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GEOCRES No. 30M12-241

DIST. 6 REGION

W.P. No. 580-90-01

CONT. No. 92-54

W. O. No.

STR. SITE No. 24-529

HWY. No. 403

LOCATION Hwy 403 / Glen Erin
Underpass

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

SEND
TOJOSEPH LAI
P&D SECTION

FROM

BALU IYER FOUND. DESIGN SECT DATE 1-19-92 CC

SUBJECT

800mm ϕ CBP @ 403 - GLEN EIZIN

CONTRACT 92-54

1. FURTHER WORK IN THE PRESENT ALIGNMENT OF PIPE SHOULD NOT BE PERMITTED.
2. THE TEST PIT SHOULD BE BACKFILLED IMMEDIATELY.
3. RELOCATE THE PIPE IN THE SHOULDER AREA.
4. SEEK A PROPOSAL FROM CONTRACTOR RE HIS METHOD OF FIXING OF PRESENT MISALIGNMENT OF PIPE.

Bryon

REPLY

▶

▶

Batu Iyer, P.E.
Sr. Foundation Eng.

REPLY FROM

REPLY DATE

memorandum



To: V.F. Boehnke
Head, Structural Section
Central Region

Attn: Joseph Kumentas

From: Foundation Design Section
Room 315, Central Bldg.

Re: Relocation of 800 mm Dia. CSP Culvert
W.P. 580-90-01, Site 24-529
Glen Erin Drive Underpass
Hwy. 403, District 4, Burlington

Date: 1991 08 09

Further to your letter dated 91 07 29 and subsequent meeting with Joseph Kumentas, Intermediate Structural Engineer, Central Region on 91 08 06, this memo summarizes our comments.

Considering the site conditions, an open trench excavation will endanger the existing abutment foundation. The proposed culvert should be constructed using a tunnelling method which does not cause any vibration and also, capable of placing the liner immediately following the boring.

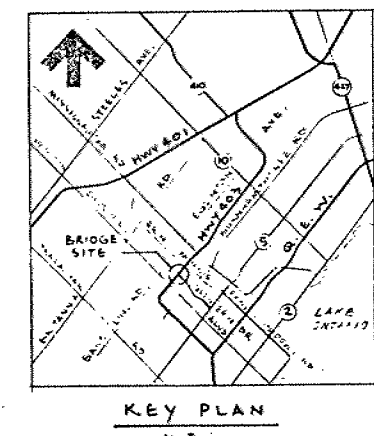
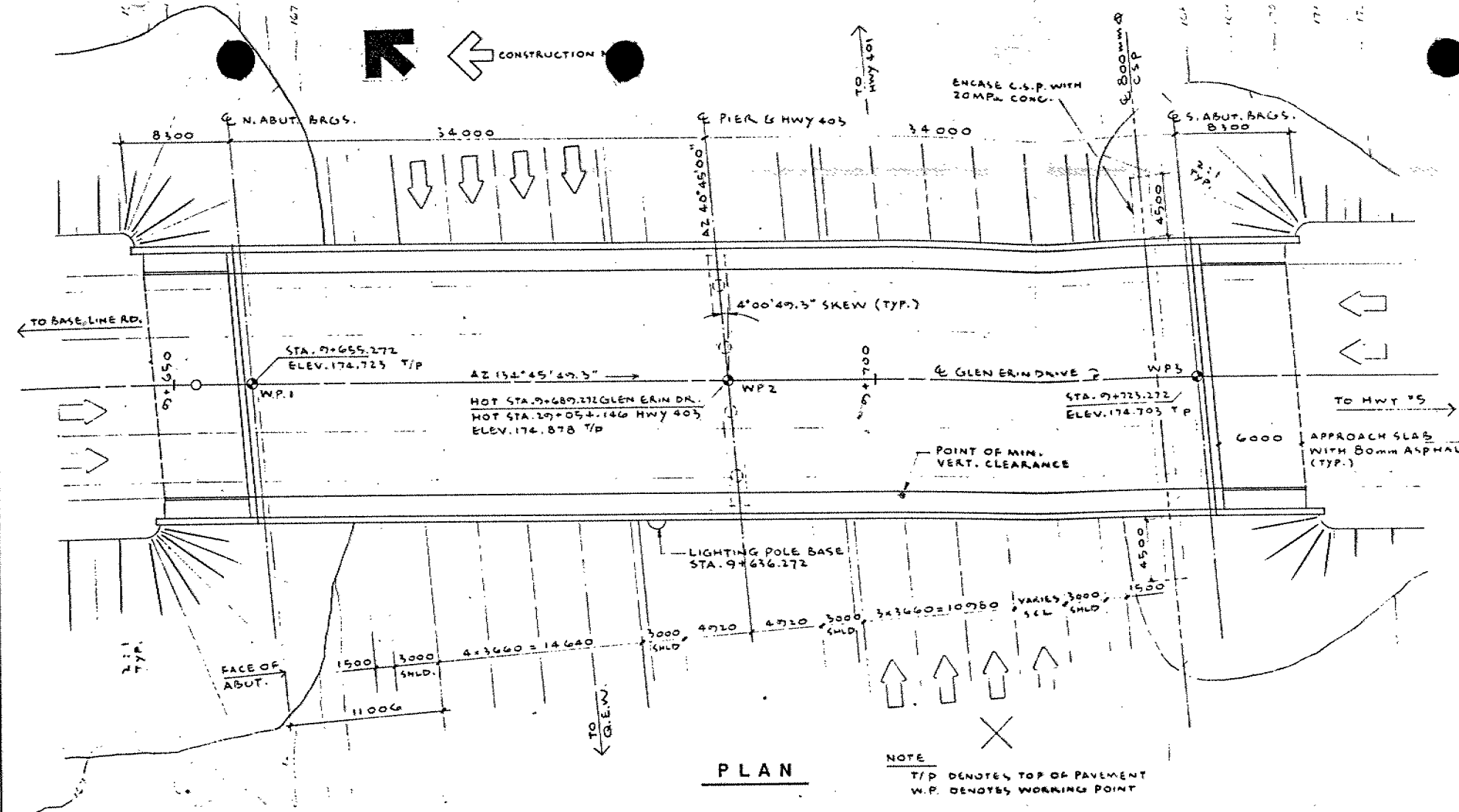
A handwritten signature in cursive script, appearing to read "M. Vasavithasan".

M. Vasavithasan, P. Eng.
Foundation Engineer

for

P. Payer, P. Eng.
Sr. Foundation Engineer

PP/MV/me



REVISIONS		
DATE	DETAILS	INIT
MAY 12, 1998	REV. 1 - AS PER M.T.O.'S COMMENTS	T.W.

