



FOUNDATION INVESTIGATION AND DESIGN REPORT

for

HIGHWAY 637 UNDERPASS

SITE NO. 46-511

HIGHWAY 69 FOUR-LANING

W.P. 5265-05-01

DISTRICT 54, SUDBURY, ONTARIO

***PHASE 2: STA. 15+180 TO 22+346.5, TOWNSHIP OF SERVOS
STA. 10+000 TO 11+300, TOWNSHIP OF BURWASH***

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PML Ref.: 06TF052E
Index No.: 736FIR and 737FDR
GEOCRES No.: 41I-232
May 5, 2009



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FOUNDATION INVESTIGATION REPORT

for
Highway 637 Underpass
Site No. 46-511
Highway 69 Four-Laning
W.P. 5265-05-01
District 54, Sudbury, Ontario

*Phase 2: Sta. 15+180 To 22+346.5, Township of Servos
Sta. 10+000 To 11+300, Township of Burwash*

1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed Highway 637 Underpass at the new alignment of Highway 69 about 41 km south of Sudbury. The investigation was conducted for AECOM on behalf of the Ministry of Transportation of Ontario (MTO).

This report provides subsurface information pertaining to the foundation of the proposed underpass and approach embankments within 20 m of the abutments.

All elevations in this report are expressed in metres.

2. SITE DESCRIPTION AND GEOLOGY

The site is located approximately 41 km south of Sudbury and on a new Highway 69 alignment approximately 300 m east of the existing Highway 637 intersection. Site photographs are provided in Appendix A.

The underpass site is generally located in the Precambrian Laurentian peneplane. The local topography is irregular and comprises wooded areas on sloping ground separated by steep rock ridges. Soil cover over the rock outcrops is generally sparse. The bridge is located over an extensive rock outcrop which lies adjacent to a swamp on the east of the proposed structure.

In general, Metasedimentary rocks of the Huronian Supergroup and gneisses of the Grenville Province underlie the new Highway 69 alignment. The area has undergone considerable folding, intrusive activity, regional metamorphism and faulting. The Servos Pluton occurs to the east of the bridge site.



3. INVESTIGATION PROCEDURES

The subsurface investigation for the proposed underpass was carried out during the period from August 6 to 14, 2008. A supplementary investigation of the rock slope at the location of the eastern boreholes which included six auger probes was carried out on December 17, 2008.

The scope of this investigation included 36 boreholes in total. Thirty-four boreholes were designated for structure foundation and two boreholes were designated for the west and east approach embankments. Borehole numbers and locations are shown on Drawing E1, appended. Twelve of the 36 boreholes, boreholes E2, E4, E5, E7, E8, E10, E11, E13, E14, E16, E17 and E19, were cored 3.1 to 3.9 m into the bedrock to depths ranging between 3.1 and 9.2 m. Borehole locations, elevations and depths of drilling/coring are summarized in Table below:

BOREHOLE / PROBEHOLE NO.	GROUND SURFACE ELEVATION (m)	DEPTH OF BOREHOLE / PROBEHOLE (m)
E1	236.9	0.1
E2	236.2	3.5
E3	236.0	0.2
E4	236.2	3.5
E5	236.2	4.8
E6	236.0	0.8
E7	235.9	4.0
APW1	236.2	0.6
APW2	236.2	0.0
APW3	236.2	0.8
E8	235.4	4.2
E9	234.6	0.5
E10	236.0	3.4



BOREHOLE / PROBEHOLE NO.	GROUND SURFACE ELEVATION (m)	DEPTH OF BOREHOLE / PROBEHOLE (m)
E11	235.7	3.1
E12	235.3	0.0
E13	233.8	3.6
APP1	235.9	0.0
APP2	235.8	0.0
APP3	235.2	0.0
E14	231.9	4.0
E15	231.4	3.4
E16	231.3	6.4
E17	231.3	7.4
E18	231.4	2.6
E19	231.3	9.2
APE1	231.7	1.0
APE2	231.9	0.0
APE3	231.3	4.1
APE4	231.7	0.0
APE5	231.3	4.6
APE6	231.3	4.7
APE7	231.3	3.8
APE8	231.3	4.3
APE9	231.4	3.2
APE10	231.4	2.1
E20	231.0	3.2



SRQ Ltd. Ontario Land Surveyors (SRQ) staked the alignment and working points of the new Highway 637 underpass at the structure location. Peto MacCallum Ltd. (PML) laid-out the positions of the boreholes along the staked alignment and determined the ground surface elevations at the borehole locations. The ground surface elevations for recently drilled boreholes APE5 to APE10 were referred to the previously drilled borehole ground elevations in the area. SRQ provided the following temporary benchmarks (TBM) established on existing ground level at the working points (WP) for each of the foundation units:

TBM	DESCRIPTION	ELEVATION (*)
TBM1	Existing ground at West abutment W.P.1	236.227
TBM2	Existing ground at East abutment W.P.3	231.273
TBM3	Existing ground at Centre Pier W.P.2	234.637

(*) Geodetic, metric

The boreholes were advanced by various methods, as required by the site accessibility and prevalent weather limitations. Boreholes E1, E12, APW2, APP1, APP2, APE2, APP3, and APE4 were advanced using manual probing methods. The remaining boreholes were advanced using continuous flight solid and hollow stem augers powered by a track-mounted CME-D50 drill rig also, equipped for rotary diamond drilling, supplied and operated by a specialist drilling contractor. The drilling crews worked under the full-time supervision of a PML field supervisor.

Representative samples of the soils encountered in the boreholes were recovered at frequent depth intervals. In the boreholes advanced with conventional drill rigs, soil samples were obtained using a split spoon sampler in conjunction with standard penetration tests. Where standard penetration tests were not carried out, the consistency/relative density of the encountered soils was estimated from manual examination of the samples or the rate and ease to advance the augers. Penetrometer and field vane tests were performed on cohesive soil samples. The results of penetrometer tests are typically lower than the actual values due to sample disturbance.

Boreholes E2, E4, E5 and E7 drilled west of the future highway median, boreholes E8, E10, E11 and E13 in the area of the new median and boreholes E14, E16, E17 and E19 in the area east of the



median were extended 3.1 to 3.9 m into the bedrock using NQ diamond rock coring equipment. Photographs of rock cores are shown in Appendix B.

The boreholes were backfilled in accordance with the MTO guidelines and MOE Regulation 903 for borehole abandonment procedures using a bentonite/cement mixture grout.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open boreholes.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. Recovered soil samples were returned to our laboratory for detailed visual examination, soil classification and laboratory testing. The laboratory test program comprised the following tests:

- Atterberg limits determinations (9)
- Grain size analyses (10)
- Natural moisture contents (25)

The results of natural moisture contents, grain size analyses and Atterberg limits are shown on the Record of Borehole sheets. The grain size distribution charts are presented on Figures GS-1 to GS-4 and the plasticity charts are presented on Figures PC-1 to PC-3.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil and rock classifications, inferred stratigraphy, boundary elevations and groundwater observations.

Bedrock outcrops at the location of test holes E1, E12, APW2, APP1, APP2, APP3, APE2 and APE4. The borehole locations, stratigraphic profile and cross-sections prepared from the borehole data are presented on the appended Drawings E1 and E2.



In the remaining boreholes the depth of the soil cover varies from 0.1 to 6.1 m. The soil cover generally consists of surficial 100 to 1000 mm thick topsoil overlying localized 0.8 to 1.6 m thick an upper layer of silty sand/gravelly sand or bedrock at the west abutment and pier locations. In the eastern boreholes, the topsoil is underlain by discontinuous 0.7 to 4.5 m thick clayey silt/silty clay/clay deposits which in turn cover a localized 0.2 to 1.5 m thick sand/sandy gravel/sand unit (lower layer). Scattered layers of cobbles and boulders are encountered within the upper and lower layers of cohesionless native soils in boreholes E5, E19, APE3, APE5, APE7 through APE10. All test holes encountered bedrock.

In the supplementary auger probes APE5 to APE10 drilled in the eastern area, the depth of the soil cover varies from 2.1 to 4.7 m. The soil cover generally consists of surficial 200 to 300 mm thick peat overlying a 1.9 to 4.4 m thick layer of silty clay with a localized 0.7 m thick sand layer mantling probable bedrock. Scattered layers of cobbles and boulders are encountered within the silty clay deposit.

4.1 Topsoil and Peat

The surficial topsoil and peat units are present in all boreholes except E11, E12, APW2, APP1, APP2, APP3, APE2 and APE4, where bedrock was found at ground surface. The brown to dark brown topsoil and peat layers are 100 to 600 mm thick and extends to elevations 230.8 to 236.8 with locally thicker deposits of 800 and 1000 mm extending to elevations 235.4 and 235.2 at boreholes APW3 and E5, respectively.

4.2 Silty Sand/Gravelly Sand (Upper Layer)

An upper layer of cohesionless soils consisting of silty sand/gravelly sand were encountered in boreholes E5, E6 and E8 at depths of 0.3 to 1.0 m below surface grades and extended to 0.7 to 1.7 m depths, elevations 234.5 to 235.2. Cobbles and boulders were encountered in the gravelly sand unit in borehole E5.



4.3 Clayey Silt/Silty Clay/Clay

The cohesive clayey silt/silty clay/clay units were only encountered in the east abutment boreholes E15 to E19, auger probes APE1, APE3, APE5 to APE10, and east approach embankment borehole E20. The 0.7 to 4.1 m thick cohesive materials were encountered below the topsoil and peat units in boreholes E15 to E20, APE1, APE3, APE5 to APE10, at depths of 0.2 to 0.6 m and extended to 1.0 to 4.9 m depths, elevations 226.4 to 230.7. In boreholes E16, E17, E18, APE1 and E20 the clayey soils extended to bedrock that was encountered at 1.0 to 3.5 m depths, elevations 227.8 and 230.7. In boreholes E15 and APE3 the cohesive soils terminated on cohesionless soils (described in the following section). In borehole E19, the clayey soils were interbedded by a 0.8 m thick sand layer between 2.3 and 3.1 m depths, elevations 229.0 and 228.2 and extended to cohesionless soils at 4.9 m depth, elevation 226.4.

The consistency of the clayey silt/silty clay/clay soils is typically stiff to very stiff, except at borehole E19 below depth of about 3.1 m where a 1.8 m thick very soft to soft sandy clayey silt layer is present. Penetrometer tests indicated undrained shear strengths of 65 to 225 kPa. Two field vane tests indicated shear strength of 25 and 55 kPa and sensitivity of 4 and 7. N values typically ranged from 3 to 17. Two N values of 1 were obtained below 3.1 m depth in the very soft to soft layer found in borehole E19.

The grain size distribution charts of seven samples of the clayey silt/silty clay/clay materials are presented on Figures GS-1 to GS-3. Natural moisture content determinations ranged from 20 to 35%.

The plasticity charts for the nine samples are presented in Figures PC-1 to PC-3. The liquid and plastic limits and plastic index for the materials are shown on the corresponding boreholes log sheets and are summarised below.



