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GEO-CANADA

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REPORT ON GEOTECHNICAL INVESTIGATION STREETSVILLE FEEDERMAIN ERIN MILLS PARKWAY REGION OF PEEL PROJECT NO. 95-1960 CONTRACT 3 TUNNEL UNDER HWY 403

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Prepared for:

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GEOTECHNICAL INVESTIGATION

STREETSVILLE FEEDERMAIN

ERIN MILLS PARKWAY

REGION OF PEEL PROJECT NO. 95-1960

CONTRACT NO. 3

TUNNEL UNDER HWY 403

1.0 INTRODUCTION

Presented in this report are the results of a geotechnical investigation carried out by Geo-Canada Ltd. for the design of a proposed 1500 mm diameter Streetsville Feedermain. The investigation was authorized on behalf of the Region of Peel by Marshall Macklin Monaghan Ltd. (MMM), Consulting Engineers for the project.

This report deals with the subsurface conditions found within the area extending from about Sta. 3+940 to Sta. 4+300. This section includes a tunnel under Hwy 403 and a short open cut section north of the tunnel.

PART 1 - FACTUAL INFORMATION

1.1 The Project

The Streetsville Feedermain project will connect the Herridge Reservoir and Pumping Station to the Streetsville Reservoir and Pumping Station via a 1500 mm diameter concrete pressure pipe. The length of this route is about 7 km. A portion of the feedermain is located within the limits of the MTO right-of-way at the intersection of Hwy 403 and Erin Mills Parkway (Regional Road No. 1). The invert of the watermain under Hwy 403 lies between El. 153.1 m at the south and 153.8 m at the north end. In the open cut sections the invert elevations range between El. 153.8 and 158.45 m. In the tunnelled section, the watermain will be installed inside a 2400 mm diameter steel liner. The depth of cover over the tunnel will range between 11 and 5 m, and the depth of excavation in the open cut section will range between about 4 and 9 m.

1.2 Geology

The geology of the region within which the project lies has been well documented by Chapman and Putnam (1984) and Karrow (1984).

Southern Ontario, including the project area, had been subjected to extensive glaciation during the last 200,000 years. At least four periods of glaciation are known to have occurred which were interrupted by warmer climate inter-glacial periods. The last glacier (Wisconsin Glacier) withdrew from the area approximately 8,000 to 10,000 years ago.

Remnants from the soil deposits laid down during the first three glaciations and the inter-glacial periods have been largely or completely obliterated by the last Wisconsin Glacier. As the last glacier retreated eastward into the Lake Ontario basin, a shallow water body, Lake Peel, was dammed between the ice front and the Niagara escarpment. Traces of glacial lake sediments can be found in shallow depressions along the creek and river valleys. Sands and gravels left behind as near shore or delta deposits can also be found. As the glacier withdrew further, and when drainage via the Hudson River into the Atlantic Ocean became possible, lake levels stabilized in the Ontario basin. This stable stage formed the prominent shoreline of glacial Lake Iroquois, the remnant of which can be found a short distance south of Dundas Street.

The region is underlain by the Paleozoic bedrock of Ordovician Age. In the eastern part of the City of Mississauga, grey to olive-green shale and siltstone of the Georgian Bay Formation is found, while red shale of the overlying Queenston Formation underlies the west part of the City. Erin Mills Parkway is near the contact zone between the two formations and, therefore, both rock types are intermittently present. The surface of the bedrock is often at shallow depth near the ground surface.

1.3 Method of Investigation

Eleven (11) boreholes, numbered Boreholes 33 to 39 inclusive, and Boreholes 134, 135, 136 and 136A were put down within the limits of this contract. Boreholes 33 to 39 were drilled in February and March of 1995, while the 100 series boreholes were put down in May of 1996. The drilling was carried out under the full time supervision of a senior technician and a junior engineer from our office who kept an accurate log of the boreholes, obtained and collected the soil samples, installed and monitored the piezometers. Borehole locations are shown on the enclosed Drawings 1 and 2. Their locations in plan and the ground surface elevations were surveyed by MMM.

The boreholes were drilled with a power auger machine, but after penetrating into the highly weathered zone of the shale rock, the boreholes were further advanced by diamond core drilling in NQ (48 mm) size. The overburden above the rock was sampled at 0.75 and 1.5 m intervals of depth by the standard penetration test (SPT) method. Piezometers were installed in Boreholes 33 to 39 inclusive, in which the water levels were initially monitored over a period of several days. Final water levels were obtained in May 1996, i.e. about fourteen (14) months later.

The soil and rock core samples were transported to our laboratory where they were re-examined by a senior engineer. Representative soil samples were also selected for testing. The testing program included natural moisture contents, grain size analyses and Atterberg tests.

Test results are shown on the borehole logs, and the grain size distribution curves are plotted on Figures 1 to 4 inclusive.

1.4 Summarized Subsurface Conditions

Within the tunnelled portion of the contract the shale bedrock is covered with a shallow, approximately 1 to 2 m thick, overburden of silty clay. Within the open cut section, the surface of the bedrock was not contacted to a depth at least 2 m below the proposed invert level. The overburden here consists of generally very dense silt and silty sand.

The stabilized groundwater level in the piezometers in May 1996 ranged between El. 162.5 and 159.3 m.

It is significant to note the abrupt and large changes in the surface of the bedrock. Although the rock surface appears to be reasonably level and consistent on the line of Boreholes 33, 34, 134, 35, 135 and 36, north of Borehole 36 the rock surface drops abruptly from about El. 160 to below El. 154 m within a distance of about 50 m. A similar sudden drop in rock surface elevation is known to exist in the easterly direction as the boreholes put down for the bridge structure carrying Erin Mills Parkway over Hwy 403, located about 40 m to the east, have contacted the surface of the bedrock between El. about 149 and 132 m.

1.5 Description of the Strata

In this section of the report, the relevant properties of the various soil and rock units encountered in the boreholes are briefly described.

1.5.1 Fill

Fill was encountered in Boreholes 33, 37, 38 and 39, where its thickness ranges between 1.2 and 5.6 m. The fill consists of silty clay with some shale fragments and topsoil. At the borehole locations, it has a stiff to hard consistency based on STP 'N' values ranging between 9 and 36 blows per 0.3 m. The moisture content of the fill was measured to be about 16% in the test samples.

1.5.2 Silty Clay

A thin 1.3 to 2.3 m thick layer of low plasticity silty clay was encountered below the topsoil in Boreholes 33, 34, 35 and 36 and below the fill in Borehole 39. Based on standard penetration resistances of 9 to greater than 100, the consistency of this stratum is inferred to be firm to hard, but generally hard.

1.5.3 Silt

The significant soil deposit encountered north of Borehole 36 and extending below the invert of the watermain is a silt stratum. It was encountered in Boreholes 37, 38 and 39, where its thickness ranges between 6.5 and 10.9 m. Grain size analyses performed on eight (8) samples of the deposit indicate 0 to 3% of fine sand, 71 to 85% of silt, and 13 to 31% of clay size particles. In the selected samples that were tested, the soil fines have a low plasticity as characterized by liquid limits of 20 to 25%, plastic limits of 17 to 21%, and plasticity indices of 1 to 6%. The natural moisture contents of retrieved specimens range between 13 and 20% and are generally below the plastic limit of the material. Standard penetration resistances ranged between 26 and greater than 100 blows per 0.3 m, with an average 'N' value of about 70. The above test results indicate a silt of no or slight plasticity and compact to very dense, but generally very dense state of compactness.

1.5.4 Silty Sand/Sand

In Boreholes 37, 38, 39, 136 and 136A, the silt stratum is underlain by a silty sand to sand deposit. The surface of this deposit at these locations lies between about El. 161

with depth. The hard siltstone and limestone layers are medium strong to strong.

From the cores recovered from Boreholes 33, 34, 35 and 36, the following index properties were established:

Total Core Recovery (TCR)

The TCR is the length of core recovered and is expressed as a percentage of the total length of core, usually a 1.5 m long run. The measured TCR values ranged between 29 and 100, with an average value of 85%.

Solid Core Recovery (SCR)

The SCR is the length of solid (unbroken), full diameter rock pieces expressed as percentage of the total length of the core run. The SCR values in the rock cores ranged between 7 and 93%, with an average value of 59%.

Rock Quality Designation (RQD)

The RQD is the sum of the length of the rock core pieces longer than 100 mm expressed as a percentage of a given total length drilled. Measured values ranged between 0 and 89%, with an average value of 44%. These values indicate a rock of very poor to good quality, but generally very poor to poor quality. Bear in mind, however, that the low RQD values are also likely in part due to drilling-induced disturbance.

Fracture Index (FI)

The FI is the number of discontinuities such as fractures, joints, etc. within a 0.3 m length of core. The higher the FI the lower the mass strength of the rock. The measured FI values ranged between 0 and 7.9 with an average value of 3.6. The FI values shown on the borehole logs are average values for the length of the core run.

Percent of Hard Layers

As mentioned earlier, the shale is interbedded with hard layers of siltstone and limestone. The percent of hard layers ranged from 0 to 87%, and averaged around 24%. Layer thicknesses ranged from 25 to 300 mm. The formation is known to occasionally contain hard layers up to 500 mm thick.