- GENERAL NOTES**
- DESIGN CONFORMS TO ONTARIO HIGHWAY BRIDGE DESIGN CODE 83.
DESIGN LIVE LOAD = OHBDC-83, CLASS A
 - CLASS OF CONCRETE
 - ALL CONCRETE UNLESS OTHERWISE SPECIFIED 30 MPa
 - CLEAR COVER TO REINFORCING STEEL
 - FOOTINGS 100 ± 25 mm
 - ABUTMENTS & WINGWALLS
 - FRONT FACE 80 ± 20 mm
 - BACK FACE 70 ± 20 mm
 - PIERS 80 ± 20 mm
 - DECK & SIDEWALKS
 - TOP 70 ± 20 mm
 - BOTTOM & SIDES 40 ± 10 mm
 - BARRIER WALLS 70 ± 20 mm
 - APPROACH SLABS 80 ± 20 mm
 - REMAINDER 70 ± 20 mm
 - REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BARS MARKED WITH THE SUFFIX 'C' DENOTE COATED BARS.
 - CONSTRUCTION NOTES
 - (1) THE CONTRACTOR SHALL FINISH THE BEARING SEATS LEVEL TO THE SPECIFIED ELEVATIONS.
 - SOIL INVESTIGATION WAS CARRIED OUT BY WARNOCK HERSEY PROFESSIONAL SERVICES LTD. (REPORT NO. 50231-C7-3414-00).

- LIST OF STRUCTURAL DRAWINGS**
- | | |
|-----|--|
| B1 | GENERAL ARRANGEMENT |
| B2 | FOOTING LAYOUT & DETAILS |
| B3 | PIER |
| B4 | ABUTMENTS |
| B5 | WINGWALLS |
| B6 | STRUCTURAL STEEL I |
| B7 | STRUCTURAL STEEL II |
| B8 | STRUCTURAL STEEL III |
| B9 | DECK REINFORCING |
| B10 | DECK LAYOUT & SCREED ELEVATIONS |
| B11 | BARRIER WALL ON SIDEWALK |
| B12 | RAILING FOR BARRIER WALL |
| B13 | JOINT ANCHORAGE AND ARMOURING |
| B14 | 6000 mm APPROACH SLAB |
| B15 | DETAILS OF CONC. SLOPE PAVING |
| B16 | BRIDGE DATE & SITE NUMBER DATA |
| B17 | AS CONSTRUCTED ELEV. & DIM. |
| B18 | MISCELLANEOUS DETAILS & STANDARDS |
| B19 | ELECTRICAL EMBEDDED WORK AND PROVISIONS FOR UNDERPASS LIGHTING |

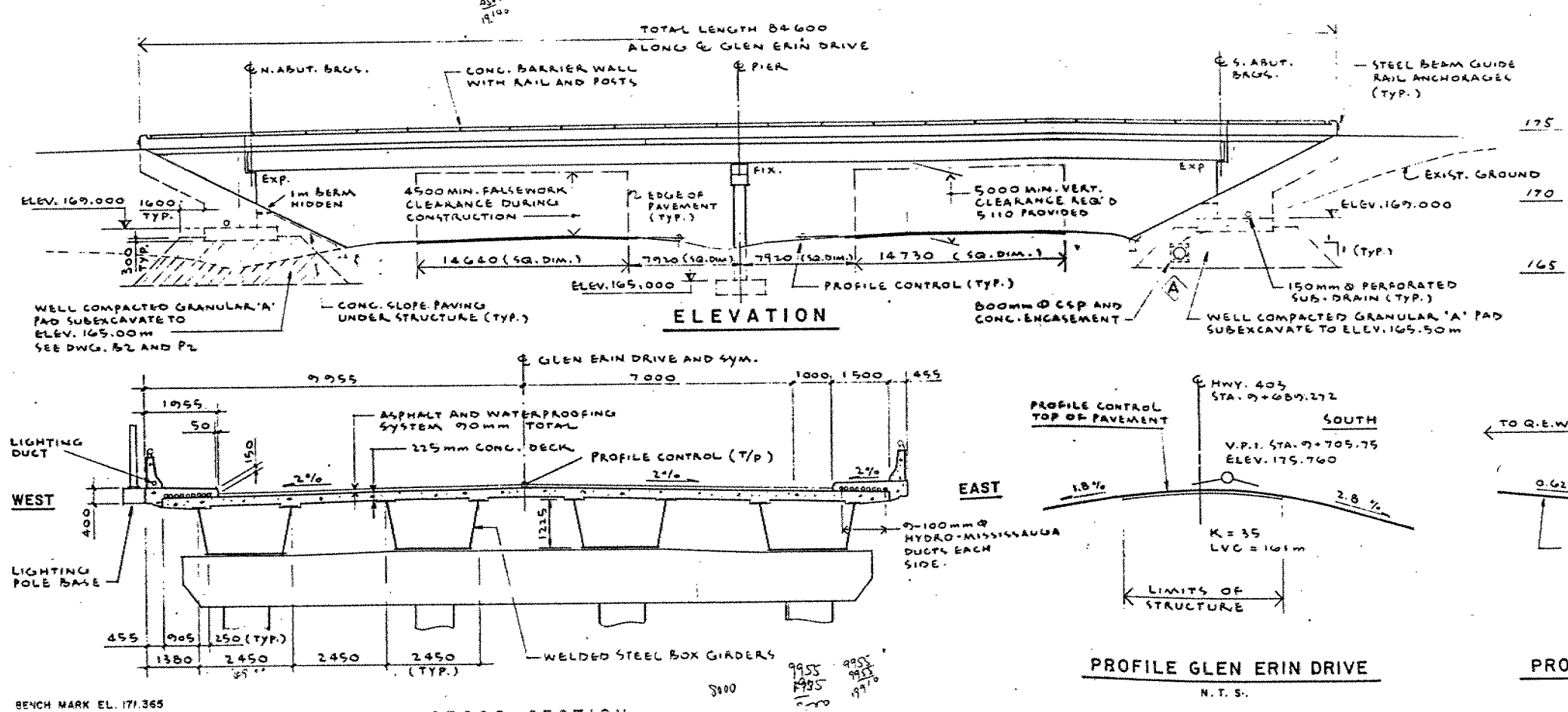
APPLICABLE STANDARD DRAWINGS
 OPSD 508.02 (REV.1) BRIDGE DECK WATERPROOFING
 DD-3503 (REV.2) MINIMUM GRANULAR BACKFILL REQUIREMENTS