MATERIAL	BOREHOLE	SAMPLE	DEPTH (m)	WATER CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
Clay	E20	3	1.5 – 2.1	32	52	22	30
Silty Clay	E15	3	1.5 – 2.1	35	48	23	25
	E16	3	1.5 – 2.1	29	45	22	23
	E17	4	2.3 – 2.9	33	38	19	19
	E18	2	0.8 – 1.4	31	48	21	27
	E19	2	0.8 – 1.4	27	46	21	25
	E19	3	1.5 – 2.1	31	46	21	25
	E20	4	2.3 – 2.9	21	42	20	22
Clayey Silt	E19	5	3.0 – 3.6	28	28	15	13

4.4 Sand/Gravelly Sand (Lower Layers)

A localized unit of sand was interbedded in the clayey soils in borehole E19 between 2.3 and 3.1 m depths, elevations 229.0 and 228.2. Cobbles and boulders were encountered in the sand/gravelly sand units in boreholes/probeholes E19, APE3, APE5, APE7, APE8, APE9 and APE10. The relative density of the material is compact with one N value of 14.

A lower layer of cohesionless sand and gravelly sand is present below the clayey soils in boreholes E15, E19 and APE3 at 3.2 and 4.9 m depths from ground surface and extended to 3.4 and 5.7 m depths, elevations 225.6 and 228.0 where bedrock was proved by core drilling or was inferred by refusal to augering.

A 0.7 m thick sand layer was encountered in borehole APE9 at depth of 4.0 m (elevation 227.3) extending to the probable bedrock level.

The grain size distribution chart of one sample is presented on Figure GS-4. Natural moisture content determination on the interbedded layer of borehole E19 was 9%.



4.5 Bedrock

A detailed description of the rock cores retrieved from boreholes E2, E4, E5, E7, E8, E10, E11, E13, E14, E16, E17 and E19 is provided in Table A and summarized on the record of borehole logs. Rock outcrops were encountered in boreholes E11, E12, APW2, APP1, APP2, APP3, APE2 and APE4 at elevations 231.7 to 235.9.

In the west abutment boreholes E2, E4, E5 and E7, the level of the bedrock surface was confirmed by drilling four 3.1 to 3.6 m long cores from depths of 0.4 to 1.7 m, elevations 234.5 to 235.8. Bedrock was also inferred by refusal in five test holes at depths of 0.0 to 0.8 m, elevations 235.2 to 236.2 indicating a maximum surface level difference of 1.7 m between borehole locations (E5 and APW2). The slope of the bedrock surface within the west abutment footing area is 9 to 18°. Photographs of the rock core taken in boreholes E2, E4, E5 and E7 are shown on the west abutment core photographs 1 to 4.

At the pier boreholes, the level of the bedrock surface was confirmed in boreholes E8, E10, E11 and E13 by drilling four 3.1 to 3.5 m long cores from depths of 0.0 to 0.7 m, elevations 233.7 to 235.9. Bedrock was also interred by refusal in five boreholes at depths of 0.0 to 0.5 m, elevations 234.1 to 235.9. Indicating a maximum bedrock surface relief of 1.8 m between borehole locations. The slope of bedrock surface within the pier footing area is 10° at the north and centre sections, and slopes southerly downward at 22° within the south section. Photographs of the rock core surface taken in boreholes E8, E10, E11 and E13 are shown on the pier core photographs 1 to 6.

In the east abutment boreholes E14, E16, E17 and E19, the bedrock surface was confirmed by drilling four 3.5 to 3.9 m long cores into the rock from depths of 0.3 to 5.7 m, elevations 225.6 to 231.6. Bedrock was also inferred by refusal in two boreholes and 10 auger probes at depths of 0.0 to 4.7 m, elevations 226.2 to 231.9. The bedrock surface within the east abutment footing area generally slopes downward at angles ranging from 15 to 44° from west to east and at flatter slope angles ranging from about 3 to 28° from the north and centre to the southern area. Borehole E19 located at the southeast corner of the abutment yielded a lowest bedrock surface elevation 225.6. It was confirmed by the supplementary auger probes drilled at the east abutment area between Sta. 10+40.5 and 10+043 that the bedrock surface slopes easterly downward at typical slope angles ranging from 14 to 23° with local steeper angels of 49°. The bedrock surface slopes downward at an



overall angle of about 6° from the north to the south areas (APE9 to APE5). A maximum bedrock surface level difference of 6.3 m was measured between auger probe APE2 located at northwest and borehole E19. Photographs of the rock core taken at boreholes E14, E16, E17 and E19 are shown on the east abutment core photographs 1 and 8.

In the west approach embankment borehole E1, the bedrock was encountered below 100 mm of topsoil at elevation 236.8. In the east approach embankment borehole E20, the bedrock surface was inferred by refusal at 3.2 m depth, elevation 227.8.

The table below summarizes the depths and elevations of the probable bedrock, bedrock and rock outcrops encountered in boreholes/probeholes:

BOREHOLE / PROBEHOLE NO.	DEPTH (m)	ELEVATION (m)
E1	0.1	236.9
E2	0.4	235.8
E3	0.2	235.8
E4	0.4	235.8
E5	1.7	234.5
E6	0.8	235.2
E7	0.4	235.5
E8	0.7	234.7
E9	0.5	234.1
E10	0.1	235.9
E11	0.0	235.7
E12	0.0	235.3
E13	0.1	233.7
E14	0.3	231.6
E15	3.4	228.0
E16	2.7	228.6



BOREHOLE / PROBEHOLE NO.	DEPTH (m)	ELEVATION (m)
E17	3.5	227.8
E18	2.6	228.8
E19	5.7	225.6
E20	3.2	227.8
APE1	1.0	230.7
APE2	0.0	231.9
APE3	4.1	227.2
APE4	0.0	231.7
APE5	4.6	226.7
APE6	4.7	226.6
APE7	3.8	227.5
APE8	4.3	227.0
APE9	3.2	228.2
APE10	2.1	229.3
APP1	0.0	235.9
APP2	0.0	235.8
APP3	0.0	235.8
APW1	0.6	235.6
APW2	0.0	236.2
APW3	0.8	236.2



The rock core recovery varied typically between 89 and 100%, with three isolated values of 66, 79 and 83% in boreholes E16, E19 and E13, respectively. The RQD determined from the rock cores is typically greater than 91% (range of 91 to 100%) at the west abutment, indicating excellent quality rock. The range of RQD values for the pier boreholes varies from 64 to 98% indicating fair to excellent quality rock. The RQD values at the east abutment range between 65 and 100%, indicating fair to excellent quality rock. One RQD value of 79% was caused by a lost core piece in the hole.

4.6 Groundwater

Groundwater was observed in the eastern boreholes E15, E16, E19, E20 and APE6 to APE10 at 1.5 to 3.4 m depths, elevations 228.0 to 228.6, during and upon completion of drilling. No groundwater strikes were observed in the remaining boreholes during and upon completion of drilling.

Table below summarizes the groundwater depths and Elevations encountered in boreholes/probeholes:

BOREHOLE / PROBEHOLE NO.	DEPTH (m)	ELEVATION (m)
E15	1.5	229.9
E16	2.7	228.6
E19	1.8	229.5
E20	1.5	229.5
APE5	3.4	227.9
APE6	3.0	228.3
APE7	3.0	228.3
APE8	3.4	227.9
APE9	3.0	228.4

5. CLOSURE

The field work was carried out under the supervision of Mr. F. Portela, Senior Field Supervisor and direction of Mr. C. M. P. Nascimento, P.Eng., Senior Project Engineer. Walker Drilling Ltd. supplied the soil and rock drilling equipment. The laboratory testing was carried out in the PML laboratory in Toronto.



This report was prepared by Mr. I. Sadoun, MSc, P. Eng. and Mr. C. M. P. Nascimento, P.Eng. Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact, carried out an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.

**NOTE: Hard copies signed
and stamped**

Idib (Adeeb) Sadoun, M. Sc., P. Eng.
Project Engineer

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and stamped**

Carlos M. P. Nascimento, P. Eng.
Senior Project Engineer

**NOTE: Hard copies signed
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Brian R. Gray, M.Eng., P.Eng.
MTO Designated Contact

IS/CN/BRG:is-lr-mi



TABLE A
ROCK CORE DESCRIPTION

CORE RECOVERY					CORE DESCRIPTION	
BH	RC	DEPTH (m)	Rec (%)	RQD (%)	DEPTH (m)	DESCRIPTION
E2	1	0.4 – 2.0	100	100	0.4 – 3.5	GRANODIORITE GNEISS: Grey, fine to medium grained, high strength, unweathered, close to moderate spaced flat cross joints, rough planar, upper parting open to 1 mm with sand filling, lower partings generally oxidized to slightly altered, purple staining on surface, occasionally friable, some vertical partings, excellent quality.
	2	2.0 – 3.5	100	100		
E4	1	0.4 – 2.0	100	97	0.4 – 3.5	GRANODIORITE GNEISS: Grey, with occasional pink inclusions, fine to medium grained, slight banding, high strength, unweathered, with 10 mm thick dipping layer of friable gneiss/schist at 2.3 m depth, close to moderate spaced flat to dipping cross joints, rough planar, tight, some vertical partings with some silt on partings, excellent quality.
	2	2.0 – 3.5	100	92		
E5	1	1.7 – 2.0	100	100	1.7 – 4.8	GRANODIORITE GNEISS: Grey, fine to medium grained, high strength, slightly weathered to unweathered, close to wide spaced flat to dipping cross joints, rough planar, tight becoming oxidized to slightly altered with brown to black mineralization on parting, minor silt, excellent quality.
	2	2.0 – 3.2	100	91		
	3	3.2 – 4.8	100	100		
E7	1	0.4 – 1.9	100	95	0.4 – 4.0	GRANODIORITE GNEISS: Grey, fine to medium grained, slight banding, high strength, unweathered, close to moderate spaced flat to dipping cross joints, rough planar, tight to oxidized with red, brown and black mineralization on parting, locally open to 1 mm with silt infilling, excellent quality.
	2	1.9 – 3.2	100	96		
	3	3.2 – 4.0	100	100		
E8	1	0.7 – 1.8	100	79	0.7 – 4.2	GRANODIORITE GNEISS: Grey, fine to medium grained, dipping bands, high strength, unweathered, close to moderate spaced flat to dipping cross joints, rough planar, oxidized to slightly altered with red to dark red mineralization on parting surface, locally porous for 0.5 mm, some vertical partings, tight, fair to excellent quality.
	2	1.8 – 3.3	100	83		
	3	3.3 – 4.2	100	91		
E10	1	0.1 – 1.7	92	88	0.1 – 3.4	GRANITE-GRANODIORITE GNEISS: Pink, medium grained, slight banding, sugary texture, high strength, unweathered, close to moderate spaced flat to vertical cross joints, rough planar, oxidized to tight, fair to good quality.
	2	1.7 – 3.4	100	64		