1.6 Groundwater

The groundwater level was monitored in the piezometers installed in each of the boreholes put down in 1995. In the piezometers, the water level was monitored over a sufficiently long period of time to establish the stabilized groundwater levels at the time of the investigation. Water level readings are shown on the individual borehole logs indicating that the stabilized groundwater level in the Spring of 1995 was between El. 162.4 and 158.2 m. Similar readings were obtained in May 1996, when water levels in the piezometers were recorded between El. 162.5 and 159.3 m. Seasonal and temporal fluctuations in groundwater level should be expected.

PART 2 - INTERPRETATION OF THE RESULTS

For the purpose of this discussion, the project and the subsurface conditions can be divided into two distinctly different sections:

1. Tunnelling in the shale bedrock, and
2. Open cut trenching in overburden formations.

2.1 Tunnelling

The main tunnel under Hwy 403 and its associated ramps will be approximately 260 m long. The feedermain pipe will be installed inside an approximately 2,400 mm diameter steel liner. The finished pipe invert level in this section ranges between 153.1 and 153.8 m.

The records of Boreholes 33 to 36 inclusive and of Boreholes 134 and 135 suggest that on the present alignment, the tunnel will likely be entirely within the shale bedrock with a rock cover of about 3.5 to 7 m. This should provide adequate cover for the safe installation of the tunnel without loss of ground or excessive settlement at the ground surface. The rock, however, is of poor quality. It is thinly laminated to very thinly bedded and is also weathered to a variable degree. RQD values in the zone through which the tunnel will be driven range from a high of 67 to a low of 0 (average 38). The percentage of hard layers in the same zone ranges between 9 and 29%. Excavation of the shale in this zone, whether by mechanical excavation techniques or with a TBM machine should be possible, but on account of the hard layers progress could be slow. The shale is slightly fissile and it disintegrates rapidly when exposed to free water and air.

Stand-up time is therefore expected to be short. The roof of the tunnel above the spring line should, therefore, be provided with adequate support immediately or shortly after making the opening. Conventional supports of steel ribs and timber lagging, or steel liner plates, could be considered where the rock is of very poor quality. Where better rock conditions exist, the support system could consist of rock bolts and welded wire mesh, combined where necessary, with steel ribs and shotcrete. Below the travelled lanes of the roadway, the MTO may require that ribs and lagging be used throughout.

As the rock is known to have high horizontal stresses and long term deformation characteristics, it will "squeeze" into the tunnel opening causing the diameter of the tunnel at the spring line to shorten with time. This could exert high stresses and damage a rigid structure that is placed in intimate contact with the rock. For this reason, it is suggested that to protect the pipe from the forces induced by the "rock squeeze" consideration should be given to delay the placing of the steel liner and the pipe, and especially the grouting of the annular space between the steel liner and the rock, and around the pipe for a period of about 90 days after the excavation. As an alternative, the pipe should be surrounded with an appropriate thickness of compressible material that can absorb the deformations without transferring high pressures to the pipe.

Based on empirical and observational data in the same rock formation, the rate of long term, time dependent deformation is estimated to be about 0.15% of the diameter of the tunnel opening per log cycle of time. For the proposed 2400 mm opening, this will be about 3.6 mm per log cycle of time. It is suggested that the rate of deformation be monitored by convergence points installed into the rock inside the tunnel.

2.2 Open Cut Excavation

Based on the available data, with the exception of the most southerly, approximately 20 m length of the open cut section which will extend into the Queenston Shale and the overlying sand, the rest of the open cut trench is expected to be through fill, a thin layer of silty clay and very dense silt. The depth of excavation to the proposed invert levels will range between about 4 and 9 m.

Unsupported excavations in the fine grained clayey silt and silt deposits should be temporarily stable at angles of about 1.5H:1V in the clayey silt and 2H:1V in the silt above the groundwater table. These slope angles would apply below the groundwater table only in the event that the deposits are successfully dewatered (i.e. draw water table down 0.5 m below base of trench). If space limitation prohibits such wide excavations, steeper excavations should be supported by interlocking continuous sheeting. Seepage into the excavation should be at a slow to moderate rate and normal trench sump pumping should be able to cope with the rate of water accumulation. Water seepage from the silt will cause the ravelling of this soil and, therefore, the excavations should not be left open.

The undisturbed silt subgrade should provide adequate support to the pipe and normal granular bedding should be sufficient. It is noted, however, that the silt is slightly dilatant, i.e. it will expand when disturbed by vibration such as those created by construction equipment or excessive foot traffic. In the event that the pipe is placed on the dilated base of the excavation, excessive post-construction settlements could occur when the dilated silt is recompressed under the weight of the pipe and the backfill. It is, therefore, important that the dilation of the silt be prevented. Measures to achieve this could include the keeping of disturbance to a minimum and placing a well graded granular fill or weak concrete working mat shortly after reaching the proposed subgrade level.

The excavation will extend into the silty sand deposit in the southern portion of the excavation (e.g. Boreholes 136 and 136A). The sand is expected to be unstable below the water table and the rate of groundwater flow through this material will likely be high. To provide stable conditions, the sand should be either dewatered (e.g. eductors), or supported by tight interlocking sheeting. Where tight interlocking sheeting is used, the toe of the sheeting should be driven into an impervious stratum to provide a seepage cutoff. This will require toeing the sheeting into the surface of the bedrock, which may be very difficult to achieve. Alternatively, the toe of sheeting must extend below the excavation base to a depth greater than the height of the water table above the base of the trench.

It should be noted that in some areas, trenching will be aligned near the toe of existing slopes and roadway embankments. In such cases, there exists a potential for destabilizing the slope/embankment unless the sewer is trenched and backfilled in short sections at a time (i.e. pipe segment by pipe segment). In severe cases, it may be necessary to pre-install shoring rather than use trench boxes. Refer to Section 3.3 for additional comments in this regard.

With the exception of the sand, the recompaction of the excavated materials to a high degree of compaction may be difficult. The silt in particular will require tight control of its moisture content. At very low moisture contents, the silt will tend to be dusty, while at moisture contents above the Optimum Moisture Content (O.M.C.) the soil will be jelly-like and liverish. For best results, the moisture content should be between 1 and 3% below the O.M.C.

LOG OF BOREHOLE 33

CLIENT: OCWA c/o Marshall Macklin Monaghan
PROJECT: Streetsville Feedermain
LOCATION: Erin Mills Parkway
DATUM ELEVATION: Geodetic

DRILLING DATA
Method: Augering
Diameter: 100 mm (H/S)
Date: 02/01-02/95

REF. NO: G-94.1202
ENCL. NO: 1

(m) ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%)
164.0	Ground Surface						
0.0	FILL silty clay, topsoil red/brown, v. stiff	1	SS	14			
162.8		2	SS	28			
1.2	SILTY CLAY with shale fragments, (possibly completely weathered shale) red, hard	3	SS	48		162	
		4	SS	54/15 cm			
160.5		5	SS	60/15 cm			
3.5	SHALE thinly laminated, interbedded with hard layers of siltstone (8-22%) highly to moderately weathered to fresh red very week to medium strong with medium strong to strong hard layers	6	SS	75/15 cm		160	
		7	SS	100/10 cm			
		8	SS	100		158	
		9	RC	TCR 89%	Bentonite Seal		RC 9 SCR 10% RQD 8% FI 5
		10	RC	TCR 100%		156	RC 10 SCR 48% RQD 48% FI 3
		11	RC	TCR 97%		154	RC 11 SCR 55% RQD 55% FI 4
		12	RC	TCR 100%		152	RC 12 SCR 56% RQD 53% FI 3
		13	RC	TCR 98%		150	RC 13 SCR 81% RQD 78% FI 2
		14	RC	TCR 96%			RC 14 SCR 80% RQD 79% FI 2
15.0	END OF BOREHOLE						

Column headings also printed: STRAT PLOT; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, x LAB VANE); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ; GR SA SI CL

Date	W.L.(m)
02/02	158.2

LOG OF BOREHOLE 34

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : March 3 & 6, 1995

REF. NO. : G-94.1202
ENCL. NO. : 2

(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	'N' BLOWS/0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L / WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
163.9	Ground Surface										
0.0	100mm Topsoil		1	SS	12	Seal					
	SILTY CLAY red, hard		2	SS	36						
			3	SS	54		162				
161.6 / 2.3	SHALE completely weathered		4	SS	60/15cm						
			5	SS	75/15cm						
			6	SS	84/15cm		160				
159.3 / 4.6	SHALE Bedrock horizontally bedded red (see Encl. 2B)		7	SS	100/8cm	Seal; W.L. 159.3 m 03/20/95					
			8	RC	TCR=86% RQD=22%		158				
			9	RC	TCR=97% RQD=40%						
			10	RC	TCR=72% RQD=23%		156				
			11	RC	TCR=95% RQD=43%		154				
153.0 / 10.9	Continued										

LOG OF BOREHOLE 34

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : March 3 & 6, 1995

REF. NO. : G–94.1202
ENCL. NO. : 2 A

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L / WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
153.0	Continuation										
10.9	SHALE Bedrock horizontally bedded red (see Encl. 2B)		12	RC	TCR= 89% RQD= 76%		152				
			13	RC	TCR= 95% RQD= 39%		150				
			14	RC	TCR= 93% RQD= 66%						
148.6			15	RC	TCR= 98% RQD= 89%	Piezometer					
15.3	END OF BOREHOLE										Date W.L.(m) 03/06 163.9 03/20 159.3 May/96 159.3

ROCK CORE DRILLING RECORDS
BORE HOLE .34

PROJECT: Streetsville Feedermain
LOCATION: Erin Mills Parkway
ROCK SURFACE ELEV. 159.3 m