Proctor & Redfern Limited
Consulting Engineers and Architects
Toronto

E.O. 87346

DESIGNED BY
T.F. WONG
CHKS

APPROVED BY
S.W. COOPE



CITY OF MISSISSAUGA
ENGINEERING AND WORKS DEPARTMENT

**GLEN ERIN DRIVE UNDERPASS
AT HWY 403**

GENERAL ARRANGEMENT

SCALE 1:200

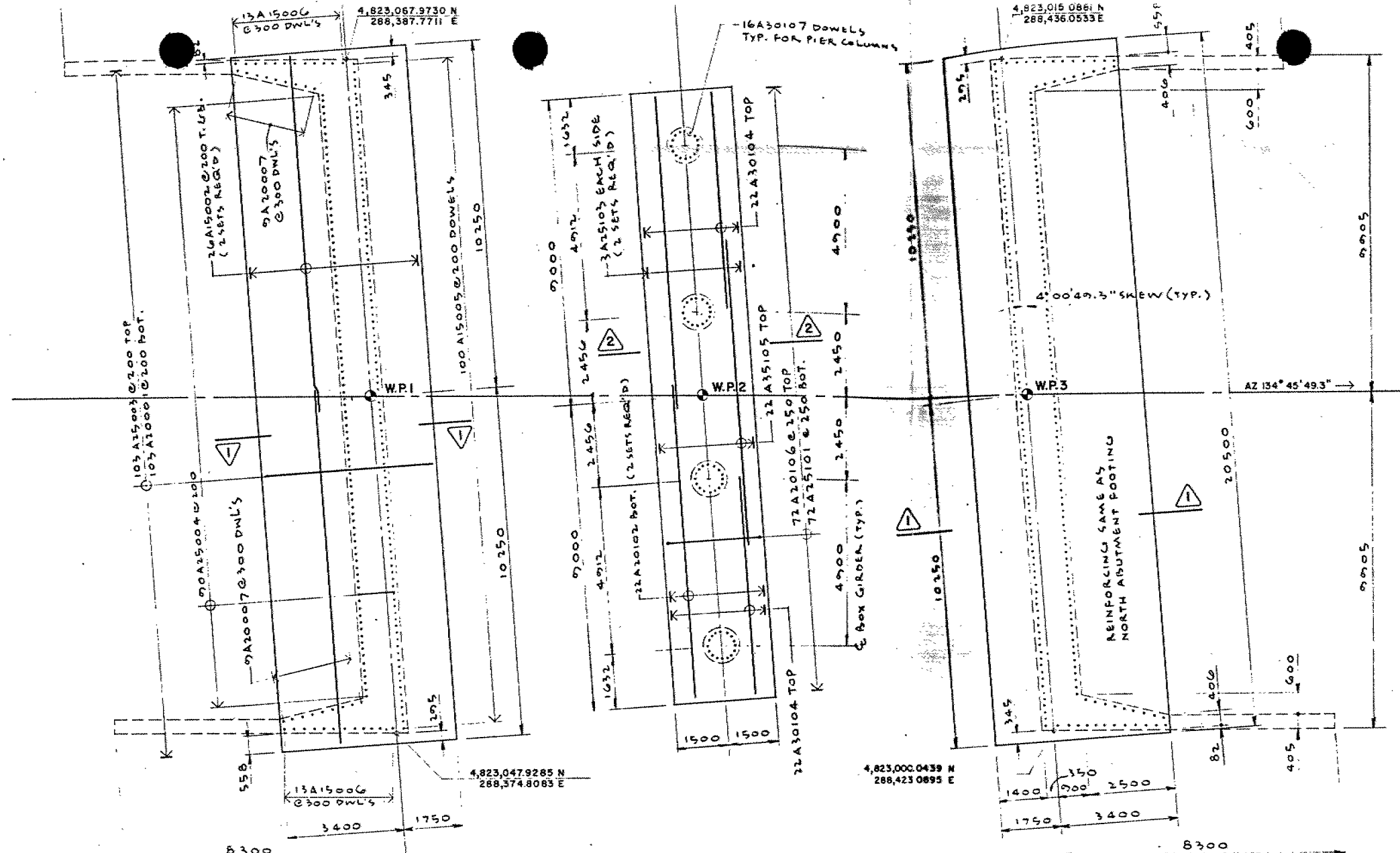
AREA

PROJECT NO.

REVISIONS		
DATE	DETAILS	INIT
1988	REV 1 - AS PER M.T.O.'S COMMENTS	T.W.

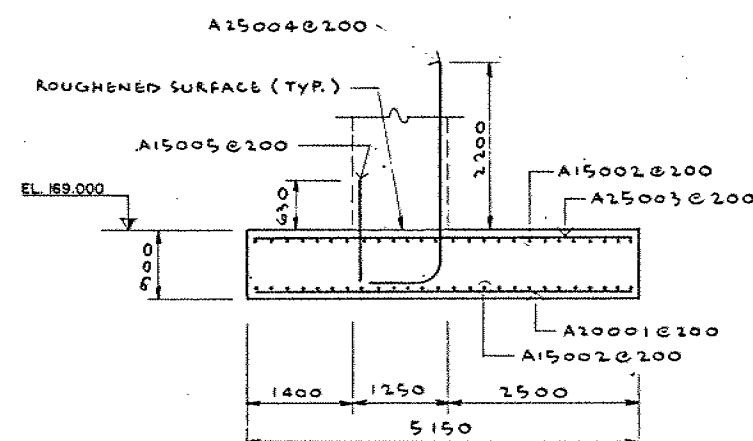
LOCATION OF WORKING POINTS

W.P.	STATIONS	CO-ORDINATES	
		NORTH	EAST
1	9+655.272	4,823,055.4506	288,381.2897
2	9+689.272	4,823,031.5083	288,405.4303
3	9+723.272	4,823,007.5660	288,429.5709

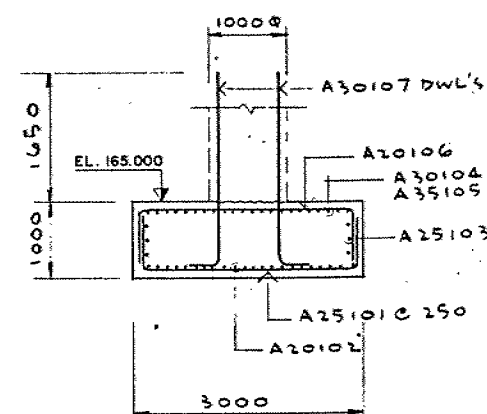


FOOTING LAYOUT PLAN

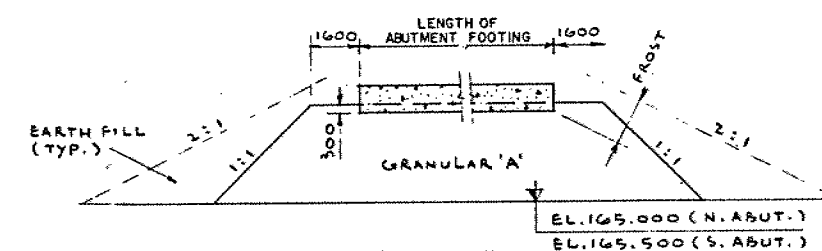
1:75



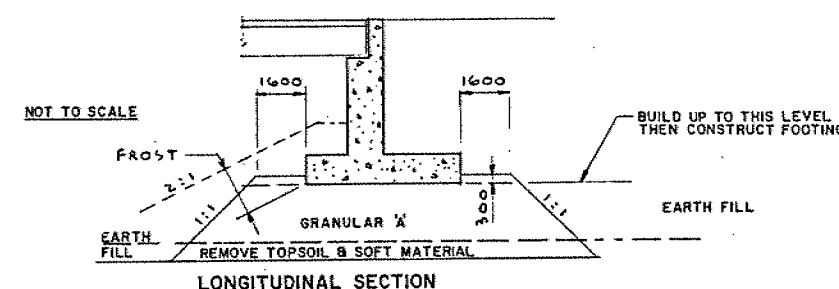
1:50



1:50



X SECTION



LONGITUDINAL SECTION

- NOTES:
- 1- REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
 - 2- PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL COMPACTED ACCORDING TO CURRENT O.P.S. STANDARD.
 - 3- CONSTRUCT CONCRETE FOOTING.
 - 4- PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.

ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

M.T.C. STRUCTURE SITE No. 24-81-529

Proctor & Redfern Limited
Consulting Engineers and Architects
Toronto E.O. 87346



DESIGNED BY
T.F. WONG



APPROVED BY
E.K. COOPER

CITY OF MISSISSAUGA
ENGINEERING AND WORKS DEPARTMENT

GLEN ERIN DRIVE UNDERPASS
AT HWY 403
FOOTING LAYOUT & DETAILS

SCALE 1:75 Other As Noted	AREA	PROJECT No.
DRAWN BY C.K.	CHECKED BY T.W.	PLAN No. AL-87346-B2
DATE APR 11/88	SHEET OF	C-

Warnock Hersey Professional Services Ltd.

EO: 37346

REPORT NO.: 50231-C7-3414-00

FOUNDATION INVESTIGATION REPORT

for

GLEN ERIN BRIDGE

OVER HIGHWAY 403

MISSISSAUGA

prepared for

PROCTOR AND REDFERN GROUP

CONSULTING ENGINEERS & PLANNERS.

JANUARY 1988

Warnock Hersey Professional Services Ltd.

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Warnock Hersey Professional Services Ltd.

3210 American Drive, Mississauga, Ontario L4V 1B3 (416) 678-7820 Telex 06-968801

50231-C7-341400

January 13, 1988

Proctor and Redfern Group
45 Greenbelt Drive
Don Mills, Ontario
M3C 3K3

Attention: Mr. Geoff Cook, P. Eng.

Re: Glen Erin Bridge over Hwy. 403
Mississauga, Ontario

Gentlemen:

I. INTRODUCTION

This report summarizes the results of a subsurface investigation which was carried out for the above structure by Warnock Hersey Professional Services Ltd.

The purpose of the investigation was to define the subsoil, bedrock, and groundwater conditions underlying the site, and evaluate the foundation conditions and geotechnical parameters relating to the design of the proposed bridge overpass.

The exploratory work was performed on the dates of December 24 and 25, 1987 by means of C.M.E. 55 drill rig employing standard flight augers and conventional split spoon sampling techniques at regular intervals of depth. The recovered samples were visually logged by a supervising geologist and returned to our laboratory for further examination and classification purposes. These samples will be stored for a period of 3 months from the date of this report, after which time they will be discarded unless instructions to the contrary are received.

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I. INTRODUCTION (Cont'd)

Wetness conditions were recorded during the course of the drilling and the stabilized water levels measured in the open boreholes at completion of the fieldwork. In addition, standpipes were also installed in selected boreholes for future measurement. As no water is used in the drilling operation, the recorded levels are solely the result of local conditions.

II. SITE LOCATION

The site is located on Highway 403 in west Mississauga, midway between Winston Churchill Blvd. and Erin Mills Parkway. Highway 403 at this point is paralleled on the north by a utility corridor containing underground high pressure natural gas pipelines and overhead high tension power lines. On the south side a noise berm of approximately 5 to 6 meters in height is present immediately beyond the roadside ditch. The surrounding lands to the north and south consist of built up residential subdivisions containing conventional single detailed houses. The highway grade through this area appears to correspond approximately with the natural grade.

III. GEOLOGICAL SETTING

The site is physiographically located within the Peel Glacial Till Plain which typically consists of flat to rolling terrain and a well developed stream drainage network. The overburden soil of glacial till or residual clay is of variable thickness though frequently comparatively shallow and directly overlying shale bedrock. Local occurrences of buried glacial valleys infilled with silt, sand and gravel are documented in this area.

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IV. SUBSURFACE CONDITIONS

IV.1 General

Individual borehole records providing a detailed description of subsurface conditions and exploratory data are contained in the appendix of this report. The accompanying drawing includes a location plan of the boreholes and a stratigraphic section across the site. Laboratory grading analyses of representative samples are shown on distribution curves while natural moisture contents are plotted on the borehole logs.

The natural subsurface stratigraphy at this site is reasonably uniform and consists of a sequence of very dense glacial till strata over Queenston shale bedrock which occurs at depths of approximately 7 to 10 meters below grade.

The glacial till deposit is comprised of a brown sandy silt till to locally clayey silt horizon within the upper 4 to 5 meters, followed by grey silt and silt till horizon to depths of 5 to 9 meters, and reddish brown clay/shale basal till immediately above the weathered shale.

Within this framework localized fill material is present in the form of surficial earth and road bed fills as well as suspected earth backfill to an existing culvert or sewer.

Soil wetness occurs within the surficial zone, local backfill and wet sandy seams in the upper sandy silt till deposit, whereas the underlying tills are essentially free of excess moisture.

Detailed descriptions of the various stratigraphic units are provided in the subsequent sections.

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IV.2 Fill

Fill material was identified in 3 of the boreholes to depths of 1.8 to 2.7 meters with the deepest occurrence resembling backfill to an existing culvert or sewer installation. The fill is comprised of a varying mixture of brown and reddish brown sandy clayey silt with minor gravel.

The fill is typically very moist to occasionally wet and occurs in a moderately compact to loose state.

IV.3 Brown Sandy Silt Till

Brown sandy silt till generally constitutes the upper native sub-soil at this site and occurs immediately below the road base or local earth fill materials. In the area of the south abutment a nominal mantle of reddish brown clayey till overlies the sandy till which occurs at depths of 1.8 to 2.7 meters.

The sandy silt till typically consists of 5 to 10 percent clay, 50 to 70 percent silt, 10 to 30 percent sand, and 0 to 10 percent gravel. It contains occasional sand layers at depth and displays minor oxide fissuring throughout.

The upper 1-2 meter zone of the sandy fill occurs in a very moist to wet state noting however that boreholes were located within the highway ditches where the ground is subject to surface water effects. The soil moisture content tends to decrease somewhat with depth though local wet sand layers and lenses are prevalent below approximately 3 meters.

The sandy silt till typically occurs in a compact to progressively dense state within the upper 2 to 2.5 meters and in a very dense state below.

IV.4 Grey Silt Till

Grey silt till underlies the upper brown sandy silt till with a transition zone of grey laminated silt occurring locally at the north end. The upper boundary of the grey till is relatively flat at approximate elevations of 162 to 163 whereas the lower boundary dips significantly towards the south. The actual depth varies between approximately 5 to 9 meters below grade.

The grey silt till is comprised of approximately 60 to 80 percent silt and the remainder of fine sand and minor gravel. It typically occurs in a very dense state throughout and in a damp only condition with no free water.

IV.5 Reddish Brown Clay/Shale Till

A basal till layer of reddish brown silty clay/shale till occurs below the grey till and immediately above the shale bedrock. The basal till is comprised for the most part of clayey silt material containing shale fragments and occasional shale slabs. It occurs in a damp condition and very dense state throughout.

IV.6 Shale Bedrock

Red shale bedrock of the Queenston Formation occurs at depths of approximately 7 to 10 meters with a dipping trend towards the south. The shale is finely laminated and fissile with occasional grey bands and layers of hard limestone. It is typically weathered within the upper 1 to 2 meters and becomes progressively more sound with depth.

IV.7 Groundwater

Most boreholes experienced significant wetness from surficial seepage and localized wet sandy layers within the sandy glacial till below approximately 3 meters depth. The surficial water hampered accurate determination of the groundwater table. On the basis of the soil samples however, the actual groundwater table is believed to occur in the lower zone of the sandy till deposit at a depth of approximately 3+ meters below borehole grade. Some seasonal fluctuation of the groundwater table is likely, depending on the amount of precipitation.