RQD: Rock Quality Designation

Originated: JFW
Compiled: IS
Checked: CN

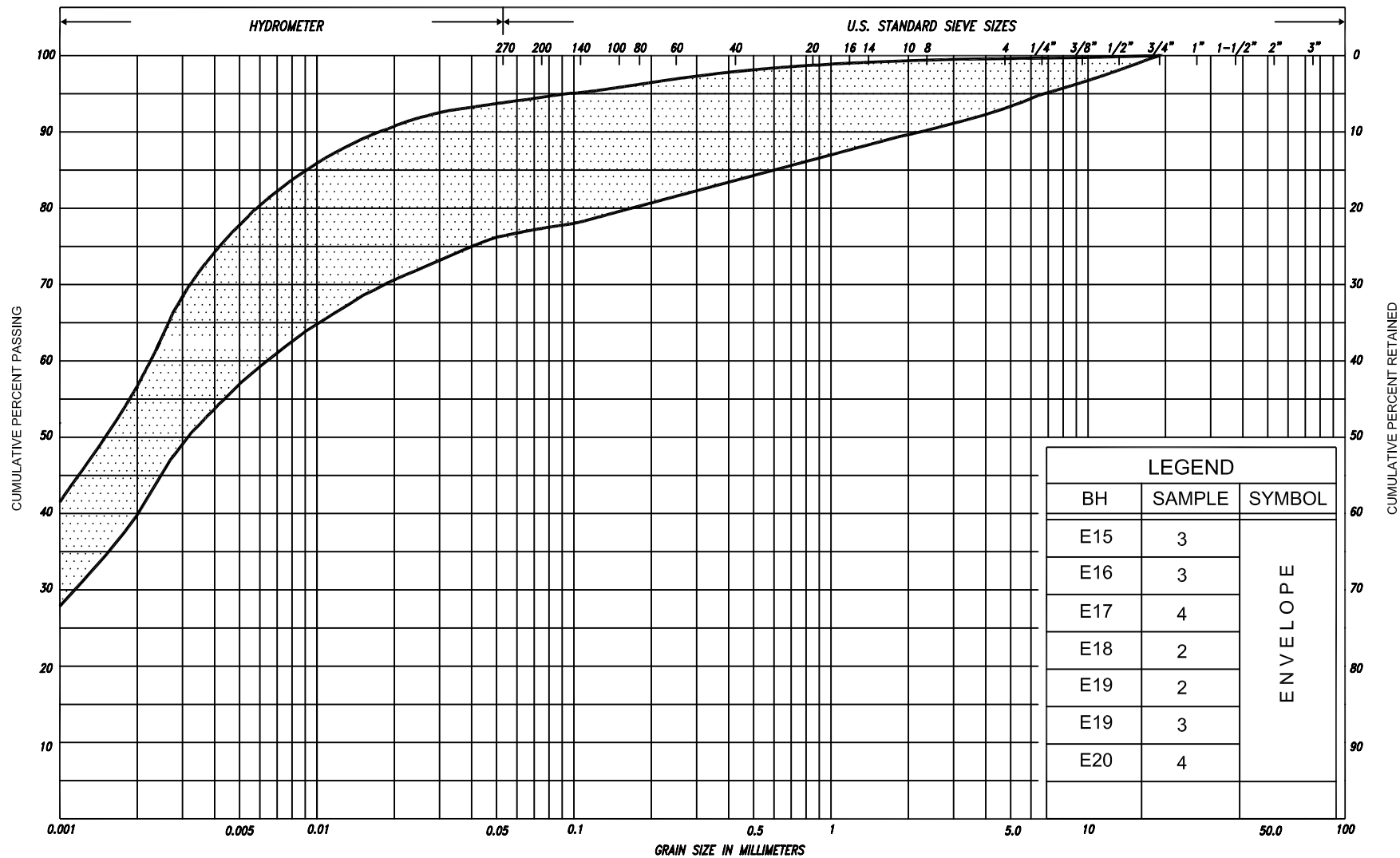


TABLE A
ROCK CORE DESCRIPTION

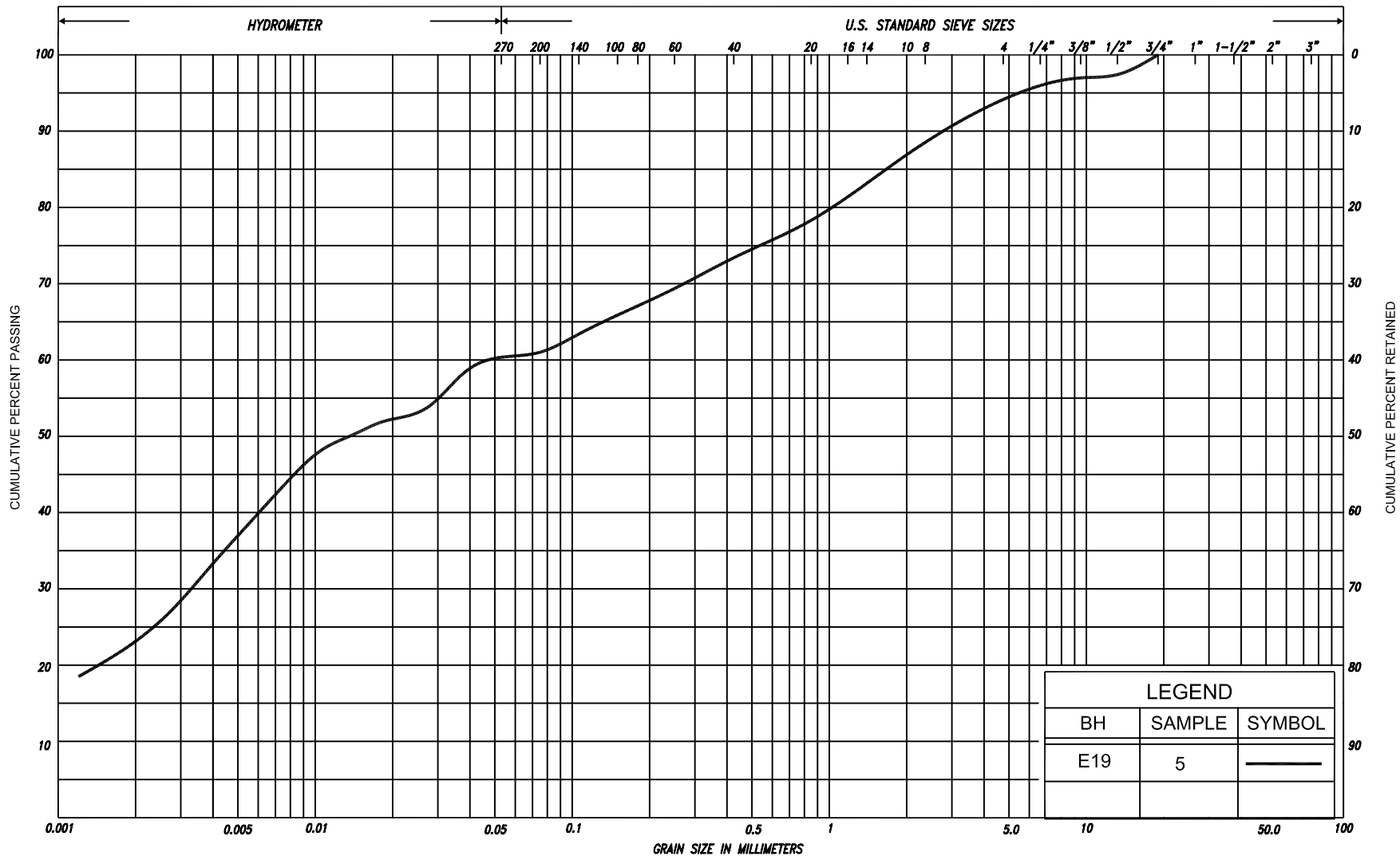
CORE RECOVERY					CORE DESCRIPTION	
BH	RC	DEPTH (m)	Rec (%)	RQD (%)	DEPTH (m)	DESCRIPTION
E11	1	0.0 – 1.6	100	68	0.0 – 3.1	GRANITE-GRANODIORITE GNEISS: Pink, fine grained, high strength, unweathered, close to moderate spaced flat to dipping cross joints, rough planar, tight to oxidized with yellow and brown mineralization on parting, locally with silt, fair to excellent quality.
	2	1.6 – 3.1	98	98		
E13	1	0.1 – 1.7	100	97	0.1 – 3.6	GRANITE-GRANODIORITE GNEISS: Pink, medium grained, slight banding, sugary texture, high strength, unweathered, very close to moderate spaced flat to vertical cross joints, rough planar, tight to oxidized, occasionally with red residue on parting, good to excellent quality.
	2	1.7 – 3.0	100	94		
	3	3.0 – 3.6	83	83		
E14	1	0.3 – 1.8	95	95	0.3 – 4.0	GRANODIORITE GNEISS: Grey, medium grained, slight banding, high strength, unweathered, moderate to wide spaced flat cross joints, rough planar, tight, excellent quality.
	2	1.8 – 3.4	95	94		
	3	3.4 – 4.0	96	96		
E16	5	2.7 – 3.5	66	66	2.7 – 6.4	GRANODIORITE GNEISS: Dark grey, medium grained, dipping bands, high strength, unweathered, close to moderate becoming wide spaced flat to dipping cross joints, rough planar, tight, fair to excellent quality.
	6	3.5 – 4.9	100	95		
	7	4.9 – 6.4	100	100		
E17	5	3.5 – 4.3	89	65	3.5 – 7.4	GRANODIORITE GNEISS: Grey to dark grey, medium grained, dipping bands, high strength, unweathered, very close to moderate becoming wide spaced flat to dipping cross joints, rough planar, tight to oxidized, with occasional vertical partings, oxidized to slightly altered with dark green mineralization on surface, good to excellent quality.
	6	4.3 – 5.7	100	96		
	7	5.7 – 6.1	100	100		
	8	6.1 – 7.4	98	98		
E19	7	5.7 – 6.6	100	100	5.7 – 9.2	GRANODIORITE GNEISS: Grey to dark grey, medium grained, dipping bands, high strength, unweathered, close to moderate becoming wide spaced flat to dipping cross joints, rough planar, tight, excellent quality. [Low recovery and RQD for Run 3 due to piece lost down hole]
	8	6.6 – 7.8	100	100		
	9	7.8 – 9.2	79	79		