REF. Nº G-94.1202
ENCL. Nº 2B

ELEV. DEPTH (m)	ROCK DESCRIPTION	ELEVATION SCALE	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY %	SOLID CORE RECOVERY %	HARD LAYER %	RQD %	FRACTURE INDEX /0·3m	DISCONTINUITIES / WEATHERING	HYDRAULIC CONDUCTIVITY cm/sec	STRENGTH: POINT LOAD INDEX, MPa	STRENGTH: UNIAXIAL COMPRESSIVE MPa	SLAKE DURABILITY %
159.3	Rock Surface													
4.6														
4.7	SHALE interbedded with siltstone and mudstone horizontally bedded red. Very weak to medium strong (Queenston Formation)	158	8	NQ	86	30	0	22	7.4	Thinly laminated to thinly bedded. Moderately weathered.				
157.7 / 6.2			9	NQ	97	77	4	40	4.8	Very thinly to thinly bedded, moderately weathered.				
156.1 / 7.8		156	10	NQ	72	33	28	23	4.1	Very thinly bedded, fractured, moderately weathered.				
154.6 / 9.3		154	11	NQ	95	58	15	43	7.4	Very thinly bedded, fractured, moderately weathered.				
153.0 / 10.9		152	12	NQ	89	82	18	76	1.9	Thinly bedded occasional vertical fractures, fresh.				
151.6 / 12.3			13	NQ	95	63	25	39	4.4	Very thinly bedded, some vertical fractures, fresh.				
150.0 / 13.9		150	14	NQ	93	79	38	66	3.4	Very thinly to thinly bedded, fresh.				
149.2 / 14.7			15	NQ	98	93	80	89	1.8	Thinly bedded, fresh.				
148.6 / 15.3	END OF BOREHOLE													

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LOG OF BOREHOLE 35

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : March 2 & 3, 1995

REF. NO. : G-94.1202
ENCL. NO. : 3

(m) ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	'N' BLOWS/0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS
164.4	Ground Surface						
0.0	75mm Topsoil	1	SS	23		164	
	SILTY CLAY red v. stiff	2	SS	18			
		3	SS	28			
162.1 / 2.3	SHALE red completely weathered	4	SS	90/ 23cm		162	
		5	SS	65/ 15cm			
160.6 / 3.8	SHALE Bedrock interbedded with siltstone and mudstone horizontally bedded, red (see Encl. 3B)	6	SS	100/ 8cm		160	
					W.L. 159.8 m 03/20/95 Seal		
		7	RC	TCR= 73% RQD= 0%			
		8	RC	TCR= 93% RQD= 8%		158	
		9	RC	TCR= 94% RQD= 18%		156	
		10	RC	TCR= 97% RQD= 30%		154	
153.5 / 10.9	Continued						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%)
UNIT WEIGHT
REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

LOG OF BOREHOLE 35

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : March 2 & 3, 1995

REF. NO. : G-94.1202
ENCL. NO. : 3 A

(m) ELEV / DEPTH	DESCRIPTION (SOIL PROFILE)	STRATA PLOT	NUMBER (SAMPLES)	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
153.5	Continuation										
10.9	SHALE Bedrock red (see Encl. 3B and 3C)		11	RC	TCR= 93% RQD= 57%						
			12	RC	TCR= 98% RQD= 81%		152				
			13	RC	TCR= 94% RQD= 81%						
			14	RC	TCR= 94% RQD= 85%		150				
149.0 / 15.4	END OF BOREHOLE					Piezometer					

Date	W.L.(m)
03/03	161.8
03/03	159.7
03/06	159.6
03/07	159.7
03/20	159.8
May/96	160.2

ROCK CORE DRILLING RECORDS
BORE HOLE .35

PROJECT: Streetsville Feedermain
LOCATION: Erin Mills Parkway
ROCK SURFACE ELEV. 160.6 m.

REF. N° G-94.1202
ENCL. N° 3B

ELEV. / DEPTH (m)	ROCK DESCRIPTION	ELEVATION SCALE	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY %	SOLID CORE RECOVERY %	HARD LAYER %	RQD %	FRACTURE INDEX /0.3m	DISCONTINUITIES / WEATHERING	HYDRAULIC CONDUCTIVITY cm/sec	STRENGTH: POINT LOAD INDEX, MPa	STRENGTH: UNIAXIAL COMPRESSIVE MPa	SLAKE DURABILITY %
160.6	Rock Surface													
3.8		160								Completely weathered.				
159.7 / 4.7	SHALE interbedded with siltstone and mudstone horizontally bedded red very weak to moderately strong		7	NQ	73	17	0	0	∞	Thinly laminated, fractured, highly weathered.				
158.2 / 6.2	(Queenston Formation) Siltstone and limestone layers moderately strong to strong	158	8	NQ	93	53	8	8	6.3	Very thinly bedded, weathered.				
156.6 / 7.8		156	9	NQ	94	41	27	18	6.2	Very thinly bedded, some fractures, moderately weathered.				
155.1 / 9.3		154	10	NQ	97	48	13	30	7.9	Thinly bedded, numerous fractures, slightly weathered.				
153.5 / 10.9			11	NQ	93	76	14	57	2.4	Thinly bedded, some vertical fractures, fresh.				
152.0 / 12.4		152	12	NQ	98	83	29	81	1.5	Thinly bedded, some vertical fractures, fresh.				
151.4 / 13.0			13	NQ	94	93	25	81	2.1	Thinly bedded, fresh.				
150.4 / 14.0	CONTINUED													

GEO-CANADA LTD.

ROCK CORE DRILLING RECORDS
BORE HOLE .. 35

PROJECT: Streetsville Feedermain
LOCATION: Erin Mills Parkway
ROCK SURFACE ELEV. 160.6 m

REF. N° G-94.1202
ENCL. N° 3C

ELEV. / DEPTH (m)	ROCK DESCRIPTION	ELEVATION SCALE	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY %	SOLID CORE RECOVERY %	HARD LAYER %	RQD %	FRACTURE INDEX / 0·3m	DISCONTINUTIES / WEATHERING	HYDRAULIC CONDUCTIVITY cm/sec	STRENGTH: POINT LOAD INDEX, MPa	STRENGTH: UNIAXIAL COMPRESSIVE MPa	SLAKE DURABILITY %
150.4	Continued													
14.0	SHALE with siltstone interbeds horizontally bedded.	150	14	NQ	94	81	42	85	2.2	Very thinly to thinly bedded, few vertical fractures, fresh.				
149.0														
15.4	END OF BOREHOLE													

LOG OF BOREHOLE 36

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : February 23, 24, & 27, 1995

REF. NO. : G-94.1202
ENCL. NO. : 4

(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	'N' BLOWS 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
162.2	Ground Surface										
0.0	150mm Topsoil		1 A B	SS	59		162				
	SILTY CLAY some shale fragments (Possibly completely weathered shale)		2	SS	74	W.L. 160.8 m 03/07/95					
			3	SS	100/ 15cm						
159.9							160				
2.3	SHALE Bedrock horizontally bedded red (see Encl. 4B)		4	SS	100/ 10cm	Seal					
			5	RC	TCR= 75% RQD= 33%		158				
			6	RC	TCR= 38%						RC6 : RQD=0%
			7	RC	TCR= 70% RQD= 35%						
			8	RC	TCR= 45% RQD= 22%		156				
			9	RC	TCR= 29% RQD= 0%						
			10	RC	TCR= 100% RQD= 67%		154				
			11	RC	TCR= 93% RQD= 28%						
			12	RC	TCR= 100% RQD= 50%		152				
151.8											
10.4	Continued										

LOG OF BOREHOLE 36

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : February 23, 24, & 27, 1995

REF. NO. : G-94.1202
ENCL. NO. : 4 A

(m) ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	STRATA PLOT	SAMPLES – NUMBER	SAMPLES – TYPE	SAMPLES – "N" BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L – WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
151.8	Continuation										
10.4	SHALE Bedrock horizontally bedded red (see Encl. 4B and 4C)		13	RC	TCR= 100% RQD= 69%						
			14	RC	TCR= 91% RQD= 50%		150				
			15	RC	TCR= 100% RQD= 76%		148				
147.2						Piezometer					
15.0	END OF BOREHOLE										

Date	W.L.(m)
02/27	160.6
02/28	160.0
03/01	160.7
03/02	160.7
03/03	160.8
03/06	160.8
03/07	160.8
May/96	161.0

ROCK CORE DRILLING RECORDS
BORE HOLE ..36

PROJECT: ...Streetsville Feedermain
LOCATION: Erin Mills Parkway
ROCK SURFACE ELEV....159.9 m

REF. N° G-94.1202
ENCL. N° 4B

ELEV. / DEPTH (m)	ROCK DESCRIPTION	ELEVATION SCALE	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY %	SOLID CORE RECOVERY %	HARD LAYER %	RQD %	FRACTURE INDEX /0·3m	DISCONTINUTIES / WEATHERING	HYDRAULIC CONDUCTIVITY cm/sec	STRENGTH: POINT LOAD INDEX, MPa	STRENGTH: UNIAXIAL COMPRESSIVE MPa	SLAKE DURABILITY %
159.9	Rock Surface													
2.3										Completely weathered.				
159.2 / 3.0	SHALE interbedded with siltstone and mudstone horizontally bedded red	158	5	NQ	75	50	10	33	3.1	Laminated, some fractures, highly weathered.				
157.6 / 4.6			6	NQ	38	35	12	0	2.8	(as above)				
157.4 / 4.8			7	NQ	70	48	25	35	3.6	(as above)				
156.9 / 5.3	very weak to medium strong (Queenston Formation)		8	NQ	45	26	10	22	2.9	(as above)				
156.1 / 6.1	Silstone and limestone layers medium strong to strong	156	9	NQ	29	7	9	0	2.7	(as above)				
155.0 / 7.2			10	NQ	100	67	29	67	4.0	Thinly bedded, some fractures, weathered.				
154.4 / 7.8		154	11	NQ	93	41	12	28	4.6	Thinly bedded, some fractures, moderately weathered.				
152.9 / 9.3		152	12	NQ	100	73	11	50	3.1	Thinly bedded, slightly weathered.				
151.8 / 10.4			13	NQ	100	83	17	69	2.1	Thinly bedded, fresh.				
150.3 / 11.9	CONTINUED													

GEO-CANADA LTD.

