

GEOCREs No:
30M3-229

**MATERIALS ENGINEERING AND
RESEARCH OFFICE
FOUNDATION GROUP**

**GWP 199-00-00
HWY QEW**

**REGION Central
SITE 18-138-104**

Henley River Bridge Widening
over Twelve Mile Creek

FOUNDATION INVESTIGATION REPORT

for

Henley River Bridge Widening over Twelve Mile Creek

St. Catharines

W.P. 199-00-00

Site 18-138-104

Central Region

Introduction

This report summarizes the factual information obtained from a previous foundation investigation conducted for the widening of the proposed Henley River Bridge in 1986 under WP 8-86-00. The report was updated to include additional information. The work was carried out at the request of Central Region, Structural Section.

Site Description

The site is located at the crossing of QEW and Twelve Mile Creek in the City of St.Catharines.

The creek lies in a preglacial valley with slopes dissecting beds of sand, silt and glacial till. The rising lake level has drowned the valley and created the lagoon known as Martindale Pond. Outside the valley, the terrain is relatively flat. The elevation of the QEW in the area of investigation varies from El 90.0 to 92.0 m. The valley is approximately 18 m deep and 135m wide. Based on the boreholes advanced in the creek, the creek bed elevation is estimated at 73.5.m. The creek is approximately 82 m wide at the bridge and the water level measured in October 2002 was El 78.9.

The existing Henley Bridge is a 6-span twin concrete arch structure. Originally constructed in 1938, the structures and substructures were widened on both north and south sides in 1988.

Slopes beyond the bridges are stable and vegetated. The forward slopes beneath the structures are scarred by erosion gullies, some of which are over 1m in depth and width.

Physiographically, the site falls within the Iroquois Plain and consists largely of thin deposits of sand overlying extensive cohesive deposits (after Putnam and Chapman, 1984, The Physiography of Southern Ontario, 3rd Edition). Land use is primarily commercial and recreational.

Investigation Procedures

i) Field

A foundation investigation was carried out by the Foundations Group for the existing structure widenings between 86 02 12 and 86 04 17. The fieldwork consisted of fourteen boreholes. Eight

boreholes (BH's 1, 2, 9, 10, 11, 12, 13 and 14) were advanced using a track-mounted auger machine equipped with hollow stem augers. A diamond drill equipped with BX and NX casings was used to advance the remaining boreholes (BH's 3, 4, 5, 6, 7 and 8).

One boring was carried out at each of the proposed footing widening locations. The boreholes at the footings were advanced to depths of between 13.4 and 29.3 m. Disturbed samples were recovered by means of a 50 mm O.D. split spoon sampler driven into the ground according to the specifications of the Standard Penetration Test (ASTM D 1586-8). The samples were retrieved at 0.76 m intervals for depths of up to 10 m, followed by a sampling interval of 1.5 m to the borehole termination depth. Vane tests were carried out at representative locations when soft cohesive soils were encountered. The boreholes were backfilled upon completion.

Groundwater elevations were obtained by measuring the water levels in the open boreholes prior to backfilling.

MTO Central Region Surveys and Plans Section provided survey information for the boreholes.

ii) Laboratory

Laboratory testing was carried out on representative samples to identify and determine the physical properties of the subsurface deposits including:

- Natural Moisture Content
- Atterburg Limits
- Grain Size Distribution
- Bulk Unit Weight
- Unconfined Uniaxial Compression

The results of the laboratory tests are plotted on the Record of Borehole sheets and on Plasticity Charts, Figures 1 and 2.

Subsurface Conditions

General

The definitions of the soil types and boundaries were developed as part of the original foundation report for the 1988 structure widening. Subsequent to that foundation investigation, the classification of cohesive soils at MTO was revised. The silty clay deposit encountered across much of the site is a low plasticity material and would currently be identified as a clayey silt deposit. However, for the ease of presenting the data, the original classifications have been maintained for this report.

The Twelve Mile Creek crossing extends for approximately 225 m. The depth of the valley is in the order of 12 m deep. The subsoil encountered at the site consists of an extensive deposit of silty clay within the valley slopes and a variety of alluvial deposits within the valley floor. The overburden at the crest of the west slope extends for a depth of 27.3m and overlies shale bedrock encountered at El.63.9. At the top of the east slope, the overburden is 28.8 m, overlying the shale

bedrock encountered at El. 62.6.

Within the valley, an organic silt to clay deposit extends below the silty clay deposit on the west side of the creek. On the east side coarser granular deposits were encountered. Cobbles and boulders were encountered at varying elevations across the site. Within the valley they were present within the non-cohesive fluvial deposits. BH 10 was terminated in a deposit of gravel, cobbles and boulders encountered at El. 67.1.

Shale bedrock of the Queenston Formation was encountered in all but three boreholes. The surface of the bedrock across the site varies from El. 62.5 and 66.8.

The groundwater level was measured in the open boreholes and was present at depths varying from 14.8 m at the top of the valley slopes to 0 within the valley. Generally, the ground water levels were consistent with the elevation of the creek.

The boundaries of the various strata, together with field and laboratory test results, appear on the Record of Borehole Sheets appended to this report. The locations of the borings in plan and the stratigraphical profile are shown on Drawing No. 88600-A. A detailed description of the subsurface conditions is given below.

Gravel, Sand, Clay and Asphalt (Fill)

A 1.4 m thick non-cohesive fill deposit containing varying amounts of gravel, sand, clay and asphalt was encountered only in BH 4 (East Pier). From standard penetration testing an N value of 34 was obtained, indicating that the fill is in a dense state.

Silty Clay

A surficial deposit of cohesive low plasticity silty clay was encountered in all but four boreholes. The clayey silt is the only deposit encountered in BH 13 advanced at the west end of the site and it extends for a depth of 27.3m to the top of bedrock (El. 63.9). At other locations, the thickness of the deposit ranges from 1.5 m within the valley to 26.5 m at the crest of the east slope. It is occasionally interbedded with granular seams. In BH 4, a zone of cobbles and boulders was encountered at approximate El. 80. The silty clay stratum contains trace/some sand and trace/some gravel. N values for this material range from 0, increasing with depth to greater than 120 blows per 15 cm. More typically N values range from 20 to 74, indicating that the clayey silt is very stiff to hard in consistency. The following soil properties were determined from laboratory testing carried out on representative samples:

| | <u>Range</u> | <u>Average</u> |
|---------------------------------|-------------------------------|------------------------|
| Moisture Content (w) | 5 - 30 % | 14.5% |
| Plastic Limit (w_p) | 11 - 26% | 16.1% |
| Liquid Limit (w_L) | 17 - 44% | 26.5% |
| Unit Weight (γ) | 20.6 - 22.8 kN/m ³ | 21.7 kN/m ³ |
| Shear Strength (kPa) | 80 kPa | |
| Sensitivity | 6 | |
| Unconfined Compressive Strength | 156 kPa | |

The Atterburg limits test results are plotted on the plasticity chart in Figure 1.

Silty Sand to Sandy Silt

A non-cohesive deposit of silty sand to sandy silt was encountered beneath the clayey silt stratum in boreholes 1, 2, 3, 5, 6, and 14, and interbedded within the clayey silt stratum in BH's 11 and 12. The thickness of the silty sand to sandy silt ranges from 1.3 m thick in BH 11 to 8.3 m thick in BH 3, advanced on the east side of Twelve Mile Creek. The sand to silty sand deposit extends to bedrock in boreholes 1, 2, 3, 5, 6, and 14. N values ranging from 9 to in excess of 120 blows per 30 cm were obtained from Standard Penetration testing. More typically the N values exceeded 120 blows per 30 cm, revealing that the non-cohesive deposit is in a very dense state of compaction. The composition of the deposit makes it susceptible to disturbance under conditions of unbalanced hydrostatic head. Based on laboratory testing carried out on representative samples, the moisture content of this deposit ranges from 7% to 25%.