V. GEOTECHNICAL DISCUSSION

V.1 Background

It is our understanding that the proposed bridge will be a four lane, two span structure having an overall length of 68 meters. The bridge design consists of box girders and concrete deck, supported by concrete abutments and a central concrete bent in the Hwy. 403 median. The construction of approach embankments is also required which in the case of the south approach will likely incorporate the existing noise berm.

V.2 Foundations

In general the dense glacial till subsoils at this site are competent to carry structural loads. The design options which may be considered are conventional spread footing and pier foundation founded in the upper sandy silt till, or deep foundations such as drilled caissons or piles extending to the very dense grey silt till which occurs below depths of approximately 4 to 5 meters. The design parameters, restrictions, and relative merits of each is discussed in the following.

V.2 Foundations (Cont'd)

- spread footings

Conventional spread footings should be located below the surficial 1.5 to 2.0 meter zone (relative to borehole grade) of overly moist and only moderately dense glacial till soil though above potential water bearing layers which are prevalent below approximately 3 meters depth. Accordingly, an appropriate founding level is considered to be elevation 164.0 \pm subject to restrictions and lowering of founding levels in the vicinity of any existing sewer etc. as per Section 6-7.2-h of the O.H.B.D.C., i.e. footings to be located below a plane of 30° from the base of existing foundations or former sewer trench excavations.

For design purposes, the soil bearing capacity at U.L.S. (Ultimate Limit State) based on an elongated footing with an assumed width of 2.0 to 2.5 meters is determined to be 800 kPa. The bearing capacity at S.L.S. Type II (Serviceability Limit State) is 350 kPa based on an allowable settlement tolerance of 25 mm. In the case of abutment footings, due consideration must be given to eccentric loading conditions

For calculation of sliding resistance of abutment footings a friction coefficient of 0.45 can be assumed.

In all cases, spread footings must be provided with a minimum of 1.2 meters cover for frost protection.

From a construction standpoint it is considered necessary to provide a protective concrete skin slab over the inspected and prepared founding subsoil due to its sensitivity to seepage water disturbance and softening.

V.2 Foundations (Cont'd)

- drilled cast-in-place caissons

The very dense grey silt till horizon which occurs at depths of 4 to 5 meters below grade represents a suitable bearing stratum for the alternative use of drilled cast-in-place caisson foundations.

For design purposes the factored bearing capacity of U.L.S. is in part governed by Section 6.5.3.1 of the O.H.B.D.C. which specifies a value of 1,000 kPa for spread footings on very dense till. With caisson foundations however, additional load carrying capability is contributed by the deep and confined position of the bearing surface allowing for the use of an increased bearing capacity at U.L.S. of 1,500 kPa. No check for bearing capacity at the S.L.S. is required in this case due to the "unyielding" nature of the soil and the fact that the loads required to produce detrimental settlement exceed the U.L.S. value.

For abutment foundations, support of the horizontal loads should be derived from the passive resistance of the native glacial till surrounding the caissons. This may be computed on the basis of the empirical guide in Clause C6.8.3.8 (Commentary) for determining effective depth and width of the passive resistance. The internal friction angle for the glacial till can be assumed to be 35 degrees.

In general the advantages of the caisson method are the neatness and expediency of construction as well as the avoidance of potential surface and groundwater problems, i.e. run-off flow in ditches. Caissons would also be more adaptable to the presence of any existing sewers trench backfill etc. since founding

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V.2 Foundations (Cont'd)

support would be derived well below their depth. For caisson installation it is imperative that the founding soil be hand cleaned of all loose cuttings, etc. and inspected by a geotechnical specialist to confirm the bearing capacity.

- engineered granular fill

Abutment foundations can be supported on pads of well compacted or "engineered" granular fill such as M.T.C. Granular "A" in lieu of extending down to native subsoil. The preparation and construction requirements of such pads are particularly acute including stripping of all existing topsoil, earth fill and overly moist soil to an approved hard stable subgrade. In this respect partial drying and/or special treatment may be required to adequately compact and firm up the upper native subsoils which tend to be overly moist. Appropriate diversion of ditches must also be accommodated during this stage. For estimation purposes, the required average sub-excavation depth can be assumed to be 0.8 meters subject to confirmation during construction. Placement of the granular fill should be carried out in uniform lifts not exceeding 200 mm (loose) and each compacted to a minimum density of 100 percent Standard Proctor dry density by a heavy vibratory compactor. For design purposes the recommended soil bearing capacity at U.L.S. is 900 kPa. The bearing capacity at S.L.S. Type II is 350 kPa based on an allowable settlement tolerance of 25 mm.

For the calculation of sliding resistance of abutment footings a friction coefficient of 0.45 can be assumed.

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V.2 Foundations (Cont'd)

In all cases footings must be provided with a minimum of 1.2 meters cover for frost protection.

It is noted that continuous supervision of fill placement and compaction density testing is required in the construction of the granular pads.

V.3 Approach Fill

In general, the existing topsoil cover should be stripped within the limits of the approach fills and the exposed surface proof rolled and compacted with a heavy compactor. Any excessively weak or wet soils should be assessed and corrected as required. In the case of the south approach, it is expected that the existing noise berm can be directly incorporated in the approach embankment, subject to digging of some exploratory test pits during construction.

The use of clean imported select earth fill from controlled sources is considered acceptable for the construction of embankments. Ideally the material should be within 2 percent of the optimum moisture value and in any case subject to geotechnical approval before commencing haulage.

The fill should be placed in uniform lifts not exceeding 300 mm and compacted to a minimum density of 95 percent Standard Proctor value; increased to 98 percent in the subgrade zone as per the City of Mississauga specifications.

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V.3 Approach Fill (Cont'd)

Backfill behind the retaining walls must consist of approved free draining granular material such as Granular "A" or good quality Granular "B". It should be placed in uniform lifts having a maximum thickness of 200 mm and compacted to 95 percent Standard Proctor density. The zone within 1.5 meters of the wall face should be restricted to light compaction equipment only to avoid the development of excessive earth pressures.

Appropriate drainage outlets must be provided through the retaining walls to control hydrostatic build-up.

For calculation of earth pressure on retaining abutments refer to Section 6.6.1.2 of the O.H.B.D.C. The following parameters may be assumed in the case of Granular "A" material:

$$= 22 \text{ kN/M}^3$$

$$= 35^\circ$$

V.4 Pavement

The pavement design requirements for the bridge approaches are governed by the nature of the embankment fills and the frost susceptibility character of the subgrade soil in accordance with the City of Mississauga procedures. Since this is unknown at the design stage a Category II designation should be assumed, which in conjunction with the collector class of Glen Erin Drive yields the following pavement design:

Top Asphalt mm	40
Base Asphalt mm	100
Granular "A" mm	150
Granular "B" mm	375

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V.4 Pavement (Cont'd)

A reduction of the base asphalt thickness to 65 mm is permissible if the total road structural depth is increased by 70 mm or if Granular "A" is used full depth.