ROCK CORE DRILLING RECORDS
BORE HOLE 36

PROJECT: Streetsville Feedermain
LOCATION: Erin Mills Parkway
ROCK SURFACE ELEV. 159.9 m

REF. No G-94.1202
ENCL. No 4C

ELEV. / DEPTH (m)	ROCK DESCRIPTION	ELEVATION SCALE	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY %	SOLID CORE RECOVERY %	HARD LAYER %	RQD %	FRACTURE INDEX /0.3m	DISCONTINUTIES / WEATHERING	HYDRAULIC CONDUCTIVITY cm/sec	STRENGTH: POINT LOAD INDEX, MPa	STRENGTH: UNIAXIAL COMPRESSIVE MPa	SLAKE DURABILITY %
150.3	Continued													
11.9	SHALE interbedded with siltstone and mudstone horizontally bedded red	150	14	NQ	91	79	52	50	2.5	Thinly to medium bedded, fresh.				
148.7 / 13.5	(Queenston Formation)	148	15	NQ	100	85	87	76	1.4	Thinly bedded, fresh.				
147.2														
15.0														

LOG OF BOREHOLE 37

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : February 28, 1995

REF. NO. : G-94.1202
ENCL. NO. : 5

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	GR	SA	SI	CL
161.7	Ground Surface										
0.0	FILL silty clay topsoil	1	SS	1	Seal						
		2	SS	35							
160.0 / 1.7	SILT some clay	3 A/B	SS	53/15cm	W.L. 159.8 m 03/20/95	160					
		4	SS	105	Seal			–	3	83	14
	brown / grey	5	SS	77							
	clayey slightly plastic / non plastic	6	SS	53		158		–	–	71	29
		7	SS	72							
	very dense	8	SS	50/ 13cm		156					
		9	SS	86/ 27cm		154		–	3	83	14
		10	SS	48		152					
		11	SS	39				–	1	82	17
150.7 / 11.0	Continued										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED; + FIELD VANE; ● QUICK TRIAXIAL; × LAB VANE
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30
UNIT WEIGHT
REMARKS AND GRAIN SIZE DISTRIBUTION (%)

Geo-Canada Ltd.

LOG OF BOREHOLE 37

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : February 28, 1995

REF. NO. : G-94.1202
ENCL. NO. : 5 A

(m) ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' BLOWS/0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT	GR	SA	SI	CL
150.7	Continuation										
11.0	SILT, grey v. dense										
150.0 / 11.7	cobbles SILTY SAND trace to some gravel, silt redish grey very dense					150					
		12	SS	45			o	16	64	16	4
	silty	13 A/B	SS	84		148	o	8	52	35	5
					Piezometer						
146.0		14	SS	100			o				
15.7	END OF BOREHOLE										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30
UNIT WEIGHT
REMARKS AND GRAIN SIZE DISTRIBUTION (%)

Date	W.L.(m)
02/28	161.7
03/01	159.3
03/02	159.4
03/03	159.4
03/06	159.5
03/07	159.5
03/20	159.8
May/96	160.5

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : February 27 & 28, 1995

REF. NO. : G-94.1202
ENCL. NO. : 6

(m) ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRATA PLOT	SAMPLE NUMBER	TYPE	"N" BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
162.1	Ground Surface							
0.0	FILL silty clay some topsoil multicoloured stiff		1	SS	14	Seal	162	
			2	SS	9			
			3	SS	10	Seal		
160.0 / 2.1	SILT some clay slightly plastic grey very dense					W.L. 159.8 m 03/20/95	160	
			4	SS	51			
			5	SS	88			- 3 78 19
			6	SS	84		158	
			7	SS	52/ 15cm			- 2 85 13
			8	SS	47		156	
			9	SS	45		154	- 1 82 17
			10	SS	54		152	
151.1			11 A B	SS	90/ 13cm			- 3 78 19
11.0	Continued							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%): 10 20 30
UNIT WEIGHT

LOG OF BOREHOLE 38

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : February 27 & 28, 1995

REF. NO. : G-94.1202
ENCL. NO. : 6 A

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLE NUMBER	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
151.1	Continuation										
11.0	SILT clayey, grey very dense					Piezometer	150				
			12	SS	62						
149.1 / 13.0	SILTY SAND trace of gravel grey very dense to compact										
			13	SS	80		148		○		6 74 20 –
146.4			14	SS	17				○		1 68 31 –
15.7	END OF BOREHOLE										

Date	W.L.(m)
02/28	162.1
03/01	159.3
03/02	159.4
03/03	159.5
03/06	159.5
03/07	159.5
03/20	159.8
May/96	160.3

LOG OF BOREHOLE 39

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : March 1, 1995

REF. NO. : G-94.1202
ENCL. NO. : 7

(m) ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRATA PLOT	SAMPLE NUMBER	TYPE	'N' BLOWS/0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.4	Ground Surface										
0.0	50mm Topsoil		1	SS	82/15cm	(frozen)					
	FILL silty clay shale fragments organic matter multicoloured very stiff to stiff		2	SS	18						
			3	SS	36		164				
			4	SS	23	W.L. 162.4 m 03/20/95					
			5	SS	19		162				
			6	SS	12						
			7	SS	11	Piezometer Seal					
159.8 / 5.6	SILTY CLAY with silt layers reddish grey stiff						160				
			8	SS	9	W.L. 159.1 m 03/20/95		S=4.6			
158.5 / 6.9	SILT some clay slightly plastic grey very dense to dense						158				
			9	SS	73						
			10	SS	54		156				
			11	SS	33						
154.4 / 11.0	Continued										

LOG OF BOREHOLE 39

CLIENT : OCWA c/o Marshall Macklin Monaghan
PROJECT : Streetsville Feedermain
LOCATION : Erin Mills Parkway
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm (H/S)
Date : March 1, 1995

REF. NO. : G-94.1202
ENCL. NO. : 7 A

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L – WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
154.4	Continuation										
11.0	SILT sandy, grey, wet compact						154				
			12	SS	26						
152.0 13.4	SILTY SAND some gravel grey/red wet very dense						152				
			13	SS	110/	23cm					
						Piezometer					
			14 A/B	SS	95/	25cm	150				
149.8 15.6	END OF BOREHOLE										

Date	W.L.(m) shallow	W.L.(m) deep
03/01	162.4	154.9
03/01	162.4	155.3
03/02	162.6	157.6
03/03	162.7	158.6
03/06	162.7	159.0
03/07	162.3	159.0
03/20	162.4	159.1
May96	162.5	159.6

LOG OF BOREHOLE 134

CLIENT : Marshall Macklin Monaghan
PROJECT : OWCA Streetsville Feedermain
LOCATION : Mississauga Ontario
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : May 17, 1996

REF. NO. : G-94.1202A
ENCL. NO. : 8

SOIL PROFILE			SAMPLES						DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	'N' BLOWS 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE					
164.0	Ground Surface											
0.0 / 163.0	SILTY CLAY some organic matter, red, firm		1 A B	SS	6	W.L. 0.7 m 21/05/96						
1.0	SHALE BEDROCK red — completely weathered		2	SS	81/ 23cm		162					
			3	RC	TCR= 45% RQD= 0%							RC4: SCR=0
160.0			4	RC	TCR= 75% RQD= 0%							RC5: SCR=44%
4.0	END OF BOREHOLE Note: Water Level probably effected by water used for coring.						160					

LOG OF BOREHOLE 135

CLIENT : Marshall Macklin Monaghan
PROJECT : OWCA Streetsville Feedermain
LOCATION : Mississauga Ontario
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : May 21, 1996

REF. NO. : G-94.1202A
ENCL. NO. : 9

(m) ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%)	UNIT WEIGHT	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
161.4	Ground Surface										
0.0	SHALE Bedrock interbedded with hard siltstone bands horizontally bedded, red weathered		1	SS	50						
			2	RC	TCR=75% RQD=0%						RC2: SCR=12%
							160				
			3	RC	TCR=58% RQD=0%						RC3: SCR=7%
			4	RC	TCR=55% RQD=7%		158				RC4: SCR=33% FI=7
			5	RC	TCR=95% RQD=0%		156				RC5: SCR=58% FI=10
155.1			6	RC	TCR=100% RQD=0%						RC6: SCR=25% FI=14
6.3	END OF BOREHOLE Note: Water Level not observed because of interference of water used for coring										

LOG OF BOREHOLE 136

CLIENT : Marshall Macklin Monaghan
PROJECT : OWCA Streetsville Feedermain
LOCATION : Mississauga Ontario
DATUM ELEVATION : Geodetic

DRILLING DATA
Method : Augering
Diameter : 100mm
Date : May 16, 1996

REF. NO. : G-94.1202A
ENCL. NO. : 10

(m) ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
162.0	Ground Surface							
0.0	SILTY CLAY red soft	1	SS	2	W.L. 0.3 m 21/05/96			
161.1 / 0.9	SILT some fine sand, brown, moist dense	2	SS	41		160		
159.6 / 2.4	SILTY SAND some gravel occasional shale fragments brown, wet very dense to compact	3	SS	63			o	
						158		boulder/ cobble
		4 A/B	SS	100/ 23cm			o	
	0.6m limestone boulder	5	SS	R				
		6	RC			156		boulder
		7	SS	41			o	12 66 22 -
	boulders, cobbles							
		8	SS	23		154	o	9 74 17 -
152.9 / 9.1	END OF BOREHOLE Borehole terminated due to cave-in							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED; + FIELD VANE; ● QUICK TRIAXIAL; × LAB VANE
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30
UNIT WEIGHT

Geo-Canada Ltd.