Organic Clay/Organic Silt/Peat

Organic deposits were encountered in BH's 9 and 10 advanced along west bank of Twelve Mile Creek. Organic pockets were also present within the upper silty clay deposit in BH's 5 and 6 located on the east bank of the creek. On the west bank, the organic material varied from 2.3 to 5.3 m in thickness. It was encountered between elevations 71.3 and 76.6. The N values ranged from 0 to 11, but were typically in the order of 2 to 4, revealing a consistency of very soft to soft.

| | <u>Range</u> | <u>Average</u> |
|-------------------------|--------------|----------------|
| Moisture Content (w) | 38 - 119 % | 70% |
| Plastic Limit (w_p) | 21 - 31% | 26.2% |
| Liquid Limit (w_L) | 17 - 44% | 39.4% |

The Atterburg limits test results are plotted on the plasticity chart in Figure 2.

Silty Clay to Silt

A cohesive deposit of low plasticity silty clay to silt was found in BH's 7, 10 and 12. The deposit was encountered between elevations 65.3 and 67.3 and varied in thickness from 2.5 to 4.9 m. It was composed predominantly of silt with the occasional sand seam. N values for this material ranged from 23 to greater than 120 blows per 30 cm. Generally the N values were greater than 100, indicating a hard consistency for the deposit. The following properties were obtained from laboratory testing:

| | <u>Range</u> |
|-------------------------|--------------|
| Moisture Content (w) | 16 - 24% |
| Plastic Limit (w_p) | 14 - 15% |
| Liquid Limit (w_L) | 22 - 23% |

Bedrock

Bedrock was proven in all boreholes except BH's 2, 10 and 13. The bedrock is shale of the Queenston Formation. The following are bedrock elevations encountered at the borehole locations:

| <u>Borehole</u> | <u>Bedrock Elevation</u> | |
|-----------------|--------------------------|--------------|
| | <u>Weathered</u> | <u>Sound</u> |
| 1 | - | 62.6 |
| 3 | 63.2 | 62.9 |
| 4 | 65.3 | 63.0 |
| 5 | 63.5 | 62.6 |
| 6 | 63.8 | 63.0 |
| 7 | 65.2 | 63.5 |
| 8 | 66.8 | 65.3 |
| 9 | 64.2 | 62.9 |
| 11 | 65.0 | 63.7 |
| 12 | 65.3 | 63.9 |
| 14 | 63.7 | 63.1 |

Groundwater Conditions

Water levels were measured in the open holes at the completion of each borehole.

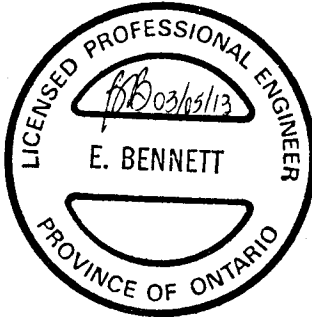
At the time of the investigation in 1986, the following groundwater elevations were measured:

| <u>Borehole</u> | <u>Groundwater Elevation</u> |
|-----------------|------------------------------|
| 1 | 88.5 |
| 2 | 76.6 |
| 3 | 76.2 |
| 4 | Not observed |
| 5 | 78.7 |
| 6 | 78.7 |
| 7 | 78.7 |
| 8 | 78.7 |
| 9 | 79.3 |
| 10 | 78.4 |
| 11 | 80.9 |
| 12 | 80.0 |
| 13 | 89.0 |
| 14 | 82.0 |

The creek elevation recorded in October 2002 was 78.9.

Miscellaneous

The original foundation investigation was carried out by Paul Payer, Sr. Foundation Engineer, in 1986. This updated report was prepared by B. Bennett, and was reviewed by D. Dundas, Senior Foundation Engineer.