The asphalt should be compacted to 97 percent of the Laboratory Marshall value and the granular materials to 98 percent Standard Proctor.

V.5 Excavation and Groundwater

In general, excavations should be provided with 45 degree side slopes except for the lower 1.2 meters which may be cut vertically. Seepage flow from surficial soils is anticipated to a greater or lesser extent depending on seasonal conditions. Groundwater seepage from water bearing sand layers may also be encountered depending on the depth of excavations. Pumping from temporary sumps should therefore be provided in conjunction with diverting any ditch flow. As indicated previously, a protective skin slab should be provided over the founding subsoil to prevent disturbance and softening.

In all cases, excavations must comply with the Occupational Health and Safety Act of Ontario.

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VI CLOSURE

We trust that this report satisfactorily addresses the geotechnical design and construction requirements of the proposed Glen Erin bridge, however if you have any questions, please contact the undersigned.

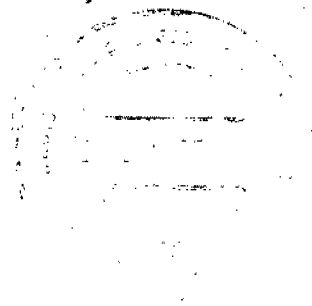
Sincerely yours,

WARNOCK HERSEY PROFESSIONAL SERVICES LTD.

B. D'Onofrio

B. D'Onofrio, P.Eng.
Manager
Geotechnical Services

BD:cc
Encls.



APPENDIX

<u>DESCRIPTIVE TERM</u>	<u>UNDRAINED SHEAR STRENGTH</u> (Pounds per sq. ft.)	<u>"N"-VALUE</u> (blows per ft.)
Very soft	< 250	< 2
Soft	250 to 500	2 - 4
Firm	500 to 1000	4 - 8
Stiff	1000 to 2000	8 - 15
Very stiff	2000 to 4000	15 - 30
Hard	> 4000	> 30

Note: Slickensided and fissured clays may have lower shear strengths than shown above, because of planes of weakness or cracks in the soil.

Terminology used for describing various soil strata encountered in a borehole is based upon the proportion of individual particle sizes present in the deposit as follows:-

<u>DESCRIPTIVE TERM</u>	<u>PROPORTION</u> (%)
Trace	< 10
Some	10 - 20
Adj (eg. Silty or Sandy)	20 - 35
and (eg. Silt and Sand)	35 - 50

SOIL TESTS PERFORMED

(Shown on Borehole Record)

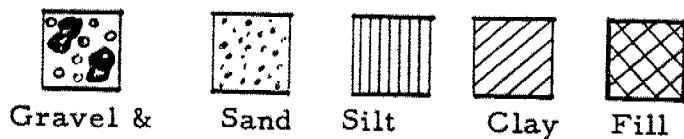
H - Hydrometer Analysis	V - In-situ Field Vane
S - Sieve Analysis	v - Laboratory Vane in Tube Sample
A - Atterberg Limits	U - Unconfined Compression Test
W - Water Content	UU - Unconsolidated Undrained Triaxial
γ_m - Unit Weight	CU - Consolidated Undrained Triaxial with pore water pressure measurements
G _s - Specific Gravity	CD - Consolidated Drained Triaxial
C - Consolidation	

TERMS CHARACTERIZING SOIL STRUCTURE

<u>Desiccated</u>	- having visible signs of weathering by oxidation of clay minerals, etc. and a conspicuous cubic structure.
<u>Fissured</u>	- containing shrinkage cracks, usually more or less vertical
<u>Varved</u>	- composed of thin layers of varying color and texture.
<u>Stratified</u>	- composed of thin alternate layers of different soil types, e.g. silt & sand or silt & clay.
<u>Well graded</u>	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
<u>Uniformly graded</u>	- predominantly of one grain size.

SYMBOLS AND TERMS USED ON THE OFFICE BOREHOLE RECORD

Soil Types (shown in symbol column)



Gravel &
Boulder



Sand



Silt

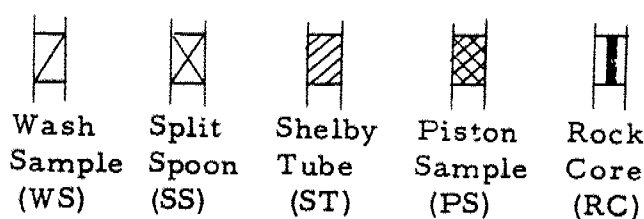


Clay



Fill

Sampler Types (shown in samples column)



Wash
Sample
(WS)

Split
Spoon
(SS)

Shelby
Tube
(ST)

Piston
Sample
(PS)

Rock
Core
(RC)

Bedrock Types



Limestone

Sandstone

Shale

Igneous

Measurement of Water Level



Borehole

Standpipe

Piezometer

TERMS DESCRIBING RELATIVE DENSITY & SOIL CONSISTENCY

- A. COARSE GRAINED SOILS (major portion retained on No. 200 sieve): includes (1) clean gravels, sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests or by the Standard Penetration Test Resistance "N" - value (the number of blows of a 140-pound hammer falling 30 inches, required to drive a 2-inch o.d. split spoon sampler one foot into the soil).

<u>DESCRIPTIVE TERM</u>	<u>"N" - VALUE</u> blows/foot	<u>RELATIVE DENSITY</u> (%)	<u>FRICTION ANGLE</u> (degrees)
Very loose	4	15	28
Loose	4 to 10	15 - 35	28 - 32
Compact or medium	10 to 30	35 - 65	32 - 36
Dense	30 to 50	65 - 85	36 - 40
Very dense	50	85	40

Note: Occasionally correlation is attempted from the Dynamic Cone Penetration Test results, which involves recording the number of blows of a 140-pound hammer falling 30 inches, required to drive a 2-inch diameter 60-degree cone one foot into the soil where the cone is attached to an "A" size drill rod and casing is not used.

- B. FINE GRAINED SOILS (major portion passing No. 200 sieve): includes, (1) inorganic and organic silts and clays, (2) gravelly sandy, silty clays, and (3) clayey silts. Consistency is rated according to undrained shear strength as indicated by in-situ field or Laboratory Vane tests, unconfined compression tests, or occasionally by standard penetration tests.



RECORD OF BOREHOLE No 1

METRIC

JOB NO. 50231-C7-3414-00

LOCATION GLEN ERIN BRIDGE, MISSISSAUGA

DIST 4 HWY 403

BOREHOLE TYPE SS AUGER

ORIGINATED BY B.D.

DATUM GEODETIC

DATE DECEMBER 23, 1987

COMPILED BY B.D.

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
166.2	GROUND SURFACE													
0.0	300mm TOPSOIL													
0.3	Brown SANDY SILT TILL Minor gravel (ML-SM) oxide staining very moist to 1.4m less moist below compact to very dense		1	SS	12									
			2	SS	26									
			3	SS	41									
			4	SS	63									
162.0	Grey SILT (ML) finely laminated moist very dense		5	SS	80/	225mm								
160.6	Reddish brown CLAYEY SILT TILL (ML) shale fragments moist very dense		6	SS	100/	75mm								
159.0	Red weathered SHALE occ. grey bands & thin limestone layers less weathered with depth (Queenston Formation)		7	SS	100/	75mm								
157.0	END OF BOREHOLE		8	SS	150/	75mm								
9.2														

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

METRIC

JOB NO. 50231-C7-3414-00

LOCATION GLEN ERIN BRIDGE, MISSISSAUGA

ORIGINATED BY B.D.