LOG OF BOREHOLE 13CA

CLIENT : Marshall Macklin Monaghan
PROJECT : OWCA Streetsville Feedermain
LOCATION : Mississauga Ontario
DATUM ELEVATION : Geodetic

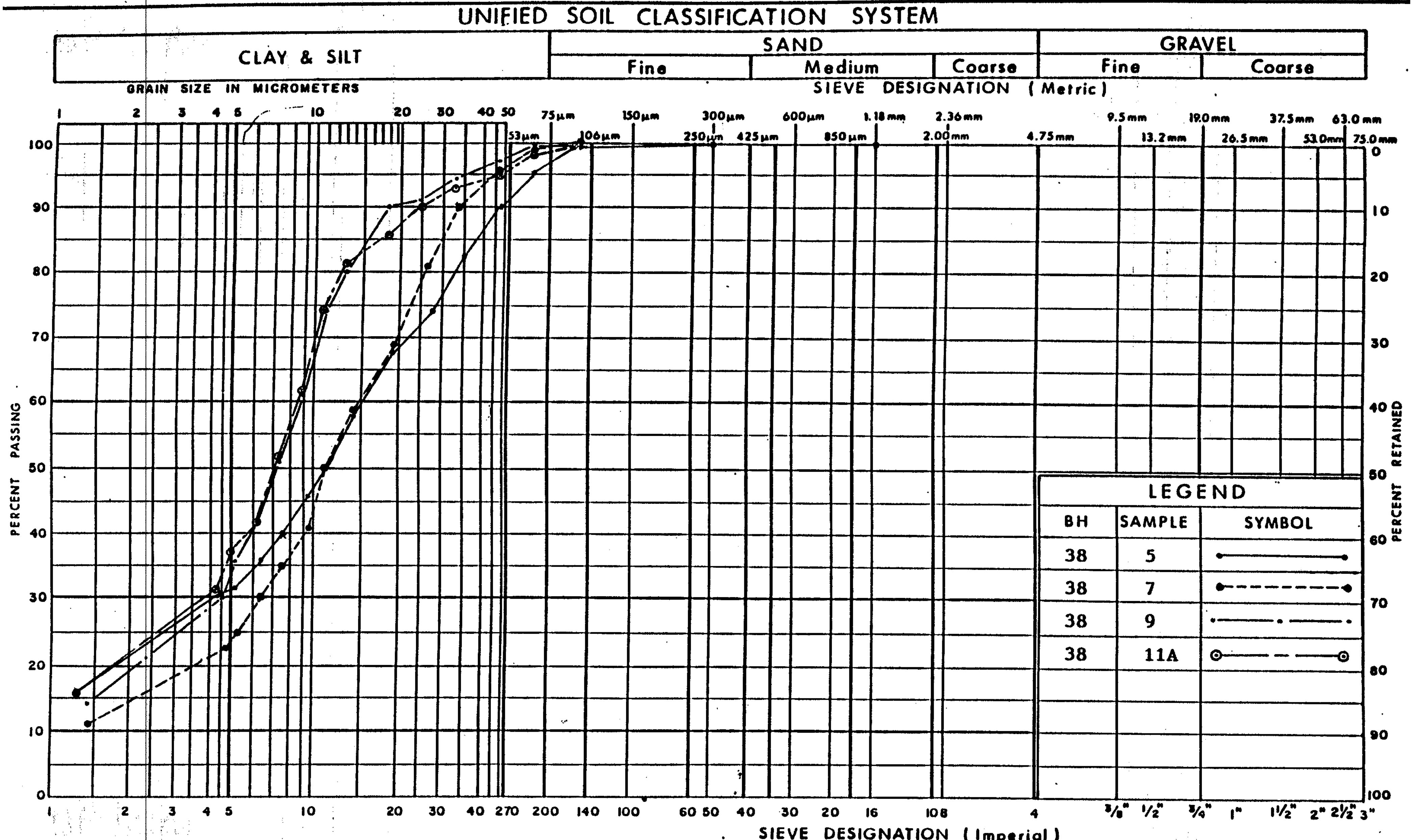
DRILLING DATA
Method : Augering
Diameter : 100mm
Date : May 17,1996

REF. NO. : G-94.1202A
ENCL. NO. : 11

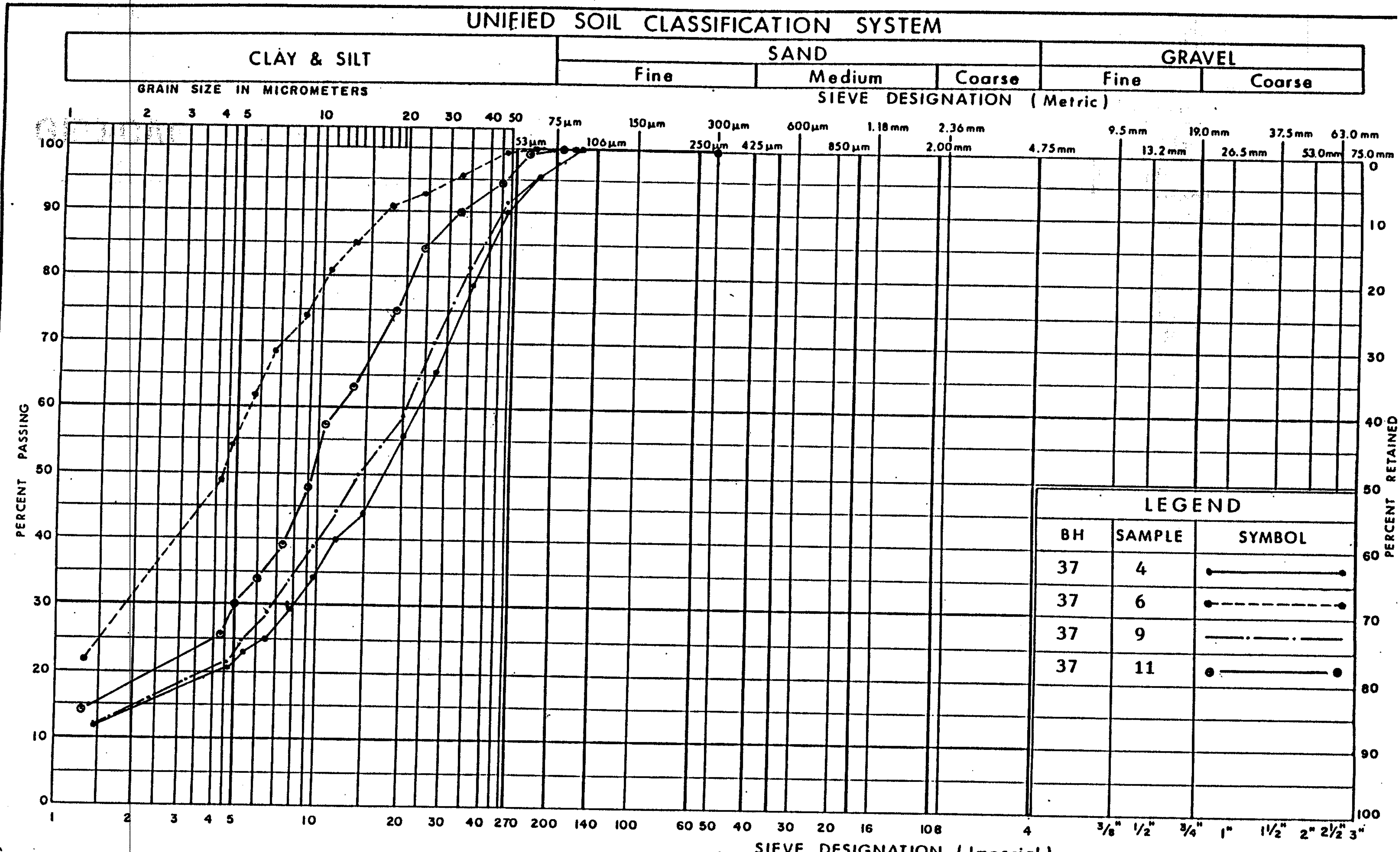
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' BLOWS / 0.3 M	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
163.4	Ground Surface							
0.0	CLAYEY SILT red, green mottled	1	SS	5				
	boulder					162		Boulder at 1.2m depth; moved hole 0.9m South
	firm to stiff	2	SS	9	W.L. 2.1 m 21/05/96			
160.8 / 2.6	SILTY SAND to SANDY SILT brown, wet	3	SS	61		160	o	
	cobbles, boulders	4 A/B	SS	60/ 8cm			o	1 90 9 –
	very dense					158		
		5	SS	60/ 10cm			o	26 41 33 –
156.1 / 7.3	SHALE Bedrock interbedded with hard siltstone bands red	6	SS	70/ 10cm		156		
		7	RC	TCR= 83% RQD= 9%				RC7: SCR=48% FI=8
154.3 / 9.1	END OF BOREHOLE							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30
UNIT WEIGHT

Geo–Canada Ltd.