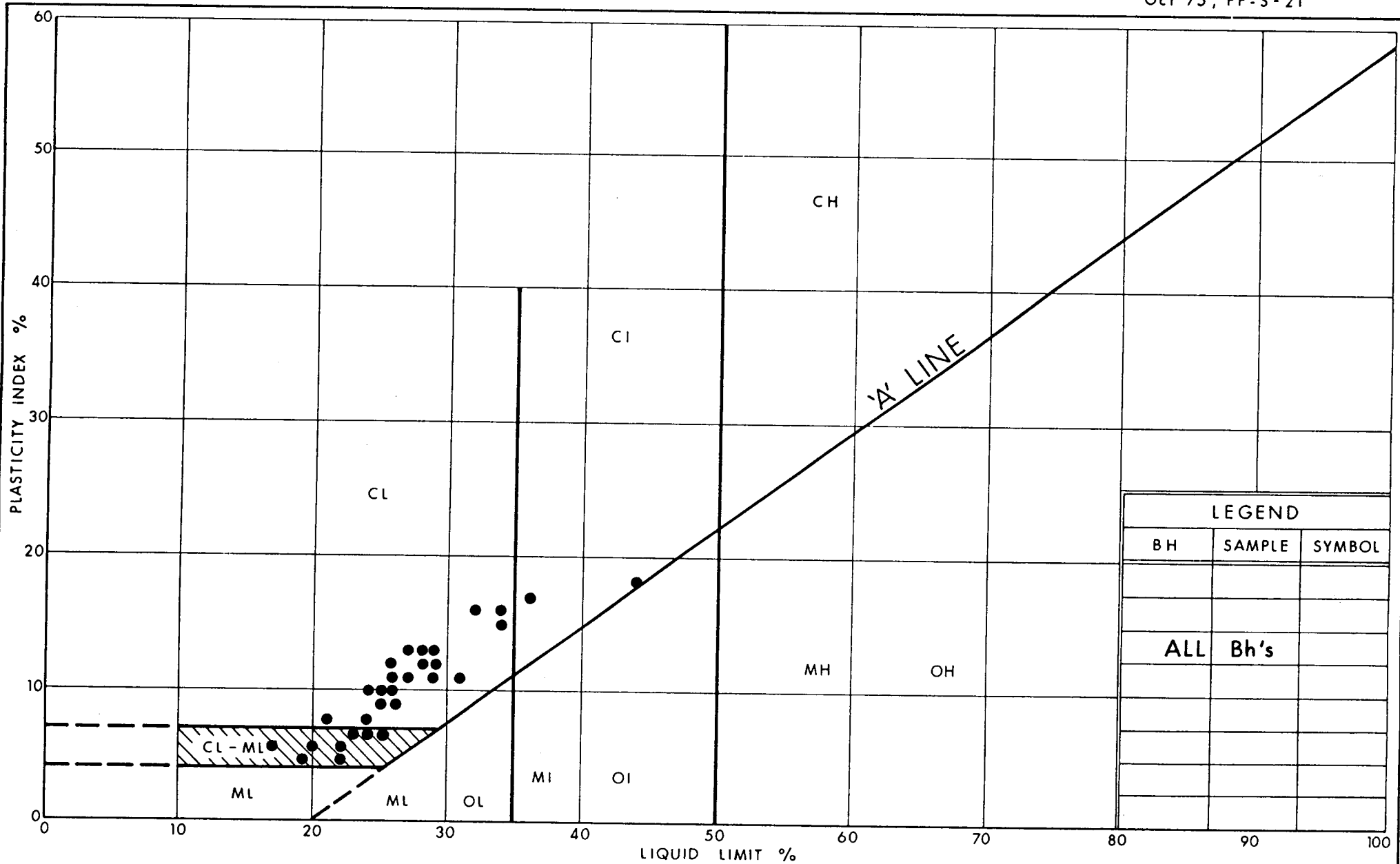


B. Bennett
Betty Bennett, P.Eng.
Foundation Engineer



D. Dundas
David Dundas, P.Eng.
Sr. Foundation Engineer

APPENDIX



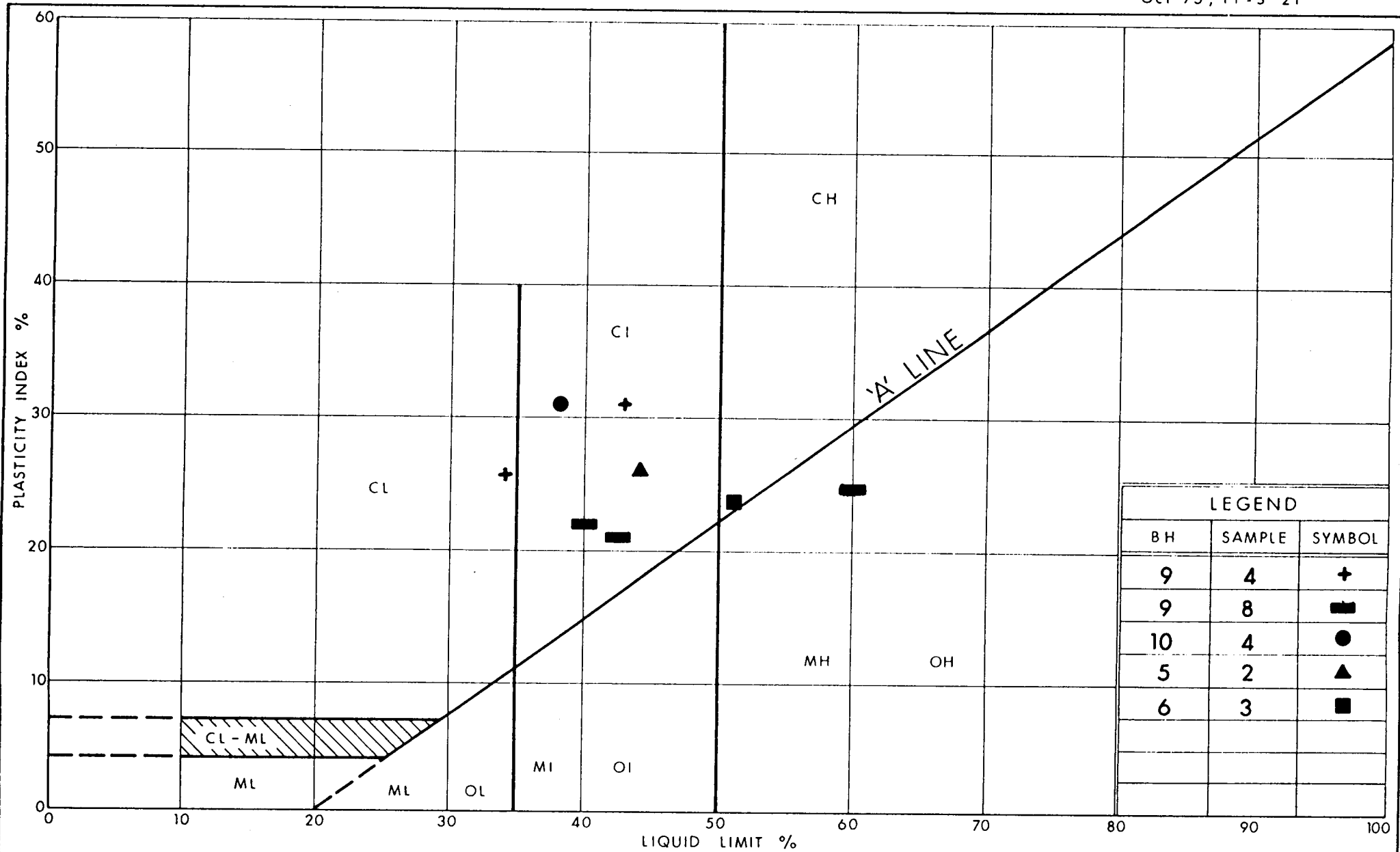
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PLASTICITY CHART SILTY CLAY

FIG No 1

W P 199-00-00



RECORD OF BOREHOLE No 1

METRIC

W P 8-86-00 LOCATION Co-ords. N 4781898.0 E 323379.7 ORIGINATED BY WD
 DIST 4 HWY Q.E.W. BOREHOLE TYPE 'Cont' Flight Auger (H.S.) COMPILED BY DG
 DATUM Geodetic DATE 86 02 27 CHECKED BY SD

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L | WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|--|------------------|--------|------|-------------------------|-----------------|---|--|--|-------------------------------|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | | | | | | |
| 91.4 0.0 | Ground Surface | | | | | | | | | | | |
| | Silty Clay trace/some sand trace of gravel | | 1 | SS | 6 | | | | | | | 2 12 (86) |
| | | | 2 | SS | 12 | | | | | | | |
| | | | 3 | SS | 20 | | | | | | | |
| | | | 4 | SS | 23 | | | | | | | |
| | | | 5 | SS | 43 | | | | | | | |
| | | | 6 | SS | 53 | | | | | | | |
| | | | 7 | SS | 62 | | | | | | | |
| | | | 8 | SS | 59 | | | | | | | |
| | | | 9 | SS | 43 | | | | | | | |
| | | | 10 | SS | 50 | | | | | | | 1 5 (94) |
| | | | 11 | SS | 48 | | | | | | | |
| | | Occ. Silt Layers | 12 | SS | 83 | | | | | | | |
| | | | 13 | SS | 43 | | | | | | | |
| | | | 14 | SS | 45 | | | | | | | |
| | | Firm to Hard | 15 | SS | 53 | | | | | | | |
| | 16 | | SS | 20 | | | | | | | | |
| | 17 | | SS | 100 | 23 cm | | | | | | | |
| 64.9 | Sandy Silt Trace of Clay some gravel Very Dense | | 18 | SS | 108 | | | | | | | 0 3 (97) |
| 26.5 | | | 19 | SS | 100 | | | | | | | |
| 62.6 | Shale Sound Bedrock | | 21 | RC | REC | | | | | | | |
| 28.8 | | | 22 | NQ | 96% | | | | | | | |
| 60.5 | | | | | | | | | | | | |
| 30.9 | End of Borehole | | | | | | | | | | | |

RECORD OF BOREHOLE No 2

METRIC

W P 8-86-00 LOCATION Co-ords. N 4781931.6 E 323366.8
 DIST 4 HWY Q.E.W BOREHOLE TYPE Cont. Flight Auger (H.S.)
 DATUM Geodetic DATE 86 02 12 & 13
 ORIGINATED BY WD
 COMPILED BY PP
 CHECKED BY *ab*

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|---------------|--------|------|----------------------------|--------------------|---|---------------------------------|----------------------------------|--------------------------------|------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | | | | | | |
| 91.4 | Ground Level | | | | | | | | | | | |
| 0.0 | | | 1 | SS | 22 | | | | | | | |
| | | | 2 | SS | 24 | | | | | | | |
| | | | 3 | SS | 38 | | | | | | | |
| | | | 4 | SS | 33 | | | | | | | |
| | | | 5 | SS | 19 | | | | | | | |
| | | | 6 | SS | 18 | | | | | | | |
| | | | 7 | SS | 16 | | | | | | | |
| | | | 8 | TW | PH | | | | | | | |
| | | | 9 | TW | PH | | | | | | | |
| | | | 10 | SS | 23 | | | | | | | |
| | Silty Clay trace/some sand trace/some gravel Occ. silt layers | | 11 | SS | 29 | | | | | | | |
| | | | 12 | SS | 32 | | | | | | | |
| | | | 13 | SS | 36 | | | | | | | |
| | | | 14 | SS | 44 | | | | | | | |
| | | | 15 | SS | 34 | | | | | | | |
| | Firm to Hard | | 16 | SS | 18 | | | | | | | |
| | | | 17 | SS | 150 | | | | | | | |
| 67.6 | | | | | | | | | | | | |
| 23.8 | Silty Sand some clay Very Dense | | 18 | SS | 95 | 15cm | | | | | | |
| | | | 19 | SS | 83 | | | | | | | |
| 62.7 | | | | | | | | | | | | |
| 28.7 | Refusal | | | | | | | | | | | |
| | End of Borehole | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION



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RECORD OF BOREHOLE No 3

METRIC

W P 8-86-00 LOCATION Co-ords N 4 781 891.4 E 323 360.8 ORIGINATED BY WD
DIST 4 HWY Q.E.W. BOREHOLE TYPE Wash Boring (NW Casing) COMPILED BY WD
DATUM Geodetic DATE 86 04 09 CHECKED BY SD

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60 | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|------------------|------------|---------|------|------------|-------------------------|-----------------|---|---|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 86.1 | Ground Surface | | | | | | | | | | |
| 0.0 | | | 1 | SS | 10 | | | | | | |
| | Silty Clay | | 2 | SS | 8 | | | | | | 1 14 56 29 |
| | trace/some sand | | 3 | SS | 12 | | | | | | |
| | trace of gravel | | 4 | SS | 12 | | | | | | |
| | | | 5 | SS | 41 | | | | | | |
| | Occ. silt Layers | | 6 | SS | 82 | 23 cm | | | | | |
| | | | 7 | SS | 86 | | | | | | |
| | | | 8 | SS | 84 | 23 cm | | | | | 1 4 69 26 |
| | | | 9 | SS | 83 | | | | | | |
| | Stiff to Hard | | 10 | SS | 58 | | | | | | |
| | | | 11 | SS | 43 | | | | | | |
| | | | 12 | SS | 11 | | | | | | |
| | | | 13 | SS | 48 | | | | | | |
| | | | 14 | SS | 33 | | | | | | |
| 71.5 | | | 15 | SS | 100 | 13 cm | | | | | 0 12 60 28 |
| 14.6 | Silty Sand | | 16 | SS | 98 | 15 cm | | | | | |
| | trace of clay | | 17 | SS | 100 | 20 cm | | | | | 0 64 26 10 |
| | trace of gravel | | 18 | SS | 73 | 20 cm | | | | | |
| | Very Dense | | | | | | | | | | |
| 63.2 | | | 19 | RC | REC | | | | | | |
| 22.9 | Shale | | | BQ | 92% | | | | | | |
| 61.7 | Bedrock | | | | | | | | | | |
| 24.4 | End of Borehole | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity
20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 8-86-00 LOCATION Co-ords. N 4 781 923.4 E 323 349.7
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Wash Boring (NW Casing) ORIGINATED BY WD
 DATUM Geodetic DATE 86 04 17 COMPILED BY WD
 CHECKED BY *LB*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|---------------|-------------|------------|---------|------|------------|----------------------------|-----------------|---|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | | | | | | | WATER CONTENT (%) |
| | | | | | | | | SHEAR STRENGTH | | | | | | | |

| | | | | | | | | | | | | | | | |
|------|--|--|----|----------|------------|-------|-------|--|--|--|--|--|--|-------------|-----------|
| 87.5 | Ground Surface | | | | | | | | | | | | | | |
| 0.0 | Gravel, Sand, Clay and Asphalt | | 1 | SS | 34 | * | | | | | | | | GR SA SI CL | |
| 86.1 | Fill Material | | 2 | SS | 39 | | | | | | | | | | |
| 1.4 | Silty Clay trace/some sand trace of gravel | | 3 | SS | 90 | | | | | | | | | 1 10 69 20 | |
| | | | 4 | SS | 67 | | | | | | | | | | |
| | | | 5 | SS | 99 | | | | | | | | | | |
| | | | 6 | SS | 69 | 20 cm | | | | | | | | | |
| | | | 7 | SS | 81 | 25 cm | | | | | | | | | |
| | | | 8 | SS | 81 | | | | | | | | | | |
| | | cobbles and boulders | | 9 | SS | 58 | 10 cm | | | | | | | | 1 5 69 25 |
| | | | | 10 | SS | 81 | 25 cm | | | | | | | | |
| | | | | 11 | SS | 74 | | | | | | | | | |
| | | Occ. Silt Layers | | 12 | SS | 84 | | | | | | | | | |
| | | Hard | | 13 | SS | 47 | | | | | | | | | |
| | | | | 14 | SS | 28 | | | | | | | | | 1 1 62 36 |
| 72.7 | | | | 15 | SS | 41 | 10 cm | | | | | | | | |
| 14.8 | | Sand and Gravel trace of silt Very Dense | | 16 | SS | 30 | 8 cm | | | | | | | | |
| 70.5 | Silty Clay some gravel some sand occ. sand layers Hard | | 17 | SS | 103 | 15 cm | | | | | | | | 27 13 50 10 | |
| 17.0 | | | 18 | RC BQ | REC 22% | | | | | | | | | | |
| 65.3 | Shale | | 19 | RC BQ | REC 72% | | | | | | | | | | |
| 22.2 | Bedrock Weathered | | | | | | | | | | | | | | |
| 62.2 | Bedrock Sound | | | | | | | | | | | | | | |
| 25.3 | End of Borehole | | | | | | | | | | | | | | |
| | * Water Level Not Observed | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 8-86-00 LOCATION Co-ords N 4 781 878.5 E 323 325.5
DIST 4 HWY Q.E.W. BOREHOLE TYPE Wash Boring - NX Casing
DATUM Geodetic DATE 86 03 25

ORIGINATED BY WD
COMPILED BY DC
CHECKED BY *SD*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|----------|------------|----------------------------|-----------------|---|-----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | | | | | |
| 78.7 | Creek Water Level | | | | | | | | | | | | | |
| 0.0 | Water Creek Bed | | | | | | 78 | | | | | | | |
| 77.2 1.5 | Silty Clay trace of sand Occ. organic layers and pockets Very Soft to Soft | | 1 | SS | 1 | | 76 | | | | | | 17.1 | 0 3 64 33 |
| 74.9 3.8 | Sand and Gravel trace/some silt trace/some clay Occ. silty clay layers | | 2 | TW | PM | | 74 | | | | | | | 34 28 26 12 |
| | | | 3 | SS | 5 | | 72 | | | | | | | 60 29 7 4 |
| | | | 4 | SS | 16 | | 70 | | | | | | | |
| | | | 5 | SS | 10 | | 68 | | | | | | | |
| | | | 6 | SS | 48 | | 66 | | | | | | | |
| | | | 7 | SS | 90 | 15 cm | 64 | | | | | | | |
| | | | 8 | SS | 100 | 18 cm | 62 | | | | | | | |
| 68.9 | Loose to Very Dense | | 9 | SS | 81 | 23 cm | 60 | | | | | | | |
| 9.8 | Silty Clay trace of sand Hard | | 10 | SS | 51 | 10 cm | | | | | | | | |
| 67.4 | | | 11 | SS | 100 | 10 cm | | | | | | | | |
| 11.3 | Sandy Silt some clay occ. silty clay layers | | 12 | SS | 100 | 13 cm | | | | | | | | |
| | Very Dense | | 13 | RC BX | REC 56% | | | | | | | | | |
| 63.5 | Weathered Shale | | 14 | RC BX | REC 80% | | | | | | | | | |
| 15.2 | Sound Bedrock | | | | | | | | | | | | | |
| 60.4 | | | | | | | | | | | | | | |
| 18.3 | End of Borehole | | | | | | 60 | | | | | | | |



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RECORD OF BOREHOLE No 6

METRIC

W P 8-86-00 LOCATION Co-ords N 4 781 909.5 E 323 313.6
DIST 4 HWY Q.E.W. BOREHOLE TYPE Wash Boring - NX Casing
DATUM Geodetic DATE 86 03 20