RQD: Rock Quality Designation

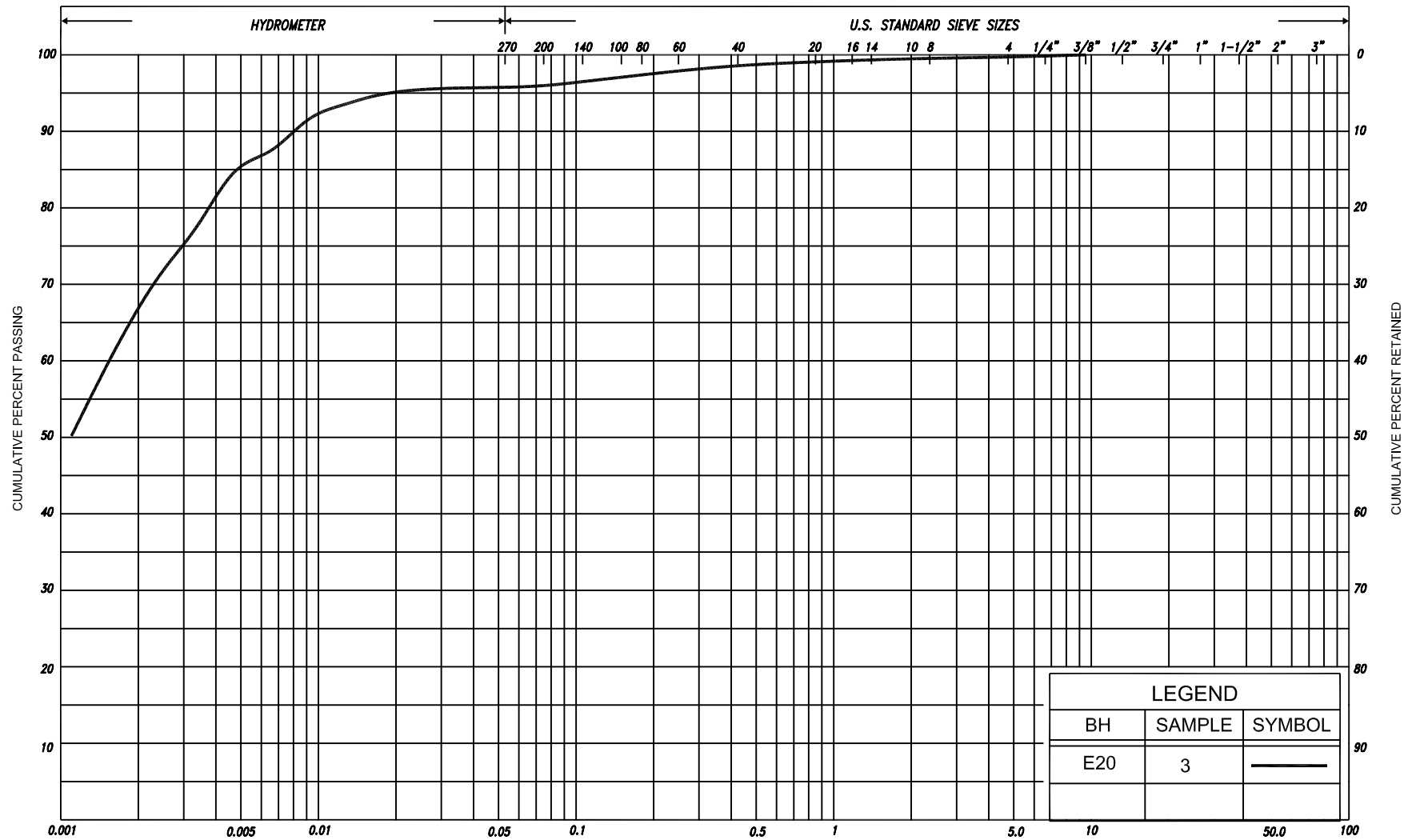
Originated: JFW
 Compiled: IS
 Checked: CN



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL			COBBLES	UNIFIED	
				SAND											
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		COBBLES
	SILT														
CLAY		SILT			V. FINE		FINE		MED.		COARSE		GRAVEL		
					SAND										

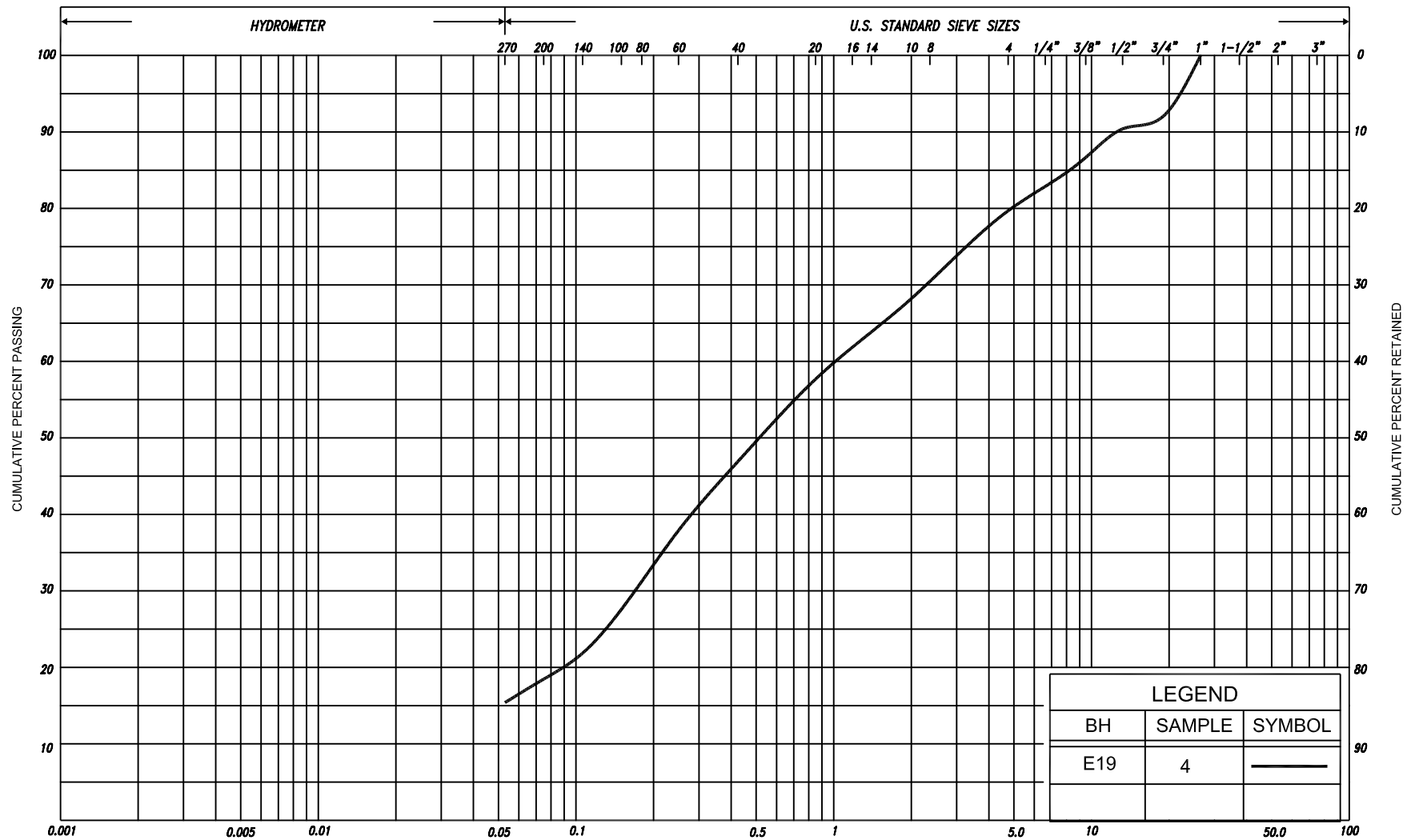


SILT & CLAY					FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED		
					SAND											
CLAY	FINE		MEDIUM		COARSE	FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT															
CLAY		SILT			V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU
					SAND											