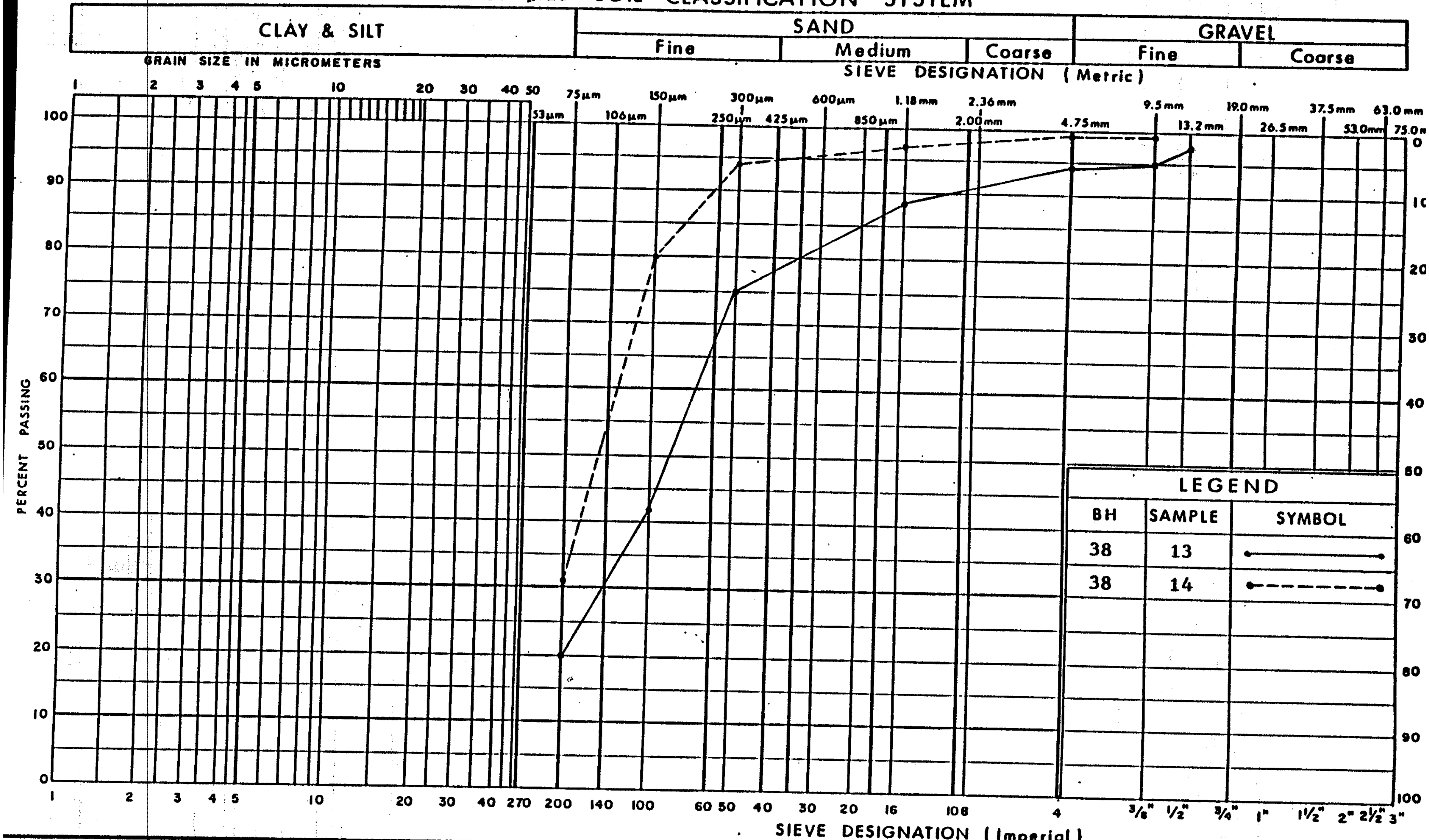


GEO-CANADA	GRAIN SIZE DISTRIBUTION SILT, SOME CLAY	FIG No 2 REF. No G-94.1202A DATE May 1996



GEO-CANADA	GRAIN SIZE DISTRIBUTION SILT, SOME CLAY	FIG No 1 REF. No G-94.1202A DATE May 1996

UNIFIED SOIL CLASSIFICATION SYSTEM



GEO-CANADA

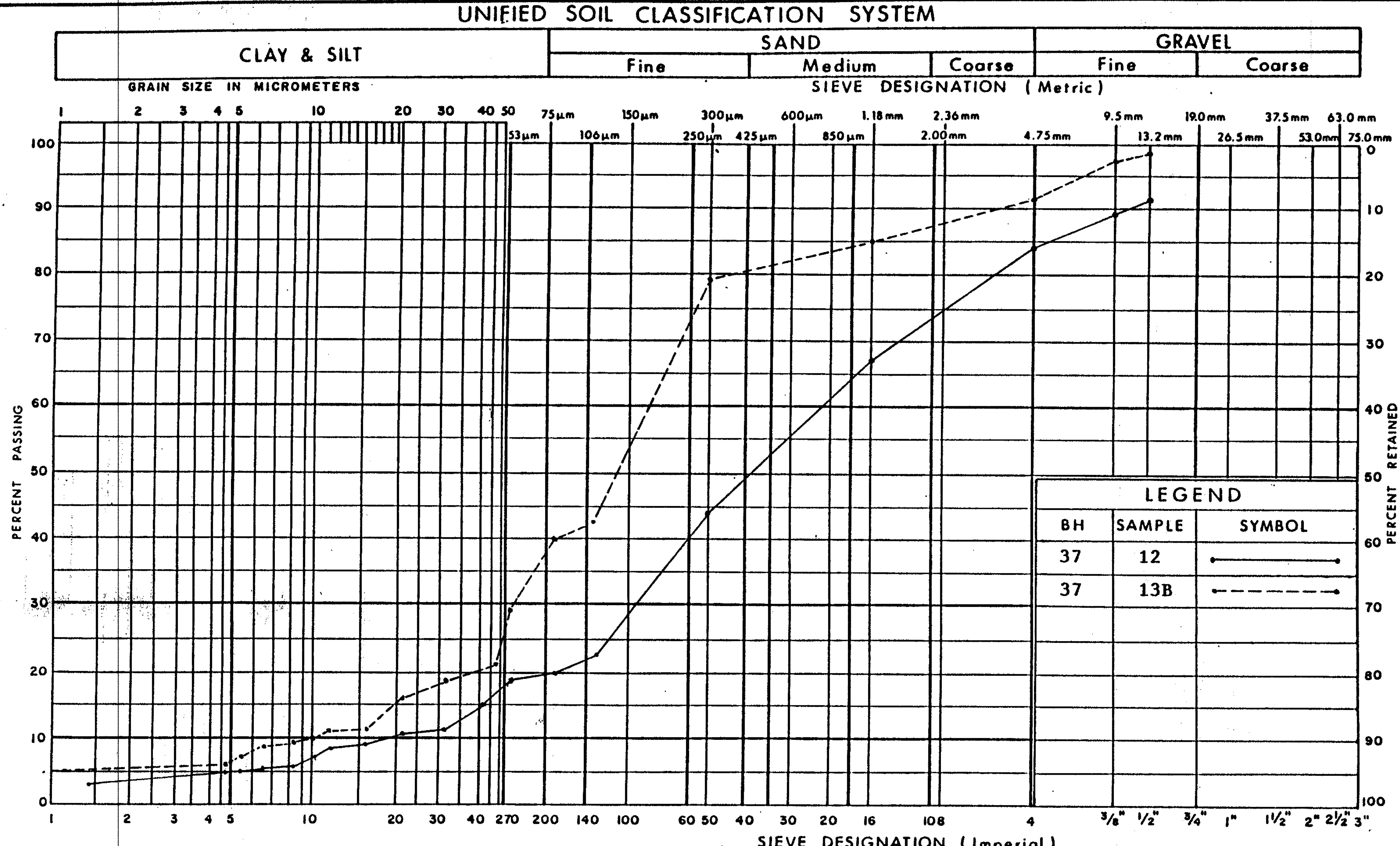
GRAIN SIZE DISTRIBUTION

SILTY SAND

FIG No 3

REF. No G-94.1202A

DATE May 1996



LEGEND

BH	SAMPLE	SYMBOL
37	12	solid line