ORIGINATED BY WD
COMPILED BY DC
CHECKED BY *SD*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--------------------|------------|---------|------|------------|----------------------------|-----------------|---|---------------|---------------|---------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 5 10 15 20 25 | 5 10 15 20 25 | 5 10 15 20 25 | | | | | |
| 78.7 | Water Surface | | | | | | | | | | | | | | | |
| 0.0 | Water | | | | | | | | | | | | | | | |
| 77.2 | Creek Bed | | | | | | | | | | | | | | | |
| 1.5 | Sand & Gravel | | 1 | SS | 0 | | | | | | | | | | | |
| 76.5 | Very Loose | | | | | | | | | | | | | | | |
| 2.2 | Silty Clay | | 2 | SS | 0 | | | | | | | | | | | |
| | to Clay | | | | | | | | | | | | | | | |
| | Occ. Organic Seams | | 3 | TW | PM | | | | | | | | | | | |
| 74.1 | Very Soft to Firm | | 4 | SS | 9 | | | | | | | | | | | |
| 4.6 | Silty Sand with | | | | | | | | | | | | | | | |
| | Gravel | | | | | | | | | | | | | | | |
| 72.3 | trace of clay | | 5 | SS | 43 | | | | | | | | | | | |
| 6.4 | Compact to Dense | | | | | | | | | | | | | | | |
| | Silty Clay | | 6 | SS | 45 | | | | | | | | | | | |
| | trace of sand | | | | | | | | | | | | | | | |
| 70.5 | Hard | | 7 | SS | 11 | 3 cm | | | | | | | | | | |
| 8.5 | | | | | | | | | | | | | | | | |
| | Sandy Silt | | 8 | SS | 90 | 15 cm | | | | | | | | | | |
| | trace/some gravel | | | | | | | | | | | | | | | |
| | trace of clay | | 9 | SS | 32 | 5 cm | | | | | | | | | | |
| | Occasional silty | | | | | | | | | | | | | | | |
| | clay layers | | 10 | SS | 67 | 13 cm | | | | | | | | | | |
| | Very Dense | | | | | | | | | | | | | | | |
| | | | 11 | SS | 47 | 15 cm | | | | | | | | | | |
| 63.8 | | | | | | | | | | | | | | | | |
| 14.9 | Weathered | | 12 | SS | 100 | 13 cm | | | | | | | | | | |
| | Shale | | 13 | RC | REC | | | | | | | | | | | |
| | Sound | | | BX | 72% | | | | | | | | | | | |
| | Bedrock | | 14 | RC | REC | | | | | | | | | | | |
| 60.7 | | | | BX | 98% | | | | | | | | | | | |
| 18.0 | End of Borehole | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to 20
Sensitivity 15 5 (%) STRAIN AT FAILURE
1C

RECORD OF BOREHOLE No 7

METRIC

W P 8-86-00 LOCATION Co-ords. N 4 781 867.0 E 323 280.0 ORIGINATED BY WD
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Wash Boring NW Casing COMPILED BY WD
 DATUM Geodetic DATE 86 04 01 CHECKED BY WD

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|---------|----------|------------|----------------------------|-----------------|---|----------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 | | | | | |
| 78.7 0.0 | Creek Water Level | | | | | | | | | | | | | GR SA SI CL |
| 73.2 5.5 | Creek Bed | | | | | | | | | | | | | |
| | Heterogenous Mixture of gravel, sand silt, clay | | 1 | SS | 7 | | | | | | | | | 21 48 21 10 |
| | | | 2 | SS | 38 | | | | | | | | | |
| | | | 3 | SS | 74/ | 8 cm | | | | | | | | |
| | | | 4 | SS | 38/ | 5 cm | | | | | | | | |
| | | | 5 | SS | 100/ | 8 cm | | | | | | | | 42 17 34 7 |
| | | | 6 | SS | 100/ | 15 cm | | | | | | | | |
| 67.9 10.8 | Firm to Hard | | 7 | SS | 100/ | 18 cm | | | | | | | | |
| | Silty Clay to Silt | | 8 | SS | 79/ | 20 cm | | | | | | | | |
| | | | 9 | SS | 75/ | 15 cm | | | | | | | | 0 0 84 16 |
| 65.2 13.5 | Hard | | 10 | SS | 100/ | 8 cm | | | | | | | | |
| | Shale Weathered | | 11 | RC BQ | REC 75% | | | | | | | | | |
| 62.2 16.5 | Bedrock Sound | | 12 | RC BQ | REC 88% | | | | | | | | | |
| | End of Borehole | | | | | | | | | | | | | |

*3, x5: Numbers refer to
Sensitivity

20
15 x 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 8

METRIC

W P 8-86-00 LOCATION Co-ords. N 4 781 894.5 E 323 273.0
DIST 4 HWY Q.E.W. BOREHOLE TYPE Wash Boring (NW Casing)
DATUM Geodetic DATE 86 04 03

ORIGINATED BY WD
COMPILED BY WD
CHECKED BY *ld*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|--|------------|---------|----------|------------|-------------------------|-----------------|---|--|---------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 78.7 | Creek Water Level | | | | | | | | | | |
| | Water | | | | | | | | | | |
| 74.3 | Creek Bed | | | | | | | | | | |
| 4.3 | Sandy Silt some gravel trace of clay Loose to Compact | | 1 | SS | 8 | | | | | | |
| 72.6 | | | 2 | SS | 20 | | | | | | |
| 6.1 | | | 3 | SS | 28 | | | | | | |
| | Silty Clay some sand trace gravel Very Stiff to Hard | | 4 | SS | 49 | 15 cm | | | | | |
| | | | 5 | SS | 407 | 10 cm | | | | | |
| | | | 6 | SS | 357 | 5 cm | | | | | |
| | | | 7 | SS | 100 | 8 cm | | | | | |
| | | | 8 | SS | 687 | 2 cm | | | | | |
| | | | 9 | SS | 317 | 15 cm | | | | | |
| 66.8 | | | 10 | SS | 917 | 0 cm | | | | | |
| 11.9 | Shale - Weathered Sound | | 11 | SS | 1007 | 0 cm | | | | | |
| | Bedrock | | 12 | SS | 1007 | 0 cm | | | | | |
| | | | 13 | RC BQ | REC 82% | | | | | | |
| 62.3 | | | 14 | RC BQ | REC 92% | | | | | | |
| 16.4 | End of Borehole | | | | | | | | | | |



RECORD OF BOREHOLE No 9

METRIC

W P 8-86-00 LOCATION N 4 781 846.3 E 323 240.9 ORIGINATED BY WD
DIST 4 HWY Q.E.W. BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY PP
DATUM Genderic DATE 86 03 18 & 19 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|----------|-------------|----------------------------|--------------------|--|---|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 79.5 | Ground Level | | | | | | | | | | |
| 0.0 | Silty Clay with sand trace of gravel Firm | | 1 | SS | 4 | | | | | | 2 35 (63) |
| 76.6 | | | 2 | SS | 5 | | | | | | |
| 2.9 | | | 3 | SS | 4 | | | | | | |
| | Organic Clay and Peat Layers Very Soft to Soft | | 4 | SS | 4 | | | | | | |
| | | | 5 | SS | 4 | | | | | | |
| | | | 6 | SS | 11 | | | | | | |
| | | | 7 | SS | 2 | | | | | | |
| | | | 8 | SS | 1 | | | | | | 0 6 (94) |
| | | | 9 | SS | 4 | | | | | | |
| 71.3 | | | 10 | TW | PH | | | | | | |
| 8.2 | Heterogenous Mixture of gravel, sand, silt, clay | | 11 | SS | 100 | 15 cm | | | | | 14 78 (8) |
| | | | 12 | SS | 100 | 15 cm | | | | | 0 88 (12) |
| | | | 13 | SS | 110 | 15 cm | | | | | |
| | | | 14 | SS | 100 | 10 cm | | | | | |
| | Hard | | 15 | SS | 150 | | | | | | 20 35 (45) |
| | | | 16 | SS | 100 | 5 cm | | | | | |
| 64.2 | | | 17 | SS | 100 | 10 cm | | | | | |
| 15.3 | Shale Weathered Sound | | 18 | RC NQ | REC 53% | | | | | | |
| | Bedrock | | 19 | RC NQ | REC 100% | | | | | | |
| | | | 20 | RC NQ | REC 100% | | | | | | |
| 59.7 | | | | | | | | | | | |
| 19.8 | End of Borehole | | | | | | | | | | |

METRIC

W P 8-86-00 LOCATION Co-ords. N 4 781 877.5 E 323 228.6 ORIGINATED BY WD
DIST 4 HWY Q.E.W. BOREHOLE TYPE Cont. Flight Auger H.S. COMPILED BY DC
DATUM Geodetic DATE 86 02 14 CHECKED BY l.j.