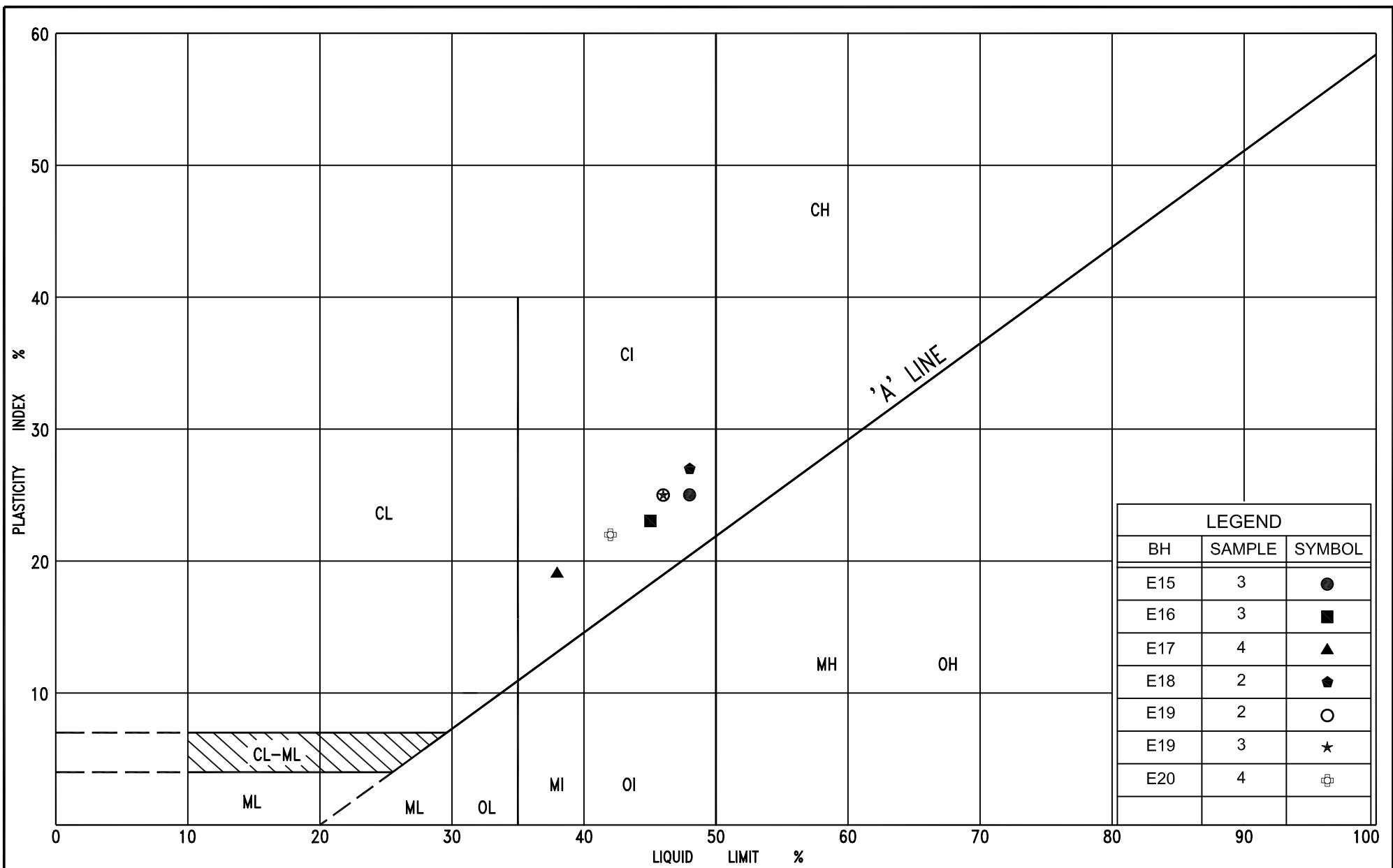


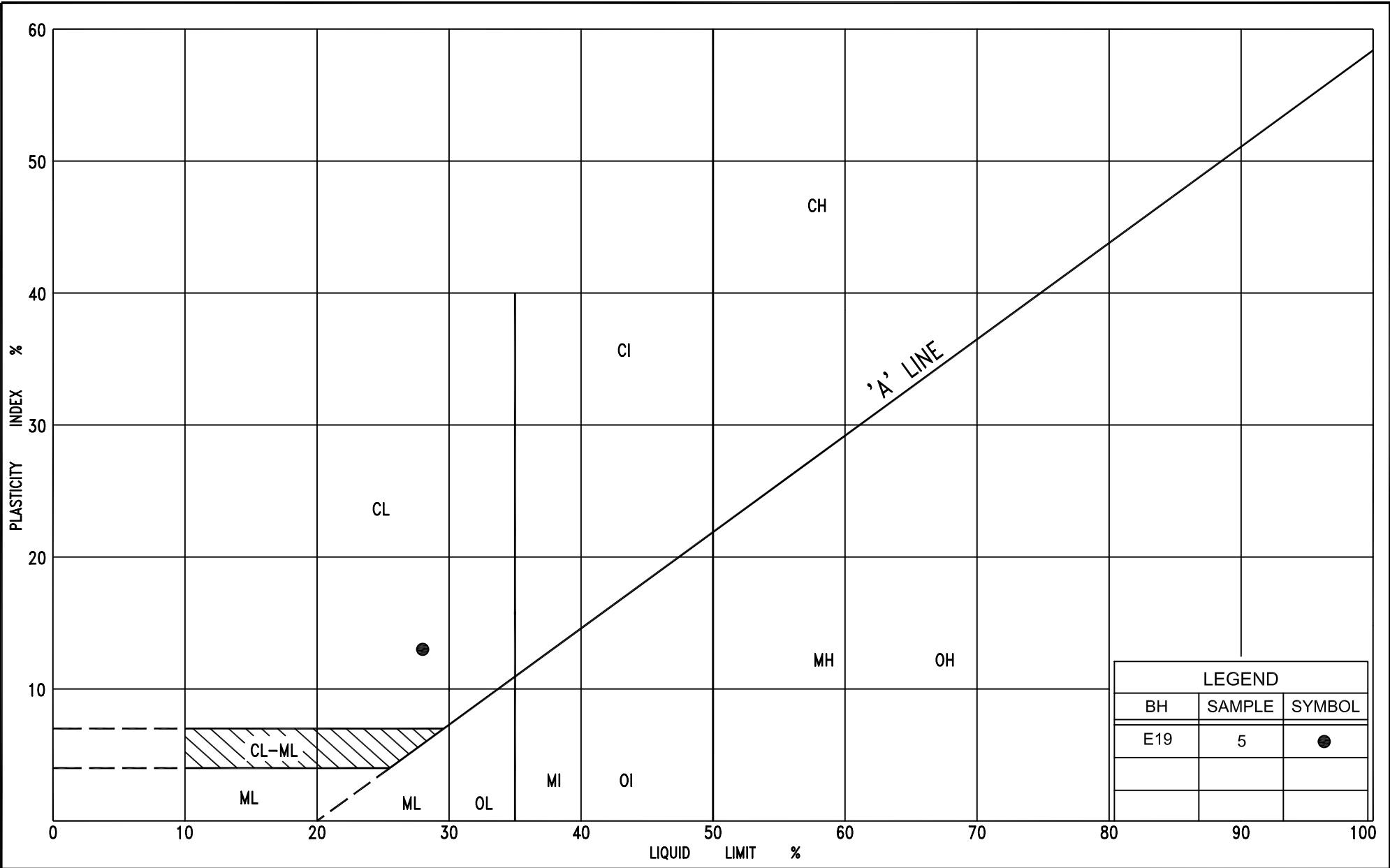
LEGEND		
BH	SAMPLE	SYMBOL
E20	3	—

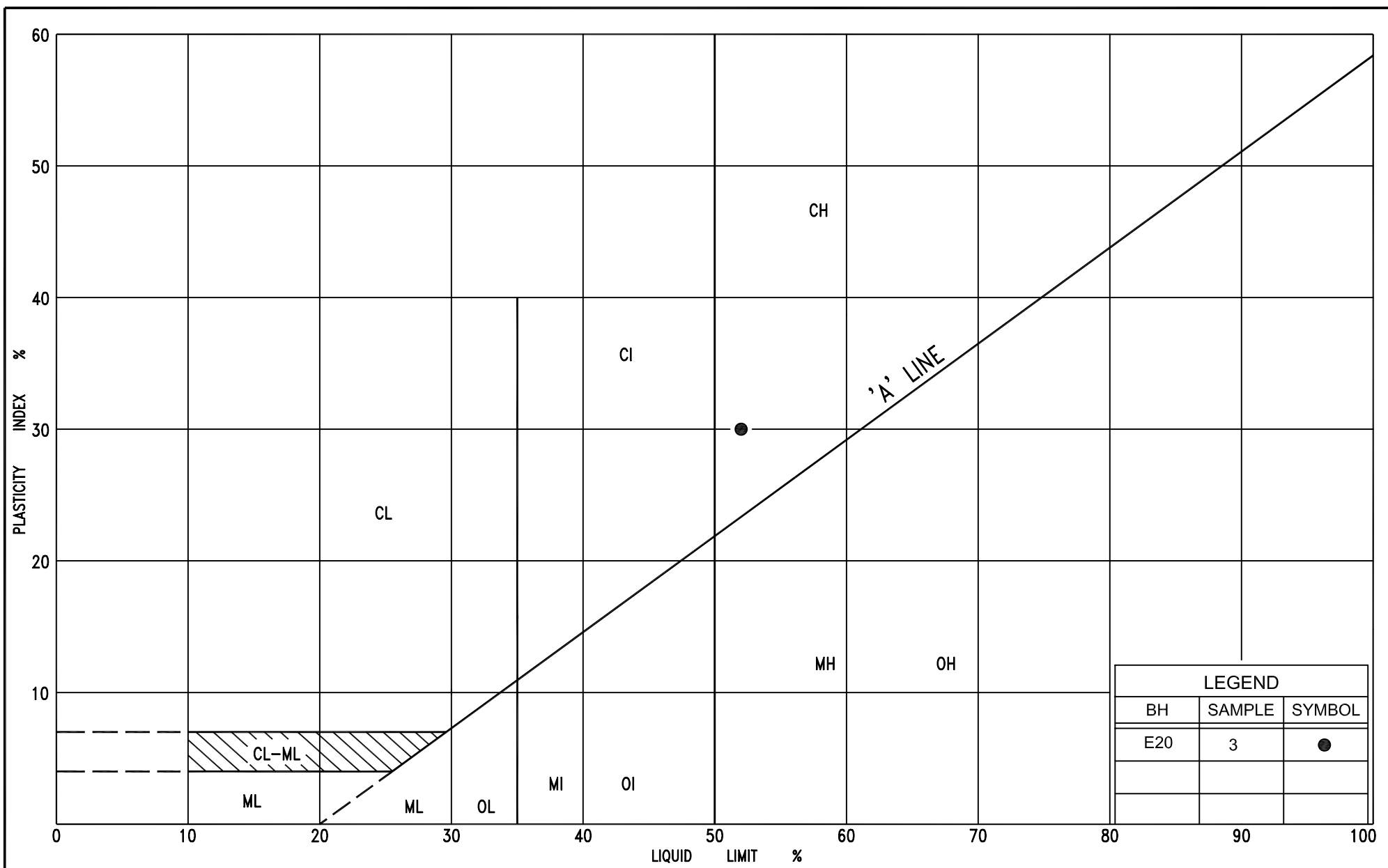
SILT & CLAY				FINE SAND			MEDIUM SAND		COARSE SAND		GRAVEL		COBBLES	UNIFIED
													COBBLES	M.I.T.
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE							COBBLES	M.I.T.
CLAY	SILT			V. FINE	FINE	MED.	COARSE							U.S. BUREAU



SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COBBLES	UNIFIED				
					SAND														
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.		
	SILT																		
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL							U.S. BUREAU	
					SAND														







EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	e_{\max}	1, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	e_{\min}	1, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m^3	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
γ_w	kN/m^3	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m^3/s	RATE OF DISCHARGE
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	kN/m^2	SEEPAGE FORCE
e	1, %	VOID RATIO						

RECORD OF BOREHOLE No E 1

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 120 999 N; 322 292 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Manual Probe COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.



SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m³	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							
236.9 0.0	Ground Surface																			
236.8 0.1	Topsoil																			
	End of borehole																			
	Refusal on bedrock outcrop																			

RECORD OF BOREHOLE No E 2

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 011 N; 322 306 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling COMPILED BY A.S.
 DATUM Geodetic DATE August 12, 2008 CHECKED BY C.N.

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																
236.2	Ground Surface																									
0.0	Topsoil																236									
235.8																	235									
0.4	Granodiorite Gneiss bedrock Unweathered High strength Excellent quality		1	RC NQ	REC 100%																					
			2	RC NQ	REC 100%												234									
232.7	End of borehole																									
3.5																										
	* Borehole dry C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers																									

RECORD OF BOREHOLE No E 3

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 120 999 N; 322 311 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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									
236.0	Ground Surface		1	SS	3/15cm												
0.0	Topsoil																
235.8	End of borehole																
0.2	Refusal on probable bedrock																
	Sample 1: Sampler bouncing																
	* Borehole dry																

RECORD OF BOREHOLE No E 4										1 of 1		METRIC	
G.W.P. 5265-05-01			LOCATION Co-ords: 5 121 006 N; 322 310 E			ORIGINATED BY F.P.							
DIST 54 HWY 69 & 637			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling			COMPILED BY A.S.							
DATUM Geodetic			DATE August 13, 2008			CHECKED BY C.N.							
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L			WATER CONTENT (%)	
236.2	Ground Surface												
0.0	Topsoil						236						
235.8	Granodiorite Gneiss bedrock Unweathered High strength Excellent quality		1	RC NO	REC 100%		235					RQD 97%	
0.4								234					RQD 92%
			2	RC NO	REC 100%			233					
232.7	End of borehole												
3.5	* Borehole dry C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers												

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

15 — 20 — 5
|
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No E 6

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 013 N; 322 309 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 13, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m³	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					
236.0	Ground Surface							20	40	60	80	100		20	40	60				
0.0	Topsoil		1	SS	2															
235.7	Silty sand																			
0.3	Loose Brown Moist																			
235.2	End of borehole																			
0.8	Refusal on probable bedrock																			
	* Borehole dry																			


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RECORD OF BOREHOLE No E 9

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 014 N; 322 345 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 11, 2008 CHECKED BY C.N.

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									
234.6 0.0	Ground Surface																
234.1 0.5	Topsoil																
	End of borehole Refusal on probable bedrock																
	* Borehole dry																

METRIC


20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No E 11

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 025 N; 322 345 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling COMPILED BY A.S.
 DATUM Geodetic DATE August 12, 2008 CHECKED BY C.N.

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		
235.7	Ground Surface							20	40	60	80	100									
0.0	Granite-granodiorite Gneiss bedrock Unweathered High strength Fair to excellent quality		1	RC NQ	REC 100%												RQD 68%				
			2	RC NQ	REC 98%												RQD 98%				
232.6	End of borehole																				
3.1	* Borehole dry C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers																				

RECORD OF BOREHOLE No E 12

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 028 N; 322 343 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Manual Probe COMPILED BY A.S.
 DATUM Geodetic DATE August 12, 2008 CHECKED BY C.N.