37	13B	dashed line

GEO-CANADA

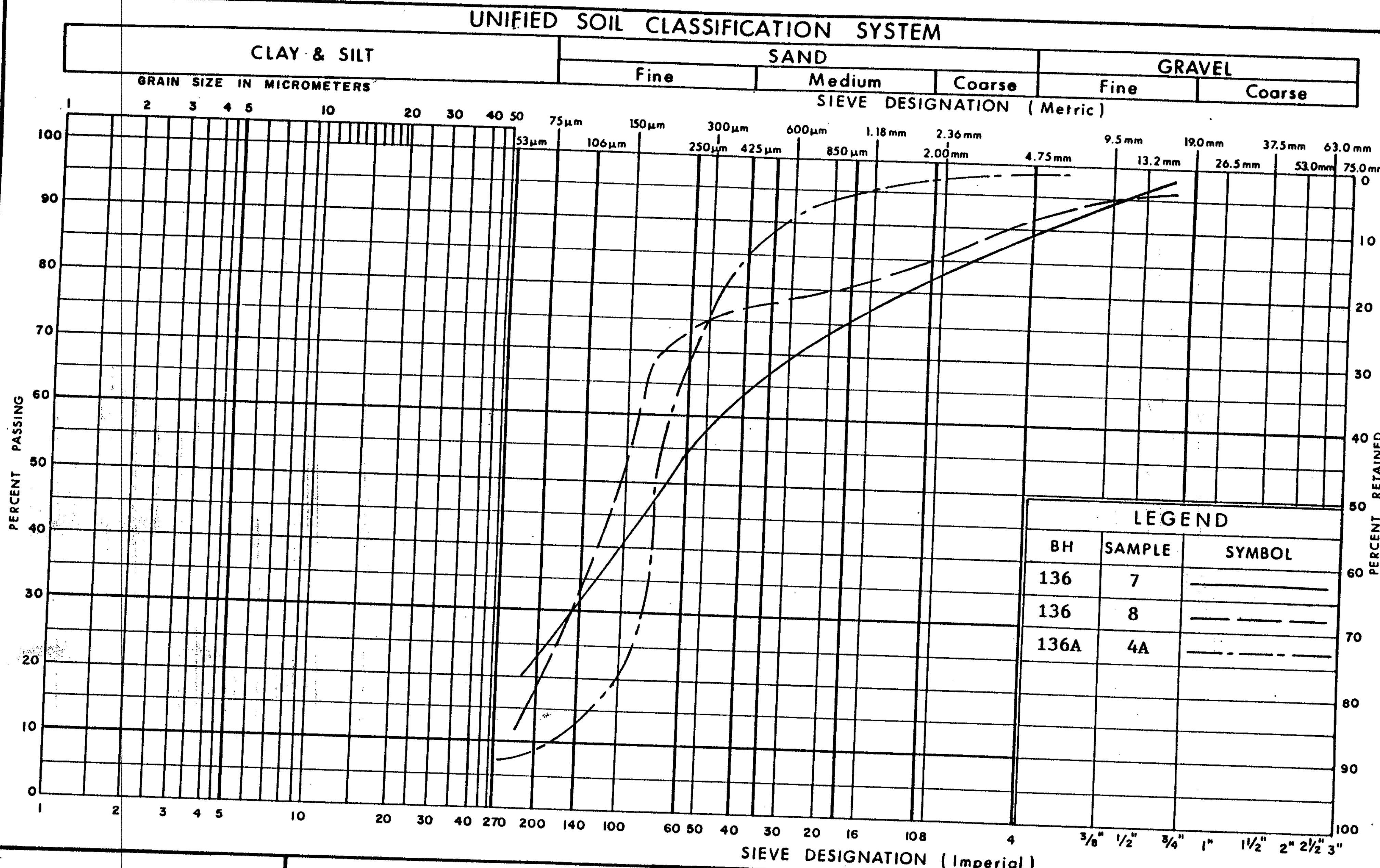
GRAIN SIZE DISTRIBUTION

SILTY SAND, TRACE TO SOME GRAVEL

FIG No 4

REF. No G-94.1202A

DATE May 1996

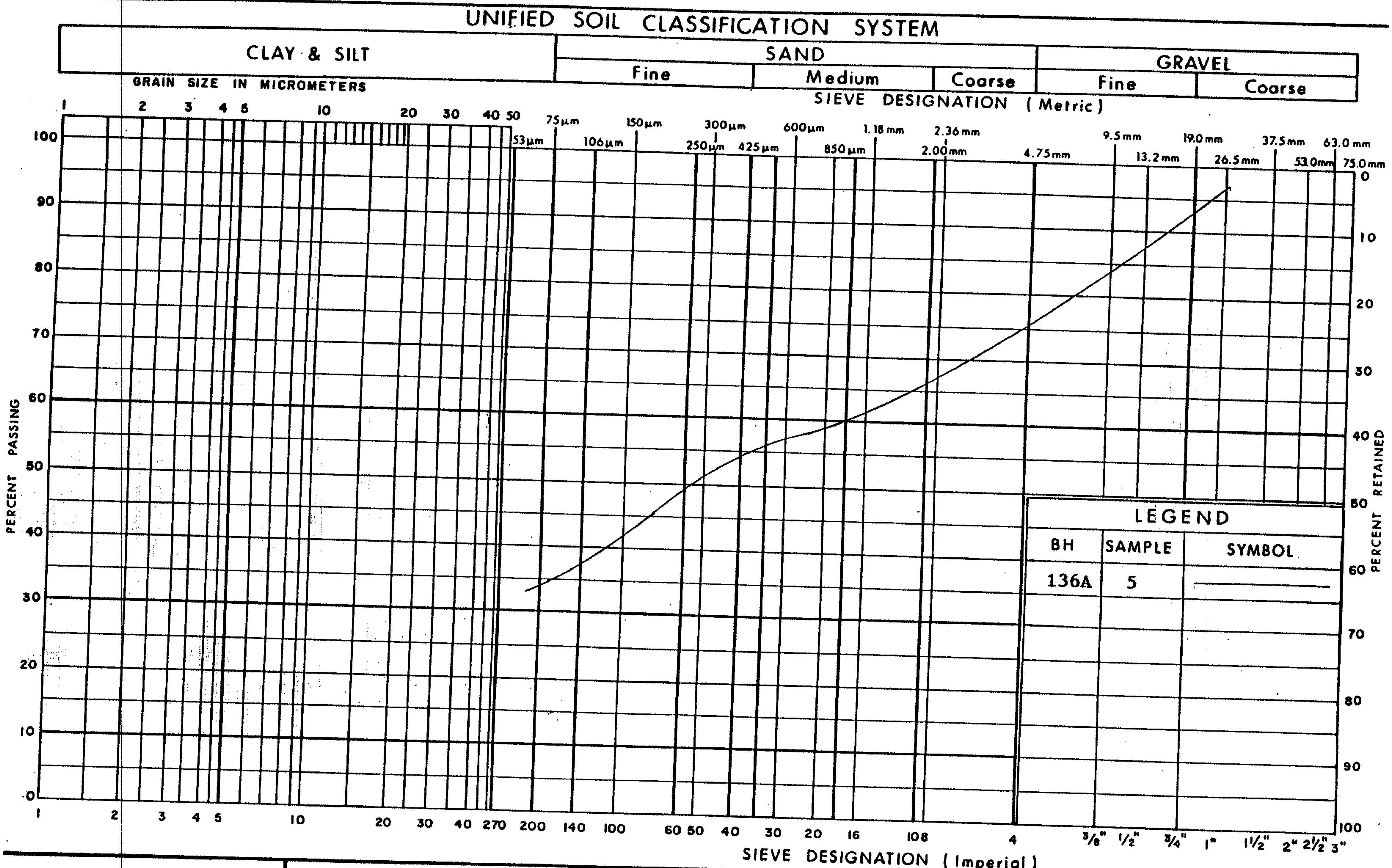


GEO - CANADA LTD.

GRAIN SIZE DISTRIBUTION

SAND, TRACE TO SOME SILT, GRAVEL

FIG No:	5
REF. No:	G-94.1202A
DATE :	May 27, 1996



GRAIN SIZE DISTRIBUTION

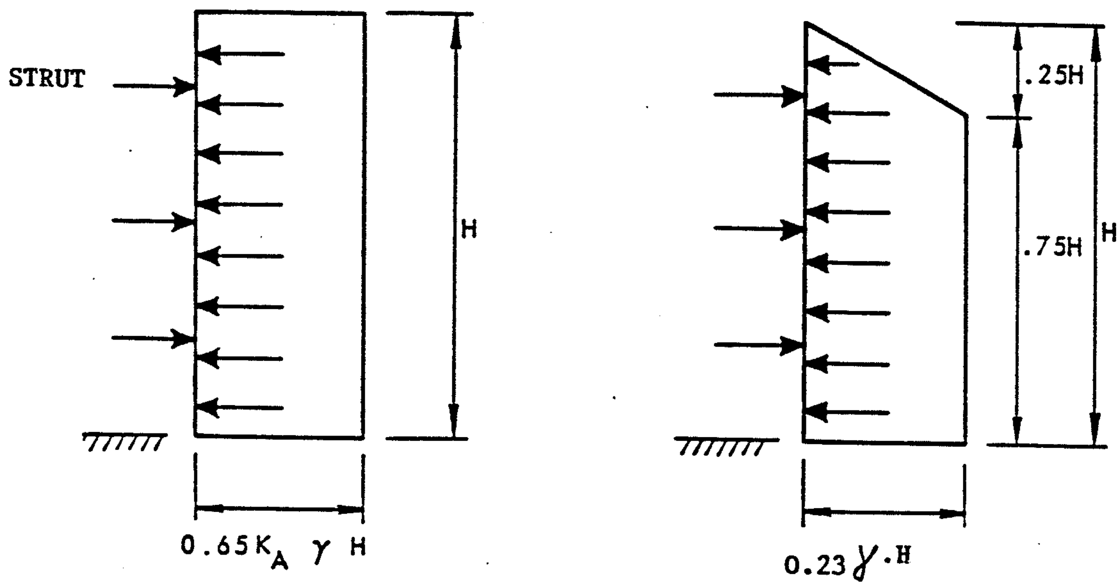
SILTY SAND AND GRAVEL

GEO - CANADA LTD.