[illegible]

3, x5: Numbers refer to Sensitivity



RECORD OF BOREHOLE No 11

METRIC

W P 8-86-00 LOCATION Co-ords. N 4 781 830.2 E 323 197.6 ORIGINATED BY WD
DIST 4 HWY Q.E.W. BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY DC
DATUM Geodetic DATE 86 02 19 CHECKED BY LB

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|--|------------|---------|----------|-------------|-------------------------|-----------------|---|---|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 81.8 0.0 | Ground Surface | | | | | | | | | | |
| | Silty Clay trace sand Firm to Very Stiff Some Gravel | | 1 | SS | 5 | | | | | | 14 7 (79) |
| | | | 2 | SS | 22 | | | | | | |
| | | | 3 | SS | 27 | | | | | | |
| | | | 4 | SS | 25 | | | | | | |
| | | | 5 | SS | 21 | | | | | | |
| | | | 6 | SS | 16 | | | | | | |
| | | | 7 | SS | 17 | | | | | | |
| 75.6 6.2 | Silt to Sandy Silt trace clay Dense | | 8 | TW | PH | | | | | | 0 10 87 3 |
| 74.3 | | | 9 | SS | 45 | | | | | | |
| 7.5 | Silty Clay Some Sand Some Gravel Hard | | 10 | SS | 76 | | | | | | 15 28 (57) |
| | | | 11 | SS | 41 | | | | | | |
| | | | 12 | SS | 59 | | | | | | |
| | | | 13 | SS | 63 | | | | | | |
| | | | 14 | SS | 100 | 10 cm | | | | | |
| | | | 15 | SS | 100 | 15 cm | | | | | |
| | | | 16 | SS | 144 | 25 cm | | | | | |
| | | | 17 | SS | 100 | 7 cm | | | | | |
| 65.0 16.8 | Shale - Weathered Sound Bedrock | | 18 | RC NQ | REC 40% | | | | | | 0 5 83 12 |
| | | | 19 | RC NQ | REC 50% | | | | | | |
| | | | 20 | RC NQ | REC 100% | | | | | | |
| 62.0 19.8 | End of Borehole | | | | | | | | | | |



RECORD OF BOREHOLE No 12

METRIC

W P 8-86-00 LOCATION Co-ords. N 4 781 860.5 E 323 186.5 ORIGINATED BY WD
DIST 4 HWY Q.E.W. BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY DC
DATUM Geodetic DATE 86 02 20 CHECKED BY LB

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|-------------------------------|------------|-------------|------|------------|----------------------------|--------------------|---|----------------------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH kPa | | | | | | | WATER CONTENT (%) |
| | | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | + FIELD VANE x LAB VANE | | | | | | |
| 81.0 | Ground Surface | | | | | | 20 40 60 80 100 | | 20 40 60 | | | | | | |
| 0.0 | Silty Clay trace/some sand | | 1 SS | | 9 | | | | | | | | 0 14 (86) | | |
| | | | 2 SS | | 7 | | | | | | | | | | |
| | | | 3 SS | | 2 | | | | | | | | | | |
| | Soft to Stiff | | 4 SS | | 4 | | | | | | | | | | |
| | | | 5 SS | | 6 | | | | | | | | | | |
| 75.8 | | | 6 SS | | 5 | | | | | | | | | | |
| 5.2 | Sandy Silt to Silt | | 7 SS | | 9 | | | | | | | | 0 3 (97) | | |
| | Loose to Dense | | 8 SS | | 9 | | | | | | | | | | |
| 73.5 | | | 9 SS | | 38 | | | | | | | | | | |
| 7.5 | | | 10 SS | | 47 | | | | | | | | | | |
| | Silty Clay trace of sand | | 11 SS | | 46 | | | | | | | | | | |
| | | | 12 SS | | 85 | | | | | | | | | | |
| | Occ. Silt Layers | | 13 SS | | 147 | | | | | | | | | | |
| | Hard | | 14 SS | | 165 | | | | | | | | | | |
| | | | 15 SS | | 75 | | | | | | | | 0 10 (90) | | |
| 67.8 | | | 16 SS | | 103/20 cm | | | | | | | | | | |
| 13.2 | Silty Clay to Silt | | 17 SS | | 83/15 cm | | | | | | | | | | |
| | Occ. Sand Layers | | | | | | | | | | | | | | |
| 65.3 | Hard | | 18 RC NQ | | REC 80% | | | | | | | | | | |
| 15.7 | Shale Weathered Sound | | 19 RC NQ | | REC 95% | | | | | | | | | | |
| | Bedrock | | | | | | | | | | | | | | |
| 62.2 | | | | | | | | | | | | | | | |
| 18.8 | End of Borehole | | | | | | | | | | | | | | |



RECORD OF BOREHOLE No 13

METRIC

W P 8-86-00

LOCATION Co-ords. N 4 781 818.0 E 323 172.8

ORIGINATED BY WD

DIST 4 HWY Q.E.W.

BOREHOLE TYPE Cont. Flight Auger (H.S.)

COMPILED BY DC

DATUM Geodetic

DATE 86 03 03

CHECKED BY *10*

SOIL PROFILE

SAMPLES

GROUND WATER CONDITIONS

ELEVATION SCALE

DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH

○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL x LAB VANE

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT
W_p W W_L

WATER CONTENT (%)

20 40 60

UNIT WEIGHT
γ

REMARKS
&
GRAIN SIZE
DISTRIBUTION
(%)
GR SA SI CL

ELEV
DEPTH

DESCRIPTION

STRAT PLOT

NUMBER

TYPE

'N' VALUES

91.2
0.0

Ground Surface

Silty Clay
trace/some sand
trace of gravel

Stiff
to
Hard

Refusal
Probable Bedrock
End of Borehole

1

SS

12

2

SS

26

3

SS

38

4

SS

57

5

SS

32

6

SS

33

7

TW

PH

8

SS

30

9

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31

10

SS

31

11

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Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 14