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 (%)			GR					SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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235.3	Ground Surface																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

RECORD OF BOREHOLE No E 13

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 016 N; 322 349 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling COMPILED BY A.S.
 DATUM Geodetic DATE August 11, 2008 CHECKED BY C.N.



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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa					W _p	w	W _L		
233.8 0.0	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					WATER CONTENT (%)				
233.7 0.1	Topsoil Granite- Granodiorite Gneiss Bedrock Unweathered High Strength Good to excellent quality		1	RC NQ	REC 100%	233										RQD 97%
			2	RC NQ	REC 100%	232										RQD 94%
			3	RC NQ	REC 83%	231										RQD 83%
230.2 3.6	End of borehole															
	* Borehole dry C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers															

RECORD OF BOREHOLE No E 14


1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 043 N; 322 375 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling COMPILED BY A.S.
 DATUM Geodetic DATE August 06, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE					w _p w w _L							
								● QUICK TRIAXIAL x LAB VANE												
231.9	Ground Surface							20	40	60	80	100								
0.0	Topsoil		1	SS	3/15cm															
231.6	Granodiorite Gneiss Bedrock Unweathered High strength Excellent quality		2	RC NQ	REC 95%		231										RQD 95%			
0.3			3	RC NQ	REC 95%		230										RQD 94%			
			4	RC NQ	REC 96%		229													
							228											RQD 96%		
227.9	End of borehole																			
4.0	Sample 1: Sampler bouncing																			
	* Borehole dry																			
	C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers																			

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

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							○		
231.4 0.0	Ground Surface						20	40	60	80	100								
230.9 0.5	Topsoil		1	SS	5														
	Silty clay some sand, trace gravel rootlets																		
	Stiff Brown Moist		2	SS	12						225								
	thin layers of sand		3	SS	8														
	trace gravel		4	SS	4														
	Wet																		
228.2 3.2	Sand trace silt, trace gravel		5	SS	12/15cm														
228.0 3.4	Compact Grey Wet End of borehole Refusal on probable bedrock Sample 5: Sampler bouncing																		
2008 08 06																			
Water level observed during drilling																			
Water level measured after drilling																			
Penetrometer test																			

RECORD OF BOREHOLE No E 16

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 037 N; 322 379 E ORIGINATED BY F.P.
DIST 54 HWY 69 & 637 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling COMPILED BY A.S.
DATUM Geodetic DATE August 06, 2008 CHECKED BY C.N.

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											
								○ UNCONFINED + FIELD VANE											
								● QUICK TRIAXIAL × LAB VANE											
					WATER CONTENT (%)														
					20 40 60 80 100					20 40 60									
231.3	Ground Surface																		
0.0	Topsoil		1	SS	3		231												
230.8	Silty clay, some sand trace gravel, rootlets Stiff Mottled Moist grey/brown ____ ____ ____ ____ thin layers of sand ____ ____ ____ ____ Wet																		
0.5		2	SS	15		213													
		3	SS	10		163													
		4	SS	8															
228.6	Granodiorite Gneiss Bedrock		5	RC NQ	REC 66%														
2.7	Unweathered																		
	High strength		6	RC NQ	REC 100%														
	Fair to excellent quality																		
			7	RC NQ	REC 100%														
224.9	End of borehole																		
6.4	Refusal on probable bedrock																		
* 2008 08 06																			
▽ Water level observed during drilling																			
▼ Water level measured after drilling																			
■ Penetrometer Test																			
C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers																			

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

20
15 — ○ — 5
10







(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No E 18

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 045 N; 322 378 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 06, 2008 CHECKED BY C.N.
















SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)							
231.4	Ground Surface							20	40	60	80	100								
0.0	Topsoil		1	SS	2		231								○					
230.8 0.6	Silty clay, trace sand trace gravel, rootlets Stiff to Mottled Moist very stiff grey/brown		2	SS	10		230							■				1 7 35 57		
			3	SS	17									225	●	○				
			4	SS	4/15cm		229								138	■	○			
228.8 2.6	thin layers of sand Moist																			
	End of borehole																			
	Refusal on probable bedrock																			
	Sample 4: Sampler bouncing																			
	* Borehole dry																			
	■ Penetrometer test																			

RECORD OF BOREHOLE No E 19

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 032 N; 322 384 E ORIGINATED BY F.P.
DIST 54 HWY 69 & 637 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Drilling COMPILED BY A.S.
DATUM Geodetic DATE August 06, 2008 CHECKED BY C.N.

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								○		
								20	40	60	80	100								
231.3 0.0	Ground Surface																			
230.9 0.4	Topsoil		1	SS	6		231													
	Silty clay some sand, trace gravel rootlets																			
	Stiff Mottled Moist grey/brown		2	SS	15		230										1 12 39 48			
			3	SS	8												1 4 41 54			
229.0 2.3	Sand, some gravel some silt, trace clay						229													
228.2 3.1	Compact Grey Wet		4	SS	14												20 62 (18)			
	Sandy clayey silt trace gravel		5	SS	1		228										6 33 38 23			
	Very soft Grey Wet to soft																			
			6	SS	1		227													
226.4 4.9	Gravelly sand cobbles and boulders																			
225.6 5.7	Grey Wet						226													
	Granodiorite Gneiss Bedrock																			
	Unweathered		7	RC NQ	REC 100%		225										RQD 100%			
	High strength																			
	Excellent quality		8	RC NQ	REC 100%		224										RQD 100%			
			9	RC NQ	REC 79%		223										RQD 79%			
222.1 9.2	End of borehole																			
	Low RQD and recovery in rock coring due to piece lost down hole																			
	* 2008 08 06																			
	 Water level observed during drilling																			
	 Water level measured after drilling																			
	C.F.H.S.A. Denotes Continuous Flight Hollow Stem Augers																			

RECORD OF BOREHOLE No E 20										1 of 1		METRIC	
G.W.P. 5265-05-01			LOCATION Co-ords: 5 121 046 N; 322 398 E			ORIGINATED BY F.P.							
DIST 54 HWY 69 & 637			BOREHOLE TYPE Continuous Flight Hollow Stem Augers			COMPILED BY A.S.							
DATUM Geodetic			DATE August 06, 2008			CHECKED BY C.N.							
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L			20 40 60	
231.0	Ground Surface												
0.0	Topsoil		1	SS	4								
230.7	Clay trace sand, trace gravel		2	SS	12								
0.3	Stiff Brown Moist		3	SS	8								
228.7	Silty clay some sand, trace gravel		4	SS	10								
2.3	Stiff Mottled Moist grey/brown		5	SS	10/1cm								
227.8	thin layers of silty sand												
3.2	End of borehole												
	Refusal on probable bedrock												
	Sample 5: Sampler bouncing												
	2008 08 06												
	▽ Water level observed during drilling												
	▼ Water level measured after drilling												
	■ Penetrometer test												

RECORD OF BOREHOLE No APE 1 1 of 1 METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 044 N; 322 377 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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									
231.7	Ground Surface							20	40	60	80	100					
0.0	Topsoil																
231.4	Silty clay, trace sand																
0.3	Brown Moist						231										
230.7	End of borehole																
1.0	Refusal on probable bedrock																
	Auger probes were not sampled. Soil boundaries were estimated from auger cuttings																
	* Borehole dry																

METRIC


20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No APE 3

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 031 N; 322 382 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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								
231.3 0.0	Ground Surface Topsoil						20	40	60	80	100	20	40	60		
231.1 0.2	Silty clay, trace sand															
	Brown Moist															
227.7 3.6	Sand trace silt, trace gravel cobbles															
227.2 4.1	Brown Wet															
	End of borehole															
	Refusal on probable bedrock															
	Auger probes were not sampled. Soil boundaries were estimated from auger cuttings															
	* Borehole dry															

RECORD OF BOREHOLE No APE 4 1 of 1 METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 037 N; 322 378 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Manual Probe COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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					W _p	W	W _L	WATER CONTENT (%)	GR	SA			SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
						○ UNCONFINED			● QUICK TRIAXIAL	+	×	FIELD VANE	LAB VANE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
231.7	Ground Surface																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

RECORD OF BOREHOLE No APE 5

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords; 5 121 033 N; 322 386 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE December 17, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED	+	FIELD VANE					
							● QUICK TRIAXIAL	×	LAB VANE						
							20	40	60	80	100	20	40	60	
231.3	Ground Surface														
0.0	Peat, fine fibrous														
231.0	Dark brown														
0.3	Silty clay														
	trace sand, trace gravel														
	Brown Moist														
			1	CS	-										

RECORD OF BOREHOLE No APE 6

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords; 5 121 036 N; 322 384 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE December 17, 2008 CHECKED BY C.N.

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									
231.3	Ground Surface						20	40	60	80	100						
0.0 231.0 0.3	Peat, fine fibrous Dark brown						20	40	60	80	100						
	Silty clay trace sand, trace gravel					231											
	Brown Moist					230											
	Grey Wet					229											
						228											
227.3 4.0	Sand, trace silt trace clay, trace gravel					227											
226.6 4.7	Grey Wet																
	End of borehole																
	Refusal on probable bedrock																
	Auger probes were not sampled. Soil boundaries were estimated from auger cuttings																
	* 2008 12 17																
	Water level observed during drilling																
	Water level measured after drilling																

RECORD OF BOREHOLE No APE 7

1 of 1

METRIC

G.W.P.	5265-05-01	LOCATION	Co-ords; 5 121 039 N; 322 383 E	ORIGINATED BY	F.P.
DIST	54	HWY	69 & 637	BOREHOLE TYPE	Continuous Flight Solid Stem Augers
COMPILED BY	A.S.	DATUM	Geodetic	DATE	December 17, 2008
CHECKED BY	C.N.				

[illegible]

METRIC

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No APE 9

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords; 5 121 045 N; 322 380 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE December 17, 2008 CHECKED BY C.N.

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												
231.4	Ground Surface							20	40	60	80	100								
0.0 231.1 0.3	Peat, fine fibrous Dark brown																			
	Silty clay trace sand, trace gravel						231													
	Brown Moist		1	CS	-		230													
	with sand																			
	Grey Wet		2	CS	-		229													
	cobbles and boulders																			
228.2 3.2	End of borehole																			
	Refusal on probable bedrock																			
	Auger probes were not sampled. Soil boundaries were estimated from auger cuttings																			
	* 2008 12 17																			
	▽ Water level observed during drilling																			
	▼ Water level measured after drilling																			

RECORD OF BOREHOLE No APE 10

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords; 5 121 041 N; 322 380 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE December 17, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES					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	GROUND WATER CONDITIONS *	ELEVATION SCALE	SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
231.4 0.0	Ground Surface							20	40	60	80	100	20	40	60		
231.2 0.2	Peat, fine fibrous Dark brown						231										
	Silty clay trace sand, trace gravel Brown Moist						230										
229.3 2.1	End of borehole Refusal on probable bedrock Auger probes were not sampled. Soil boundaries were estimated from auger cuttings * Borehole dry on completion of drilling																

METRIC

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No APP 2

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 023 N; 322 343 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Manual Probe COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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					w _p w w _L			WATER CONTENT (%)	kN/m ³	GR		SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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RECORD OF BOREHOLE No APP 3

1 of 1


METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 018 N; 322 345 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Manual Probe COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE 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									
235.2	Ground Surface																					
0.0	Bedrock at surface																					

RECORD OF BOREHOLE No APW 1 1 of 1 METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 003N; 322 309 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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									
236.2	Ground Surface							20	40	60	80	100					
0.0	Topsoil						236										
235.6	End of borehole																
0.6	Refusal on probable bedrock																
	* Borehole dry																

METRIC



20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No APW 3

1 of 1

METRIC

G.W.P. 5265-05-01 LOCATION Co-ords: 5 121 012 N; 322 307 E ORIGINATED BY F.P.
 DIST 54 HWY 69 & 637 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
 DATUM Geodetic DATE August 14, 2008 CHECKED BY C.N.