FIG No: 6

REF. No: G-94.1202A

DATE : May 27, 1996



$K_A = 0.3$
$\gamma = 22.0$ kN/m^3

$\gamma = 20.0$ kN/m^3

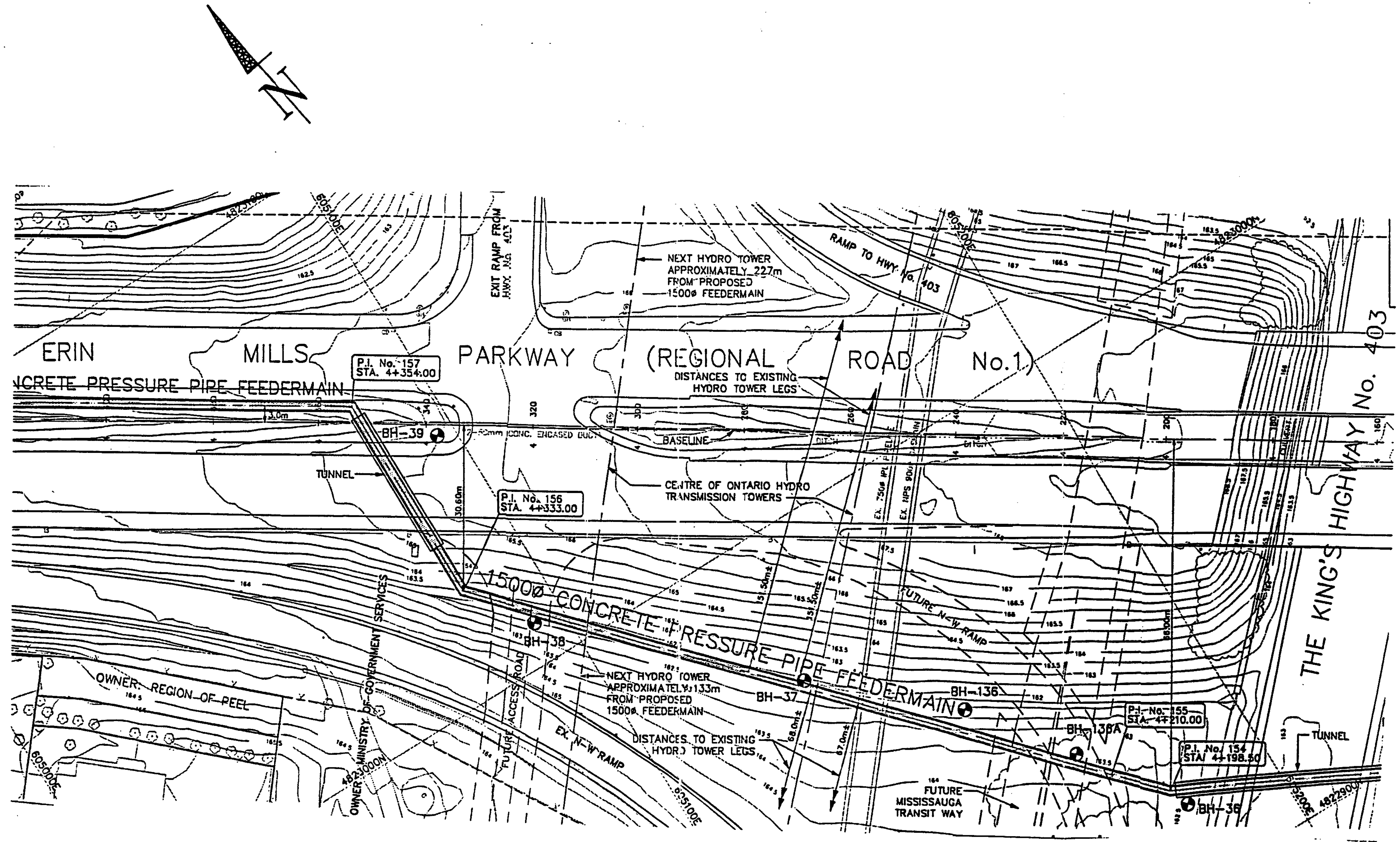
SAND, SILT

CLAYEY SILT
SILTY CLAY

NOTES:

1. CHECK SYSTEM FOR PARTIAL EXCAVATION CONDITION
2. IF THE FREE WATER LEVEL IS ABOVE THE BASE OF THE EXCAVATION THE HYDROSTATIC PRESSURE MUST BE ADDED TO THE ABOVE PRESSURE DISTRIBUTION IN SANDS
3. IF SURCHARGE LOADINGS ARE PRESENT AT OR NEAR THE GROUND SURFACE THESE MUST BE INCLUDED IN THE LATERAL PRESSURE CALCULATION.

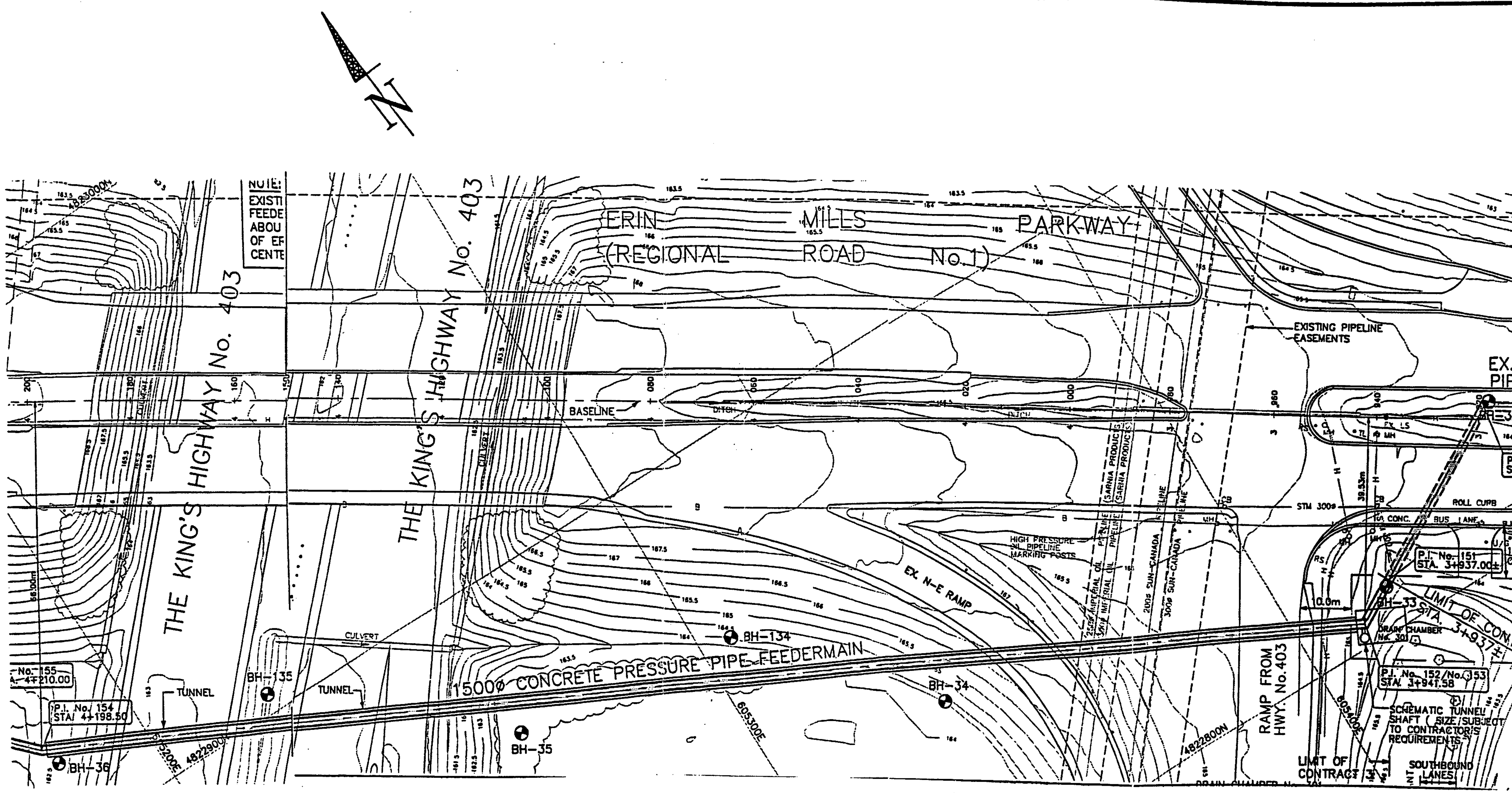
EARTH PRESSURE DISTRIBUTION ON BRACED SHEETING	G-94.1202A FIGURE 7



OWCA STREETSVILLE FEEDERMAIN

STATION 4+150 to 4+360

G-94.1202A
DWG 2



OWCA STREETSVILLE FEEDERMAIN

STATION 3+936 to 4+200

G-94.1202A
DWG 1