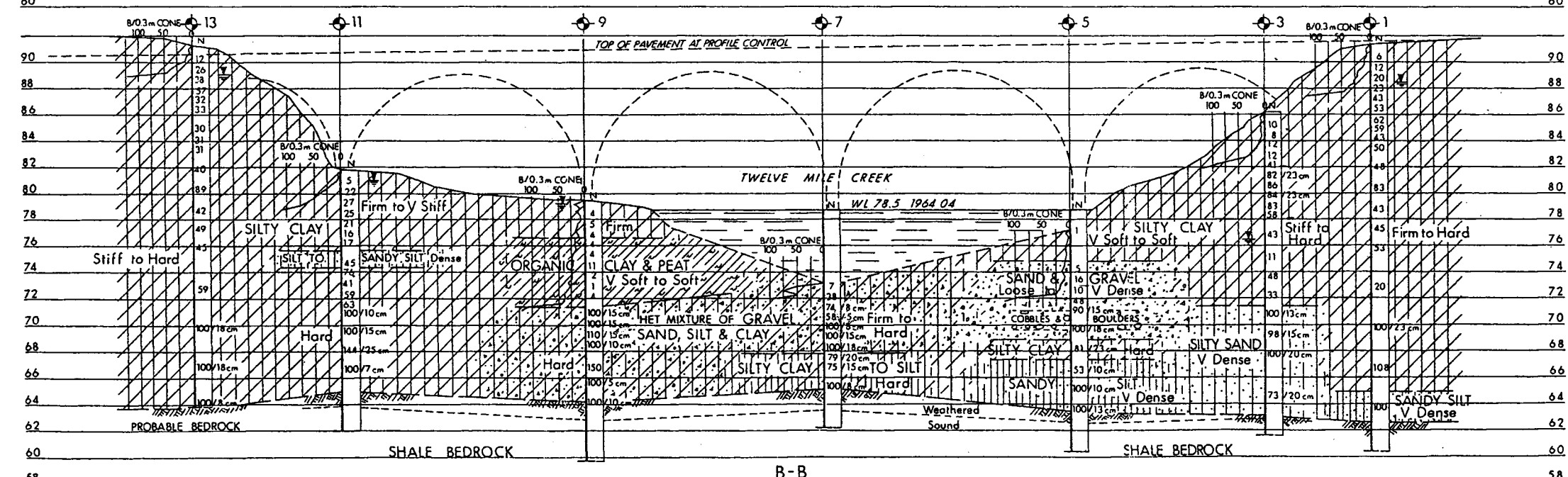
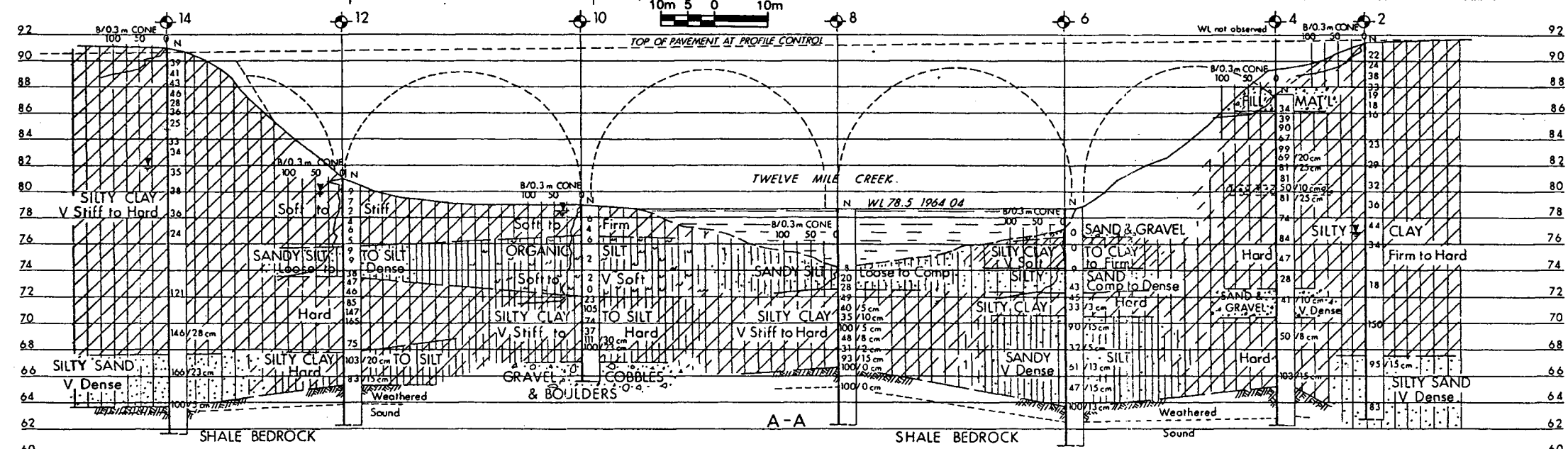
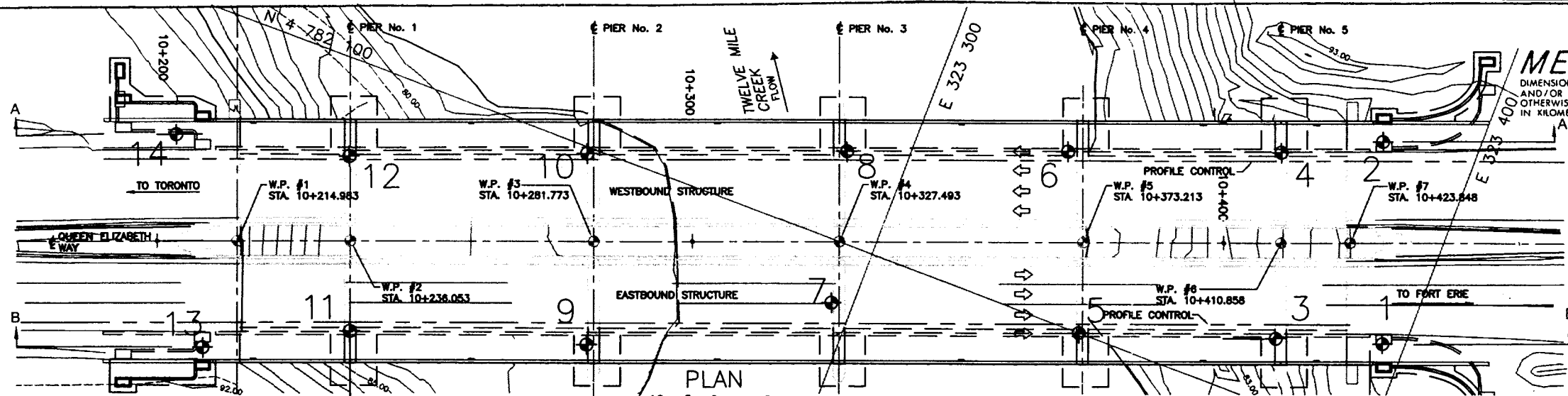
METRIC

W P 8-86-00 LOCATION N 4 781 852.7 E 323 154.5
DIST 4 HWY Q.E.W. BOREHOLE TYPE Cont. Flight Auger (H.S.)
DATUM Geodetic DATE 86 02 25
ORIGINATED BY WD
COMPILED BY DC
CHECKED BY *sk*

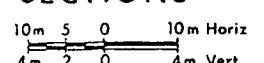
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60 | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|---|------------|--------|------|-------------------------|-----------------|---|---|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | | | | |
| 90.9 | Ground Level | | | | | | | | | |
| 0.0 | | | 1 | SS | 39 | | | | | |
| | | | 2 | SS | 41 | | | | | |
| | | | 3 | SS | 43 | | | | | |
| | | | 4 | SS | 46 | | | | | |
| | | | 5 | SS | 28 | | | | | |
| | | | 6 | SS | 36 | | | | | |
| | | | 7 | SS | 25 | | | | | |
| | | | 8 | TW | PH | | | | | |
| | | | 9 | SS | 33 | | | | | |
| | | | 10 | SS | 34 | | | | | |
| | Silty Clay some to trace sand Very Stiff to Hard trace of gravel | | 11 | SS | 35 | | | | | |
| | | | 12 | SS | 38 | | | | | |
| | | | 13 | SS | 36 | | | | | |
| | | | 15 | SS | 24 | | | | | |
| | | | 16 | TW | PH | | | | | |
| | | | 17 | SS | 121 | | | | | |
| | | | 18 | SS | 146/ 28 cm | | | | | |
| 67.7 | | | 19 | SS | 166/ 23 cm | | | | | |
| 23.2 | Silty Sand trace of gravel trace of clay Very Dense | | 20 | SS | 100/ 5 cm | | | | | |
| | | | 21 | RC | 54% | | | | | |
| 63.7 | | | 22 | RC | 100% | | | | | |
| 27.2 | Shale Bedrock | | | | | | | | | |
| 61.6 | | | | | | | | | | |
| 29.3 | End of Borehole | | | | | | | | | |

