL AT 5.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.													
8.2														

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/7/13

+ 3 4 x 3 : Numbers refer to 20
Sensitivity 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C4-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 881 441.1 E 294 833.3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.14 - 2013.05.14 CHECKED BY SKP

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	20 40 60 80 100					
226.5 0.0 0.1	ASPHALT: (75mm)													
	SAND, some to trace gravel Compact Moist (FILL)		1	GS			226							
226.2			1	SS	16									
225.2	Silty CLAY, some sand, trace gravel Very Stiff Brown		2	SS	22		225							
224.3														
224.3	Firm to Stiff		3	SS	5		224							
			4	SS	9		223							
			5	SS	6		222							
			6	SS	14									
220.9							221							
5.6	Clayey SILT, with sand, trace gravel Stiff Grey Moist (TILL)		7	SS	11		220							
			8	SS	9		219							
218.3														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 7.0m AND WATER LEVEL AT 5.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.9m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/7/13

+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SLAT51E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 881 675 9 E 294 803 8 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 08 - 2013 05 08 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>W_P</div><div>W</div><div>W_L</div></div> <div>WATER CONTENT (%)</div>	UNIT WEIGHT <div>γ</div> kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
224.9								20	40	60	80	100			
0.0															
224.6	ASPHALT: (250mm)														
0.3	SAND, some gravel Grey Moist (FILL) Compact		1	AS											
223.7			1	SS	13		224								
1.2	Silty CLAY, trace sand Stiff to Very Stiff Grey Moist		2	SS	10		223								
			3	SS	17		222								
			4	SS	9		221								
			5	SS	12		220								
			6	SS	11										
219.7															
5.2	END OF BOREHOLE AT 5.1m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 3.0m, CUTTINGS AND BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN COLD PATCH TO SURFACE.														

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No SLAT53W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 881 768.9 E 294 788.4 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY SKP

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		
225.2														
0.0 224.9	ASPHALT: (250mm)													
0.3	SAND, trace silt, trace gravel Brown Moist (FILL) Compact		1	AS			225							
			1	SS	17		224							7 85 8 (SI+CL)
223.8														
1.4	Silty CLAY, some sand, trace gravel Stiff Brown Moist		2	SS	10		223							
			3	SS	10		222							1 16 59 24
			4	SS	9		221							
221.5														
3.7	Very Stiff		5	SS	22		220							0 9 65 26
			6	SS	16		219							
							218							
219.6														
5.6	Grey		7	SS	12									
			8	SS	10									
217.0														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS AND BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No SLAT57W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 882 249.2 E 294 702.6 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
228.2	ASPHALT: (250mm)											
0.0												
227.9												
0.3	SAND and GRAVEL, trace silt Grey Moist (FILL) Compact		1	AS			228					34 58 8 (SI+CL)
			1	SS	21		227					
226.8												
1.4	Clayey SILT, trace sand, trace gravel Very Stiff Brown Moist		2	SS	23		226					
			3	SS	24							
225.2												
3.0	Silty CLAY, trace sand, trace gravel Firm to Stiff Brown Moist		4	SS	6		225					
							224					Field vane pushed to 4.0m, but would not turn
			5	SS	10		223					
	Grey Moist to Wet		6	SS	15		222					Split spoon wet
221.5												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 3.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS AND BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/7/13

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SLAT58W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 882 399.8 E 294 676.2 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.06 - 2013.05.06 CHECKED BY SKP

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						
229.2								20 40 60 80 100						
0.0	ASPHALT: (350mm)		1	AS			229							
228.8														
0.4	SAND, some gravel Compact Brown Moist (FILL)		1	SS	14		228							
228.0														
1.2	Silty CLAY, trace to some sand Very Stiff to Hard Brown Moist		2	SS	25		227							
			3	SS	21		226							0 0 58 42
	Trace gravel, occasional oxide lenses		4	SS	27		225							
			5	SS	36		224							
			6	SS	31		223							0 7 49 44
	Becoming grey													
			7	SS	15									
222.5														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, THEN CONCRETE AND ASPHALT COLD PATCH TO GROUND SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

RECORD OF BOREHOLE No SLAT62-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 882 940.5 E 294 587.3 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.05 - 2013.05.05 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
229.5	ASPHALT: (200mm)												
0.0													
0.2	SAND, some gravel Grey Moist (FILL)		1	AS			229						
228.7													
0.8	SAND, trace gravel Compact Brown Moist (FILL)		1	SS	12		228						
228.1													
1.4	Clayey SILT, and sand Stiff Brown Moist		2	SS	8		228						
227.3													
2.2	Trace gravel Very Stiff		3	SS	19		227						
	Becoming wet												
	50mm thick sand layer at 3.3m		4	SS	19		226						2 38 44 16
													Split spoon wet
			5	SS	15								
225.0							225						6 43 40 11
4.5	SAND and SILT, some clay, trace gravel Loose Grey Wet		6	SS	9		224						
223.9													
5.6	Clayey SILT, trace sand Stiff Grey Wet		7	SS	11		223						
222.8													
6.7	END OF BOREHOLE AT 6.7m BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 09/13 2.5 227.0												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

+ ³, × ³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SLAT63W-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 043 6 E 294 564 0 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.06 - 2013.05.06 CHECKED BY SKP

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	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
229.1												
0.0	ASPHALT: (150mm)						229					
0.2	SAND, some gravel, trace silt and clay Compact Brown Moist (FILL)		1	AS								
227.8			1	SS	15		228					18 75 7 (SI+CL)
1.3	Clayey SILT, trace sand Very Stiff Brown Moist		2	SS	21							
227.0							227					
2.1	Silly CLAY, trace sand, trace gravel Firm Grey Moist		3	SS	5							
	Becoming wet		4	SS	5		226					Split spoon wet
225.4												Attempted field vane. Did not advance pass 3.4m
3.7	SAND and SILT, some gravel, trace clay Loose Grey Moist		5	SS	7		225					13 41 37 9
224.6												
4.5	Stiff		6	SS	11		224					
							223					
			7	SS	9							
							222					
			8	SS	8		221					
220.4												
8.7	Clayey SILT, some sand Stiff Grey Wet		9	SS	10		220					

Continued Next Page

Numbers refer to
Sensitivity
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SLAT63W-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 043.6 E 294 564.0 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.06 - 2013.05.06 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
	Continued From Previous Page												
217.4	Clayey SILT, some sand Firm Grey Wet		10	SS	5		219						
							218						
11.7	Silty CLAY, some sand, trace gravel Stiff Grey Wet (TILL)		11	SS	13		217						Attempted filed vane test at 11.6m, unable to turn
							216						
			12	SS	11		215						
							214						
213.3			13	SS	12								
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.2m WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

RECORD OF BOREHOLE No C7-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 184.5 E 294 555.7 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.15 - 2013.05.15 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
229.9												
0.0	ASPHALT: (200mm)											
0.2	SAND, some gravel Brown Moist (FILL)		1	AS								
228.9												
1.0	Silty CLAY, with sand, trace gravel Firm to Very Stiff Brown Moist		1	SS	6		229					1 37 38 24
			2	SS	15		228					
			3	SS	14							
	Trace sand						227					
			4	SS	11							0 4 55 41
	Occasional silt seams		5	SS	14		226					
	Becoming grey, occasional sand pockets		6	SS	11		225					
							224					
			7	SS	9							2 14 41 43
			8	SS	8		222					
221.2												
8.7	Clayey SILT, some sand, trace gravel Stiff Grey Moist (TILL)						221					
			9	SS	10							
220.1												
9.8	END OF BOREHOLE AT 9.8m											

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C7-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 184.5 E 294 555.7 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.15 - 2013.05.15 CHECKED BY SKP

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					
	Continued From Previous Page													
	BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.6m, CEMENT TO 0.15m, ASPHALT TO SURFACE.													

RECORD OF BOREHOLE No C7-02

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 164.3 E 294 531.1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.14 - 2013.05.14 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
229.8												
0.0	ASPHALT: (350mm)		1	AS								44 42 14 (SI+CL)
229.4												
0.4	SAND and GRAVEL, trace silt and clay											
229.0	Brown											
0.8	Moist		1	SS	27		229					
	(FILL)											
228.4	Silty CLAY, trace to some sand, trace gravel											
1.4	Stiff to Very Stiff		2	SS	31		228					0 11 51 38
	Brown											
	Moist											
227.6	Hard											
2.2			3	SS	28		227					
			4	SS	13							
			5	SS	27		226					0 7 54 39
			6	SS	24		225					
			7	SS	13		224					
			8	SS	14		222					2 15 52 31
			9	SS	17		221					
220.0												
9.8	END OF BOREHOLE AT 9.7m.											

Continued Next Page

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

RECORD OF BOREHOLE No C7-02

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 164.3 E 294 531.1 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 14 - 2013 05 14 CHECKED BY SKP

SOIL PROFILE			SAMPLES			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 NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE										

RECORD OF BOREHOLE No SLAT65-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 883 273 8 E 294 528 4 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.05 - 2013.05.05 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100		
230.8	ASPHALT: (200mm)											
0.0												
0.2	SAND, trace gravel, trace to some silt and clay Compact Grey Moist (FILL)		1	AS			230					
			2	SS	14							6 80 14 (SI+CL)
229.0			3	SS	18		229					
1.8	SILT, some clay, trace gravel Compact Brown Moist		4	SS	16		228					
227.8			5	SS	9		227					0 0 55 45
3.0	Silty CLAY Stiff Grey Moist		6	SS	9		226					
			7	SS	8		225					
			8	SS	8							
224.1	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 09/13 2.5 228.3											
6.7												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

+ 3, x 3; Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SLAT67-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 863 452 7 E 294 496 7 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.05 - 2013.05.05 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
232.5 0.0	ASPHALT: (325mm)												
232.2 0.3	Gravelly SAND		1	AS									
232.0 0.5	(FILL)												
	Sandy SILT, some gravel, trace clay												
	Compact												
	Brown												
231.2 1.3	Moist		1	SS	16								
	(FILL)												
	Silly CLAY, trace sand												
	Stiff												
	Brown		2	SS	15								0 9 47 44
	Moist												
			3	SS	11								
			4	SS	8								0 3 48 49
			5	SS	8								
			6	SS	9								
226.9 5.6	Firm												
			7	SS	7								
225.8 6.7	END OF BOREHOLE AT 6.7m. BORHEOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.												
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 09/13 1.8 230.7												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

RECORD OF BOREHOLE No C8-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 663.2 E 294 471.6 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.15 - 2013.05.15 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
234.4												
0.0	ASPHALT: (175mm)											
0.2	SAND, some gravel Brown Moist (FILL)		1	AS			234					
233.2			1	SS	7							
1.2	Clayey SILT, some sand, trace gravel Very Stiff to Stiff Brown to Grey Moist		2	SS	17		233					3 27 40 30
			3	SS	13		232					
			4	SS	9		231					
230.6												
3.8	Silty CLAY, trace to some sand, trace gravel Firm Mottled Brown and Grey Moist		5	SS	7		230					0 7 43 50
229.9			6	SS	25							Split spoon wet
4.5	Very Stiff to Stiff						229					
			7	SS	20		228					
							227					
			8	SS	12		226					0 21 36 43
			9	SS	8		225					
224.6												
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C8-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 663 2 E 294 471 6 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 15 - 2013 05 15 CHECKED BY SKP

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			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
	BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 5.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.6m, CEMENT TO 0.12m THEN ASPHALT TO SURFACE.													

RECORD OF BOREHOLE No C8-02

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 652.3 E 294 445.3 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 14 - 2013 05 14 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
234.3												
0.0	ASPHALT: (375mm)		1	AS			234					
233.9												
0.4	SAND, trace gravel											
233.5	Brown											
0.8	Moist											
	(FILL)		1	SS	28		233					8 36 38 18
	Clayey SILT, with sand, trace gravel											
	Very Stiff		2	SS	26		232					
	Brown/Grey											
	Moist		3	SS	21		231					
231.1												
3.2	Silty CLAY, some sand, trace gravel,		4	SS	16		230					1 14 49 36
	trace organics											
	Very Stiff to Hard		5	SS	36		229					
	Brown/Grey											
	Moist		6	SS	47		228					
			7	SS	24		227					
227.1												
7.2	Stiff to Firm		8	SS	9		226					1 18 50 31
			9	SS	7		225					
224.5												
9.8	END OF BOREHOLE AT 9.7m											

Continued Next Page

+ 3 x 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C8-02

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 883 652.3 E 294 445.3 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 14 - 2013 05 14 CHECKED BY SKP

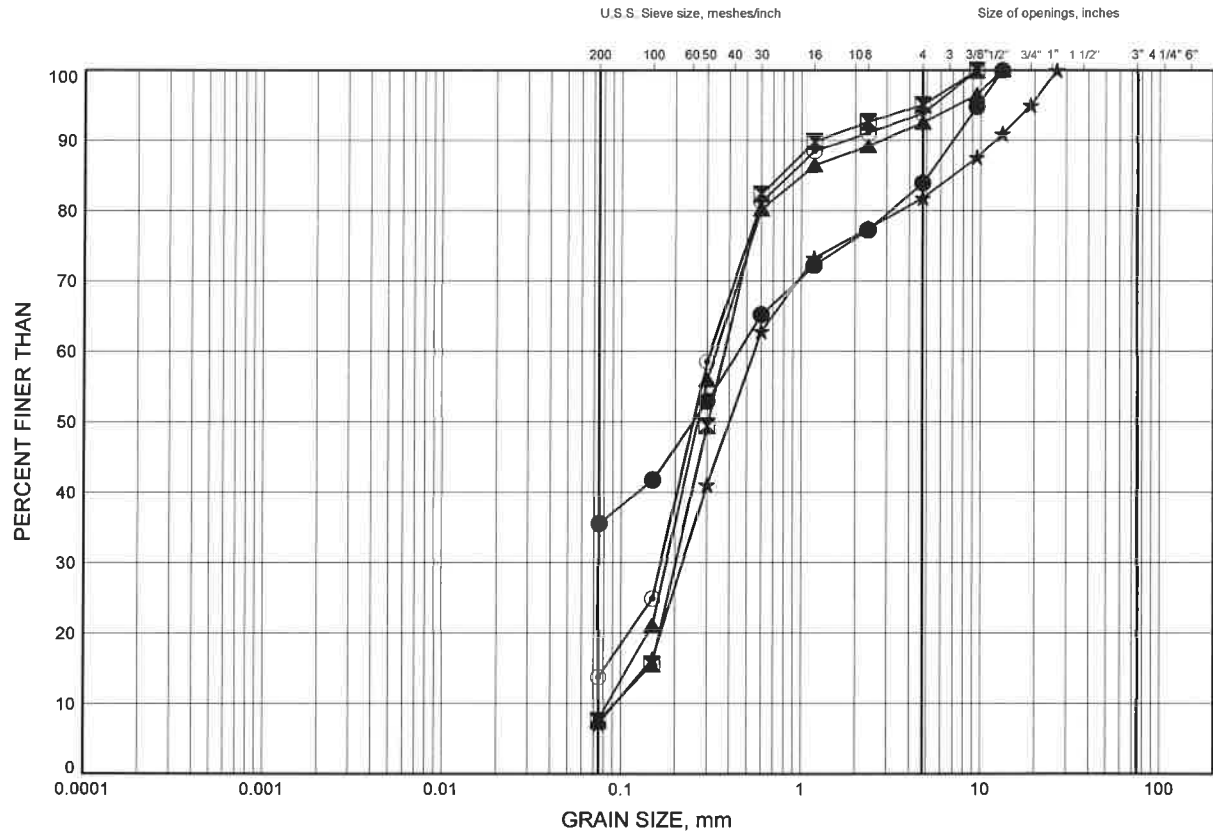
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page BOREHOLE OPEN TO 9.7m AND WATER LEVEL AT 8.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/7/13

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A1

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C2-02	1.71	226.29
⊠	C4-01	1.07	225.33
▲	SLAT53W-01	1.07	224.13
★	SLAT63W-01	1.07	228.03
⊙	SLAT65-01	1.07	229.73

Date August 2013
GWP# 83-00-00

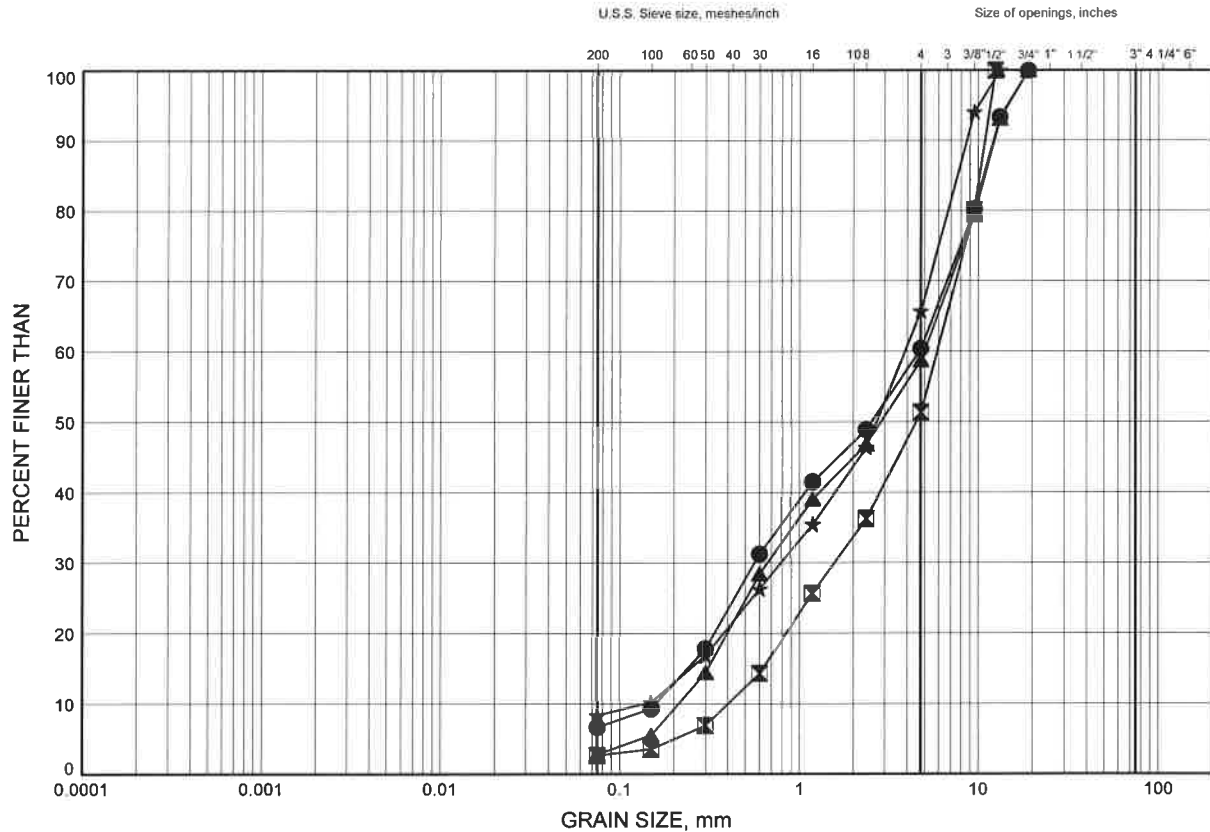


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A2

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-01	0.38	230.52
⊠	C2-01	0.30	228.00
▲	C7-02	0.30	229.50
★	SLAT57W-01	0.30	227.90

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/26/13

Date August 2013
GWP# 83-00-00

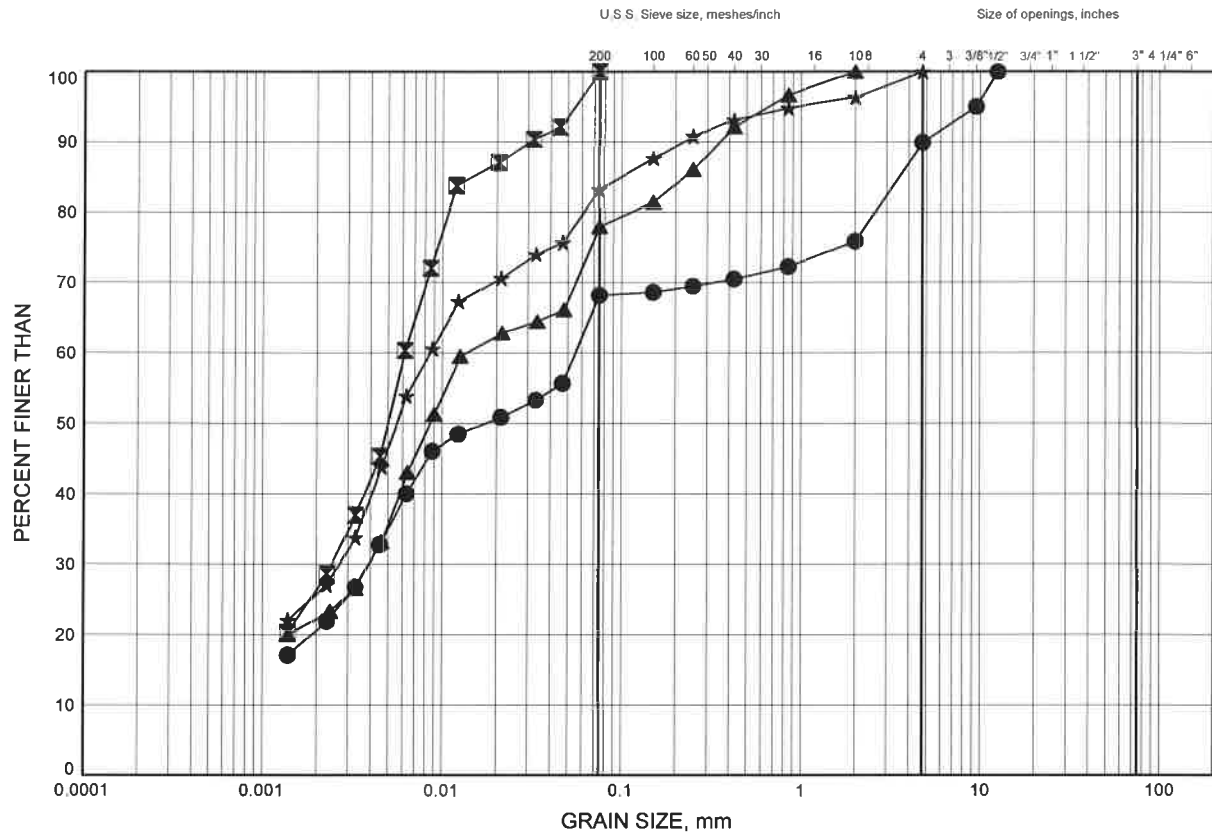


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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A3

CLAYEY SILT/SILTY CLAY FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-02	1.83	229.27
⊠	C2-01	1.83	226.47
▲	C2-02	2.59	225.41
★	C4-01	2.59	223.81

Date August 2013
GWP# 83-00-00

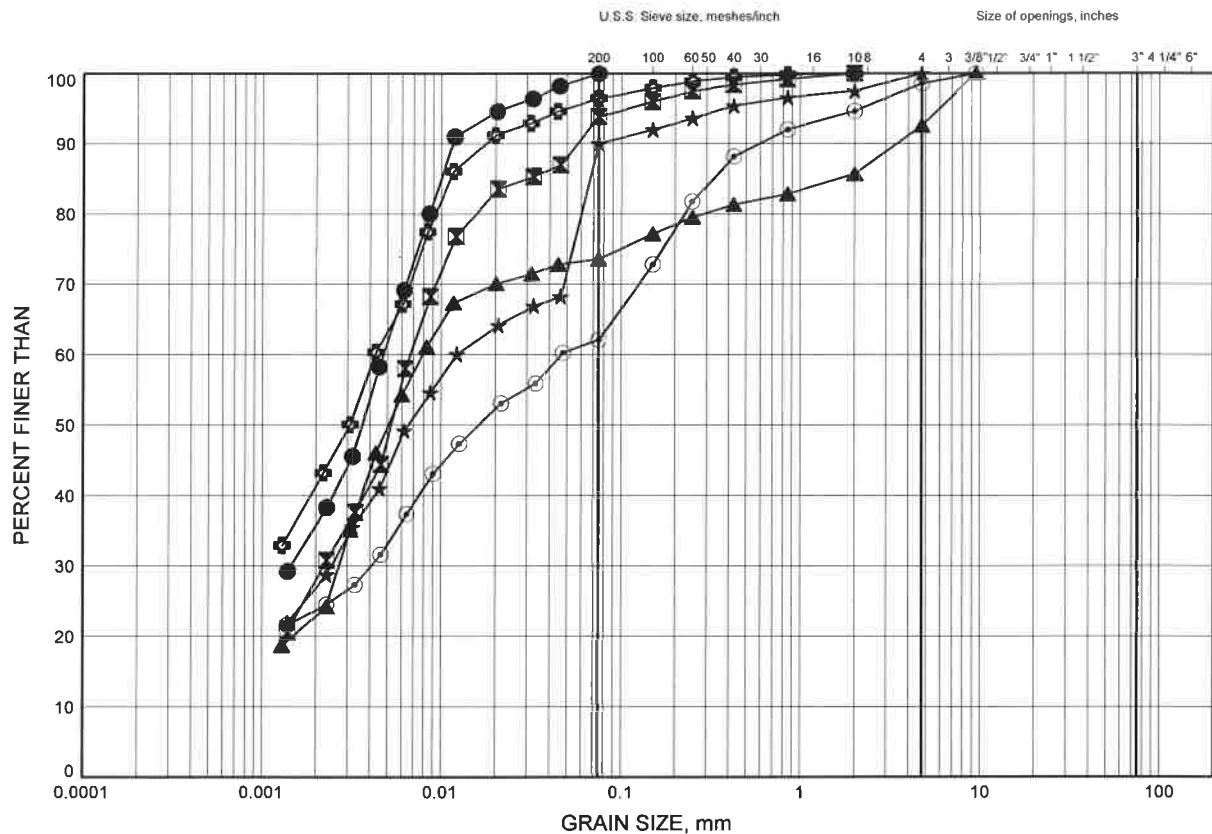


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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A4

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-01	1.83	229.07
⊠	C2-01	9.45	218.85
▲	C4-02	1.83	224.67
★	C4-02	3.35	223.15
⊙	C7-01	1.07	228.83
⊕	C7-01	3.35	226.55

Date August 2013

GWP# 83-00-00



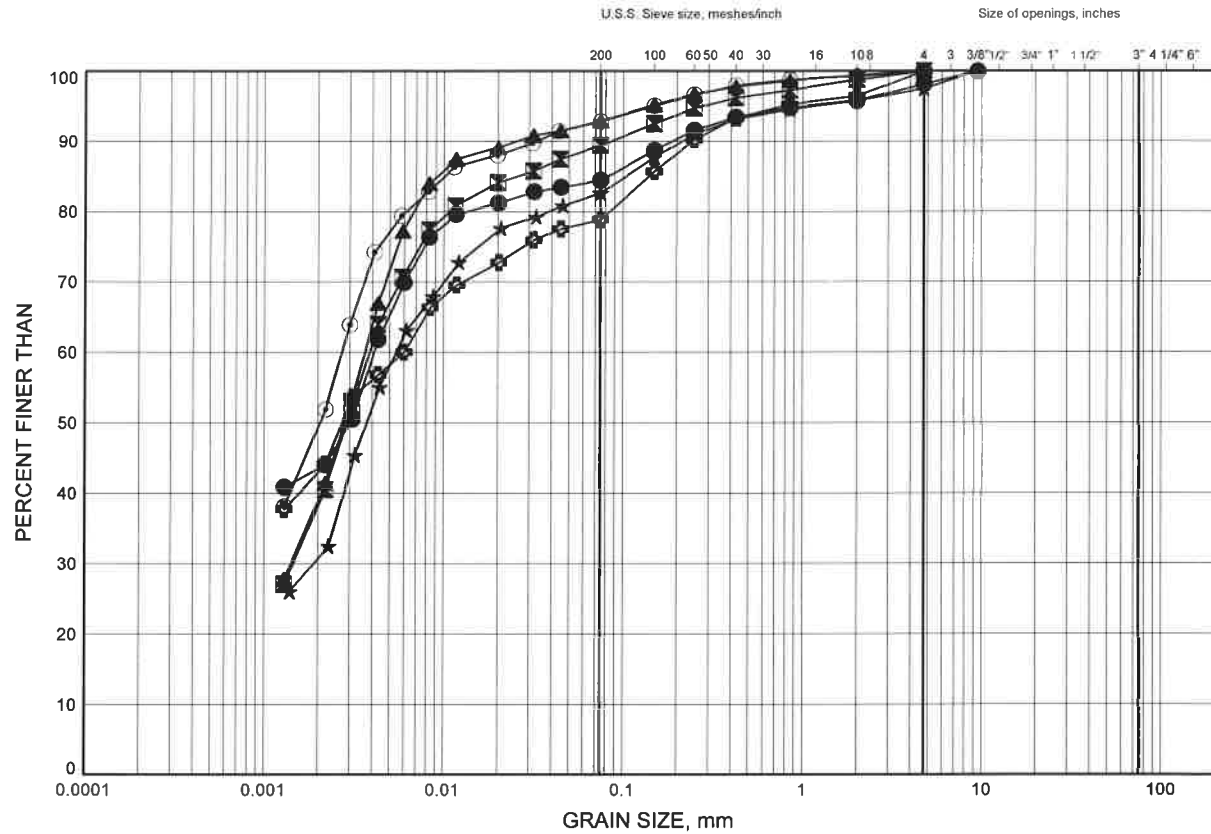
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A5

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-01	6.40	223.50
⊠	C7-02	1.83	227.97
▲	C7-02	4.11	225.69
★	C7-02	7.92	221.88
⊙	C8-01	4.11	230.29
⊕	C8-01	7.92	226.48

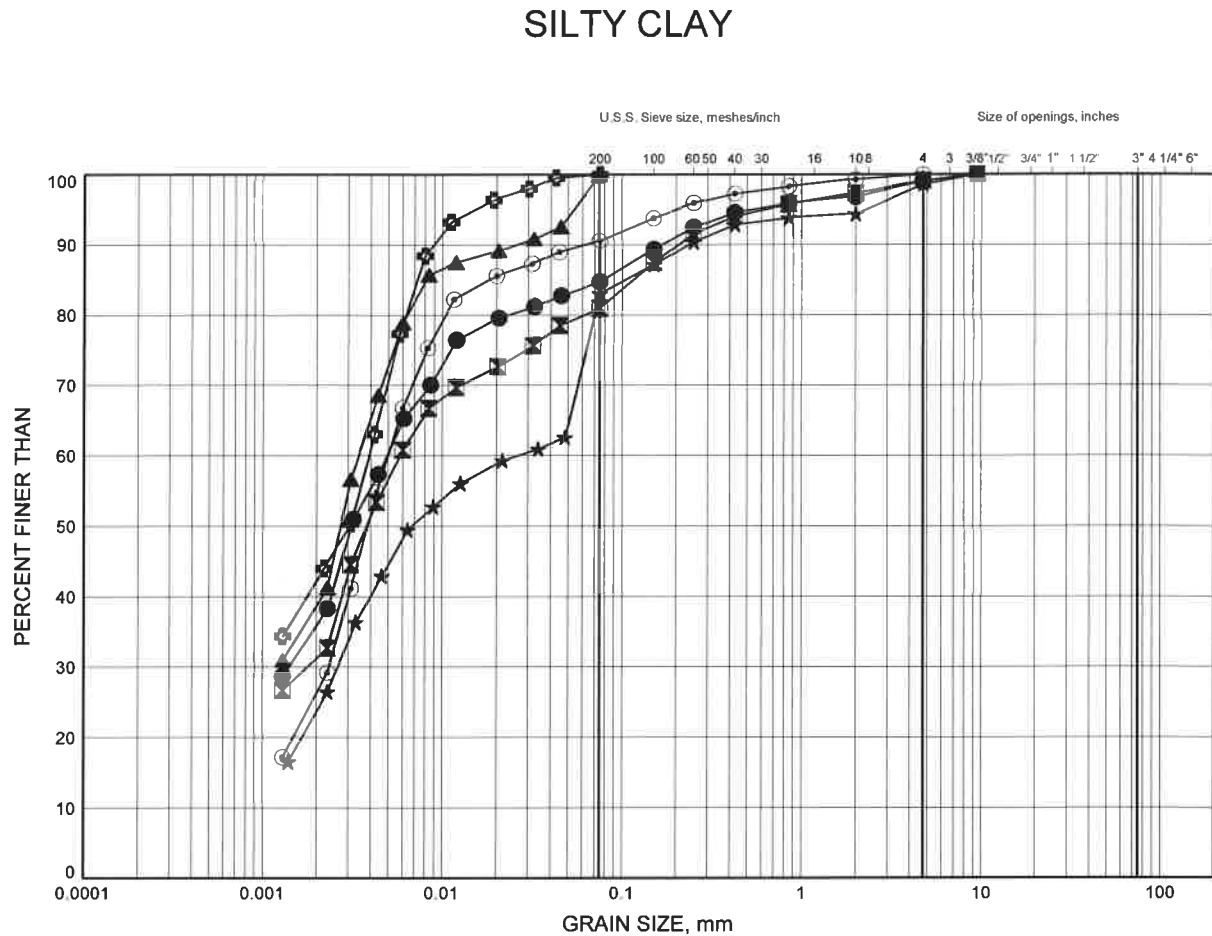
Date August 2013
GWP# 83-00-00



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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A6



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C8-02	4.11	230.19
⊠	C8-02	7.92	226.38
▲	SLAT51E-01	3.35	221.55
★	SLAT53W-01	2.59	222.61
⊙	SLAT53W-01	4.11	221.09
⊕	SLAT58W-01	2.59	226.61

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/26/13

Date August 2013
GWP# 83-00-00

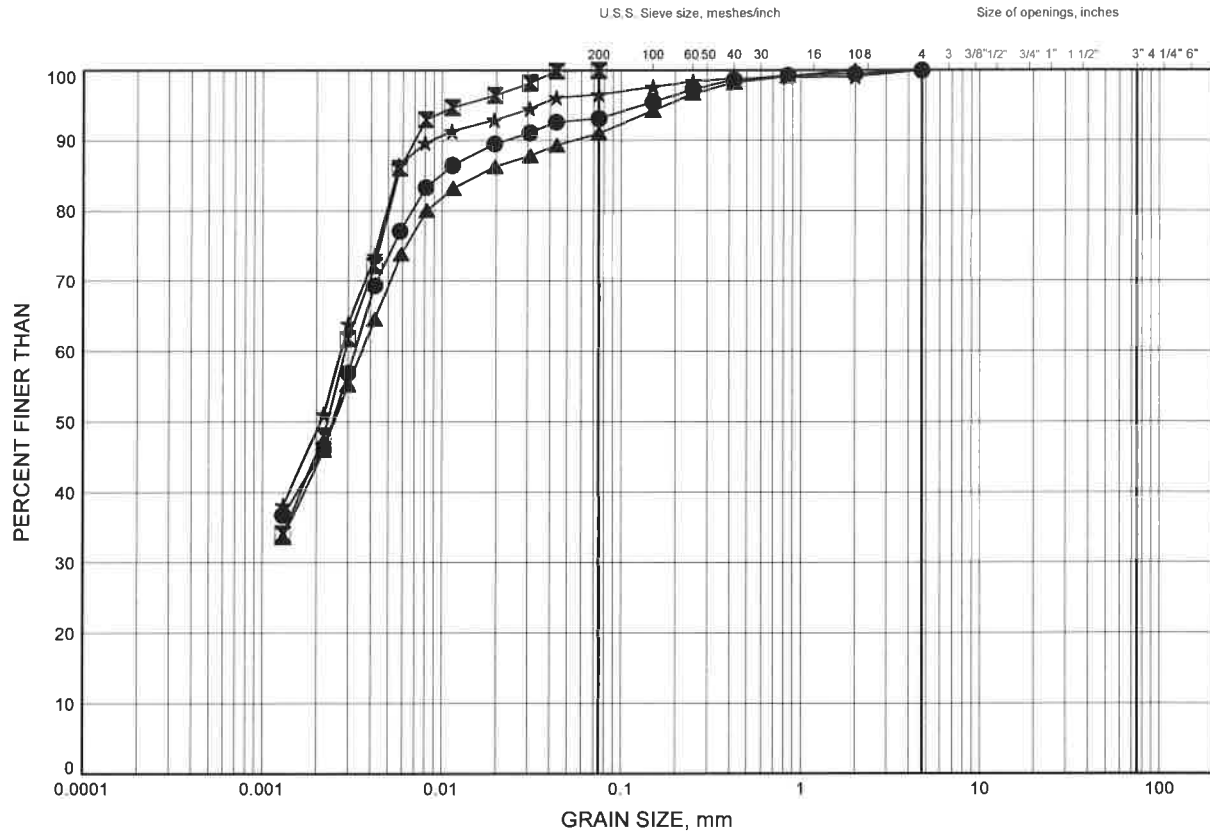


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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A7

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SLAT58W-01	6.40	222.80
■	SLAT65-01	3.35	227.45
▲	SLAT67-01	1.83	230.67
★	SLAT67-01	3.35	229.15

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/13/13

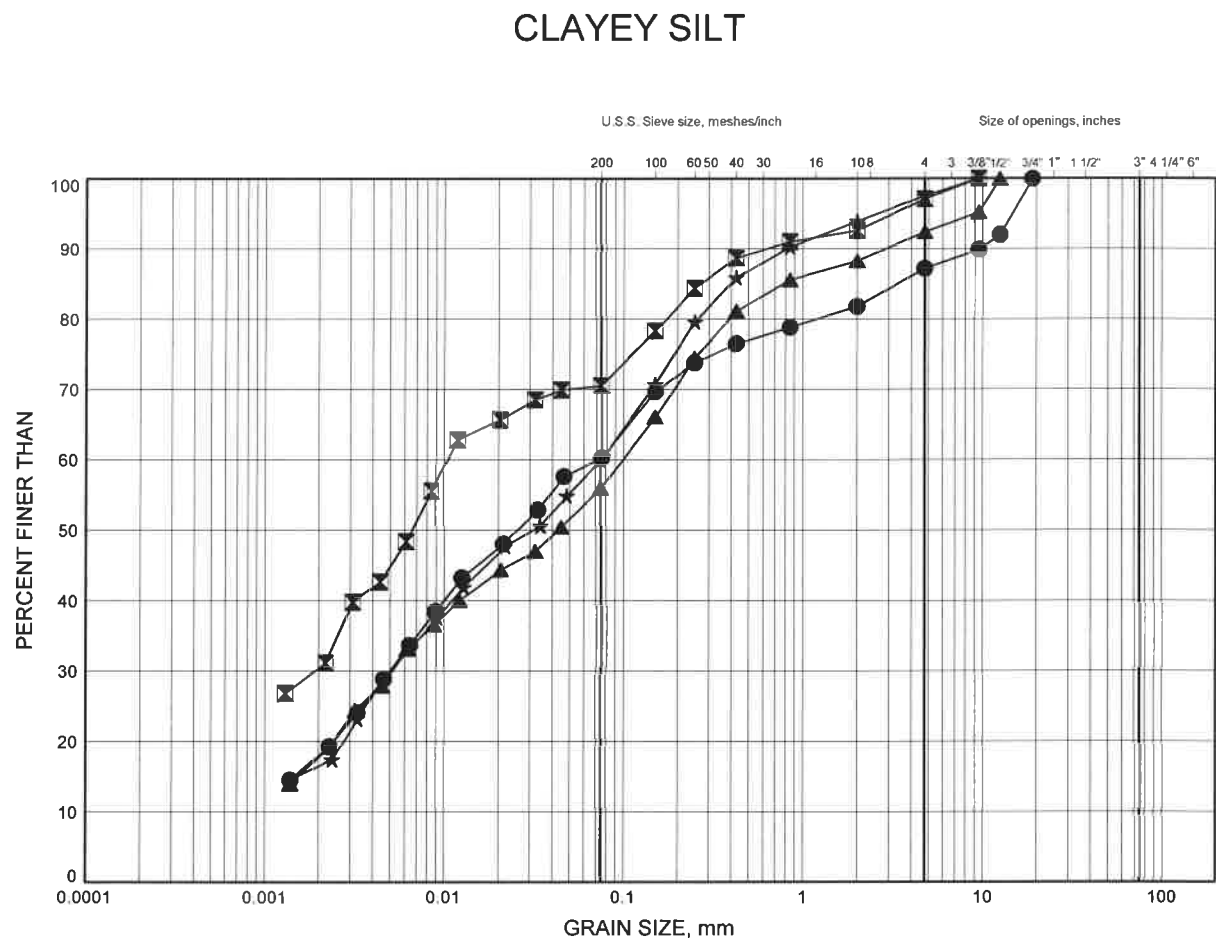
Date August 2013
GWP# 83-00-00



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Chkd. SKP

Hwy 400 Median Sewer
GRAIN SIZE DISTRIBUTION

FIGURE A8



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C2-02	4.88	223.12
⊠	C8-01	1.22	233.18
▲	C8-02	1.07	233.23
★	SLAT62-01	3.35	226.15

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/13/13

Date August 2013
 GWP# 83-00-00

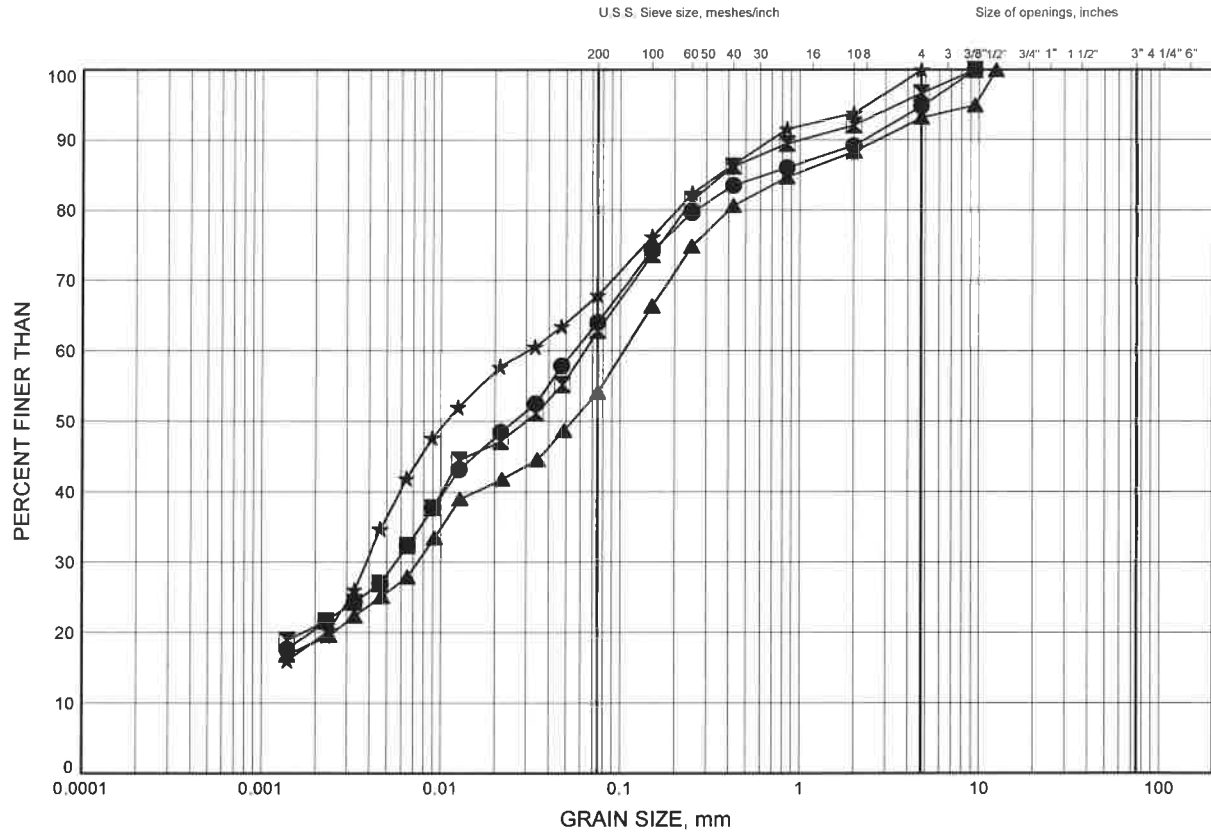


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 Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A9

CLAYEY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-01	6.40	224.50
■	C1-02	4.11	226.99
▲	C4-01	4.88	221.52
★	C4-02	6.40	220.10

Date August 2013

GWP# 83-00-00



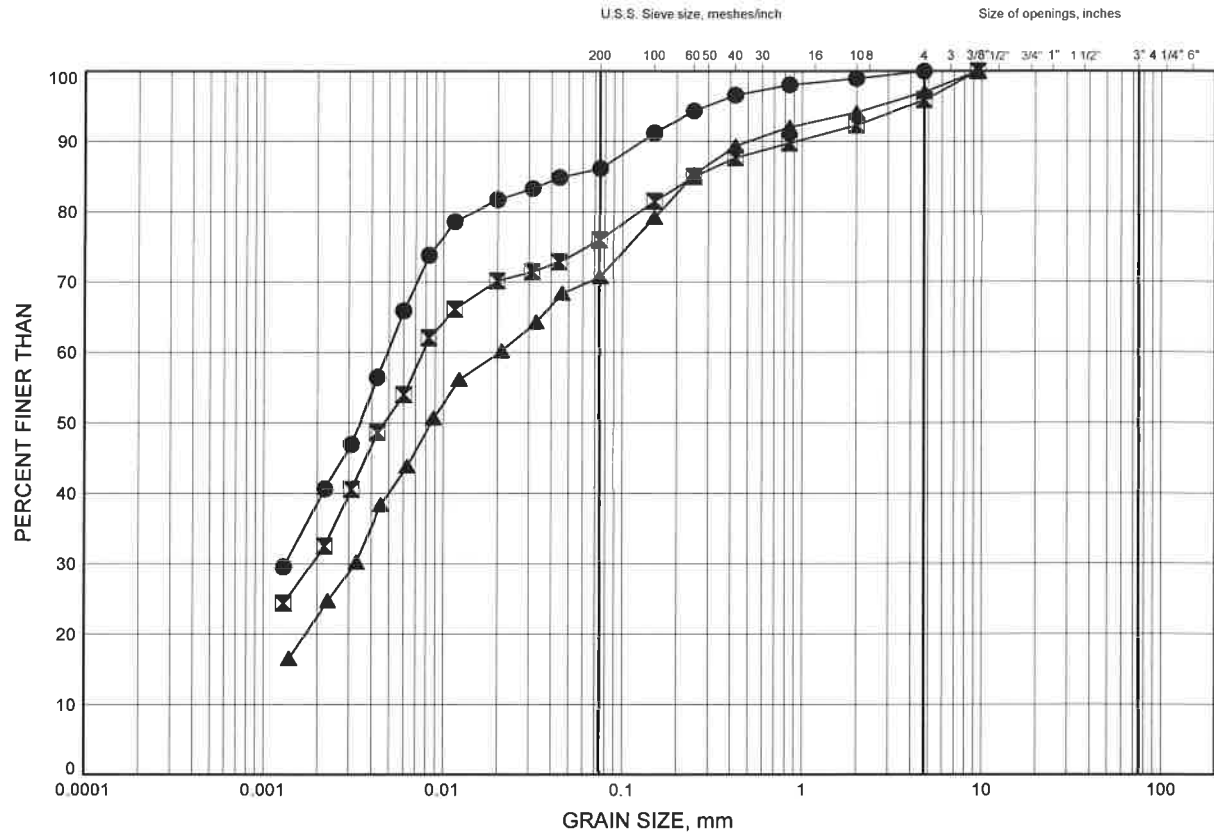
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A10

SILTY CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SLAT47W-01	4.11	223.09
■	SLAT47W-01	6.40	220.80
▲	SLAT63W-01	12.50	216.60

Date August 2013
GWP# 83-00-00

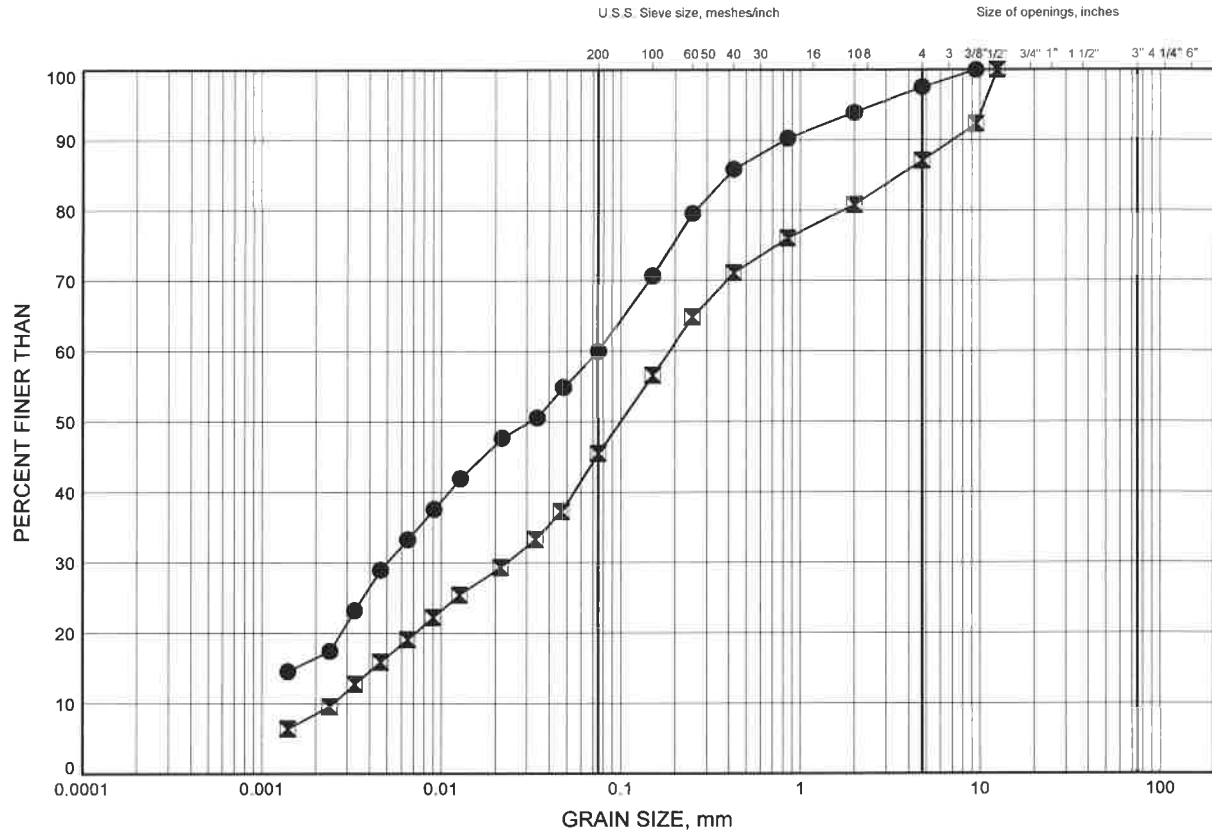


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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE A11

SAND & SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SLAT62-01	3.35	226.15
▲	SLAT63W-01	4.11	224.99

Date August 2013
GWP# 83-00-00

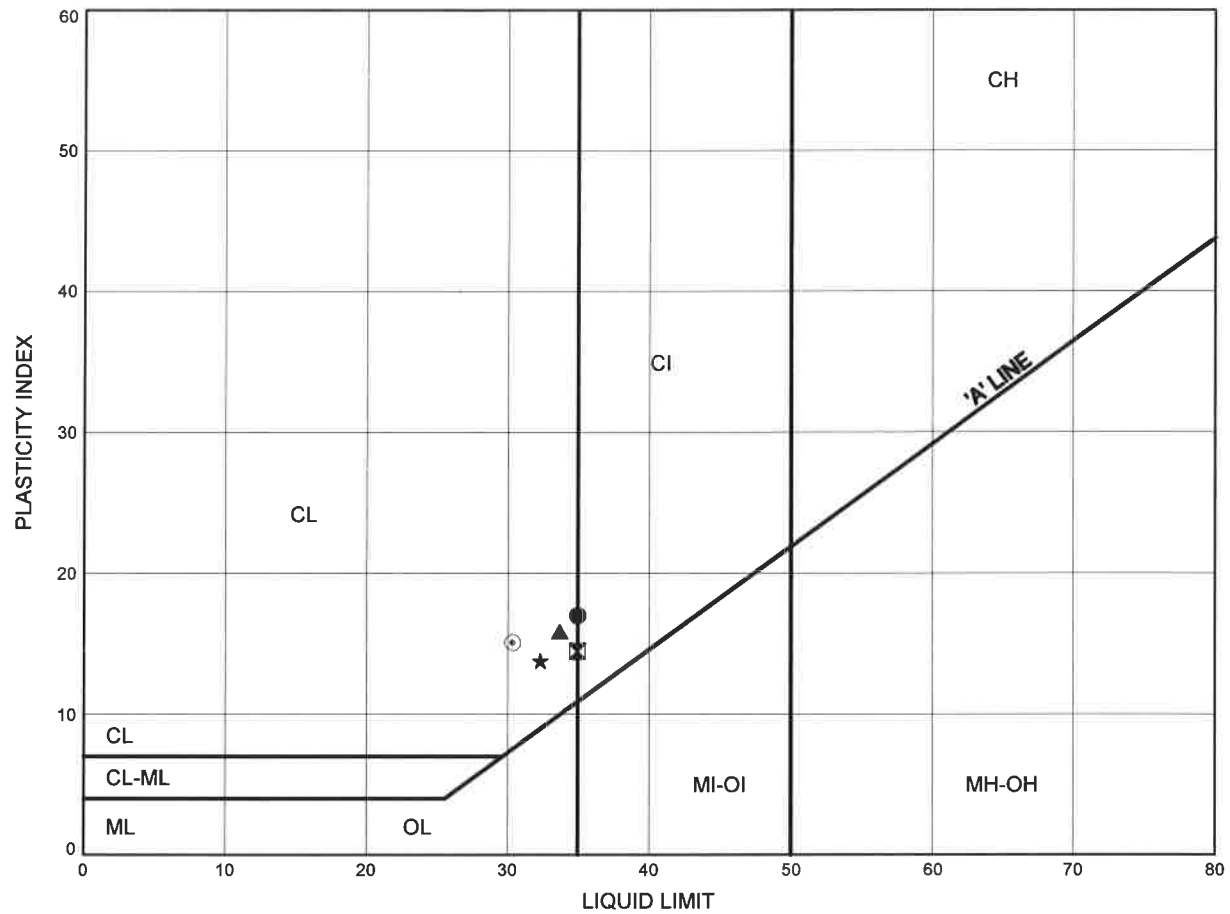


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Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE A12

CLAYEY SILT/SILTY CLAY FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-02	1.83	229.27
⊠	C1-02	2.59	228.51
▲	C2-01	1.83	226.47
★	C2-02	3.35	224.65
⊙	C4-01	2.59	223.81

Date August 2013
GWP# 83-00-00

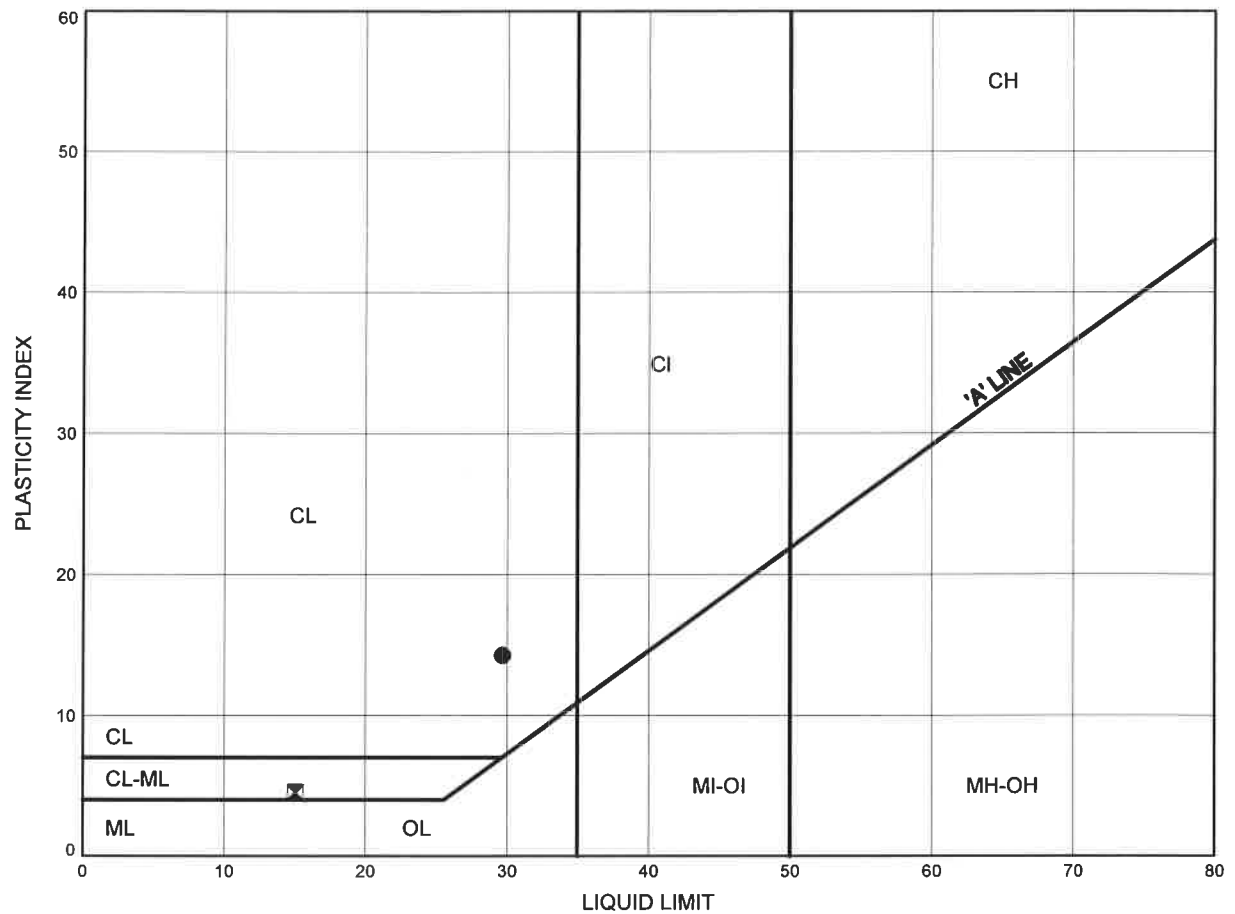


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Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE A13

CLAYEY SILT



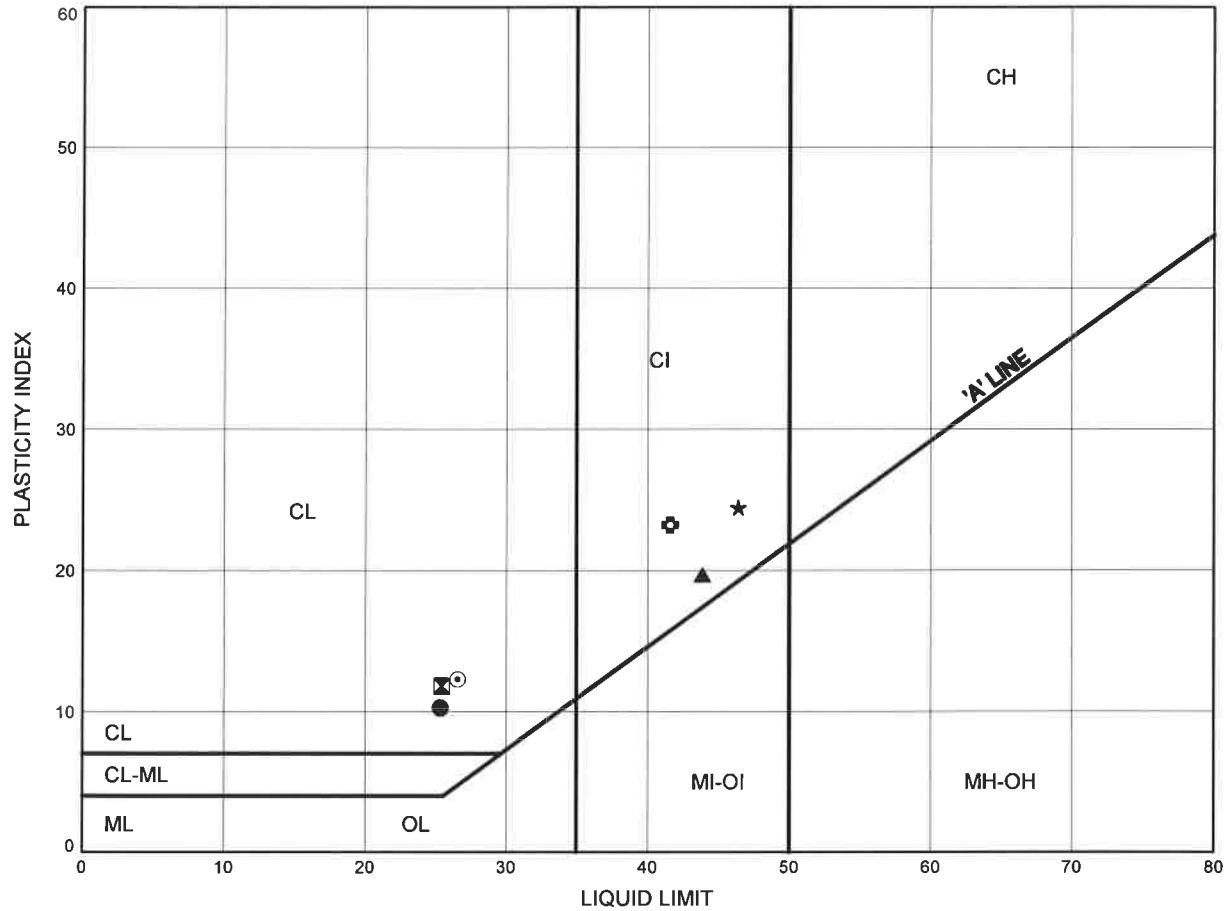
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C2-02	4.88	223.12
⊠	SLAT62-01	3.35	226.15

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE A14

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C2-01	9.45	218.85
⊠	C4-02	1.83	224.67
▲	C4-02	3.35	223.15
★	C7-01	3.35	226.55
⊙	C7-01	6.40	223.50
⊕	C8-01	4.11	230.29

Date August 2013
GWP# 83-00-00

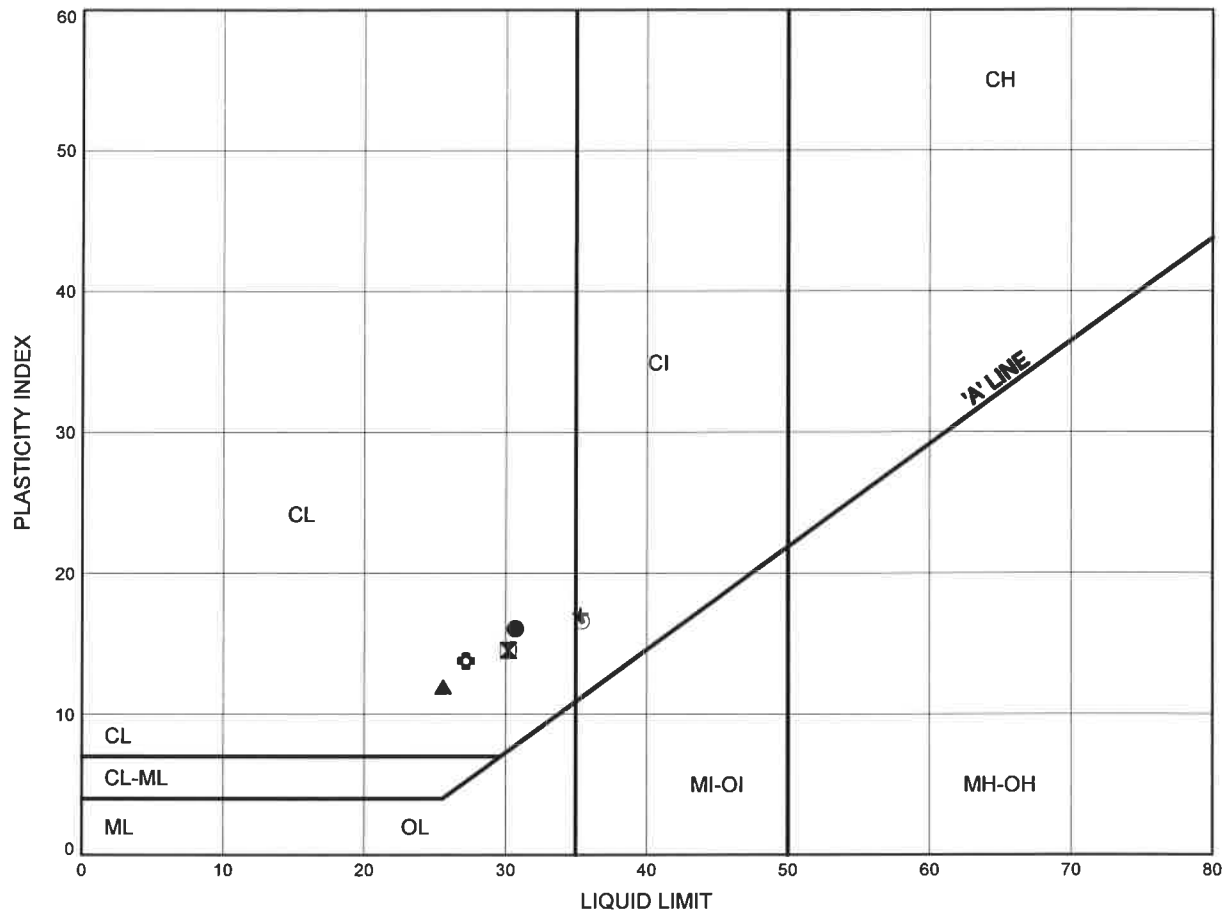


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Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE A15

SILTY CLAY



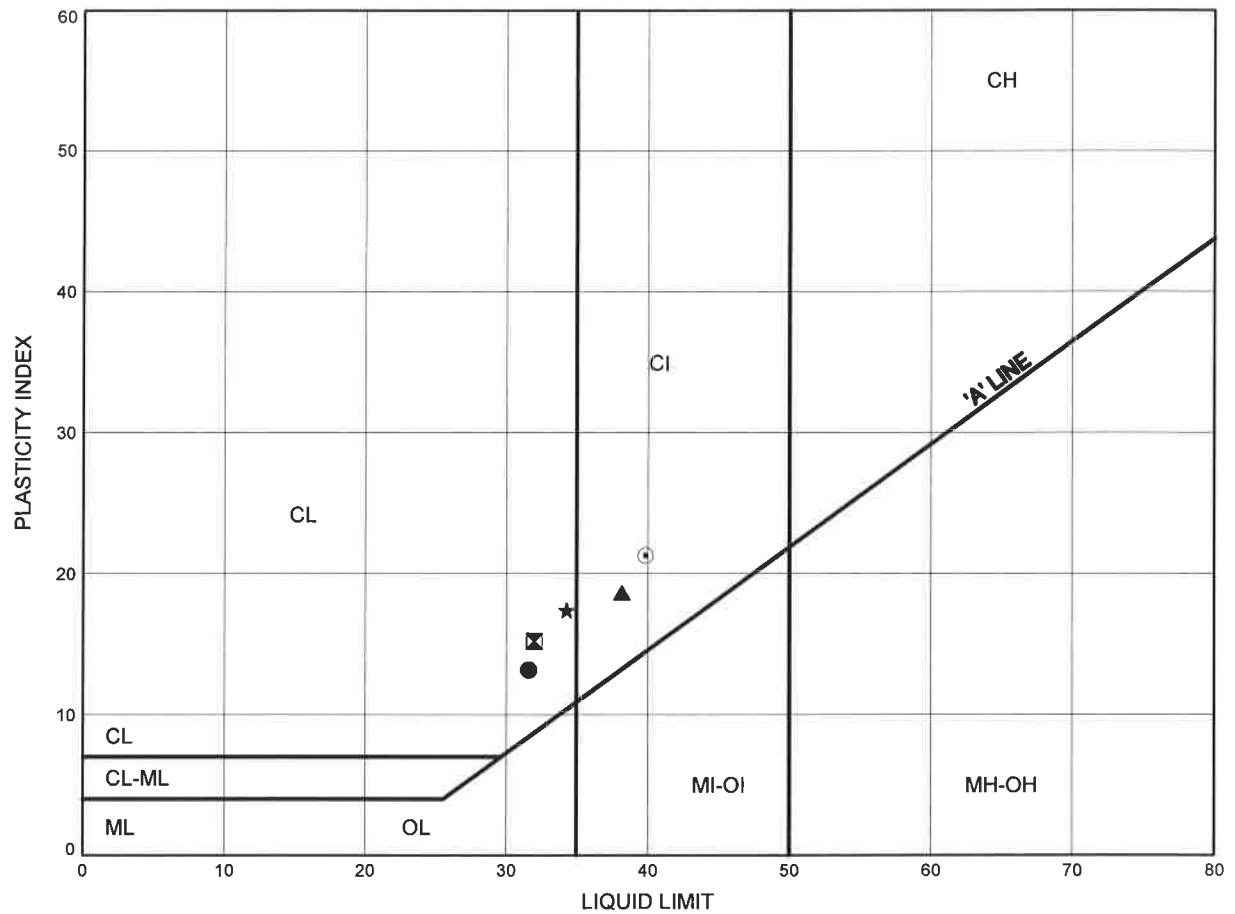
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C8-01	7.92	226.48
⊠	C8-02	4.11	230.19
▲	C8-02	7.92	226.38
★	SLAT51E-01	3.35	221.55
⊙	SLAT53W-01	2.59	222.61
⊕	SLAT53W-01	3.35	221.85

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE A16

SILTY CLAY



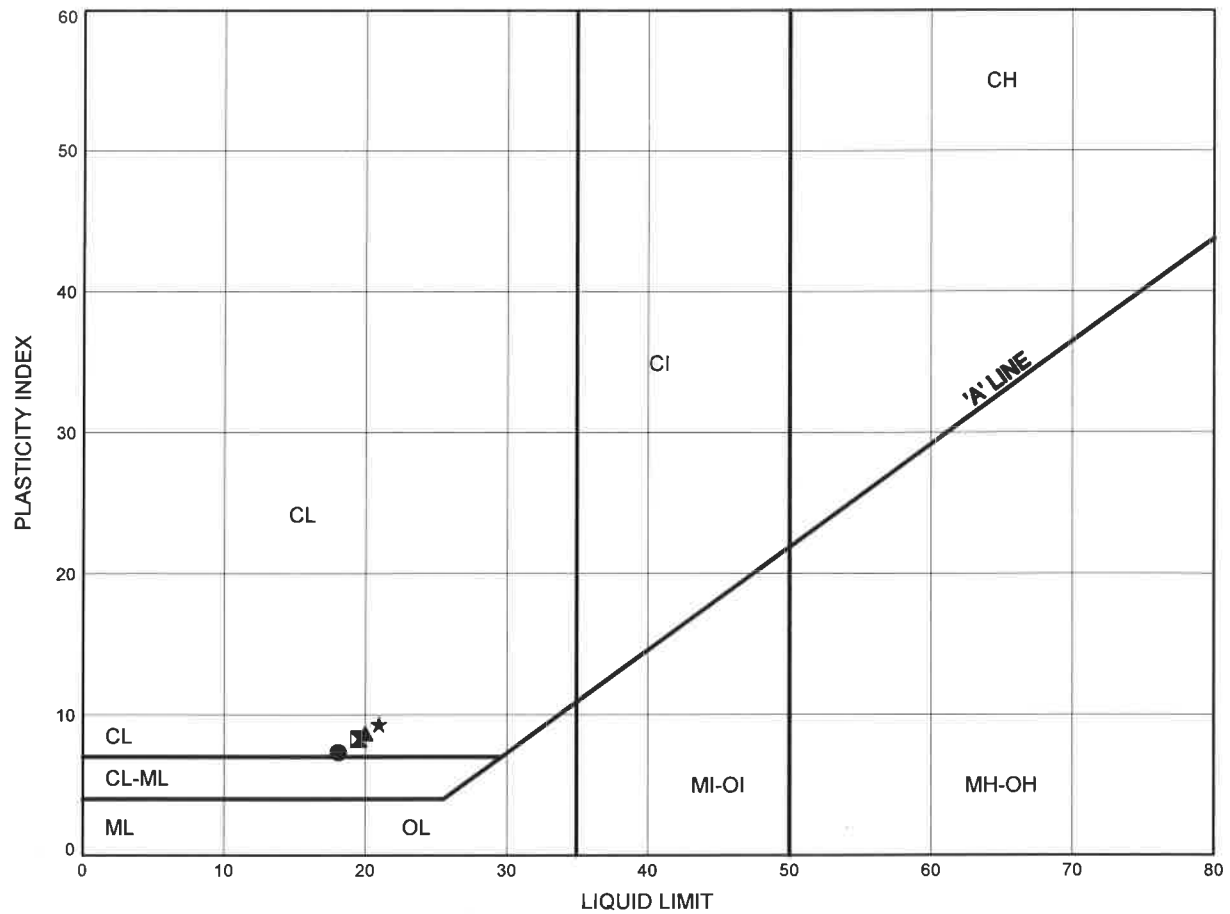
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SLAT58W-01	2.59	226.61
⊠	SLAT58W-01	6.40	222.80
▲	SLAT65-01	3.35	227.45
★	SLAT67-01	1.83	230.67
⊙	SLAT67-01	3.35	229.15

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE A17

CLAYEY SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-01	6.40	224.50
⊠	C1-02	4.11	226.99
▲	C4-01	4.88	221.52
★	C4-02	6.40	220.10

Date August 2013
GWP# 83-00-00

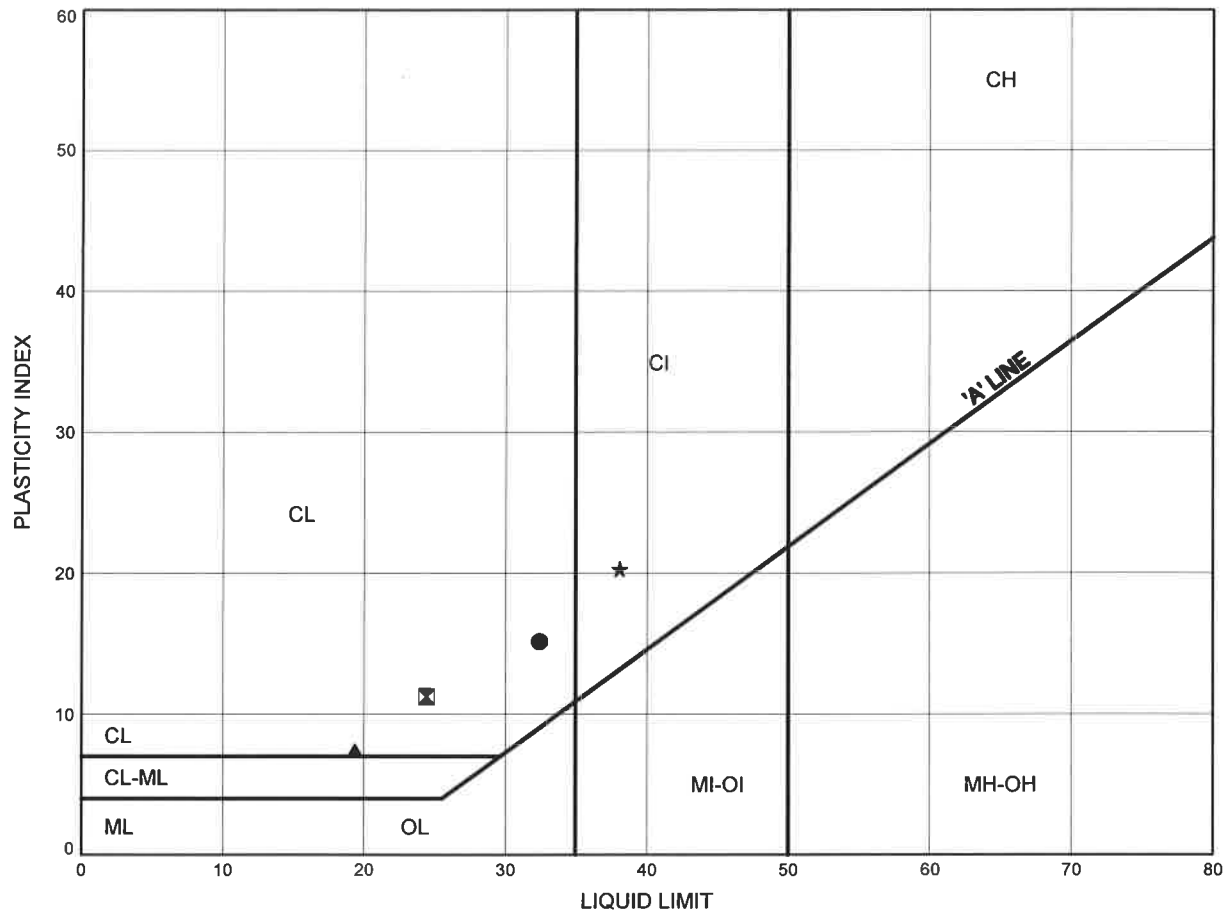


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Chkd. SKP

Hwy 400 Median Sewer
ATTERBERG LIMITS TEST RESULTS

FIGURE A18

SILTY CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SLAT47W-01	4.11	223.09
⊠	SLAT47W-01	6.40	220.80
▲	SLAT63W-01	12.50	216.60
★	SLAT83W-01	4.88	243.52

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

CONT No
GWP No 83-00-00
HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 11+600 TO 12+250)
BOREHOLE LOCATIONS AND SOIL STRATA








SHEET



KEYPLAN

LEGEND

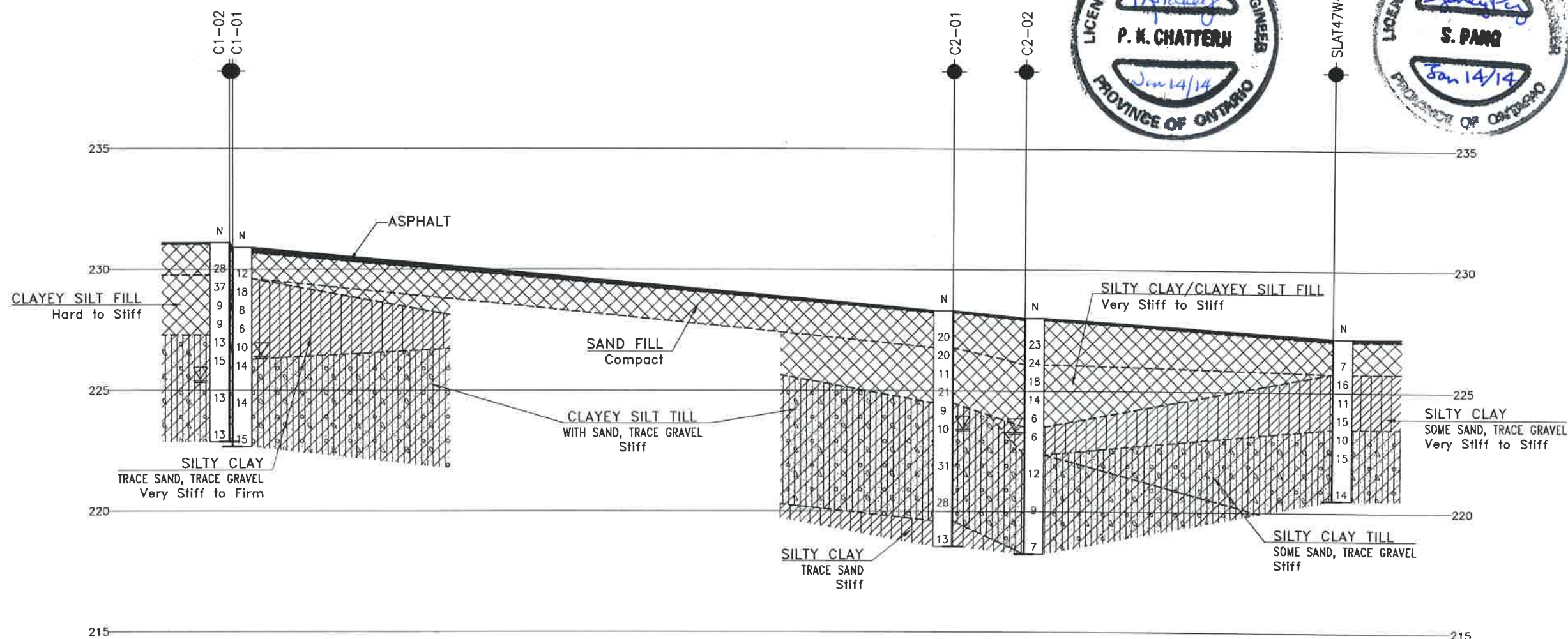
- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60' Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |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

NO	ELEVATION	NORTHING	EASTING
C1-01	230.9	4 880 121.4	295 461.4
C1-02	231.1	4 880 102.9	295 428.5
C2-01	228.3	4 880 436.0	295 262.4
C2-02	228.0	4 880 448.9	295 213.3
SLAT47W-01	227.2	4 880 589.8	295 138.7

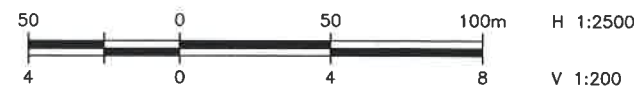
-NOTES-

- 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.