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									
236.2 0.0	Ground Surface Topsoil						236										
235.4 0.8	End of borehole Refusal on probable bedrock																
	* Borehole dry																

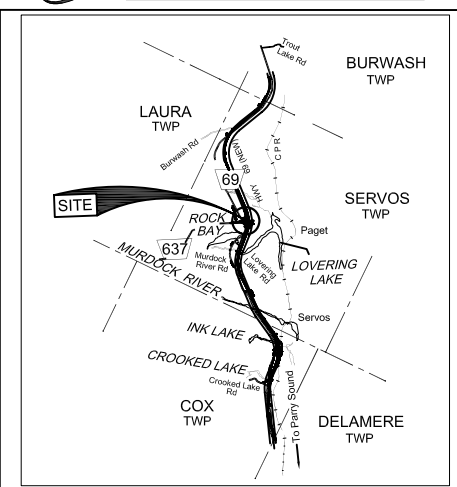
METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES

CONT No 2009-5131
GWP No 5265-05-01

HIGHWAY 637 UNDERPASS
HIGHWAY 69 FOUR-LANING
SOIL STRATA

PML Peto MacCallum Ltd
CONSULTING ENGINEERS



KEY PLAN
SCALE 1:10,000
2 0 2 4 6 km

LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60 Cone, 475 J / blow)
- W L at time of investigation Aug 2008
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No ELEVATION CO-ORDINATES
NORTHINGS EASTINGS

SEE DRAWING E 1 FOR DETAILS

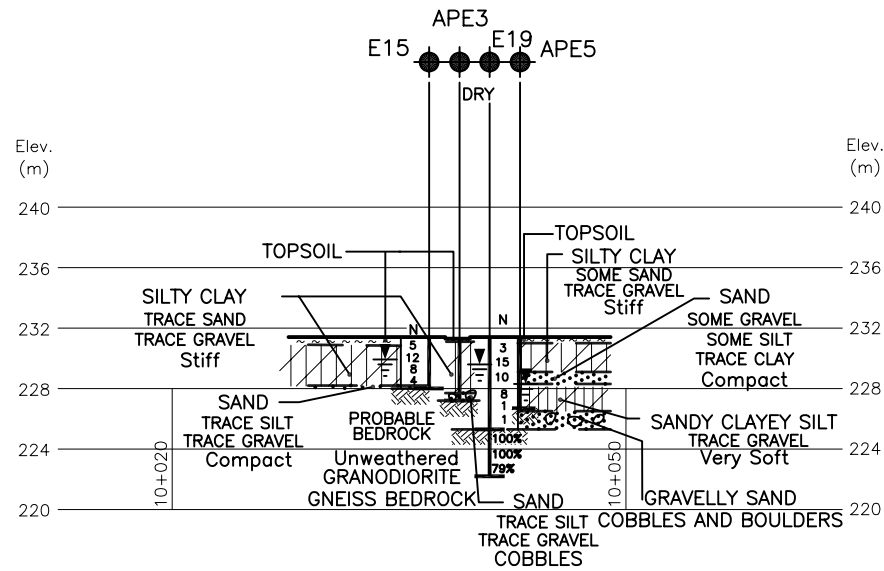
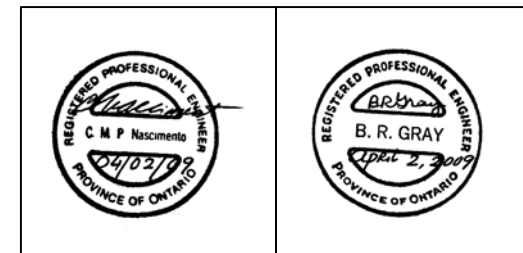
NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

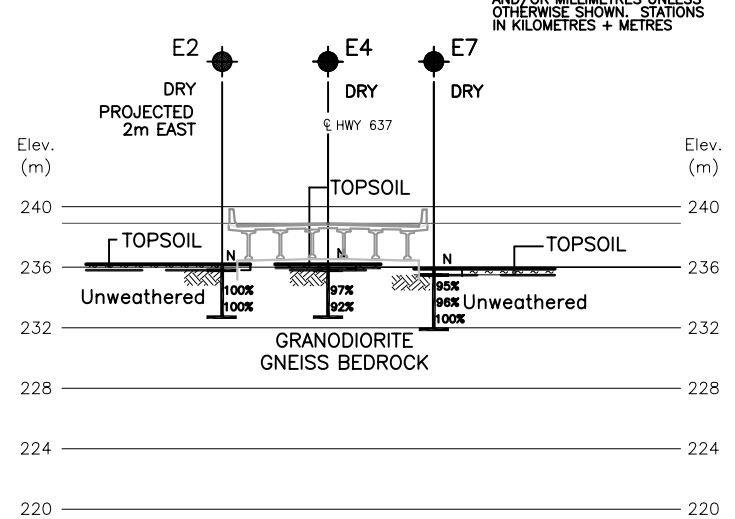
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-232	HWY No 69 & 637	DIST 54
SUBMIT AS	CHECKED CN	DATE APRIL 02, 2009
DRAWN NA	CHECKED CN	APPROVED BRG
		DWG E 2

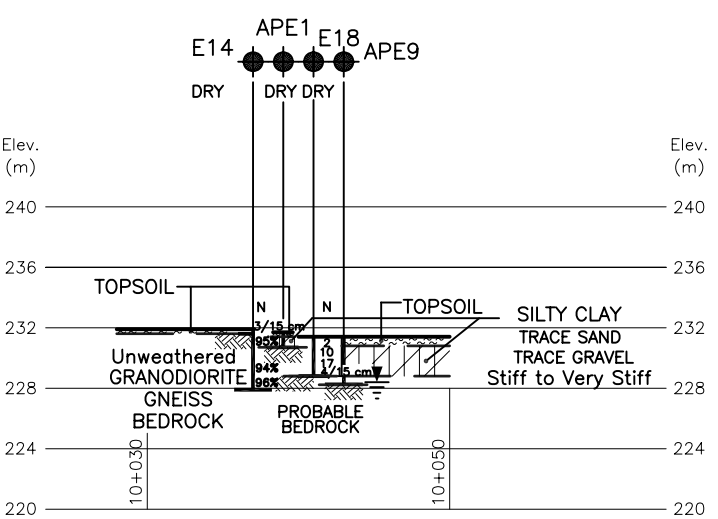
REF. TSH Drawings; Hwy 69 Servos Contract 2 Lidar
Contours.dwg dated December 19, 2007; and
91088-HWY637-1-GA.dwg; Received August 27, 2008



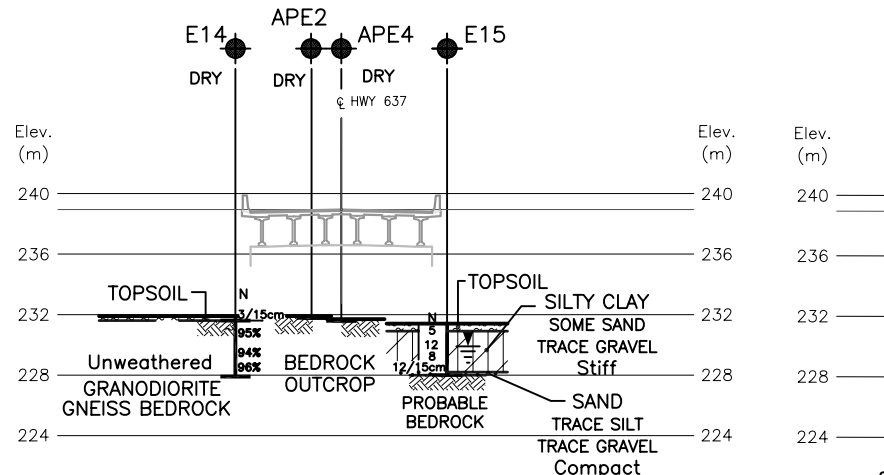
SECTION B-B



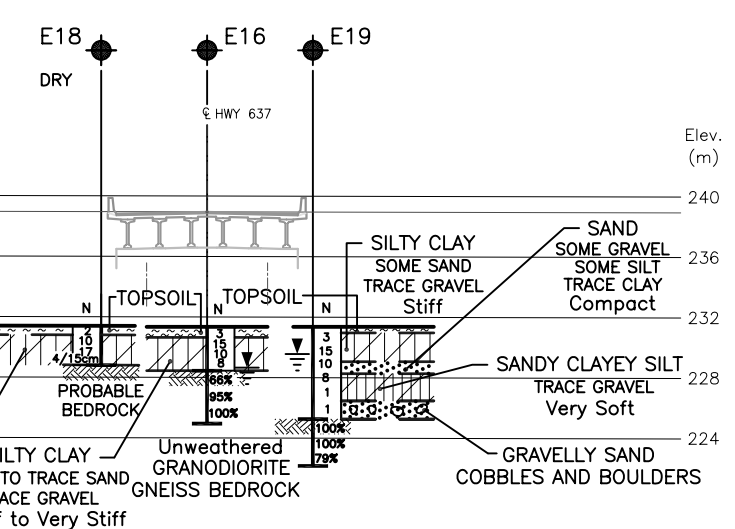
SECTION C-C



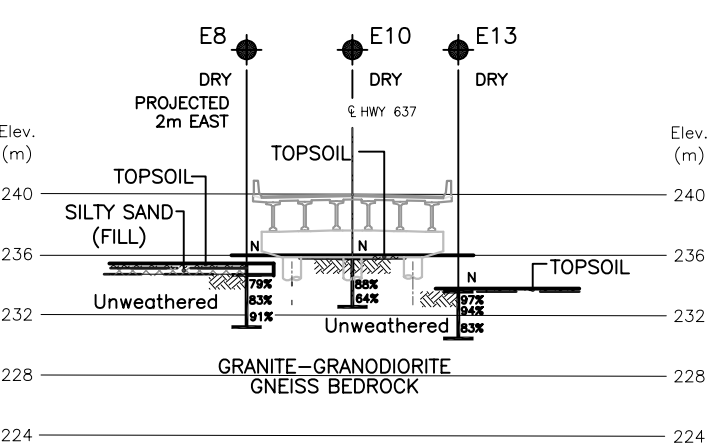
SECTION A-A



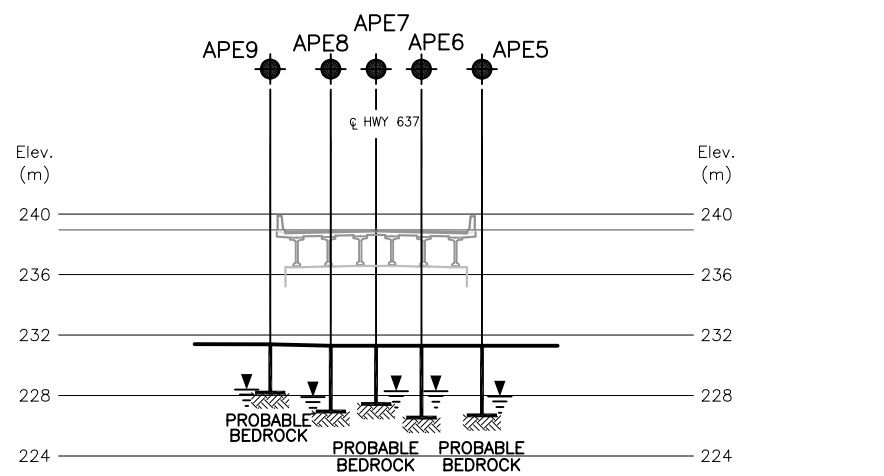
SECTION E-E



SECTION F-F



SECTION D-D



SECTION G-G



- NOTES:
- REFER TO DRAWING E1 FOR BOREHOLE LOCATIONS PLAN AND CENTRE LINE PROFILE.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - ELEVATIONS OF AUGER PROBES APE5 TO APE10 ARE APPROXIMATE.