*3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



SECTIONS



NOTE: REFER TO RECORD OF BOREHOLE FOR DETAILED SOIL DESCRIPTION

CONT No

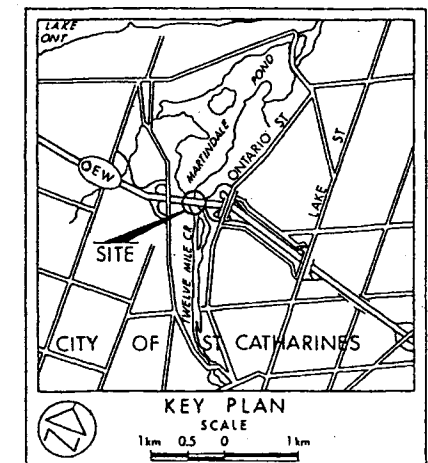
WP No 8-86-00

GWP No 199-00-00

SHEET

TWELVE MILE CREEK

BORE HOLE LOCATIONS & SOIL STRATA



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (3rd Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 1986 02, 03 & 04

| No | ELEVATION | CO-ORDINATES NORTH | CO-ORDINATES EAST |
|----|-----------|--------------------|-------------------|
| 1 | 91.4 | 4781898.0 | 323379.7 |
| 2 | 91.4 | 4781931.6 | 323366.8 |
| 3 | 86.1 | 4781891.4 | 323360.8 |
| 4 | 87.5 | 4781923.4 | 323349.7 |
| 5 | 78.7 | 4781878.5 | 323325.5 |
| 6 | 78.7 | 4781909.5 | 323313.5 |
| 7 | 78.7 | 4781867.0 | 323280.0 |
| 8 | 78.7 | 4781894.5 | 323273.0 |
| 9 | 79.5 | 4781846.3 | 323240.9 |
| 10 | 79.0 | 4781877.5 | 323228.6 |
| 11 | 81.8 | 4781830.2 | 323197.6 |
| 12 | 81.0 | 4781860.5 | 323186.5 |
| 13 | 91.2 | 4781818.0 | 323172.8 |
| 14 | 90.9 | 4781852.7 | 323154.5 |

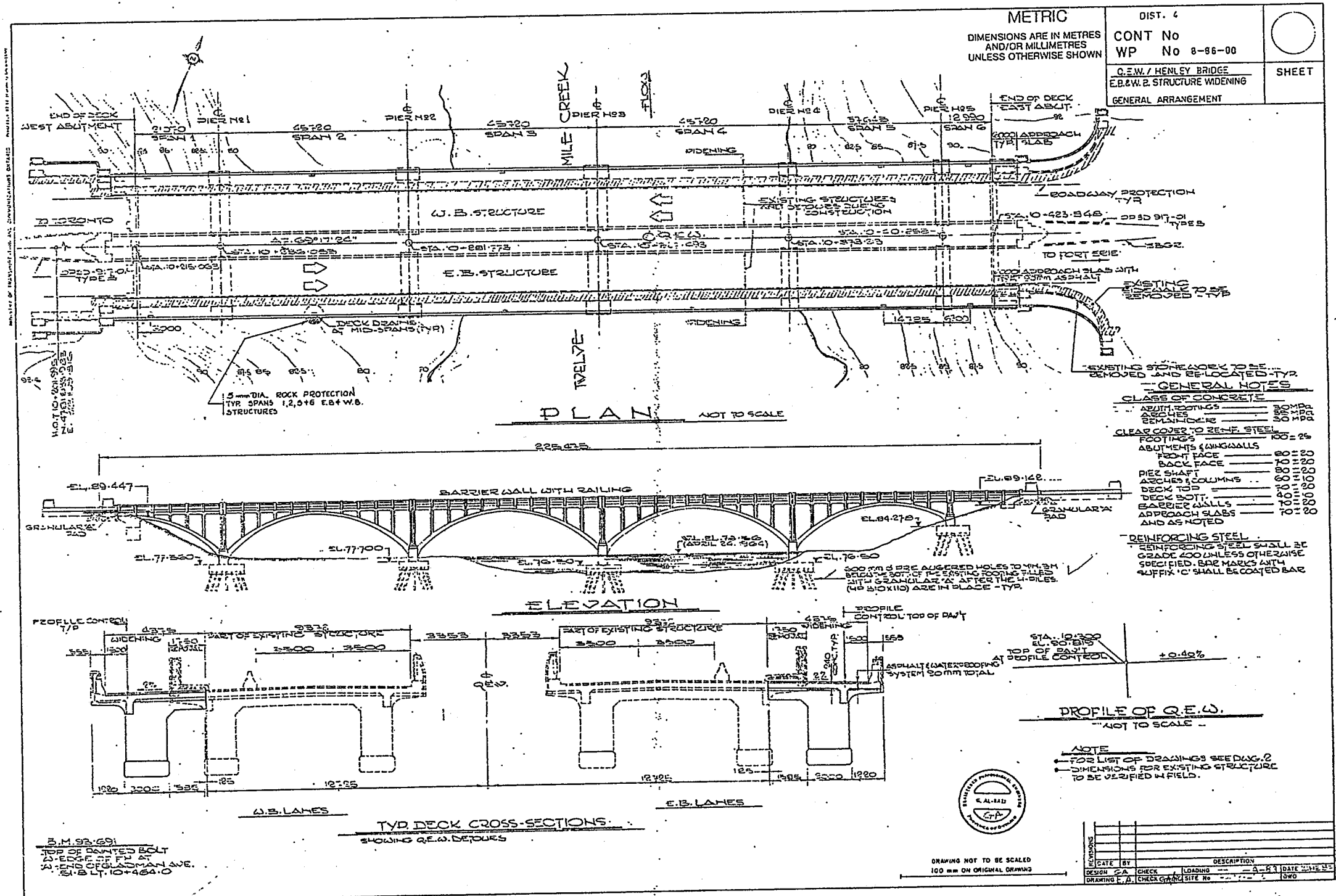
NOTE: The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

| REV. | DATE | BY | DESCRIPTION |
|------|------|----|-------------|
| | | | |
| | | | |
| | | | |

Geocres No 30M3-184

| | | | |
|------------|---------|-----------------|-------------|
| HWY No QEW | CHECKED | DATE 1986 10 21 | DIST 4 |
| SUBAND PP | CHECKED | | SITE 18-104 |
| DRAWN SO | CHECKED | | DWG 88600-A |



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

DIST. 4
CONT No
WP No 8-86-00

Q.E.W. / HENLEY BRIDGE
E.B. & W.B. STRUCTURE WIDENING
GENERAL ARRANGEMENT



- GENERAL NOTES
- CLASS OF CONCRETE
 - ABUTMENT FOOTINGS 30 MPa
 - ARCHES 30 MPa
 - REMAINING 20 MPa
 - CLEAR COVER TO REINF. STEEL
 - FOOTINGS 100 mm
 - ABUTMENTS (WINGWALLS)
 - FRONT FACE 80 mm
 - BACK FACE 70 mm
 - PIER SHAFT 80 mm
 - ARCHES & COLUMNS 60 mm
 - DECK TOP 40 mm
 - DECK BOTT. 40 mm
 - BARRIER WALLS 100 mm
 - APPROACH SLABS 70 mm
 - AND AS NOTED
 - REINFORCING STEEL
 - REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH SUFFIX 'C' SHALL BE COATED BAR

PROFILE OF Q.E.W.
NOT TO SCALE

NOTE
FOR LIST OF DRAWINGS SEE DWG. 2
DIMENSIONS FOR EXISTING STRUCTURE TO BE VERIFIED IN FIELD.



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

| DATE | BY | CHECK | LOADING | DESCRIPTION | DATE | BY |
|---------|------|-------|---------|-------------|------|----|
| DESIGN | CA | CHECK | | | | |
| DRAWING | E.A. | CHECK | | | | |

B.M. 93.691
TOP OF PAINTED BOLT
W. EDGE OF F.W. AT
W. END OF GLADMAN AVE.
E.L. 10+424.0