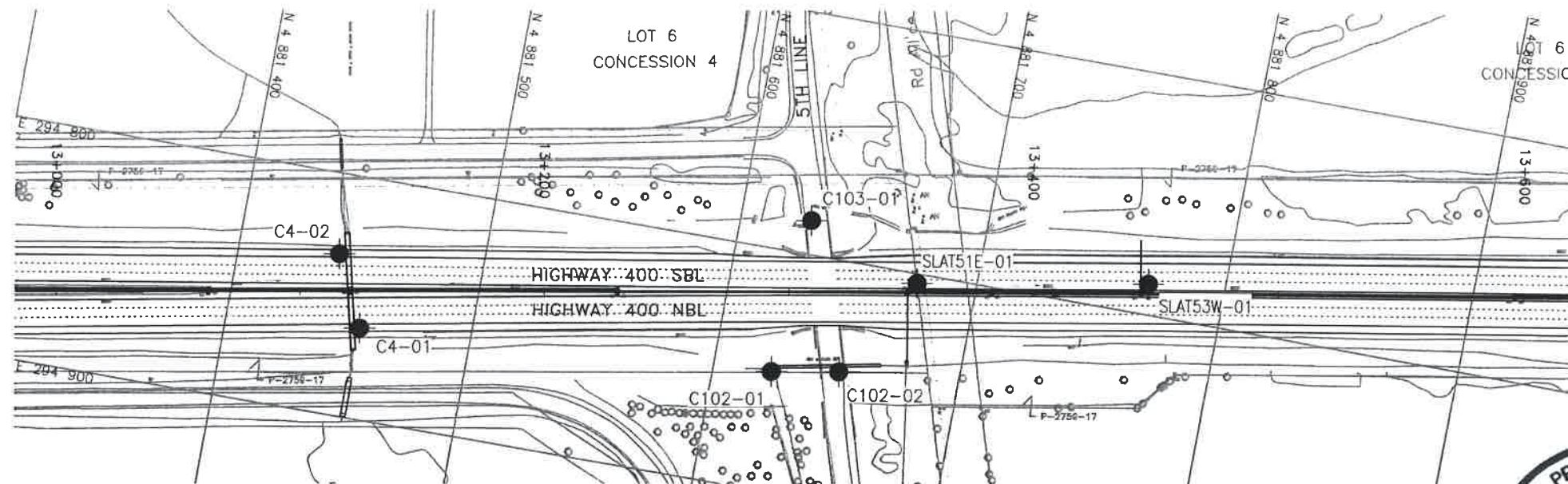
GEOCRES No. 31D-563



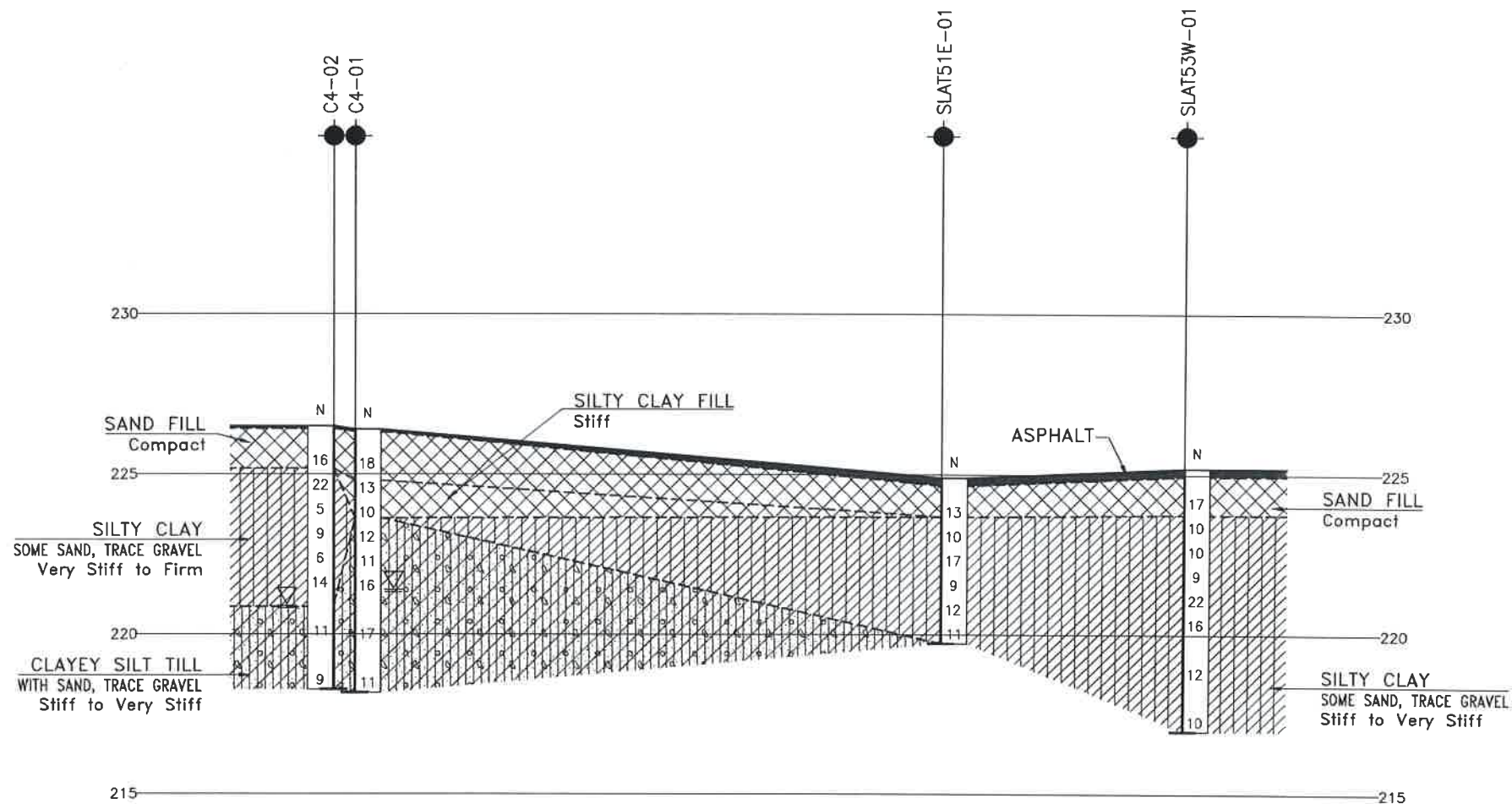
PROFILE ALONG C HWY. 400



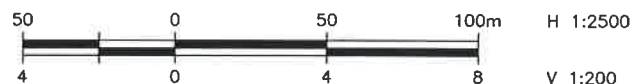
REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	SKP	CHK	SKP	CODE	LOAD	DATE		NOV. 2013	
DRAWN	AN	CHK	PKC	SITE	STRUCT	DWG	1		



PLAN



PROFILE ALONG ϕ HWY 400



METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

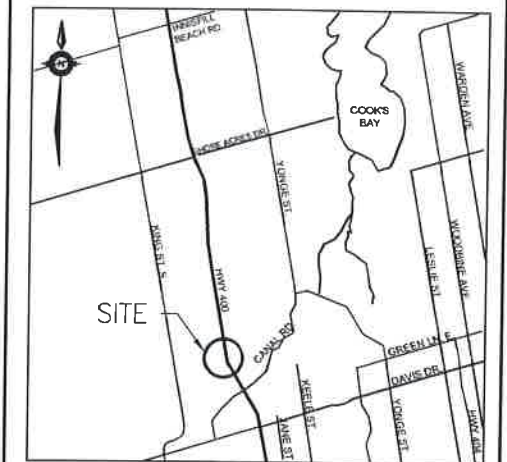
CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 13+000 TO 13+600)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

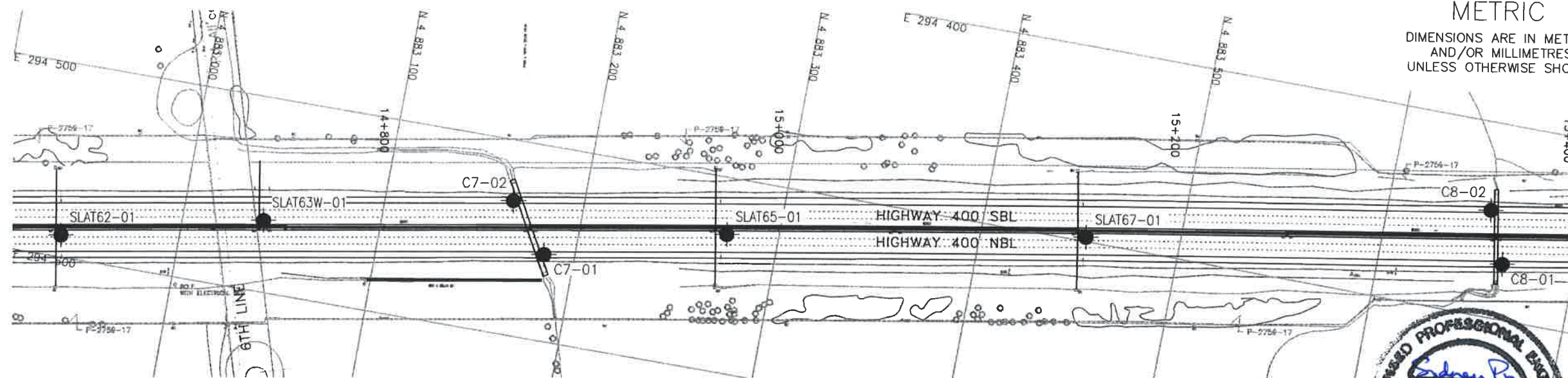
NO	ELEVATION	NORTHING	EASTING
C4-01	226.4	4 881 454.7	294 862.3
C4-02	226.5	4 881 441.1	294 833.3
SLAT51E-01	224.9	4 881 675.9	294 810.8
SLAT53W-01	225.2	4 881 768.9	294 787.2

NOTES-

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

GEOCRES No. 31D-563

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
CODE	LOAD	DATE	NOV. 2013
SITE	STRUCT	DWG	2



PLAN
SCALE 1:2500

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

CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 14+600 TO 15+400)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

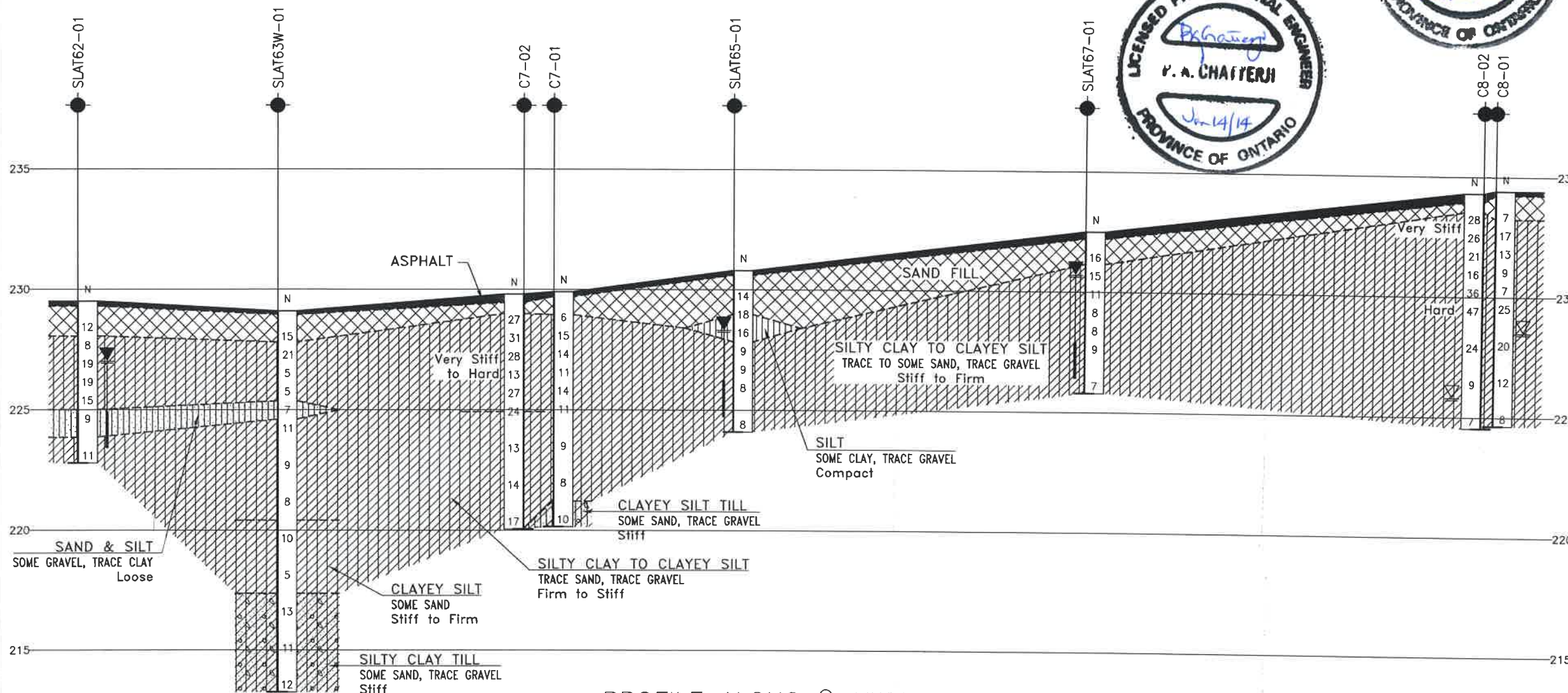
- ◆ Borehole (Current Investigation)
- ◊ Borehole (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
C7-01	229.9	4 883 184.5	294 555.7
C7-02	229.8	4 883 164.3	294 531.1
C8-01	234.4	4 883 663.2	294 471.6
C8-02	234.3	4 883 652.3	294 445.3
SLAT62-01	229.5	4 882 940.5	294 588.7
SLAT63W-01	229.1	4 883 041.0	294 563.2
SLAT65-01	230.8	4 883 273.8	294 529.1
SLAT67-01	232.5	4 883 452.7	294 497.7

-NOTES-

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

GEOCRIS No. 31D-563



PROFILE ALONG CL HWY. 400

SCALE 1:200
H 1:2500
V 1:200

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
CODE	LOAD	DATE	NOV. 2013
SITE	STRUCT	DWG	4

Appendix B

Sections 5, 6, 7, 8 and 9

(Stations 17+800 West Gwillimbury to 12+600 Innisfil)

RECORD OF BOREHOLE No C14-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 886 087 9 E 294 044 1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.12 - 2013.05.12 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
255.5 0.0	ASPHALT: (350mm)		1	AS			255							12 59 20 9
255.1 0.4	Gravelly SAND Brown Moist (FILL)		2	SS	19		254							
254.7 0.8	Silty SAND, trace clay Compact Brown Moist		3	SS	12		253							0 21 60 19
254.0 1.5	Clayey SILT, some sand Stiff Brown Moist		4	SS	9		252							Split spoon wet
251.8 3.7	Silty CLAY, trace sand, oxidation stains throughout Very Stiff Brown/Grey Moist		5	SS	13		251							0 7 65 28
			6	SS	24		250							
			7	SS	24		249							
248.8 6.7	END OF BOREHOLE AT 6.1m. BOREHOLE OPEN AND WATER LEVEL AT BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.		8	SS	22									

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RECORD OF BOREHOLE No C14-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 886 058.4 E 294 020.7 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 13 - 2013 05 13 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>W_P</div><div>W</div><div>W_L</div></div> <div>WATER CONTENT (%)</div>	UNIT WEIGHT <div>γ</div> kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								<div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>				
255.3								20 40 60 80 100	20 40 60			
0.0	ASPHALT: (350mm)											
254.9			1	AS			255			○		
0.4	Gravelly SAND, trace silt											
254.5	Brown											
0.8	Moist (FILL)		1	SS	34		254			○		
	Silty SAND, trace gravel, trace to some clay											
	Dense											
253.7	Brown											
1.6	Moist		2	SS	20		253			○		
	Clayey SILT, with sand											
	Very Stiff to Stiff											
	Brown											
	Moist		3	SS	10		252			○		
252.2												
3.1	Silty CLAY, some sand		4	SS	12		251			○		
	Stiff to very Stiff											
	Brown											
	Moist		5	SS	19		250			○		
			6	SS	16		249			○		
	Brown/Grey		7	SS	21							
248.6												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.7m AND WATER LEVEL AT 3.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.											

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RECORD OF BOREHOLE No SLAT18-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 886 540.9 E 293 952.2 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 07 - 2013 05 07 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
263.0	ASPHALT: (350mm)		1	AS			263						
262.6													
0.4	Gravelly SAND, trace silt Grey (FILL)												
262.2													
0.8	SAND, some silt, trace gravel Compact Brown Moist (FILL)		1	SS	29		262						7 82 11 (SI+CL)
261.5													
1.5	SILT, trace to some sand Compact Brown Moist (FILL)		2	SS	12		261						
			3	SS	13								
260.0							260						
3.0	SAND and SILT, some clay, trace gravel Loose to Compact Brown Moist		4	SS	7								6 52 30 12
			5	SS	11		259						Split spoon wet
			6	SS	12		258						
256.9							257						
6.1	Clayey SILT, some sand, trace gravel Stiff Brown Wet		7	SS	10								
256.3													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 5.5m WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CONCRETE AND CUTTINGS TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.												

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RECORD OF BOREHOLE No SLAT23W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 886 834.2 E 293 895.5 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.09 - 2013.05.09 CHECKED BY SKP

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		
270.5	ASPHALT: (350mm)													
0.0														
270.1			1	AS										7 90 3
0.4	SAND, trace gravel, trace silt Brown Moist (FILL)													(SI+CL)
269.7														
0.8														
	Silly SAND Compact Brown Moist		1	SS	13									
			2	SS	12									
268.2														
2.3	SAND and SILT, trace to some silt and clay Loose Brown Moist		3	SS	9									0 45 39 16
			4	SS	5									
			5	SS	7									
			6	SS	7									
264.9														
5.6	Compact													
			7	SS	22									Split spoon wet
263.8														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.													

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METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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						WATER CONTENT (%)		
278.0 0.0	ASPHALT: (325mm)	[Solid Black]	1	AS											
277.6 0.4	Gravelly SAND Brown Moist	[Cross-hatch]													
277.1 0.9	Sandy SILT , trace gravel, trace clay Dense Brown Moist	[Diagonal Lines /]	1	SS	33										
			2	SS	65								Gravel in split spoon		
275.8 2.2	Clayey SILT , with sand, trace gravel Very Stiff Brown Moist	[Horizontal Lines]	3	SS	25								1 48 33 18		
			4	SS	24										
			5	SS	17								1 42 37 20		
273.5 4.5	SAND and SILT , trace gravel, trace clay Loose to Compact Brown Moist	[Vertical Dashed]	6	SS	7										
271.3 6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 6.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.		7	SS	28								Split spoon wet 6 52 32 10		

+ 3 × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No C17-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 887 194.1 E 293 820.1 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 13 - 2013 05 13 CHECKED BY SKP

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			WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
								20 40 60 80 100			20 40 60							
278.2																		
0.0	ASPHALT: (300mm)																	
277.9			1	AS			278											
0.3	Gravelly SAND Brown Moist (FILL)																	
277.3																		
0.9	SAND and SILT, some clay, trace gravel Dense to Compact Brown Moist		1	SS	35		277											
			2	SS	20											5	49 33 13	
			3	SS	24		276											
275.2																		
3.0	Gravelly, trace clay		4	SS	19		275									33	37 22 8	
274.5																		
3.7			5	SS	30		274									No sample recovery		
			6	SS	14													
							273											
			7	SS	11		272									4	51 32 13	
271.5																		
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 5.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.																	

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RECORD OF BOREHOLE No SLAT30W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 887 412.1 E 293 792.8 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.09 - 2013.05.09 CHECKED BY SKP

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		
279.8														
0.0	ASPHALT: (325mm)		1	AS										33 63 4 (SI+CL)
279.4														
0.4	SAND and GRAVEL, trace silt Moist (FILL)													
278.9														
0.9	Clayey SILT, trace sand Firm Brown Moist		1	SS	7									
278.3														
1.5	Silty CLAY, trace gravel Stiff to Very Stiff Brown Moist		2	SS	14									
			3	SS	17									
276.7														
3.1	Clayey SILT, trace sand, oxidation Very Stiff to Hard Brown Moist		4	SS	17									
			5	SS	21									
			6	SS	32									Split spoon wet
273.1	Auger head disconnected and left at bottom of hole (retrieval attempts unsuccessful)													
6.7	END OF BOREHOLE AT 6.8m. BOREHOLE OPEN TO BOTTOM WITH WATER AT BOTTOM UPON COMPLETION BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS TO 1.5m THEN ASPHALT COLD PATCH TO SURFACE.													

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RECORD OF BOREHOLE No SLAT31E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 887 531.1 E 293 777.5 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 07 - 2013 05 07 CHECKED BY SKP

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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w _P w w _L				
280.8							20 40 60 80 100							
0.0	ASPHALT: (350mm)		1	AS										
280.4														
0.4	SAND, trace silt, trace gravel Brown Moist (FILL)		1	SS	17		280							5 88 7 (SI+CL)
279.8														
1.0	SAND and SILT, some clay, trace gravel Compact Brown Moist		2	SS	19		279							
			3	SS	19		278							4 52 31 13
			4	SS	20		277							
			5	SS	18		276							
			6	SS	21		275							
			7	SS	10									Split spoon wet
274.1														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CONCRETE AND CUTTINGS TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.													

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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
281.7							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)				GR SA SI CL				
							20	40	60	80	100				20	40	60

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			20 40 60	GR SA SI CL
								SHEAR STRENGTH kPa	WATER CONTENT (%)						
								○ UNCONFINED + FIELD VANE							
								● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100	20 40 60						
281.7 0.0	ASPHALT: (375mm)		1	AS									15 80 5 (SI+CL)		
281.3 0.4	SAND, some gravel, trace silt Brown Moist														
280.9 0.8	(FILL) SILT, trace to some sand, trace gravel Compact Brown Moist		1	SS	20										
280.1 1.6	Clayey SILT, with sand, trace gravel Hard Brown Moist (TILL)		2	SS	37								2 51 28 19		
	Inferred cobbles or boulders		3	SS	50										
			4	SS	80										
277.9 3.8	Sandy SILT, trace clay, trace gravel Very Dense Brown Moist (TILL)		5	SS	71										
			6	SS	38										
275.0 6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CONCRETE AND CUTTINGS TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.		7	SS	81										

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+ 3 × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SLAT59-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 889 951.1 E 293 410.9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
308.1												
0.0	ASPHALT: (200mm)											
0.2	SAND, some gravel Brown Moist (FILL) Dense		1	AS			308					
			1	SS	34		307					
306.7												
1.4	Silty SAND, trace gravel Very Dense Brown Moist (TILL)		2	SS	65		306					
			3	SS	100							
	Some gravel Wet		4	SS	50/ 0.100		305					Spill spoon wet
							304					
303.3			5	SS	50/ 0.100							
4.8	END OF BOREHOLE AT 4.8m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTING MIXED WITH HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.											

RECORD OF BOREHOLE No SLAT64-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 890 134 8 E 293 396.4 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100		
303.9												
0.0	ASPHALT: (150mm)											
0.2	SAND, some gravel Brown Moist (FILL) Compact		1	AS								
			1	SS	23		303					
			2	SS	17		302					
301.7												
2.2	Sandy SILT, trace gravel Dense to Very Dense Grey Moist (TILL)		3	SS	100/ 0.275		301					
			4	SS	43							
			5	SS	50/ 0.125		300					
			6	SS	86/ 0.100		299					
							298					
297.6			7	SS	50/ 0.050							
6.3	END OF BOREHOLE AT 6.3m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTING MIXED WITH BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.											

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RECORD OF BOREHOLE No SLAT68-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 890 297.6 E 293 394.1 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY SKP

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 (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
299.1							20 40 60 80 100							
0.0	ASPHALT: (150mm)													
0.2	SAND, trace silt Compact Grey Moist (FILL)		1	AS			299							
			1	SS	17		298							
297.7														
1.4	Gravelly SAND, trace to some silt Dense Brown Moist (FILL)		2	SS	45		297							29 59 12 (SI+CL)
296.9														Resistance to augering
2.2	Silty SAND, trace gravel, trace to some clay Dense to Very Dense Grey Wet (TILL)		3	SS	38		296							2 59 29 10 Split spoon wet
			4	SS	100/ 0.175		295							
			5	SS	100/ 0.275									2 63 25 10
			6	SS	105									
294.1														
5.0	END OF BOREHOLE AT 5.0m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTING MIXED WITH HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.													

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RECORD OF BOREHOLE No SLAT72-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 890 470.4 E 293 385.1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY SKP

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								
								20	40	60	80					
294.0																
0.0	ASPHALT: (450mm)		1	AS												
293.5																
0.5	Gravelly SAND Brown															20 76 4 (SI+CL)
293.1	Moist (FILL)		1	SS	32											
0.9	SILT, some sand, some clay, occasional oxidation stains Very Dense Brown Moist (TILL)		2	SS	69											0 13 76 11
			3	SS	91											
			4	SS	99/ 0.280											0 21 68 11
			5	SS	94											
289.6																
4.4	END OF BOREHOLE AT 4.4m BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS, CONCRETE AND COLD PATCH TO GROUND SURFACE.															

RECORD OF BOREHOLE No NLAT51E-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 896 966.1 E 291 992.3 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.26 - 2013.05.26 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT		
231.4							20 40 60 80 100					
0.0	ASPHALT: (350mm)		1	AS								
231.0												
0.4	SAND, some gravel, some silt and clay Compact Brown Moist (FILL)		1	SS	19							10 75 15 (SI+CL)
229.9												
1.5	Silly CLAY, with sand Firm to Stiff Brown Moist		2	SS	5							0 31 39 30
			3	SS	8							
			4	SS	10							Split spoon wet
227.7	Wet											
3.7	Very Stiff		5	SS	26							0 4 52 44
			6	SS	24							
			7	SS	18							
			8	SS	16							
			9	SS	25							
221.6												
9.8	END OF BOREHOLE AT 9.8m											

Continued Next Page

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

RECORD OF BOREHOLE No NLAT51E-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 896 966 1 E 291 992 3 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.26 - 2013.05.26 CHECKED BY SKP

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							
	Continued From Previous Page							20 40 60 80 100							
	BOREHOLE OPEN TO 9.1m AND WATER LEVEL AT 8.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT COLD PATCH TO SURFACE.														

RECORD OF BOREHOLE No NLAT07E-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 897 294 2 E 291 930 3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.27 - 2013.05.27 CHECKED BY SKP

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	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
233.0							233					
0.0	ASPHALT: (200mm)											
0.2	SAND, some to trace gravel, trace silt Compact Brown Moist (FILL)		1	AS								
			1	SS	18		232					8 84 8 (SI+CL)
231.3												
1.7	Silty SAND, trace clay, trace gravel Loose Brown to Grey Moist (FILL)		2	SS	7		231					
230.7												
2.3	Clayey SILT, with sand, some organics, roots and rootlets Firm Dark Brown Moist		3	SS	6							0 35 48 17
230.1							230					Split spoon wet
2.9	SAND and SILT, trace gravel, trace clay Loose to Compact Grey Moist		4	SS	6							
			5	SS	9		229					8 36 47 9
			6	SS	19		228					
227.4												
5.6	Sandy SILT, some clay Compact to Very Dense Grey Wet to Moist		7	SS	11		227					
							226					
			8	SS	39		225					
							224					
			9	SS	53							
223.2												
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

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

RECORD OF BOREHOLE No NLAT07E-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 897 294.2 E 291 930.3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.27 - 2013.05.27 CHECKED BY SKP

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			<div><div>20406080100</div><div>SHEAR STRENGTH kPa</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>							<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>w_P</div><div>w</div><div>w_L</div></div>
								WATER CONTENT (%) <div>204060</div>							
	Continued From Previous Page														
	BOREHOLE OPEN TO 6.4m AND WATER LEVEL AT 3.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.9m, CEMENT TO 0.2m, ASPHALT TO SURFACE.														

RECORD OF BOREHOLE No NLAT06-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 897 402.2 E 291 909.6 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.27 - 2013.05.27 CHECKED BY SKP

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							WATER CONTENT (%)		
								<div><div></div><div></div><div></div><div></div><div></div></div> <div>20406080100</div> <div>20406080100</div>							<div><div></div><div></div><div></div></div> <div>W_PW W_L</div> <div>204060</div>		
234.5																	
0.0	ASPHALT: (215mm)																
0.2	SAND and GRAVEL, trace to some silt Compact Brown Moist (FILL)		1	AS			234							33 55 12 (SI+CL)			
			1	SS	22												
233.0							233										
1.5	Silty SAND, some clay, trace gravel Dense Brown Moist (TILL)		2	SS	34									3 60 21 16			
			3	SS	42		232										
231.5																	
3.0	Compact Grey		4	SS	28		231							2 58 24 16			
230.8																	
3.7	Very Dense		5	SS	67		230										
			6	SS	50												
							229										
	Moist		7	SS	69		228										
227.8																	
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m, ASPHALT TO SURFACE.																

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No C47-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 897 526 4 E 291 897 1 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.31 - 2013.05.31 CHECKED BY SKP

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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%) w _p w w _L		
236.8							20	40	60	80	100				GR	SA	SI	CL
0.0	ASPHALT: (200mm)																	
0.2	Gravelly SAND, trace silt Brown Moist (FILL)		1	AS														
236.0																		
0.8	Sandy SILT, some clay, trace gravel Compact Brown Moist		1	SS	18													
235.3																		
1.5	Silty SAND, trace gravel, trace clay Compact Brown Moist		2	SS	18												4	71 25 (SI+CL)
234.5																		
2.3	Clayey SILT, trace sand, organic staining Firm Brown Moist		3	SS	5													
233.7																		
3.1	Silty CLAY, some sand, trace gravel Stiff Brown/Grey Moist		4	SS	15												2	16 31 51 Split spoon wet
			5	SS	10													
232.2																		
4.6	Clayey SILT, trace sand, trace gravel Very Stiff Brown Moist (TILL)		6	SS	16													
230.7																		
6.1	Silty SAND, some clay, trace gravel Compact Brown Moist to Wet (TILL)		7	SS	15												2	60 24 14
			8	SS	22													
228.6																		
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 7.6m AND WATER LEVEL AT 4.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE																	

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

RECORD OF BOREHOLE No C47-02

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 897 512.7 E 291 871.2 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.31 - 2013.05.31 CHECKED BY SKP

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					
236.6								20 40 60 80 100					
0.0	ASPHALT: (200mm)												
0.2	SAND, some gravel Compact Brown Moist (FILL)		1	AS			236						
235.6													
1.0	Silty SAND, some clay, trace gravel Compact to Loose Brown Moist (FILL)		1	SS	13		235						6 57 24 13
			2	SS	13								
			4	SS	6		234						Split spoon wet
233.6													
3.0	SAND and SILT, some clay, trace gravel Compact Dark Grey to Grey Moist to Wet Sand layer from 3.5m to 3.9m		5	SS	11		233						
			6	SS	8								4 44 41 11
			7	SS	11		232						
231.0													
5.6	Silty SAND, trace gravel, trace clay Compact Grey Moist (TILL)		8	SS	19		231						
							230						
			9	SS	25		229						
							228						
226.8			10	SS	26		227						3 59 29 9
9.8	END OF BOREHOLE AT 9.8m												

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C47-02

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 897 512.7 E 291 871.2 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.31 - 2013.05.31 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page							20 40 60 80 100		20 40 60					
	BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 3.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.4m, CUTTINGS TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.														

RECORD OF BOREHOLE No NLAT11E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 897 661.1 E 291 860.2 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.27 - 2013.05.27 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
239.1													
0.0	ASPHALT: (200mm)						239						
0.2	SAND, some to trace gravel, trace to some silt Compact Brown Moist (FILL)		1	AS									
			1	SS	20		238						5 84 11 (SI+CL)
237.7													
1.4	SAND and SILT, some clay, trace gravel Compact Brown Moist (FILL)		2	SS	17		237						8 48 30 14
236.5			3	SS	10								
2.6	Silty CLAY, with sand, trace organics, trace rootlets Firm to Very Stiff Dark Brown Moist to Wet		4	SS	6		236						0 28 39 33
			5	SS	17		235						
234.6													
4.5	Sandy SILT, some clay, trace gravel Dense Brown Moist		6	SS	33		234						
233.5													
5.6	Sandy SILT, trace gravel Very Dense to Dense Grey Moist (TILL)		7	SS	93/ 0.275		233						
							232						
			8	SS	34								
230.9							231						
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 6.9m AND WATER LEVEL AT 3.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.7m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No NLAT20E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 897 805.8 E 291 833.6 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.27 - 2013.05.27 CHECKED BY SKP

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		
241.8								SHEAR STRENGTH kPa						
0.0	ASPHALT: (190mm)							○ UNCONFINED + FIELD VANE						
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS			241							40 53 7 (SI+CL)
240.5			1	SS	20									
1.3	Silty SAND, trace to some clay, trace gravel Loose Brown to Dark Grey Wet (FILL)		2	SS	7		240							1 61 28 10
239.1			3	SS	6									
2.7	Silty CLAY, some sand Firm Brown to Grey Moist to Wet		4	SS	7		239							Split spoon wet
238.1			5	SS	10		238							
3.7	Occasional sand seams Stiff		6	SS	12		237							0 17 49 34
236.2			7	SS	6		236							
5.6	Firm													
235.1														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 2.7m UPON COMPLETION BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.													

ONTM14S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No NLAT18W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 897 945.2 E 291 800.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.28 - 2013.05.28 CHECKED BY SKP

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
244.2	ASPHALT: (200mm)											
0.0												
0.2	Gravelly SAND, trace silt Compact Brown Moist (FILL)		1	AS			244					28 64 8 (SI+CL)
			1	SS	18							
							243					
	Trace silt		2	SS	24							
							242					Split spoon wet
			3	SS	37							
241.0							241					40 51 9 (SI+CL)
3.2	SAND and GRAVEL, trace silt Compact Brown Wet		4	SS	29							
240.0			5	SS	33		240					
4.2	Sandy SILT, trace gravel Compact Brown Moist											
239.6												
4.6												
239.2	SAND, some silt, trace gravel Loose Brown Wet		6	SS	4		239					
5.0												
	Clayey SILT, some sand Firm Grey Wet											
238.1							238					
6.1	Silty SAND, trace gravel, trace clay Compact Grey Saturated		7	SS	12							
237.5												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 4.2m AND WATER LEVEL AT 2.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m, ASPHALT TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/7/13

RECORD OF BOREHOLE No NLAT15-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 898 089 1 E 291 780 0 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 27 - 2013 05 27 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				GR	SA	SI	CL
246.8								20 40 60 80 100									
0.0	ASPHALT: (200mm)																
0.2	SAND, some to trace gravel, trace to some silt Compact Brown Moist (FILL)		1	AS			246								10	77	13 (SI+CL)
245.2			1	SS	23												
1.6	Silty SAND, some clay, trace gravel Compact to Dense Brown to Grey Moist Occasional inferred cobble		2	SS	18		245										
			3	SS	24		244								2	60	23 15
	Occasional black sand pockets		4	SS	40		243										
			5	SS	33		242								3	57	25 15
	Grey																
			6	SS	26		241										Split spoon wet
	Very Dense		7	SS	52												
240.1																	
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.2m, CUTTINGS TO 1.8m, CEMENT TO 0.2m, ASPHALT TO SURFACE																

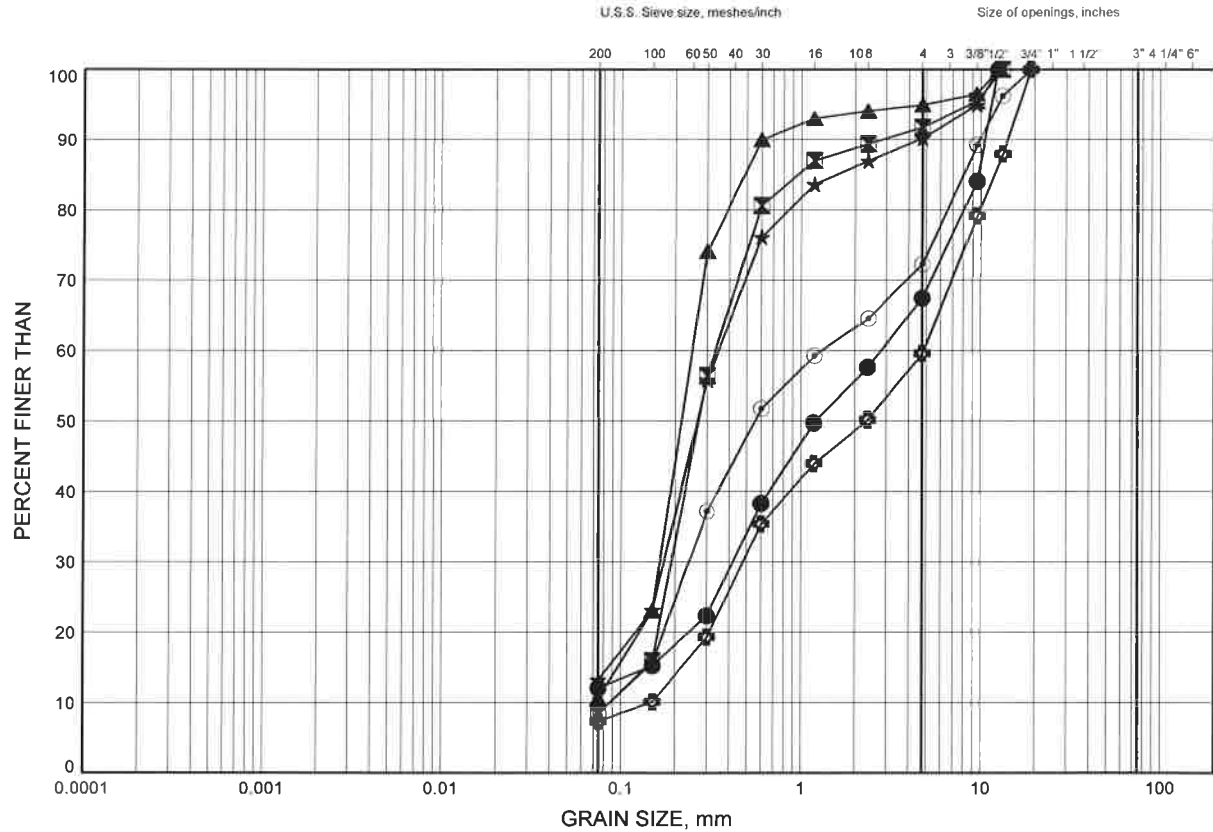
ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/26/13

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

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND/GRAVELLY SAND/SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT06-01	0.38	234.12
⊠	NLAT07E-01	1.07	231.93
▲	NLAT11E-01	1.07	238.03
★	NLAT15-01	1.07	245.73
⊙	NLAT18W-01	0.38	243.82
⊕	NLAT20E-01	0.38	241.42

Date August 2013
GWP# 83-00-00

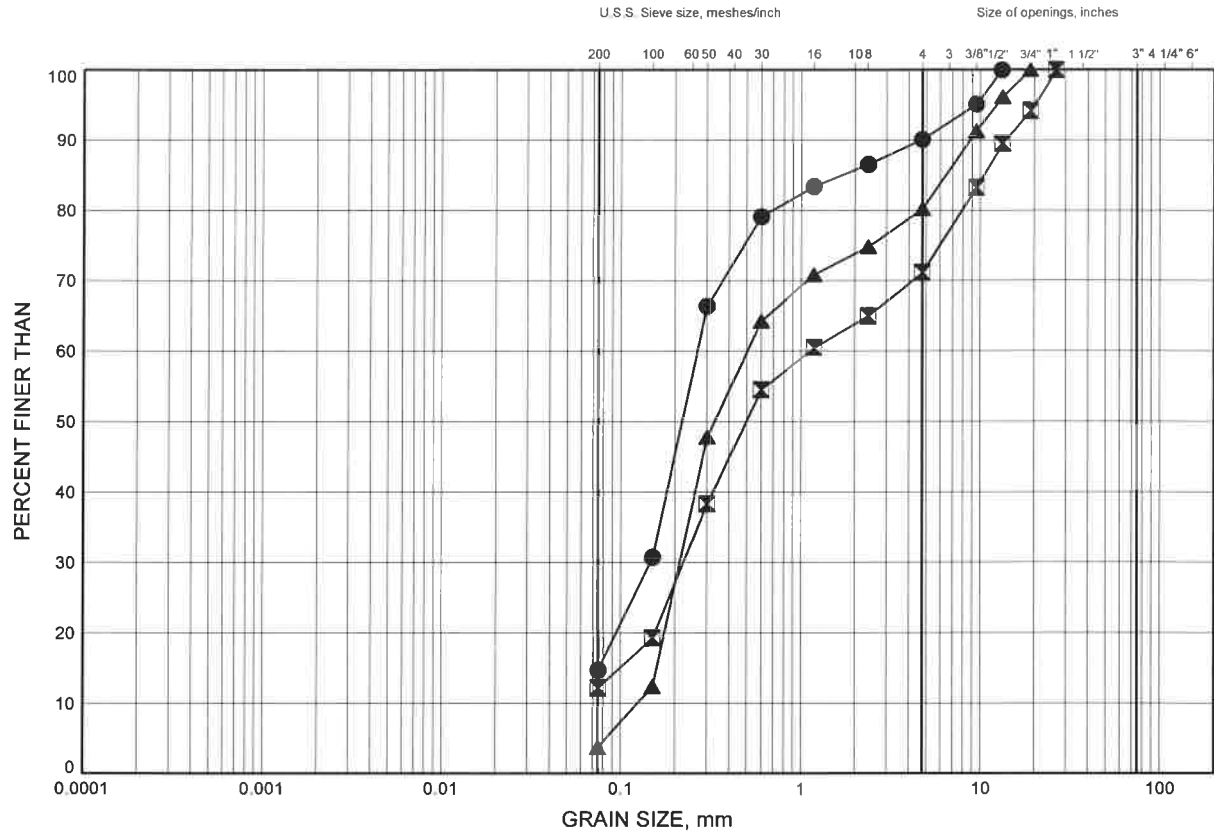


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND/GRAVELLY SAND/SAND & GRAVEL FILL



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

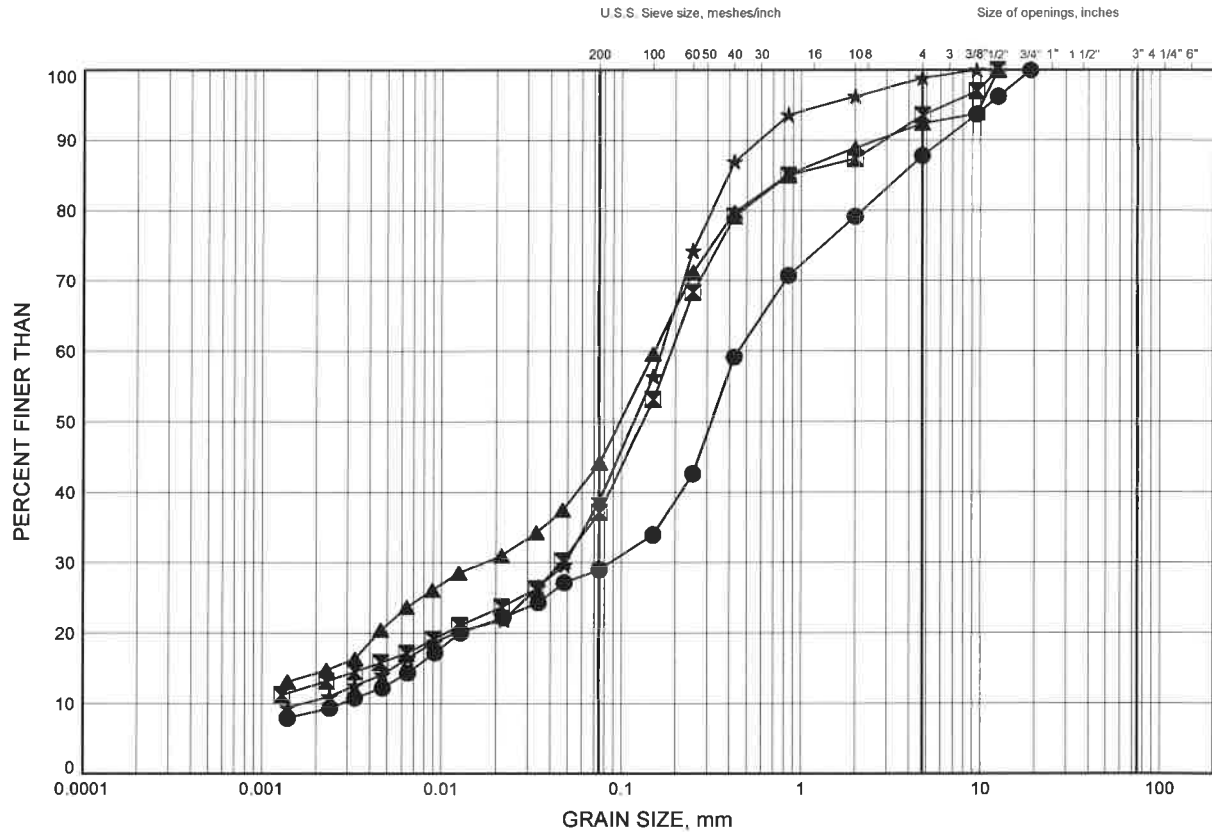
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT51E-01	1.07	230.33
⊠	SLAT68-01	1.79	297.31
▲	SLAT72-01	0.46	293.54

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY SAND/SAND & SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C14-01	0.30	255.20
⊠	C47-02	1.07	235.53
▲	NLAT11E-01	1.83	237.27
★	NLAT20E-01	1.83	239.97

Date August 2013

GWP# 83-00-00



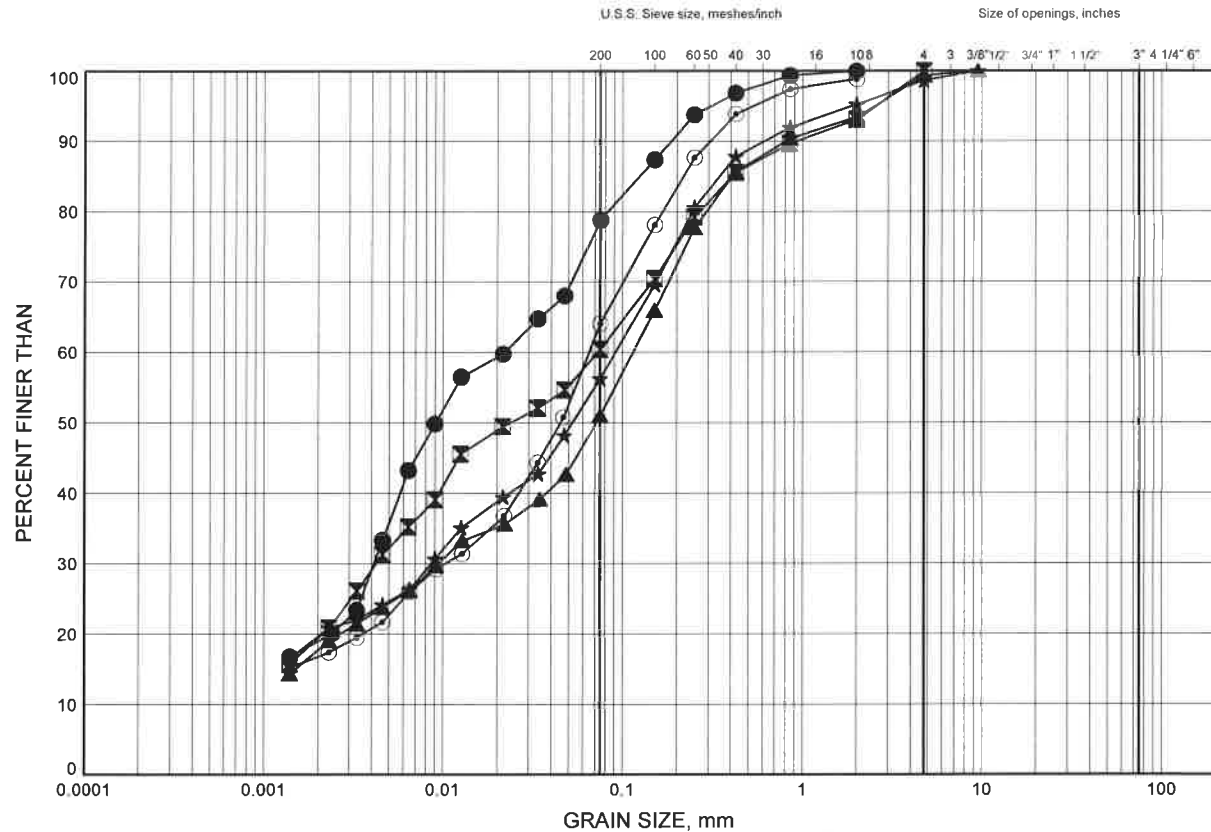
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B4

CLAYEY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C14-01	2.59	252.91
⊠	C14-02	1.83	253.47
▲	C17-01	2.59	275.41
★	C17-01	4.11	273.89
⊙	NLAT07E-01	2.59	230.41

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/13/13

Date August 2013
GWP# 83-00-00

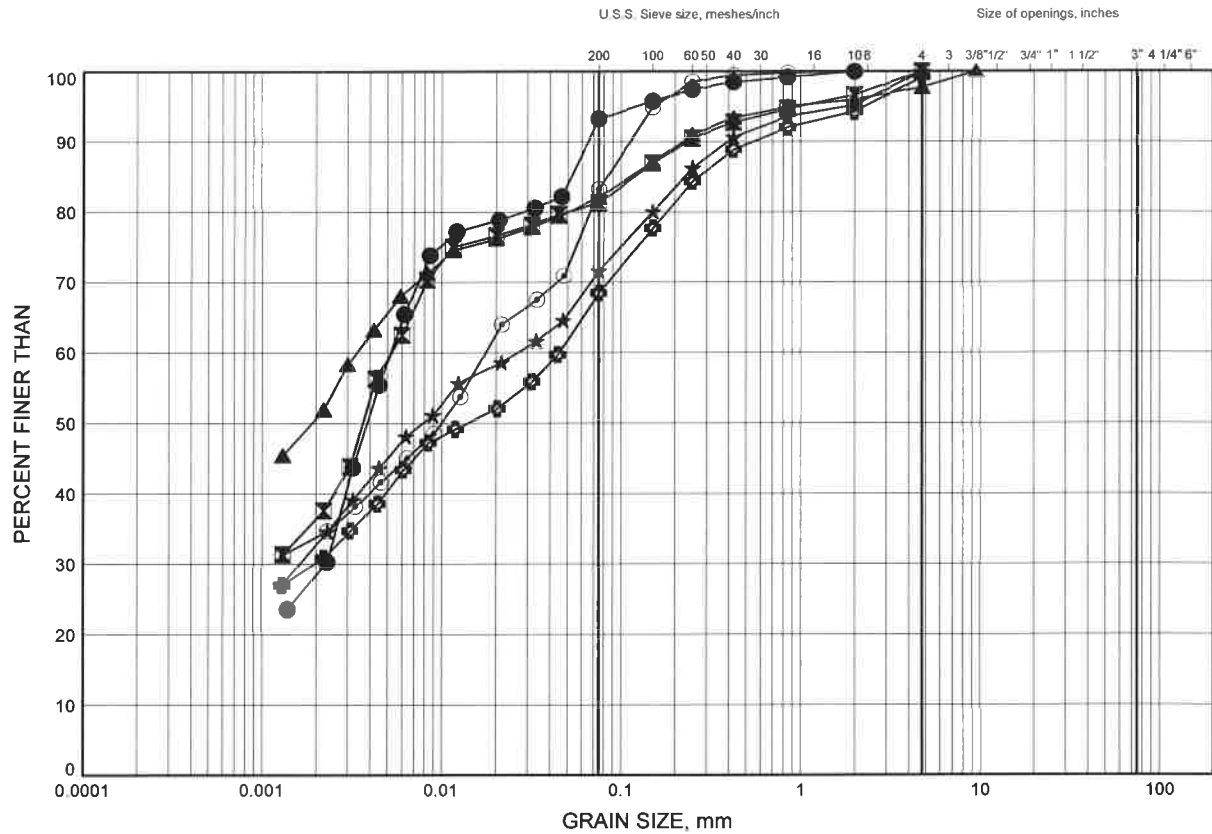


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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C14-01	4.11	251.39
⊠	C14-02	4.88	250.42
▲	C47-01	3.35	233.45
★	NLAT11E-01	3.35	235.75
⊙	NLAT20E-01	4.11	237.69
⊕	NLAT51E-01	1.83	229.57

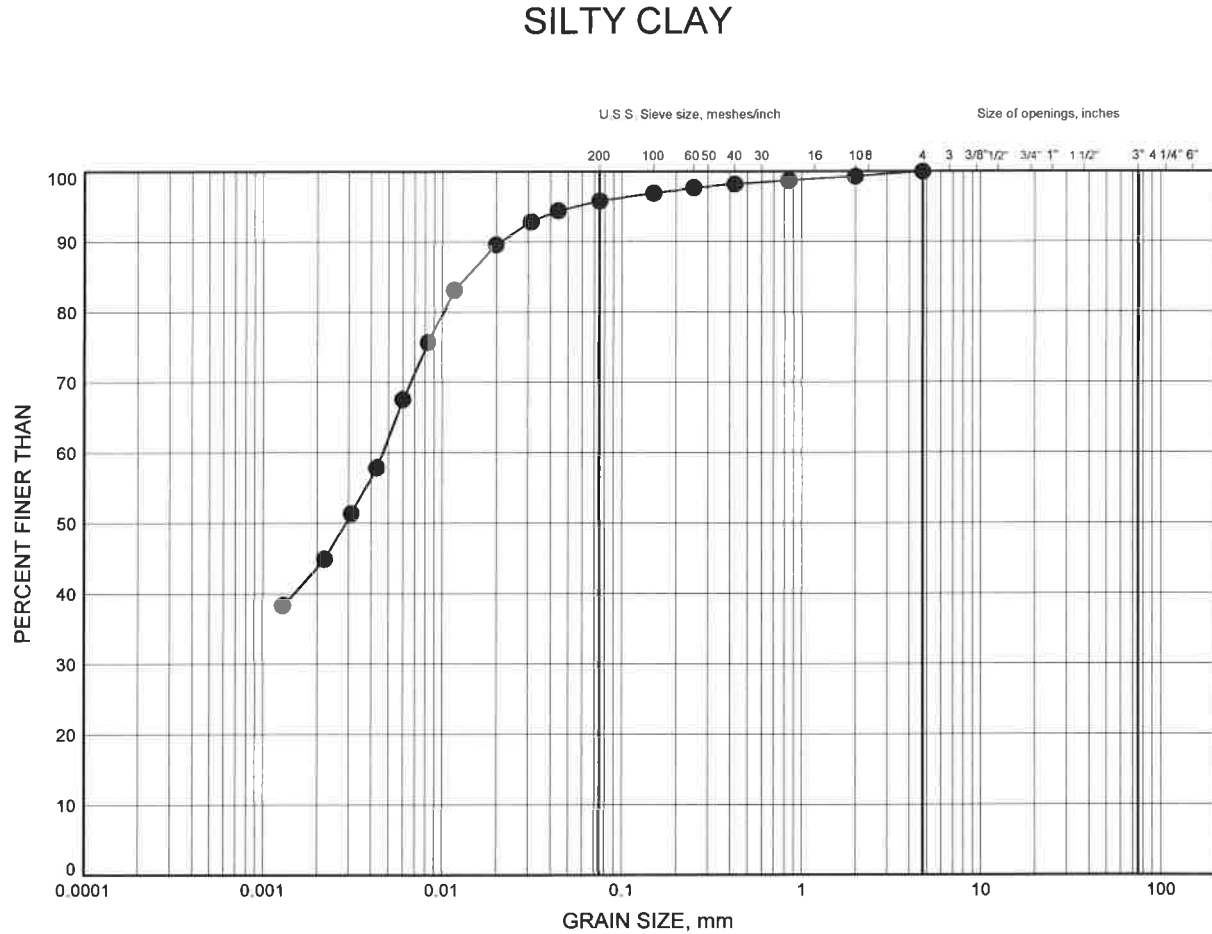
Date August 2013
GWP# 83-00-00



Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B6



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

LEGEND

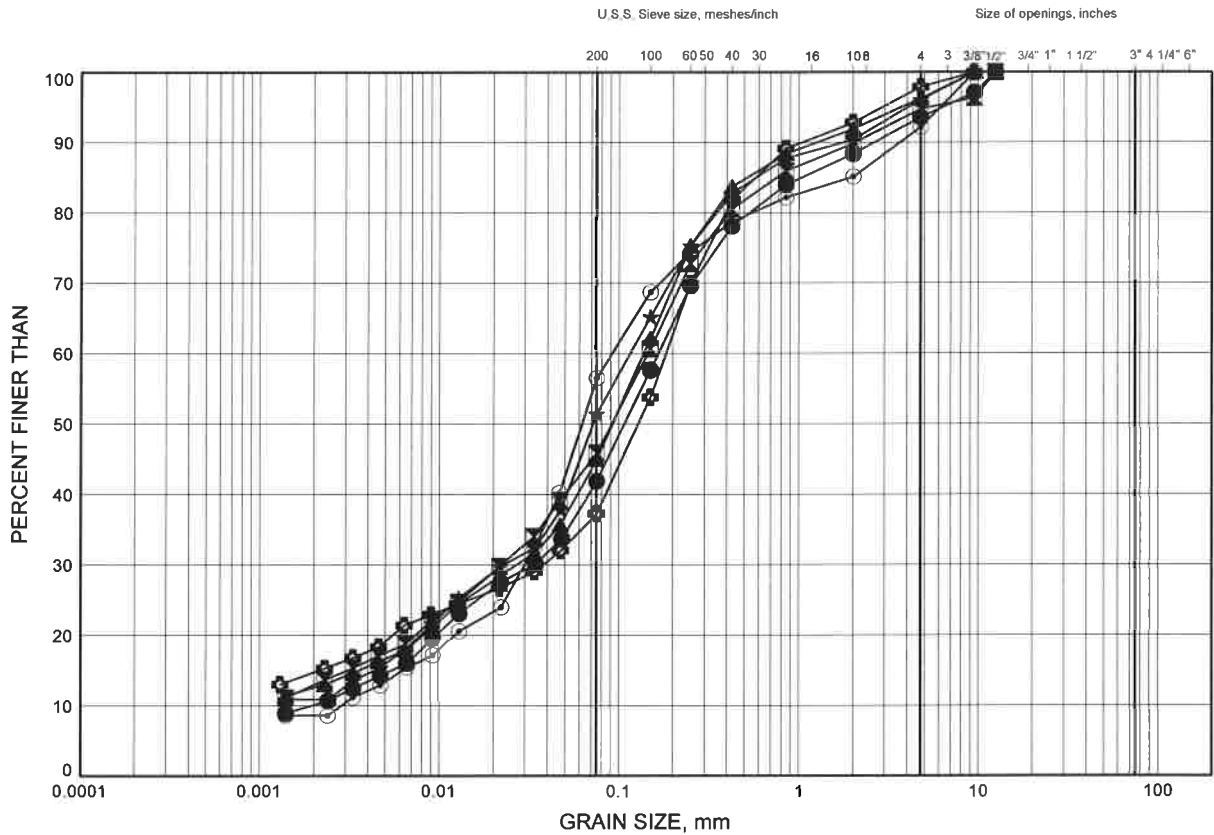
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT51E-01	4.11	227.29

Hwy 400 Median Sewer

GRAIN SIZE DISTRIBUTION

FIGURE B7

SAND & SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C17-01	6.40	271.60
⊠	C17-02	1.83	276.37
▲	C17-02	6.40	271.80
★	C47-02	4.11	232.49
⊙	NLAT07E-01	4.11	228.89
⊕	NLAT15-01	2.59	244.21

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/26/13

Date August 2013
GWP# 83-00-00

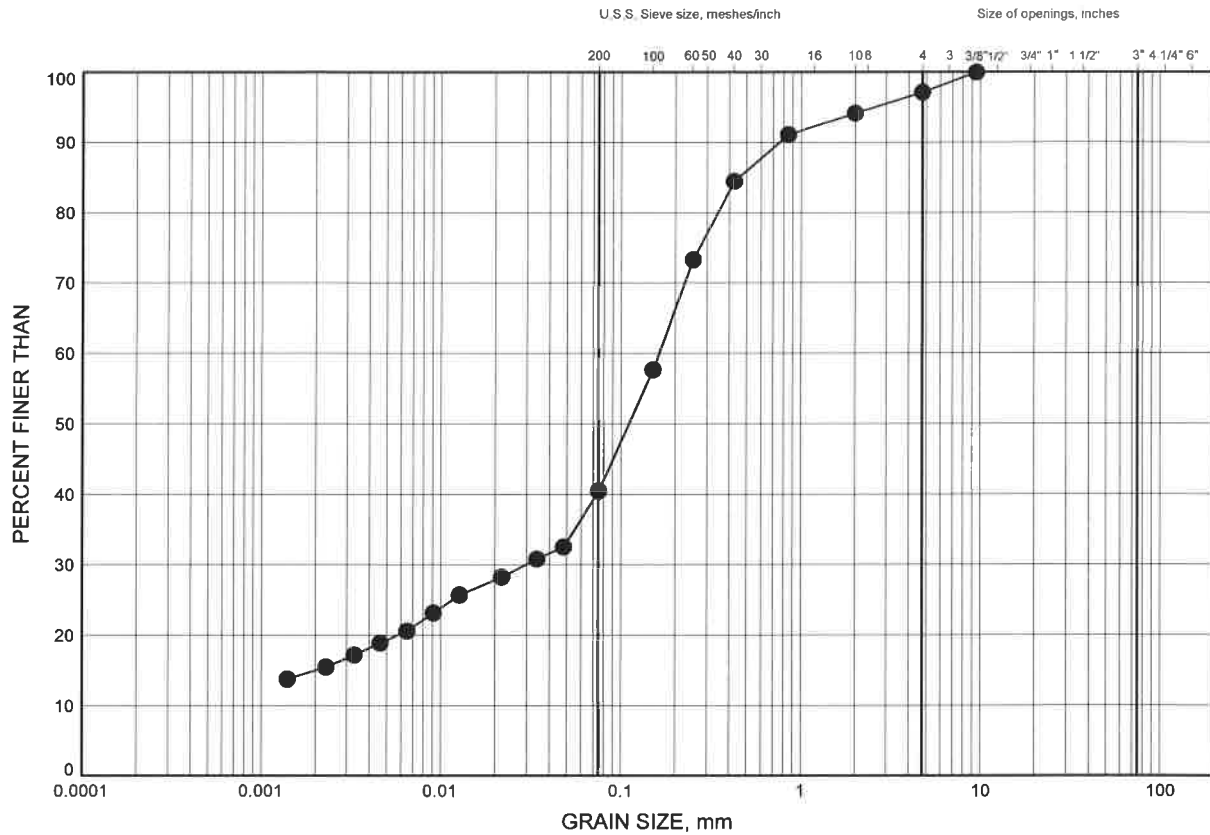


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B8

SAND & SILT



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

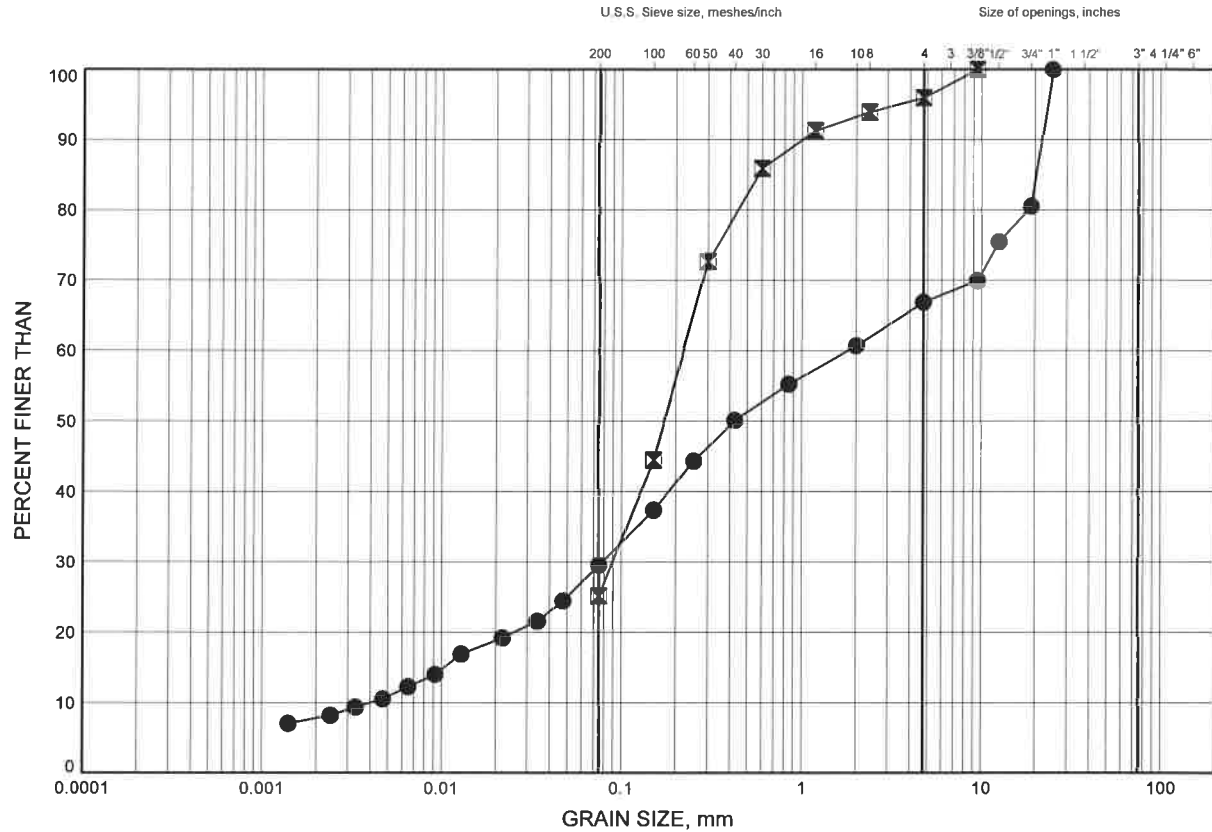
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT15-01	4.11	242.69

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B9

SILTY SAND



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

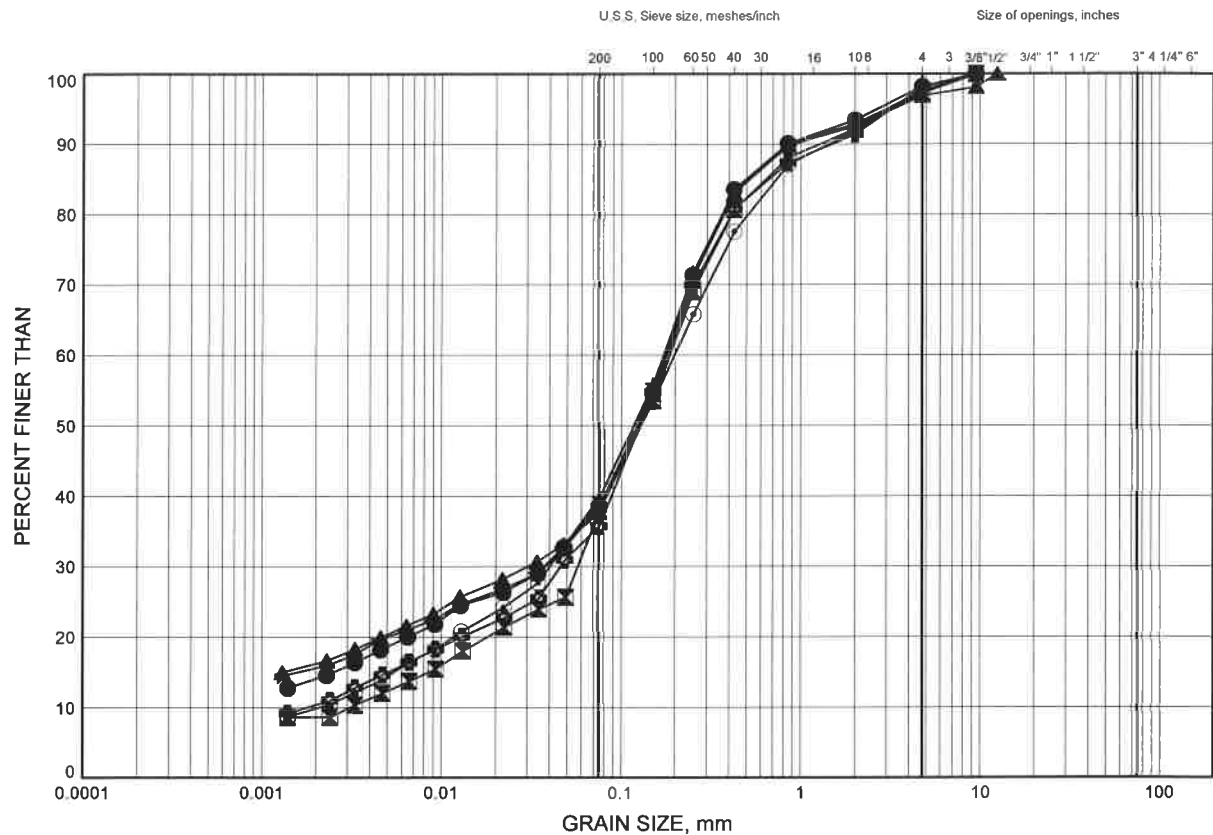
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C17-02	3.35	274.85
☒	C47-01	1.83	234.97

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B10

SANDY SILT to SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C47-01	6.40	230.40
⊠	C47-02	9.45	227.15
▲	NLAT06-01	1.83	232.67
★	NLAT06-01	3.35	231.15
⊙	SLAT68-01	2.51	296.59
⊕	SLAT68-01	4.11	294.99

Date August 2013

GWP# 83-00-00



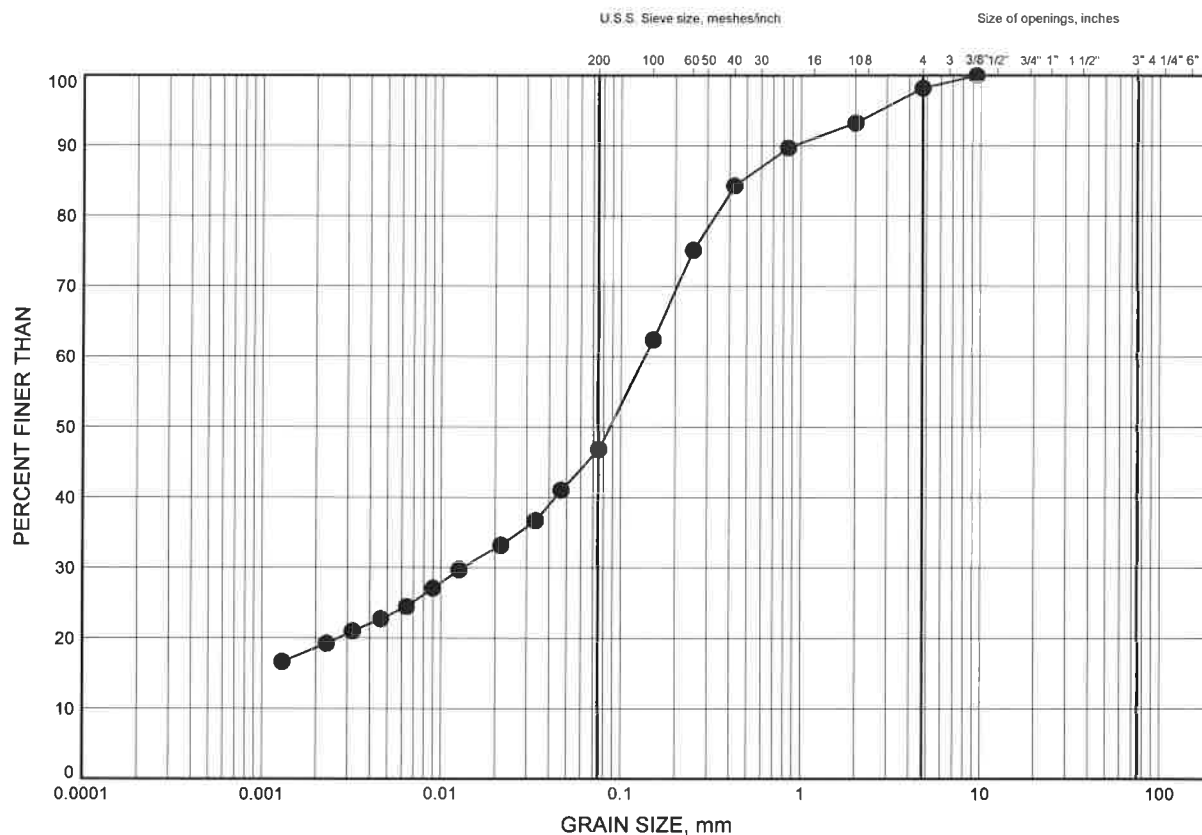
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE B11

CLAYEY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SLAT32E-01	1.83	279.87

Date August 2013
GWP# 83-00-00

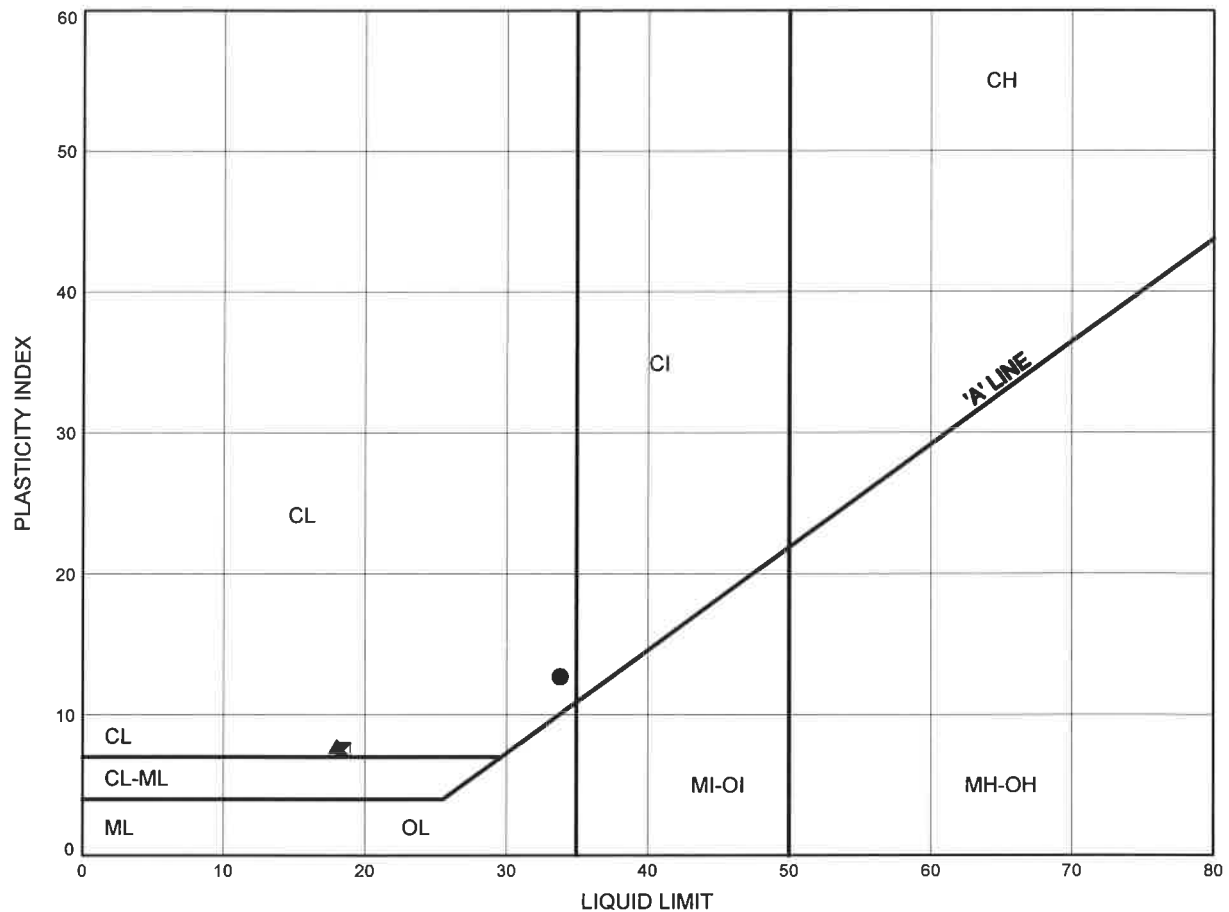


Prep'd AN
Chkd SKP

Hwy 400 Median Sewer
ATTERBERG LIMITS TEST RESULTS

FIGURE B12

CLAYEY SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C14-01	2.59	252.91
⊠	C14-02	1.83	253.47
▲	C17-01	2.59	275.41

Date August 2013

GWP# 83-00-00



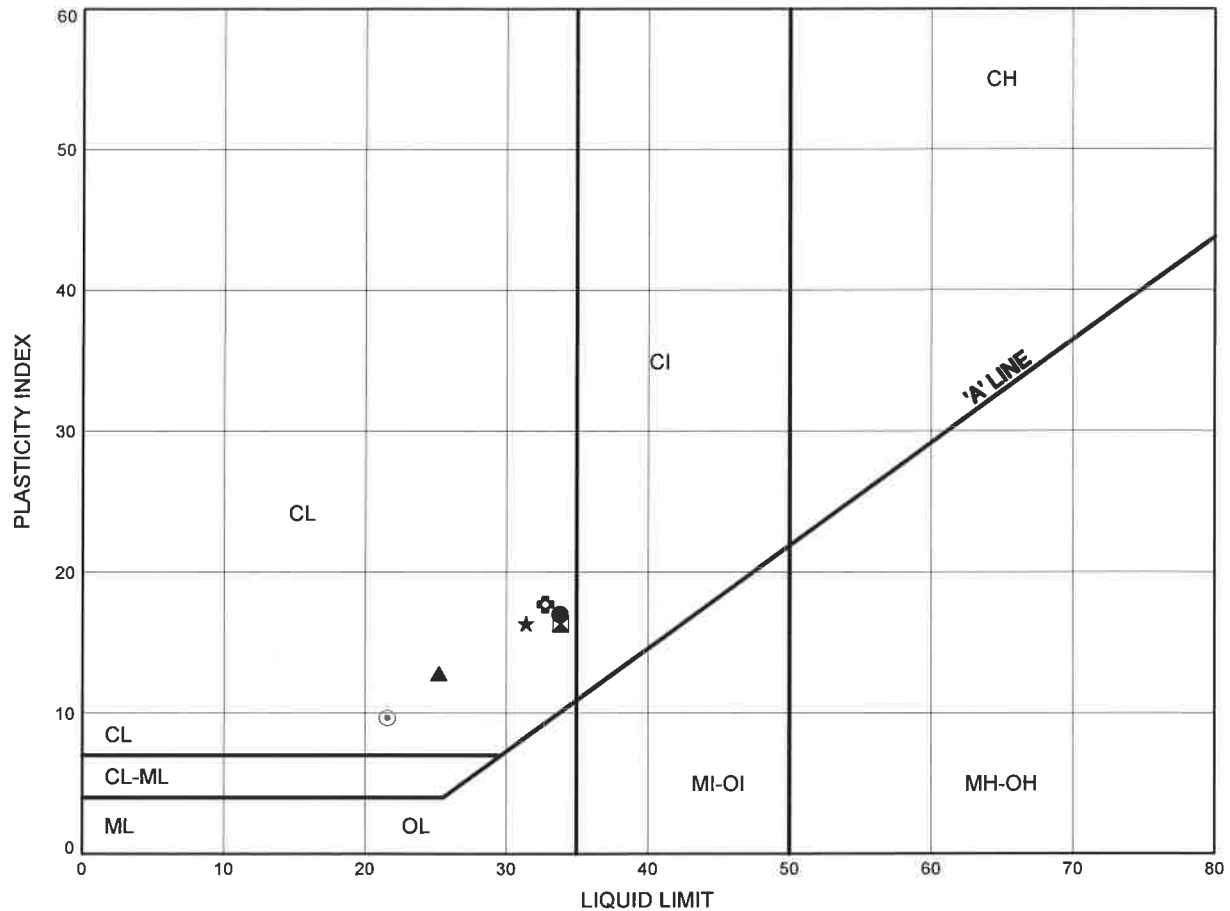
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE B13

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C14-01	4.11	251.39
⊠	C14-02	4.88	250.42
▲	C47-01	3.35	233.45
★	NLAT11E-01	3.35	235.75
⊙	NLAT20E-01	4.11	237.69
⊕	NLAT51E-01	1.83	229.57

Date August 2013
GWP# 83-00-00

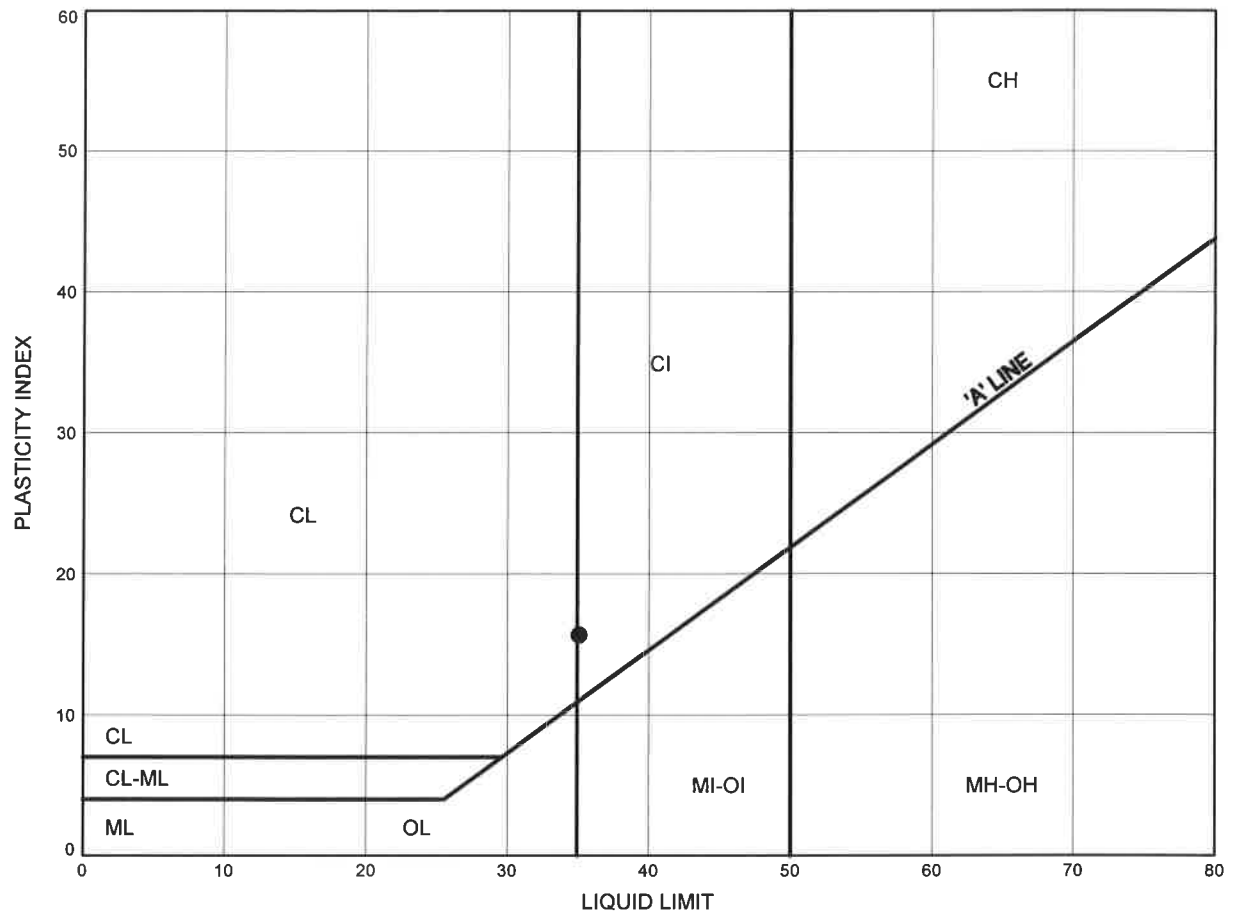


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

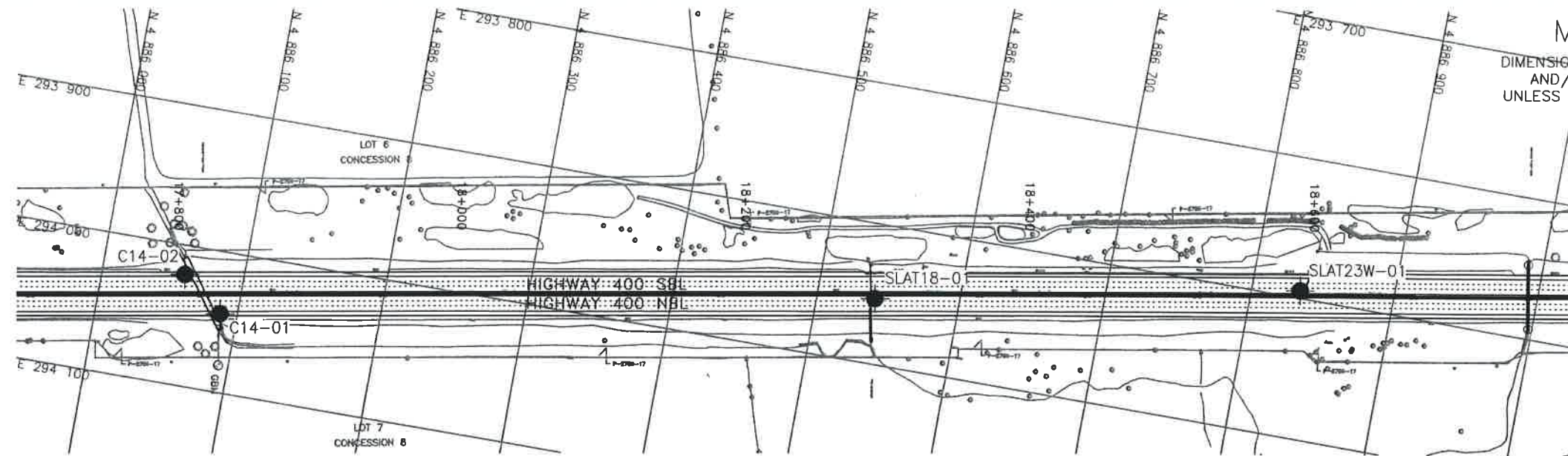
FIGURE B14

SILTY CLAY

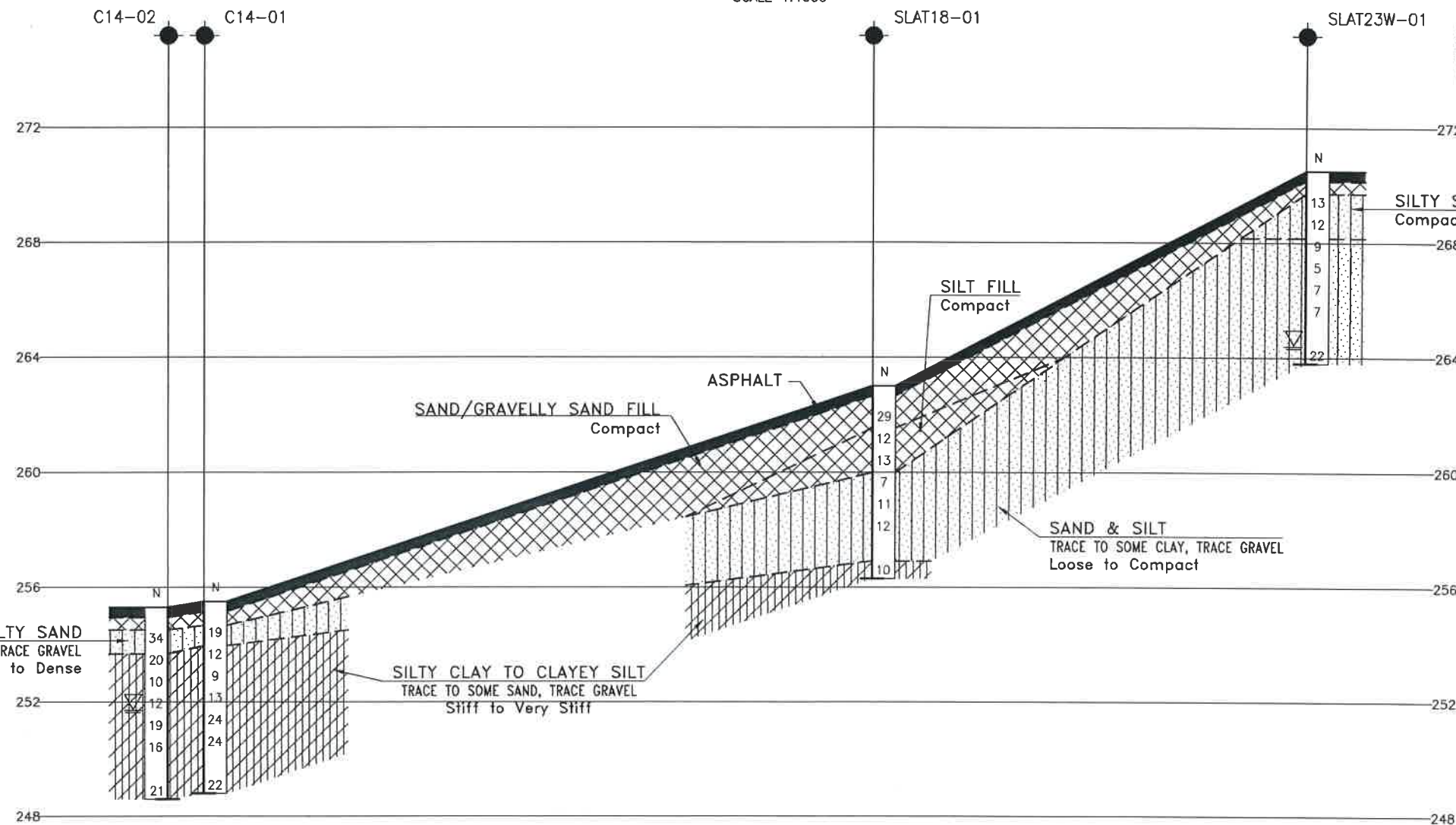


LEGEND

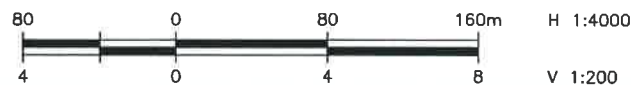
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT51E-01	4.11	227.29



PLAN



PROFILE ALONG CL HWY 400



METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 17+800 TO 18+600)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
C14-01	255.5	4 886 087.9	294 044.1
C14-02	255.3	4 886 058.4	294 020.7
SLAT18-01	263.0	4 886 540.9	293 953.2
SLAT23W-01	270.5	4 886 834.3	293 894.5

-NOTES-

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

GEOCREs No. 31D-563

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
DATE	NOV. 2013		
LOAD			
STRUCT			
DWG	5		

PLAN




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



CONT No
GWP No 83-00-00

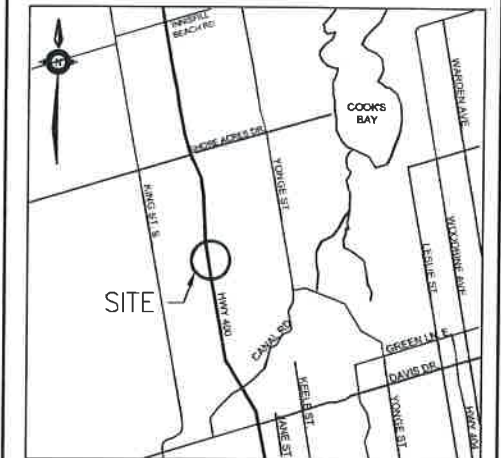
HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 18+900 TO 19+450)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET








THURBER ENGINEERING LTD.



KEYPLAN

L E G E N D

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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 |

[illegible]

-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. 31D-563

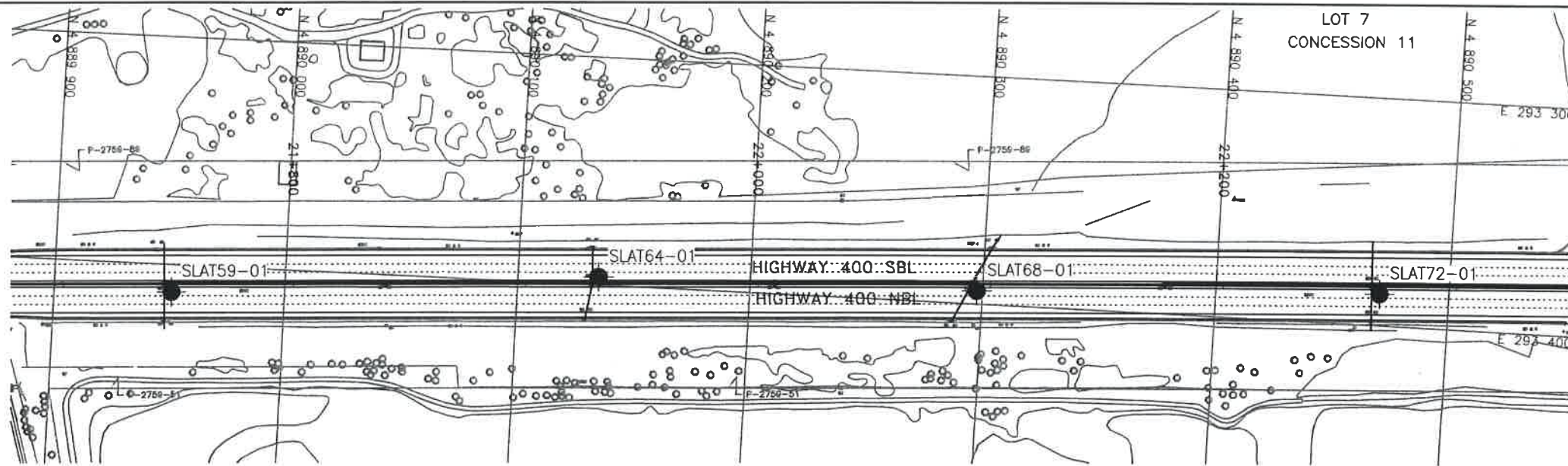
PROFILE ALONG \odot HWY 400



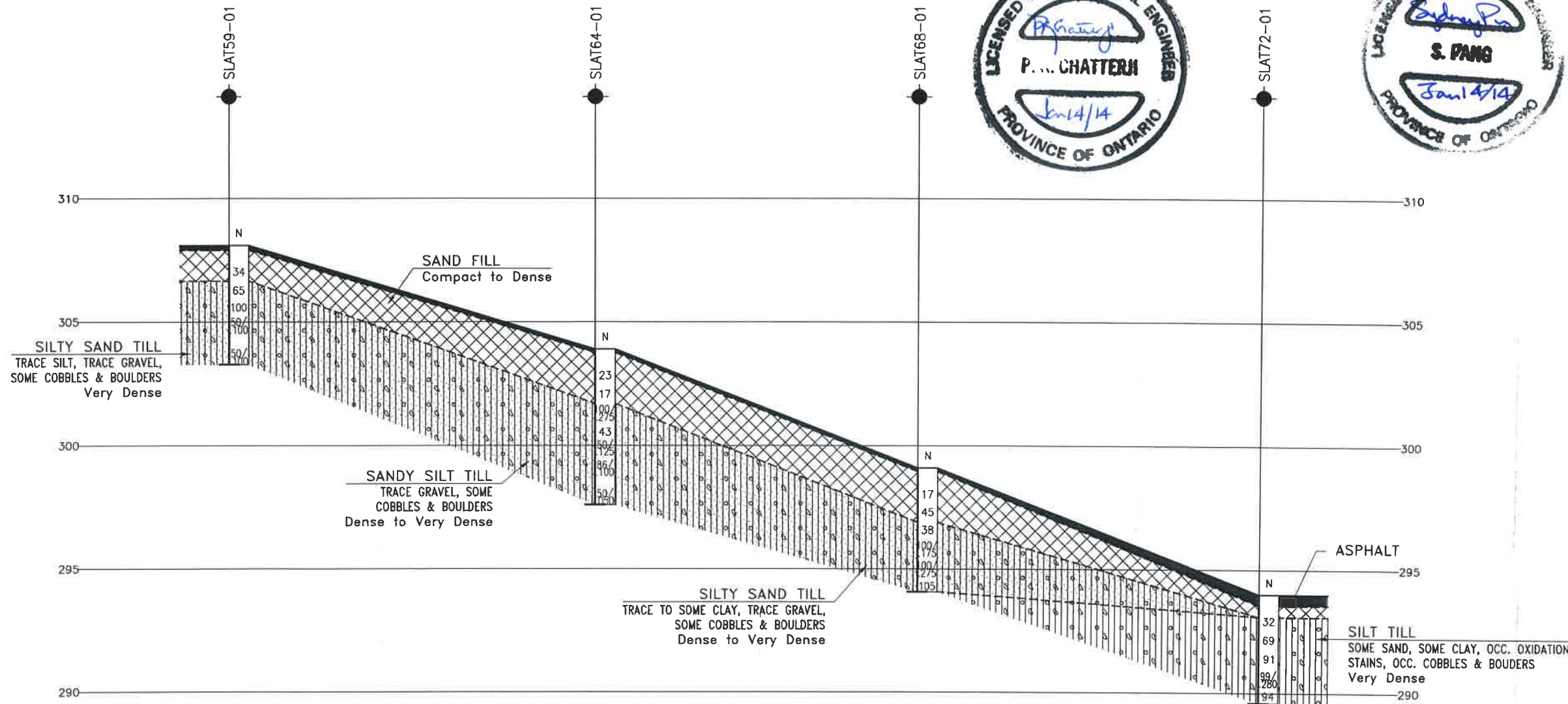
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V 1:200

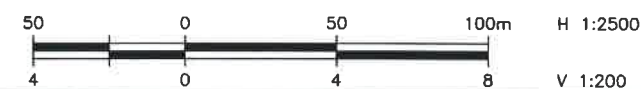
REVISIONS										
	DATE		BY		DESCRIPTION					
DESIGN	SKP	CHK	SKP	CODE	LOAD			DATE	NOV. 2013	
DRAWN	AN	CHK	PKC	SITE	STRUCT		DWG	6		



PLAN



PROFILE ALONG CL HWY 400



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

CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 21+700 TO 22+210)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- ◆ Borehole (Current Investigation)
- ◊ Borehole (Previous Investigation)
- 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

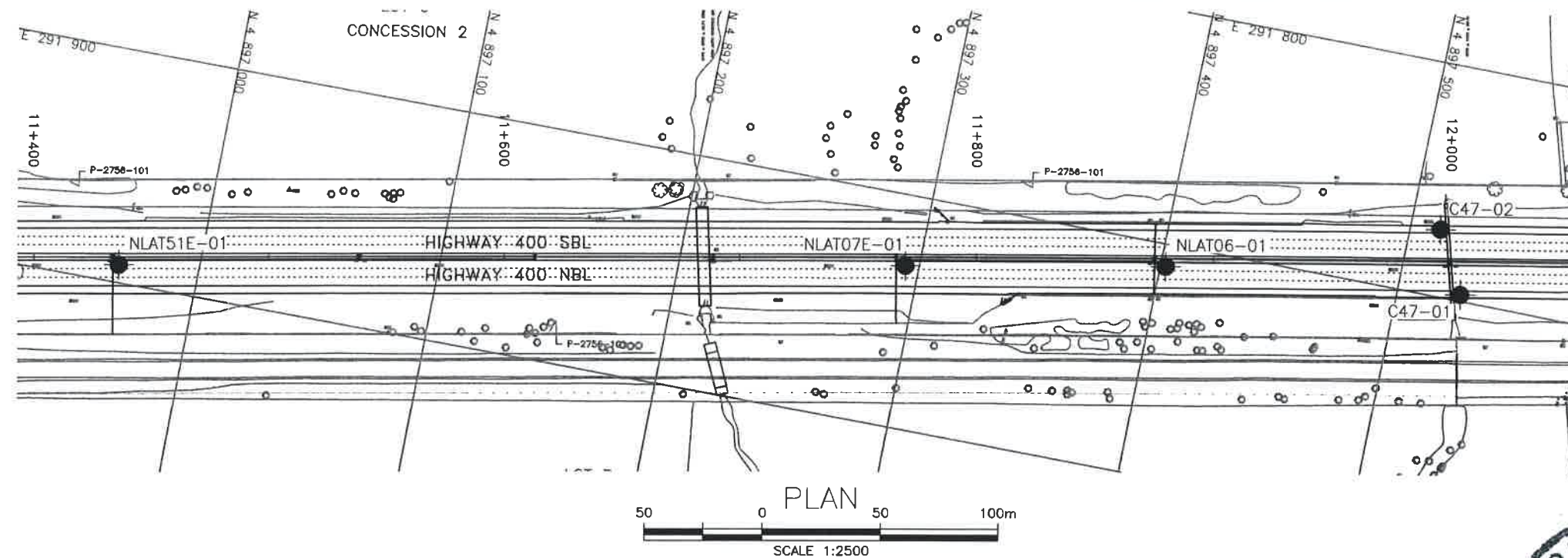
NO	ELEVATION	NORTHING	EASTING
SLAT59-01	308.1	4 889 951.1	293 411.9
SLAT64-01	303.9	4 890 134.8	293 396.4
SLAT68-01	299.1	4 890 297.6	293 394.1
SLAT72-01	294.0	4 890 470.3	293 386.1

NOTES

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GEOCRES No. 31D-563

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK SKP	CODE
DRAWN	AN	CHK PKC	SITE
			LOAD
			STRUCT
			DWG 7
			DATE NOV. 2013



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



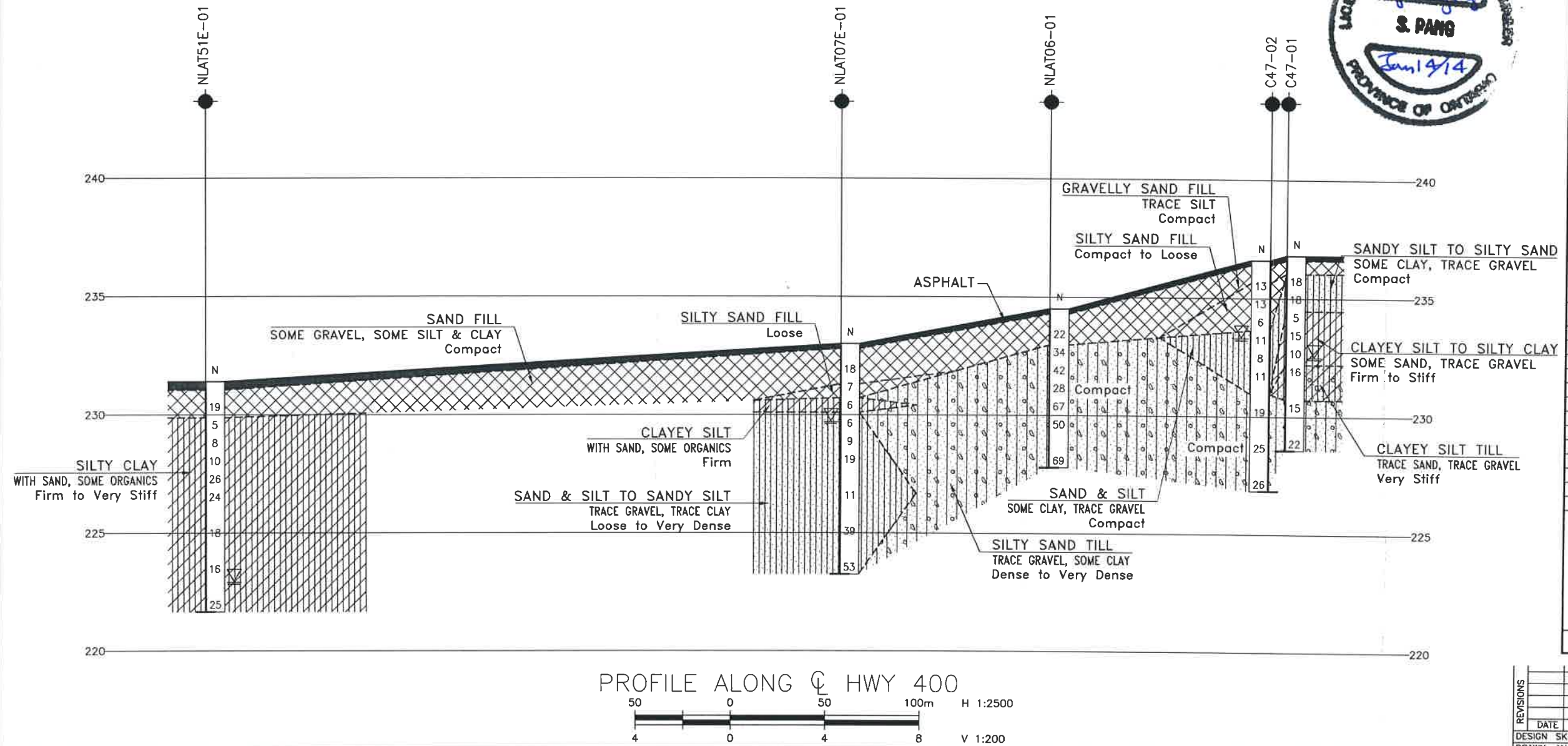
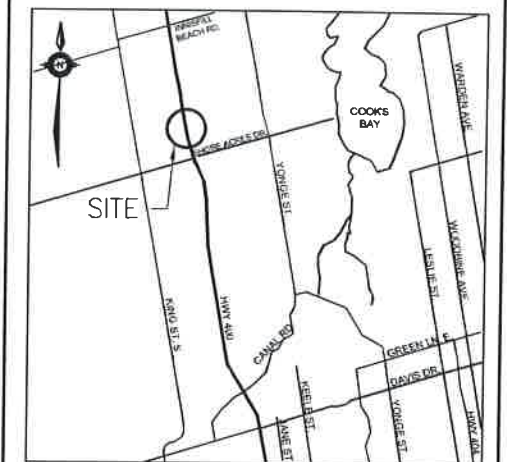
CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 11+400 TO 12+050)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

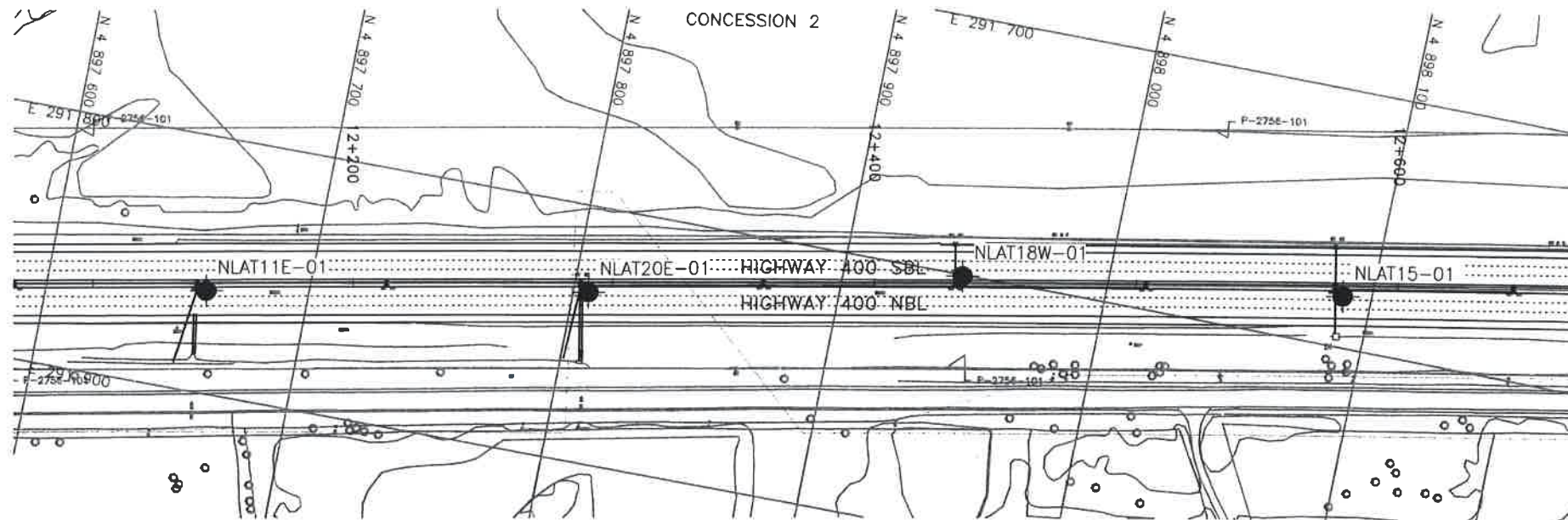
NO	ELEVATION	NORTHING	EASTING
NLAT51E-01	231.4	4 896 966.1	291 992.3
NLAT07E-01	233.0	4 897 294.2	291 930.3
NLAT06-01	234.5	4 897 402.2	291 909.6
C47-01	236.8	4 897 526.4	291 897.1
C47-02	236.6	4 897 512.7	291 871.2

NO	ELEVATION	NORTHING	EASTING
NLAT51E-01	231.4	4 896 966.1	291 992.3
NLAT07E-01	233.0	4 897 294.2	291 930.3
NLAT06-01	234.5	4 897 402.2	291 909.6
C47-01	236.8	4 897 526.4	291 897.1
C47-02	236.6	4 897 512.7	291 871.2

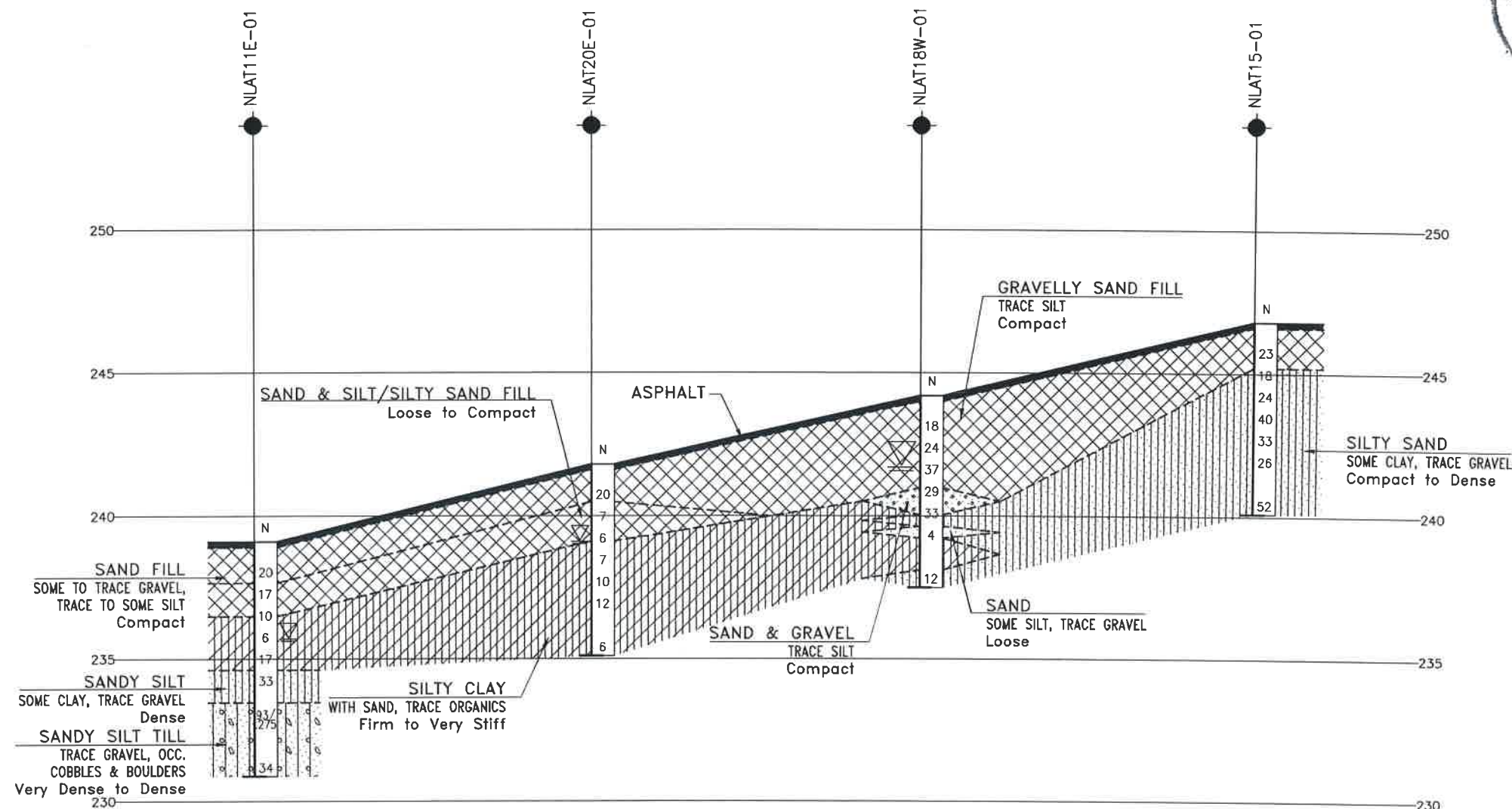
- NOTES:**
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31D-563

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
CODE	LOAD	DATE	NOV. 2013
STRUCT	DWG	B	



PLAN
SCALE 1:2500



PROFILE ALONG C HWY 400

SCALE 1:2500
SCALE 1:200

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



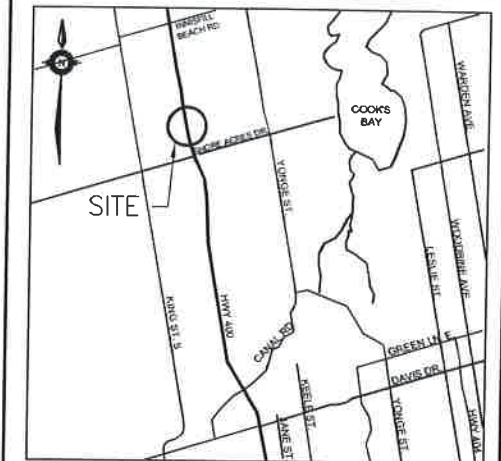
CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 12+100 TO 12+600)
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
NLAT11E-01	239.1	4 897 661.2	291 860.2
NLAT20E-01	241.8	4 897 805.8	291 833.6
NLAT18W-01	244.2	4 897 945.2	291 800.4
NLAT15-01	246.8	4 898 089.1	291 780.1

NOTES

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

GEOCRIS No. 31D-563

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
CODE	LOAD	DATE	NOV. 2013
SITE	STRUCT	DWG	9

Appendix C

Sections 10, 11, 12, 13 and 14
(Stations 12+850 to 17+000 Innisfil)

RECORD OF BOREHOLE No C51-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 899 612.4 E 291 501.9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 31 - 2013 05 31 CHECKED BY SKP

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				
285.7 0.0 0.1	ASPHALT: (100mm)						20 40 60 80 100	PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		GR SA SI CL
	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS								32 64 4 (SI+CL)
			1	SS	27							
			2	SS	17							Split spoon wet
283.5 2.2	Silly CLAY, with sand Very Stiff to Stiff Brown Moist		3	SS	18							
			4	SS	13							0 26 26 48
			5	SS	15							
281.2 4.5	Hard		6	SS	37							0 25 40 35
280.1 5.6	SAND and SILT, trace clay, trace gravel Very Dense Brown Moist (TILL)		7	SS	90							
			8	SS	50/ 0.075							
			9	SS	92/ 0.200							
276.2 9.5	END OF BOREHOLE AT 9.5m. BOREHOLE OPEN TO 1.5m AND WATER LEVEL AT 1.5m UPON											

Continued Next Page

3
+ 3 x 3

Numbers refer to
Sensitivity

20
15 5
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C51-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 899 612.4 E 291 501.9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.31 - 2013.05.31 CHECKED BY SKP

SOIL PROFILE			SAMPLES			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	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
	COMPLETION BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT COLD PATCH TO SURFACE.										

RECORD OF BOREHOLE No C51-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 601.0 E 291 475.4 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.31 - 2013.05.31 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								20 40 60 80 100	w P w w L						
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
285.7								20 40 60 80 100	20 40 60				GR SA SI CL		
0.0	ASPHALT: (160mm)														
0.2	SAND, some to trace gravel Compact Brown Moist (FILL)		1	AS			285						14 76 10 (SI+CL)		
284.4			1	SS	11										
1.3	Silty SAND, trace clay, trace gravel Loose Brown Moist (FILL)		2	SS	8		284								
283.3															
2.4	Clayey SILT, some sand, trace gravel Firm Dark Brown (FILL)		3	SS	6		283								
282.5															
3.2	Silty CLAY, trace sand Stiff Brown Moist		4	SS	11		282						0 5 26 69 Split spoon wet		
281.4			5	SS	9										
4.3	Sandy SILT, trace gravel Loose Brown Wet to Saturated		6	SS	9		281								
280.1															
5.6	SAND and SILT, trace clay, trace gravel Dense to Very Dense Grey Moist (TILL)		7	SS	32		280						1 58 34 7		
							279								
			8	SS	55		278								
277.6															
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE OPEN TO 5.5m AND WATER LEVEL AT 2.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.9m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.														

RECORD OF BOREHOLE No NLAT100E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 902 116.7 E 291 016.1 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
296.6 0.0	ASPHALT: (210mm)												
0.2	SAND, some to trace gravel, trace silt Compact Brown Moist (FILL)		1	AS			296						
295.3			1	SS	21								7 88 5 (SI+CL)
1.3	Silty SAND, trace gravel Dense Brown Moist (FILL)		2	SS	34		295						
	Occasional inferred cobbles		3	SS	40		294						
293.6													
3.0	SAND, fine grained, some silt, trace clay and gravel Loose Brown Moist		4	SS	8		293						1 74 17 8
			5	SS	3								
							292						
291.6			6	SS	9								
5.0	SAND and SILT, trace gravel Loose Brown Moist						291						
			7	SS	40								
289.9	Dense						290						
6.7	END OF BOREHOLE AT 6.7m BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.9m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.												

+ 3 x 3 : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT104W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 902 218.1 E 290 990.1 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.16 - 2013.05.16 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
295.9								20 40 60 80 100		w _p w w _L				GR SA SI CL
0.0	ASPHALT: (350mm)							○ UNCONFINED + FIELD VANE						
295.5			1	GS				● QUICK TRIAXIAL × LAB VANE						19 69 12 (SI+CL)
0.4	Gravelly SAND, some silt and clay Brown Moist							20 40 60 80 100		20 40 60				
295.1	(FILL)													
0.8	Silly SAND, trace gravel, trace clay Compact Brown Moist		2	SS	26		295							
			3	SS	26		294							0 58 23 13
			4	SS	10									
292.9							293							
3.0	Sandy SILT, trace gravel, trace clay, trace organics Compact Brown Moist		5	SS	11									1 57 29 13
							292							
			6	SS	10									
			7	SS	24		291							
290.3							290							
5.6	Dense													
			8	SS	40		289							Split spoon wel
							288							
287.7			9	SS	63									
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 7.6m AND WATER LEVEL AT 6.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.													

+ 3 x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT106W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 902 403.5 E 290 954.2 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.16 - 2013.05.16 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100	w _P w w _L	20 40 60			
296.7 0.0	ASPHALT: (325mm)													
296.3 0.4	Gravelly SAND, trace silt Brown Moist		1	AS										27 70 3 (SI+CL)
295.9 0.8	(FILL) SAND and SILT, trace gravel, some clay Dense to Compact Brown Moist		1	SS	46									
			2	SS	27									8 49 32 11
294.5 2.2	Silty CLAY, trace gravel, some sand Firm to Very Stiff Brown Moist		3	SS	5									
			4	SS	29									0 12 40 48
			5	SS	15									
292.2 4.5	Sandy SILT, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		6	SS	49									
			7	SS	85									Split spoon wet
290.0 6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 5.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/12/13

RECORD OF BOREHOLE No NLAT23AW-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 898 385 2 E 291 716 3 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.28 - 2013.05.28 CHECKED BY SKP

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		WATER CONTENT (%)				
								20 40 60 80 100	w _p w w _L					
254.6								○ UNCONFINED + FIELD VANE						
0.0	ASPHALT: (200mm)							● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100	20 40 60					
0.2	SAND, some gravel, trace silt Compact Brown Moist (FILL)		1	AS			254							
			1	SS	14									14 83 3 (SI+CL)
			2	SS	12		253							
252.1														
2.5	Sandy SILT, some clay, trace gravel Compact Dark Brown Moist (FILL)		3	SS	21		252							
251.5														
3.1	Silty SAND, trace to some clay, trace gravel Compact Brown Moist		4	SS	19		251							
			5	SS	15		250							7 55 27 11 Split spoon wet
			6	SS	31									
							249							
			7	SS	20									
247.9							248							
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 5.4m AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.9m, CEMENT TO 0.2m, ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/12/13

RECORD OF BOREHOLE No NLAT28E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 898 492 8 E 291 703.2 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 29 - 2013 05 29 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT 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						
257.9							20 40 60 80 100							
0.0	ASPHALT: (325mm)													
257.6			1	AS										
0.3	Gravelly SAND, trace silt													
257.2	Brown													
0.7	Moist (FILL)													
	SAND, trace to some silt, trace gravel		1	SS	16		257							
	Compact to Dense													
	Brown		2	SS	25		256							1 87 12
	Moist													(SI+CL)
			3	SS	32									Split spoon wet
254.8							255							
3.1	Silty SAND, trace to some clay, trace gravel		4	SS	60									5 62 21 12
	Very Dense													
	Brown		5	SS	52		254							
	Moist													
	(TILL)		6	SS	88		253							
			7	SS	50		252							
251.2														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.													

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 9/26/13

RECORD OF BOREHOLE No NLAT32E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 898 597.9 E 291 682.2 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.29 - 2013.05.29 CHECKED BY SKP

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
261.2	ASPHALT: (350mm)											
0.0												
260.8			1	AS			261					19 78 3 (SI+CL)
0.4	SAND, some gravel, trace silt Brown Moist (FILL)											
260.4												
0.8	Silty SAND, trace clay, trace gravel Compact to Very Dense Brown Moist (TILL)		1	SS	19		260					
			2	SS	72							8 57 26 9
258.9							259					
2.3	SAND and SILT, some clay, trace gravel Compact Brown Moist		3	SS	21							
			4	SS	11		258					2 52 32 14
257.3												
3.9	Sandy SILT, trace gravel, trace to some clay, trace organic staining Very Dense Brown Moist (TILL)		5	SS	50/ 0.150		257					
			6	SS	56		256					
							255					
			7	SS	35							Split spoon wet
254.5												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/12/13

RECORD OF BOREHOLE No NLAT37-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 454.4 E 291 506.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.31 - 2013.05.31 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
285.3												
0.0	ASPHALT: (150mm)											
0.2	SAND, some gravel Brown Moist (FILL)		1	AS			285					
284.4												
0.9	SAND and SILT, trace to some clay, trace gravel Compact to Loose Brown Moist (FILL)		1	SS	11		284					3 54 32 11
			2	SS	12							
			3	SS	8		283					Split spoon wet
282.3												
3.0	Silty CLAY, trace sand, trace gravel Firm Brown Moist		4	SS	6		282					0 8 26 66
281.2												
4.1	Sandy SILT, trace gravel, trace clay Compact Brown Moist (TILL)		5	SS	6		281					
			6	SS	25							
							280					
279.7												
5.6	Very Dense											
			7	SS	62		279					
278.7												
6.6	END OF BOREHOLE AT 6.6m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.9m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/12/13

+ 3, X 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT41-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 299.9 E 291 543.5 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.28 - 2013.05.28 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
282.5 0.0	ASPHALT: (200mm)												
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS			282						48 47 5 (SI+CL)
			1	SS	22								
281.1 1.4	Silty SAND, some clay, trace gravel Dense Brown Moist		2	SS	43		281						4 58 25 13
			3	SS	37		280						
279.2 3.3	SAND, trace silt, trace gravel Very Dense Brown Wet		4	SS	94/ 0.250		279						
278.6 3.9	Clayey SILT, with sand, trace gravel Hard Brown (TILL)		5	SS	54		278						1 38 38 23 Split spoon wet
			6	SS	80/ 0.225		277						
276.3 6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 4.4m UPON COMPLETION BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.4m, CUTTINGS TO 1.8m, CEMENT TO 0.2m, ASPHALT TO SURFACE.		7	SS	50/ 0.125								

RECORD OF BOREHOLE No NLAT46-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 152.1 E 291 571.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 28 - 2013 05 28 CHECKED BY SKP

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				
								20 40 60 80 100				20 40 60			
278.1															
0.0	ASPHALT: (200mm)						278								
0.2	SAND, trace gravel, some silt and clay Compact to Dense Brown Moist (FILL)		1	AS											
			1	SS	30		277							7 71 22 (SI+CL)	
276.8															
1.3	Silty SAND, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		2	SS	37		276								
			3	SS	50/ 0.100										
			4	SS	50/ 0.100		275							8 54 25 13	
			5	SS	50/ 0.125		274								
			6	SS	50/ 0.150		273								
271.9			7	SS	50/ 0.100		272								
6.2	END OF BOREHOLE AT 6.2m BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m, ASPHALT TO SURFACE.														

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No NLAT50W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 898 999.7 E 291 600.0 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.28 - 2013.05.28 CHECKED BY SKP

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	20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
273.4 0.0	ASPHALT: (213mm)												
0.2	Gravelly SAND, trace silt Compact Brown Moist (FILL)		1	AS			273						
272.1			1	SS	24								22 71 7 (SI+CL)
1.3	Silty SAND, trace to some gravel, some clay Very Dense Brown Moist (TILL)		2	SS	50/ 0.125		272						
			3	SS	55/ 0.150		271						10 57 21 12
			4	SS	50/ 0.100		270						
			5	SS	50/ 0.125		269						
			6	SS	50/ 0.150		268						
267.2 6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOELPLUG TO 2.7m, CUTTINGS TO 1.8m, CEMENT TO 0.2m, ASPHALT TO SURFACE.		7	SS	50/ 0.100								

RECORD OF BOREHOLE No NLAT54-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 898 852 7 E 291 633 7 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 29 - 2013 05 29 CHECKED BY SKP

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
269.0							269					
0.0	ASPHALT: (300mm)		1	AS								
268.7												
0.3	SAND, some gravel, trace silt Brown Moist (FILL)											11 84 5 (SI+CL)
268.2												
0.8	Silty SAND, some clay, trace gravel Dense to Very Dense Brown Moist to Wet (TILL)		1	SS	43		268					
			2	SS	50/ 0.025							7 59 24 10
			3	SS	50/ 0.025		267					
			4	SS	50/ 0.100		266					
			5	SS	50/ 0.100		265					
264.4			6	SS	50/ 0.075							Split spoon wet
4.6	END OF BOREHOLE AT 4.6m. BOREHOLE OPEN TO 0.9m AND WATER LEVEL AT 0.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE/CUTTINGS AND ASPHALT PATCH TO SURFACE											

+ 3 . X 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT60-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 882 3 E 291 432 8 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 27 - 2013 05 27 CHECKED BY SKP

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						PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L
287.4								20	40	60	80	100		
0.0	ASPHALT: (325mm)		1	AS			287							
287.1														
0.3	SAND, trace gravel													
286.6	Loose		1	SS	24		286							0 65 25 10
0.8	Brown													
	Moist (FILL)													
	Silty SAND, trace to some clay, trace gravel													
	Compact to Very Dense		2	SS	45		285							Split spoon wet
	Brown													
	Moist		3	SS	67									
			4	SS	51		284							2 81 15 2
	Loose		5	SS	5									
283.0														
4.4	END OF BOREHOLE AT 4.4m, BOREHOLE OPEN TO 3.0m AND WATER LEVEL AT 3.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE, CONCRETE AND COLD PATCH ASPHALT TO SURFACE.													

RECORD OF BOREHOLE No NLAT65W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 900 020 8 E 291 406 3 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.27 - 2013.05.27 CHECKED BY SKP

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					
								WATER CONTENT (%)					
288.2							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
0.0	ASPHALT: (350mm)		1	AS				○ UNCONFINED + FIELD VANE	W _P	W	W _L		
287.8								● QUICK TRIAXIAL × LAB VANE					
0.4	SAND, trace silt, trace gravel Brown Moist (FILL)												9 87 4 (SI+CL)
287.4													
0.8	Clayey SILT, with sand, trace gravel Hard to Very Stiff Brown Moist		1	SS	34								
			2	SS	18								0 43 39 18
			3	SS	29								
285.2													
3.0	Silty SAND, trace clay, trace gravel Very Dense Brown Moist (TILL)		4	SS	52								8 65 20 7
			5	SS	50/ 0.150								Split spoon wet
			6	SS	50/ 0.150								
			7	SS	9								
281.5	Loose												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 3.6m AND WATER LEVEL AT 3.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT COLD PATCH TO SURFACE.												
















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RECORD OF BOREHOLE No NLAT68W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 900 257.3 E 291 360.6 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 27 - 2013.05.27 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
289.5							20 40 60 80 100							GR SA SI CL
0.0	ASPHALT: (325mm)		1	AS										
289.2														
0.3	SAND, some gravel Brown Moist													
288.7	(FILL)		1	SS	22									
0.8	Silty SAND, trace gravel, trace clay Compact to Very Dense Brown Moist													
			2	SS	74									0 67 26 7
														
			3	SS	46									
														
			4	SS	58									6 59 27 8
285.8														Split spoon wet
3.7	Loose to Compact		5	SS	9									
														
			6	SS	12									
														
283.9														
5.6														
			7	SS	84									
282.8														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15M THEN ASPHALT COLD PATCH TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

RECORD OF BOREHOLE No NLAT70W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 900 377.4 E 291 338.8 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.17 - 2013.05.17 CHECKED BY SKP

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							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							w _p w w _L		
							20	40	60	80	100	20	40	60			
290.1																	
0.0	ASPHALT: (200mm)																
0.2	SAND, some to trace gravel, trace to some silt and clay Compact Brown Moist (FILL)		1	AS			290										
			1	SS	10		289							4 83 13 (SI+CL)			
288.7																	
1.4	Dense to Compact		2	SS	37		288										
			3	SS	24												
			4	SS	25		287							8 67 25 (SI+CL)			
286.4																	
3.7	Trace clay, trace organics Loose		5	SS	7		286										
285.4																	
4.7	Clayey SILT, some sand, trace gravel Stiff Grey		6	SS	9		285							Split spoon wet			
284.5																	
5.6	Silty SAND, trace gravel Compact to Dense Grey Moist																
			7	SS	30		284										
283.4																	
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 5.5m AND WATER LEVEL AT 5.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.9m, CUTTINGS TO 1.7m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE																







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RECORD OF BOREHOLE No NLAT72W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 900 496.7 E 291 316.2 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.17 - 2013.05.17 CHECKED BY SKP

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						
								20 40 60 80 100						
290.7														
0.0	ASPHALT: (188mm)							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
0.2	SAND, trace to some gravel Compact Brown Moist (FILL)		1	AS			290	w _p w w _L						
	Occasional inferred cobbles		1	SS	21				WATER CONTENT (%)					
									20 40 60					
289.0														
1.7	SAND, some gravel, some silt Dense to Compact Brown Moist		2	SS	43		289	○ UNCONFINED + FIELD VANE						
									● QUICK TRIAXIAL × LAB VANE					
			3	SS	39			288						20 61 19 (SI+CL)
	Trace organics, trace rootlets Dark Grey		4	SS	17			287						Split spoon wet
286.6			5	SS	13									
4.1	SAND and SILT, trace to some clay Compact to Loose Brown to Grey Moist		6	SS	7		286						2 52 34 12	
285.1														
5.6	SAND, trace silt, trace gravel Very Dense Grey Wet		7	SS	57		285							
284.0														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 5.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.3m, CUTTINGS TO 1.7m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No NLAT75-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 900 886.2 E 291 242.5 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.17 - 2013.05.17 CHECKED BY SKP

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
294.0	ASPHALT: (200mm)						294					
0.0												
0.2	SAND, some gravel, trace silt Compact to Very Dense Brown Moist (FILL)		1	AS								
			1	SS	20		293					13 79 8 (SI+CL)
			2	SS	79		292					
			3	SS	100/ 0.175							
291.0			4	SS	100/ 0.250		291					4 57 31 8
3.0	SAND and SILT, trace clay, trace gravel Very Dense Brown Moist (TILL) Inferred cobbles at 3.9m		5	SS	50/ 0.125		290					
			6	SS	101/ 0.225		289					
			7	SS	100/ 0.150		288					
287.8												
6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.											

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RECORD OF BOREHOLE No NLAT78-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 900 752.8 E 291 274.8 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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 (%)				
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× LAB VANE	20	40	60	80
292.6																				
0.0	ASPHALT: (200mm)																			
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS											43 53 4 (SI+CL)					
			1	SS	17															
290.7			2	SS	46															
1.9	Silty CLAY, some sand, trace gravel Hard Brown														0 24 44 32					
290.2			3	SS	83															
2.4	SAND and SILT, some clay, trace gravel Very Dense Brown Moist (TILL)		4	SS	58/ 0 150										0 44 35 21 Split spoon wet					
			5	SS	54/ 0 150															
			6	SS	50/ 0 100															
286.4			7	SS	50/ 0 125															
6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.6m, CUTTINGS TO 2.1m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.																			

RECORD OF BOREHOLE No NLAT79E-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 900 629.8 E 291 298.3 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	w _p w w _L					
291.4								20 40 60 80 100						
0.0	ASPHALT: (200mm)													
0.2	SAND, some gravel, trace silt Compact Brown Moist (FILL)		1	AS			291							
			1	SS	19									19 72 9 (SI+CL)
290.0							290							
1.4	Dense		2	SS	38									
289.2														
2.2			3	SS	11		289							
288.4														
3.0	SAND and SILT, trace gravel Compact Brown Moist		4	SS	22		288							
287.3			5	SS	28									
4.1	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown (TILL)		6	SS	36		287							1 41 28 30
							286							
285.3														
6.1	Sandy SILT, trace gravel Very Dense Brown Moist (TILL)		7	SS	54/ 0.150		285							
			8	SS	51/ 0.150		284							
	Grey						283							
282.1			9	SS	55/ 0.150									
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 4.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH													

Continued Next Page

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

RECORD OF BOREHOLE No NLAT79E-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 900 629.8 E 291 298.3 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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				
	Continued From Previous Page							20 40 60 80 100		w _p w w _L		
	BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
								20 40 60 80 100		20 40 60		

RECORD OF BOREHOLE No NLAT96W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 901 873.7 E 291 055.4 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.17 - 2013.05.17 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
300.0												
0.0	ASPHALT: (175mm)						300					
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS								37 55 8 (SI+CL)
298.7			1	SS	17		299					
1.3	Silty SAND, some clay, trace gravel, occasional inferred cobbles Very Dense Brown Moist (FILL)		2	SS	52		298					2 60 24 14
297.8			3	SS	69		297					
2.2	Silty SAND, some clay, trace gravel Very Dense Brown Moist (TILL)		4	SS	76		296					1 60 24 15
			5	SS	65		295					
			6	SS	94/ 0.275		294					
			7	SS	91							
293.4												
6.6	END OF BOREHOLE AT 6.6m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.5m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.											

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RECORD OF BOREHOLE No NLAT99W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 901 993.7 E 291 032.4 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.16 - 2013.05.16 CHECKED BY SKP

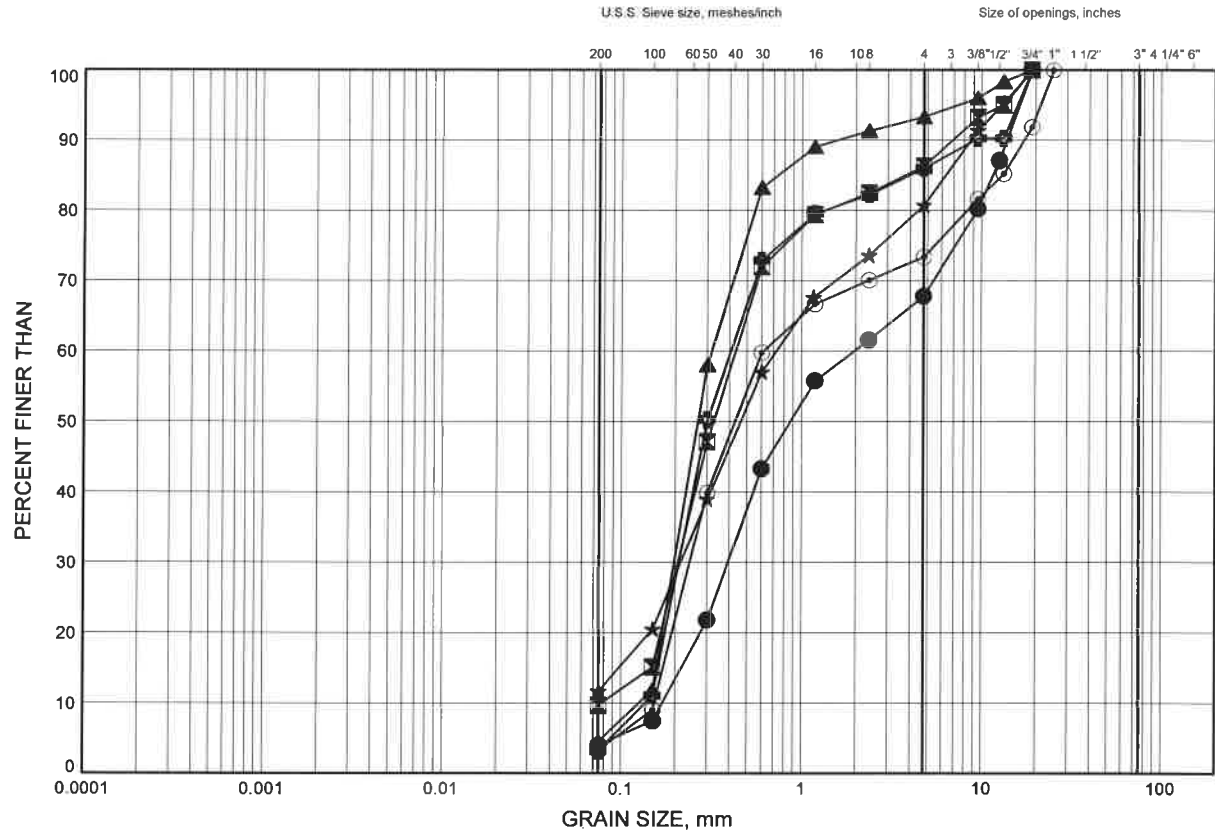
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ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	w _p w w _L	WATER CONTENT (%)				
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
298.3	ASPHALT: (300mm)		1	AS			298							
0.0														
297.9	Gravelly SAND, trace silt Brown Moist (FILL)		2	SS	53		297							
0.4														
297.4	Silty SAND, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		3	SS	49		296							
0.9														
			4	SS	82									
			5	SS	100		295							
			6	SS	50		294							
			7	SS	95		293							
			8	SS	50		292							
291.6	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 5.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.													
6.7														

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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C1

SAND/SAND & GRAVEL/GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C51-01	0.30	285.40
⊠	C51-02	1.07	284.63
▲	NLAT100E-01	1.07	295.53
★	NLAT104W-01	0.30	295.60
⊙	NLAT106W-01	0.30	296.40
⊕	NLAT23AW-01	1.07	253.53

Date August 2013

GWP# 83-00-00



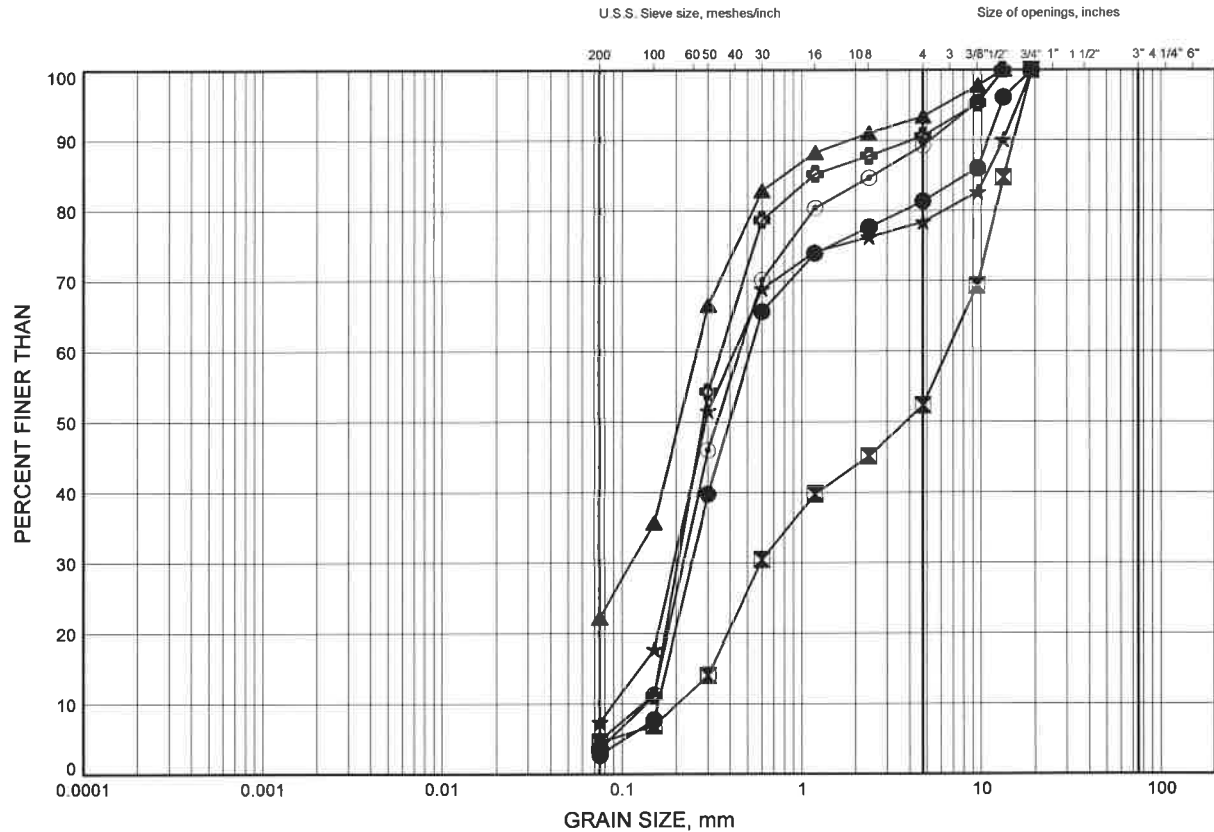
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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C2

SAND/SAND & GRAVEL/GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT32E-01	0.30	260.90
⊠	NLAT41-01	0.38	282.12
▲	NLAT46-01	1.07	277.03
★	NLAT50W-01	1.07	272.33
⊙	NLAT54-01	0.46	268.54
⊕	NLAT65W-01	0.46	287.74

Date August 2013
GWP# 83-00-00

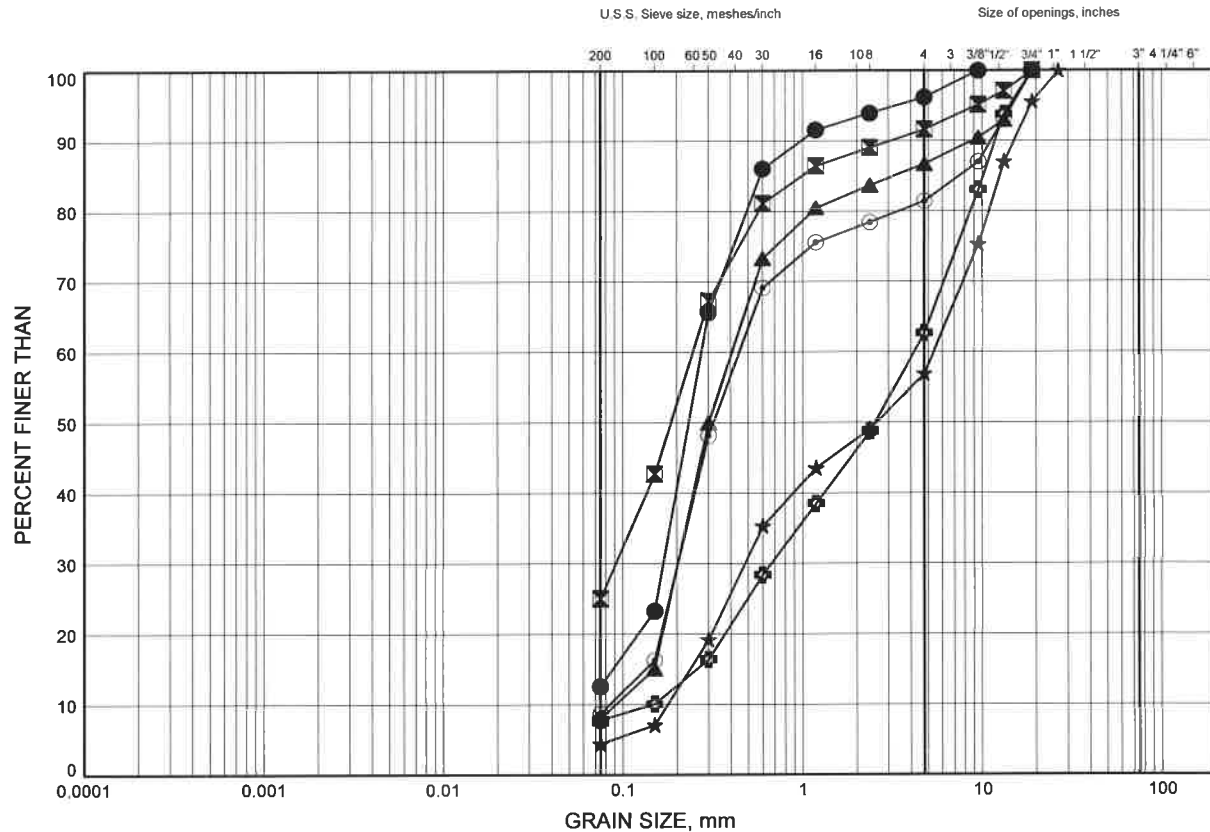


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C3

SAND/SAND & GRAVEL/GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT70W-01	1.07	289.03
⊠	NLAT70W-01	3.35	286.75
▲	NLAT75-01	1.07	292.93
★	NLAT78-01	0.38	292.22
⊙	NLAT79E-01	1.07	290.33
⊕	NLAT96W-01	0.38	299.62

Date August 2013
GWP# 83-00-00

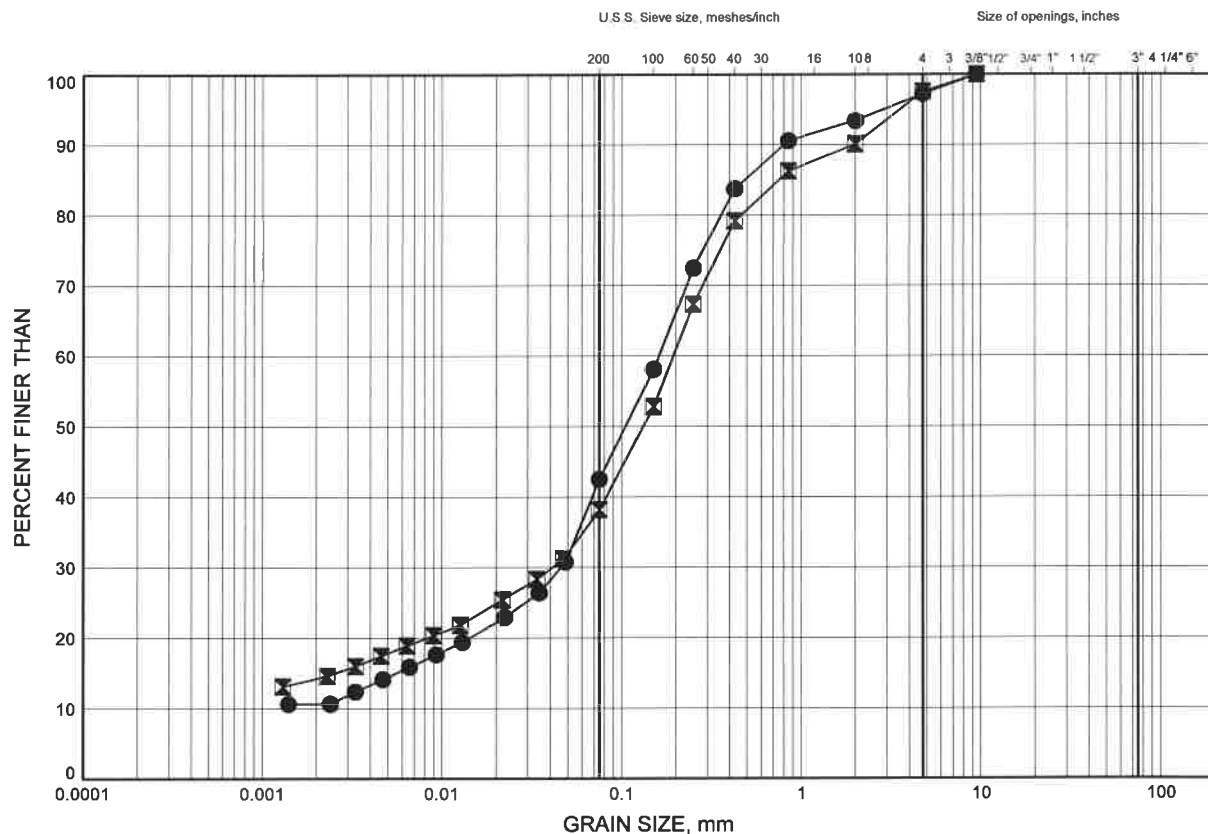


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C4

SAND & SILT/SILTY SAND FILL



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

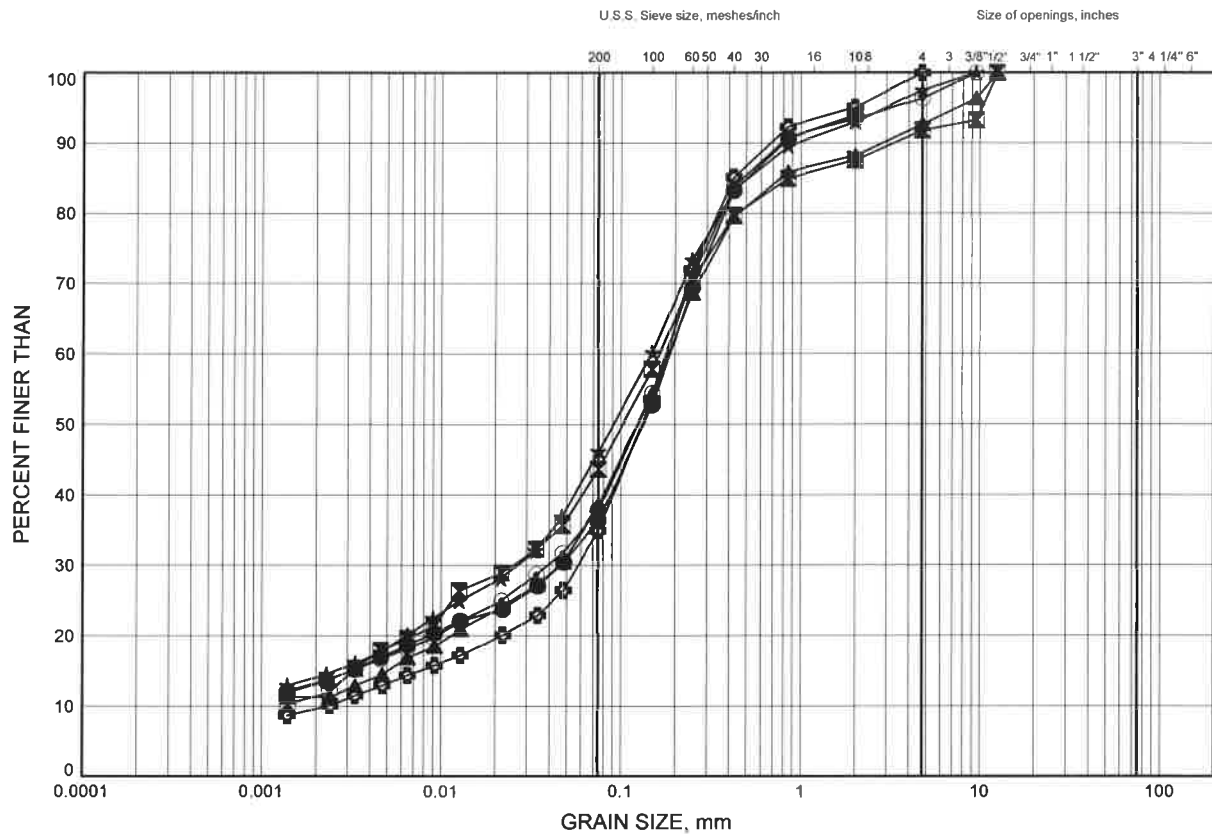
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT37-01	1.07	284.23
⊠	NLAT96W-01	1.83	298.17

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C5

SAND & SILT/SILTY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT104W-01	1.83	294.07
⊠	NLAT106W-01	1.83	294.87
▲	NLAT23AW-01	4.11	250.49
★	NLAT32E-01	3.35	257.85
⊙	NLAT41-01	1.83	280.67
⊕	NLAT60-01	1.07	286.33

Date August 2013
GWP# 83-00-00

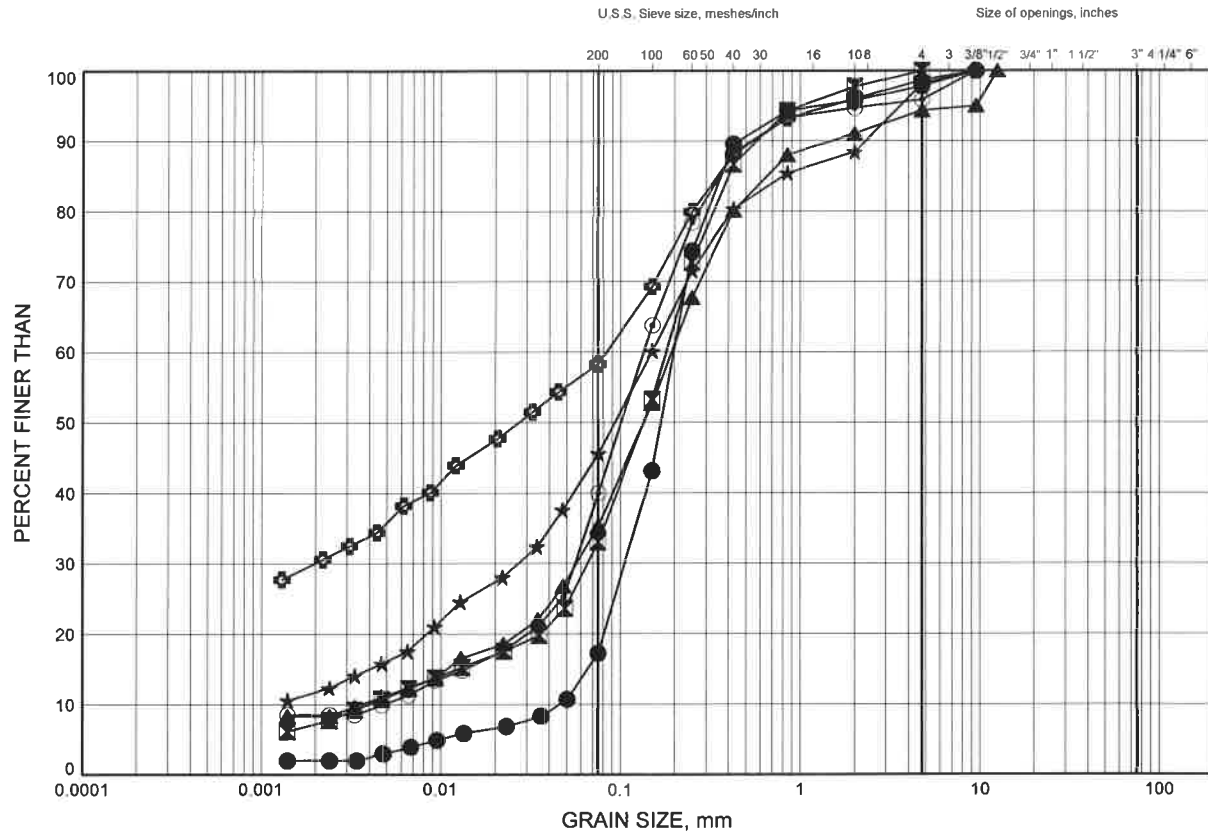


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C6

SAND & SILT/SILTY SAND



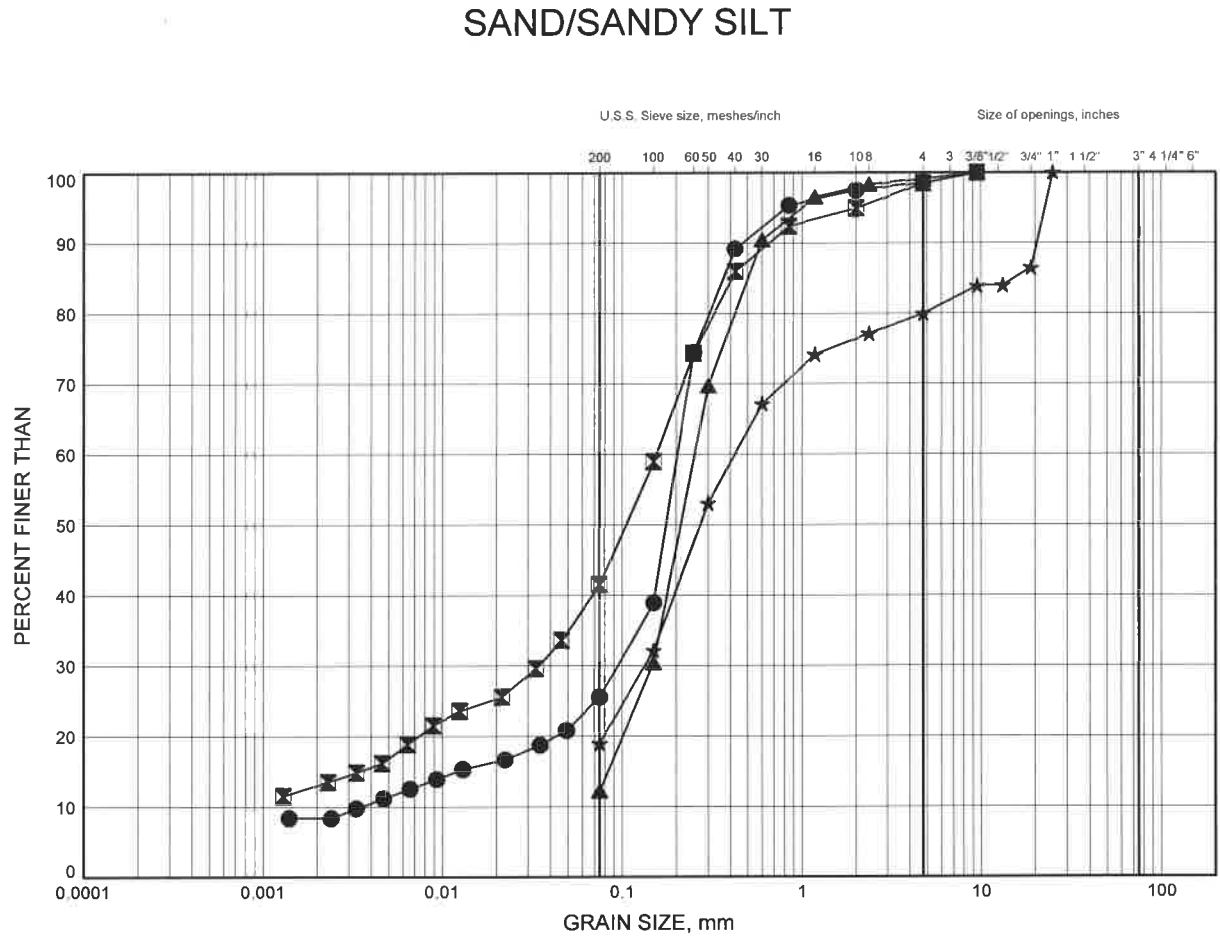
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT60-01	3.35	284.05
⊠	NLAT68W-01	1.83	287.67
▲	NLAT68W-01	3.35	286.15
★	NLAT72W-01	4.27	286.43
⊙	NLAT75-01	3.18	290.82
⊞	NLAT79E-01	4.19	287.21

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C7



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT100E-01	3.35	293.25
⊠	NLAT104W-01	3.35	292.55
▲	NLAT28E-01	1.83	256.07
★	NLAT72W-01	2.59	288.11

Date August 2013
GWP# 83-00-00

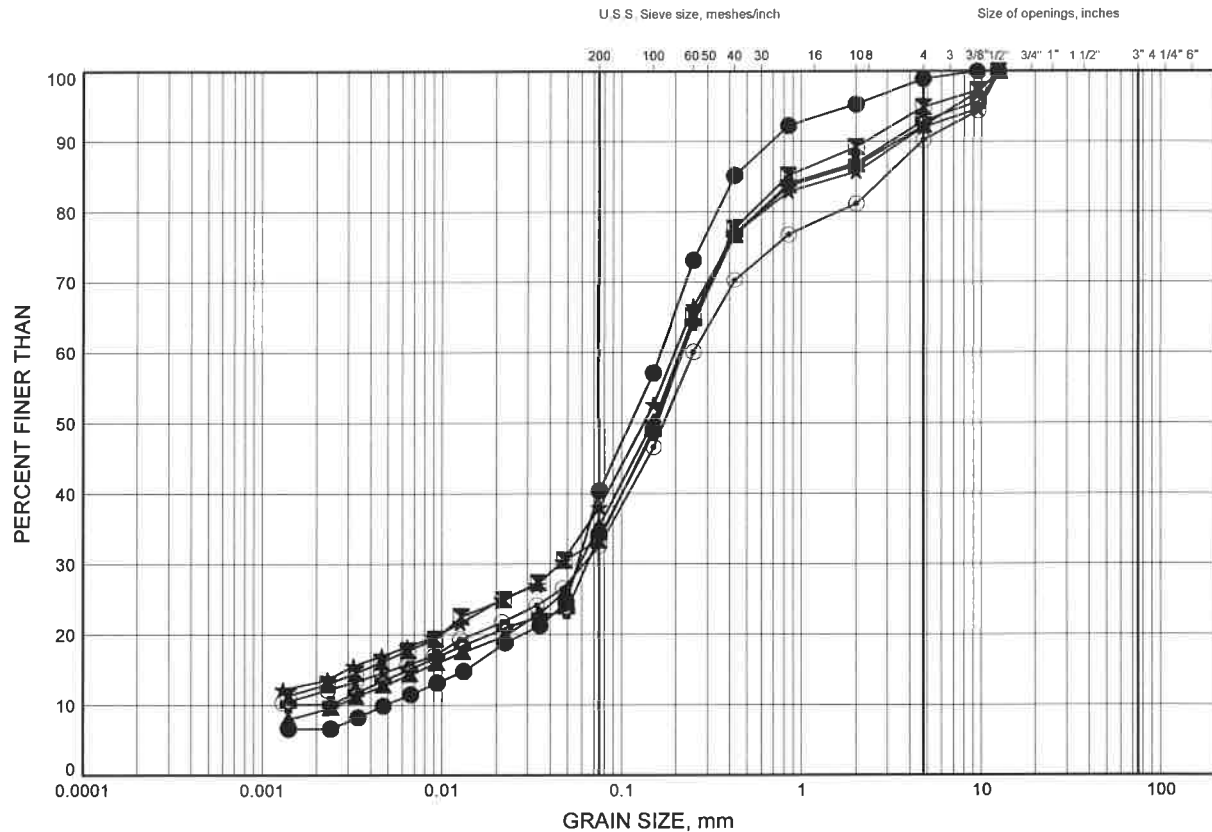


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C8

SAND & SILT/SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C51-02	6.40	279.30
⊠	NLAT28E-01	3.35	254.55
▲	NLAT32E-01	1.83	259.37
★	NLAT46-01	3.17	274.93
⊙	NLAT50W-01	2.59	270.81
⊕	NLAT54-01	1.83	267.17

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/26/13

Date August 2013
GWP# 83-00-00

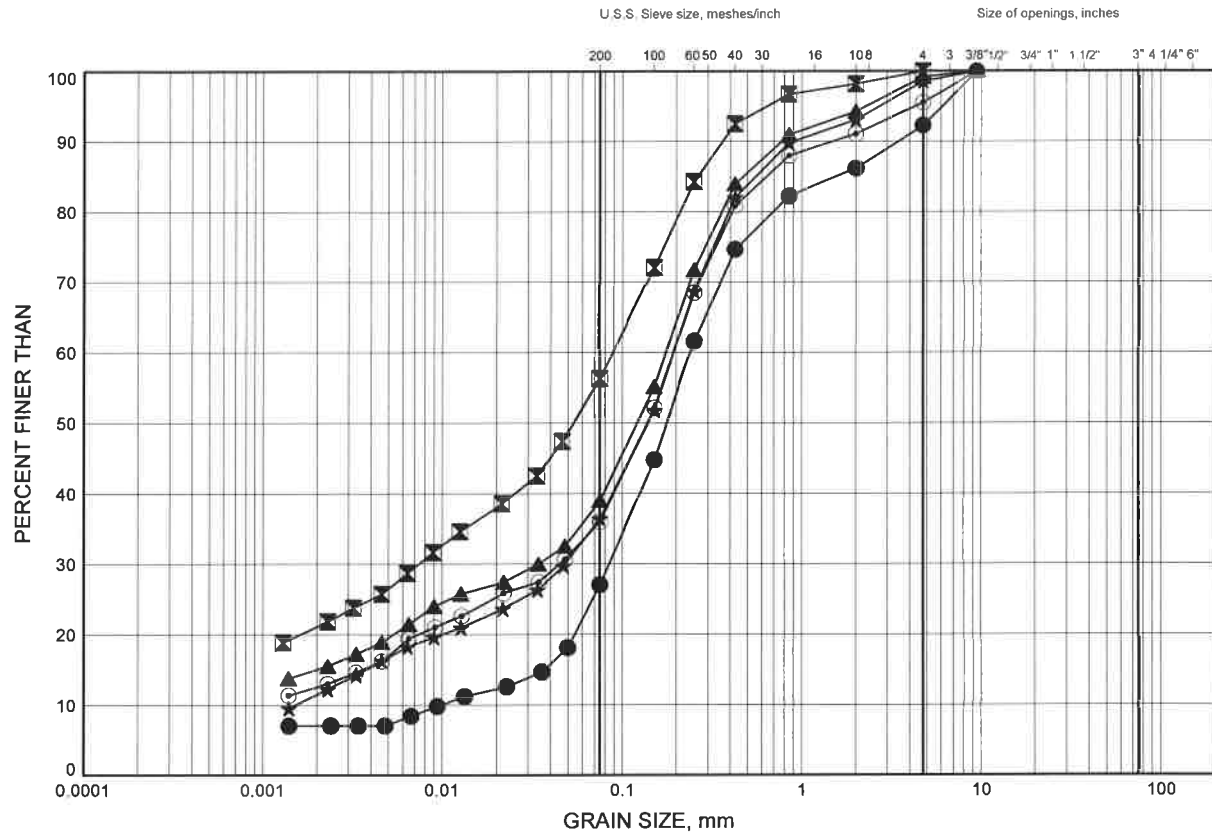


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C9

SAND & SILT/SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT65W-01	3.35	284.85
⊠	NLAT78-01	3.12	289.48
▲	NLAT96W-01	4.04	295.96
★	NLAT99W-01	1.07	297.23
⊙	NLAT99W-01	2.59	295.71

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/26/13

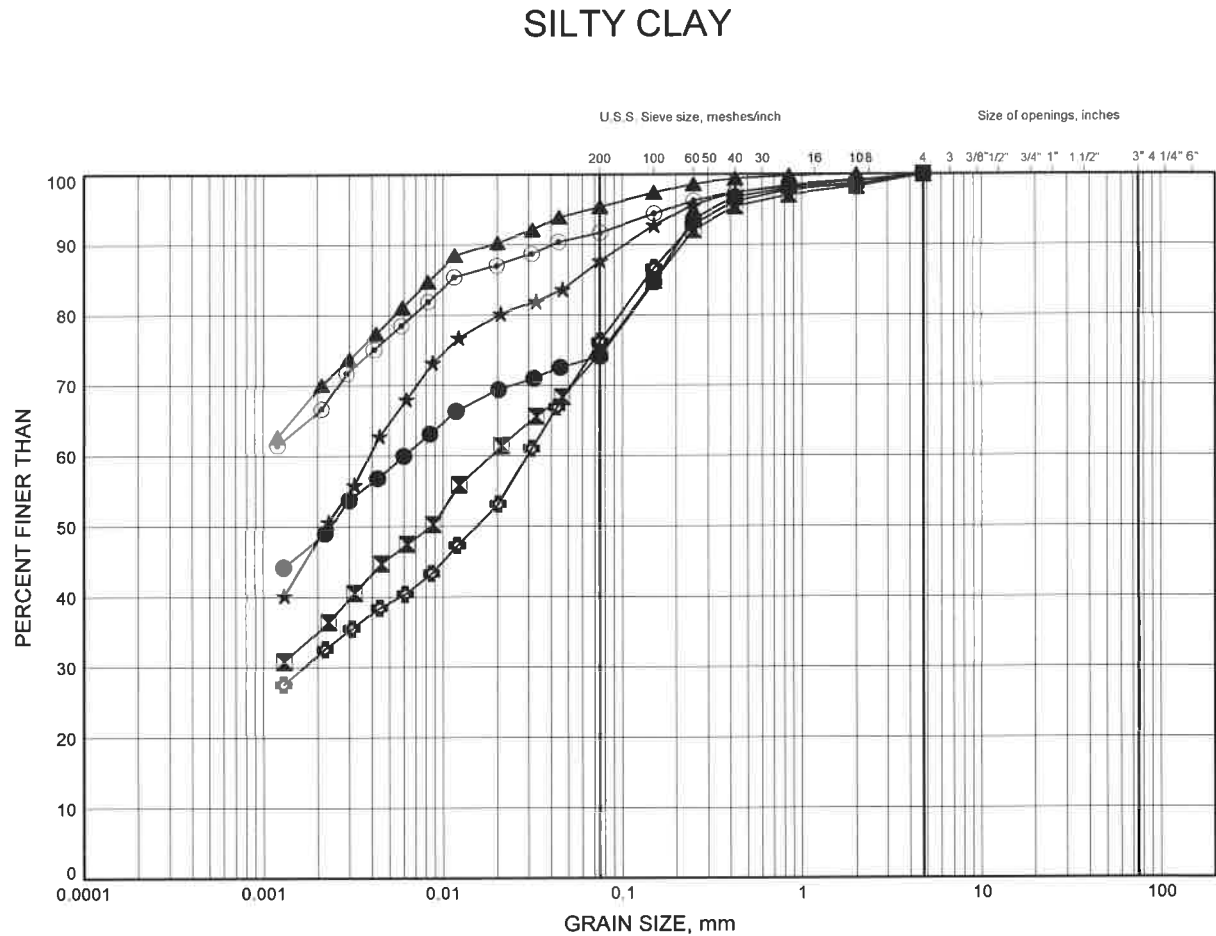
Date August 2013
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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C10



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C51-01	3.35	282.35
⊠	C51-01	4.88	280.82
▲	C51-02	3.35	282.35
★	NLAT106W-01	3.35	293.35
⊙	NLAT37-01	3.35	281.95
⊕	NLAT78-01	1.98	290.62

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/26/13

Date August 2013
GWP# 83-00-00

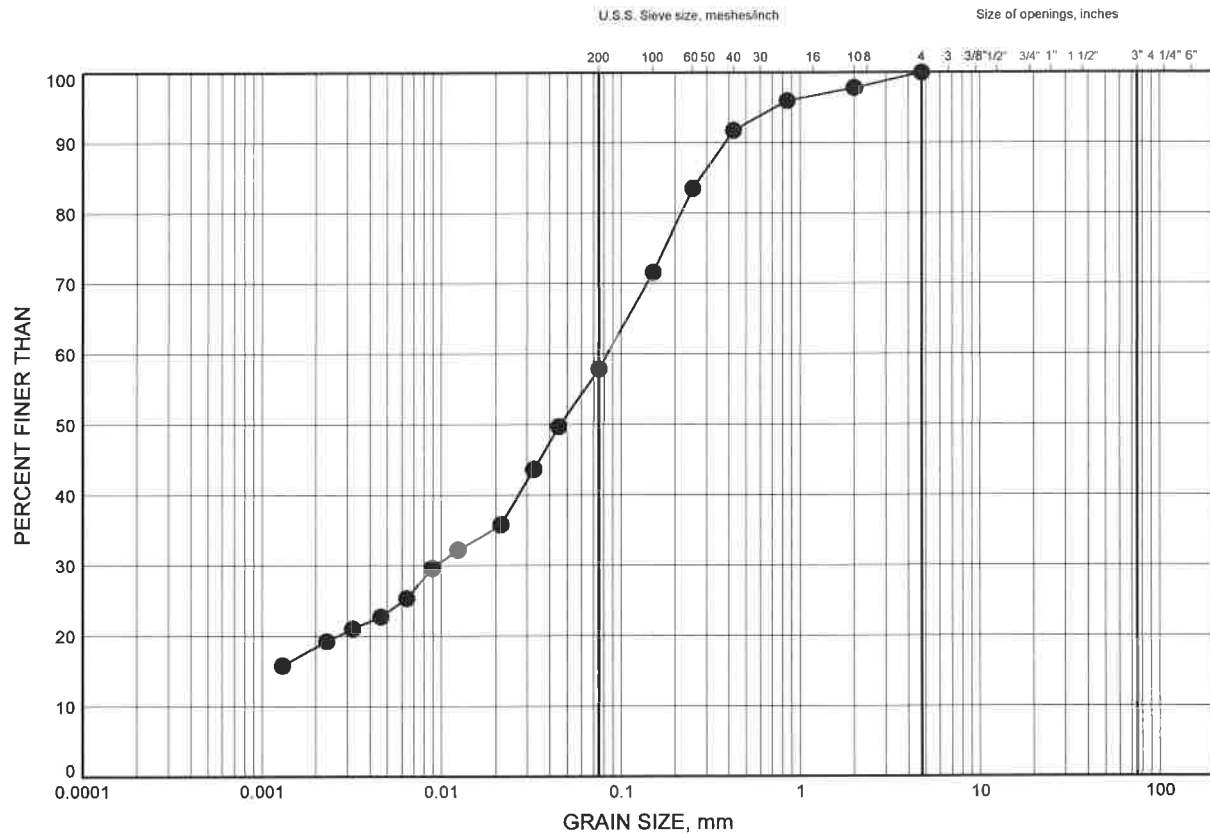


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE C11

CLAYEY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT65W-01	1.83	286.37

FIGURE C12

U.S.S. Sieve size, meshes/inch

Size of openings, inches

PERCENT FINER THAN

GRAIN SIZE, mm

Grain Size (mm)	Percent Finer (%)
0.075	21
0.15	25
0.3	28
0.6	32
1.2	35
2.5	38
5.0	43
10	47
20	50
40	53
75	62
150	72
300	82
600	90
1250	94
2500	96
5000	99
10000	100

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

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT41-01	4.11	278.39

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/26/13

Date August 2013

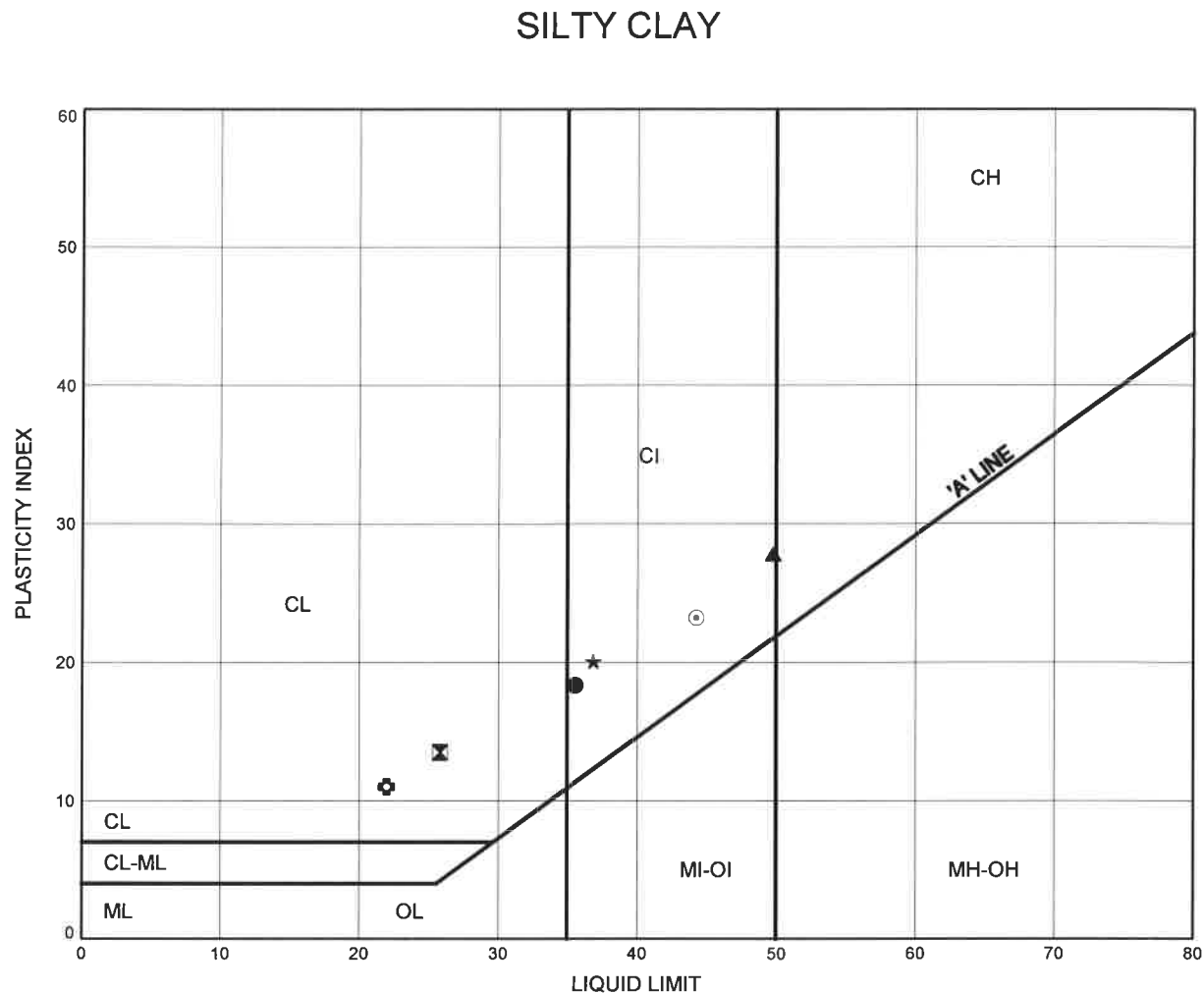
GWP# 83-00-00



Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE C13



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C51-01	3.35	282.35
⊠	C51-01	4.88	280.82
▲	C51-02	3.35	282.35
★	NLAT106W-01	3.35	293.35
⊙	NLAT37-01	3.35	281.95
⊕	NLAT78-01	1.98	290.62

Date August 2013
GWP# 83-00-00

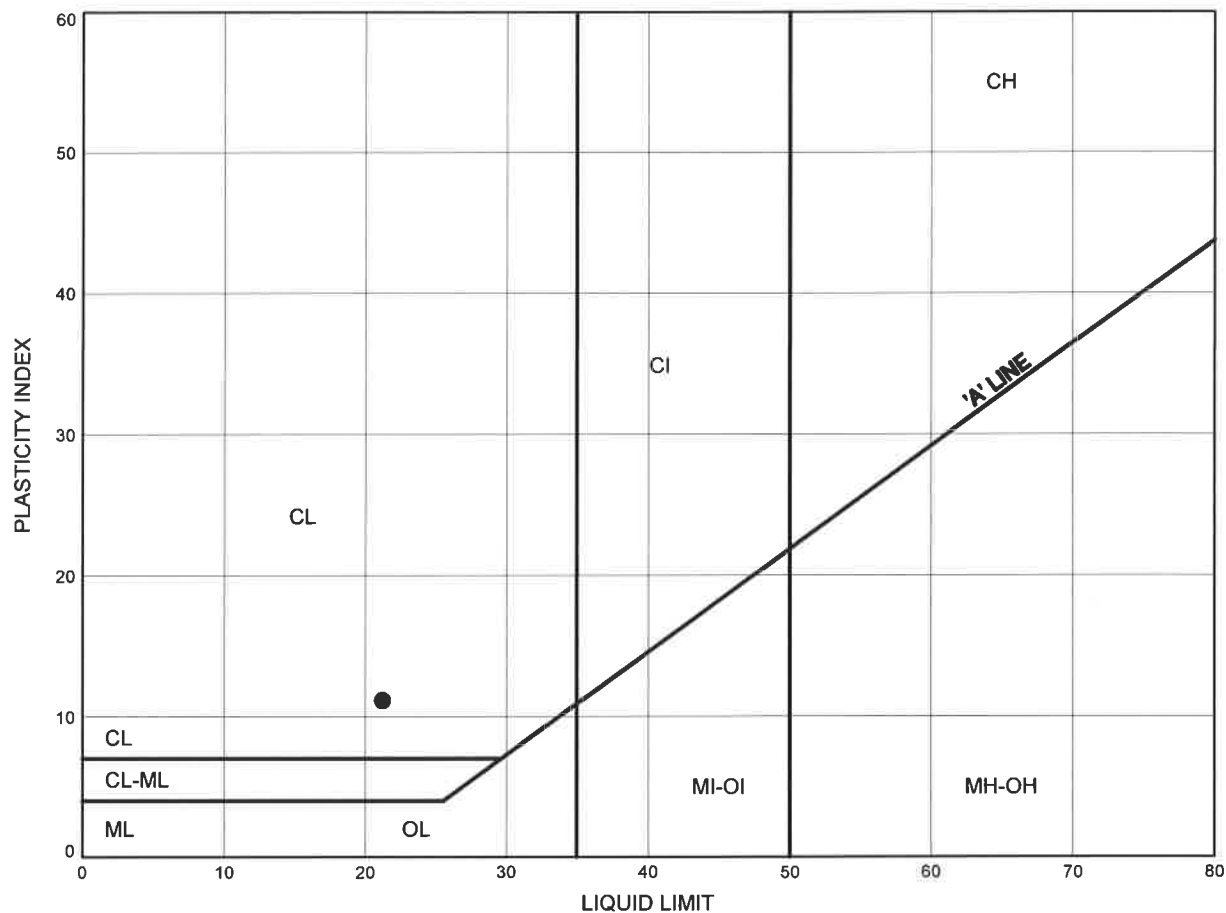


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE C14

SILTY CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT79E-01	4.19	287.21

Date August 2013
GWP# 83-00-00

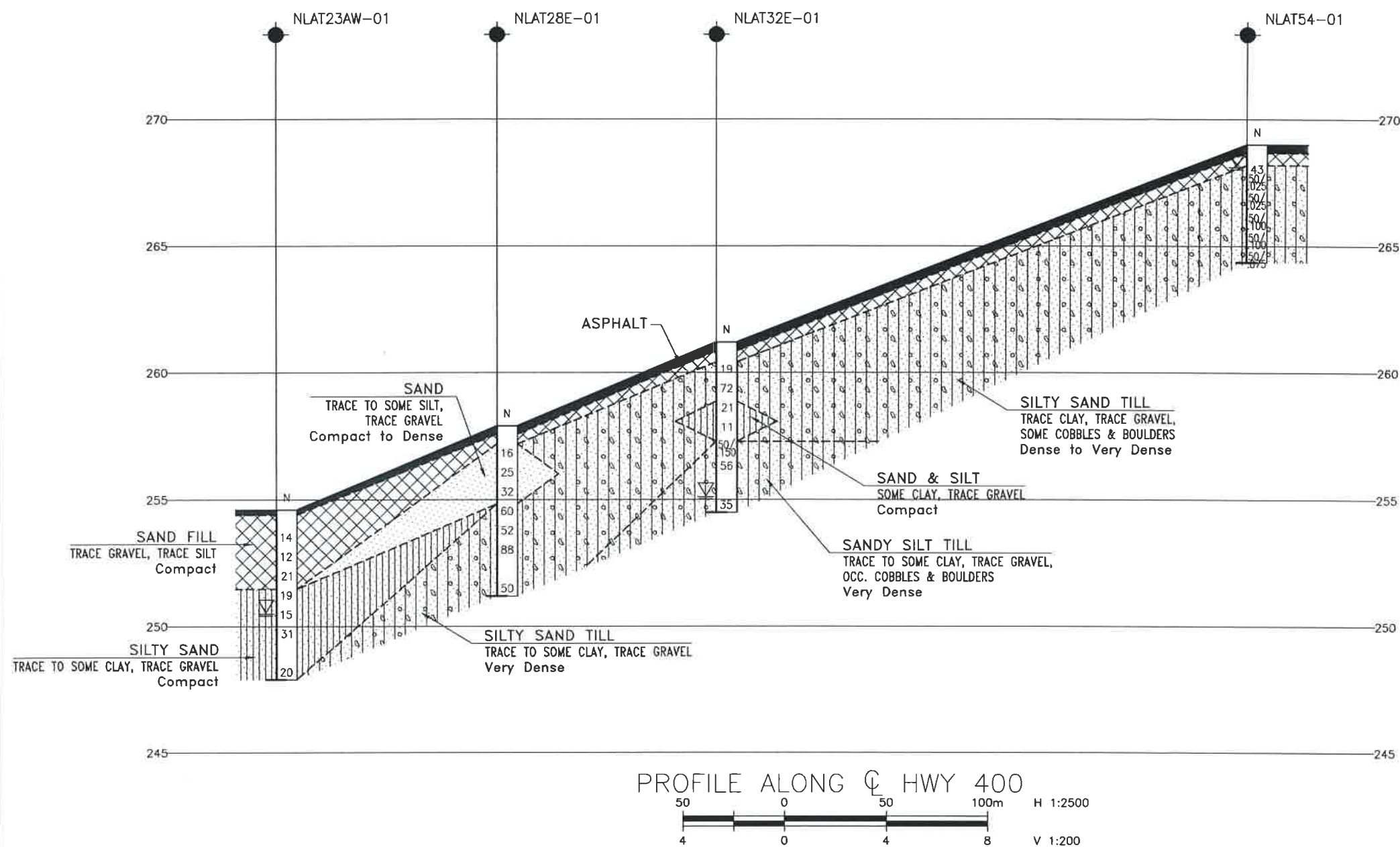


Prep'd AN
Chkd. SKP

LEGEND

- | NO | ELEVATION | NORTHING | EASTING |
|-------------|-----------|-------------|-----------|
| NLAT23AW-01 | 254.6 | 4 898 385.2 | 291 716.3 |
| NLAT28E-01 | 257.9 | 4 898 492.8 | 291 703.2 |
| NLAT32E-01 | 261.2 | 4 898 597.9 | 291 682.2 |
| NLAT54-01 | 269.0 | 4 898 852.7 | 291 634.7 |

GEOCRES No. 31D-563

[illegible]



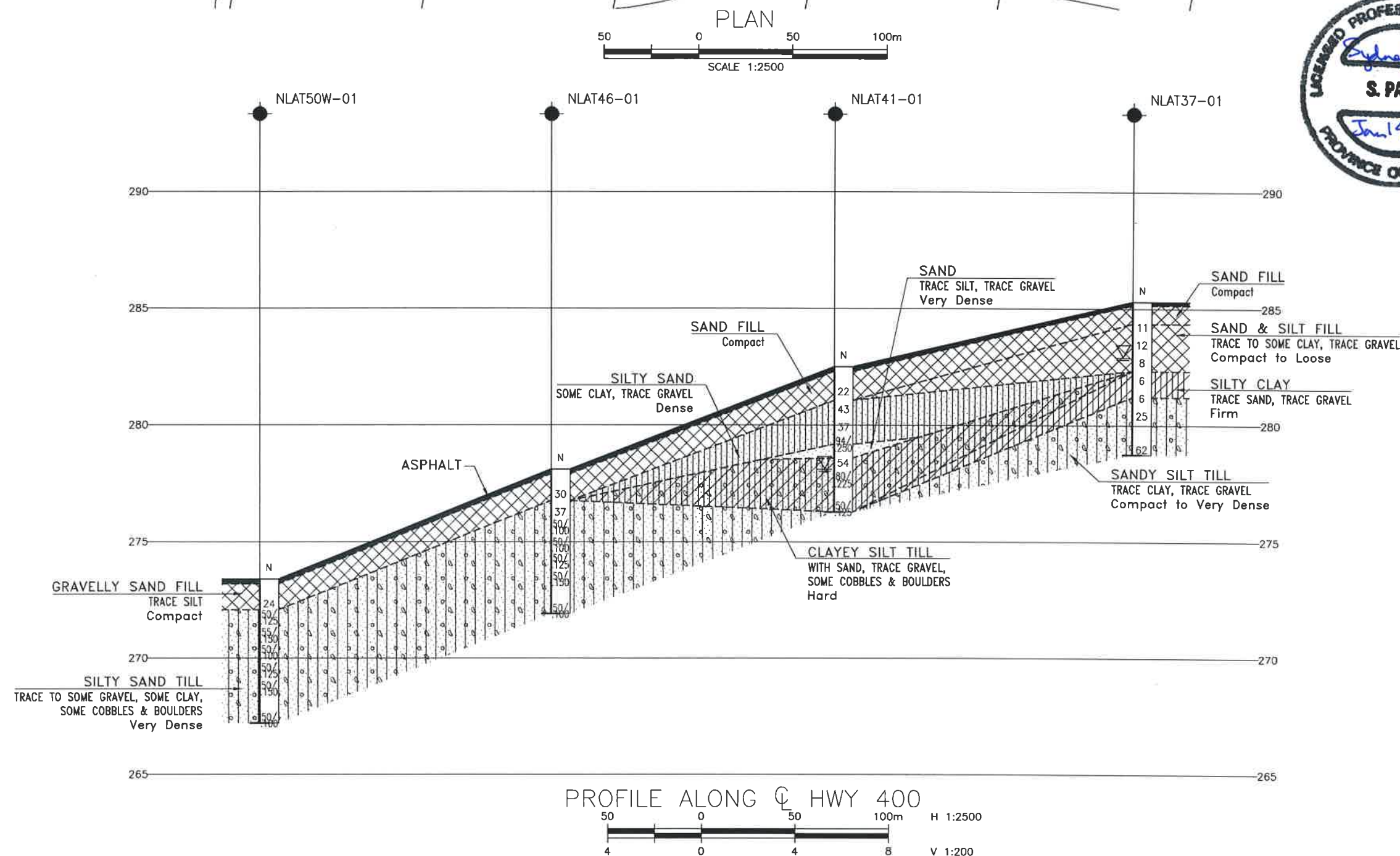
LEGEND

- | NO | ELEVATION | NORTHING | EASTING |
|------------|-----------|-------------|-----------|
| NLAT50W-01 | 273.4 | 4 898 999.7 | 291 600.0 |
| NLAT46-01 | 278.1 | 4 899 152.1 | 291 571.0 |
| NLAT41-01 | 282.5 | 4 899 299.9 | 291 543.0 |
| NLAT37-01 | 285.3 | 4 899 454.4 | 291 506.0 |

- 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.

[illegible]

3 FILENAME: H:\Drafting\19\1351\218\19d1218-Plan&Profile.dwg



DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

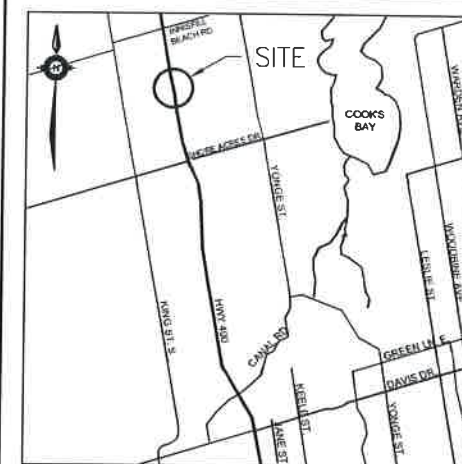
CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 14+750 TO 15+450)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET







THURBER ENGINEERING LTD



KEYPLAN

LEGEND

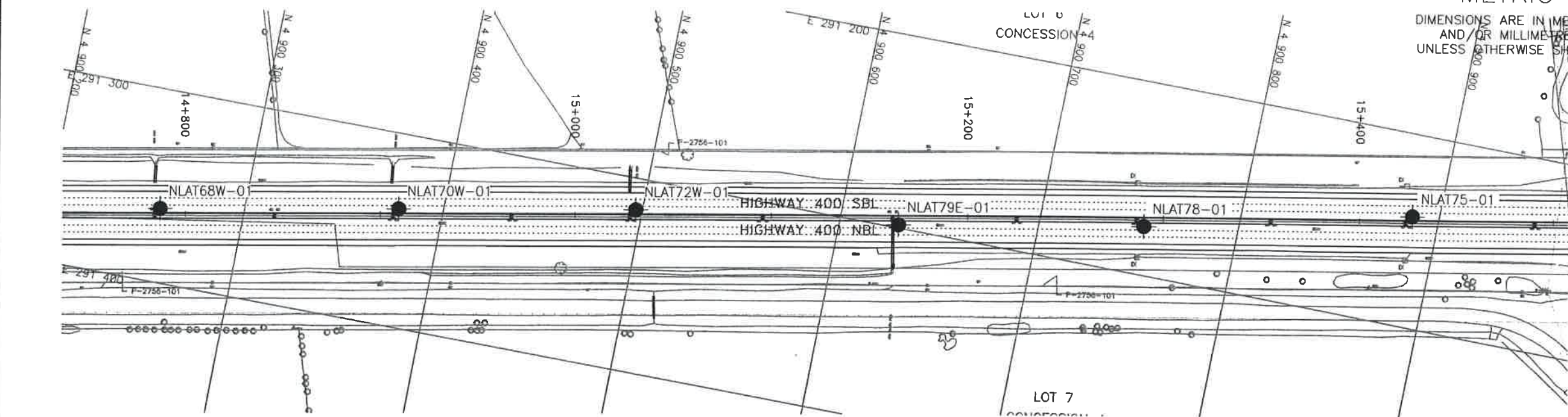
- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |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

[illegible]

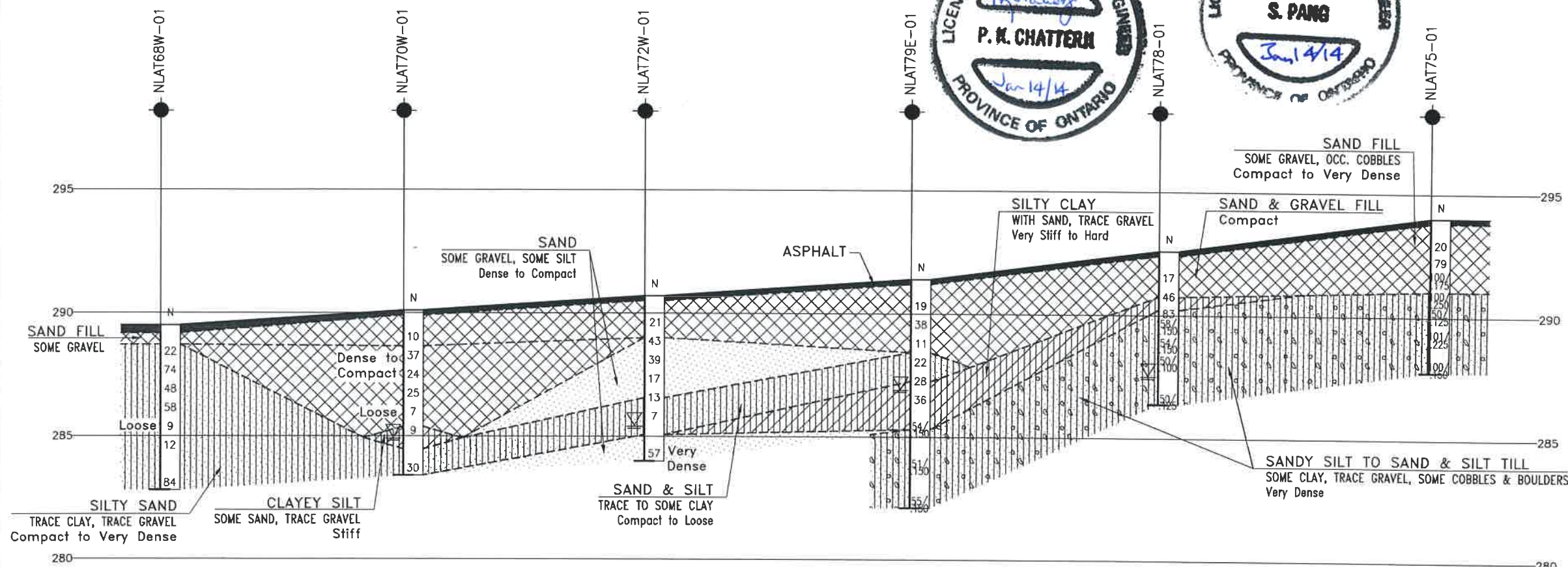
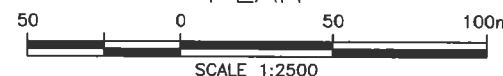
-NOTES-

- 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.

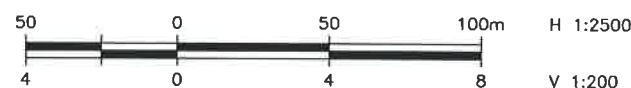
GEOCRES No. 31D-563



PLAN



PROFILE ALONG C HWY 400

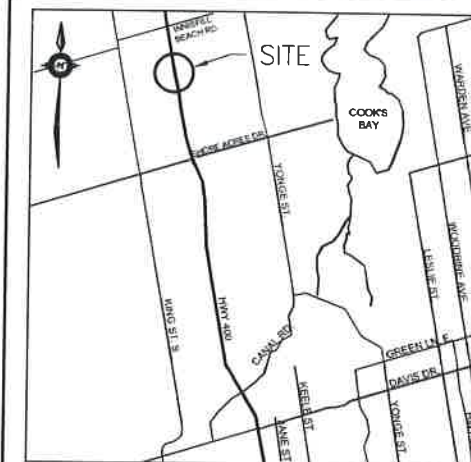
[illegible]



SHEET







THURBER ENGINEERING LTD



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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 |

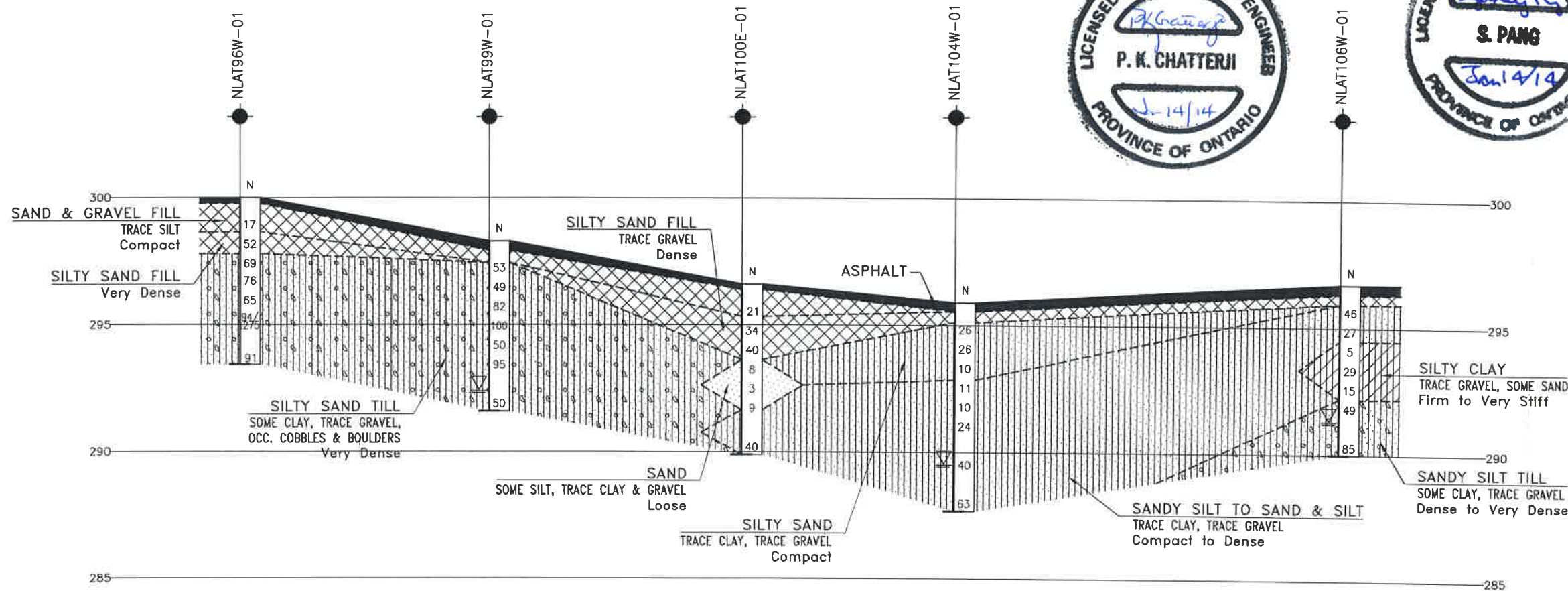
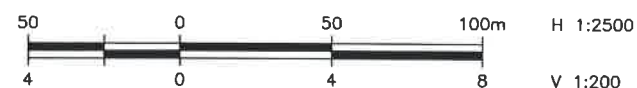
NO	ELEVATION	NORTHING	EASTING
NLAT96W-01	300.0	4 901 873.7	291 055.
NLAT99W-01	298.3	4 901 993.7	291 032.
NLAT100E-01	296.6	4 902 116.7	291 016.
NLAT104W-01	295.9	4 902 218.1	290 990.
NLAT105W-01	296.7	4 902 403.5	290 954.

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
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GEOCRES No. 31D-563

PROFILE ALONG C_L HWY 400

[illegible]

Appendix D

Sections 15 and 16








(Stations 18+350 to 19+800 Innisfil)

RECORD OF BOREHOLE No NLAT04-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 388.5 E 290 578.0 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 15 - 2013 05 15 CHECKED BY SKP

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					
							20 40 60 80 100						
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL × LAB VANE						
							20 40 60 80 100						
								PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
								W _p	W	W _L			
								WATER CONTENT (%)					
								20 40 60					
304.1													
0.0	ASPHALT: (300mm)						304						
303.8			1	AS									
0.3	SAND, trace gravel												
303.3	Brown												
0.8	Moist												
	(FILL)												
	Silty SAND, trace clay, trace to some gravel		1	SS	10		303						10 70 20
	Compact												(SI+CL)
302.5	Brown												
1.6	Moist												
	Silty CLAY, with sand, trace gravel		2	SS	17		302						1 39 31 29
301.8	Very Stiff												
	Brown												
2.3	Moist												
	(FILL)												
	Silty SAND, trace to some gravel, trace clay		3	SS	96		301						
	Very Dense												
	Brown												
	Moist												
300.4			4	SS	59								
3.7	Compact												
			5	SS	18		300						
			6	SS	14		299						
298.5													
5.6													
	Wet						298						
			7	SS	36								
297.4													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.												

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/13/13

RECORD OF BOREHOLE No NLAT08-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 238.1 E 290 605.5 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 16 - 2013 05 16 CHECKED BY SKP

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
302.4												
0.0	ASPHALT: (200mm)											
0.2	SAND, some to trace gravel, occasional cobble Dense Brown Moist (FILL)		1	AS			302					
			1	SS	35							
300.9							301					
1.5	Silty SAND, some clay, trace gravel Very Dense Brown Moist (TILL)		2	SS	99							6 58 25 11
			3	SS	88		300					
			4	SS	57		299					
	Occasional inferred cobbles		5	SS	76		298					3 61 25 11
			6	SS	69		297					
295.8			7	SS	101		296					
6.6	END OF BOREHOLE AT 6.6m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.7m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO), GDT 8/26/13

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

RECORD OF BOREHOLE No NLAT118W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 921.3 E 290 477.0 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.15 - 2013.05.15 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
307.8	ASPHALT: (325mm)		1	AS									
0.0													
307.4													
0.4	Gravelly SAND, trace silt												
307.0	Brown												
0.8	Moist												
	(FILL)												
	Silty SAND, some clay, trace gravel		1	SS	21								
	Compact												
	Brown												
	Moist												
			2	SS	19								
305.5													
2.3	Clayey SILT, with sand, trace gravel		3	SS	25								
	Very Stiff to Hard												
	Brown												
	Moist												
	(TILL)												
			4	SS	46								
			5	SS	34								
			6	SS	43								
			7	SS	21								
301.1													
6.7	END OF BOREHOLE AT 6.7m												
	BOREHOLE OPEN TO BOTTOM												
	WITH NO FREE WATER UPON												
	COMPLETION.												
	BOREHOLE BACKFILLED WITH												
	BENTONITE TO 3.0m, CUTTINGS TO												
	1.5m, CONCRETE TO 0.15m THEN												
	ASPHALT TO SURFACE.												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

+ 3 x 3 : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT124E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 903 791.3 E 290 698.2 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.29 - 2013.05.29 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
297.2	ASPHALT: (300mm)												
0.0													
296.9													
0.3	Gravelly SAND, trace silt Brown		1	AS			297						
296.4	Moist (FILL)												
0.8	Silty SAND, some clay, trace gravel Very Dense to Compact Brown Moist		1	SS	59		296						8 63 29 (SI+CL)
			2	SS	35		295						
			3	SS	16		294						2 60 27 11
			4	SS	18		293						
293.4	Clayey SILT, with sand, trace gravel Stiff to Very Stiff Brown Moist		5	SS	12		292						4 41 39 16
3.8			6	SS	10		291						
			7	SS	21								Split spoon wet
290.5	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOELPLUG TO 3.0m, CUTTINGS TO 1.5m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.												
6.7													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No NLAT127-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 073.6 E 290 637.6 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.16 - 2013.05.16 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
300.6												
0.0	ASPHALT: (188mm)											
0.2	SAND, some gravel Brown Moist (FILL)		1	AS			300					
299.7												
0.9	Silty SAND, trace to some clay, trace gravel Compact to Dense Brown Moist		1	SS	20		299					
			2	SS	38							3 61 26 10
298.3												
2.3	Silty SAND, some clay, trace gravel Very Dense Brown Moist (TILL)		3	SS	52		298					
			4	SS	54		297					1 60 26 13
			5	SS	59							
			6	SS	65		296					
							295					
			7	SS	52							
293.9							294					
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOELPLUG TO 1.6m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

RECORD OF BOREHOLE No NLAT128W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 031.6 E 290 635.1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.03 - 2013.06.03 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
300.1												
0.0	ASPHALT: (200mm)											
0.2	SAND and GRAVEL, trace silt Brown Moist (FILL)		1	AS			300					
299.3												
0.8	SAND and SILT, trace clay, trace gravel Loose Brown Moist		1	SS	9		299					
298.7												
1.4	Very Dense		2	SS	59							2 52 36 8
			3	SS	62		298					
297.1												
3.0	Silly SAND, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		4	SS	46		297					2 59 27 12
			5	SS	59		296					
			6	SS	55		295					
			7	SS	76		294					
293.4												
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

+ 3 x 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT12W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 658 5 E 290 526 6 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.15 - 2013.05.15 CHECKED BY SKP

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		
306.4	ASPHALT: (325mm)													
0.0														
306.1			1	AS										
0.3	SAND, trace gravel Brown													
305.6	Moist (FILL)													
0.8														
	Silty SAND, some gravel Very Dense Brown Moist		1	SS	70									
			2	SS	47									
			3	SS	12									
			4	SS	26									
302.6														
3.8	Sandy SILT, trace gravel Very Dense Brown Moist (TILL)		5	SS	52									
			6	SS	90									
300.1			7	SS	50/									
6.3	END OF BOREHOLE AT 6.3m BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.				0.150									

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/26/13

RECORD OF BOREHOLE No NLAT131-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 903 907 5 E 290 669 9 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 05 16 - 2013 05 16 CHECKED BY SKP

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			SHEAR STRENGTH kPa								WATER CONTENT (%)							
								○ UNCONFINED		+ FIELD VANE						● QUICK TRIAXIAL		× LAB VANE					
								20	40	60						80	100	20	40	60	20	40	60
298.6																							
0.0	ASPHALT: (200mm)																						
0.2	SAND, some to trace gravel, some silt and clay Compact Brown Moist (FILL)		1	AS																			
			1	SS	18											6 69 25 (SI+CL)							
	Loose		2	SS	7																		
296.4																							
2.2	Silty SAND, some clay, trace gravel Loose Brown Moist FILL)		3	SS	8											2 58 28 12							
295.1			4	SS	12																		
3.5	SAND, fine grained, trace silt Loose to Compact Brown Moist																						
			5	SS	4																		
			6	SS	26																		
293.0																							
5.6	Trace gravel Dense Moist to Wet		7	SS	34																		
290.4			8	SS	30																		
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 7.3m AND WATER LEVEL AT 6.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.6m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.																						

RECORD OF BOREHOLE No NLAT13E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 904 687.8 E 290 544.5 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.06.02 - 2013.06.02 CHECKED BY SKP

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					
306.7								20 40 60 80 100		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
0.0	ASPHALT: (200mm)									W _P	W	W _L	
0.2	SAND and GRAVEL, trace silt Brown Moist (FILL) Compact		1	AS									
			1	SS	20								31 64 5 (SI+CL)
305.1													
1.6	SILT, trace sand, trace organics Compact Dark Brown Moist		2	SS	12								
304.4													
2.3	Clayey SILT, with sand, trace gravel Stiff to Very Stiff Brown Moist		3	SS	10								3 41 34 22
			4	SS	19								6 40 32 22
302.9													
3.8	Sandy SILT, trace clay Compact Brown Moist		5	SS	18								
302.1													
4.6	Silty SAND, trace clay, trace gravel Very Dense Brown Moist (TILL)		6	SS	50								
			7	SS	67								
300.0													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM WITH NO FREE WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/26/13

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

RECORD OF BOREHOLE No NLAT14W-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 904 776 3 E 290 491 9 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 06 03 - 2013 06 03 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100		
307.4	ASPHALT: (350mm)											
0.0												
307.0			1	AS								
0.4	SAND and GRAVEL, trace silt											
306.6	Brown											
0.8	Moist											
	(FILL)											
	Compact		1	SS	29							
			2	SS	15							
305.1												
2.3	Silty CLAY, with sand, trace gravel											
	Firm		3	SS	7							
	Brown											
	Moist											
			4	SS	4							
303.6												
3.8	Silty SAND, some gravel, some clay											
	Compact to Very Dense		5	SS	11							
	Brown											
	Moist											
	(TILL)											
			6	SS	51							
			7	SS	58							
			8	SS	88							
			9	SS	85							
297.6												
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

+ ³, × ³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT14W-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 904 776.3 E 290 491.9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.03 - 2013.06.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)			GR SA SI CL
								20 40 60 80 100	W P W W L	20 40 60									
Continued From Previous Page																			
	BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 9.5m UPON COMPLETION BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT COLD PATCH TO SURFACE.																		

METRIC

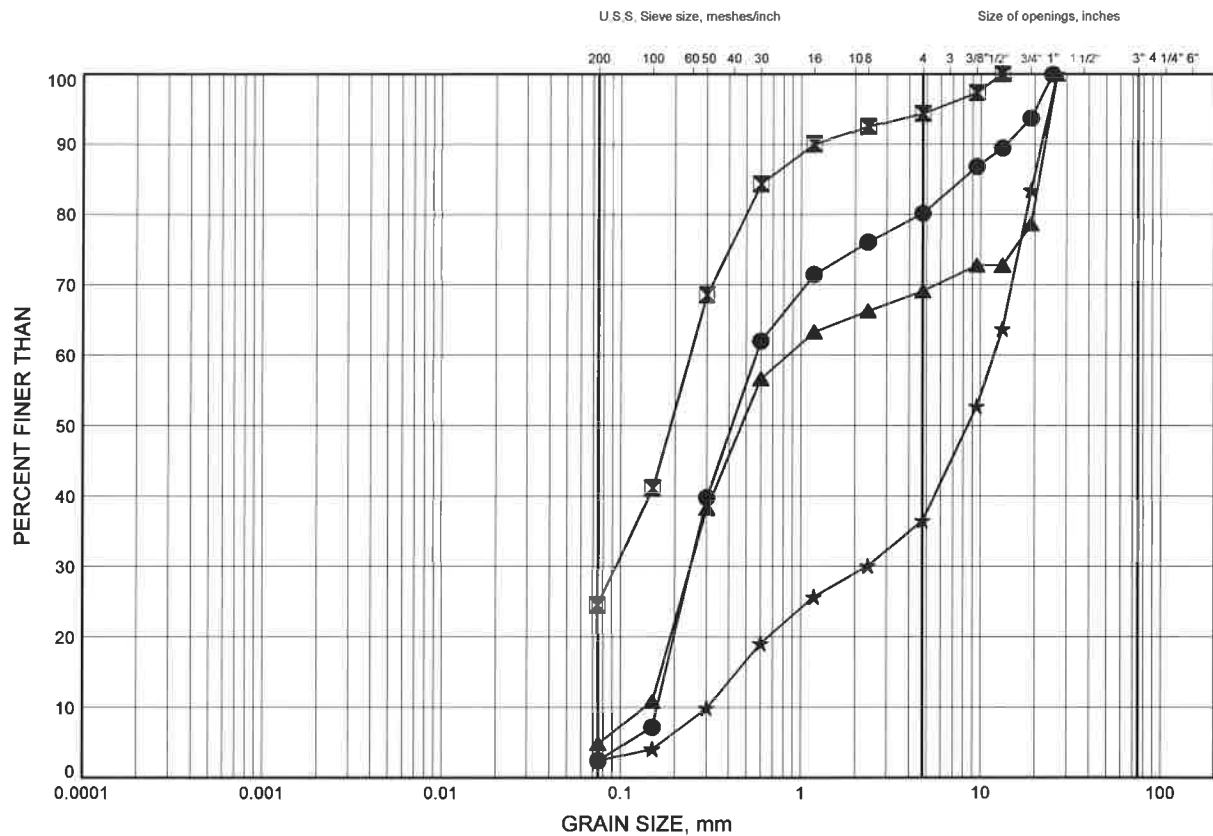
CHECKED BY SKP

+ 3, × 3: Numbers refer to Sensitivity

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D1

SAND/SAND & GRAVEL/GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT118W-01	0.53	307.27
⊠	NLAT131-01	1.07	297.53
▲	NLAT13E-01	1.07	305.63
★	NLAT14W-01	0.53	306.87

Date August 2013
GWP# 83-00-00

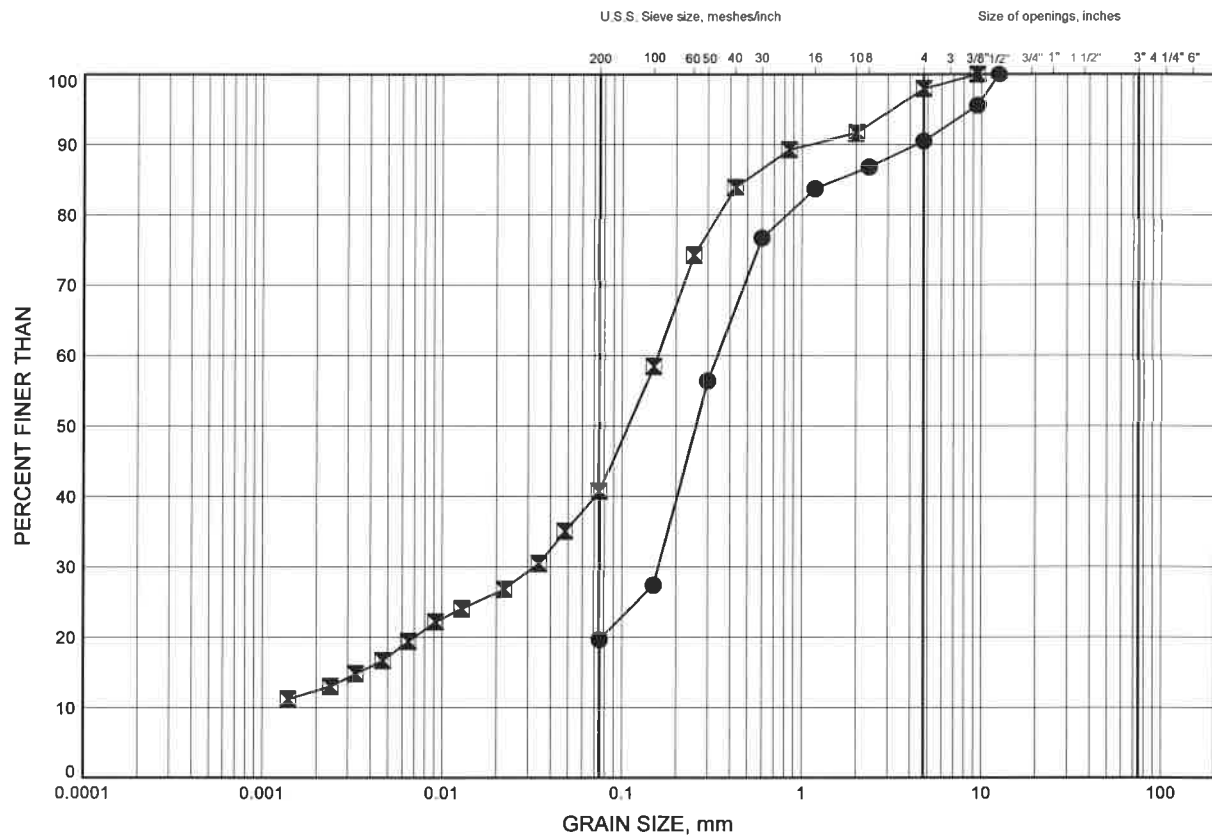


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D2

SAND & SILT/SILTY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT04-01	1.07	303.03
⊠	NLAT131-01	2.59	296.01

Date August 2013
GWP# 83-00-00

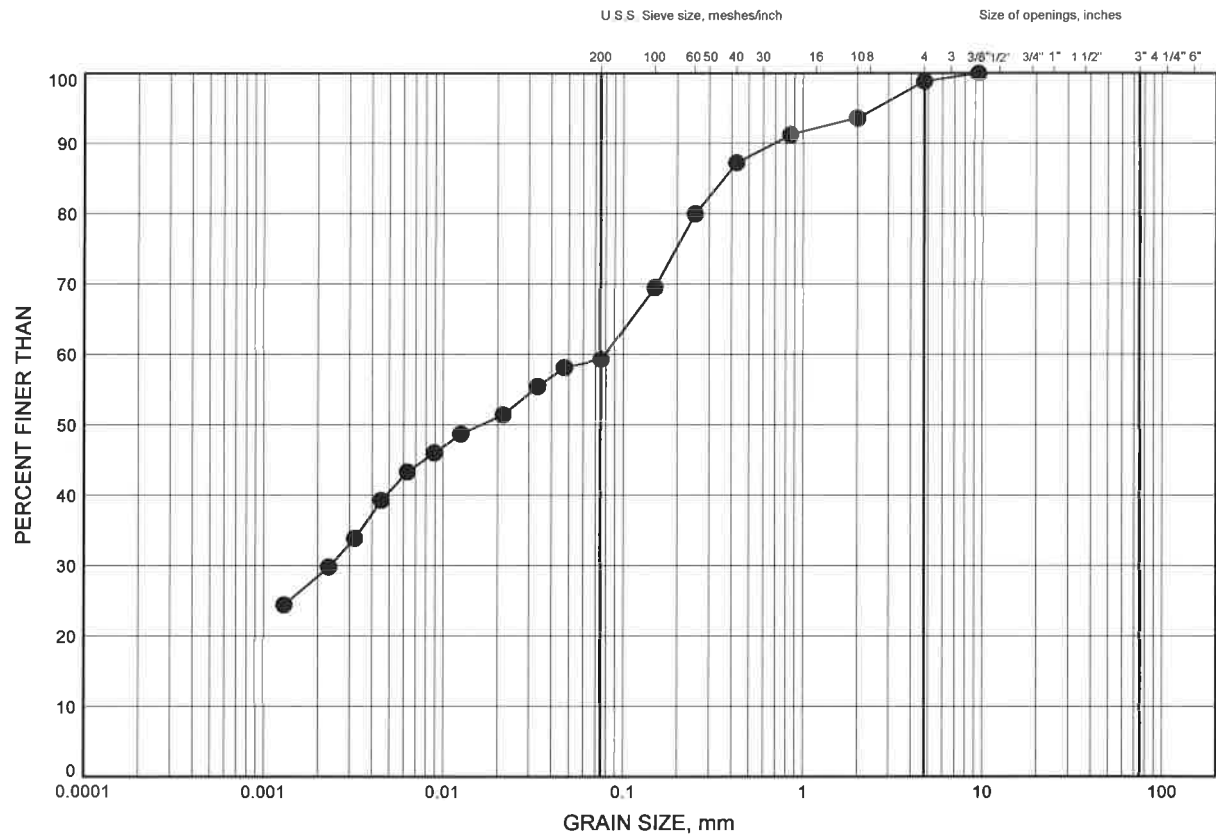


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D3

SILTY CLAY FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT04-01	1.83	302.27

Date August 2013
GWP# 83-00-00

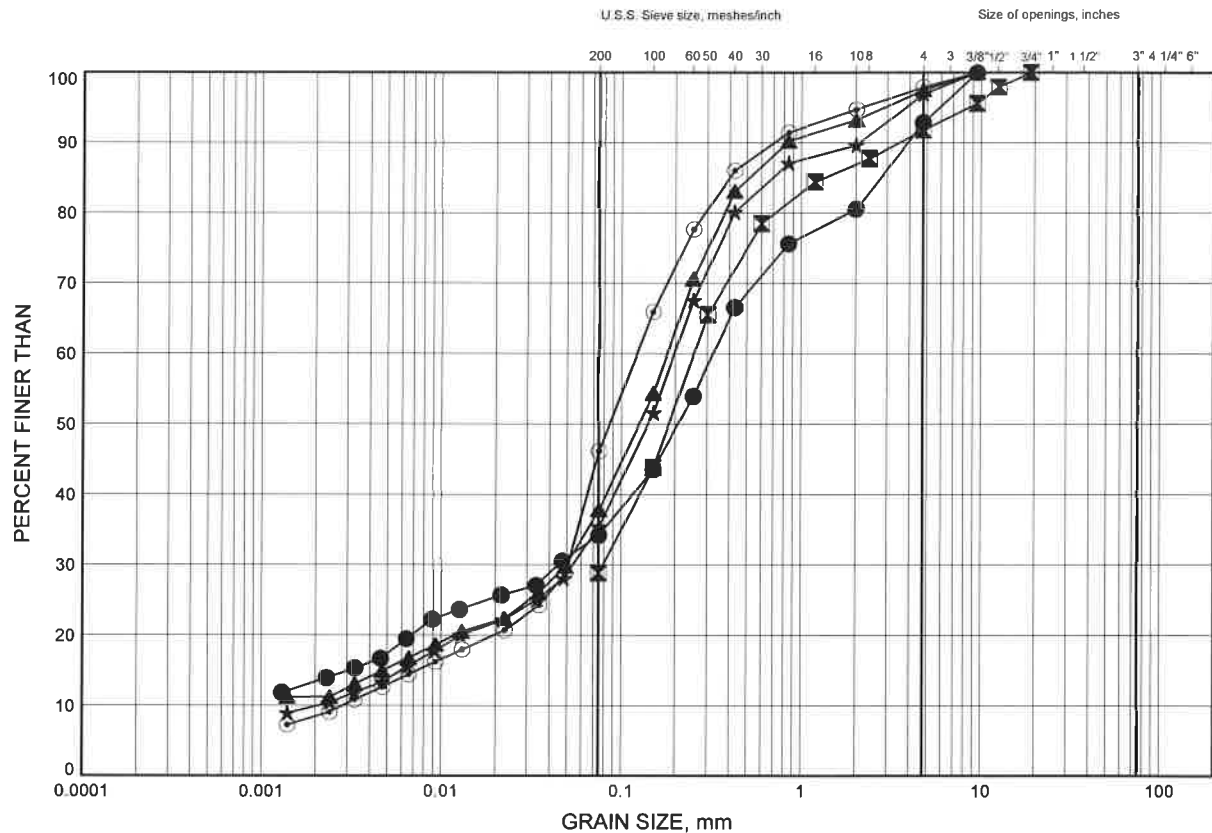


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D4

SAND & SILT/SILTY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT118W-01	1.83	305.97
⊠	NLAT124E-01	1.07	296.13
▲	NLAT124E-01	2.59	294.61
★	NLAT127-01	1.83	298.77
⊙	NLAT128W-01	1.83	298.27

Date August 2013

GWP# 83-00-00



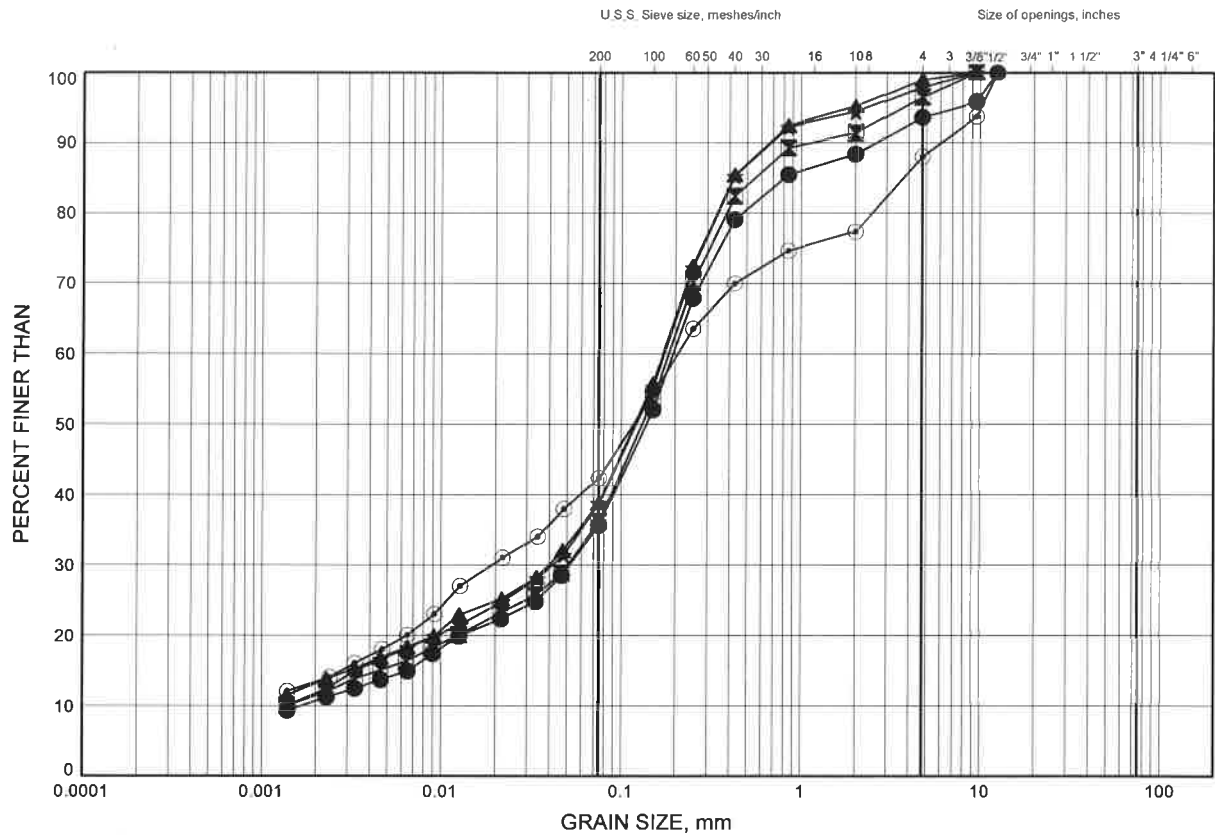
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D5

SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT08-01	1.75	300.65
⊠	NLAT08-01	4.11	298.29
▲	NLAT127-01	3.35	297.25
★	NLAT128W-01	3.35	296.75
⊙	NLAT14W-01	4.11	303.29

Date August 2013
GWP# 83-00-00

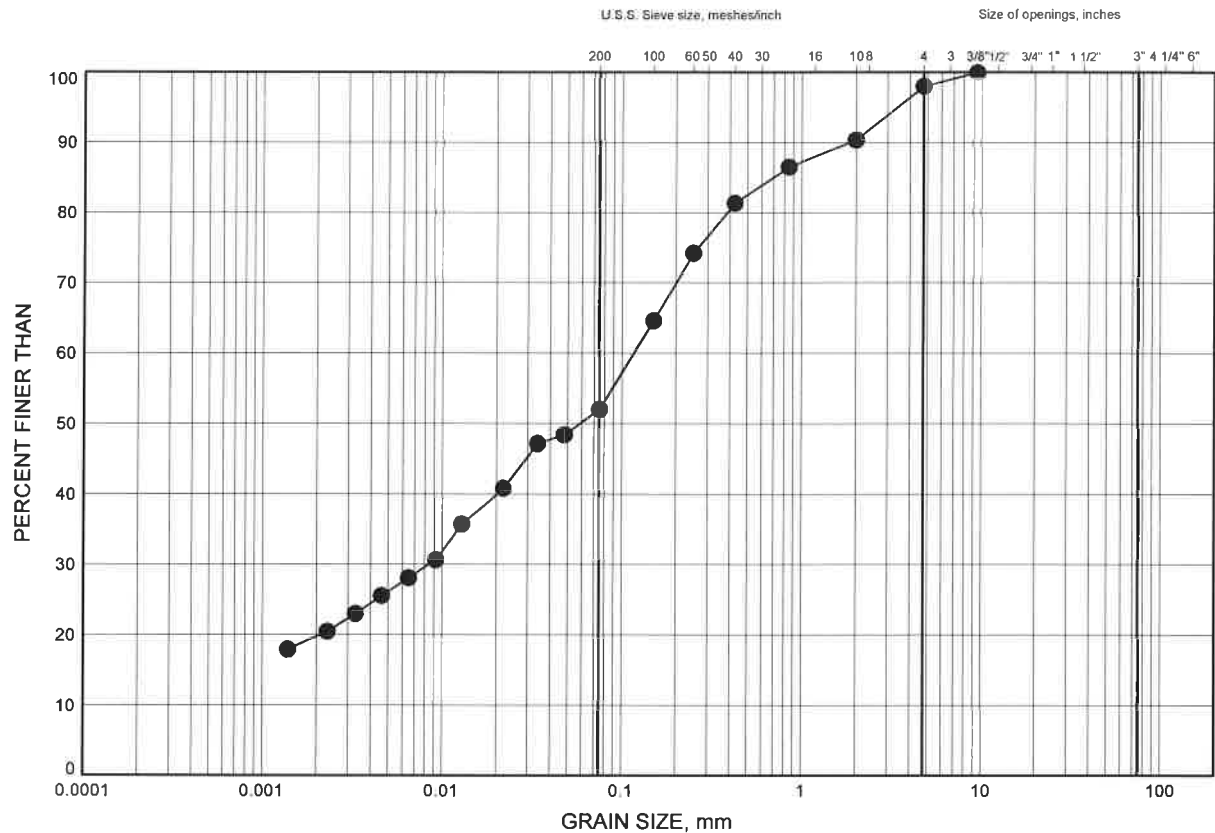


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D6

CLAYEY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT118W-01	4.11	303.69

Date August 2013

GWP# 83-00-00



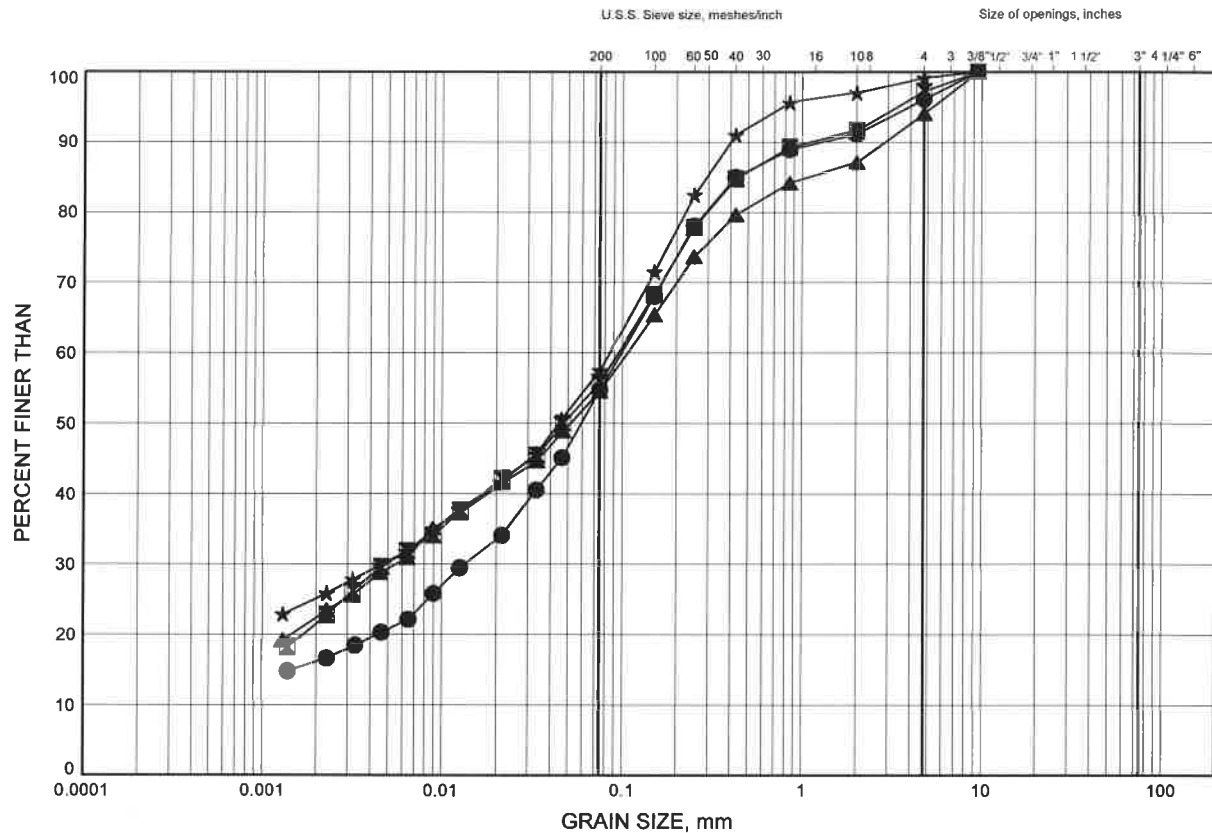
Prep'd AN

Chkd SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE D7

SILTY CLAY/CLAYEY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT124E-01	4.11	293.09
■	NLAT13E-01	2.59	304.11
▲	NLAT13E-01	3.35	303.35
★	NLAT14W-01	2.59	304.81

Date August 2013
GWP# 83-00-00

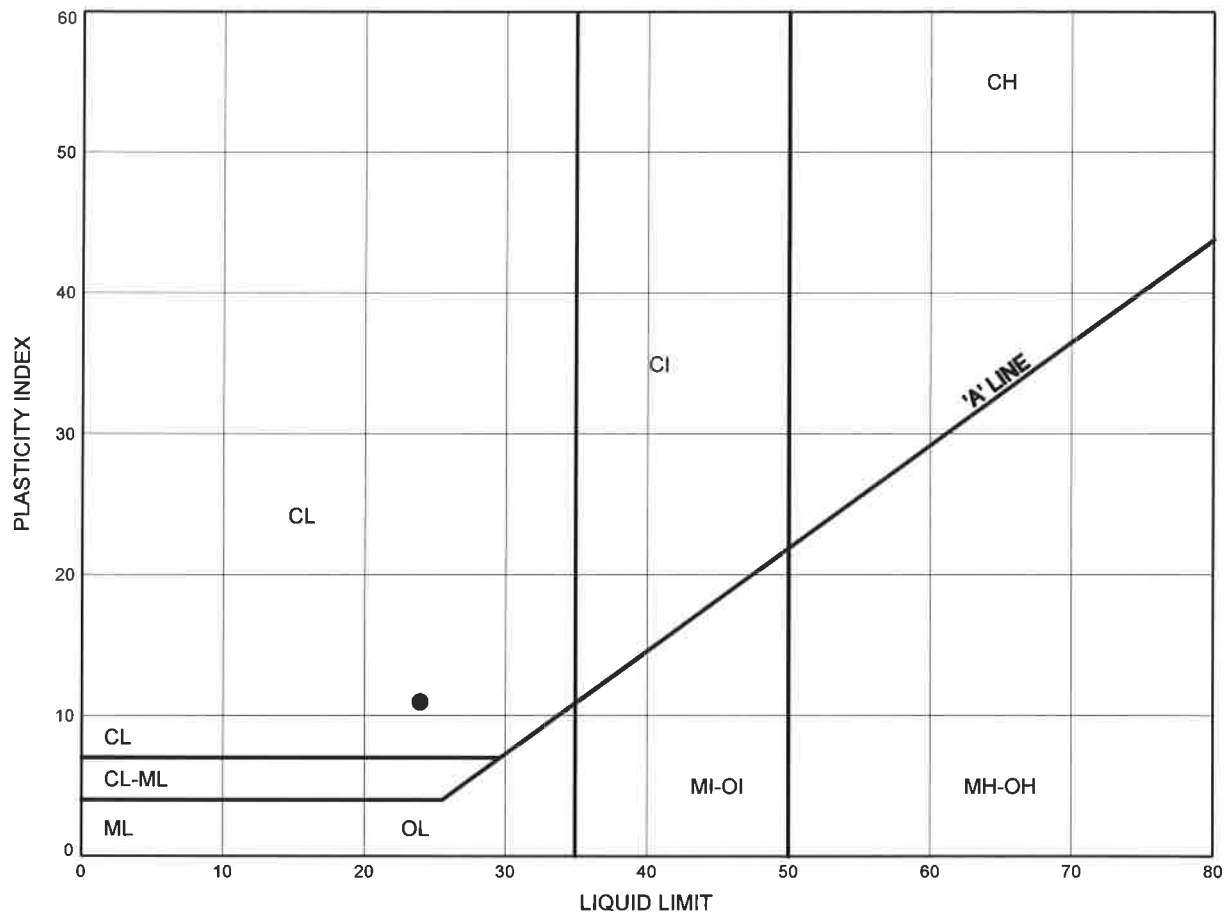


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer
ATTERBERG LIMITS TEST RESULTS

FIGURE D8

SILTY CLAY FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT04-01	1.83	302.27

Date August 2013
 GWP# 83-00-00

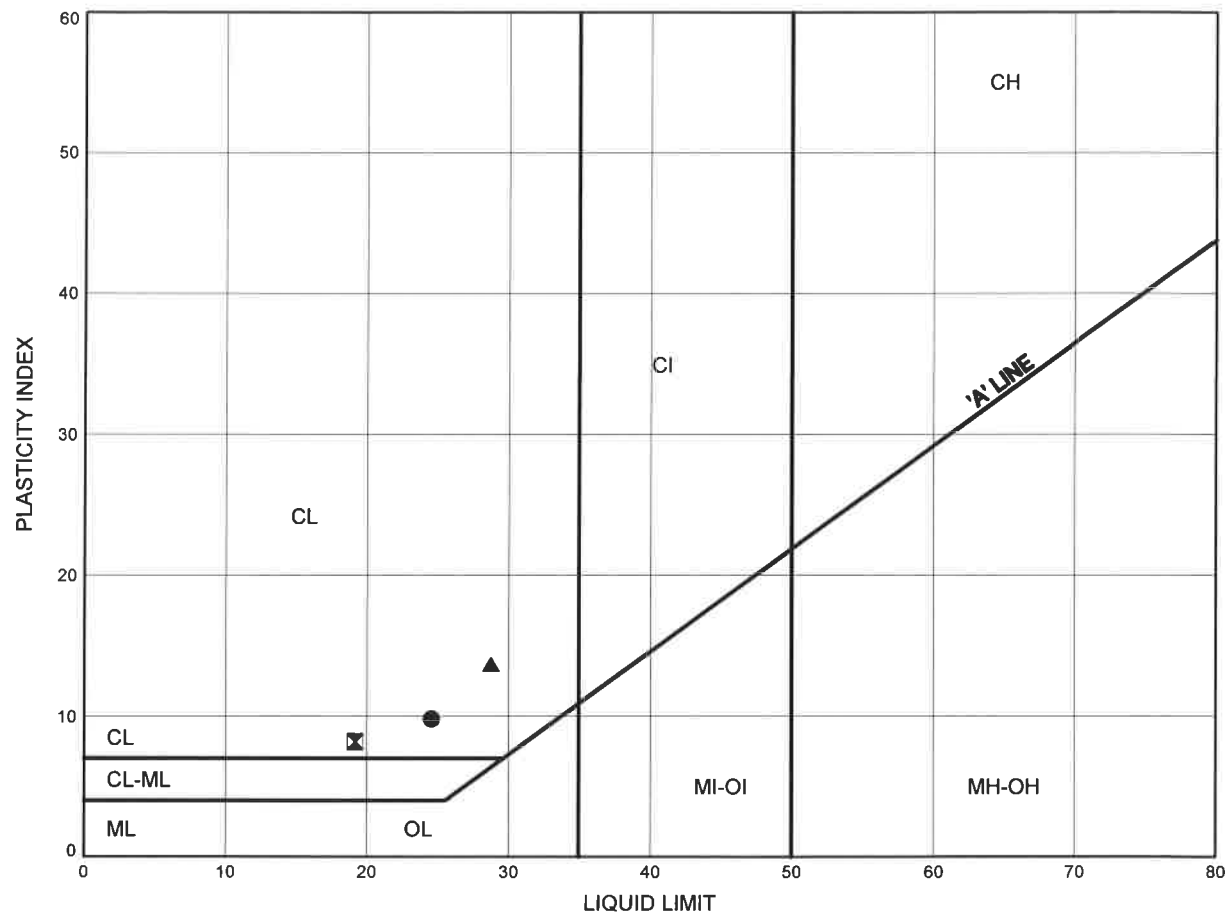


Prep'd AN
 Chkd. SKP

Hwy 400 Median Sewer
ATTERBERG LIMITS TEST RESULTS

FIGURE D9

SILTY CLAY/CLAYEY SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT124E-01	4.11	293.09
⊠	NLAT13E-01	3.35	303.35
▲	NLAT14W-01	2.59	304.81

Date August 2013
 GWP# 83-00-00

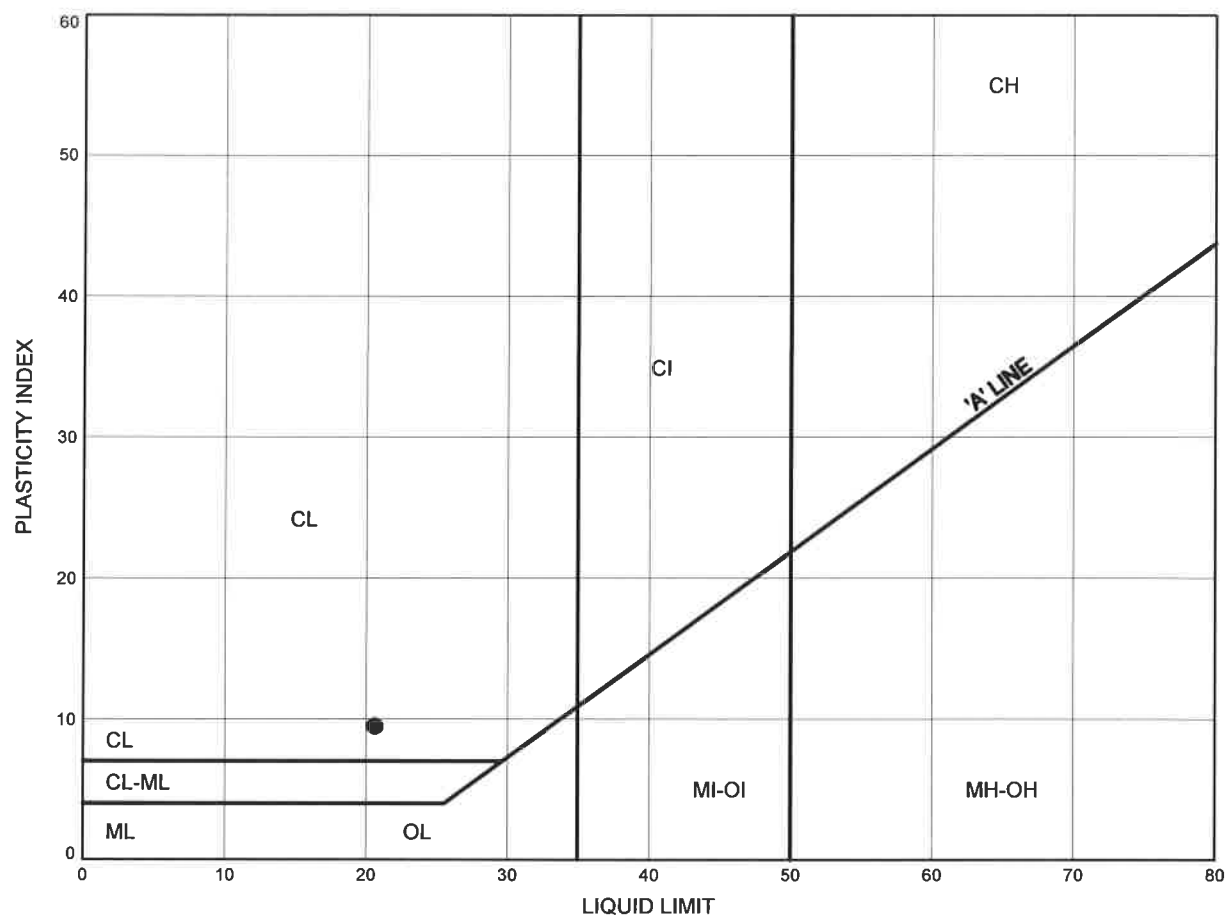


Prep'd AN
 Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE D10

CLAYEY SILT TILL



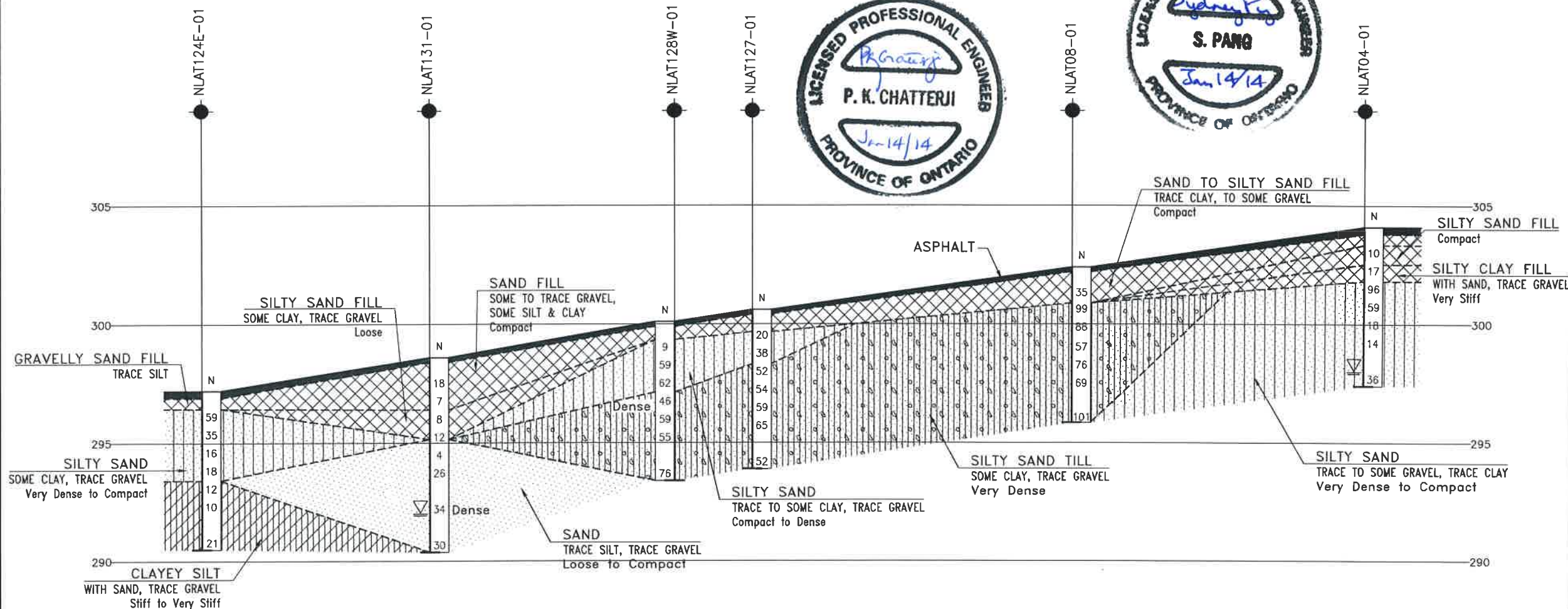
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT118W-01	4.11	303.69

Date August 2013
GWP# 83-00-00



Prep'd AN
Chkd. SKP



PROFILE ALONG C_L HWY 400



H 1:2500

V 1:200

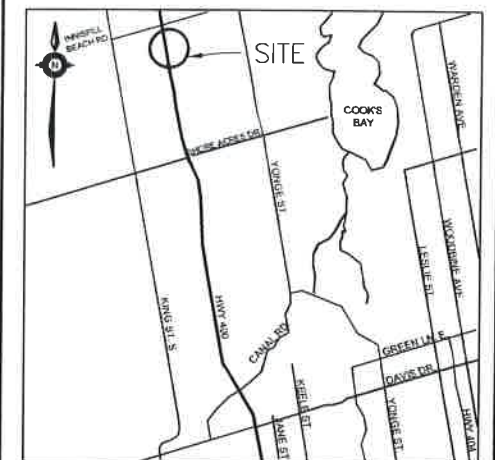
CONT No GWP No 83-00-00
HWY 400 MEDIAN SEWER MEDIAN SEWER (STA. 18+350 TO 19+000) BOREHOLE LOCATIONS AND SOIL STRATA



SHEET








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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 |

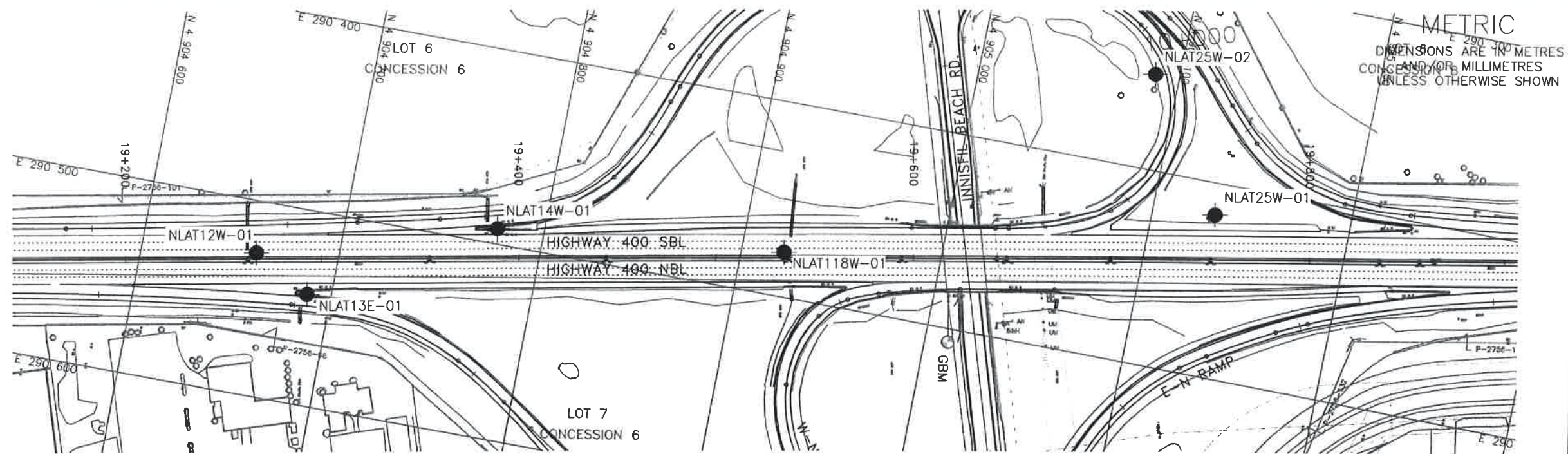
NO	ELEVATION	NORTHING	EASTING
NLAT124E-01	297.2	4 903 791.3	290 698.2
NLAT131-01	298.6	4 903 907.5	290 669.9
NLAT128W-01	300.1	4 904 031.6	290 635.1
NLAT127-01	300.6	4 904 073.6	290 637.6
NLAT08-01	302.4	4 904 238.1	290 606.5
NLAT04-01	304.1	4 904 388.5	290 578.0

-NOTES-

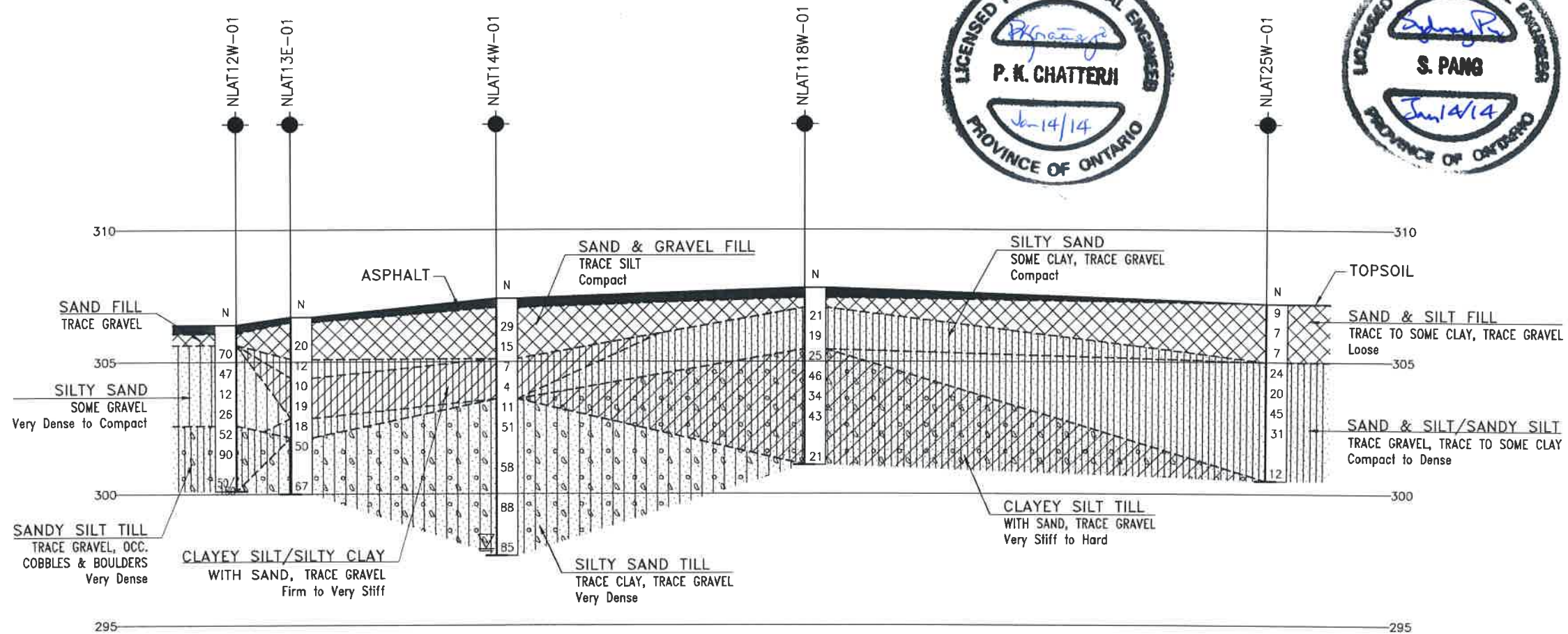
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31D-563

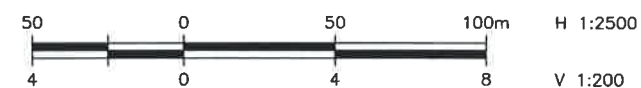
REVISIONS									
	DATE	BY							
DESIGN	SKP	CHK	SKP	CODE		LOAD		DATE	NOV. 2013
DRAWN	AN	CHK	PKC	SITE		ISTRUCT	IDWG	15	



PLAN



PROFILE ALONG C_L HWY 400



H 1:2500

V 1:200

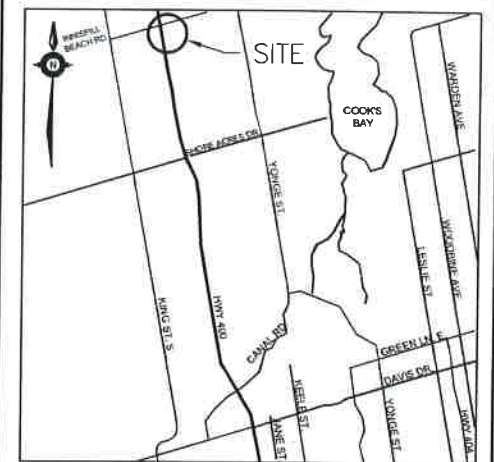
CONT No
GWP No 83-00-00

HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 19+200 TO 19+800)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET







THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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 |

[illegible]

-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. 31D-563

REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	SKP	CHK	SKP	CODE		LOAD		DATE	NOV. 2013
DRAWN	AN	CHK	PKC	SITE		ISTRUCT	1DWG	15	

Appendix E

Culvert, Headwall and Other Median Locations

RECORD OF BOREHOLE No SLAT83W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 884 709 8 E 294 270 2 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 06 - 2013 05 06 CHECKED BY SKP

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					WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			
248.4							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
0.0	ASPHALT: (350mm)							W _P	W	W _L			
248.0			1	AS									
0.4	Gravelly SAND, trace to some silt												
247.8	Brown												
0.6	Moist (FILL)		1	SS	15								
	Clayey SILT, with sand, trace gravel, occasional black staining												
	Stiff to Very Stiff												
	Brown												
	Moist (FILL)		2	SS	26								
246.2													
2.2	Trace organic pockets												
	Firm		3	SS	7							2 37 43 18	
			4	SS	6								
244.7													
3.7	Silty CLAY, some sand, trace gravel												
	Very Stiff												
	Brown												
	Moist (TILL)		5	SS	17								
			6	SS	23							0 19 44 37	
242.8													
5.6	Stiff												
	Wet												
			7	SS	14							Split spoon wet	
241.7													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 5.2m AND WATER LEVEL AT 5.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTINGS, CONCRETE AND THEN COLD PATCH TO GROUND SURFACE.												

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No SLAT41-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 888 371.1 E 293 629.8 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
288.6														
0.0	ASPHALT: (150mm)													
0.2	SAND, trace gravel, trace silt Grey Moist (FILL) Compact		1	AS			288							
			1	SS	17									0 95 5 (SI+CL)
287.3	Clayey SILT, with sand, trace gravel Stiff Brown Moist		2	SS	10		287							1 47 38 14
1.3			3	SS	15		286							
285.6	SAND and SILT, trace clay, trace gravel Compact Brown Moist Coarse sand layer (25mm) at 3.3m		4	SS	24		285							5 54 37 4
3.0			5	SS	20									Split spoon wet
			6	SS	24		284							
	Inferred cobbles						283							
			7	SS	24		282							
281.4	Clayey SILT, some sand, trace gravel Very Stiff Brown Moist (TILL)		8	SS	21		281							
7.2														
280.4	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM WITH NO PONDED WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTING MIXED WITH BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.													
8.2														

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No SLAT44-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 888 521.3 E 293 603.2 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY SKP

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		
291.0	ASPHALT: (150mm)						291							
0.0														
0.2	Gravelly SAND, trace silt		1	AS										27 67 6
290.3	Grey													(SI+CL)
0.7	Moist (FILL)													
	Compact		1	SS	20		290							
289.6														
1.4	SAND and SILT, trace gravel, trace clay Dense to Compact		2	SS	36		289							
	Brown													
	Moist													
	(TILL)													
	Compact		3	SS	37		288							6 45 44 5
			4	SS	20		287							
			5	SS	31		286							
			6	SS	22		285							
285.4							284							
5.6	Clayey SILT, trace sand, trace gravel													
	Stiff to Firm													
	Brown		7	SS	10		283							Split spoon wet
	Wet													
			8	SS	7									
282.8														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM WITH NO PONDED WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, CUTTING MIXED WITH BENTONITE HOLEPLUG TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No SLAT06E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 891 275.9 E 293 341.0 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY SKP

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				
269.7								20	40	60	80	100		
0.0	ASPHALT: (350mm)													
269.3			1	AS										
0.4	SAND and GRAVEL, trace silt													
269.0	Brown													
0.7	Moist (FILL)													
	Clayey SILT, with sand, trace gravel		1	SS	9									1 53 26 20
	Stiff to Very Stiff													
	Brown													
	Moist		2	SS	25									
267.4														
2.3	Silty CLAY, some sand, trace gravel, some organics		3	SS	4									
	Firm													
	Brown													
	Moist		4	SS	49									
	Inferred cobbles at 3.4m													
265.9														
3.8	Silty SAND, some clay, trace gravel		5	SS	15									8 51 29 12
	Compact to Dense													
	Brown													
	Moist to Wet		6	SS	35									
	Inferred cobbles													
	Inferred cobbles													
263.6														
6.1	Sandy SILT, trace gravel		7	SS	26									
	Compact													
263.0	Brown													
	Moist													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.0m WITH NO PONDED WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT TO SURFACE.													

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No SLAT19W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 892 651.3 E 293 271.2 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY SKP

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					WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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238.1							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No C32-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 892 816.8 E 293 281.5 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers/Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.09 - 2013.05.09 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100		
235.6												
0.0	ASPHALT: (225mm)											
0.2	Silty SAND, some gravel, trace clay Compact Brown Moist (FILL)		1	AS			235					
234.3			1	SS	14							16 60 21 3
1.3	Clayey SILT, some sand, trace gravel, some organics Stiff Grey Moist		2	SS	9		234					
233.3												
2.3	SAND and GRAVEL, trace to some silt Compact to Dense Grey Wet		3	SS	29		233					Split spoon wet
			4	SS	34							37 50 13 (SI+CL)
231.9							232					
3.7	Sandy SILT, some gravel Compact Grey Wet		5	SS	10							
231.1												
4.5	Clayey SILT, with sand, trace gravel Stiff Grey Wet		6	SS	9		231					2 48 34 16
230.0							230					
5.6	Sandy SILT, trace gravel Very Dense Grey Wet		7	SS	57							Resistance to split spoon advance. Borehole sloughed to 2.8m. Switched to hollow stem augers.
							229					
228.5												
7.1	Compact						228					
			8	SS	18							
							227					
			9	SS	24							
225.8							226					
9.8	END OF BOREHOLE AT 9.7m											

Continued Next Page

+ 3 x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C32-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 892 816.8 E 293 281.5 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers/Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.09 - 2013.05.09 CHECKED BY SKP

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	W _p	W	W _L		
	Continued From Previous Page																
	BOREHOLE WET UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m)																

METRIC

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 C					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								UNCONFINED ○	FIELD VANE +			QUICK TRIAXIAL ●	LAB VANE ×	P	N	L
235.8 0.0	ASPHALT: (175mm)	[Pattern]														
0.2	SAND, some to trace gravel Compact Brown Moist (FILL)	[Pattern]	1	AS												
234.3 1.5	Silty SAND, trace clay, trace gravel Compact Brown Moist (FILL)	[Pattern]	1	SS	28											
233.6 2.2	Loose	[Pattern]	2	SS	14											
232.8 3.0	Occasional inferred cobble	[Pattern]	3	SS	4											
232.0 3.8	Gravelly SAND, occasional inferred cobble Dense Brown Wet	[Pattern]	4	SS	11											
231.5 4.3	Clayey SILT, with sand, trace gravel Stiff Brown to Grey Moist	[Pattern]	5	SS	41											
229.7 6.1	Gravelly SAND Compact Grey Saturated	[Pattern]	6	SS	15											
229.3 6.5	Clayey SILT, some sand, trace gravel Stiff Grey Wet	[Pattern]	7	SS	10											
228.0 7.8	Gravelly seams Sandy SILT, trace gravel Compact Grey Wet	[Pattern]	8	SS	12											
226.0 9.8	END OF BOREHOLE AT 9.8m.	[Pattern]	9	SS	28											

+ ³, × ³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No C32-02

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 892 810.9 E 293 251.1 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.15 - 2013.05.15 CHECKED BY SKP

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	WATER CONTENT (%)	W _p	W		
	Continued From Previous Page						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
	BOREHOLE OPEN TO 6.3m AND WATER LEVEL AT 3.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.15m THEN ASPHALT TO SURFACE.												

RECORD OF BOREHOLE No SLAT109W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 892 917.8 E 293 256.3 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
235.5	ASPHALT: (350mm)												
0.0			1	AS									41 50 9
235.1													(SI+CL)
0.4	SAND and GRAVEL, trace silt Brown Moist						235						
234.6	(FILL)												
0.9	Silty SAND, some clay Loose Brown Moist		1	SS	9								
234.0							234						
1.5	Clayey SILT, with sand, trace gravel, occasional oxidized staining Firm to Very Stiff Brown Moist		2	SS	5								
			3	SS	7		233						Split spoon wet
			4	SS	14								0 29 54 17
			5	SS	16		232						
			6	SS	26		231						
							230						
	Wet		7	SS	13		229						
228.8													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 6.1m WITH NO PONDED WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, THEN ASPHALT COLD PATCH TO SURFACE.												

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RECORD OF BOREHOLE No NLAT37E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 895 779.1 E 292 386.4 ORIGINATED BY JG
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.26 - 2013.05.26 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
229.1	ASPHALT: (450mm)		1	AS			229						31 63 6 (SI+CL)
0.0													
228.6	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	SS	27		228						
0.5													
227.5	Silty SAND, trace gravel Compact Brown Moist		2	SS	10		227						
1.6													
226.8	SAND and SILT, trace to some clay, trace organics Compact Brown Moist		3	SS	12		226						0 57 33 10
2.3													
			4	SS	15		225						Split spoon wet
			5	SS	14		224						0 42 51 7
			6	SS	19		223						
							222						
			8	SS	23		221						
220.9													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 6.1m UPON COMPLETION. BORHEOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE												

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/15/13

RECORD OF BOREHOLE No NLAT40W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 896 189.8 E 292 207.1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.26 - 2013.05.26 CHECKED BY SKP

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		
228.9	ASPHALT: (350mm)													
0.0														
228.5			1	AS										
0.4	SAND, some gravel, trace silt Brown Moist (FILL)													18 75 7 (SI+CL)
228.0														
0.9	Silty SAND, trace clay Compact Brown Moist		1	SS	12		228							
			2	SS	25									
226.7							227							
2.2	Clayey SILT, with sand, trace gravel Very Stiff Brown Moist		3	SS	12		226							0 33 48 19
			4	SS	27									
225.1														
3.8	Silty SAND, trace clay Compact Brown Wet		5	SS	26		225							
			6	SS	20		224							Split spoon wet
							223							
			7	SS	29									
							222							
	Loose		8	SS	9		221							
220.7														
8.2	END OF BOREHOLE AT 8.2m BOREHOLE OPEN TO 7.0m WITH NO PONDED WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m THEN ASPHALT COLD PATCH TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/15/13

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

RECORD OF BOREHOLE No NLAT91W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 901 334.7 E 291 146.5 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.06.05 - 2013.06.05 CHECKED BY SKP

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			SHEAR STRENGTH kPa				WATER CONTENT (%)					
								20	40	60	80	100	w _p	w			w _L
298.6																	
0.0	ASPHALT: (225mm)																
0.2	SAND, trace silt, some gravel Brown Moist (FILL)		1	AS												13	81 6 (SI+CL)
297.8																	
0.8	Silty SAND, trace silt, some gravel Dense to Compact Brown Moist (FILL)		1	SS	31												
			2	SS	27											19	52 21 8
			3	SS	27												
295.3																	
3.3	Silty SAND, trace clay, trace gravel Veyr Dense Brown Moist (TILL)		4	SS	15											1	68 22 9
			5	SS	71												
	Occasional inferred cobbles		6	SS	50/ 0.075												
292.2			7	SS	52/ 0.150												
6.4	END OF BOREHOLE AT 6.4m. BOREHOLE OPEN TO BOTTOM WITH NO PONDED WATER UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.9m, CUTTINGS TO 1.6m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.																

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/15/13

RECORD OF BOREHOLE No NLAT90-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 901 425.9 E 291 140.2 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.17 - 2013.05.17 CHECKED BY SKP

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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL	
299.5								20	40	60	80	100							
0.0	ORGANICS: (200mm)																		
0.2	SAND, some to trace gravel Dense Brown Moist (FILL)		1	AS			299												
298.2			1	SS	32														
1.3	Silty SAND, trace gravel, trace to some clay Dense Brown Moist		2	SS	39		298										5	61	24 10
297.2																			
2.3	SAND, fine grained, trace gravel Very Dense Brown Moist		3	SS	60		297												
296.3																			
3.2	Silty SAND, some clay, trace gravel Very Dense Brown Moist (TILL) Possible cobble/boulders		4	SS	63		296										0	65	24 11
			5	SS	50/ 0.125														
			6	SS	100/ 0.275		295												
							294												
293.2			7	SS	50/ 0.100														
6.3	END OF BOREHOLE AT 6.3m. BOREHOLE OPEN TO BOTTOM WITH NO WATER PONDED UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.																		

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/15/13

+ 3 1/2 X 3 1/2

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No NLAT87-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 901 517 8 E 291 129 9 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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	20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
300.3													
0.0	ASPHALT: (185mm)												
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS			300						40 55 5 (SI+CL)
			1	SS	28								
298.9							299						
1.4	SAND, some silt, trace gravel, trace clay Dense to Very Dense Brown Moist (TILL)		2	SS	44								1 75 24 (SI+CL)
			3	SS	46		298						
			4	SS	77		297						3 76 21 (SI+CL)
			5	SS	50/								
					0.100		296						
			6	SS	56/								
					0.150		295						
294.1			7	SS	100/								
6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN TO BOTTOM WITH NO WATER PONDED UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.4m, CUTTINGS TO 1.9m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.				0.125								

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No NLAT108W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 902 612.9 E 290 915.3 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.16 - 2013.05.16 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
297.9														
0.0	ASPHALT: (200mm)													
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS										39 56 5 (SI+CL)
296.6			1	SS	13		297							
1.3	Silty SAND, some clay, trace gravel Compact Brown Wet (FILL)		2	SS	22		296							6 54 27 13 Split spoon wet
295.7														
2.2	Silty SAND, some clay, trace to some gravel Compact Brown Moist to Wet		3	SS	15		295							
			4	SS	11									10 48 29 13
294.2														
3.7	Dense		5	SS	35		294							
293.4														
4.5	SAND and SILT, trace gravel Very Dense Brown to Grey Moist (TILL)		6	SS	78		293							
							292							
			7	SS	70									
291.2														
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 2.1m UPON COMPLETION. BOREHOLE CAVED TO 1.6m, WITH BIG VOID FROM 0.6m TO 1.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/15/13

RECORD OF BOREHOLE No NLAT110W-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 902 816 0 E 290 876 3 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 05 16 - 2013 05 16 CHECKED BY SKP

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	20 40 60 80 100	20 40 60 80 100		
299.0	ASPHALT: (175mm)						299					
0.0												
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL) Occasional inferred cobble		1	AS								
297.7			1	SS	18		298					41 56 3 (SI+CL)
1.3	SAND and SILT, some clay, trace gravel Compact Brown Moist (FILL) Trace clay		2	SS	27		297					
			3	SS	10							0 54 34 12
296.0												
3.0	Clayey SILT, some sand, trace gravel Very Stiff Brown Moist (FILL)		4	SS	17		296					
295.1												
3.9	Silty CLAY, with sand, trace gravel Very Stiff Brown Moist		5	SS	19		295					2 32 34 32
294.3												
4.7	SAND and SILT, trace gravel Compact to Dense Brown Moist to Wet		6	SS	24		294					
							293					Split spoon wet
292.3			7	SS	46							
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 5.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.											

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No NLAT114E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 903 202 0 E 290 809 9 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
298.3													
0.0	ASPHALT: (200mm)												
0.2	SAND, some to trace gravel, trace silt Compact Brown Moist (FILL)		1	AS			298						
			1	SS	25								12 83 5 (SI+CL)
	Some silt		2	SS	12		297						
295.9													
2.4	Clayey SILT, with sand, trace organics and rootlets Firm Dark Brown Moist (FILL)		3	SS	7		296						0 42 44 14
295.3													
3.0	Silly SAND, trace gravel, some clay Loose Brown Wet		4	SS	8		295						Split spoon wet
294.6													
3.7	Dense		5	SS	35		294						0 59 26 15
			6	SS	32								
293.1													
5.2	END OF BOREHOLE AT 5.2m BOREHOLE OPEN TO 4.3m AND WATER LEVEL AT 3.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, CEMENT TO 0.20m THEN ASPHALT TO SURFACE.												

RECORD OF BOREHOLE No NLAT119E-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 903 491.6 E 290 755.2 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.05.30 - 2013.05.30 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100	20 40 60				
296.7														
0.0	ASPHALT: (175mm)													
0.2	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS			296							37 56 7 (SI+CL)
			1	SS	18									
295.0							295							
1.7	SAND and SILT, trace clay, trace gravel, organic stains Loose Dark Brown (FILL)		2	SS	9									0 43 49 8
294.4							294							
2.3	Clayey SILT, some sand, trace to some gravel Firm to Stiff Brown Moist to Wet		3	SS	5									
			4	SS	7		293							
	Trace gravel		5	SS	15									
	Hard		6	SS	40		292							
291.6														
291.4	Sandy SILT, trace gravel Dense Brown Moist													
5.2	END OF BOREHOLE AT 5.2m BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 4.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, CUTTINGS TO 1.8m, CEMENT TO 0.2m THEN ASPHALT TO SURFACE.													

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

+ 3 × 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C102-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 881 623 8 E 294 850 4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 26 - 2013 06 26 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				
224.3								20 40 60 80 100						
0.0	TOPSOIL: (125mm)							○ UNCONFINED + FIELD VANE						
0.1	Clayey SILT, some sand, roots and rootlets		1	SS	7		224	● QUICK TRIAXIAL × LAB VANE						
223.5	Firm													
0.8	Brown													
	Silty CLAY, some sand, trace gravel		2	SS	25		223							0 19 45 36
	Very Stiff													
	Brown													
	Moist													
	Grey		3	SS	30		222							
			4	SS	15		221							0 11 49 40
221.3	Stiff		5	SS	11		220							
3.0														
			6	SS	11									
219.1														
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN TO BOTTOM WITH NO PONDED WATER UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Aug. 7/13 0.5 223.8													

+ 3 × 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C102-02

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 881 651.0 E 294 845.7 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013 06 26 - 2013 06 26 CHECKED BY SKP

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
231.2	ASPHALT: (225mm)											
0.0												
0.2	SAND and GRAVEL, some silt Brown Moist (FILL) Compact Some silt, trace gravel		1	AS			231					37 46 17 (SI+CL)
230.0			1	SS	12							
1.2	Silty CLAY, trace sand Stiff Brown (FILL)		2	SS	14		230					
			3	SS	11		229					
			4	SS	10		228					0 9 54 37
			5	SS	15		227					
	Occasional wood fibres						226					
225.1			6	SS	14		225					
6.1	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Brown Moist		7	SS	19		224					1 9 44 46
			8	SS	17		223					
	Grey						222					

Continued Next Page

+ 3 x 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No C103-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 881 628.7 E 294 785.8 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 26 - 2013 06 26 CHECKED BY SKP

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		
231.2	ASPHALT: (175mm)												
0.0													
0.2	SAND and SILT, some gravel, trace clay		1	AS			231						0 56 36 8
230.4	Brown Moist (FILL)												
0.8	Silty CLAY, trace sand, trace gravel		1	SS	11		230						
	Stiff Brown to Grey (FILL)												
			2	SS	14								1 4 40 55
229.0	Firm						229						
2.2			3	SS	5								
228.2													
3.0			4	SS	13		228						
							227						
226.5	Silty CLAY, trace sand, trace gravel		5	SS	17		226						
4.7	Very Stiff Mottled Brown/Grey Moist												
			6	SS	20		225						1 7 56 36
	Occasional brown silt seams, occasional oxide staining						224						
			7	SS	23		223						
			8	SS	19		222						

Continued Next Page

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

RECORD OF BOREHOLE No C103-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 881 628.7 E 294 785.8 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.06.26 - 2013.06.26 CHECKED BY SKP

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						
								WATER CONTENT (%)						
								20	40	60	80	100		
								PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				
								W _p	W	W _L				
218.4			9	SS	15		221							0 0 49 51
							220							
			10	SS	17		219							
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO BOTTOM WITH NO PONDED WATER UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Aug. 7/13 0.9 230.3													

RECORD OF BOREHOLE No C107-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 895 657 2 E 292 371.1 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 13 - 2013 06 13 CHECKED BY SKP

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			SHEAR STRENGTH kPa							WATER CONTENT (%)										
								○ UNCONFINED + FIELD VANE							w _p w w _L										
								● QUICK TRIAXIAL × LAB VANE																	
							20	40	60	80	100	20	40	60		GR	SA	SI	CL						
227.5	TOPSOIL: (75mm) SAND, some gravel, trace silt Loose to Compact Brown Moist (FILL)		1	SS	8		227										13	80	7	(SI+CL)					
0.0 0.1			2	SS	9																				
			3	SS	11																				
225.5	Trace organics																					0	63	30	7
2.0	SAND and SILT, trace clay Compact Grey Wet to Moist	4	SS	17				225																	
		5	SS	18				224																	
		6	SS	19				223																	
		7	SS	12		222																			
						221										0	36	57	7						
220.8	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 3.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																								
6.7																									

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

METRIC

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 (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE				
227.5 0.0 0.1	TOPSOIL: (100mm) SAND and SILT , trace clay, trace gravel Loose Light Brown Moist (FILL)		1	SS	9								
226.2 1.3	Silty SAND , trace rootlets, occasional organics Compact Brown Moist (FILL)		2	SS	7							3 61 30 6	
225.1 2.4 224.9 2.6	Clayey SILT , with sand Stiff Brown Moist SILT and SAND , trace clay Compact Brown Moist to Wet		3	SS	10							0 32 50 18	
			4	SS	12							Split spoon wet	
			5	SS	19								
	Grey		6	SS	17							0 22 70 8	
220.8 6.7	END OF BOREHOLE AT 6.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Aug. 7/13 1.8 225.7		7	SS	13								

+ 3, × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No C108-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 895 653.3 E 292 223.5 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.06.13 - 2013.06.13 CHECKED BY SKP

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			SHEAR STRENGTH kPa						WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
227.3								20	40	60	80	100	W _p	W	W _L					
0.0	TOPSOIL: (50mm)		1	SS	12		227						○				0	60	30	10
	SAND and SILT, trace to some clay, trace organics Compact Brown Moist (FILL) Grey		2	SS	26		226						○							
225.5			3	SS	17		225						○							
1.8	Sandy SILT, trace clay Compact Brown Moist to Wet Grey		4	SS	19		224						○				0	25	69	6
			5	SS	20		223													
			6	SS	19		222													
			7	SS	14		221						○							
			8	SS	11		220						○							
219.1																				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 3.9m UPON COMPLETION. BORHEOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																			

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

RECORD OF BOREHOLE No C108-02

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 895 658.8 E 292 204.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 12 - 2013 06 12 CHECKED BY SKP

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 (%)					
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
226.7							20	40	60	80	100	20	40	60						
0.0	TOPSOIL: (85mm)																			
0.1	SAND, trace to some silt, trace gravel		1	SS	5															
	Loose																			
226.2	Brown																			
0.5	Moist																			
	(FILL)																			
	SAND and SILT, trace to some clay		2	SS	14											0 58 35 7				
	Compact																			
	Brown																			
	Moist																			
			3	SS	19															
	Grey		4	SS	16											0 36 54 10				
	Wet																			
			5	SS	17															
			6	SS	15															
			7	SS	16															
			8	SS	12															
	Silt seam (50mm) at 8.1m																			
			9	SS	12											0 18 57 25				
216.9																				
9.8	END OF BOREHOLE AT 9.8m																			

Continued Next Page

+ 3, × 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C108-02

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 895 658.8 E 292 204.4 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 12 - 2013 06 12 CHECKED BY SKP

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						
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun. 12/13 0.3 226.4 Aug 7/13 0.9 225.8												

RECORD OF BOREHOLE No C112-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 632.0 E 291 453.3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.05 - 2013.06.05 CHECKED BY SKP

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		
285.0								SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								WATER CONTENT (%)						
								20	40	60	80	100		
								PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				
								W _P	W	W _L				
0.0	Silty SAND, trace gravel, trace roots, trace organics Loose to Compact Brown Moist (FILL)		1	SS	6		285							
283.7			2	SS	10		284							
283.8	ORGANICS, trace roots and rootlets, some sand Dark Brown													
1.4	Clayey SILT, some sand, trace gravel Very Stiff Brown Moist		3	SS	18		283							
282.6			4	SS	27		282							
2.4	Silty CLAY, some sand, trace gravel Very Stiff Brown		5	SS	27		281							
281.2			6	SS	33		280							
3.8	Clayey SILT, with sand, trace gravel Hard Grey Moist		7	SS	73		279							
280.5			8	SS	55/									
4.5	Silty SAND, some clay, trace gravel Very Dense Grey Moist (TILL)													
278.8	END OF BOREHOLE AT 6.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
6.2														
WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun 05/13 2.5 282.5 Aug 7/13 0.3 284.7														

RECORD OF BOREHOLE No C112-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 686 4 E 291 444 4 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.06.05 - 2013.06.05 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)				
284.6								20 40 60 80 100						
0.0	Clayey SILT, some sand, mixed with organics, trace roots and rootlets Firm to Stiff Brown to Dark Brown Moist (FILL)		1	SS	4									
			2	SS	9									
282.9														
1.7	Silty CLAY, some sand Stiff Brown		3	SS	12									0 15 29 56
282.2														
2.4	Clayey SILT, with sand, trace gravel Stiff to Very Stiff Brown Moist		4	SS	13									
			5	SS	19									6 53 26 15
280.7														
3.9	SAND, trace gravel Dense Brown Wet		6	SS	47									
279.9														
4.7	Silty SAND, some clay, trace gravel, occasional inferred cobbles Very Dense Brown Moist (TILL)		7	SS	78/ 0.275									
278.2			8	SS	50/ 0.125									1 60 24 15
6.4	END OF BOREHOLE AT 6.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun. 05/13 2.9 281.7 Aug. 7/13 0.0 284.6													

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/27/13

RECORD OF BOREHOLE No C113-01

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 651.7 E 291 513.0 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 05 - 2013 06 05 CHECKED BY SKP

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					WATER CONTENT (%)						
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20	40	60	80			100	20
285.2	TOPSOIL: (50mm)																GR SA SI CL		
0.0	SAND, some silt, some gravel, trace roots and rootlets Loose Dark Brown Moist (FILL)		1	SS	7		285												
284.4	Sandy SILT, trace gravel, trace to some clay Compact Grey Moist (FILL)		2	SS	18		284										2 30 58 10		
283.3	Sandy SILT, trace gravel Compact to Loose Brown to Dark Brown Moist		3	SS	37		283												
1.9	Trace rootlets and organics		4	SS	6		282										1 87 12 (SI+CL)		
282.2	SAND, fine grained, trace to some silt, trace gravel Compact Brown Wet		5	SS	16		281												
	Dense		6	SS	45		280												
279.1	Silty CLAY, some sand, trace gravel Very Dense Grey Moist (TILL)		7	SS	50/ 0.100		279										3 20 40 38		
6.1 278.9 6.3	END OF BOREHOLE AT 6.3m Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun. 06/13 2.5 282.7 Aug. 7/13 0.8 284.4																		

RECORD OF BOREHOLE No C113-02

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 899 702.0 E 291 502.6 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2016.06.06 - 2013.06.06 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
285.2 0.0 0.1	TOPSOIL: (75mm)						285					
284.4	Clayey SILT, with sand, trace gravel, trace roots Firm		1	SS	5							3 52 31 14
284.8	Brown (FILL)											
284.8	ORGANICS, trace rootlets Dark Brown		2	SS	19							
283.6	Sandy SILT, trace gravel Compact											
283.6	Brown Moist (FILL)		3	SS	14							1 18 32 49
282.9	Silty CLAY, some sand, trace gravel Stiff											
282.9	Brown (FILL)		4	SS	26							
282.2	Sandy SILT, trace gravel Compact											
282.2	Brown Moist		5	SS	25							
281.1	SAND, fine grained Compact Brown Wet											
281.1	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		6	SS	61							0 23 49 28
279.0	END OF BOREHOLE AT 6.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		7	SS	57/							
6.2					0.150							
WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun. 06/13 3.4 281.8 Aug. 7/13 0.5 284.7												

RECORD OF BOREHOLE No C114-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 904 982.9 E 290 636.1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.02 - 2013.06.02 CHECKED BY SKP

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 (%)	
								○ UNCONFINED + FIELD VANE								
						● QUICK TRIAXIAL × LAB VANE										
						20 40 60 80 100										
302.7																
0.0	ASPHALT: (250mm)															
302.4																
0.3	Gravelly SAND, trace to some silt		1	AS												
	Brown															
	Moist															
301.9	(FILL)															
0.8	Dense		1	SS	48									29 61 10 (SI+CL)		
301.2																
1.5	SAND and SILT, some gravel, some clay, trace cobbles Dense to Very Dense Brown Moist		2	SS	37											
			3	SS	81											
			4	SS	95/ 0.280									13 43 32 12		
			5	SS	77											
298.1																
4.6	Sandy SILT, trace gravel Very Dense Brown Moist		6	SS	71											
296.6																
6.1	Silty SAND, trace to some gravel Very Dense Brown Moist (TILL) Inferred cobble/boulder at 6.4m		7	SS	50											
			8	SS	54									Split spoon wet		
293.6																
9.1	Silty CLAY, with sand, trace gravel Hard Brown Moist		9	SS	47									0 34 34 32		
292.9																
9.8	END OF BOREHOLE AT 9.8m.															

Continued Next Page

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

RECORD OF BOREHOLE No C114-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 904 982 9 E 290 636 1 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 02 - 2013.06.02 CHECKED BY SKP

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						
	BORHEOLE OPEN TO BOTTOM AND WATER LEVEL AT 9.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.							20 40 60 80 100						

RECORD OF BOREHOLE No C116-01

1 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 905 082 7 E 290 644 9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.02 - 2013.06.02 CHECKED BY SKP

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			SHEAR STRENGTH kPa						
301.5								20 40 60 80 100						
0.0	ASPHALT: (450mm)		1	AS				○ UNCONFINED + FIELD VANE						
301.0								● QUICK TRIAXIAL × LAB VANE						
0.5	SAND and GRAVEL, trace to some silt Dense Brown Moist (FILL)		1	SS	37		301							34 53 13 (SI+CL)
300.0														
1.5	SAND and SILT, some clay Compact to Dense Brown Moist		2	SS	26		300							
			3	SS	36		299							0 48 41 11
298.5	Very Dense		4	SS	98/ 0.275		298							
297.8	Trace gravel		5	SS	43		297							
			6	SS	29									Split spoon wet
295.9							296							
5.6	SAND and SILT, trace clay, trace gravel Dense to Very Dense Brown Moist (TILL)		7	SS	48		295							2 60 31 7
			8	SS	50/ 0.125		294							
							293							
			9	SS	94/ 0.250		292							
291.9	END OF BOREHOLE AT 9.6m. BOREHOLE OPEN TO 9.1m AND													
9.6														

Continued Next Page

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

RECORD OF BOREHOLE No C116-01

2 OF 2

METRIC

GWP# 83-00-00 LOCATION N 4 905 082 7 E 290 644 9 ORIGINATED BY JG
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.02 - 2013.06.02 CHECKED BY SKP

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							20 40 60 80 100						
	WATER LEVEL AT 7.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 3.0m, CUTTINGS TO 1.5m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE													

RECORD OF BOREHOLE No C18-01 HW

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 887 709.2 E 293 769.5 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 04 - 2013 06 04 CHECKED BY SKP

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 (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
279.7							20 40 60 80 100		20 40 60						
0.0 0.1	TOPSOIL: (75mm)														
279.2	SAND, trace silt, trace gravel, roots and rootlets Very Loose Brown (FILL)		1	SS	3										
0.5	SAND and SILT, trace to some clay, trace gravel, rootlets Very Loose to Compact Dark Brown to Brown Saturated to Wet		2	SS	4										
			3	SS	13									1 57 32 10	
277.4															
2.3	SAND and SILT, some clay, trace gravel Very Dense Brown to Grey Moist (TILL)		4	SS	69										
			5	SS	88/ 0.275										
276.0															
3.7	Dense		6	SS	47									5 50 33 12	
275.2															
4.5			7	SS	55										
			8	SS	58									5 50 32 13	
			9	SS	70										
271.5															
8.2	END OF BOREHOLE AT 8.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV (m) Aug 07/13 0.1 279.6														

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO) GDT 8/15/13

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

RECORD OF BOREHOLE No C18-02 HW

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 887 717.3 E 293 769.1 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.03 - 2013.06.03 CHECKED BY SKP

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				
								20 40 60 80 100				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
						WATER CONTENT (%)						
						w _p w w _L						
280.0												
0.0	TOPSOIL: (125mm)						280					
0.1	SAND and SILT, some clay, trace gravel Loose to Very Loose Brown Moist to Wet		1	SS	6							
			2	SS	3		279					0 45 44 11
278.2												
1.8	SAND and SILT, some clay, trace gravel Very Dense Brown to Grey Moist (TILL)		3	SS	55		278					
			4	SS	92							3 50 33 14
			5	SS	85		277					
			6	SS	63		276					
			7	SS	52		275					2 50 34 14
			8	SS	75		274					
			9	SS	34		273					
271.8	Dense						272					
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 0.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.											

ONTMT4S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

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

RECORD OF BOREHOLE No C27-01 HW

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 891 551.8 E 293 304.3 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013 06 06 - 2013 06 06 CHECKED BY SKP

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			SHEAR STRENGTH kPa		WATER CONTENT (%)							
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	w _p	w	w _L					
							20	40	60	80	100	20	40	60			
258.8	TOPSOIL: (50mm) Sandy SILT, trace clay, trace gravel, trace roots and rootlets Loose Brown to Dark Brown Moist (FILL)		1	SS	6												
0.0			2	SS	5												
257.3	Sandy SILT, trace clay, trace gravel Compact Brown Moist		3	SS	21												
1.5			4	SS	18												
			5	SS	29												
255.6	SAND and SILT, some clay, trace gravel Compact to Very Dense Brown to Grey Moist (TILL) Inferred cobbles/boulders		6	SS	61/ 0.150												
3.2			7	SS	50/ 0.075												
			8	SS	50/ 0.050												
251.1	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 4.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																
7.7																	

ONTMT4S 1218.GPJ 2012TEMPLATE(MTO).GDT 8/27/13

RECORD OF BOREHOLE No C27-02 HW

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 891 558 9 E 293 303.8 ORIGINATED BY ES
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.06.05 - 2013.06.05 CHECKED BY SKP

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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
258.3	TOPSOIL: (50mm)											
257.5	SAND, trace gravel, trace roots Loose Dark Brown Moist (FILL)		1	SS	7		258					
256.8	Silty SAND, some clay, trace gravel, trace rootlets Very Loose Dark Brown Moist		2	SS	4		257					
256.1	Clayey SILT, with sand Firm Brown Moist		3	SS	6		256					0 29 55 16
255.0	Sandy SILT, trace gravel, occasional inferred cobbles Dense Brown Wet		4	SS	47		255					4 48 34 14
254.0	SAND and SILT, some clay, trace gravel Very Dense Brown Moist (TILL)		5	SS	67		254					
253.0	Inferred cobbles/boulders		6	SS	50/ 0.100		253					
252.0			7	SS	50/ 0.075		252					
251.0			8	SS	50/ 0.050		251					
250.6	END OF BOREHOLE AT 7.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.											
WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Aug 08/13 1.4 256.9												

METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)											
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	20	40	60	GR	SA	Si	CL			
226.9 0.0	PEAT, organics, roots and rootlets Very Loose to Loose Dark Brown Wet		1	SS	1																			
			2	SS	6																			
			3	SS	2																			
224.8 2.1	SAND and SILT, trace clay Compact Brown Wet																							
			4	SS	16																			
			5	SS	17																			
223.2 3.7	Dense																							
			6	SS	38																			
222.4 4.5	Dense																							
					7	SS	21																	
			8	SS	33																			
			9	SS	22																			
218.7 8.2	END OF BOREHOLE AT 8.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																							
WATER LEVEL READINGS: DATE DEPTH (m) ELEV (m) Aug 08/13 0.5 226.4																								



+³, ×³ Numbers refer to Sensitivity

RECORD OF BOREHOLE No C39-02 HW

1 OF 1

METRIC

GWP# 83-00-00 LOCATION N 4 894 676.4 E 292 818.6 ORIGINATED BY ES
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.06.04 - 2013.06.04 CHECKED BY SKP

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			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
								20 40 60 80 100									
									PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT						
									w _p	w	w _L						
									WATER CONTENT (%)								
									20 40 60								
227.1							227						195				
0.0	PEAT, organics, trace roots and rootlets Very Loose to Loose Dark Brown Wet		1	SS	1		227										

ONTM14S 1218 GPJ 2012TEMPLATE(MTO).GDT 8/15/13

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

FIGURE E1

Figure 1 is a semi-logarithmic plot showing the relationship between Grain Size (mm) on the x-axis and Percent Finer Than on the y-axis. The x-axis ranges from 0.0001 mm to 100 mm, and the y-axis ranges from 0% to 100%. The plot displays several curves, each representing a different soil sample, showing how the percentage of material finer than a given grain size varies. The curves generally show that as grain size increases, the percentage of material finer than that size decreases. The curves are labeled with different symbols and markers, indicating different soil types or samples.

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

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C102-02	0.38	230.82
☒	C107-01	0.30	227.20
▲	C114-01	1.07	301.63
★	C116-01	0.53	300.97
⊙	NLAT108W-01	0.38	297.52
⊕	NLAT110W-01	1.07	297.93

GWP# 83-00-00

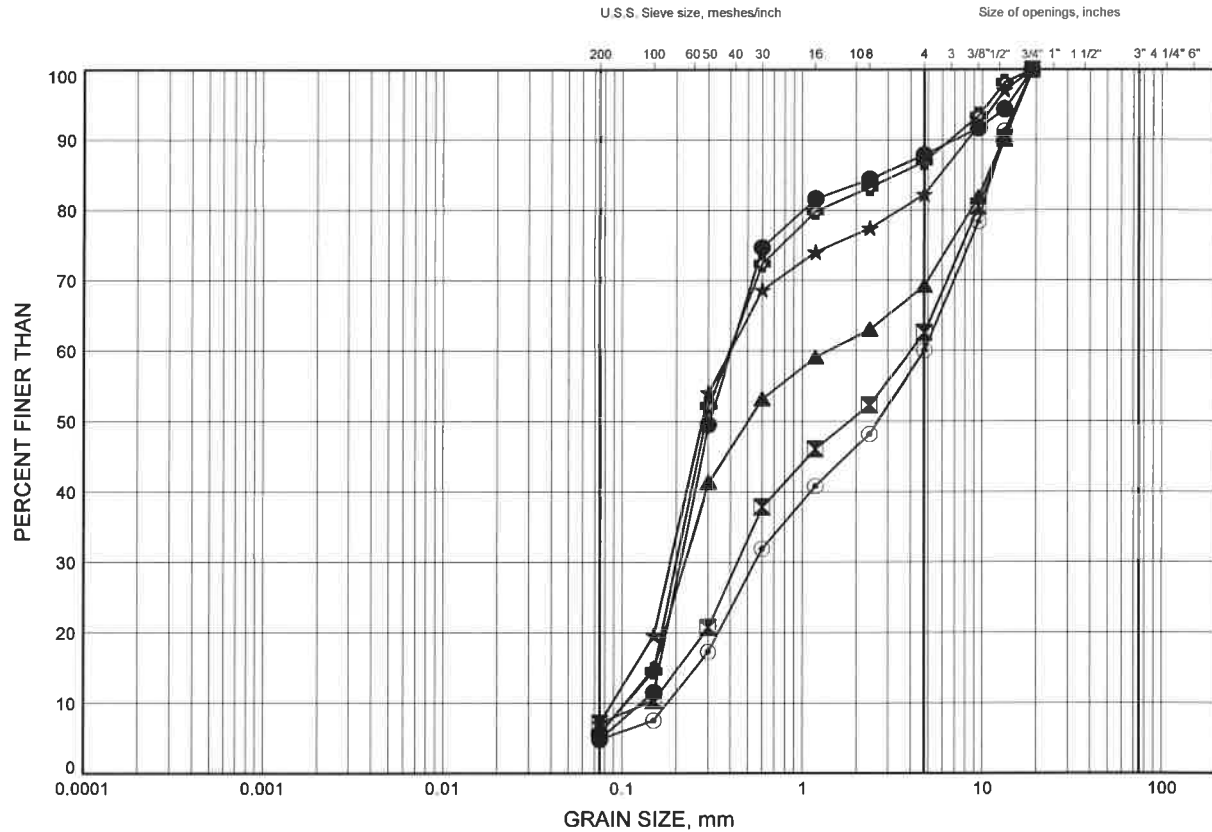


Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E2

SAND/SAND & GRAVEL/GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	NLAT114E-01	1.07	297.23
⊠	NLAT119E-01	0.38	296.32
▲	NLAT37E-01	0.30	228.80
★	NLAT40W-01	0.46	228.44
⊙	NLAT87-01	0.38	299.92
⊕	NLAT91W-01	0.38	298.22

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/15/13

Date August 2013
GWP# 83-00-00

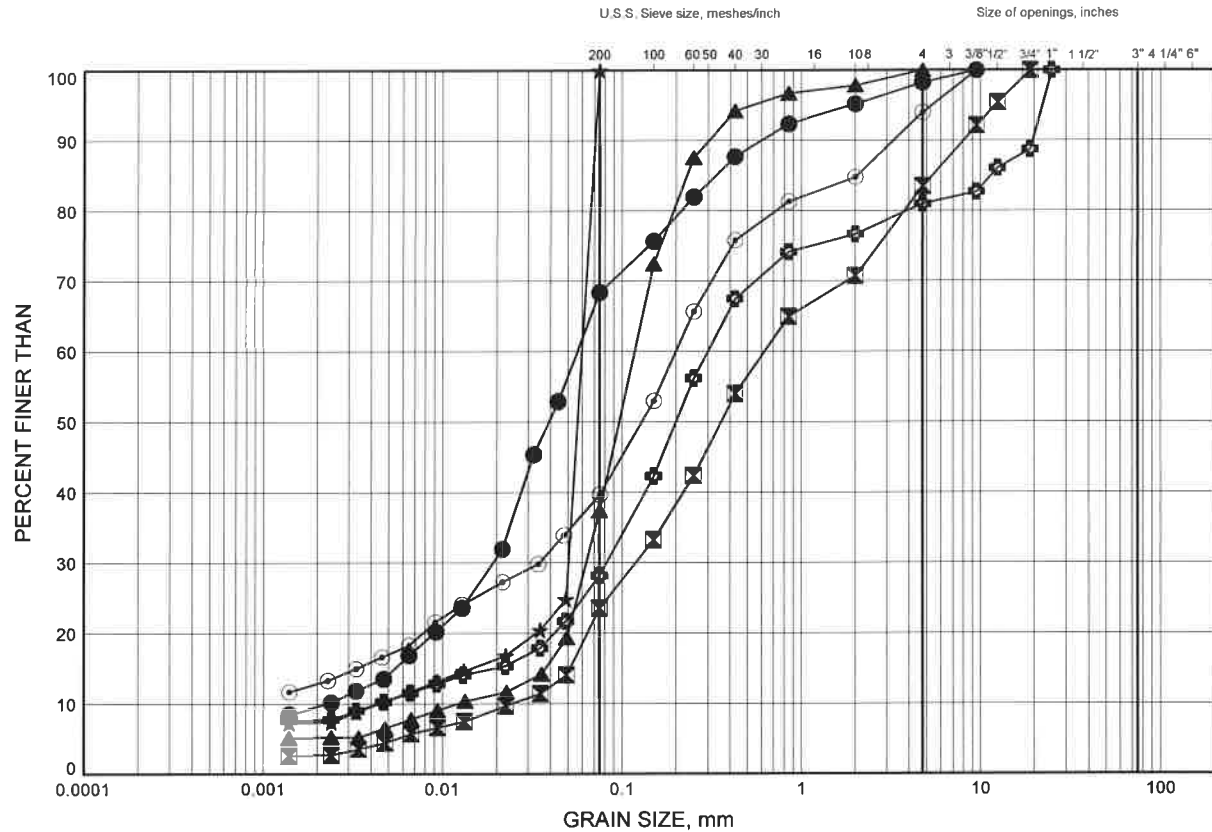


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E3

SILTY SAND/SANDY SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C113-01	1.07	284.13
⊠	C32-01	1.07	234.53
▲	C32-02	1.83	233.97
★	C32-02	3.35	232.45
⊙	NLAT108W-01	1.83	296.07
⊕	NLAT91W-01	1.83	296.77

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/28/13

Date August 2013
GWP# 83-00-00

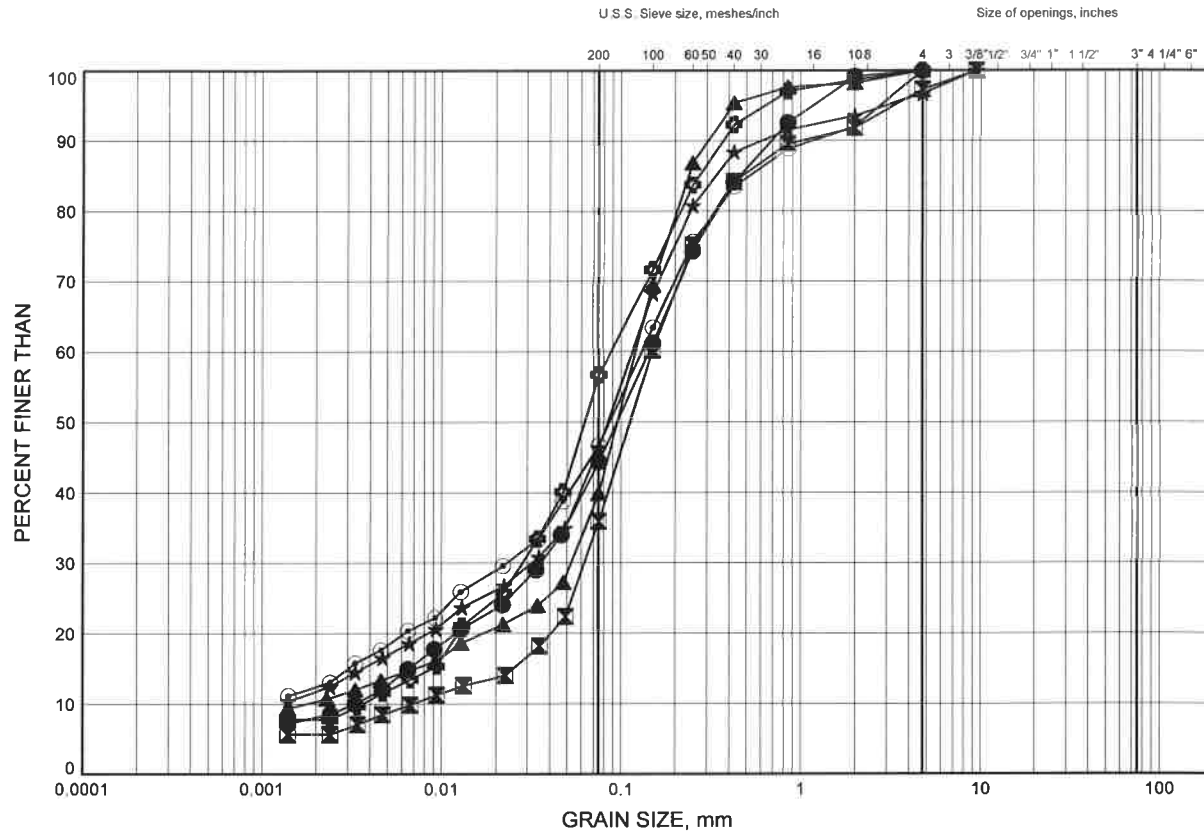


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E4

SAND & SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C103-01	0.38	230.82
⊠	C107-02	1.07	226.43
▲	C108-01	0.39	226.91
★	C27-01 HW	3.35	255.45
⊙	NLAT110W-01	2.59	296.41
⊕	NLAT119E-01	1.83	294.87

Date August 2013
GWP# 83-00-00

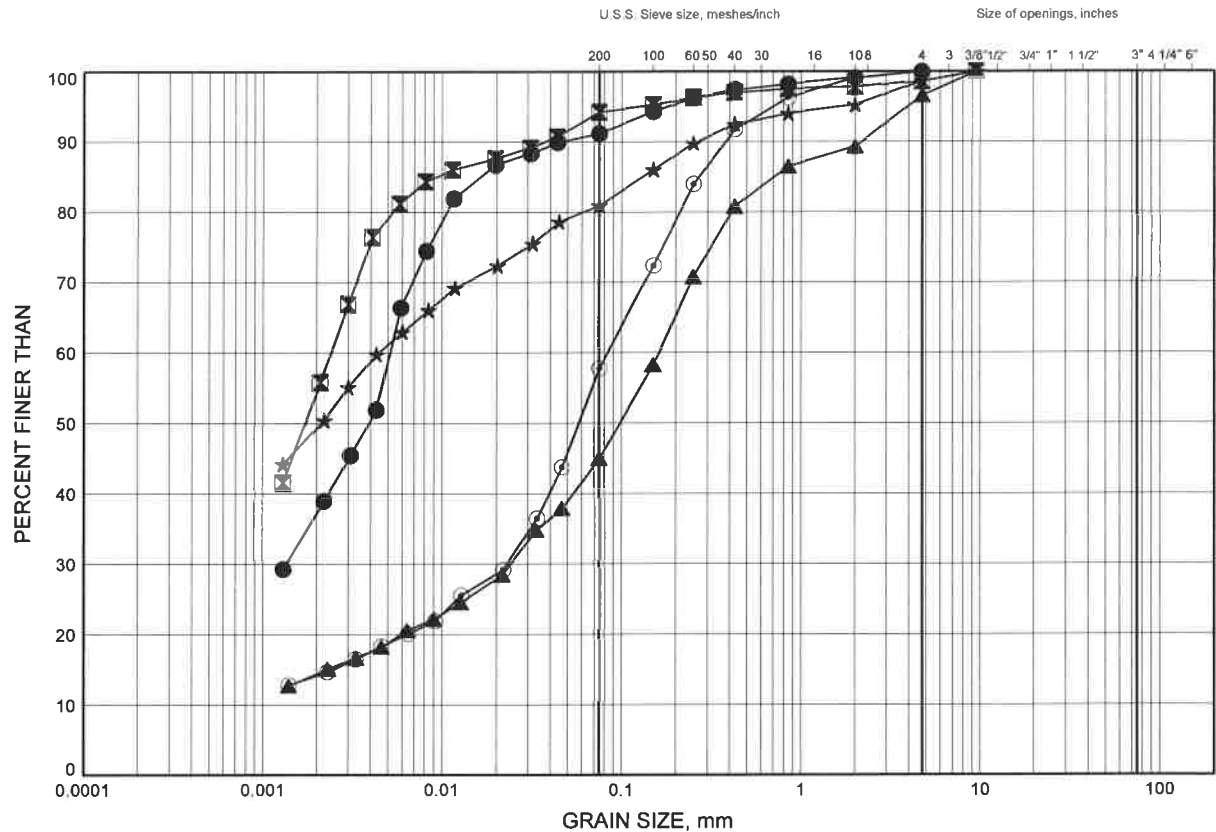


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E5

SILTY CLAY/CLAYEY SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C102-02	3.35	227.85
⊠	C103-01	1.83	229.37
▲	C113-02	0.30	284.90
★	C113-02	1.83	283.37
⊙	NLAT114E-01	2.59	295.71

Date August 2013
GWP# 83-00-00

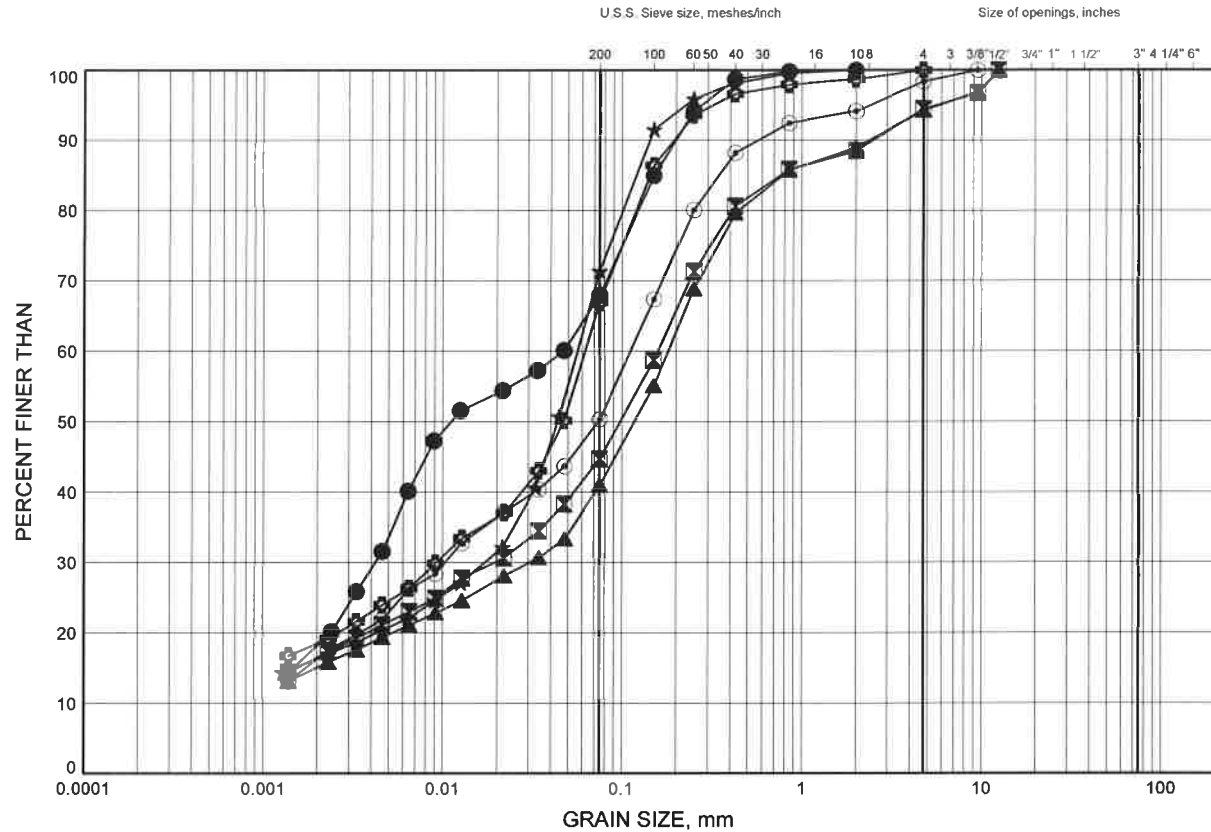


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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E6

CLAYEY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C107-02	2.46	225.04
⊠	C112-01	4.11	280.89
▲	C112-02	3.35	281.25
★	C27-02 HW	1.83	256.47
⊙	C32-01	4.88	230.72
⊞	NLAT40W-01	2.59	226.31

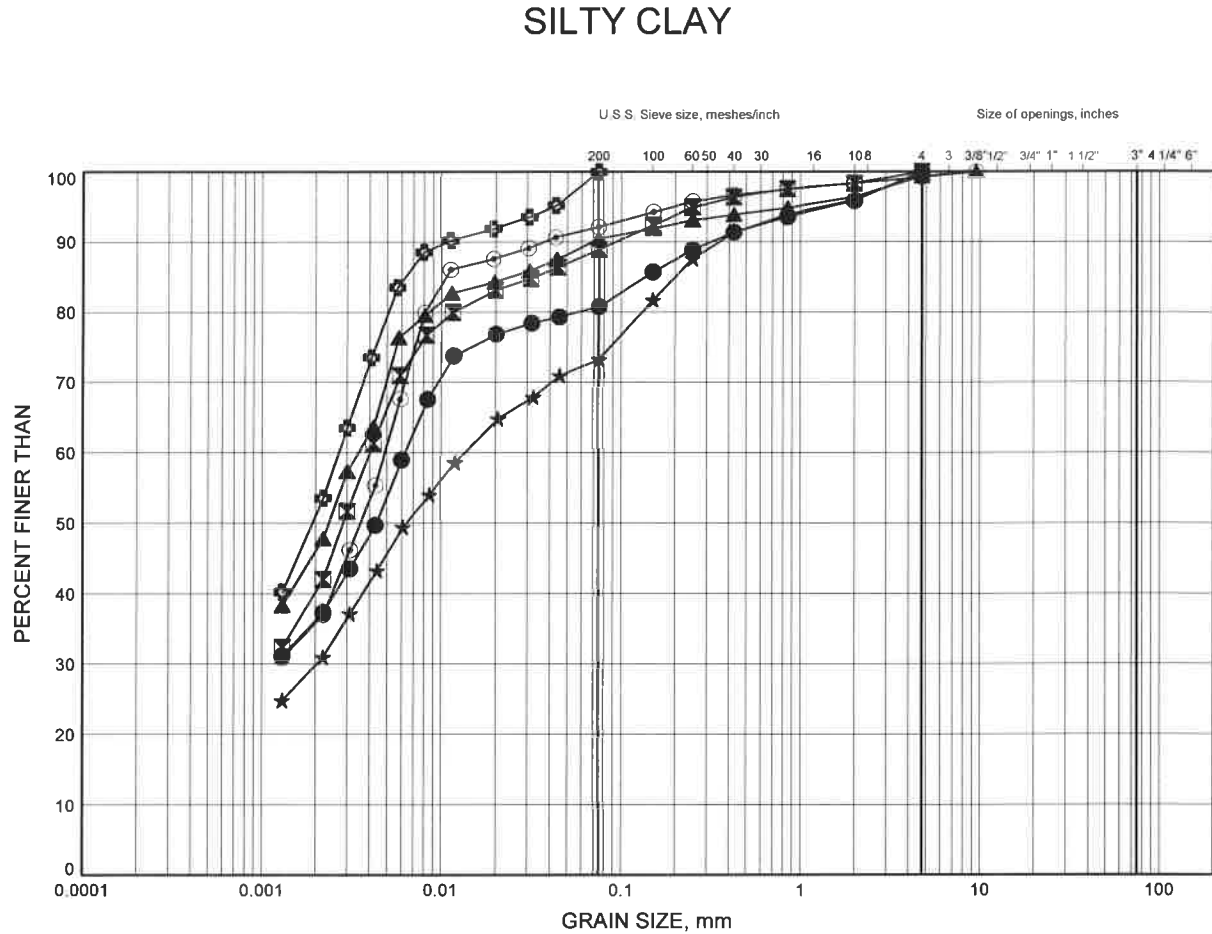
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Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E7



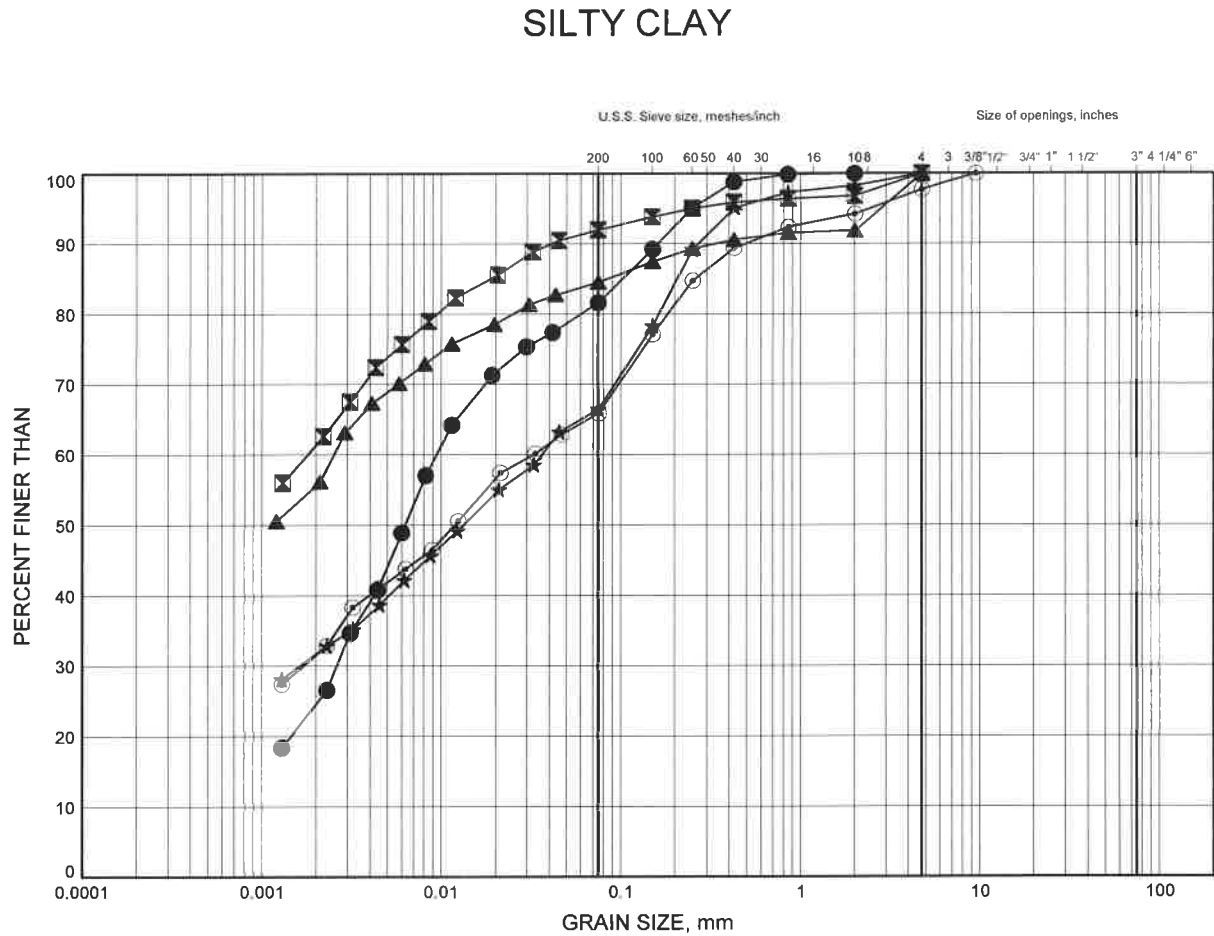
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C102-01	1.07	223.23
⊠	C102-01	3.35	220.95
▲	C102-02	7.92	223.28
★	C102-02	12.50	218.70
⊙	C103-01	6.40	224.80
⊕	C103-01	10.97	220.23

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E8



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C108-02	9.45	217.25
⊠	C112-01	2.59	282.41
▲	C112-02	1.83	282.77
★	C114-01	9.45	293.25
⊙	NLAT110W-01	4.11	294.89

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/27/13

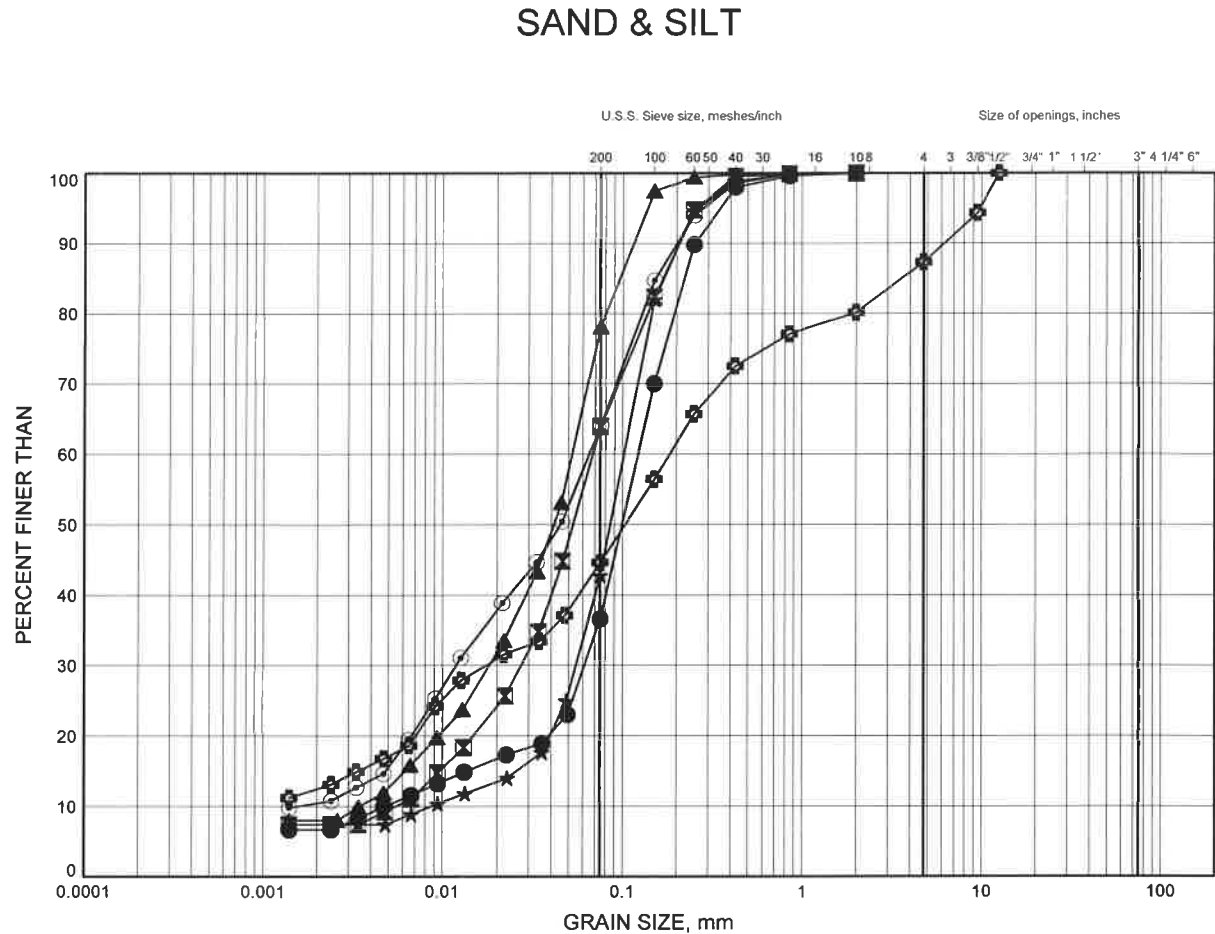
Date August 2013
GWP# 83-00-00



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Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E9



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C107-01	2.06	225.44
⊠	C107-01	6.40	221.10
▲	C107-02	4.88	222.62
★	C108-02	1.07	225.63
⊙	C108-02	2.59	224.11
⊕	C114-01	3.35	299.35

Date August 2013

GWP# 83-00-00



Prep'd AN

Chkd. SKP

FIGURE E10

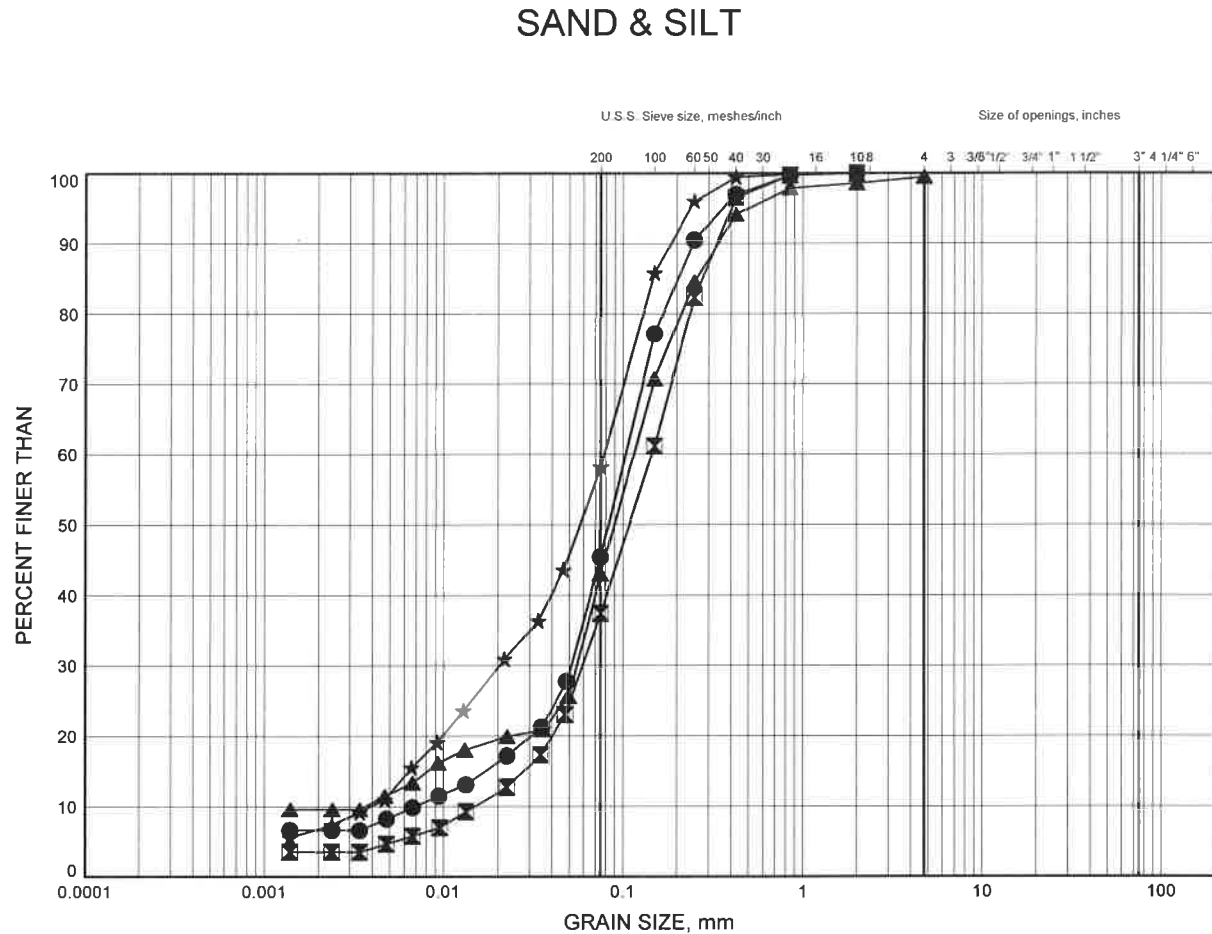


SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C116-01	2.59	298.91
☒	C18-01 HW	1.83	277.87
▲	C18-02 HW	1.07	278.93
★	C39-01 HW	2.59	224.31
⊙	C39-01 HW	4.11	222.79
⊕	C39-01 HW	7.92	218.98

Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E11



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C39-02 HW	4.11	222.99
⊠	C39-02 HW	6.40	220.70
▲	NLAT37E-01	2.59	226.51
★	NLAT37E-01	4.11	224.99

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/27/13

Date August 2013
GWP# 83-00-00

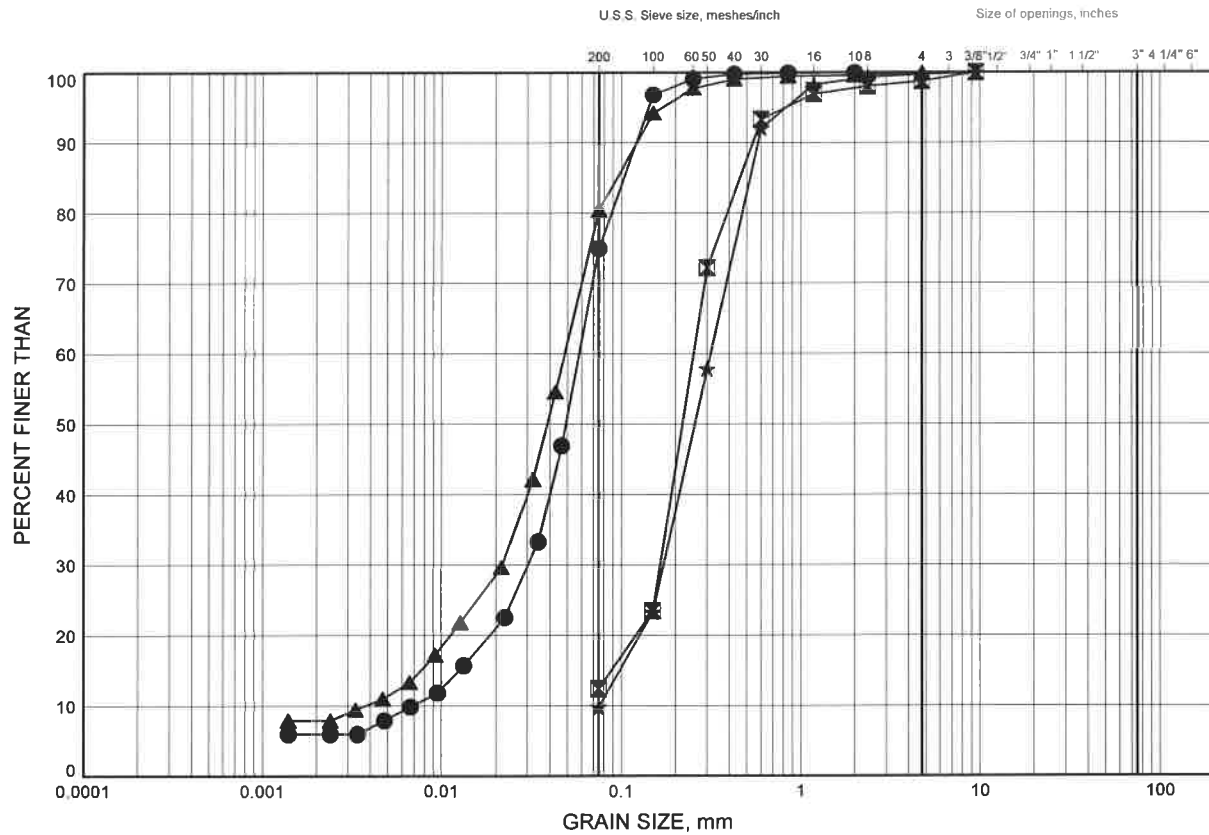


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E12

SAND/SANDY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C108-01	3.35	223.95
■	C113-01	3.30	281.90
▲	C27-01 HW	1.83	256.97
★	C39-02 HW	2.59	224.51

GRAIN SIZE DISTRIBUTION - THURBER 12/18 GPJ 8/27/13

Date August 2013
GWP# 83-00-00

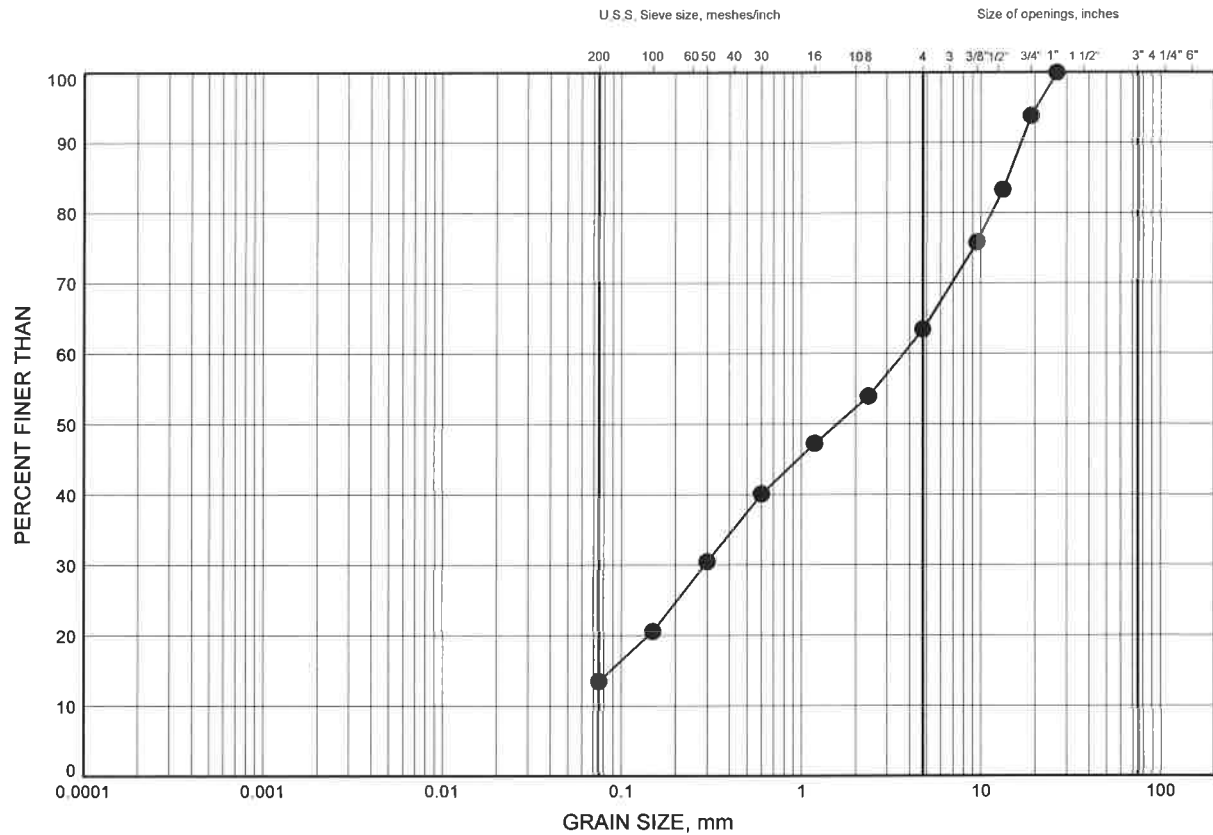


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E13

SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C32-01	3.35	232.25

Date August 2013
GWP# 83-00-00

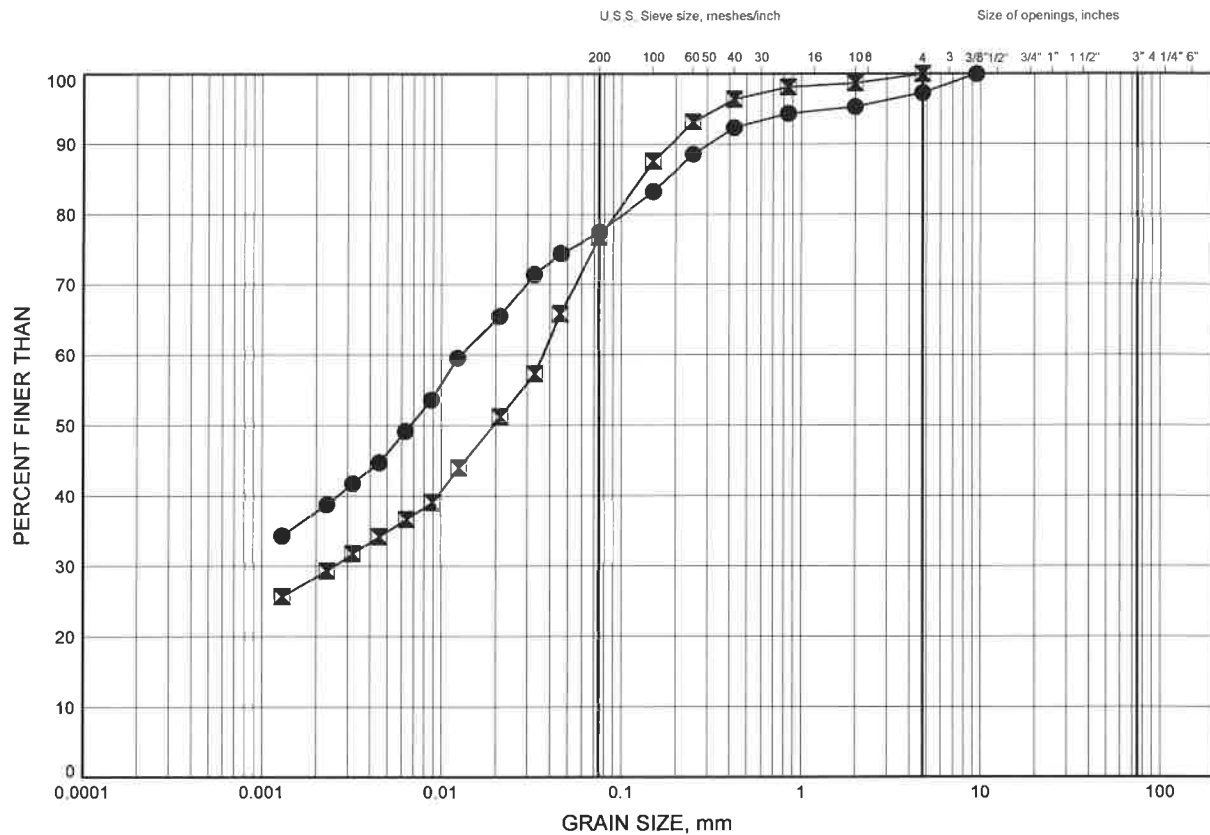


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E14

SILTY CLAY TILL



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

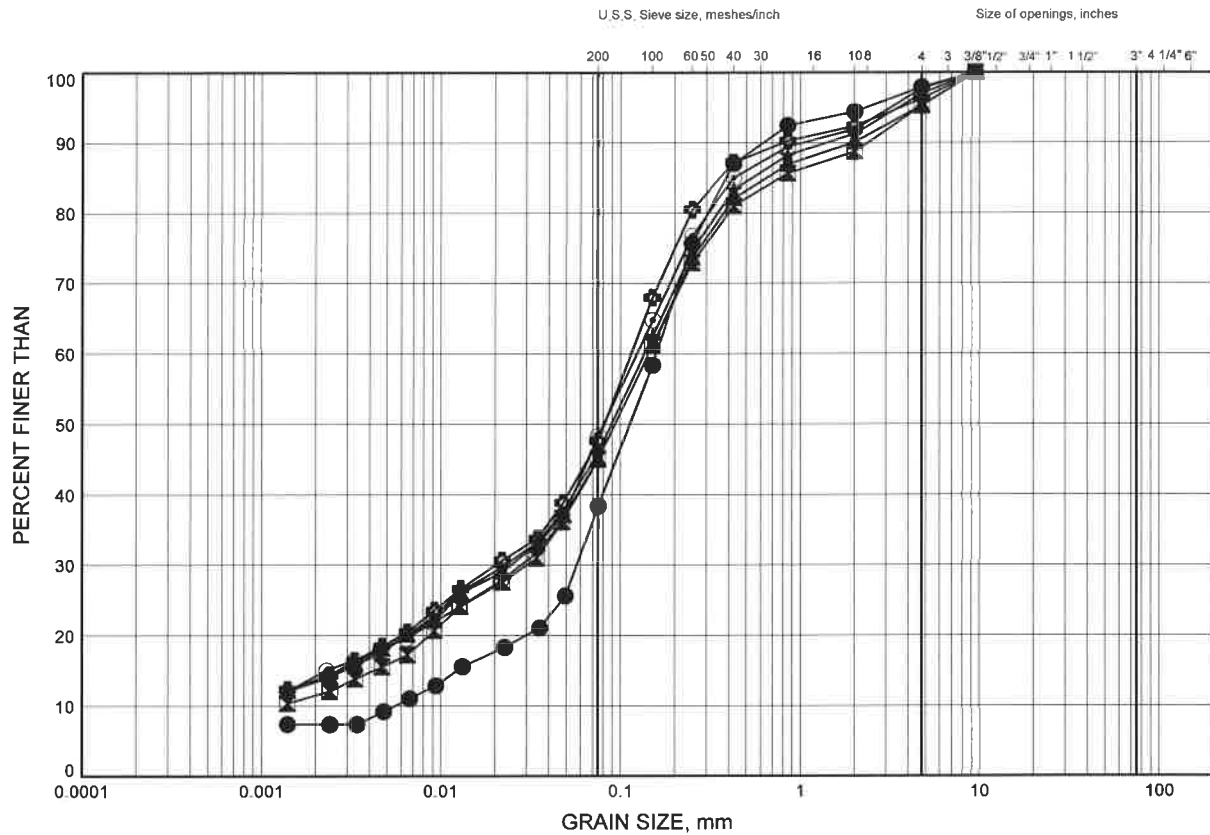
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C113-01	6.22	278.98
◻	C113-02	4.88	280.32

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E15

SAND & SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C116-01	6.40	295.10
⊠	C18-01 HW	4.11	275.59
▲	C18-01 HW	6.40	273.30
★	C18-02 HW	2.59	277.41
⊙	C18-02 HW	4.88	275.12
⊕	C27-02 HW	3.28	255.02

GRAIN SIZE DISTRIBUTION - THURBER 1218.GPJ 8/27/13

Date August 2013
GWP# 83-00-00

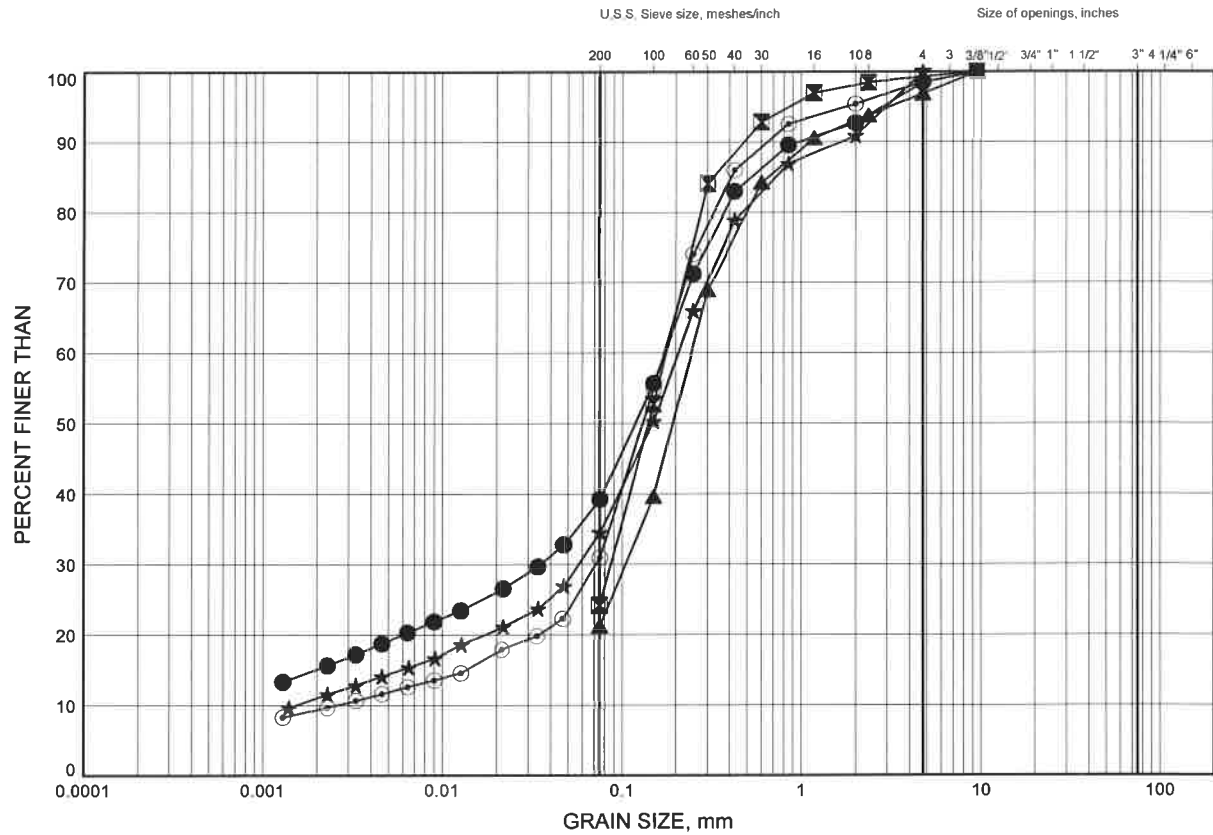


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer GRAIN SIZE DISTRIBUTION

FIGURE E16

SAND/SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C112-02	6.23	278.37
⊠	NLAT87-01	1.83	298.47
▲	NLAT87-01	3.28	297.02
★	NLAT90-01	3.35	296.15
⊙	NLAT91W-01	3.35	295.25

GRAIN SIZE DISTRIBUTION - THURBER 1218 GPJ 8/27/13

Date August 2013
GWP# 83-00-00

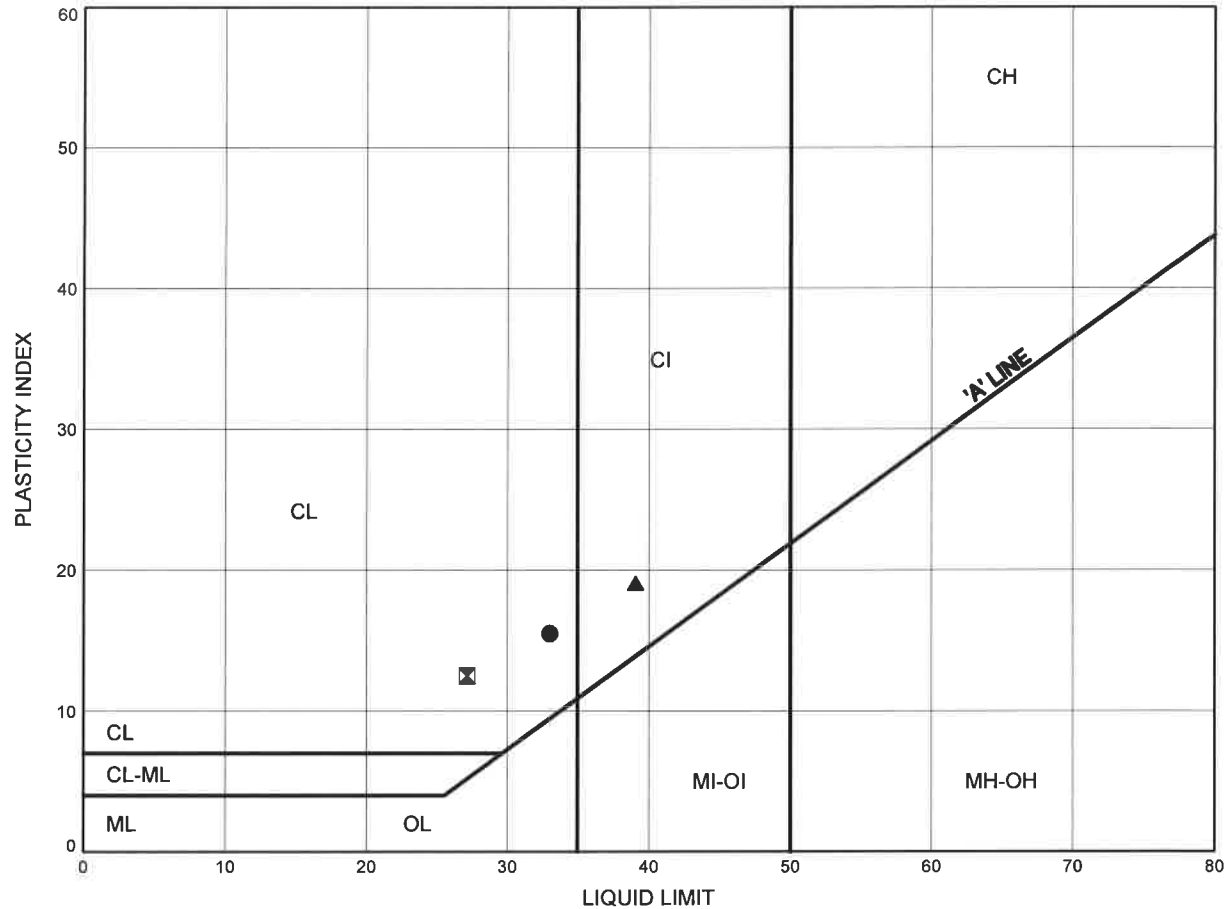


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE E17

SILTY CLAY FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C102-02	3.35	227.85
⊠	C103-01	1.83	229.37
▲	C113-02	1.83	283.37

Date August 2013

GWP# 83-00-00



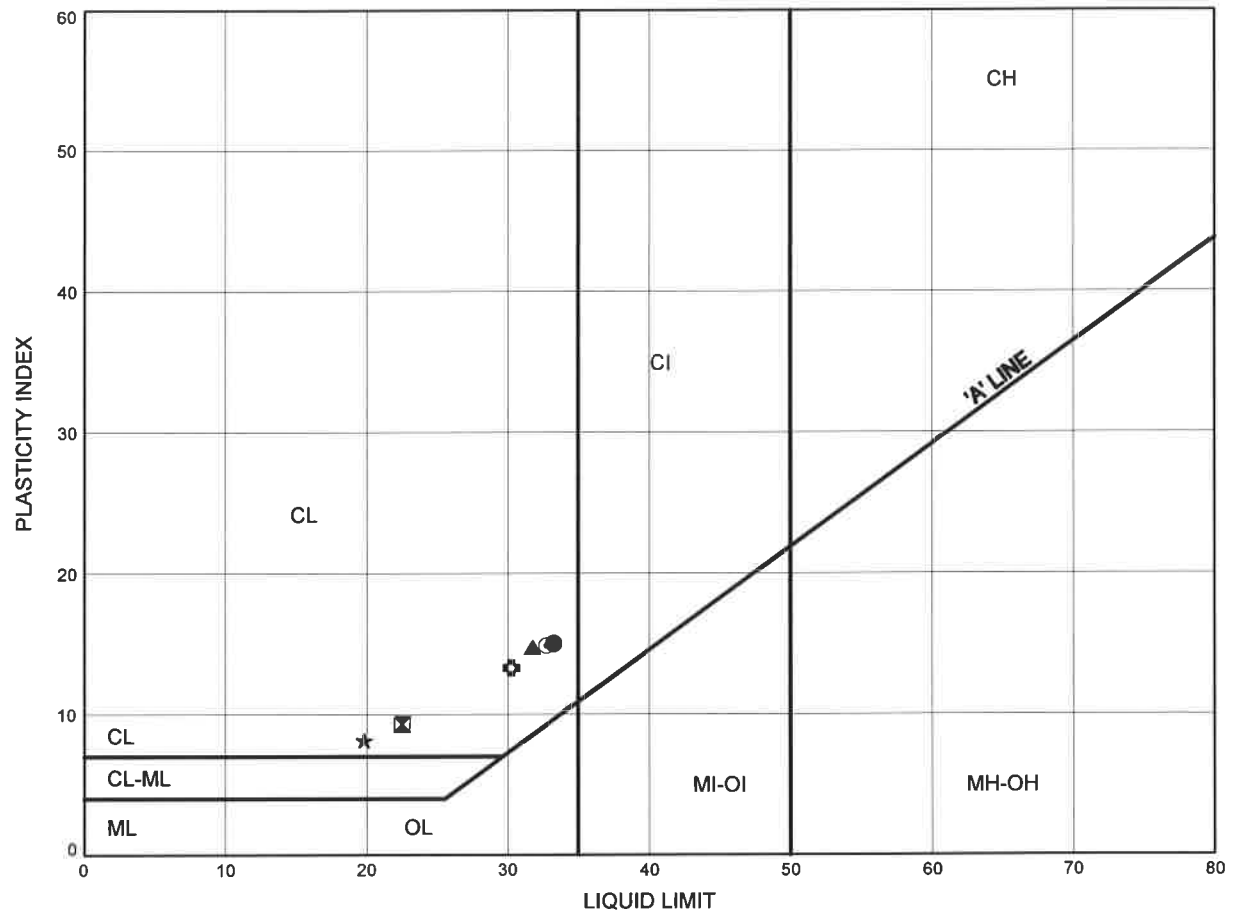
Prep'd AN

Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE E18

SILTY CLAY/CLAYEY SILT



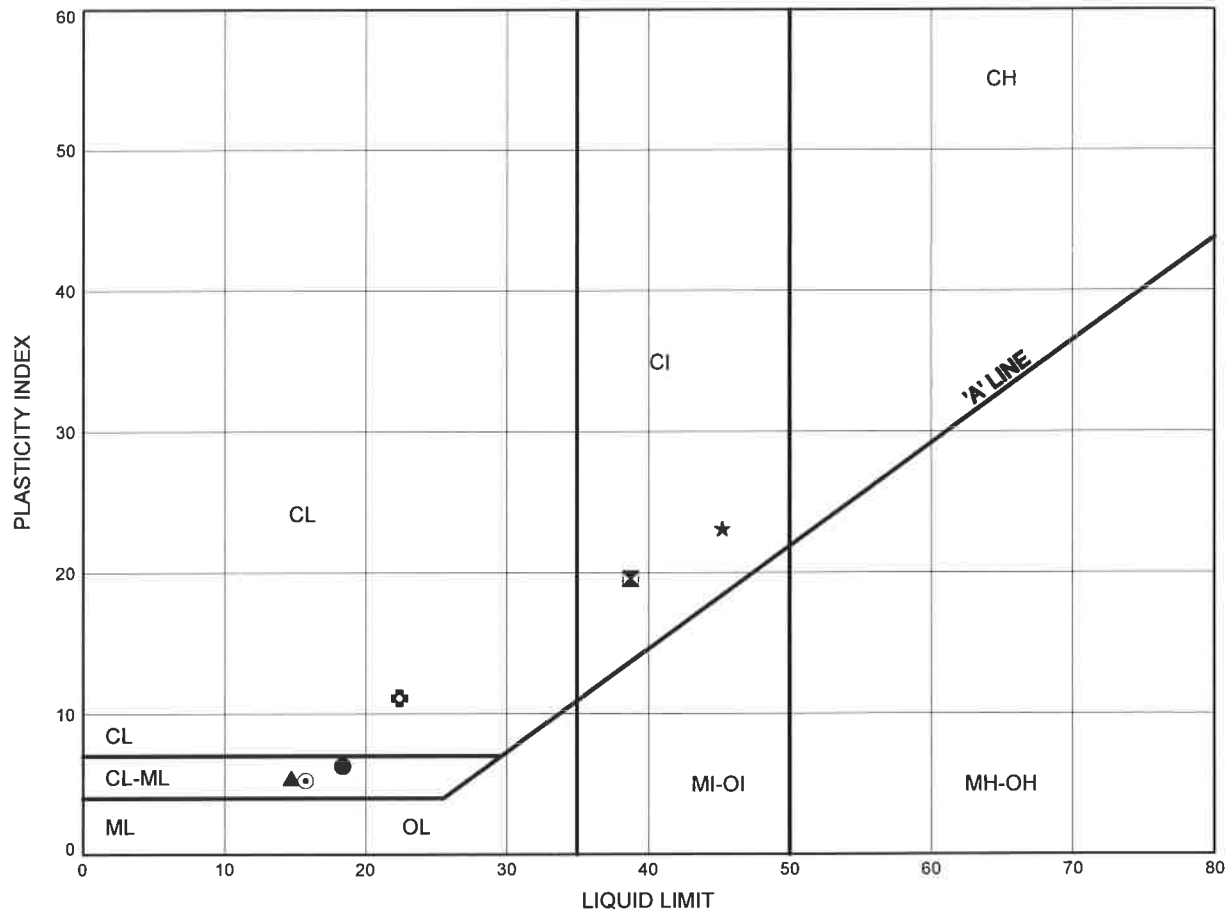
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C102-01	1.07	223.23
⊠	C102-01	3.35	220.95
▲	C102-02	7.92	223.28
★	C102-02	12.50	218.70
⊙	C103-01	6.40	224.80
⊕	C103-01	10.97	220.23

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE E19

SILTY CLAY/CLAYEY SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C107-02	2.46	225.04
⊠	C112-01	2.59	282.41
▲	C112-01	4.11	280.89
★	C112-02	1.83	282.77
⊙	C112-02	3.35	281.25
⊕	C114-01	9.45	293.25

Date August 2013
GWP# 83-00-00

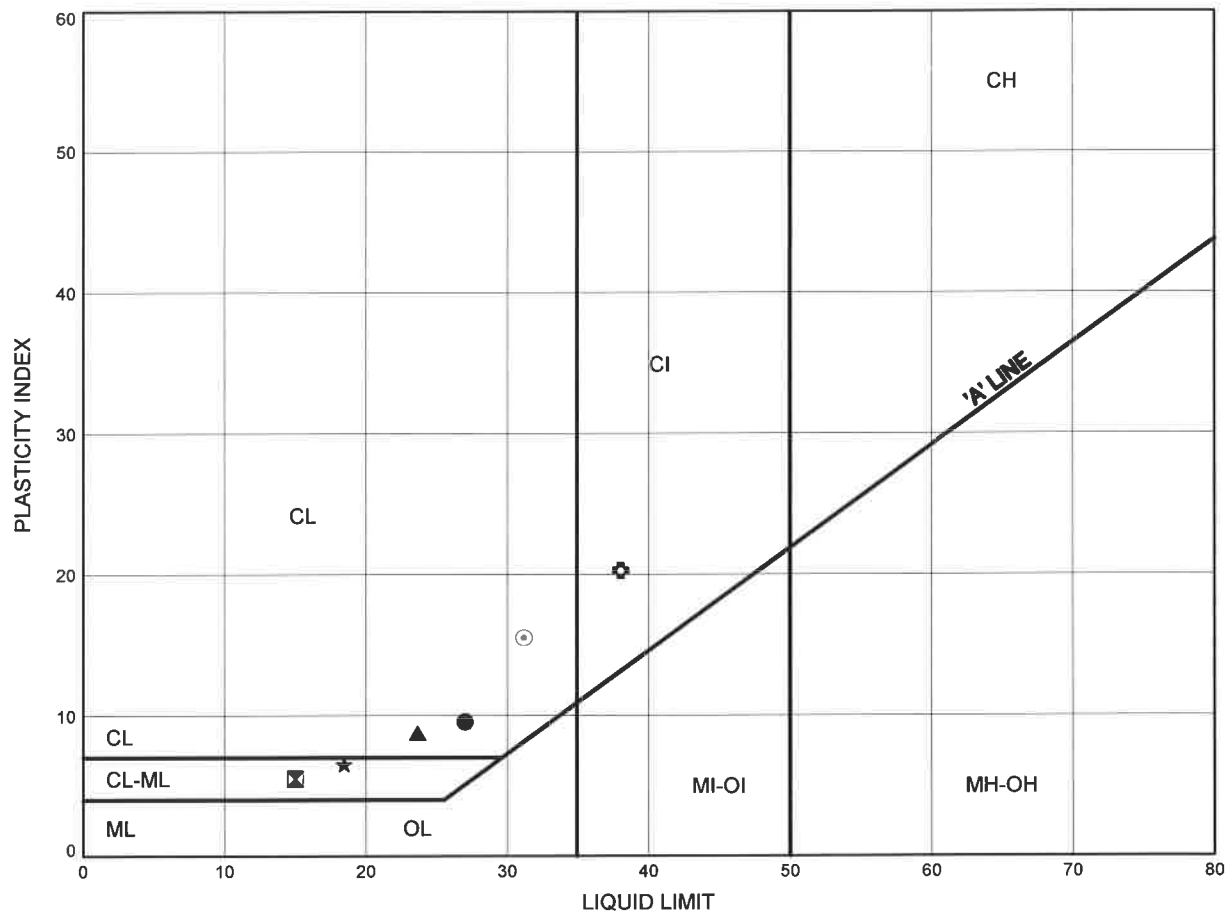


Prep'd AN
Chkd. SKP

Hwy 400 Median Sewer ATTERBERG LIMITS TEST RESULTS

FIGURE E20

SILTY CLAY/CLAYEY SILT



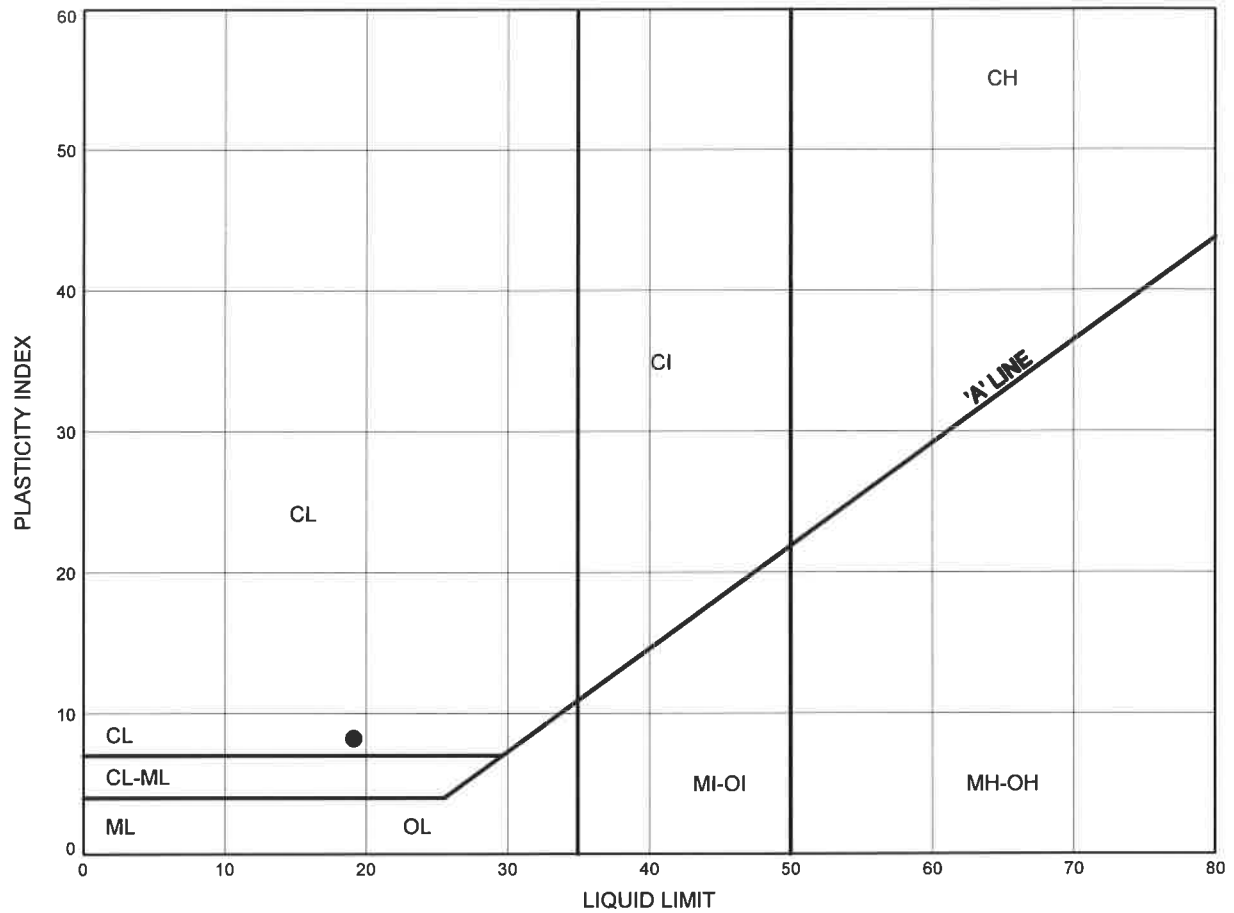
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C27-02 HW	1.83	256.47
⊠	C32-02	4.88	230.92
▲	NLAT40W-01	2.59	226.31
★	SLAT06E-01	1.07	268.63
⊙	SLAT06E-01	2.59	267.11
⊕	SLAT83W-01	4.88	243.52

Hwy 400 Median Sewer
ATTERBERG LIMITS TEST RESULTS

FIGURE E21

SILTY CLAY TILL



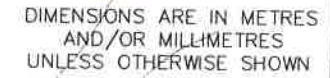
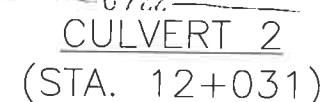
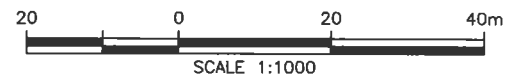
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C113-02	4.88	280.32

Date August 2013
 GWP# 83-00-00



Prep'd AN
 Chkd. SKP



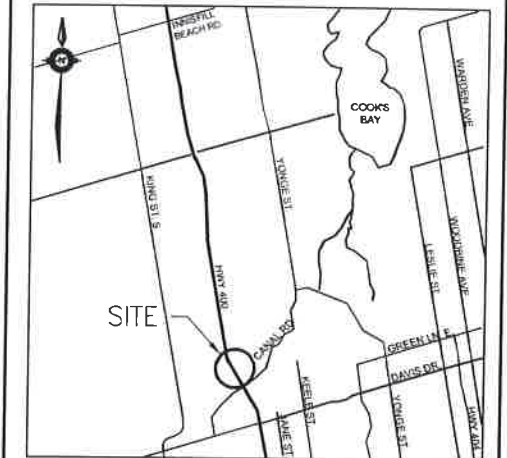
CONT No
GWP No 83-00-00

HIGHWAY 400
MEDIAN SEWER
CULVERT CROSSINGS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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
C1-01	230.9	4 880 121.4	295 461.4
C1-02	231.1	4 880 102.9	295 428.5
C2-01	228.3	4 880 436.0	295 262.4
C2-02	228.0	4 880 448.9	295 213.3

-NOTES-

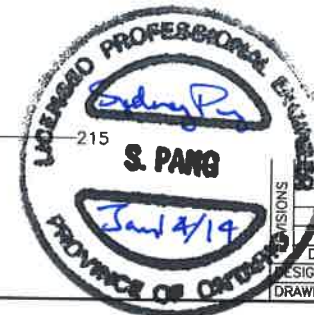
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31D-563

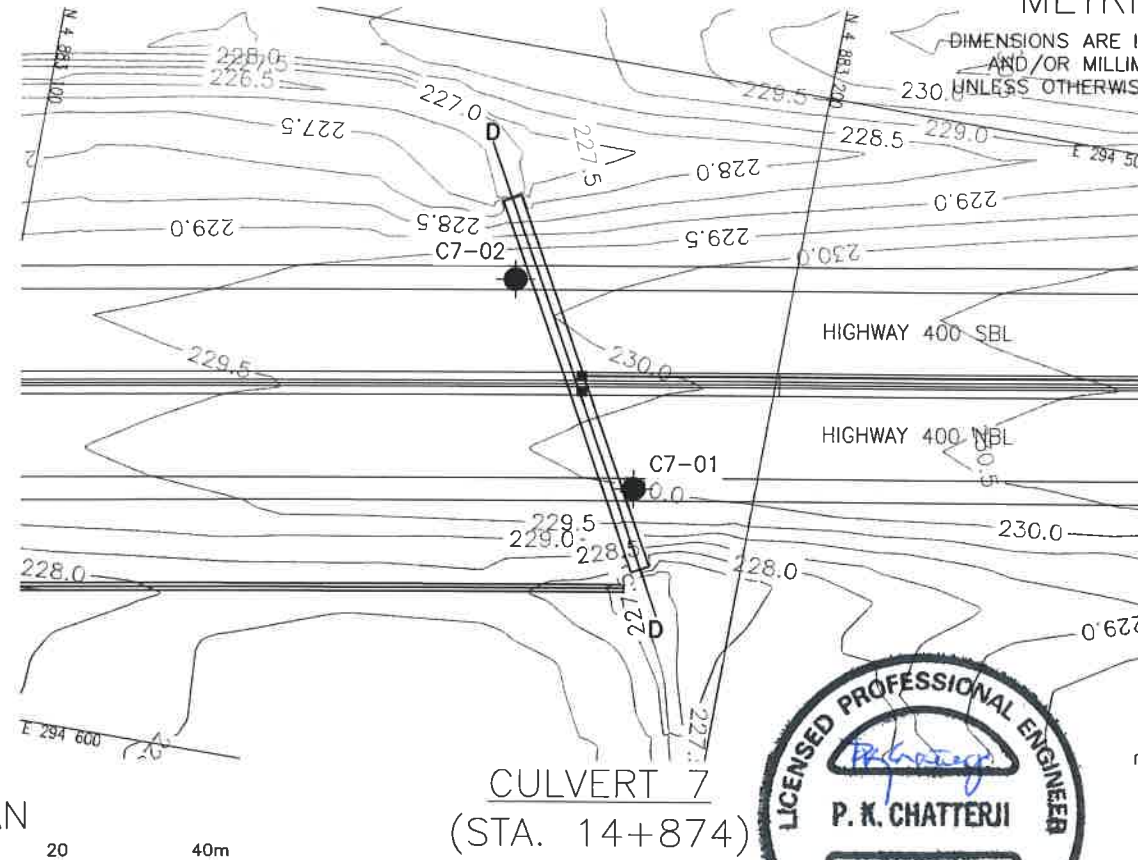
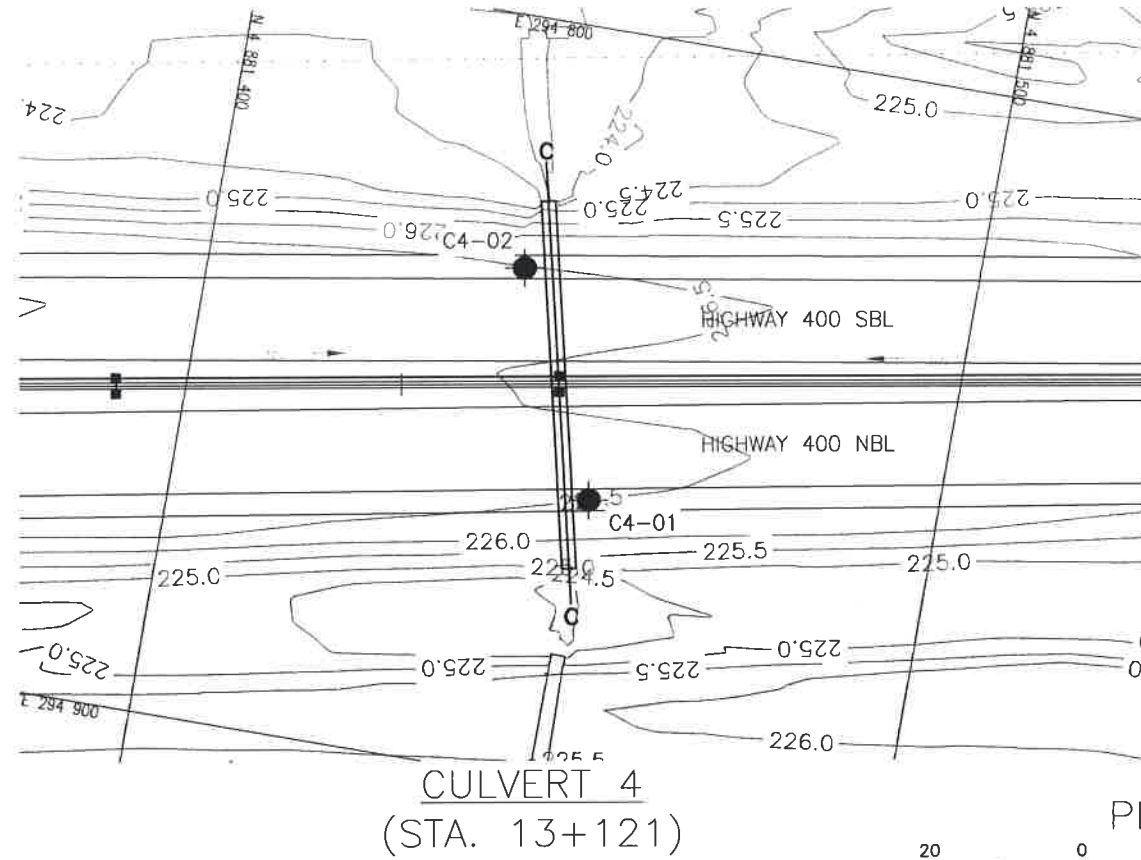


H 1:1000

V 1:200



DATE	BY	DESCRIPTION			
DESIGN SKP	CHK SKP	CODE	LOAD	DATE NOV. 2013	
DRAWN AN	CHK PKC	SITE	STRUCT	DWG	1



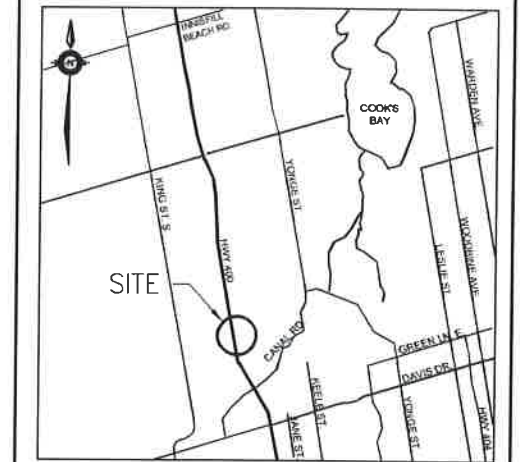
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 83-00-00



HIGHWAY 400
MEDIAN SEWER
CULVERT CROSSINGS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

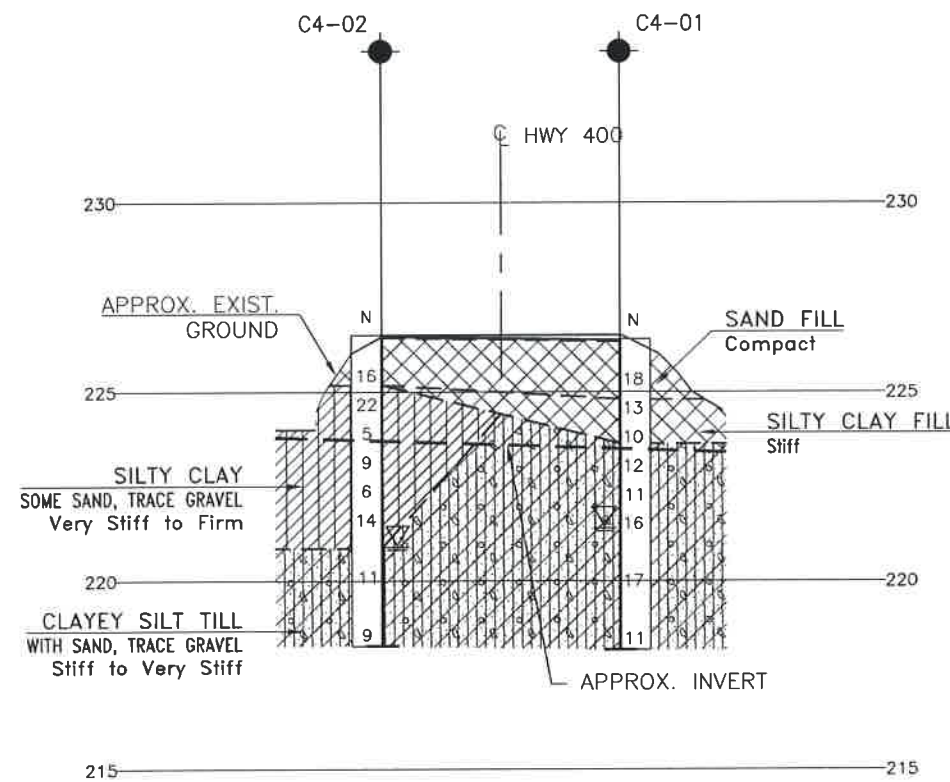
- ◆ Borehole (Current Investigation)
- ◆ Borehole (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- ▽ Water Level
- ▽ Head Artesian Water
- ▽ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
C4-01	226.4	4 881 454.7	294 862.3
C4-02	226.5	4 881 441.1	294 833.3
C7-01	229.9	4 883 184.5	294 555.7
C7-02	229.8	4 883 164.3	294 531.1

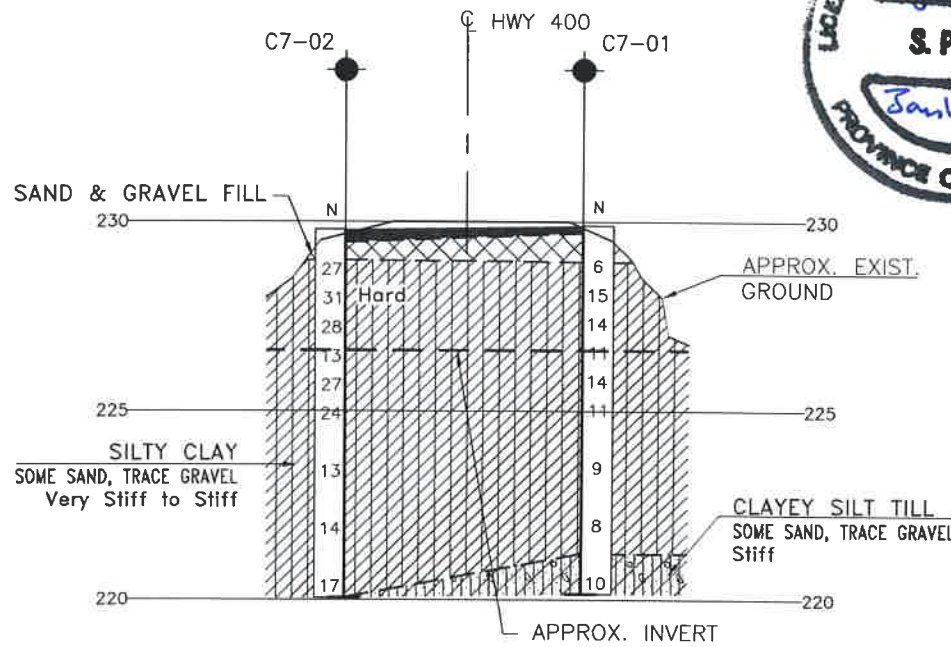
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
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GEOCRES No. 31D-563



SECTION C-C



SECTION D-D






H 1:1000
V 1:200

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
DATE	NOV. 2013		
DWG	2		

SHEET



LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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
C8-01	234.4	4 883 663.2	294 471.6
C8-02	234.3	4 883 652.3	294 445.3
C14-01	255.5	4 886 087.9	294 044.1
C14-02	255.3	4 886 058.4	294 020.7

-NOTES-

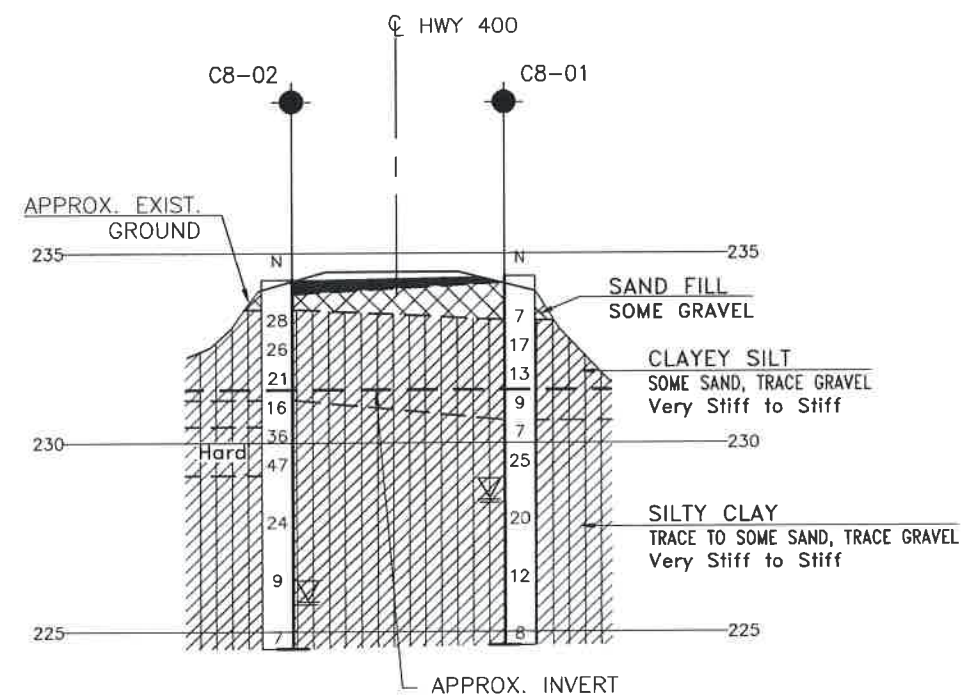
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31D-563

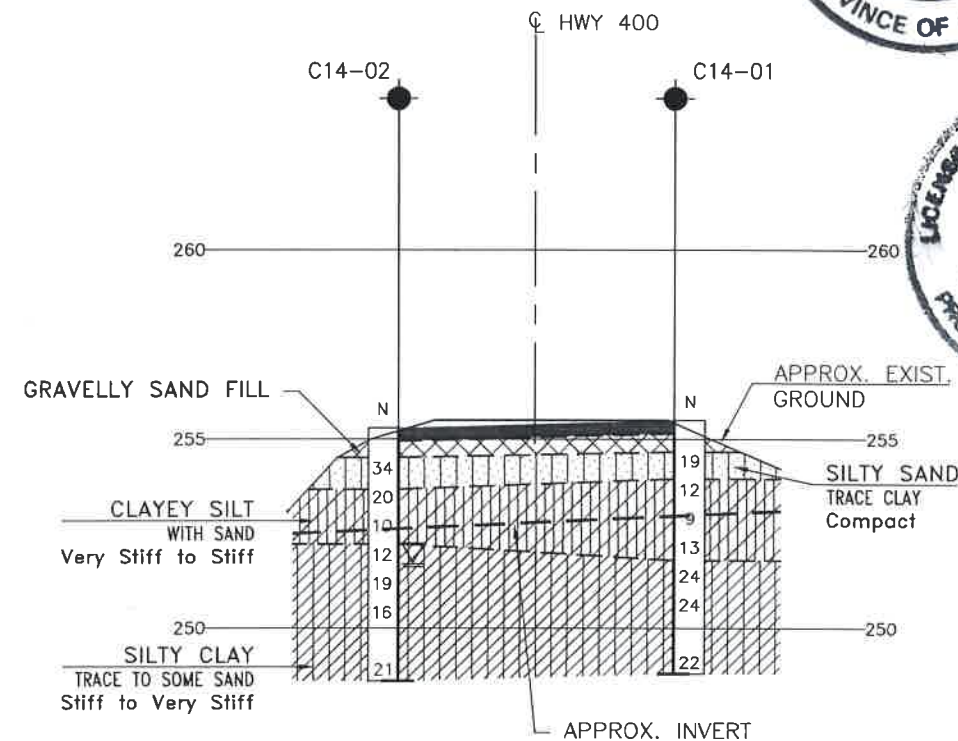
REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	SKP	CHK	SKP	CODE	LOAD	DATE	NOV. 2013		
DRAWN	AN	CHK	PKC	SITE	STRUCT	DWG	3		



PLAN



SECTION ALONG E-E

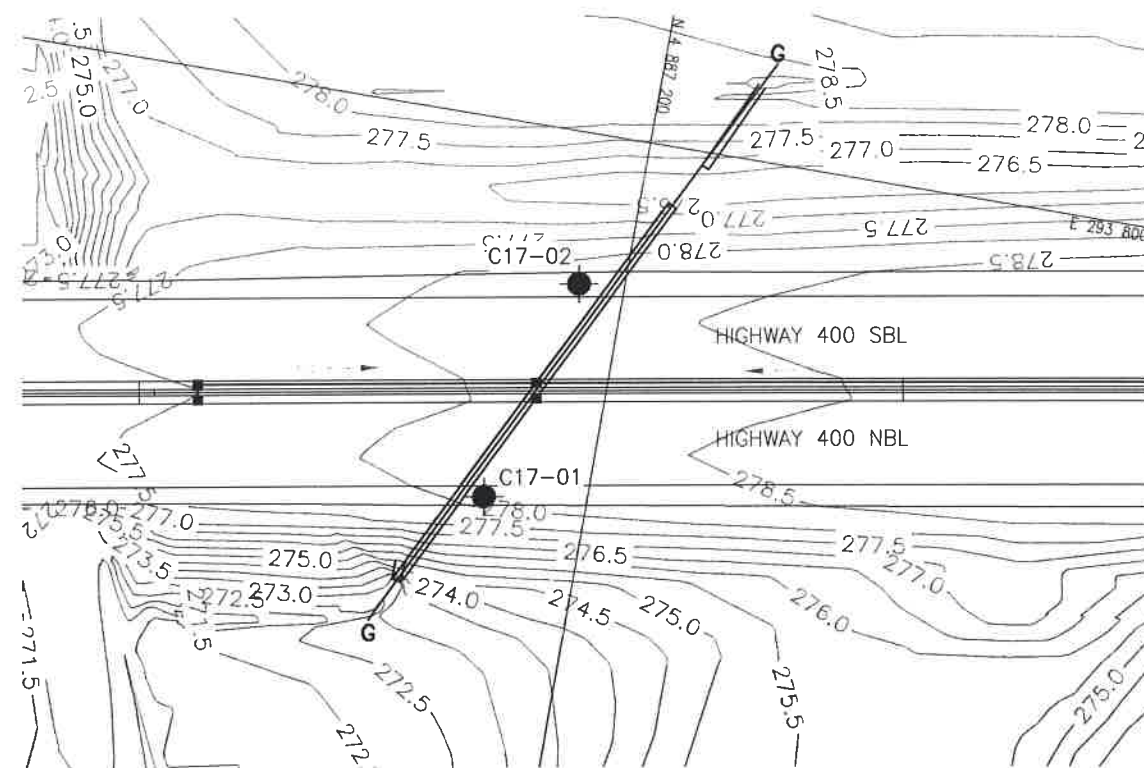


SECTION ALONG F-F

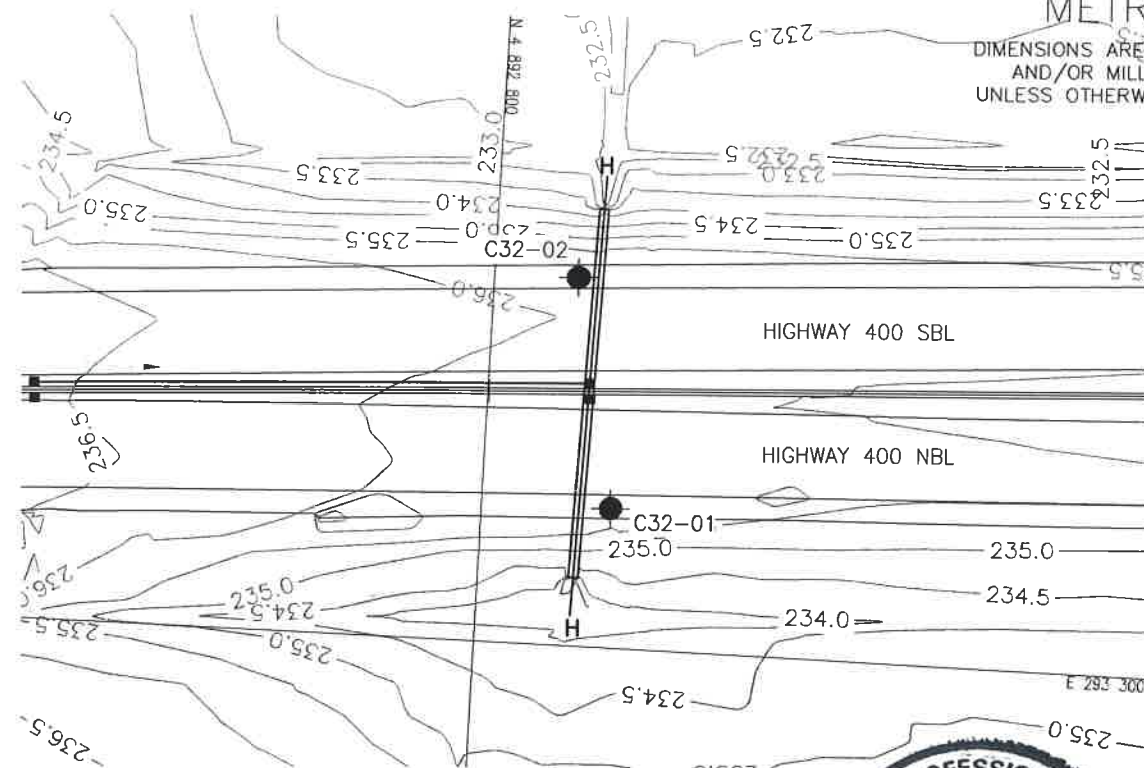


H 1:1000

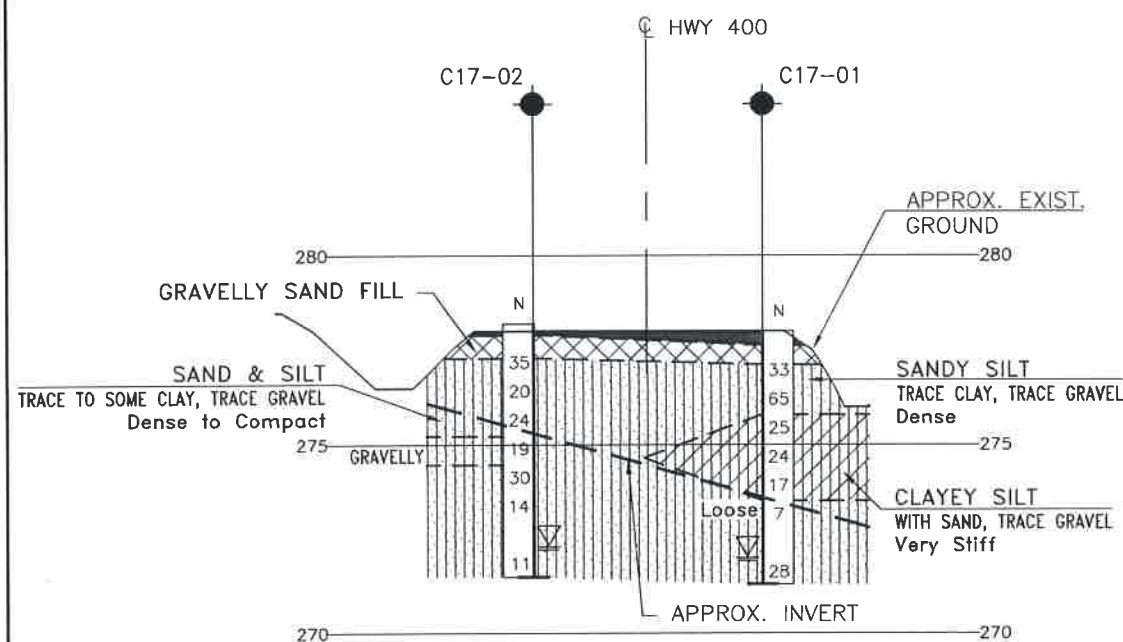
V 1:200



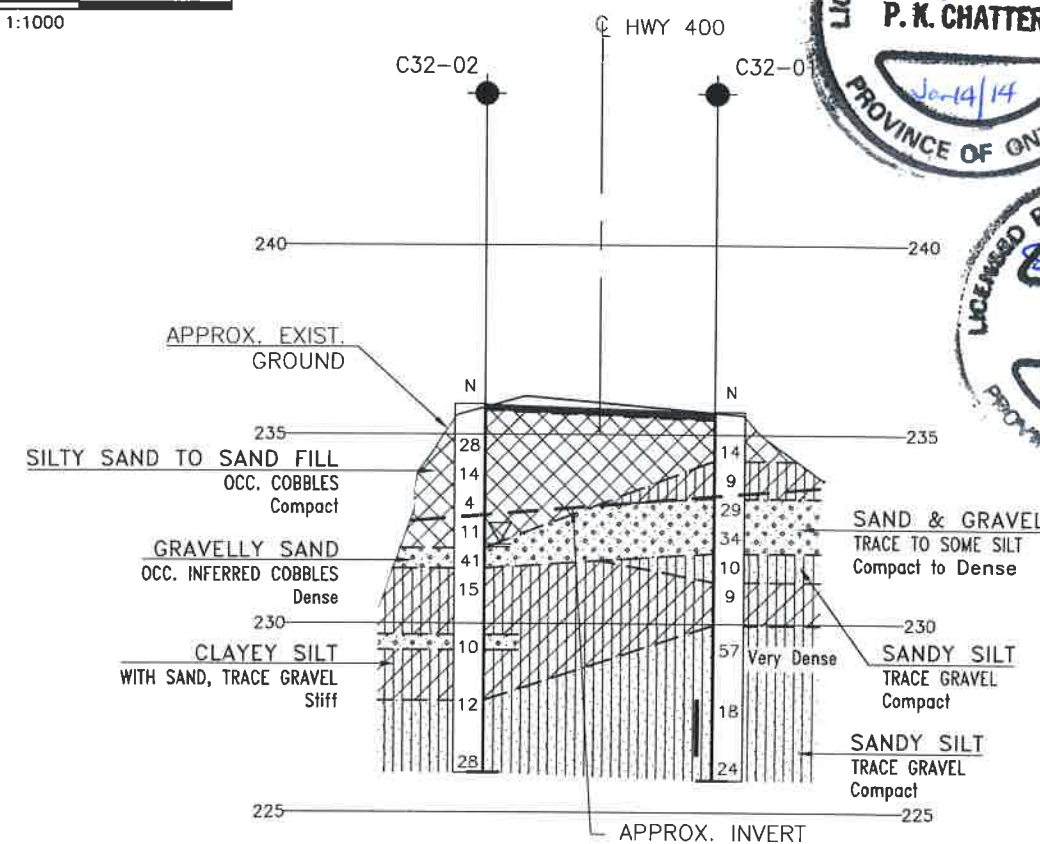
CULVERT 17
(STA. 18+952)



CULVERT 32
(STA. 24+613)



SECTION ALONG G-G



SECTION ALONG H-H



H 1:1000

V 1:200

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

CONT No
GWP No 83-00-00

HIGHWAY 400
MEDIAN SEWER
CULVERT CROSSINGS
BOREHOLE LOCATIONS AND SOIL STRATA








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

	Borehole (Current Investigation)
	Borehole (Previous Investigation)
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

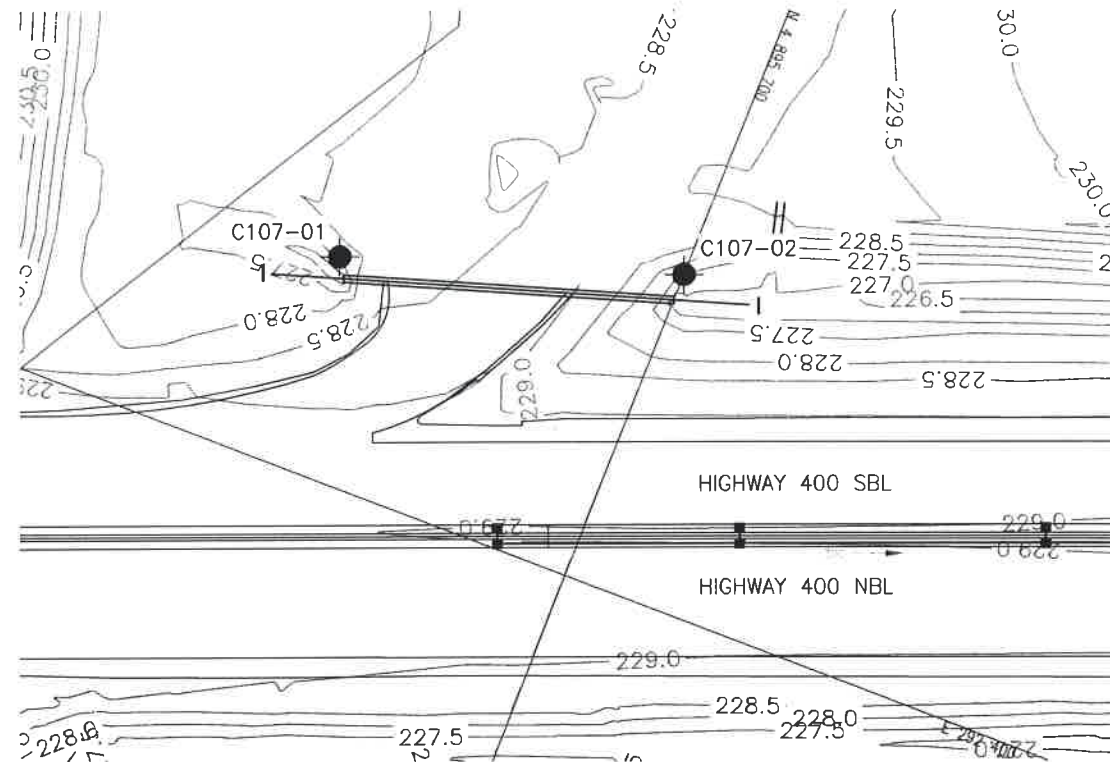
NO	ELEVATION	NORTHING	EASTING
C17-01	278.0	4 887 186.8	293 850.0
C17-02	278.2	4 887 194.1	293 820.1
C32-01	235.6	4 892 816.3	293 281.5
C32-02	235.8	4 892 810.9	293 251.1

-NOTES-

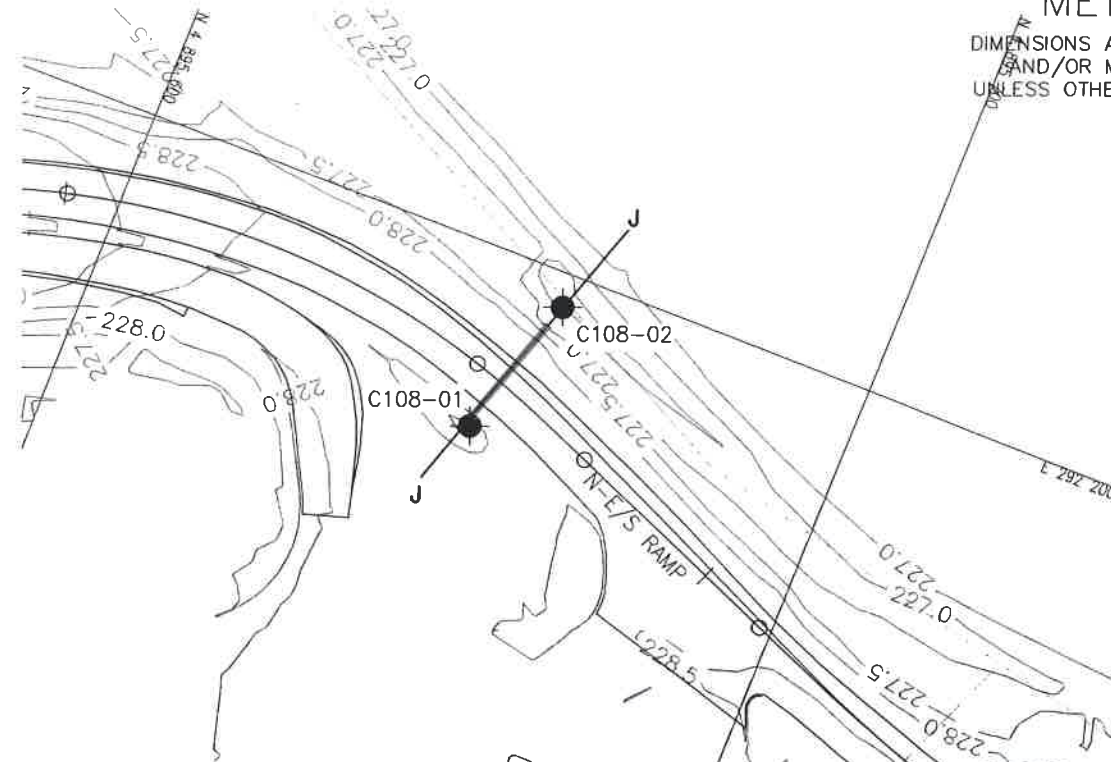
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31D-563

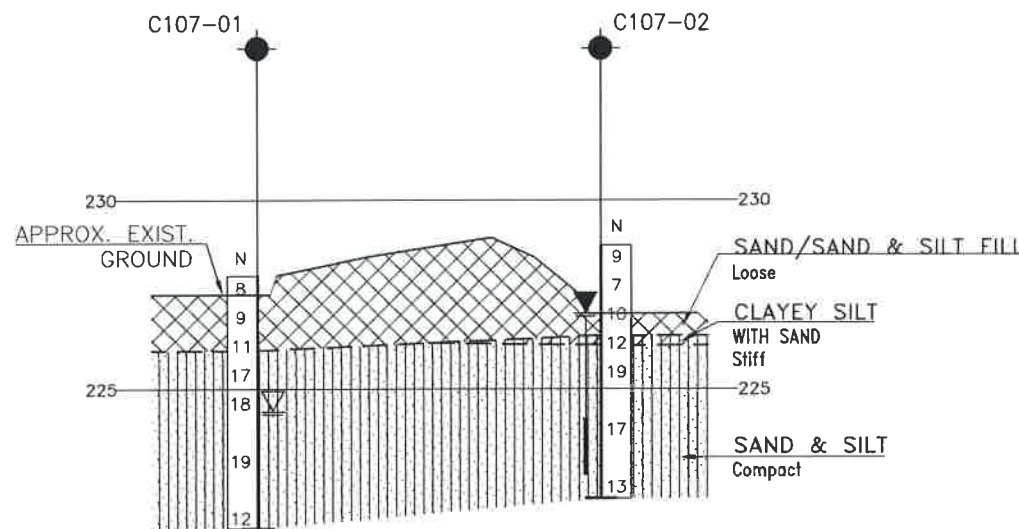
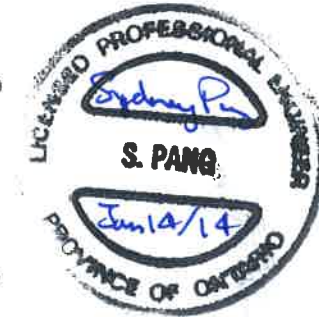
REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	SKP	CHK	SKP	CODE	LOAD	DATE	NOV. 2013		
DRAWN	AN	CHK	PKC	SITE	STRUCT	DWG	4		



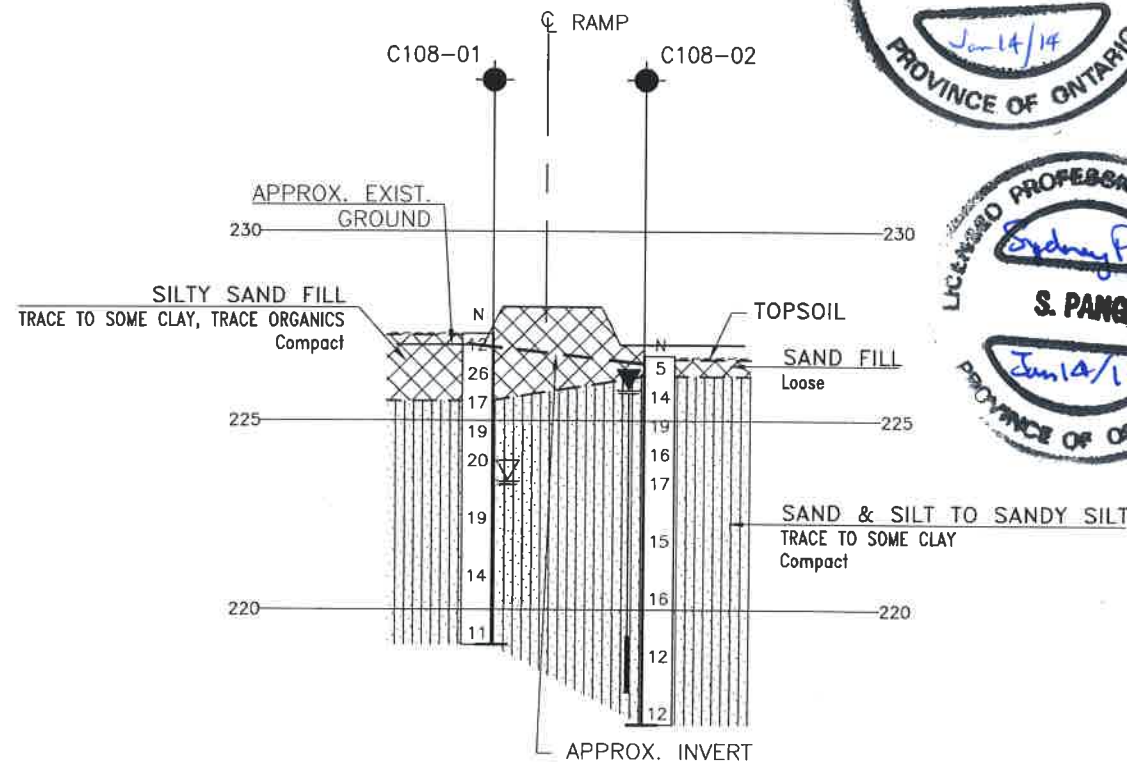
CULVERT HR107
(STA. 10+100 HWY 400)



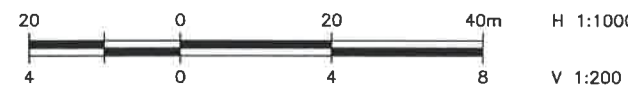
CULVERT HR108
(STA. 10+126 HWY 400)



SECTION ALONG I-I



SECTION ALONG J-J



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

CONT No
GWP No 83-00-00

HIGHWAY 400
MEDIAN SEWER
CULVERT CROSSINGS
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

◆	Borehole (Current Investigation)
◆	Borehole (Previous Investigation)
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

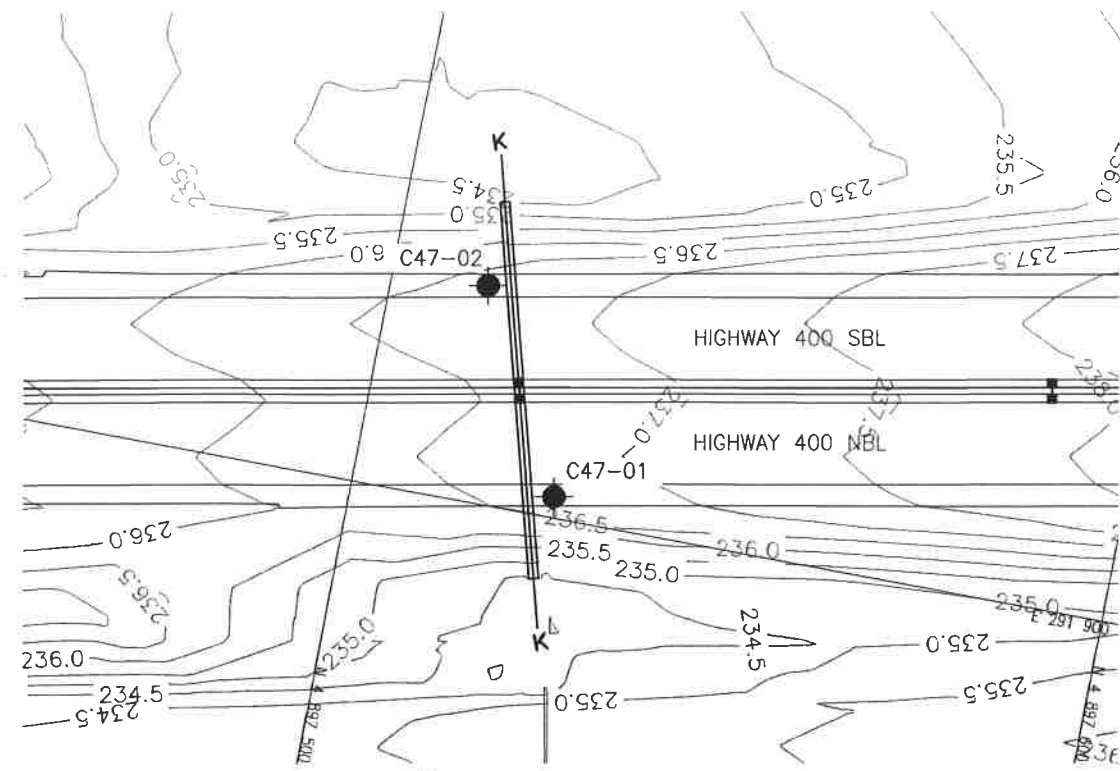
NO	ELEVATION	NORTHING	EASTING
C107-01	228.0	4 895 658.1	292 369.8
C107-02	228.8	4 895 697.3	292 351.9
C108-01	227.3	4 895 653.3	292 223.5
C108-02	226.7	4 895 658.8	292 204.4

NOTES

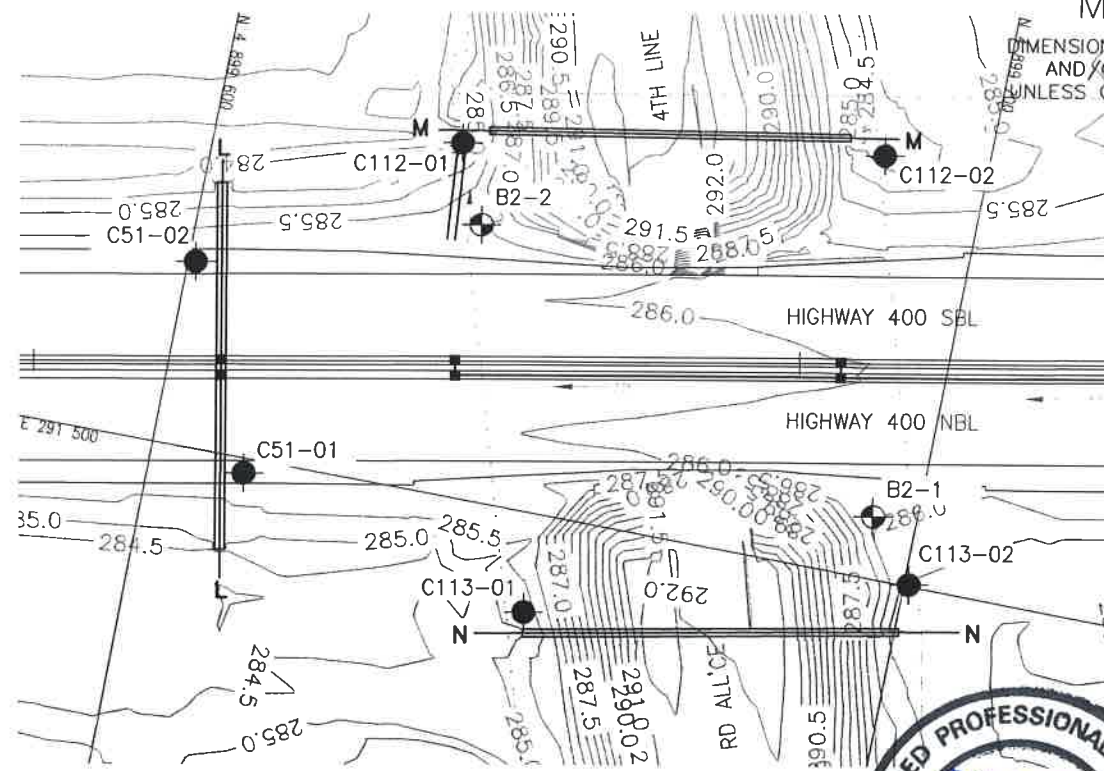
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31D-563

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK	SKP
DRAWN	AN	CHK	PKC
CODE	SITE	LOAD	STRUCT
DATE	NOV. 2013	DWG	5



CULVERT 47
(STA. 12+000)



CULVERT 51
(STA. 14+125)

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

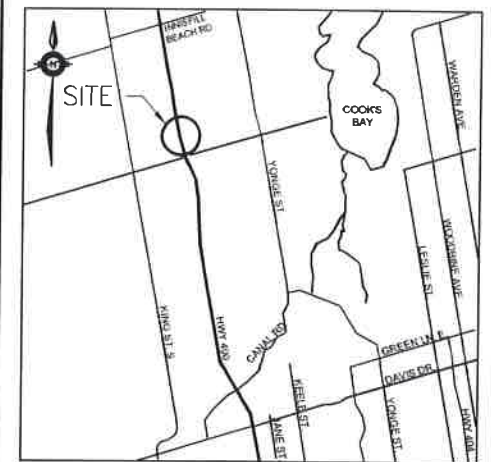
CONT No
GWP No 83-00-00

HIGHWAY 400
MEDIAN SEWER
CULVERT CROSSINGS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

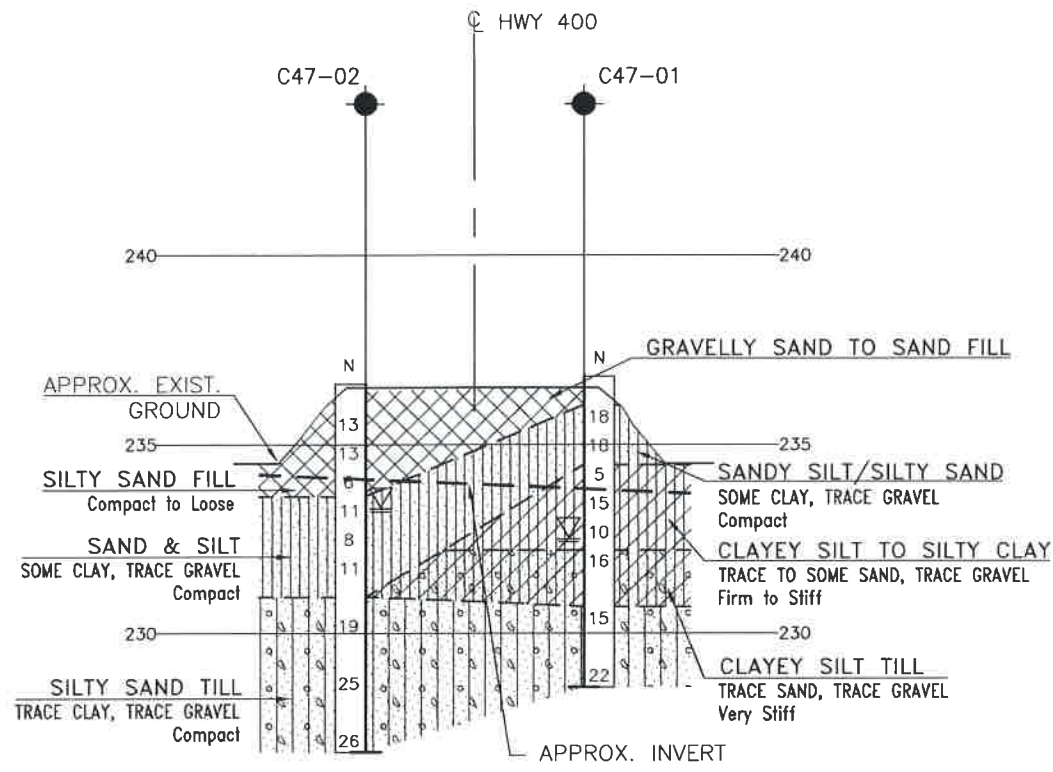
- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |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

NO	ELEVATION	NORTHING	EASTING
C47-01	236.8	4 897 526.4	291 897.1
C47-02	236.6	4 897 512.7	291 871.2
C51-01	285.7	4 899 612.4	291 501.9
C51-02	285.7	4 899 601.0	291 475.4

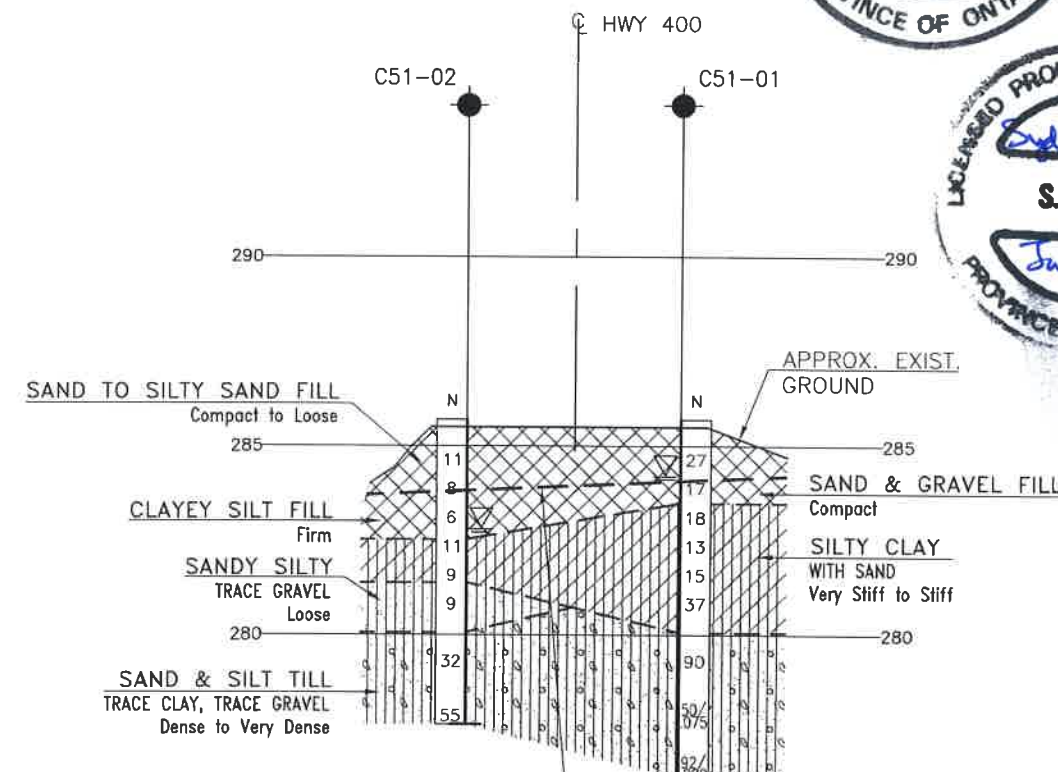
-NOTES-

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GEOCRES No. 31D-563



SECTION ALONG K-K



SECTION ALONG L-L

PLAN

20 0 20 40m

SCALE 1:1000

12345

LICENSED PROFESSIONAL ENGINEER

P. K. CHATTERJI

PROVINCE OF ONTARIO

Jan 14/14



H 1:1000

V 1:200

[illegible]

A circular professional seal for a Licensed Professional Engineer in the Province of Ontario. The seal contains the following information:





- Top Arc:** LICENSED PROFESSIONAL ENGINEER
- Signature:** Sydney Pang
- Center:** S. PANG
- Bottom Arc:** 14414
- Bottom Edge:** PROVINCE OF ONTARIO

SHEET



Map of the area around Cooks Bay, showing streets and the location of the site. The map includes a compass rose indicating North. Streets shown include Washburn Ave, Wackerline Ave, Lehigh St, Green Rd, Davis Rd, Young St, 50th Ave, Kent Ave, Kane St, Hwy 40, and Wingo St. A circle marks the 'SITE' location near the intersection of Washburn Ave and Hwy 40.

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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 |

[illegible]

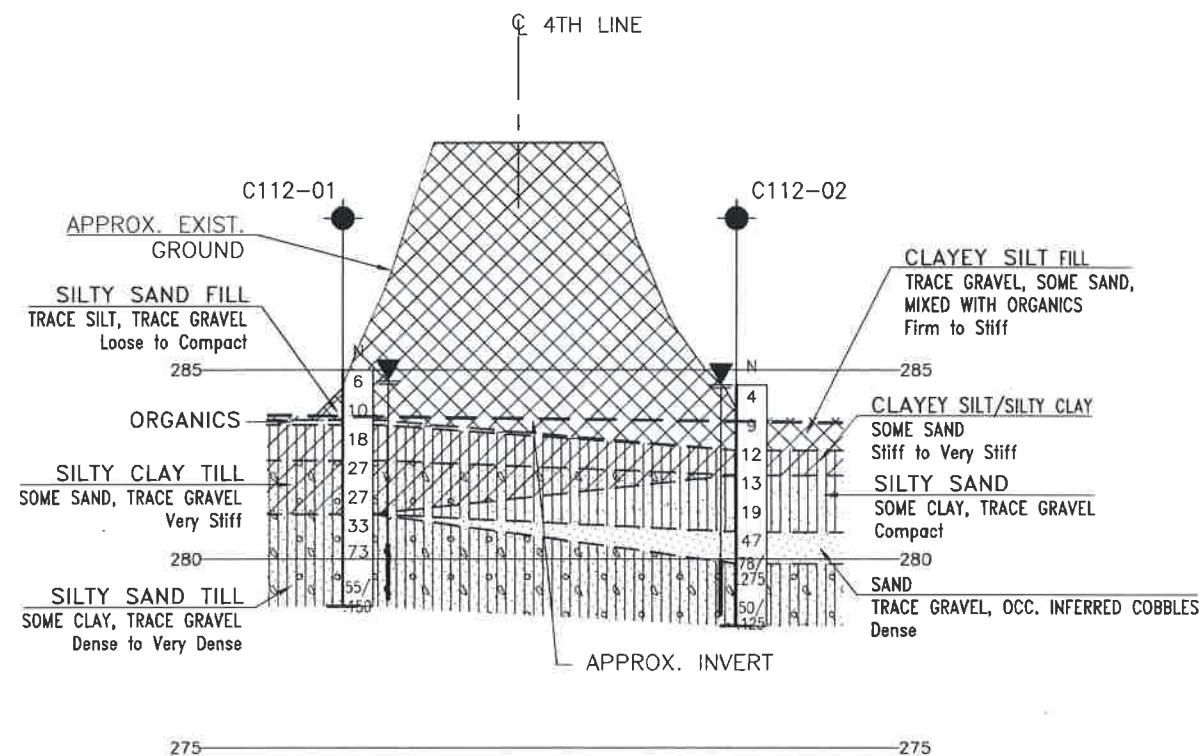
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

[illegible]

PLAN

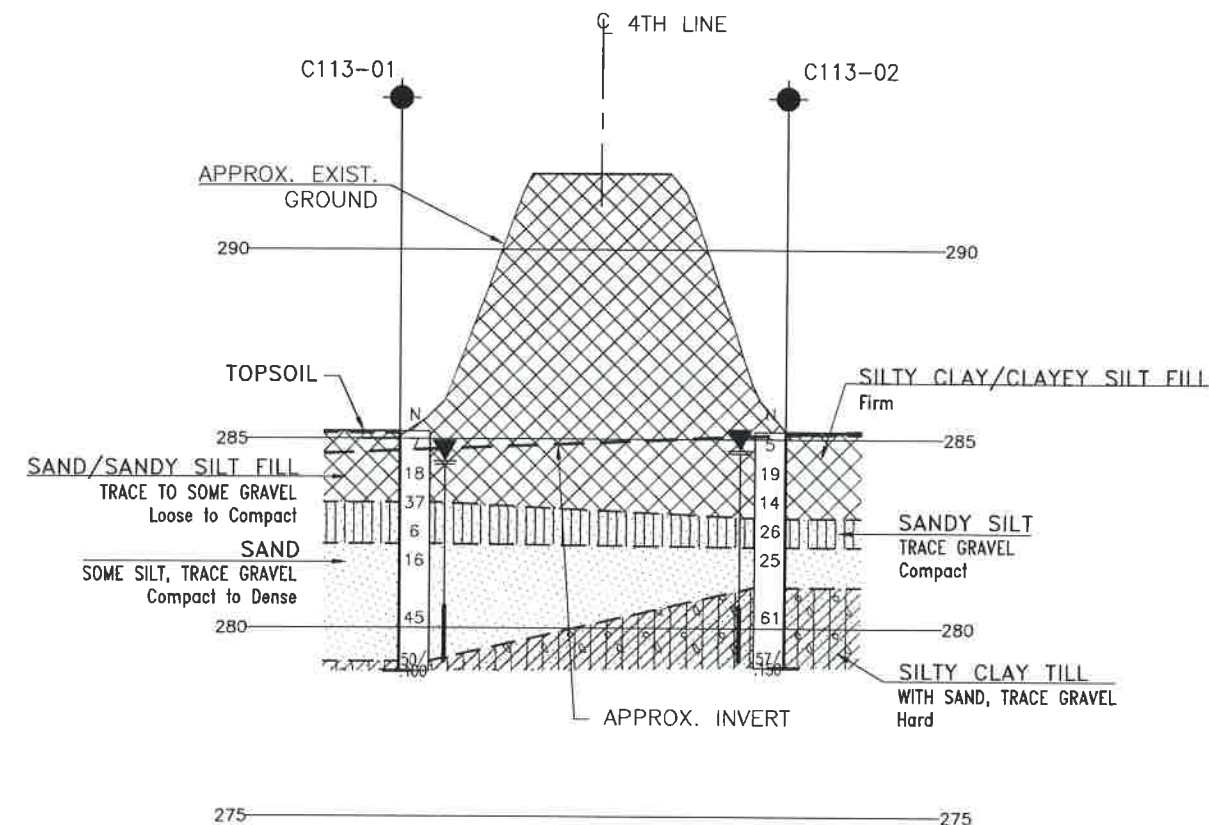
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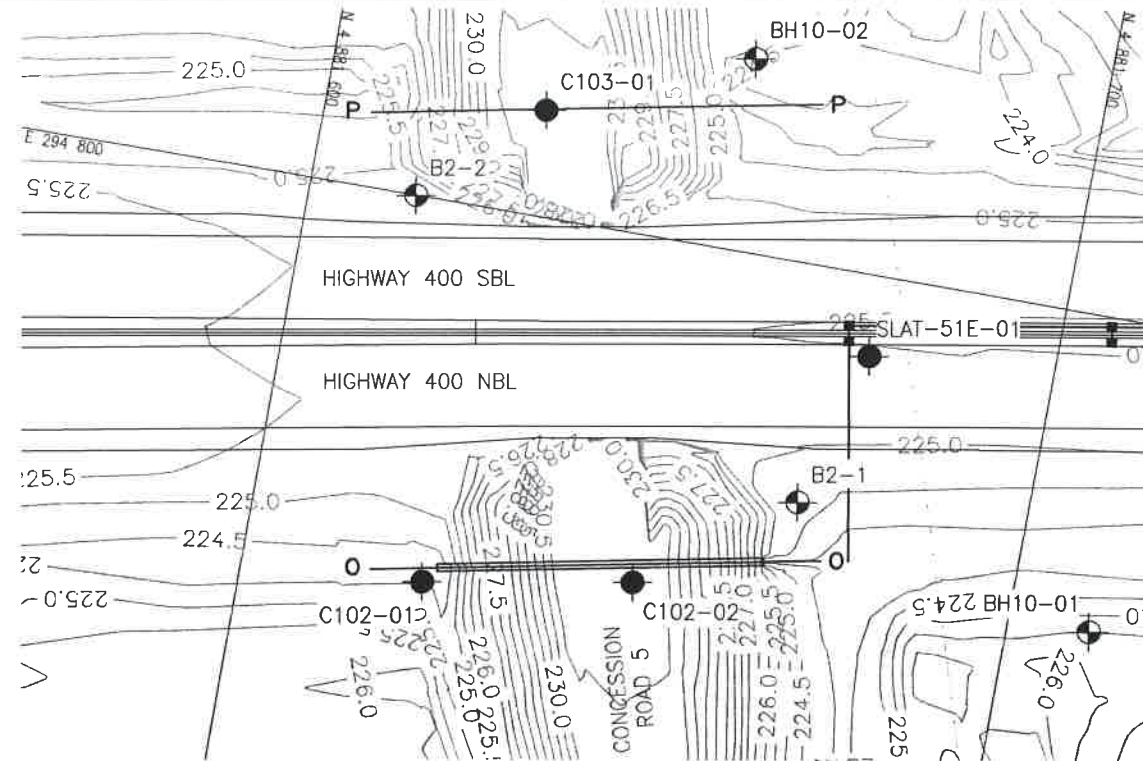
SECTION ALONG M-M

CULVERT SR113
(STA. 14+150 HWY 400)



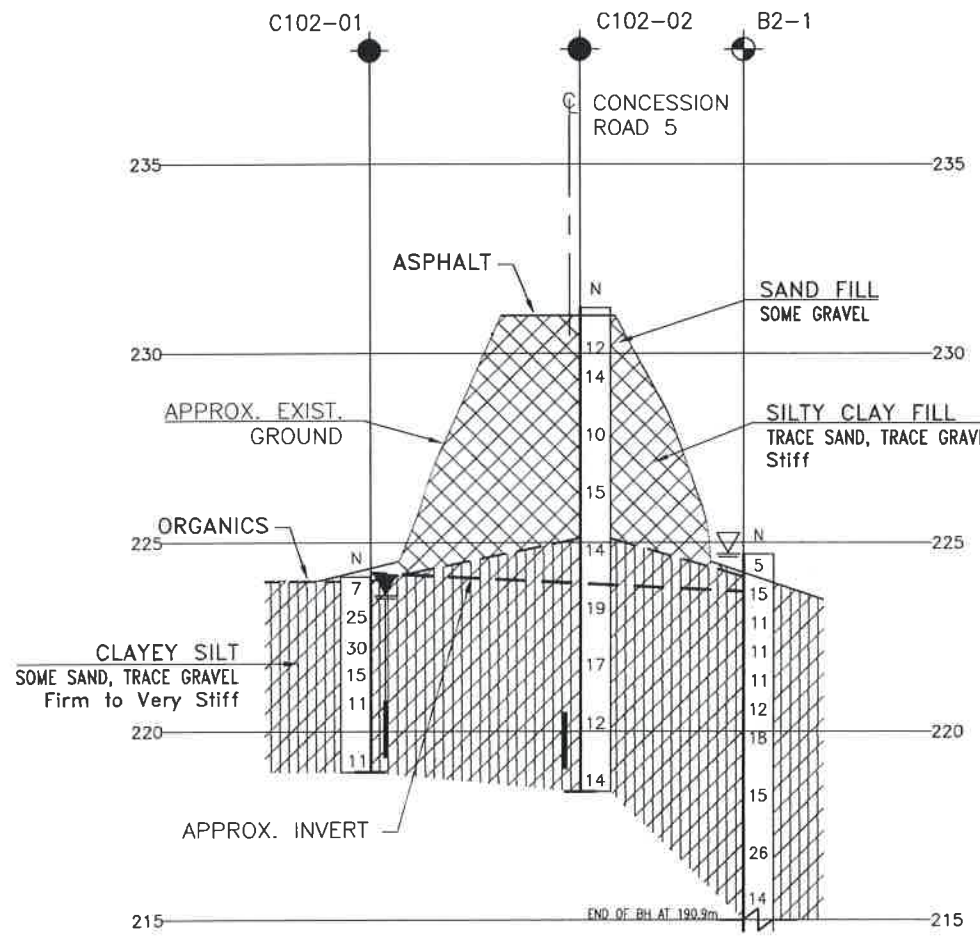
SECTION ALONG N-N

H 1:1000

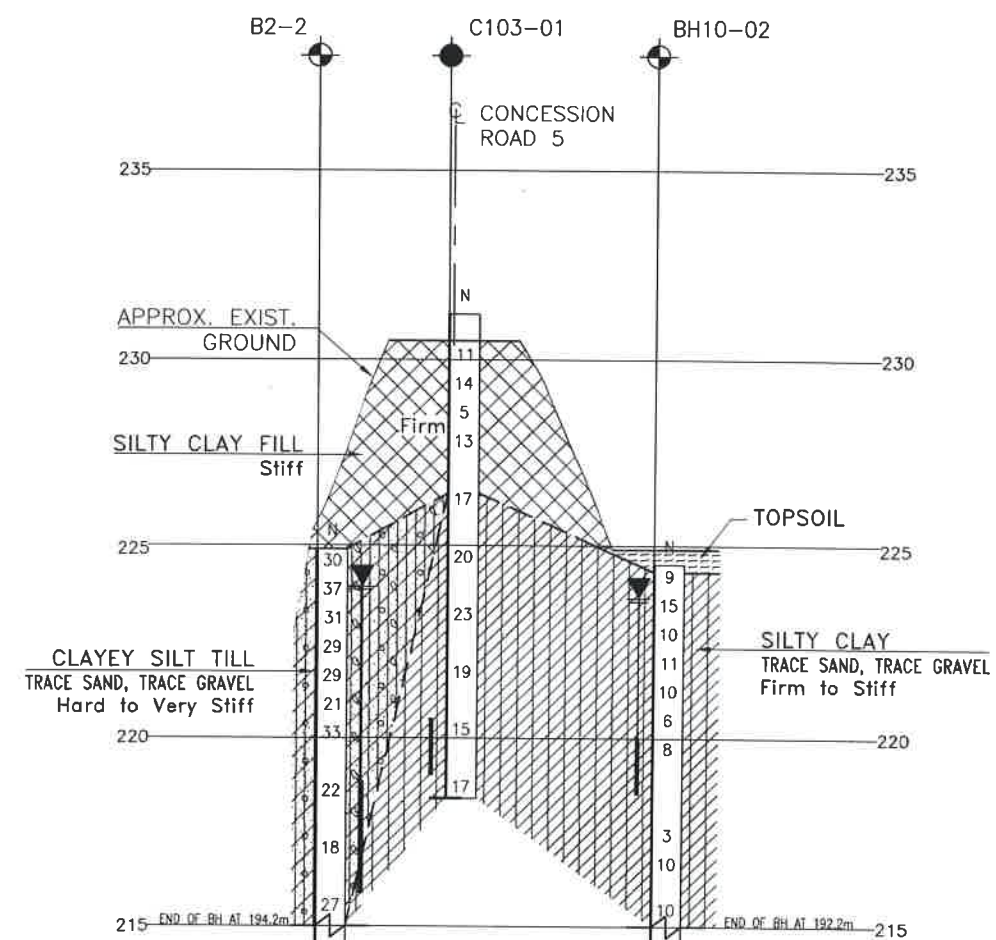
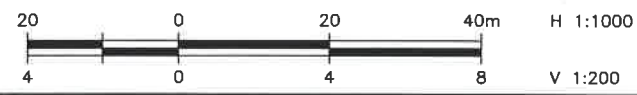


CULVERT SR102
(STA. 13+300 HWY 400)

CULVERT SR103
(STA. 13+300 HWY 400)



SECTION ALONG O-O



SECTION ALONG P-P

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



CONT No
GWP No 83-00-00

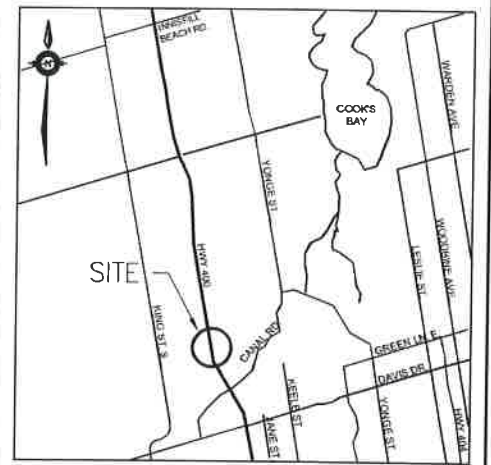
HIGHWAY 400
MEDIAN SEWER
CULVERT CROSSINGS
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- ◆ Borehole (Current Investigation)
- ◊ Borehole (Previous Investigation)
- 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
C102-01	224.5	4 881 625.0	294 852.3
C102-02	231.3	4 881 651.2	294 845.6
C103-01	231.2	4 881 628.7	294 786.0
BH10-01	225.2	4 881 710.7	294 841.6
BH10-02	224.6	4 881 654.2	294 774.3
B2-1	224.7	4 881 670.2	294 831.5
B2-2	225.1	4 881 613.9	294 800.0

NOTES

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


GEOCRES No. 31D-563

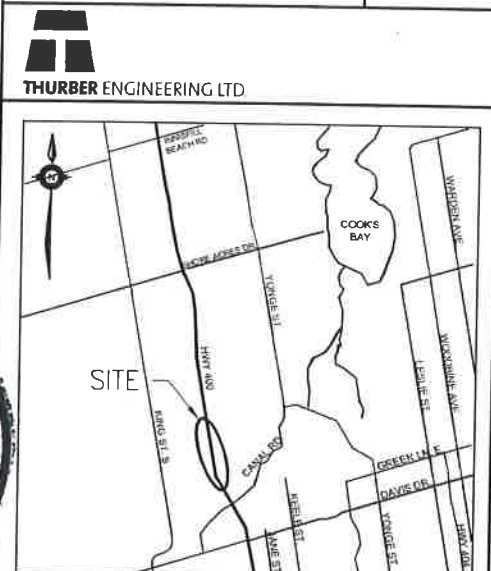
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The plan view shows the proposed rail alignment (HWY. 400 SBL and NBL) running horizontally across the middle of the page. Stationing markers are present along the alignment, including 292+000, 292+200, 292+400, and 292+500. A vertical road, labeled '10+400', crosses the alignment. To the left of the alignment, there are building footprints and a road labeled '10+200'. To the right, there are more roads and a circular stamp from the 'PROVINCE OF ONTARIO' dated 'Jan 4/14'. A table in the bottom right corner provides stationing data for specific points along the alignment.





C39-01HW	227.9	4 894 668.0
C39-02HW	228.0	4 894 676.3
NLAT37E-01	229.1	4 895 779.1
NLAT40W-01	228.9	4 896 189.8

001798
PROFESSIONAL ENGINEER
S. PANG
JUNE 4/14
PROVINCE OF ONTARIO

CONT No GWP No 83-00-00	
HWY 400 MEDIAN SEWER MEDIAN SEWER (STA. 16+400 TO 10+600)	SHEET
BOREHOLE LOCATIONS PLAN	



KEYPLAN
LEGEND

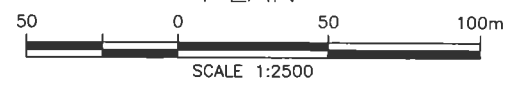
- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60' Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |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

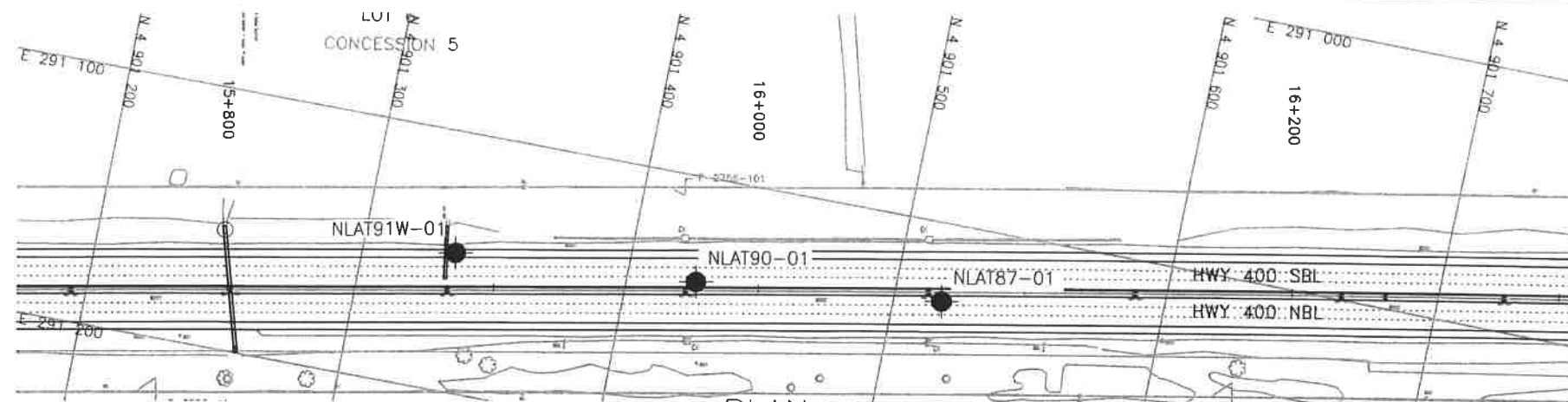
NO	ELEVATION	NORTHING	EASTING
SLAT83W-01	248.4	4 884 709.8	294 270.2
SLAT132E-01	281.7	4 887 650.4	293 757.6
C18-01HW	279.8	4 887 708.1	293 770.1
C18-01HW	280.0	4 887 719.6	293 769.3
SLAT41-01	288.6	4 888 371.1	293 629.8
SLAT44-01	291.0	4 888 521.3	293 603.2
SLAT06E-01	269.7	4 891 275.9	293 341.0
C27-01HW	258.9	4 891 551.7	293 304.2
C27-02HW	258.4	4 891 558.2	293 303.3
SLAT19W-01	238.1	4 892 651.3	293 271.2
C32-01	235.6	4 892 816.8	293 281.5
C32-02	235.8	4 892 810.9	293 251.1
SLAT109W-01	235.5	4 892 917.8	293 256.3

-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. 31D-563

[illegible]



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

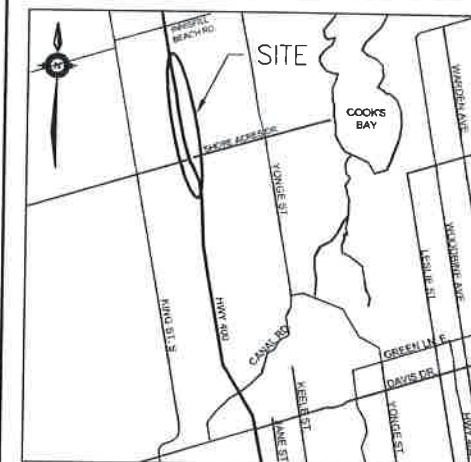
CONT No
GWP No 83-00-00
HWY 400 MEDIAN SEWER
MEDIAN SEWER
(STA. 26+400 TO 19+800)
BOREHOLE LOCATIONS PLAN



SHEET







THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

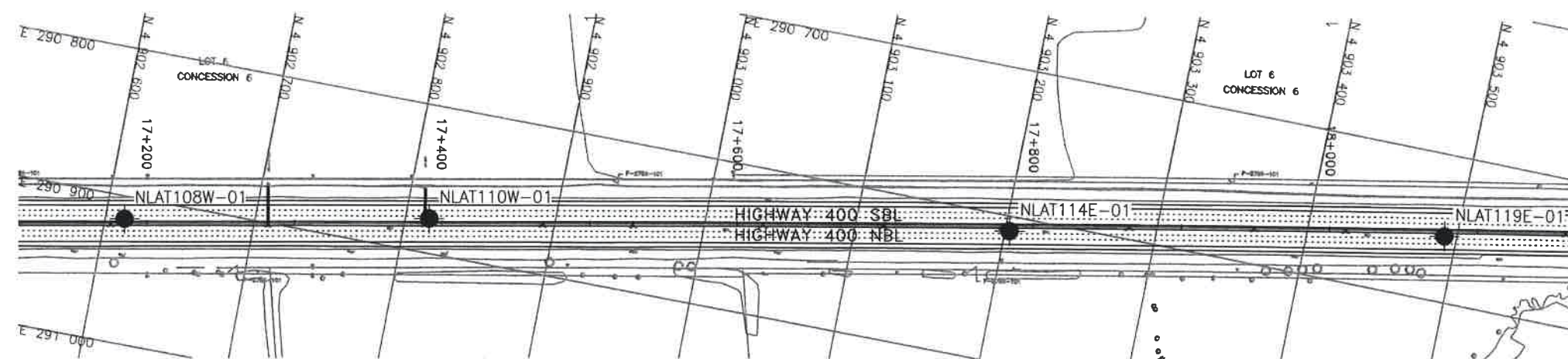
- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |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

NO	ELEVATION	NORTHING	EASTING
NLAT91W-01	298.6	4 901 334.7	291 146.5
NLAT90-01	299.5	4 901 425.9	291 140.2
NLAT87-01	300.3	4 901 517.8	291 129.9
NLAT108W-01	297.9	4 902 612.9	290 915.3
NLAT110W-01	299.0	4 902 816.0	290 876.3
NLAT114E-01	298.3	4 903 202.0	290 809.9
NLAT119E-01	296.7	4 903 491.6	290 755.2
NLAT118W-01	307.8	4 904 921.3	290 477.0
C114-01	302.8	4 904 983.1	290 636.1
C116-01	301.5	4 905 085.3	290 645.0

-NOTES-

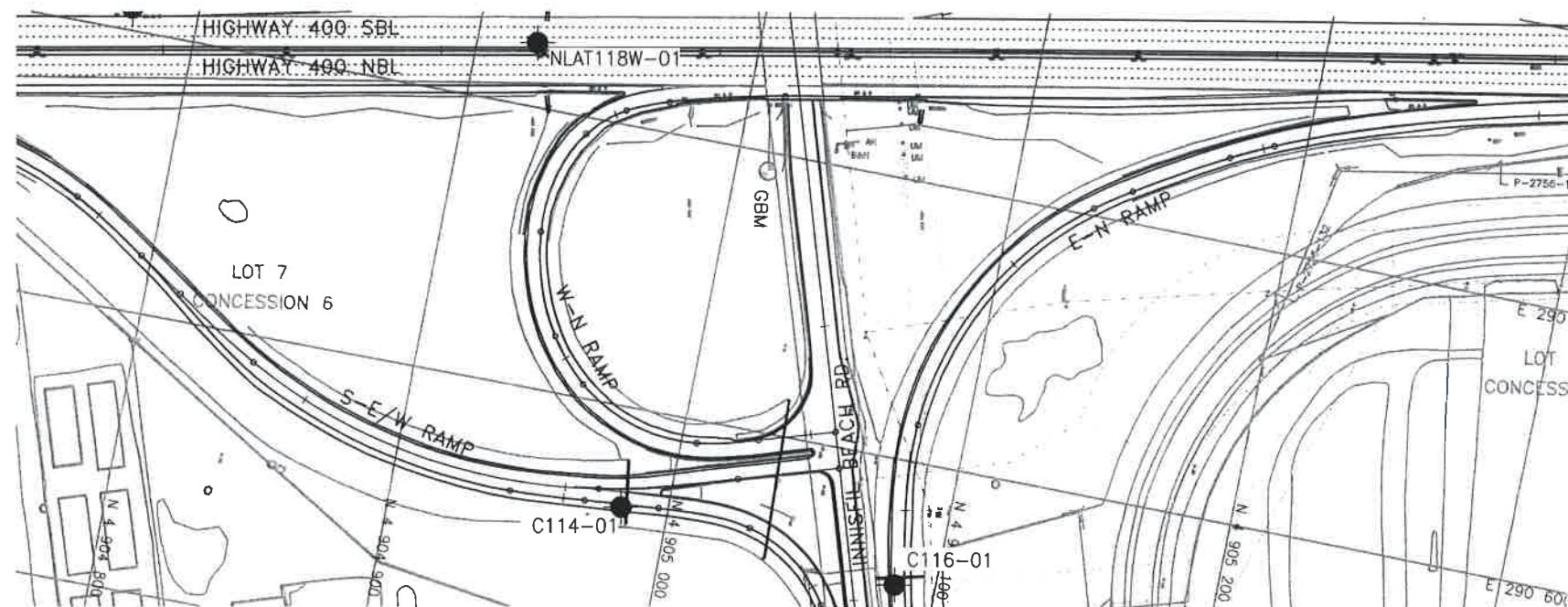
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GEOCRES No. 31D-563



PLAN

SCALE 1:4000



PLAN

SCALE 1:2500

[illegible]

Appendix F

List of Special Provisions and Suggested Text for NSSP

PIPE INSTALLATION BY TRENCHLESS METHOD – Item No.

Non Standard Special Provision

October 2013

1. SCOPE

This specification covers the general requirements for the installation of pipes by trenchless methods.

The Contractor shall determine the most appropriate method of installation. Specifications for Jack and Bore, Pipe Ramming, Directional Drilling, and Tunnelling are provided herein, and shall be applied to the installation method considered feasible by the Contractor.

OPSS 415 (Construction Specification for Pipeline and Utility Installation by Tunnelling), OPSS 416 (Construction Specification for Pipeline and Utility Installation by Jacking and Boring) and OPSS 450 (Construction Specification for Pipeline and Utility Installation in Soil by Horizontal Directional Drilling) shall not be used to do the work for the above tender item.

2. REFERENCES

This specification refers to the following standards, specifications, or publications:

Foundation Investigation Report, Median Sewer, Lateral and Culvert Replacements, Highway 400, North Canal Road to Innisfil Road, Simcoe County, Ontario, G.W.P. 83-00-00 prepared by Thurber Engineering Ltd., Reference No. 19-1351-218.

Ontario Provincial Standard Specifications, General

OPSS 180 Management and Disposal of Excess Material

Ontario Provincial Standard Specifications, Construction

OPSS 504 Preservation, Protection, and Reconstruction of Existing Facilities

OPSS 507 Site Restoration Following Installation of Pipelines, Utilities and Associated Structures in Open Cut

OPSS 514 Trenching, Backfilling, and Compaction

OPSS 517 Dewatering of Pipeline, Utility, and Associated Structure Excavation

OPSS 538 Support Systems

OPSS 539 Protection Schemes

Ontario Provincial Standard Specifications, Material

OPSS 1004 Aggregates - Miscellaneous

OPSS 1350 Concrete - Materials and Production

OPSS 1440 Steel Reinforcement for Concrete

OPSS 1802 Smooth Walled Steel Pipe

MTO Specifications

OPSS 1820 Material Specification for Circular Concrete Pipe

OPSS 1840 Material Specification for Non-Pressure Polyethylene Plastic Pipe Products

American Society for Testing and Materials (ASTM) International Standards

ASTM A252-93	Welding and Seamless Steel Pipe Piles
ASTM D2657-03	Standard Practice for Heat Fusion Joining of Polyelofin Pipe and Fittings
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM F894	Polyethylene Large Diameter Profile Wall Sewer and Drain Pipe

Canadian Standards Association Standards:

CSA B182.6	Profile Polyethylene Sewer Pipe and Fittings.
CAN/CSA A5-93	Portland Cement
CSA W59	Welded Steel Construction (Metal Arc Welding)

3. DEFINITIONS

For the purpose of this specification, the following definitions apply:

Backreamer: a cutting head suitably designed for the subsurface conditions that is attached to the end of a drill string to enlarge the pilot bore during a pullback operation.

Bore Path: a drilled path according to the grade and alignment tolerances specified in the Contract Documents.

Design Engineer: means the Engineer retained by the Contractor who produces the original design and working drawings. The design engineer shall be licensed to practice in the Province of Ontario.

Design Checking Engineer: means the Engineer retained by the Contractor who checks the original design and working drawings. The design checking engineer shall be licensed to practice in the Province of Ontario.

Digger Shield/Hand Mining: a method of forming a horizontal bore in the subsurface by essentially simultaneously jacking ahead while tunnelling advances using hand-mining (man-entry operation or “Jack and Mine) or a “digger” type shield with a hydraulic excavator arm to remove materials from inside the liner pipe.

Drilling Fluids: a mixture of water and additives, such as bentonite, polymers, surfactants, and soda ash, designed to block the pore space on a bore wall, reduce friction in the bore, and to suspend and carry cuttings to the surface.

Drilling Fluid Fracture or Frac Out: a condition where the drilling fluid’s pressure in the bore is sufficient to overcome the in situ confining stress, thereby fracturing the soil and/or rock materials and allowing the drilling fluids to migrate to the surface at an unplanned location.

Engineer: a Professional Engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario.

Excavation: includes all materials encountered regardless of type and extent. Excavation shall include removal of natural soil, large boulders, cobbles, wood and fill regardless of means necessary to break consolidated materials for removal.

Environmentally Sensitive Area (ESA): areas adjacent to construction that are off limits to the Contractor as specified elsewhere in the Contract.

Fill: man-made mixture of previously placed/handled materials such as sand, clay, silt, gravel, broken rock, sometimes containing organic and/or deleterious materials, placed in an excavation or other area to raise the surface elevation.

Grouting: injection of grout into voids.

Guidance System: an electronic system capable of locating the position, depth and orientation of the drill head during the directional drilling process.

Directional Drilling (DD): directional boring or guided boring.

HDPE: high density polyethylene.

Inadvertent Returns: the flow of unexpected fluids, saturated materials (or running soil) towards the drilling rig that typically originated from an artesian aquifer encountered during the drilling process.

Jack and Bore: a method of forming a horizontal bore in the subsurface by essentially simultaneously jacking ahead and rotating a cutter head, followed by removal of material from inside the bore.

Loss of Circulation: the discontinuation of the flow of drilling fluid in the bore back to the entry or exit point or other planned recovery points.

Pilot Bore: the initial bore to set directional controlled horizontal and vertical alignment between the connecting points.

Pipe Jacking: a method for installing steel casing or concrete pipe in the subsurface utilizing hydraulically operated jacks of adequate number and capacity to ensure smooth and uniform advancement without overstressing the liner/pipe.

Pipe Ramming: a method for installing steel casings utilizing the energy from a percussion hammer to advance a steel casing with a cutting shoe attached at the front end of the casing.

Primary Liner (Support): system installed prior to or concurrent with excavation, to maintain stability of an excavation and to support earth or rock and any structure utilities or other facilities in or on the supported earth or rock mass, until the excavation is completed.

Product: pipe culverts, pipe sewers, watermain pipe and sanitary pipe.

Pullback: that part of the DD method in which the drill string is pulled back through the bore path to the entry point.

Quality Verification Engineer (QVE): an Engineer who has a minimum of five (5) years experience in the field of pipe installation using trenchless methods or alternatively has demonstrated expertise by providing satisfactory quality verification services for the work at a minimum of two (2) projects of similar scope to the contract. The Quality Verification Engineer shall be retained by the Contractor to certify that the work is in general conformance with the contract documents and to issue Certificate(s) of Conformance.

Reaming: a process for pulling a tool attached to the end of the drill string through the bore path to enlarge the bore and mix the cuttings with the drilling fluid. This typically includes multiple passes.

Rock: natural beds or massive fragments, or the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or sedimentary in origin, which may or may not be weathered and includes boulders having a size equivalent to 0.3 m in diameter or greater.

Secondary Liner: concrete pipe, HDPE pipe or un-reinforced cast-in-place concrete, installed subsequent to tunnel excavation.

Shaft: vertically sided excavation used as entry and/or exit points from which the trenchless method is initiated or directed for the installation of product.

Strike Alert: a system that is intended to alert and protect the operator in the case of inadvertent drilling into an electrical utility cable. The strike alert system consists of a sensor and an alarm connected to the drill rig and a grounding stake. The alarm may be audio or visual or both.

Slurry: a mixture of soil and/or rock cuttings, and drilling fluid.

Soil: all materials except those defined as rock, and excludes stone masonry, concrete, and other manufactured materials; includes rock fragments having an equivalent size less than 0.3 m in diameter.

Tunnelling: an underground method of constructing a passage open at both ends that involves installing a pipe.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.01 General

The Contractor's documentation, submission requirements and installation methods shall specifically consider and address the subsurface conditions at each pipe crossing as identified in the Foundation Investigation Report.

4.02 Working Drawings

Three copies of stamped working drawings for portal or shaft construction, primary liner, excavation, secondary lining, dewatering and groundwater control and grouting shall be submitted to the Contract Administrator (CA) at least one (1) week prior to the commencement of the work for information

purposes. All submissions shall bear the seal and signature of the Design Engineer and Design Checking Engineer. The Contractor shall have a copy of the stamped working drawings at the site during construction.

As a minimum, working drawings/details pertaining to the tunnel design and construction shall include the following (as appropriate):

a) Plans, Elevations and Details:

- A work plan outlining the materials, procedures, methods and schedule to be used to execute the work;
- A list of personnel, including backup personnel, and their qualifications and experience;
- A safety plan including the company safety manual and emergency procedures;
- The work area layout;
- An erosion and sediment control plan that includes a contingency plan in the event the erosion and sediment control measures fail;
- A drilling fluid management plan, if applicable, that addresses control of frac-out pressures, any potential environmental impacts and includes a contingency plan detailing emergency procedures in the event that the fluid management plan fails;
- Lighting, ventilation and fire safety details as may be required by applicable occupational health and safety regulations; and
- Excavated materials disposal plan.

b) Design Criteria:

- Primary liner design details, if applicable; and
- Design assumption and material data when materials other than those specified are proposed for use.
- Drill path design, details of alignment and alignment control, maximum curvature and reaming stages;

c) Materials:

- Certification from the manufacturer that the product furnished on the contract meets the specifications cited in the manufacturer's product specification and that the materials supplied are suitable for the application; and
- Material mixture for filling voids and installation procedures.

d) Upstream/Downstream Portal Installation Procedure:

- The access shaft or entry/exit pit details designed and stamped/signed by the Design Engineer, as applicable; and
- Face support and other temporary support details, if applicable.

e) Primary Liner/Secondary Liner Installation and Grouting Procedure:

- Excavation and pipe jacking procedures, including methodology to handle obstructions and preventing soil cave-in; and
- Details of tunnelling equipment/methods to be used for the works.

f) Excavation and Dewatering:

- Ground control/dewatering details, as applicable, describing the proposed method for control, handling, treatment, and disposal of water.

g) Monitoring Method

- The methods to be employed to monitor and maintain the alignment of the installation;

4.03 Site Survey

Prior to commencing the work, the Contractor shall, at each pipe location, layout the alignment and install settlement monitoring points.

4.04 Certificate of Conformance

The Contractor shall submit details of the sequence and method of construction to the Quality Verification Engineer for review, prepared and stamped by the Design Engineer. The Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer a minimum of one week prior to commencement of work under this item. The Certificate shall state that the construction procedures are in conformance with the requirements and specifications of the contract documents.

The Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer upon completion of each of the following operations and prior to commencement of each subsequent operation for each pipe installation:

Site Surveying (as noted in Section 4.02)
Excavation for pits including dewatering of excavation
Jacking/Ramming/Directional Drilling of Casing/Liner
Excavation and Dewatering
Installation of the Product
Grouting Operations

Each Certificate of Conformance shall state that the work has been carried out in general conformance with the contract documents, specifications and/or stamped working drawings.

In addition, upon completion of the installation of the pipe at each location, the Contractor shall submit to the Contract Administrator a **final** Certificate of Conformance sealed and signed by the Quality Verification Engineer. The Certificate shall state that the pipe has been installed in general conformance with the Contractor's Submission and Design Requirements, stamped working drawings and contract documents.

The Design Engineer will not be permitted to carry out the work of the Quality Verification Engineer.

5. MATERIALS

5.01 Product

The product shall be concrete pipe or high density polyethylene pipe as specified.

5.02 Concrete

Concrete shall be according to OPSS 1350. The concrete strength shall be as specified in the Contractor's design submission.

5.03 Concrete Reinforcement

Steel reinforcing for concrete work shall be according to OPSS 1440.

5.04 Timber

Timber shall be sound, straight, and free from cracks, shakes and large or loose knots.

5.05 Grout

The Contractor shall submit the proposed grout mix design for grouts to be used for lubricating jacking pipe and for filling of voids and annular spaces. Purging grout shall consist of a mixture of one part Portland cement conforming to the requirements of CAN/CSA A5-93 and two parts mortar sand conforming to OPSS 1004 wetted with only sufficient water to make the mixture plastic.

5.06 Jack and Bore Materials

5.06.01 Pipe Materials

Steel pipe shall conform with ASTM A252-95 welded joints suitable for jacking operations. The Contractor shall select pipe class for pipe jacking.

Concrete pipe as per OPSS 1820.

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

5.07 Pipe Ramming Materials

5.07.01 Pipe Materials

Steel pipe shall conform with ASTM A 252-93 welded joints.

New steel casing when specified shall be smooth wall carbon steel pipe according to ASTM A252-93 Grade 2.

Used steel casing can be used provided that the steel casing can resist the applicable static and dynamic loadings.

Pipe wall thickness shall be determined by the Contractor based on static and dynamic loads from traffic loading and anticipated ramming forces for selected pipe and driven pipe lengths. The wall thickness shall be increased as required to ensure the casing is not damaged during handling and installation. A minimum wall thickness of 50 mm and minimum yield strength of 240 MPa is required.

Pipe segments shall be determined by the Contractor.

Steel pipe joints shall be pressure fit type or welded.

All steel casing pipe shall be square cut.

Steel casing pipe shall have roundness such that the difference between the major and minor outside diameters shall not exceed 1% of the specified nominal outside diameter or 6 mm, whichever is less.

Steel casing pipe shall have a minimum allowable straightness of 1.5 mm maximum per metre of length.

5.07.02 Mill Certificates

For permanent casing, the Contractor shall submit to the Contract Administrator at the time of delivery one copy of the mill certificate, indicating that the steel meets the requirements for the appropriate standards for casings.

Where mill test certificates originate from a mill outside Canada or the United States of America the Contractor shall have the information on the mill certificate verified by testing by a Canadian laboratory. The laboratory shall be accredited by a Canadian National Accreditation Body to comply with the requirements of ISO/IEC Guide 25 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date and the signature of an authorized officer of the Canadian testing laboratory.

5.08 Directional Drilling Materials

5.08.01 Drilling Fluids

The drilling fluids shall be mixed according to the manufacturer's recommendations and be appropriate for the anticipated subsurface conditions.

5.08.02 Pipe Materials

High Density Polyethylene (HDPE) pipe as per OPSS 1840 shall be used in accordance with ASTM D3350.

The requirements for fittings shall be suitable for and compatible with the class and type of pipe with which they will be used and in according to CAN/CSA-B182.6 or ASTM F894.

The Contractor shall determine the required dimensional ratio (DR) of the HDPE pipe to support all subsurface conditions and hydrostatic pressures, and to withstand the grouting pressure and installation forces. The Contractor shall identify these forces in his submission requirements.

The Contractor's submission shall demonstrate, in conjunction with the manufacturer's specifications, that the heat resistance of the pipe material is sufficient to tolerate without damage the heat of hydration generated by grout curing.

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

Joining of HDPE piping shall be completed by thermal butt fusion in accordance with manufacturer's recommended procedures and as outlined in the latest revision of ASTM D2657. All manufacturer's recommendations and procedures shall be followed during the joining process.

Joining of HDPE piping to other piping materials or appurtenances shall be completed using flanged connections.

5.09 Tunnelling Materials

5.09.01 Primary Liner

Tunnelling methods will require installation of a primary liner to provide support and stability to the excavation.

5.09.02 Secondary Liner

Concrete or High Density Polyethylene Pipe shall be used according to the following requirements.

5.09.02.01 Concrete Pipe

Concrete pipe as per OPSS 1820 shall be used. The Contractor shall select the pipe class to withstand grouting pressure and installation forces. The Contractor shall identify these forces in his submission requirements.

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

5.09.02.02 High Density Polyethylene (HDPE)

High Density Polyethylene (HDPE) pipe as per OPSS 1840 shall be used in accordance with ASTM D3350.

The requirements for fittings shall be according to CAN/CSA-B182.6 or ASTM F894.

The Contractor shall determine the required dimensional ratio (DR) to withstand the grouting pressure and installation forces. The Contractor shall identify these forces in his submission requirements.

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

Jointing of HDPE piping shall be completed by thermal butt fusion in accordance with manufacturer's recommended procedures and as outlined in the latest revision of ASTM D2657. All manufacturer's recommendations and procedures shall be followed during the jointing process.

Jointing of HDPE piping to other piping materials shall be completed using flanged connections.

6. EQUIPMENT

6.01 Jack & Bore Equipment

Jack & bore equipment shall be determined by the Contractor and shall be identified in the submission requirements specified herein.

Specific details of the manner in which rock or boulders will be broken and removed from the face and the face will be protected to prevent soil loss into the liner shall be submitted to the Contract Administrator for information purposes prior to proceeding with the works.

6.02 Pipe Ramming Equipment

Pipe ramming equipment shall be determined by the Contractor and shall be identified in the submission requirements specified herein.

The pipe ramming hammer(s) shall be capable of driving the pipe casing from the drive pit through the existing subsurface conditions at the site.

Specific details of the manner in which rock or boulders will be broken and removed from the face and the face will be protected to prevent soil loss into the pipe shall be submitted to the Contract Administrator for information purposes prior to proceeding with the works.

6.03 Directional Drilling Equipment

6.03.01 General

The directional drilling equipment shall consist of a directional drilling rig and a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the product installation without exceeding the maximum tensile strength of the product being installed.

6.03.02 Drilling Rig

The directional drilling rig shall:

- consist of a leak free hydraulically powered boring system to rotate, push, and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head;
- contain a guidance system to accurately guide boring operations;
- be anchored to the ground to withstand the rotating, pushing, and pulling forces required to complete the product installation; and
- be grounded during all operations unless otherwise specified by the drilling rig manufacturer.

6.03.03 Drill Head

The drill head shall be steerable by changing its rotation, be equipped with the necessary cutting surfaces and drilling fluid jets, and be of the type for the anticipated subsurface conditions,

6.03.04 Guidance System

The guidance system shall be setup, installed, and operated by trained and experienced personnel. The operator shall be aware of any magnetic or electromagnetic anomalies and shall consider such influences in the operation of the guidance system when a magnetic or electromagnetic system is used.

6.03.05 Drilling Fluid Mixing System

The drilling fluid mixing system shall be of sufficient size to thoroughly and uniformly mix the required drilling fluid.

6.03.06 Drilling Fluid Delivery System

The delivery system shall have a means of measuring and controlling fluid pressures and be of sufficient flow capacity to ensure that all slurry volumes are adequate for the length and diameter of the final bore and the anticipated subsurface conditions. Connections between the delivery pump and drill pipe shall be leak-free.

6.04 Tunnelling Equipment

Tunnelling equipment shall be determined by the Contractor and shall be identified in the submission requirements specified herein.

Specific details of the manner in which rock or boulders will be broken and removed from the tunnel face shall be submitted to the Contract Administrator information purposes. Use of explosives or rock fracturing chemicals shall only be considered subject to a field demonstration satisfactory to the Ministry prior to its use.

7. CONSTRUCTION

7.01 General

The Contractor shall notify the Contract Administrator at least 48 hours in advance of starting work. The proposed method of pipe installation shall be subject to the limitations presented in the following subsections.

7.01.01 Layout, Alignment and Depth Control

The location of the installation shall be established from the lines, elevations and tolerances specified in the Contract Documents. The pipe installation shall be to the horizontal and vertical alignments specified in the Contract Drawings. Deviations from location, alignment, grades and/or invert levels shall be corrected by the Contractor at no cost to the Ministry.

All reference points necessary to construct the pipe installation and appurtenances shall be laid out.

The Contractor shall calibrate tracking and locating equipment at the beginning of each work day, and shall monitor and record the alignment and depth readings provided by the tracking system at every 5 m in normal conditions and every 2 m where precise alignment control is necessary;

The Contract Administrator shall be provided with the assistance and access necessary to check the layout of the pipe installation and associated appurtenances.

All excavations shall be carried out in accordance with the Occupational Health and Safety Act (OHSA) of Ontario.

For directional drilling, the contractor shall ensure that during pilot hole drilling the maximum degree of deviation or “dog-leg” shall be 2.5 degrees per 9m drill pipe length. Any deviation exceeding 2.5 degrees will necessitate a pull-back and straightening of the alignment at the Contractor’s sole expense. The pilot hole exit location shall be within 0.5m of the target location.

7.01.02 Shafts

Shafts shall be specified in the Contractor's submission. The boundaries and protection of these shall be as required to contain all disturbances to areas outside of the ESA limits.

Shafts shall be maintained in a drained condition.

A minimum 2.4 m high secure fence shall be installed around the perimeter of the construction shaft area with gates and truck entrances. The fence shall be removed on completion of the work.

7.01.03 Protection Systems

The construction of all protection systems shall be according to OPSS 539. Where the stability, safety, or function of an existing roadway, watercourse, other works, proposed works or ESA's may be impaired due to the method of operation, protection shall be provided. Protection systems include primary liner and portal excavation support systems. Protection may include sheathing, shoring, and piles where necessary to prevent damage to such works or proposed works

7.01.04 Settlement or Heave

Any disturbance to the ground surface (settlement or heave) as a result of the pipe installation shall be immediately corrected by the Contract, at no additional cost to the Ministry.

7.01.05 Stability of Excavation

The construction methods, plant, procedures, and precautions employed shall ensure that excavations are stable, free from disturbance, and maintained in a drained condition.

The construction methods, plant, and materials employed shall prevent the migration of soil and/or rock material into the excavation from adjacent ground.

7.01.06 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 504.

Existing underground facilities shall be exposed to verify its horizontal and vertical locations when the outlet pipe path comes within 1.0 m horizontally or vertically of the existing facility. Existing facilities shall be exposed by non-destructive methods.

7.01.07 Transporting, Unloading, Storing and Handling Materials

Manufacturer's handling and storage recommendations shall be followed.

7.01.08 Trenching, Backfilling and Compacting

Trenching, backfilling, and compacting for entry and exit points or other locations along the pipe path shall be according to OPSS 514.

7.01.09 Dewatering

The work of this Section includes control, handling, treatment, and disposal of groundwater. The Contractor shall review the foundation investigation report for reference to soil and groundwater conditions on the project site and plan a dewatering scheme accordingly.

The Contractor shall control groundwater inflows to excavations to maintain stability of surrounding ground, to prevent erosion of soil, to prevent softening of ground exposed in the excavation, and to avoid interfering with execution of the work.

The Contractor shall maintain excavations free of standing water at all times during excavation, including while concrete is curing.

Should water enter the excavation in amounts that could adversely affect the performance of the work or could cause loss of ground, the Contractor shall take immediate steps to control the inflow.

The Contractor is alerted that seepage zones of perched water within the fill materials should be expected, particularly where granular materials are excavated.

Dewatering shall be according to OPSS 517.

7.01.10 Removal of Boulders

The Contractor is alerted that cobbles and boulders should be anticipated in the soil deposits at the site. Accordingly, the Contractor shall address the removal of cobbles and boulders in the proposed method of construction. The Contractor shall immediately inform the Contract Administrator of any obstruction encountered.

7.01.11 Record Keeping

Verification record requirements of the alignment and depth of the installation shall be as specified in the Contract Documents. A copy of the verification records shall be given to the Contract Administrator at the completion of the installation.

7.01.12 Testing

Testing of the product installation shall consist of verifying the specified grade between the two ends of the pipe and passing of water from the median end of the pipe to the outlet end to confirm gravity flow conditions.

7.01.13 Management and Disposal of Excess Material

Management and disposal of excess material shall be according to OPSS 180. Satisfactory re-usable excavated material required for backfill shall be separated from unsuitable excavated material.

7.01.14 Site Restoration

Site restoration shall be according to OPSS 507.

7.01.15 Supervision

A qualified individual, who is experienced in the pipe installation by trenchless methods shall supervise the work at all times.

7.02 Jack and Bore Installation

7.02.01 Method of Installation Procedure

The installation procedure to be used shall be subject to the following limitations:

- Hydraulically operated jacks of adequate number and capacity shall be provided to ensure smooth and uniform advancement without over-stressing of the pipe.

- A suitably padded jacking head or collar shall be provided to transfer and distribute jacking pressure uniformly over the entire end bearing area of the pipe.
- The jacking pipe shall be fully supported in the jacking pit at the specified line and grade.
- Selection of the excavation method and jacking equipment shall take into consideration the conditions at each pipe crossing.

7.02.02 Pipe Installation

Concrete pipe joints shall be water tight and according to OPSS 1820 and must withstand jacking forces, determined by the Contractor.

During the jacking of the liner the space between the liner and the wall of the excavation shall be kept filled with bentonite slurry. Upon completion of jacking, the space between the liner and the wall of the excavation shall be filled with grout.

The annular space between the liner and the product shall be fully grouted with a water tight, expandable and stable grout.

7.03 Pipe Ramming Installation

For pipe ramming installation the following requirements apply:

Only smooth walled steel pipe shall be used. But welding of pipe joints shall conform to CAS W59.

Ramming equipment of adequate capacity shall be provided to ensure smooth and uniform advancement without overstressing of the pipe. Delays shall be avoided between ramming operations.

A ramming head shall be provided to transfer and distribute jacking pressure uniformly over the entire end bearing area of the pipe.

Two or more lubricated guide rails or sills shall be provided of sufficient length to fully support the pipe at the specified line and grade in the ramming pit. Pipe shall be installed to the line and grade specified.

Following installation of the liner pipe, all material shall be removed from the pipe to the satisfaction of the Contract Administrator. Any voids remaining between the pipe and the excavation wall shall be grouted as soon as the pipe is rammed. The annular space between the liner pipe and the product shall be fully grouted with a water tight, expandable and stable grout.

7.04 Directional Drilling Installation

7.04.01 General

When strike alerts are provided on a drilling rig, they shall be activated during drilling and maintained at all times.

7.04.02 Site Preparation

The work site shall be graded or filled to provide a level working area for the drilling rig. No alterations beyond what is required for DD operations are to be made. All activities shall be confined to designated work areas.

7.04.03 Pilot Bore

The pilot bore shall be drilled along the bore path in accordance with the grade, alignment, and tolerances as indicated on the Contractor's submitted drilling plan to ensure that the product is installed to the line and grade shown on the Contract Drawings. The Contractor's methods shall take into consideration the conditions at each crossing within the pipe alignment and shall be suitable to advance through such obstructions such as cobbles and boulders and address the potential for deflection off these obstruction and/or soil conditions.

In the event the pilot bore deviates from the submitted path, the Contract Administrator shall be notified. The Contract Administrator may require the Contractor to pullback and re-drill from the location along the bore path before the deviation.

In the event that a drilling fluid fracture, inadvertent returns, or loss of circulation occurs during pilot bore drilling operations, the Contract Administrator shall be advised of the event and action shall be taken in accordance with the Contractor's submitted contingency plan.

At the entry and exit points, there is potential for ravelling of the existing soil, fill and or weathered rock areas along the alignment. This is conventionally addressed by the use of drilling fluid. However, casing may be required. The Contractor's methods shall take into consideration the potential need to install sections of casing to manage ravelling at or near ground surface.

If a drill hole beneath the highway must be abandoned, the hole shall be backfilled with grout or bentonite to prevent future subsidence.

The Contractor shall maintain drilling fluid pressure and circulation throughout the DD process, including during the initial pilot bore and during the reaming process.

The Contractor shall at all times and for the entire length of the installation alignment be able to demonstrate the horizontal and vertical position of the alignment, the fluid volume used, return rates and pressures.

7.04.04 Drilling Fluid Fracture (Frac-Out)

In order to reduce the potential for hydraulic fracturing of the hole during directional drilling, a minimum depth of cover of 5m is normally maintained between the pipe and the ground surface. Sections of the pipe close to the exit pit with less than 5m cover shall be cased. The Contractor shall ensure that drilling fluid pressures are properly set and controlled to prevent frac-out, for the depth of cover available between the bottom of the pavement structure (bottom of the subbase material) and the top of the bore.

Since fluid loss normally occurs in fault zones, fracture zones, or seams of coarse material, fluid migration does not always gravitate to the surface, thus making detection difficult. Once a fluid loss is detected, the Contractor shall halt operations immediately and conduct a detailed examination of the drill path and implement measures to mitigate fluid loss. If no surface migration is evident, resume operation while paying particular attention to fluid monitoring.

In the event of a fluid migration to the surface occurring, the Contractor shall halt all operations immediately, isolate the migration site, and recover fluids. Once the fracture is controlled, continue drilling operations with the operator paying particular attention to the fracture points

7.04.05 Reaming

The bore shall be reamed using the appropriate tools to a diameter at least 50% greater than the outside diameter of the product.

7.04.06 Product Installation

7.04.06.01 General

The product shall be jointed according to manufacturer's recommendations. The length of the product to be pulled shall be jointed as one length before commencement of the continuous pulling operation.

The product shall be protected from damage during the pullback operation.

The minimum allowable bending radius for the product shall not be exceeded.

Product shall be allowed to recover before connections to new or existing facility are made. Product recovery time shall be according to manufacturer's recommendations.

7.04.06.02 Pullback and Grouting

After successfully reaming the bore to the required diameter, the product shall be pulled through the bore path. Once the pullback operation has commenced, it shall continue without interruption until the product is completely pulled into bore unless otherwise approved by the Contract Administrator.

A swivel shall be used between the reamer and the product being installed to prevent rotational forces from being transferred to the product. When specified in the Contract Documents, a weak link or breakaway connector shall be used to prevent excess pulling force from damaging the product.

The product shall be inspected for damage where visible at excavation pits and where it exits the bore. Any damage noted shall be rectified to the satisfaction of the Contract Administrator,

The pull back and reaming operations shall not exceed the fluid circulation rate capabilities. Reaming and back pulling operations shall be planned to insure that, once started, all reaming and back pulling operations are completed without stopping and within the permitted work hours.

The space between the pipe and the excavation walls shall be filled with grout.

7.05 Tunnelling Installation

7.05.01 General

The method of tunnelling shall be selected by the Contractor and shall be submitted to the Contract Administrator prior to commencement of the work for information purposes.

Excavation of native soil and fill shall be done in a manner to control groundwater inflow to the excavation and to prevent loss of ground into the excavation.

Methods of excavating the tunnel shall be capable of fully supporting the face and shall accommodate the removal of boulders and other oversize objects from the face. Continuous ground support shall be maintained during excavation.

As the excavation progresses, the Contractor shall continuously monitor (every 2m) indications of support distress, such as cracking, deflection or failure of support system and subsidence of ground near the excavation.

The Contractor shall advance the ventilation system as a regular part of the normal excavation cycle.

The Contractor shall provide lighting in accordance with OHSA requirements for the entire length of the tunnel.

The tunnel is to be kept sufficiently dry at all times to permit work to be performed in a safe and satisfactory manner.

The Contractor shall maintain clean working conditions at all times in tunnels.

In the event that excavation threatens to endanger personnel, the Work, or adjacent property, the Contractor shall cease excavation. The Contractor shall then evaluate methods of construction and revise as necessary to ensure the safe continuation of the work.

The Contractor shall maintain tunnel excavation line and grade to provide for construction of final lining within specified tolerances.

7.05.01 Tunnelling Method

The tunnelling method shall be suitable to provide face support in changing ground conditions that may be encountered during the progress of the work. The selection of the tunnelling method should consider the soil conditions at each pipe crossing and the presence of obstructions, such as cobbles and boulders, with respect to the tunnel alignment.

7.05.02 Primary Liner (Support System)

Primary support systems shall prevent deterioration, loosening, or unravelling of ground surfaces exposed by excavation.

The primary liner support system shall be designed and installed to achieve the intended performance requirements.

Primary liner support system shall maintain the safety of personnel, minimize ground movement into the excavation, ensure stability and maintain strength of ground surrounding the excavation.

The primary liner shall be designed to support all subsurface conditions and hydrostatic pressures and to withstand any additional loads caused by installation and grouting, and shall ensure that no ground loading or other loading will be placed on the new work until after design strength has been reached.

The primary liner shall be installed so that the exterior is as tight as possible to the excavated surface of the tunnel and allows the placement of the full design thickness of the secondary lining.

Primary support systems shall be compatible with the encountered ground conditions, with the method of excavation, with methods for control of water, and with placement of the permanent lining.

All voids between the primary lining and the surface of the excavation shall be filled with cement grout. If an unexpanded liner is used, the space outside the liner plates shall be grouted at least daily.

7.05.03 Secondary Liner

7.05.03.01 Placing of Grout

The void outside the finished secondary liner shall be filled with cement grout according to the Contractor's submission.

Grout shall not be placed until the lining has achieved 85% of its specified strength or 30 MPa. Grouting shall be limited to such sequences and programs as are necessary to avoid damaging any part of the works or any other structure or property.

7.06 Instrumentation Monitoring

The work specified in this Section includes furnishing and installing instruments for monitoring of settlement and ground stability.

Surface settlement markers for monitoring ground stability shall be installed at the pavement/ground surface level on the shoulder, side slope and pavement at not greater than 5 m intervals along the tunnel alignment and as an array of three in ground (1.5 m depth) measurement points on the shoulder of the highway perpendicular to the alignment. The equipment and procedures used for settlement monitoring during construction must be capable of surveying the settlement point elevations to within ± 1 mm of the actual elevation.

Surface settlement markers shall be hardened steel markers treated or coated to resist corrosion, with an exposed convex head having a minimum diameter of 12 mm and similar to surveyor's PK nails. Markers shall be rigidly affixed so as not to move relative to the surface to which it is attached. Traffic shall be managed by the contractor using short term lane closures in accordance with the Ontario Traffic Manual (OTM).

In general, settlement monitoring points shall be 12-18 mm rebar encased in a 50-70 mm, SCH40 PVC pipe, set to a depth of 1.5 m below ground surface. The assembly shall be placed in a drill hole and backfilled with uniform sand as shown on the Contract Drawings.

The Contractor shall install all surface settlement instruments a minimum of one week prior to the start of works.

The surface settlement instruments shall be clearly labelled for easy identification.

The Contractor shall submit to the Contract Administrator a site plan showing the locations of the monitoring points, a geodetic survey of the settlement monitoring points including station, offset and elevation recorded at the following time intervals:

- Three consecutive readings at least one week prior to commencement of the work (Baseline Reading);
- Once per shift during tunnelling operations period; and
- Weekly after completion of the work for one month, or until such time at which all parties agree that further movement has stopped.

All readings shall be submitted to the Contract Administrative for information purposes on a weekly basis. Each report shall include all survey data collected in tabular and graphical format as plots of time versus settlement in comparison to survey data collected prior to commencement of the work.

7.07 Criteria for Assessment of Roadway Subsidence/Heave

Based on the monitoring of ground movement as specified in Subsection 4.02, the following represents trigger levels that define magnitude of movement and corresponding action:

- **Review Level:** If a maximum value of 10 mm relative to the baseline readings is reached, the Contractor shall review or modify the method, rate of sequence of construction or ground stabilization measures to mitigate further ground displacement.

If the Review Level is exceeded, the Contractor shall immediately notify the CA and review and discuss response actions. The Contractor shall submit a plan of action to prevent Alert Levels from being reached. All construction work shall be continued such that the Alert Level is not reached.
- **Alert Level:** If a maximum value of 15 mm relative to the baseline readings is reached, the Contractor shall cease construction operations, inform the Contract Administrator and execute pre-planned measures to secure the site, to mitigate further movements and to assure safety of public and maintain traffic.
 - No construction shall take place until all the following conditions are satisfied:
 - The cause of the settlement has been identified.
 - The Contractor submits a corrective/preventive plan.
 - Any corrective and/or preventive measure deemed necessary by the Contractor is implemented.
 - The CA deems it is safe to proceed.

The Contractor shall avoid damaging instrumentation during construction. Instrumentation that is damaged as a result of the Contractor's operation shall be repaired or replaced by the Contractor within one business day. The costs for replacement/repair shall be borne by the Contractor.

At the completion of the job, the Contractor shall abandon all instrumentations installed during the course of the Work.

9. MEASUREMENT FOR PAYMENT

Measurement shall be by Plan Quantity Payment as may be revised by Adjusted Plan Quantity Payment in metres, following along the centre line of the pipes from centre to centre of maintenance holes or chambers (catch basins) or from/to the end of the pipe where no maintenance hole or chamber is installed, of the actual length of pipe installed by trenchless methods.

10. BASIS OF PAYMENT

Payment at the contract price shall be full compensation for providing all labour, equipment and materials required for excavation (regardless of material encountered), dewatering, sheathing and shoring, supply and installation of pipe liners, settlement monitoring and instrumentations site restoration and for all other work necessary to complete the installation as specified.

Payment for the rigid or flexible pipe conduits installed inside the pipe liners shall be paid separately under the appropriate tender items.

Where a protection system is made necessary because of the Contractor's operations (e.g. choice of trenchless installation method), the cost shall be included in this item and shall be full compensation for all labour, equipment and materials required to carry out the work including subsequently removing the temporary protection system and performing any necessary restoration work.

Payment for connecting intercepted drains and service connections shall be made on the following basis:

- (a) Where such drains and service connections are shown on the contract drawings the cost of connections shall be included in the contract price for pipe installation.
- (b) Where such drains and service connections are not shown on the contract drawings, the cost of connections will be considered an allowable extra to the contract.

Payment for removal of boulders/obstructions greater than an equivalent 0.3 m in diameter shall be on a time and materials basis. The Contractor shall inform the Contract Administrator when boulders/obstructions are encountered and prior to removal to allow for proper and accurate tracking of time and material charges.

Notes to Designer:

Under Section 7.01.06, minimum horizontal and vertical clearances to existing facilities shall be identified in the Contract Documents. Clearances shall be measured from the nearest edge of the largest cut diameter required to the nearest edge of the facility being paralleled or crossed. The number of exposures required to monitor work progress shall be specified in the Contract Documents.