APPENDIX A

SITE PHOTOGRAPHS



Photograph 1: Viewing Centre Pier location. Note the rock outcrop at the middle and bottom of the photograph.



Photograph 2: Viewing East Abutment location. Note stakes at borehole locations.



APPENDIX B

ROCK CORE PHOTOGRAPHS

WEST ABUTMENT



West Abutment Core Photograph 1 : Rock core from borehole E2 - RC-1 and RC-2

WEST ABUTMENT



West Abutment Core Photograph 2 : Rock core from borehole E4 - RC-1 and RC-2

WEST ABUTMENT



West Abutment Core Photograph 3: Rock core from borehole E5 - RC-1 to RC-3

WEST ABUTMENT



West Abutment Core Photograph 4: Rock core from borehole E7 - RC-1, RC-2 and RC-3

CENTRE PIER



Centre Pier Core Photograph 1 : Rock core from borehole E8 - RC-1, RC-2 and RC-3

CENTRE PIER



Centre Pier Core Photograph 2 : Rock core from borehole E10 - RC-1

CENTRE PIER



Centre Pier Core Photograph 3: Rock core from borehole E10 - RC-2 and RC-3

CENTRE PIER



Centre Pier Core Photograph 4: Rock core from borehole E11 - RC-1 and RC-2

CENTRE PIER



Centre Pier Core Photograph 5: Rock core from borehole E13 - RC-1

CENTRE PIER



Centre Pier Core Photograph 6: Rock core from borehole E13 - RC-2 and RC-3

EAST ABUTMENT



East Abutment Core Photograph 1: Rock core from borehole E14 - RC-2

EAST ABUTMENT



East Abutment Core Photograph 2: Rock core from borehole E14 - RC-3 and RC-4

EAST ABUTMENT



East Abutment Core Photograph 3: Rock core from borehole E16 - RC-5 and RC-6

EAST ABUTMENT



East Abutment Core Photograph 4: Rock core from borehole E16 - RC-7

EAST ABUTMENT



East Abutment Core Photograph 5: Rock core from borehole E17 - RC-5 and top of RC-6

EAST ABUTMENT



East Abutment Core Photograph 6: Rock core from borehole E17, bottom of RC-6, RC-7 and RC-8

EAST ABUTMENT



East Abutment Core Photograph 7: Rock core from borehole E19 - RC-7 and RC-8

EAST ABUTMENT



East Abutment Core Photograph 8: Rock core from borehole E19 - RC-9



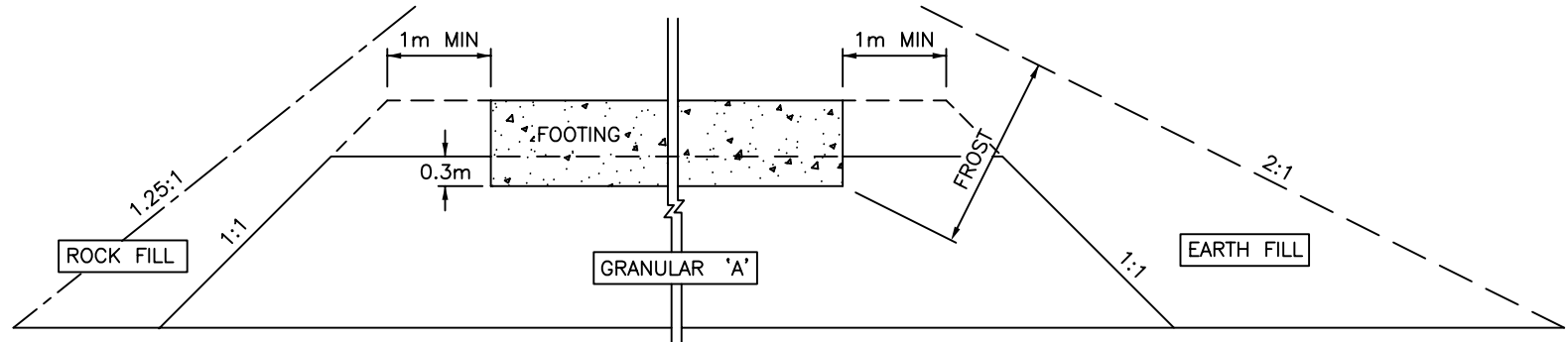
TABLE 1
LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

DOCUMENT	
OPSS 120	General Specification for the Use of Explosives
OPSS 501	Construction Specification for Compacting
OPSS 571	Construction Specification for Sodding
OPSS 572	Construction Specification for Seed and Cover
SP 105S10	Construction Specification for Compaction
SP 206S03	Construction Specification for Grading
SP 299F06	Rock Excavation (Controlled Blasting)
SP 405F03	Construction Specification for Pipe Subdrains
SP 599S22	Requirements for The Design, Supply and Construction of Retaining Soil Systems (RSS)
SP 902S01	Excavation and Backfilling of Structures
SP 903S01	Construction Specification for Piling
SP 999S26	Requirements for Design, Installation and Testing of Temporary and Permanent Pre-Stressed Anchors in Soil and Rock
OPSD 201.020	Rock Grading-Divided Rural
OPSD 202.010	Slope Flattening Using Excess Material on Earth or Rock Embankment
OPSD 202.020	Drainage Gap for Slope Flattening on Rock or Granular Embankment
OPSD 203.020	Embankments Over Swamp – Existing Slope Excavated to 1H:1V
OPSD 208.010	Benching of Earth Slopes
OPSD 3101.150	Minimum Granular Backfill Requirements - Abutments
OPSD 3101.200	Rock Backfill Requirements - Abutments
OPSD 3102.100	Walls Abutment Backfill Drain
OPSD 3121.150	Minimum Granular Backfill Requirements - Walls Retaining
OPSD 3190.100	Retaining Wall and Abutment Wall Drain Detail
NRE 98-200	Northeastern Region Directive - Platform Widening
NSSP	Dowels Into Concrete
NSSP	Shear Keys



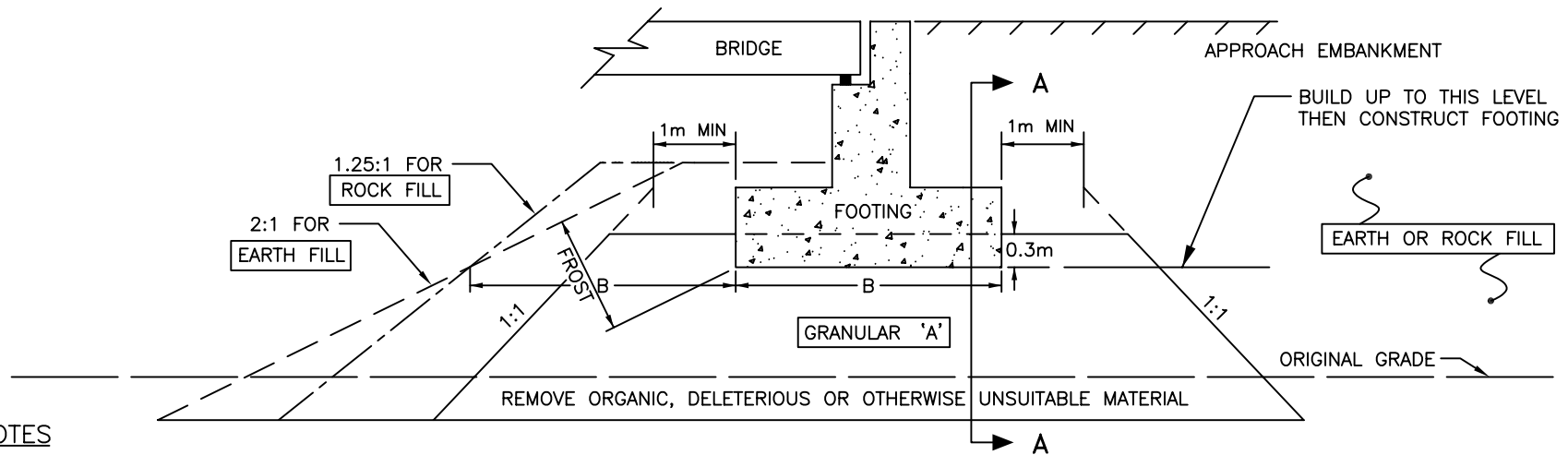
TABLE 2
GRADATION SPECIFICATION FOR SAND FILL IN
PRE-AUGERED HOLES AT INTEGRAL ABUTMENTS

MTO SIEVE DESIGNATION		PERCENTAGE PASSING BY MASS
2 mm	#10	100
600 µm	#30	80 – 100
425 µm	#40	40 – 80
250 µm	#60	5 – 25
150 µm	#100	0 – 6



CROSS SECTION A-A

NOT TO SCALE



LONGITUDINAL SECTION

NOT TO SCALE

NOTES

1. CONCEPT SHOWN DOES NOT INCLUDE A MIDHEIGHT BERM.
2. LIMITS OF GRANULAR 'A' CORE TO BE DEFINED BY A SITE SPECIFIC SURVEY.
3. REMOVE ORGANIC, DELETERIOUS OR OTHERWISE UNSUITABLE MATERIAL UNDER AREA OF COMPACTED GRANULAR 'A' AND EARTH OR ROCK FILL AS NOTED IN TEXT OF REPORT.
4. PLACE GRANULAR 'A' AND EARTH OR ROCK FILL ON APPROVED SUBGRADE TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.O. STANDARDS.
5. CONSTRUCT CONCRETE FOOTING.
6. PLACE REMAINDER OF GRANULAR 'A' AND EARTH OR ROCK FILL INCLUDING MIDHEIGHT BENCHES, AS REQUIRED.
7. REFER TO TEXT OF REPORT FOR FROST DEPTH.

FIGURE 1: ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE