FOUNDATION INVESTIGATION AND DESIGN REPORTS
PROPOSED OVERHEAD SIGN SUPPORT STRUCTURE
AVENUE ROAD/HIGHWAY 401 INTERCHANGE RECONFIGURATION
TORONTO, ONTARIO
W. O. 04-20008

Prepared For:

DELCAN CORPORATION LIMITED

Prepared by:

SHAHEEN & PEAKER LIMITED

Project: SPT1134
September 8, 2005

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1. INTRODUCTION

Shaheen & Peaker Limited (S&P) was retained by Delcan Corporation Limited to conduct a foundation investigation for a proposed overhead sign support structure at Avenue Road south of Highway 401. The purpose of the investigation was to obtain subsurface information at the site by means of exploratory boreholes.

The findings of the investigation are presented in this report. The work was performed in accordance with Consultant Agreement No. 2004-E0011.

2. PHYSIOGRAPHY

In general, the topography along the Highway 401 starts falling west of Avenue Road from about El. 183 m, towards the West Don River valley to about El. 137 m, near the riverbank. It then rises towards Bayview Avenue to about El. 168 m, dropping again to about El. 135 m, along the East Don River.

Within this general area, the overburden is comprised of Pleistocene or glacial deposits, which are laid down under a vast thickness of ice or else within the glacial rivers and lakes associated with them. Soils which were deposited by the ice itself form the glacial till deposits which are mainly unsorted by water action, while those formed by melt waters are stratified deposits. Near and within the present river valleys, these deposits were modified by rivers emptying into the glacial Lake Iroquois (fore-runner of the present Lake Ontario) and sand, gravel, silt and minor amounts of clay were deposited. Finally, further modifications took place in modern times by the West Don River and East Don Rivers.

In summary, below some man-made fill and/or modern post glacial deposits, the site is underlain by glacial tills with some sand and silt layers, except near the rivers where surficial sands and silts are more prevalent.

The depth of the overburden in the general area can be expected to be more than 40 m. The overburden which consists of mainly glacial and interglacial deposits are underlain by the Georgian Bay shale bedrock with limestone and siltstone interbeds. This formation belongs to the Upper Ordovician Period of the Paleozoic Era and is approximately 440 million years old.

3. INVESTIGATION PROCEDURES

The fieldwork for this project was performed on April 17 and 18, 2005 and consisted of drilling and sampling two boreholes. Borehole SF1 was put down immediately west of Avenue Road, in a grassed island between the N-E and W-N/S ramps, while Borehole SF2 was drilled on the edge of pavement of S-E ramp near Avenue Road. The plan locations of the boreholes are shown on Drawing No. 1.

The boreholes were advanced using truck-mounted drill rigs owned and operated by Walker Drilling Limited, under the full time supervision of a Geotechnical Engineer from S&P.

The boreholes were drilled to a depth of about 7.8 m. Sampling in the boreholes was conducted at frequent intervals of depth by the Standard Penetration Test (SPT) method, as specified in ASTM D1586. This consists of freely dropping a 63.5 kg. hammer a vertical distance of 0.76 m, to drive a 51 mm O.D. split-barrel (split-spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance or the N-value of the soil and this gives an indication of the consistency or the compactness condition of the soil deposit.

Water level observations in the open boreholes were made during drilling and at the completion of each borehole.

After completion of drilling, each borehole was grouted using cement/bentonite mixture, and the upper portion of Borehole SF2 was sealed with emulsified asphalt.

The borehole locations were established in the field by our engineering staff, in relation to the existing features. The geodetic elevations and coordinates of the boreholes were later taken from an AutoCAD drawing with topographic contours. Therefore, the elevations and coordinates of the boreholes should be considered as approximate.

The results of drilling, in-situ testing and water level measurements are summarized on the Record of Borehole Sheets in Appendix A.

A laboratory testing programme, consisting of natural moisture content and grain-size analyses was performed on selected soil samples. The results of the laboratory tests are presented on the appropriate Borehole Log Sheets and also in Appendix B.

4. SUBSURFACE CONDITIONS

In general, below topsoil or asphalt and pavement fill and/or embankment fill extending 1.7 to 2.1 m below the ground surface, the boreholes revealed the presence of a clayey silt till deposit to depths of 3.4 and 3.7 m, which is further underlain by the silt to sandy silt till to the full depth of exploration.

Details of the stratigraphy encountered in the boreholes are presented on the Record of Borehole Sheets in Appendix A. The following paragraphs are only meant to complement and amplify these data.

4.1 TOPSOIL

In Borehole SF1 located in a grassed island between the N-E and W-N/S ramps, a topsoil layer, approximately 0.2 m in thickness, was contacted at the ground surface.

4.2 ASPHALT

Borehole SF2, which was drilled on the edge of pavement of S-E ramp, encountered about 150 mm asphaltic concrete.

4.3 GRANULAR FILL

Beneath the 0.2 m thick topsoil layer in Borehole SF1 and the 150 mm thick asphaltic concrete layer in Borehole SF2, granular fill materials were contacted in both boreholes. In Borehole SF1 the granular fill was found to consist of sand and gravel extending to a depth of 1.7 m below the existing grade or to El. 180.8 m, while in Borehole SF2 the granular fill consists of crushed gravel and sand, extending to 2.1 m in depth or to El. 179.4 m. The presence of occasional clay pockets was also observed in the samples taken from the boreholes.

Standard Penetration Tests performed in this deposit yielded N-values between 15 and 63 blows/0.3 m indicating a compact to very dense condition.

4.4 CLAYEY SILT TILL

Underlying the granular fill material, Boreholes SF1 and SF2 encountered clayey silt till deposit at 1.7 to 2.1 m depths, extending to depths of 3.7 and 3.4 m below the ground surface or to Elevation 178.8 and 178.1 m, respectively. The clayey silt till is a glacial deposit, which consists of a heterogeneous mixture of clayey silt with some sand and gravel.

The result of grain-size distribution analysis carried out on one sample of this till deposit from Borehole SF2 is given in Figure 1 in Appendix B. It shows 1% gravel, 29% sand, 50% silt and 20% clay size particles. Being of glacial origin, the till can be expected to contain random cobbles and boulders, due to its mode of deposition.

This is a cohesive soil and from the recorded N-values, which range from 15 to in excess of 50 blows/0.3 m; the consistency of the material is described as very stiff to hard.

4.5 SILT TO SANDY SILT TILL

The clayey silt till was found to be underlain by a slightly coarser deposit, consisting of silt to sandy silt till, which is a basically cohesionless material. Both boreholes were terminated in this deposit at a depth of 7.8 m below the ground surface.

In general, this deposit consists of a heterogenous mixture of silt to sandy silt with traces to some clay and gravel. The result of grain-size distribution analysis carried out on one sample of this till deposit in Borehole SF1 is given in Figure 2 in Appendix B. It shows 3% gravel, 34% sand, 46% silt and 18% clay size particles. Being of glacial origin, the till can be expected to contain random cobbles and boulders, due to its mode of deposition.

Being of glacial origin, the till can be expected to contain random cobbles and boulders, due to its mode of deposition.

At a depth of approximately 6.0 m below the ground surface, the sandy silt till was found to be interbedded with some silty sand till layers in both boreholes.

N-values recorded in this till deposit are in excess of 50 blows/0.3 m, indicating a very dense relative density.

In general, during the field exploration, the silt to sandy silt till deposit was in a damp to moist condition. However, in Borehole SF2, this deposit was found to be somewhat wet below a depth of 7.0 m.

4.6 GROUNDWATER CONDITIONS

Both boreholes were dry upon their completion. This, however, does not represent stabilized conditions. Based on the colour of soil and the moisture contents of the soil samples, however, the groundwater table is believed to be at a depth of about 7 m. Seasonal fluctuations in the groundwater level, as well as fluctuations in response to major weather events, can, however be expected. In addition, a perched water condition could occur due to the accumulation of surface water in the granular fill overlying the relatively impervious natural deposit of clayey silt till.

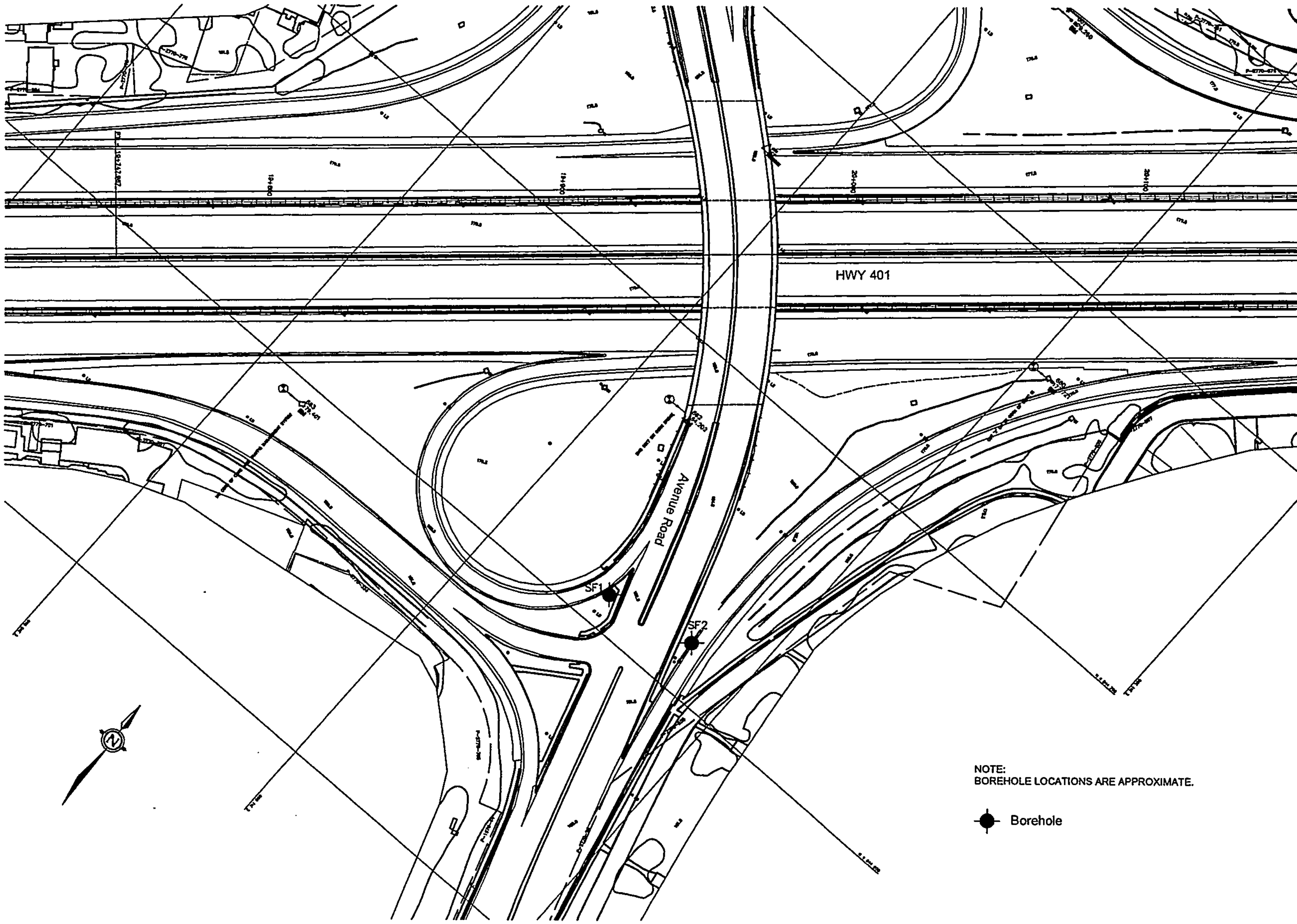
SHAHEEN & PEAKER LIMITED

Yuxin Lang, M.A. Sc. P.Eng

Z.S. Ozden, M.A. Sc. P.Eng.

REGISTERED PROFESSIONAL ENGINEER
Z. S. OZDEN
PROVINCE OF ONTARIO

Drawings



NO.	DESCRIPTION	DATE
REVISION		

shaheen & peaker limited

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Overhead Sign at Avenue Road/Highway 401 Interchange

TITLE:

BOREHOLE LOCATION PLAN

SCALE: NTS	DATE: Jun. 2005
DRAWN BY: JZ	PROJECT NO.: SPT 1134
APPROVED BY: YL	DRAWING NO.: 1

Appendix A

Records of Boreholes

SPT1134- Installation of Overhead Sign

RECORD OF BOREHOLE No SF1

METRIC

WO 04-20008 | LOCATION Highway 401 and Avenue Road IC (NE- Ramp)- Coords: N 4 844 611; E 311 044 | ORIGINATED BY C.T.

DIST ___ HWY 401 | BOREHOLE TYPE Solid Stem Auger | COMPILED BY H.A.

DATUM Geodetic | DATE 4/17/2005 to 4/17/2005 | CHECKED BY R.M.

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
182.5	Ground Surface					
0.0	0.2m **Topsoil**	1	SS	15	182	
	FILL: SAND & GRAVEL trace clay, brown, damp, compact to dense	2	SS	36		
180.8 / 1.7	**CLAYEY SILT TILL:** brown, damp, stiff to very stiff	3	SS	21	181	
		4	SS	15	180	
	hard	5	SS	31		
178.8 / 3.7	**SILT TO SANDY SILT TILL:** trace clay, brown, damp to moist, very dense	6	SS	84	179	
		7	SS	58	178	3 34 46 18
		8	SS	100/28	177	
	with silty sand till layer	9	SS	84/28	176	
	grey					
174.8 / 7.8		10	SS	50/13	175	
	End of Borehole.					
	Borehole dry (not stabilized) and open to full depth on completion.					

Other columns: STRAT PLOT; GROUND WATER CONDITIONS; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● POCKET PENETR., × LAB VANE; 20 40 60 80 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; UNIT WEIGHT γ kN/m³.

+ 3, × 3: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

SPT1134- Installation of Overhead Sign

RECORD OF BOREHOLE No SF2

METRIC

WO 04-20008 — LOCATION Highway 401 and Avenue Road IC (SE- Ramp)- Coords: N 4 844 605; E 311 077 — ORIGINATED BY C.T.

DIST ____ HWY 401 — BOREHOLE TYPE Solid Stem Auger — COMPILED BY H.A.

DATUM Geodetic — DATE 4/18/2005 — CHECKED BY R.M.

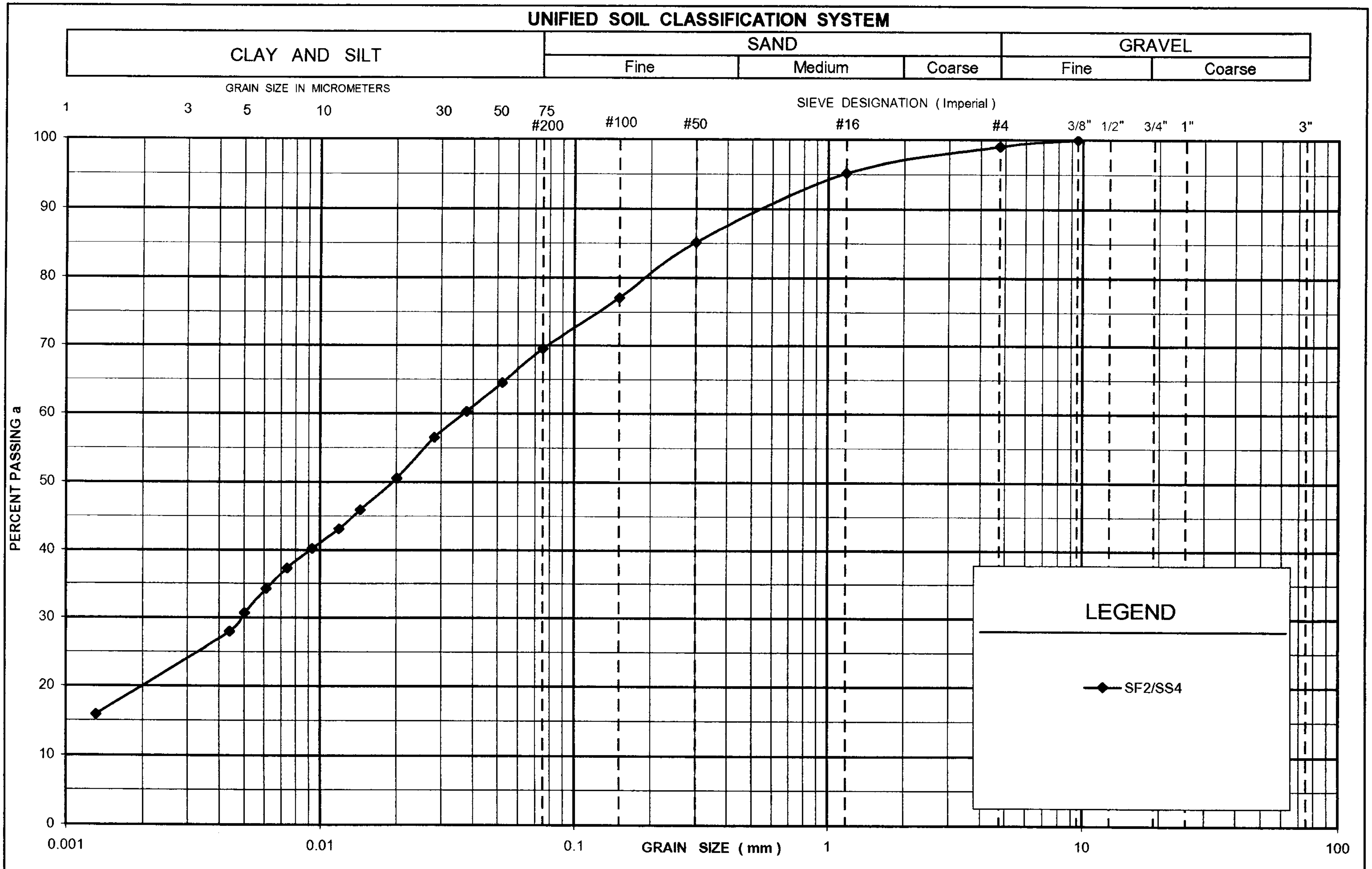
ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.5	Ground Surface						
0.0	150mm **ASPHALT**						
	FILL: crushed gravel & sand, trace clay pockets, compact	1	SS	63	181		hit a stone
	moist	2	SS	19			
	wet	3	SS	26	180		
179.4 / 2.1	**CLAYEY SILT TILL:** brown, damp, hard	4	SS	35	179		1 29 50 20
178.1 / 3.4	**SILT TO SANDY SILT TILL:** brown, damp to moist, very dense	5	SS	100/28	178		
		6	SS	50/15	177		
		7	SS	50/15			
		8	SS	100/28	176		
	with silty sand till layer	9	SS	50/13	175		
	grey, moist to wet				174		
173.8 / 7.8	End of Borehole. Borehole dry (not stabilized) and open to full depth on completion.	10	SS	50/13			

Column headings: SOIL PROFILE; STRAT PLOT; SAMPLES; GROUND WATER CONDITIONS; ELEVATION SCALE; DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ kN/m³.

+ ³, × ³: Numbers refer to Sensitivity — (%) STRAIN AT FAILURE

Appendix B

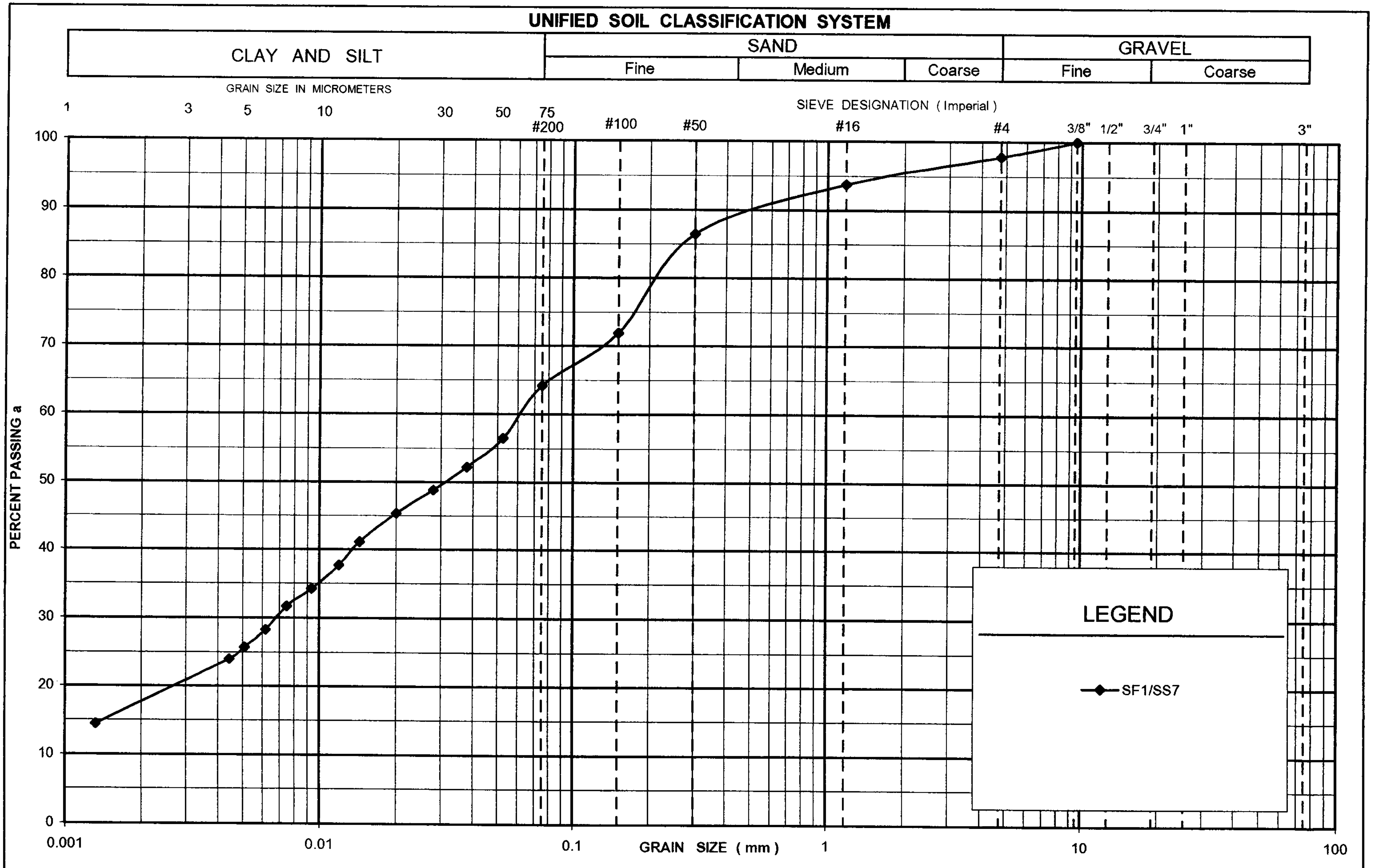
Laboratory Test Results



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION
CLAYEY SILT TILL

FIGURE No.	1
REF. No.	SPT 1148
GWP:	



SHAHEEN & PEAKER LIMITED	GRAIN SIZE DISTRIBUTION SANDY SILT TILL	FIGURE No.	2
		REF. No.	SPT 1148
		GWP:	

Appendix C

Explanation of Terms Used in Report

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 63.5 kg, 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 $\overline{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J 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 COMPOSION AND STRUCUTRAL 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*

JOINT 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

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_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
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICALL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
c_c	1	COMPRESSION INDEX
c_s	1	SWELLING INDEX
c_a	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 = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_s	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $(W_L - W_L)$
I_L	1	LIQUIDITY INDEX = $(W - W_P)/ I_P$
I_C	1	CONSISTENCY INDEX = $(W_L - W) / 1_P$
$e_{,max}$	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{,max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	N PERCENT – DIAMETER
C_u	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

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5. DISCUSSION AND RECOMMENDATIONS

The project entails the construction of a new overhead sign support structure on Avenue Road south of Highway 401. Two boreholes (Boreholes SF1 and SF2) were drilled for this project and the borehole locations are shown on Drawing No. 1.

5.1 SUMMARIZED SUBSURFACE CONDITIONS

In general, below pavement and/or embankment fill extending 1.7 to 2.1 m below the ground surface, the boreholes revealed the presence of clayey silt till deposit to depths of 3.4 and 3.7 m, which was further underlain by the silt to sandy silt till to the full depth of exploration.

Details of the subsurface conditions encountered in each borehole are given on the individual Record of Borehole Sheets in Appendix A.

5.2 DESIGN CONSIDERATION

Generally, each overhead sign structure is supported on caisson (i.e. drilled and cast-in-place concrete pile) foundations and the depth of the caissons is typically 6 to 8 m, but would vary depending on the height of the structure and the subsurface conditions encountered at each location. According to MTO practice, the design can be carried out in accordance with the method described by Broms, as detailed in the following papers.

BROMS, B.B.: Lateral Resistance of Piles in Cohesive Soils, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 90 No. SM2, March 1964.

BROMS, B.B.: Lateral Resistance of Piles in Cohesionless Soils, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 90 No. SM3, March 1964.

BROMS, B.B.: Design of Laterally Loaded Piles, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 91. SM3, May 1965.

Based on the results of the two boreholes, the soil parameters at each pole location are given in Table 5.2.1. The following notations have been adopted:

ϕ = apparent angle of friction for cohesionless soils in degrees.

q_u = unconfined compressive strength in kPa (q_u=2xC_u) for cohesive soils and C_u is the undrained shear strength.

γ = bulk unit weight in kN/m^3.

TABLE 5.2.1

BH No.	Elevation (m) From	Elevation (m) To	Type of Soil	Consistency or Compactness Condition	q_u (kPa)	ϕ (degrees)	γ (kN/m^3)	Water Level depth (m)
SF1	182.3	181.9	Fill	Compact	-	30	21.0	7.0♦
	181.9	180.8	Fill	Dense	-	32	21.5	
	180.8	178.8	Cohesive	Very stiff to Hard	300	-	21.0	
	178.8	176.6	Cohesionless	Very Dense	-	34	22.0	
	176.6	174.8	Cohesionless	Very Dense	-	35	22.5	
SF2	181.4	180.6	Fill	V. Dense to Dense	-	33	21.5	7.0♦
	180.6	179.4	Fill	Compact	-	32	21.0	
	179.4	178.1	Cohesive	Hard	400	-	21.5	
	178.1	173.8	Cohesionless	Very Dense	-	35	22.0	

♦ = estimated

The contribution to lateral resistance of the soil within the frost depth (i.e. 1.2 m) should not be included in the calculations, except of course, for the weight of the soil. Research shows, however, that restraint (fixity) provided at the ground surface level plays a significant role in the performance of high pole structures and, therefore, the placement of well compacted, competent material at and near the ground surface immediately around the caisson is recommended.

5.3 CONSTRUCTION COMMENTS

The boreholes show the presence of some surficial fill deposits followed by essentially competent overburden.

Below the fill material, the clayey silt till can be expected to be self-supporting and should not yield significant amounts of water in the short term, in caisson holes, even below the groundwater table. However, the concrete should be poured expeditiously on completion of the caisson hole, without undue delay.

The sandy silt till can be expected to be somewhat more pervious but it too would be relatively self supporting and should not yield significant amounts of water, provided that open caisson holes are backfilled with concrete without delay. However, the silty sand till and the water bearing sand seams in the otherwise relatively impervious deposits will yield more water. If at the time of construction a perched water table occurs due to the accumulation of surface water in the fill deposits, this will also create some problems during the installation of the caissons.

Water bearing layers can, therefore, be expected to yield water and may cause instability problems during the installation of the caissons. Where these layers are rather thin and the soil is relatively fine grained, it may be possible to effect construction by pouring the concrete rapidly upon the completion of the excavation of the caisson hole. In other cases, however, the coarse silty sand till and the sand layers may cause cave-ins or excessive groundwater seepage in unlined caisson holes and will necessitate special precautions.

Within the coarser textured till below the water table, the soil is susceptible to disturbance due to the unbalanced hydrostatic head and seepage and may likely become unstable, especially with increased depth of excavation below the water table. The contractor should maintain the stability of the soil at the sides and bases of the holes for the concrete footings, at all times from the commencement of excavation to the completion of the pouring of the concrete.

In view of these, we recommend that the following special provisions be included in the contract documents:

- The contractor shall install concrete foundations in earth for sign foundations. At the foundation locations, strata may consist of fill, clayey silt till, silt to sandy silt till and silty sand till along with sand layers. Groundwater may be encountered above the base of the excavations.

- The contractor shall maintain the stability of the soil along the sides and in the bases of the holes for the concrete footings at all times from the commencement of their construction to the placing of the concrete.

- Dewatering may be required to maintain a sufficiently dry condition for proper installation of the caisson hole and the placement of concrete.

Being of glacial origin, the glacial till deposits can be expected to contain random cobbles and boulders. Cobbles may also be present in the fill deposits. The contractor should be made aware that the presence of cobbles and boulders can always be expected which can cause problems during the installation of the caissons, such as increasing the time required for drilling, the employment of special equipment, etc.

6.0 CLOSURE

The Limitations of Report, as quoted in Appendix J, is an integral part of this report.

SHAHEEN & PEAKER LIMITED

Yuxin Lang, M.A. Sc. P.Eng

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REGISTERED PROFESSIONAL ENGINEER
Z. S. OZDEN
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Appendix D

Limitations of Report

LIMITATIONS OF REPORT

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Shaheen & Peaker Limited at the time of preparation. Unless otherwise agreed in writing by Shaheen & Peaker Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Shaheen & Peaker Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time. Any user of this report specifically denies any right to claims against the Consultant, Sub-Consultants, their officers, agents and employees in excess of the fee paid for professional services.

Highway 401 / Avenue Road Interchange Reconfiguration
Agreement No. 2004-E0011
WP 2436-04-00

Design Synopsis

Scope/Purpose of Work:

The project consists of the reconfiguration of the southern portion Highway 401/Avenue Road Interchange as follows:

a) Removal of the W-S channelization
b) Reconstruction of the W-N/S ramp terminal to include one (1) left turn and two (2) right turn lanes from Highway 401 EB to Avenue Road.
c) Installation of new traffic signals at the newly reconfigured ramp terminal intersection.
d) Extension of the existing left turn lane from Avenue Road southbound onto Wilson Avenue eastbound.
e) Realignment of the Avenue Road northbound lanes and reduction from three lanes to two lanes south of the ramp intersection in order to improve lane continuity from Avenue Road northbound south of Wilson Avenue.
f) Development of a new right turn lane from Avenue Road southbound onto Wilson Avenue.
g) Relocation/Upgrading of existing illumination.
h) Inclusion of a GO Transit Bus through lane through the ramp intersection onto the S-E ramp. The S-E ramp is to be widened to allow merging of GO bus traffic with ramp traffic.
i) Replacement of two sign supports, one on S-E ramp, one on N-E ramp.
j) Resurfacing of the S-E, N-E, W-N/S Ramps and Avenue Road.

Staging:

Stage 1
During this stage, removals and new construction required for the median on Avenue Road will take place. Work shall occur during off peak times with placement of TC-54s. Only 2 full night ramp closures are envisaged on the W-N/S ramp for this stage.

Stage 2
During this stage, the S/W quadrant of the W-N/S ramp is to be constructed. Ramp traffic will travel on existing channelization for southbound Avenue Road and existing left for Avenue Road northbound. In addition the bus pull through on the S-E ramp is to be constructed. Work shall take place during off peak hours. There will also be approximately 15 full night ramp closures for the ramps in this stage.

Stage 3
During this stage, the N/W quadrant of the W-N/S ramp will be constructed. Work will take place during off peak times. Ramp traffic will travel on existing channelization for southbound Avenue Road and existing left for Avenue Road southbound. There will be approximately 11 full night ramp closures for the ramps in this stage.

Stage 4

During this stage, the terminal of the W-N/S ramp will be finalized. The new traffic signals will be operational during this stage with temporary lane configuration. There will be approximately 6 full night ramp closures that will also include for the resurfacing of the N-E ramp.

Utilities:

No Relocations necessary. Empty Bell conduits crossing the W-N/S ramp will be relocated during construction. Provisions for this work have been included and Bell has endorsed this approach.

Environmental:

An environmental screening for the proposed Highway 401/Avenue Road Interchange Reconfiguration Detailed Design project was carried out in accordance with the Class EA for Provincial Transportation Facilities 2000, Group "C". This included describing the project, contacting external agencies and the public (including flyers), and identifying potential environmental effects and standard mitigation measures. The project was presented at the PIC for the Highway 401 Eastbound Collector Rehabilitation Project on May 5, 2005. A noise by-law exemption from the City of Toronto has also been obtained.

Full Ramp Closures

W-N/S Ramp – 8 Nights – Stage 1 to 4
S-E Ramp – 2 Nights – Stages 2 & 3
N-E Ramp – With full Closures of Eastbound Collectors Project

Working Days:

This contract is estimated to take 87 working days. A fixed completion date of August 11, 2006 with an incentive/disincentive will be applied. .

Value:

Total Estimated Program Value of $1,100,000 which includes $825,000 for capital costs, $125,000 for Sundry & CA costs and $150,000 for Force Accounts & contingencies.

Award Schedule:

This project is to be tendered as Part A of a Part A/Part B contract with WP 158-00-00 401 EB Collector Rehabilitation Project from Avenue Road to Bayview to be awarded in the summer of 2005. Part A which is this project will be constructed in a single season in 2006 to avoid carryover in the middle of construction stages. Completion by mid-August 2006.