DIST 4 HWY 403

BOREHOLE TYPE SS AUGER

COMPILED BY B.D.

DATUM GEODETIC

DATE DECEMBER 23, 1987

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD RESISTANCE PLOT		PENETRATION		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARK & GRAIN S DISTRIBUTI (%) GR SA SI
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
165.9	GROUND SURFACE															
0.0	Brown SANDY SILT TILL minor gravel (ML-SM) oxide staining very moist above 1.2m less moist below compact to very dense		1	SS	36		165									
			2	SS	47		164									
			3	SS	100/	200mm	163									
162.8							162									
162.4	Wet sand seam (SM)		4	SS	44		161									
3.5	Grey laminated SILT grading to SILT TILL (ML) minor gravel moist very dense		5	SS	105/	275mm	160									
160.3																
5.6	Reddish brown clayey SILT TILL (ML)															
159.7	very dense		6	SS	100/	75mm										
6.2	END OF BOREHOLE															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

JOB NO. 50231-C7-3414-00

LOCATION GLEN ERIN BRIDGE, MISSISSAUGA

ORIGINATED BY B.I.

DIST 4 HWY 403

BOREHOLE TYPE SS AUGER

COMPILED BY B.D.

DATUM GEODETIC

DATE DECEMBER 23, 1987

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD RESISTANCE PLOT		PENETRATION		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN S DISTRIBUT (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
167.2	GROUND SURFACE															
0.2	Reddish brown to brown SANDY CLAYEY SILT minor gravel (ML) (Possible Fill) very moist compact		1	SS	16		167									
			2	SS	14		166									
165.0							165									
2.2	Brown SANDY SILT TILL minor gravel (ML-SM) wet, dense		3	SS	15		164									
164.2			4	SS	44		163									
3.0	Brown SANDY SILT TILL minor gravel (ML-SM) moist to very moist very dense						162									
			5	SS	65	150mm	161									
161.6	occ. wet seams						160									
5.6							159									
	Grey SILT TILL (ML) minor gravel moist very dense		6	SS	60	125mm	158									
160.0							157									
7.2	Reddish brown (ML) CLAYEY SILT TILL shale fragments moist, very dense		7	SS	60	50mm	156									
158.4							155									
8.8							154									
157.9							153									
9.3	END OF BOREHOLE		8	SS	100	50mm	152									

OFFICE REPORT ON SOIL EXPLORATION

158.4
8.8

RECORD OF BOREHOLE No 4

METRIC

JOB NO. 50231-C7-3414-00 LOCATION GLEN ERIN BRIDGE, MISSISSAUGA
DIST 4 HWY 403 BOREHOLE TYPE SS AUGER ORIGINATED BY B.D.
DATUM GEODETIC DATE DECEMBER 23, 1987 COMPILED BY B.D.
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SI. DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
167.2	GROUND SURFACE																GR SA SI
0.0	Reddish brown to brown SANDY CLAYEY SILT (ML) Minor gravel (Possible Fill) very moist to wet compact to loose		1	SS	10		167										
			2	SS	14		166										
			3	SS	7		165										
164.3			4	SS	84		164										
2.9	Brown SANDY SILT TILL minor gravel (ML-SM) oxide staining moist, very dense occ. wet seams		5	SS	76/	275mm	163										
161.8							162										
5.4	Grey SILT TILL (ML) minor gravel moist, very dense		6	SS	60/	150mm	161										
160.9																	
6.3	END OF BOREHOLE																

OFFICE REPORT ON SOIL EXPLORATION

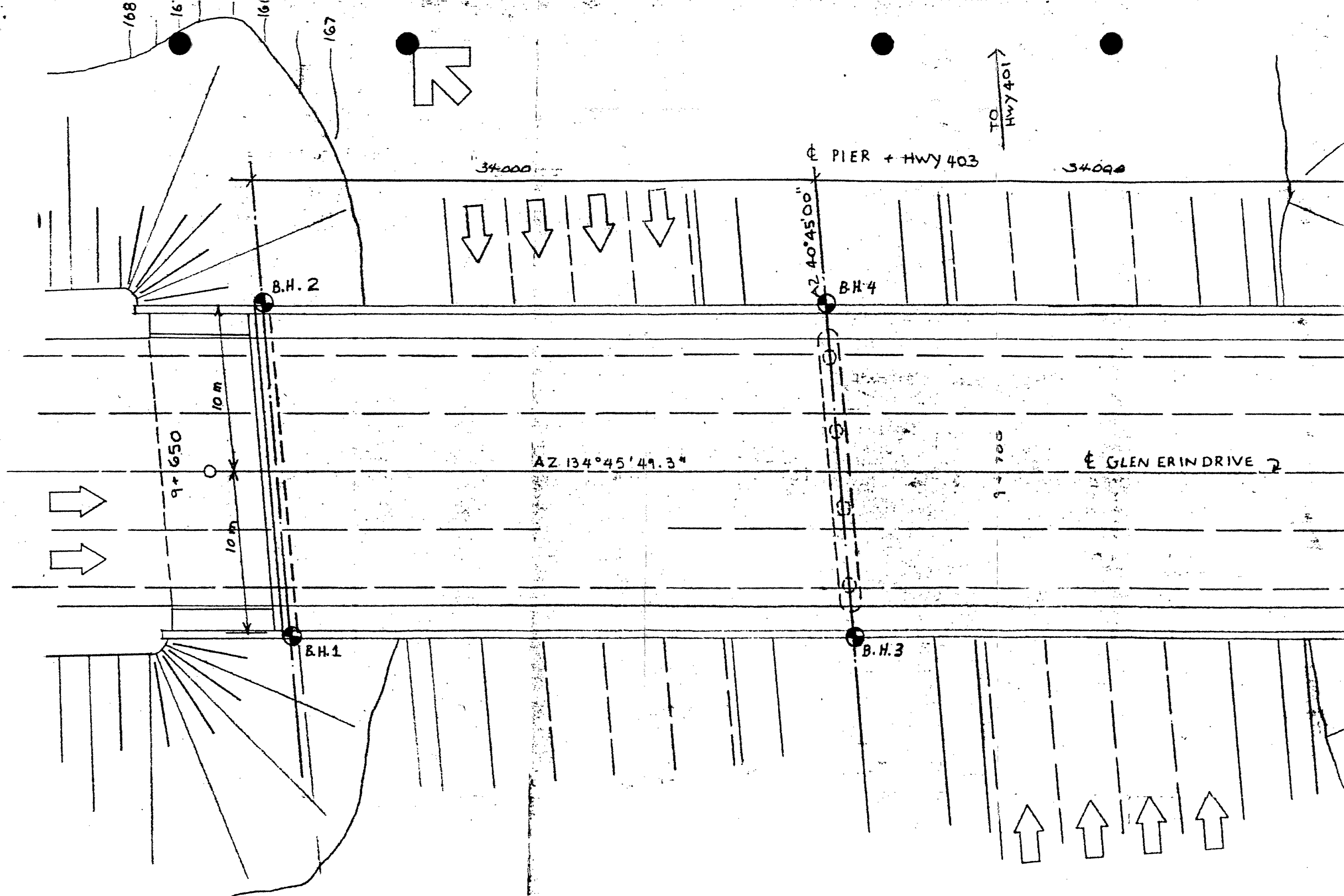
RECORD OF BOREHOLE No 5

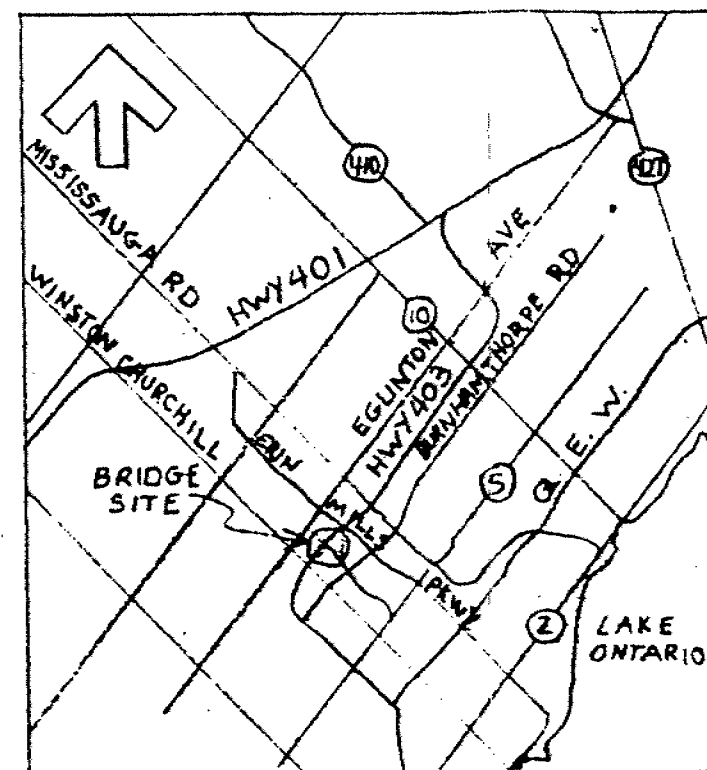
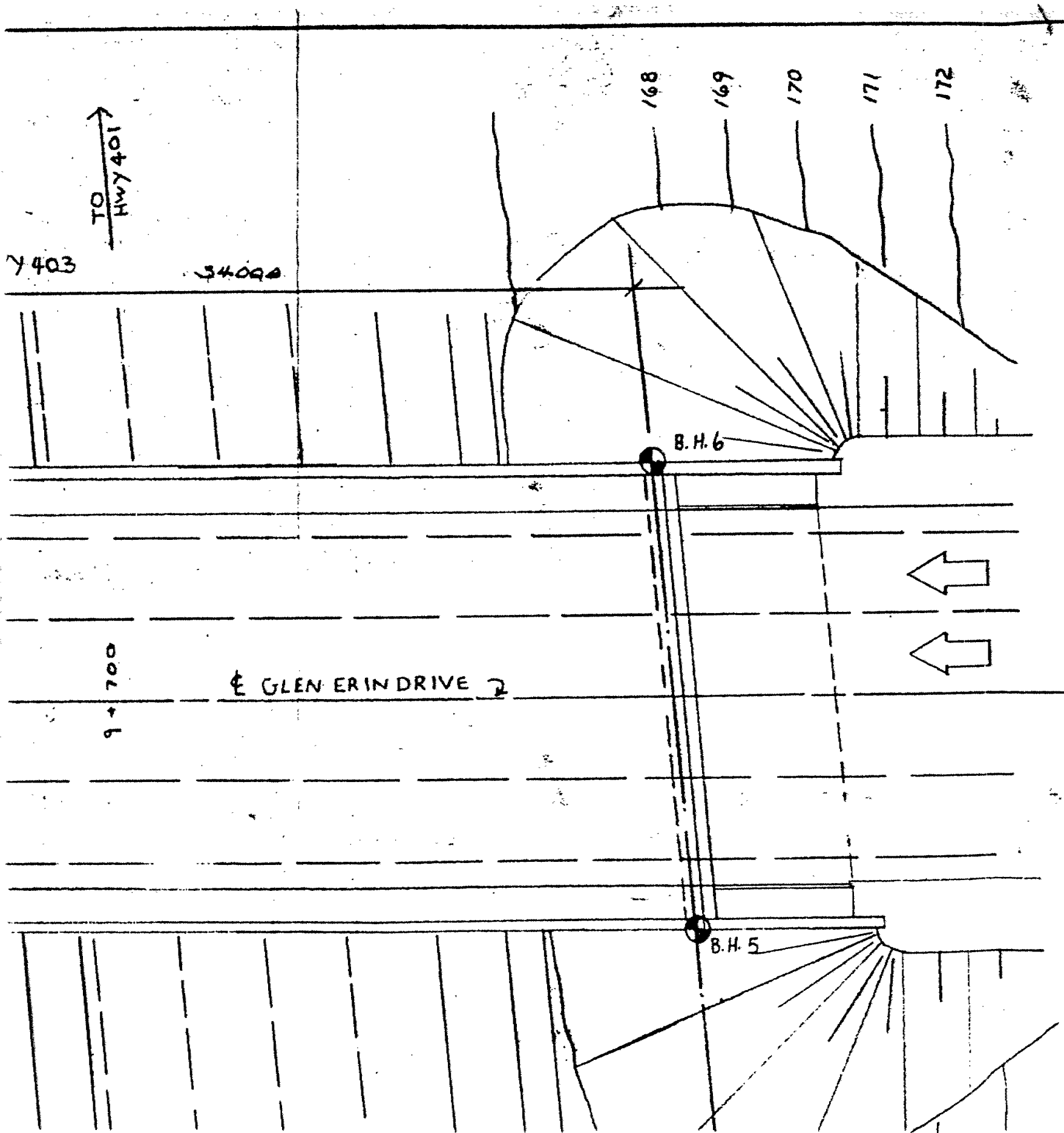
METRIC

JOB NO. 50231-G7-3414-00 LOCATION GLEN ERIN BRIDGE, MISSISSAUGA
 DIST 4 HWY 403 BOREHOLE TYPE SS AUGER ORIGINATED BY B.D.
 DATUM GEODETIC DATE DECEMBER 23, 1987 COMPILED BY B.D.
 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD - PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
167.4	GROUND SURFACE													
0.0	Brown to reddish brown CLAYEY SILT TILL (ML) Minor gravel moist to very moist compact to dense		1	SS	36		167							
			2	SS	40		166							
164.7	wet zone		3	SS	49		165							
2.7	Brown SANDY SILT TILL minor gravel (ML-SM) oxide staining moist, very dense		4	SS	307	150mm	164							
163.2	wet seams						163							
4.2	Grey SILT TILL (ML) minor gravel occ. boulders moist, very dense		5	SS	70	300mm	162							
161.1			6	SS	807	150mm								
6.3	END OF BOREHOLE													

OFFICE REPORT ON SOIL EXPLORATION





KEY PLAN
 N.T.S.



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