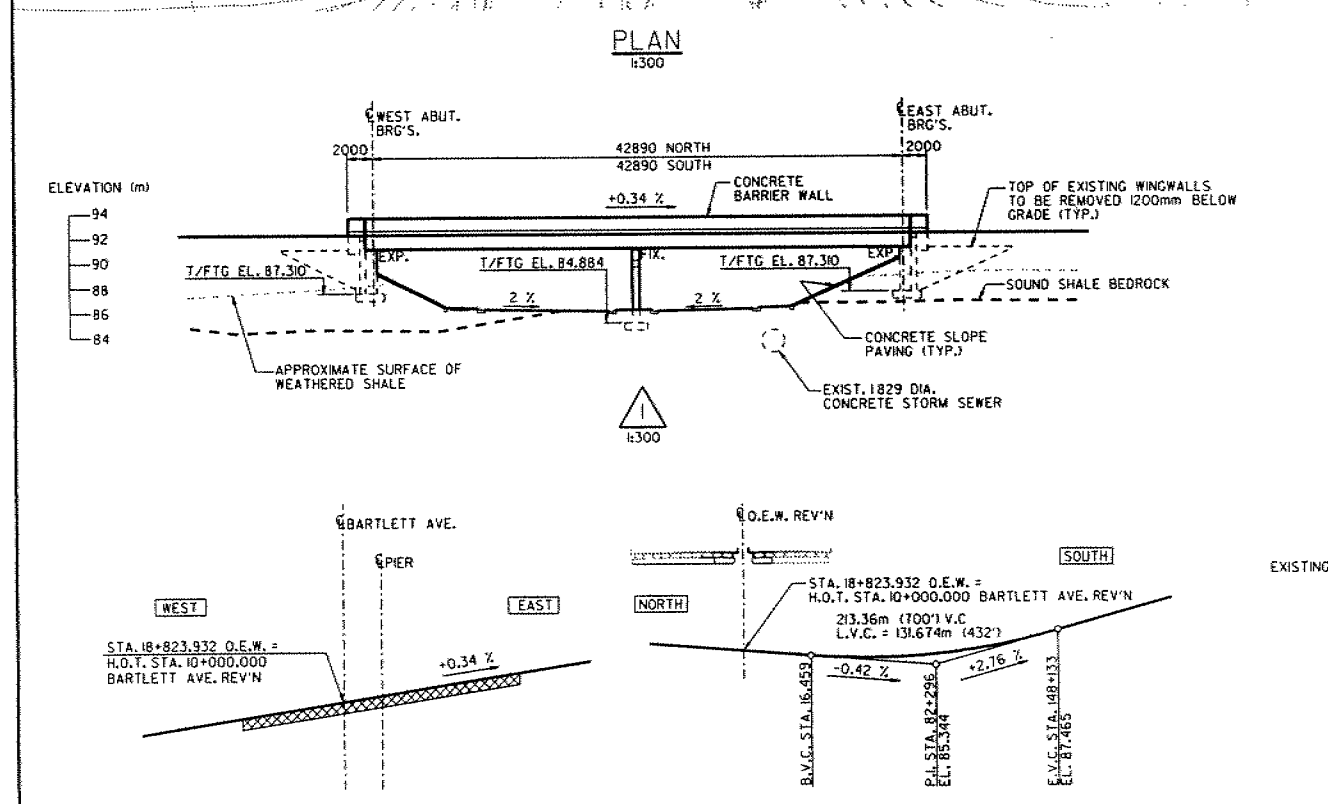
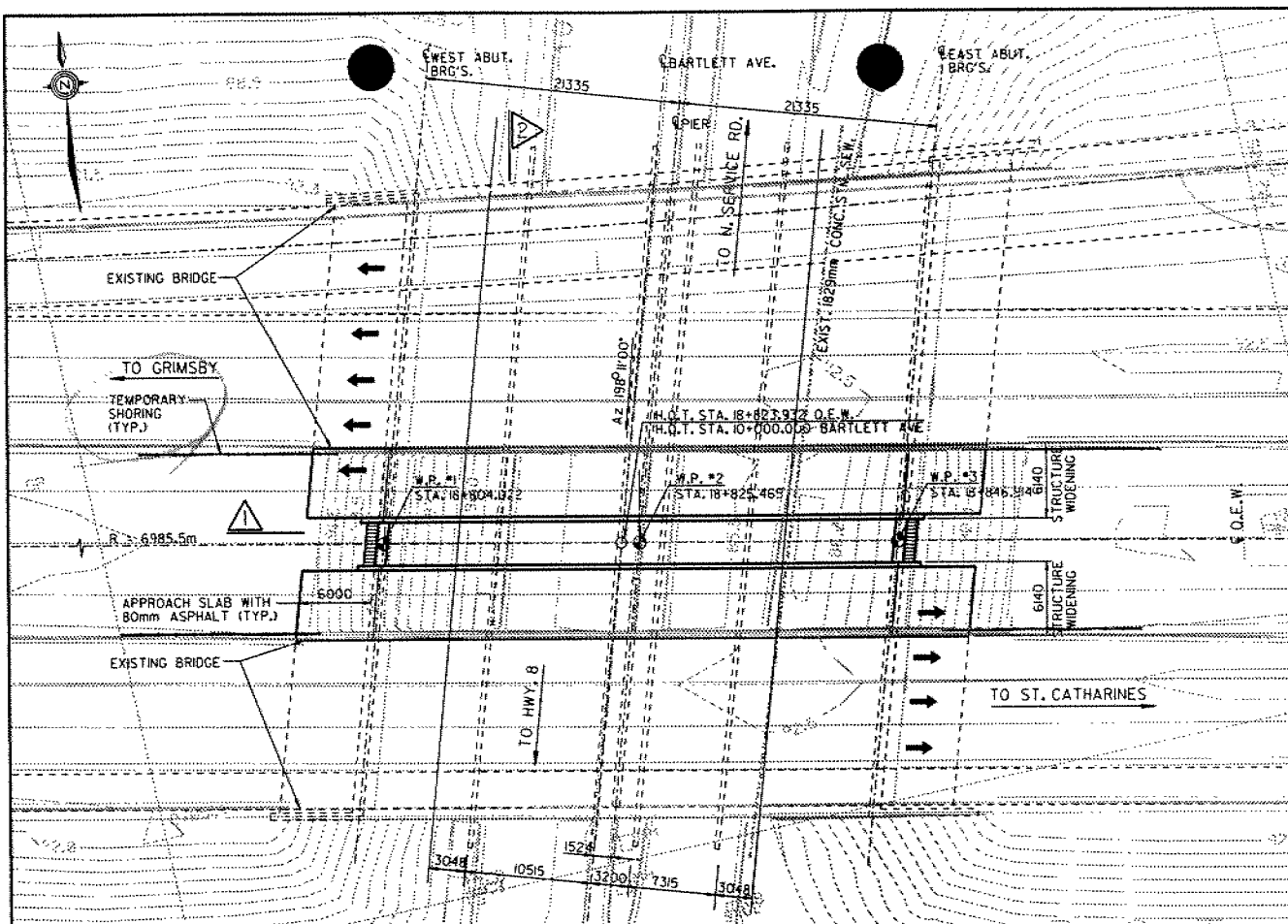


G.I.-30 SEPT. 1976

GEOCRES No. 30M4-79DIST. CR REGION W.P. No. CONT. No. W. O. No. 95-11008STR. SITE No. HWY. No. Q.E.W.LOCATION Q.E.W at 40 Mill
Creek & Bartlett Ave.No of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



REFERENCE BENCHMARK
G.B.M. 748496
EL. 88.031
BRASS TABLET IN WEST FACE OF EAST CONCRETE
ABUTMENT 20.2 m RT AT STATION 18 + 845.5

* NOTE:
BENCH MARK FOR PROFILE ON
BARTLETT AVENUE IS NOT
THE REFERENCE BENCH MARK
SHOWN ON THIS DRAWING.

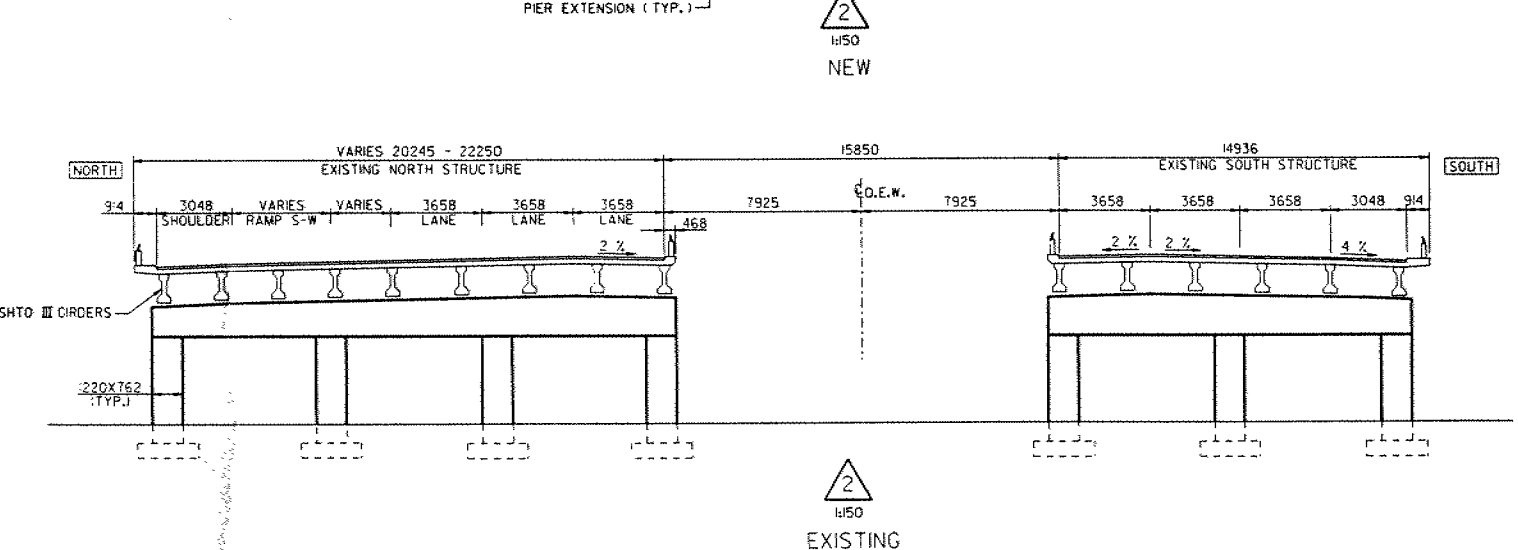
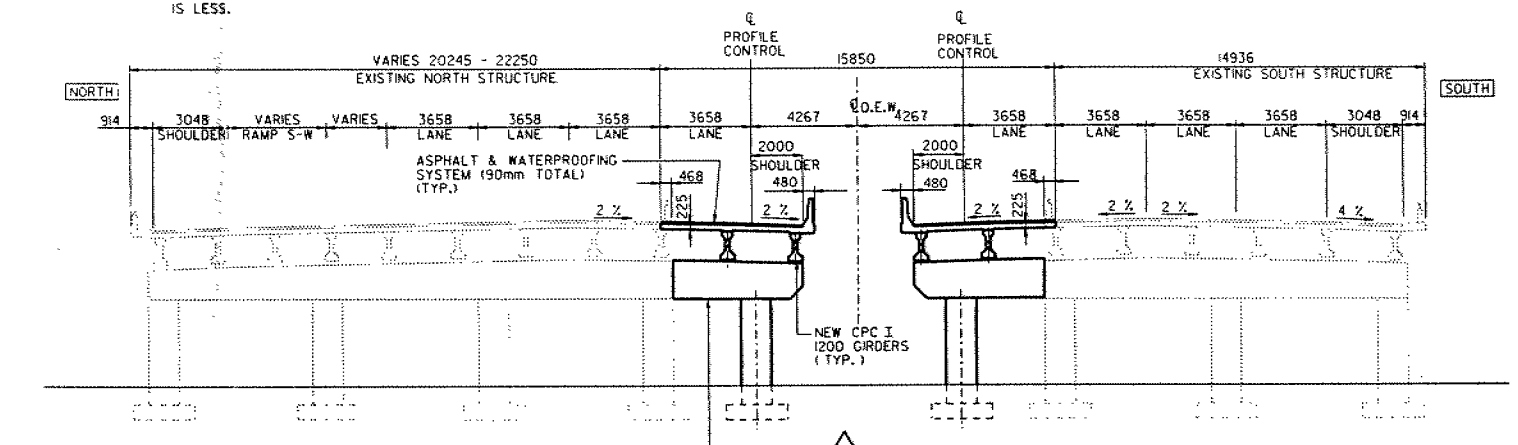
- GENERAL NOTES:
- CLASS OF CONCRETE:
ALL CONCRETE UNLESS NOTED OTHERWISE 30MPa
 - CLEAR COVER TO REINFORCING STEEL:
FOOTINGS 100±25
ABUTMENTS AND WINGWALLS 70±20
DECK TOP 70±20
BOTTOM 40±10
REMAINDER UNLESS OTHERWISE NOTED 70±20
 - REINFORCING STEEL
REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.
BAR MARKED WITH SUFFIX 'C' DENOTE COATED BARS.
WHERE SPLICES ARE NOT SHOWN ON THE DRAWINGS SPLICES SHALL BE AT LEAST:
15M - 650 mm
20M - 800 mm
25M - 1200 mm
30M - 1650 mm
35M - 2350 mm
 - CONSTRUCTION NOTES:
THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND REINFORCING STEEL TO SUIT.
DOWELS TO BE SET IN 250mm DEEP HOLES AND GROUTED WITH EPOXY RESIN (ROUT UNLESS NOTED OTHERWISE, DIAMETER OF HOLES AS PER MANUFACTURER'S RECOMMENDATIONS).
THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS OF THE EXISTING WORK ON SITE AND REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
UNLESS OTHERWISE NOTED, SAWCUT ALL LIMITS OF CONCRETE REMOVAL 25mm DEEP OR TO THE FIRST LAYER OF REINFORCING STEEL, WHICHEVER IS LESS.

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

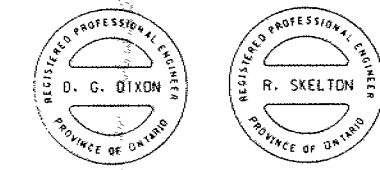
DIST	CONT No	SHEET
WP	No	
Q.E.W. WIDENING BARTLETT AVE. OVERPASS		
GENERAL ARRANGEMENT		
TREC		

LIST OF DRAWINGS

- GENERAL ARRANGEMENT
- TRAFFIC STAGING AND REMOVALS
- FOOTING LAYOUT AND REINFORCING
- ABUTMENTS
- PIER
- PRESTRESSED GIRDERS AND BEARINGS
- DECK LAYOUT AND REINFORCING
- DECK REINFORCING DETAILS
- EXPANSION JOINT DETAILS
- JOINT ANCHORAGE AND ARMOURING
- BARRIER WALL
- 6000mm APPROACH SLAB
- CONCRETE SLOPE PAVING
- STANDARD DETAILS

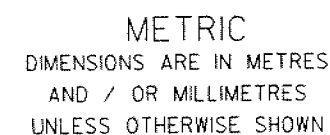


APPLICABLE STANDARD DRAWINGS
OPSD 3501.00 GRANULAR BACKFILL REQUIREMENTS
- ABUTMENTS



DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION	DATE
DESIGN D.G.D./CHK R.S./CODE OHBOC 1991	LOAD	DATE FEB/95
DRAWN N.S.P./CHK D.G.D./SITE 18-20	STRUCT	SCHEME
	DWG	1



DIST
CONT No
WP No

O.E.W. WIDENING
BARTLETT AVE. OVERPASS

SHEET

TRAFFIC STAGING & REMOVALS

TRF

SUGGESTED CONSTRUCTION SEQUENCE:

STAGE 1

- 1.1 INSTALL STAGE 1 TRAFFIC STAGING AS SHOWN ON THE DRAWINGS.
- 1.2 INSTALL ROADWAY PROTECTION FOR CONSTRUCTION OF ABUTMENTS AND PIER.
- 1.3 CONSTRUCT FOOTING FOR NEW PIERS AND FOR ABUTMENT WIDENING.
- 1.4 REMOVE EXISTING CONCRETE PARAPET WALLS, ASPHALT AND WATERPROOFING, CONCRETE FROM CURB OVERHANGING THE MEDIAN SIDE OF THE TOP PORTION OF THE WING WALLS (4) AND PORTIONS OF THE APPROACH SLAB AS NOTED.
- 1.5 COMPLETE WIDENING AT BOTH BRIDGES.
- 1.6 PLACE NEW ASPHALT AND WATERPROOFING ON THE WIDENED PORTION OF THE SOUTH STRUCTURE.
- 1.7 INSTALL NEW EXPANSION JOINTS ON WIDENED PORTION OF THE SOUTH STRUCTURE.

STAGE 2

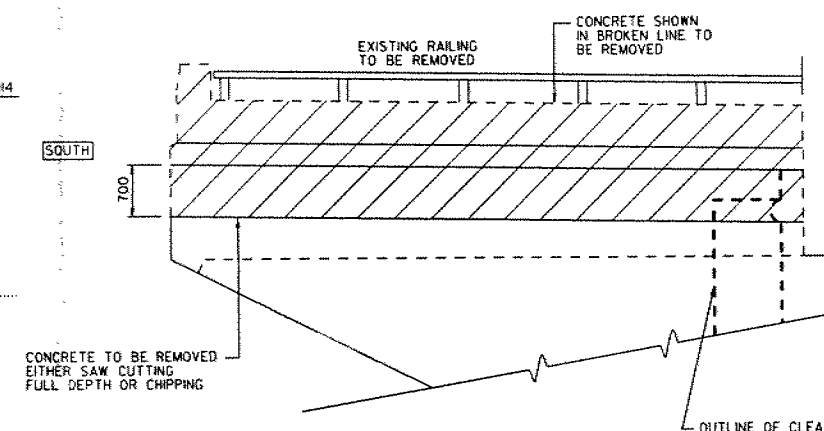
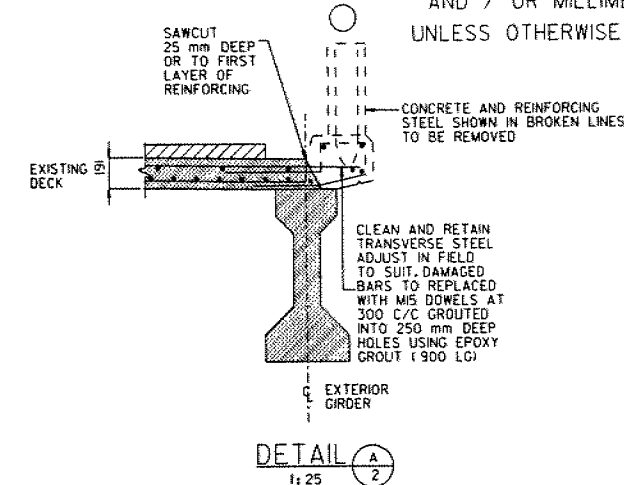
- 2.1 RELOCATE THE TEMPORARY CONCRETE BARRIERS TO THE LOCATIONS INDICATED ON THE DRAWINGS AND DETOUR TRAFFIC TO SOUTH STRUCTURE.
- 2.2 REMOVE THE ASPHALT AND WATERPROOFING ON THE ORIGINAL BRIDGE DECK.
- 2.3 REMOVE DETERIORATED CONCRETE IN THE DECK AND PATCH WITH NORMAL SLUMP CONCRETE.
- 2.4 REMOVE THE EXISTING EXPANSION JOINT, PORTIONS AT THE APPROACH SLAB AND PORTIONS AT THE BALLAST WALL.
- 2.5 REMOVE CONCRETE AND PATCH THE PARAPET WALLS.
- 2.6 INSTALL NEW EXPANSION JOINT IN ENTIRE WIDTH OF NORTH STRUCTURE.

2.7 WATERPROOF AND PAVE THE DECK OF THE NORTH STRUCTURE.
STAGE 3

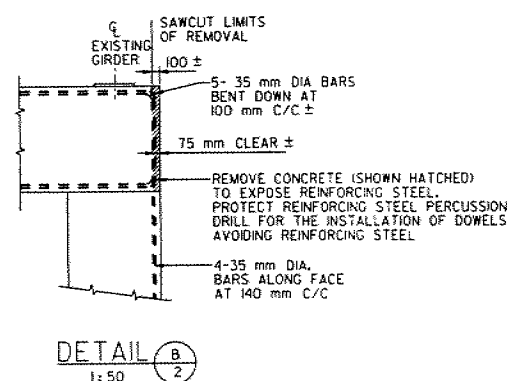
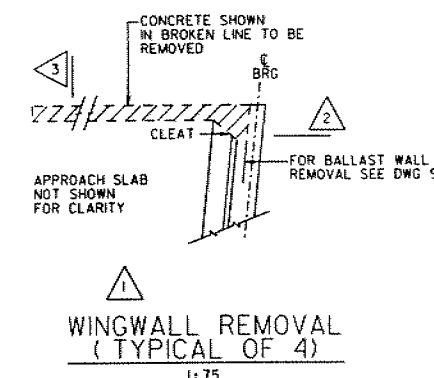
STAGE 3

- 3.1 RELOCATE THE TEMPORARY CONCRETE BARRIERS TO THE LOCATIONS INDICATED ON THE DRAWINGS AND DETOUR TRAFFIC TO THE NORTH STRUCTURE.
- 3.2 REPEAT STAGE 2.2 TO 2.5 INCLUSIVE FOR THE SOUTH BRIDGE.
- 3.3 INSTALL NEW EXPANSION JOINT IN THE ORIGINAL PORTION OF THE SOUTH BRIDGE AND SPlice TO THE EXPANSION JOINT INSTALLED IN STEP 1.7.
- 3.4 WATERPROOF AND PAVE THE EXISTING SOUTH STRUCTURE.

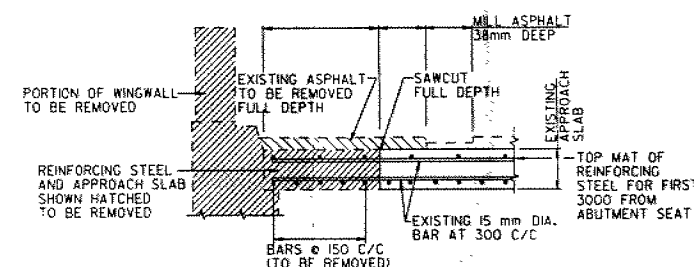
3.4 WATERPROOF AND PAVE THE EXISTING SOUTH STRUCTURE.



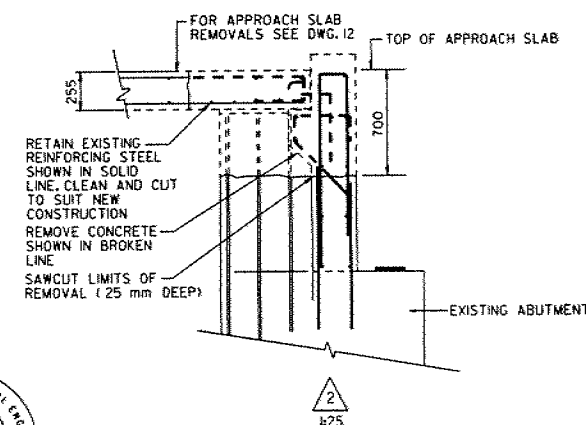
WINGWALL ELEVATION (TYP.)



DETAIL (B)
1:50 2



WINGWALL REMOVAL
(TYPICAL OF 4)

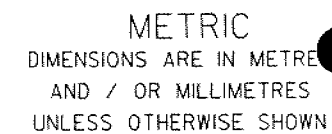
 $\frac{1}{k^2}$

REGISTERED PROFESSIONAL ENGINEER
D. G. DIXON
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
R. SKELTON
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION									
	DESIGN D.G.D.	CHK	R.S.	CODE	OH	BDC	%	LOAD	DATE	FEB./95
	DR3KN B.T.	CHK	D.G.D.	SUF.	18-28			INSTRCT	ISCHMF	10WG 2



DIST
CONT No
WP No

O.E.W. WIDENING
BARTLETT AVE. OVERPASS

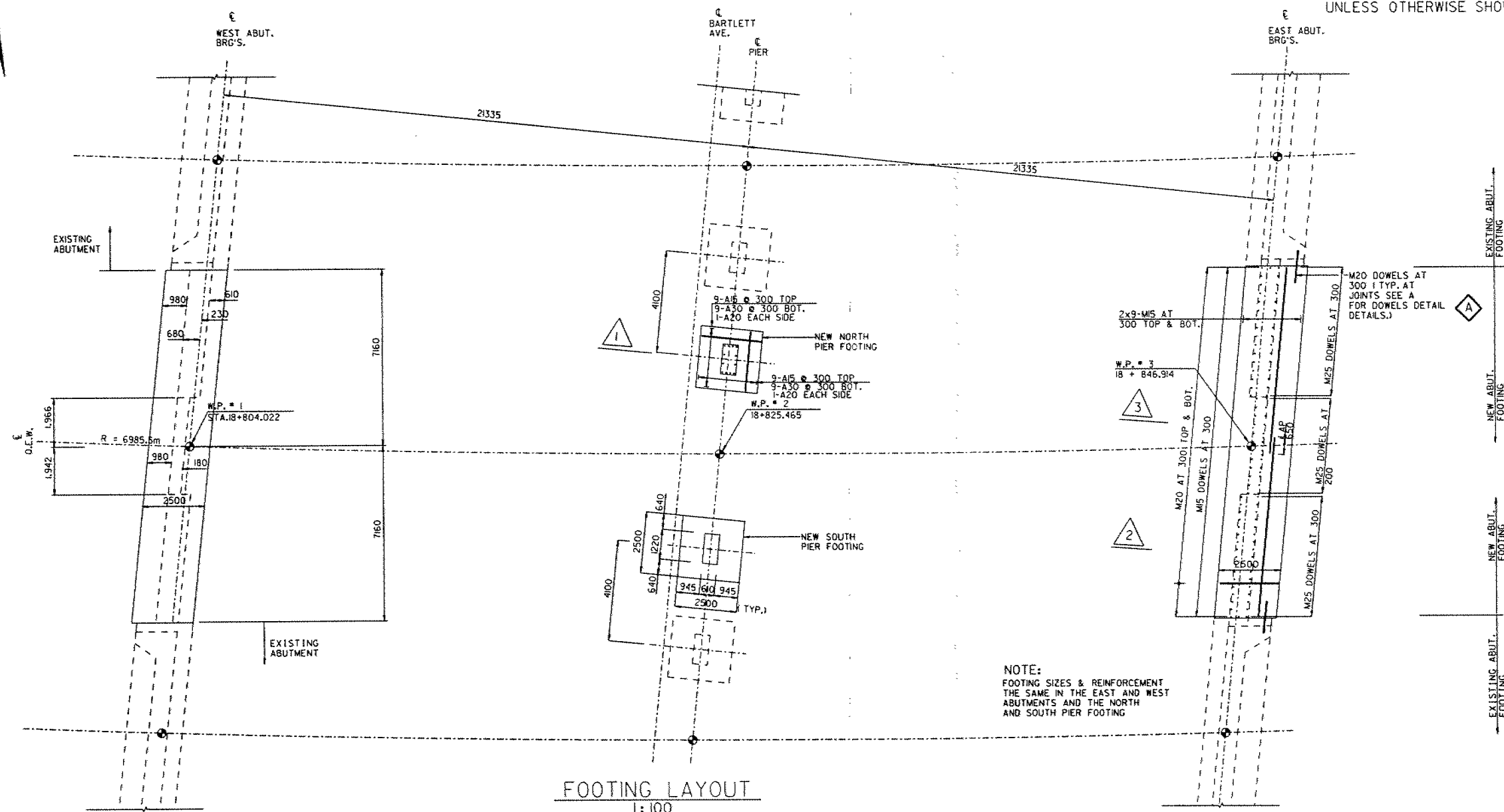
SHEET

FOOTING LAYOUT AND REINFORCING

TRC

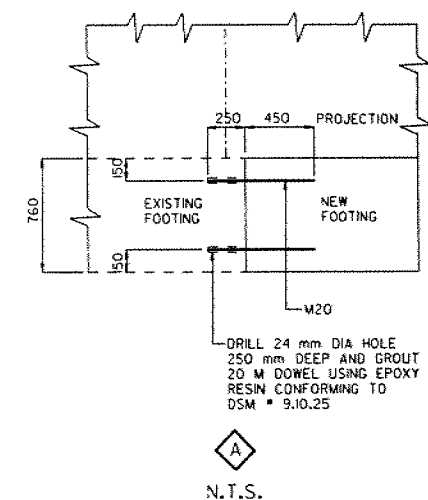
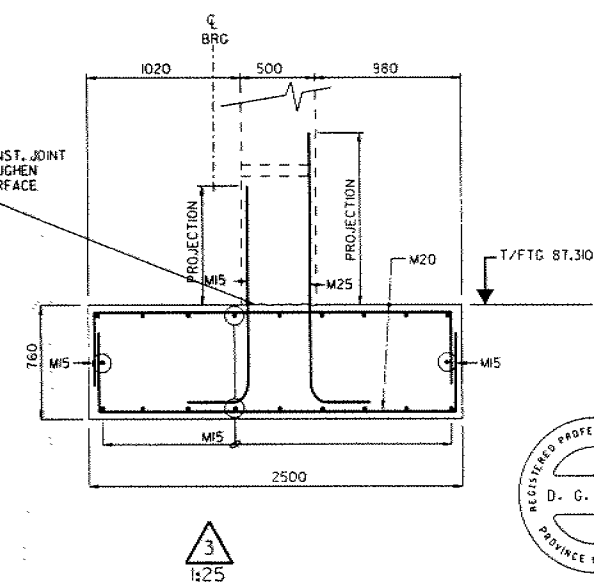
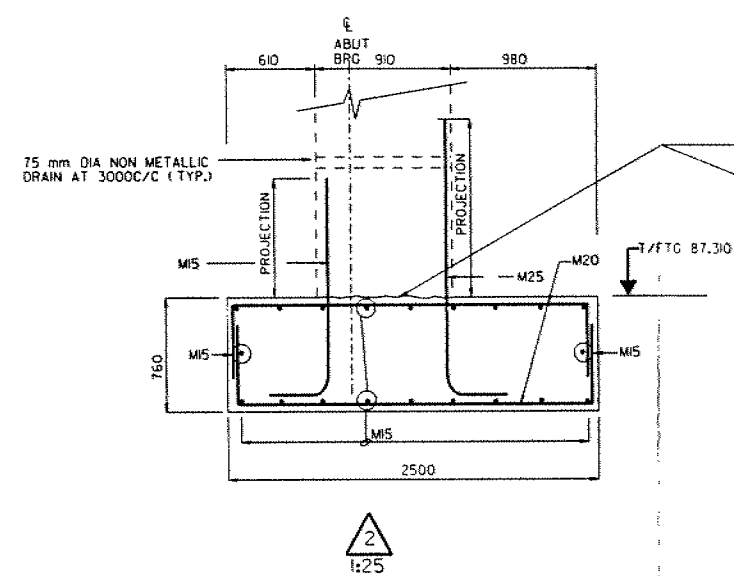
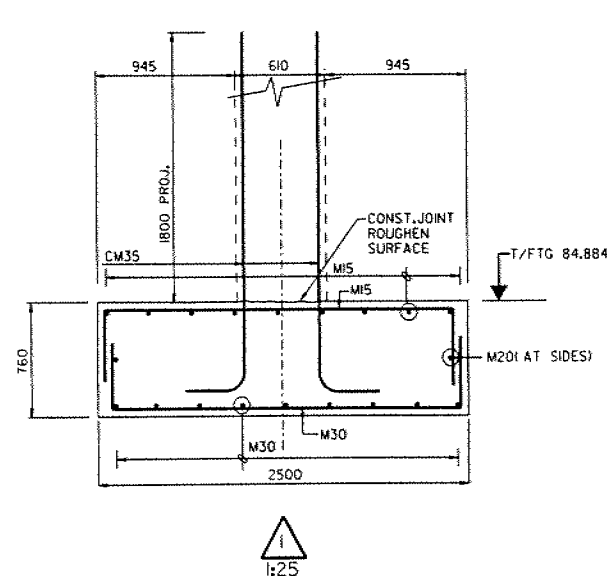
NOTES:

1. ANY OVER-EXCAVATION WHICH RESULTS IN THE LOSS OF MATERIAL BENEATH EXISTING FOOTINGS MUST BE REPLACED WITH CONCRETE.



NOTE:
FOOTING SIZES & REINFORCEMENT
THE SAME IN THE EAST AND WEST
ABUTMENTS AND THE NORTH
AND SOUTH PIER FOOTING

FOOTING LAYOUT
1:100



APPLICABLE STANDARD DRAWINGS
 OPSD 3506.00 RETAINING WALL AND ABUTMENT
 GROOVE BELOW DRAINS



REGISTERED PROFESSIONAL ENGINEER
D. G. DIXON
PROVINCE OF ONTARIO



DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

[illegible]

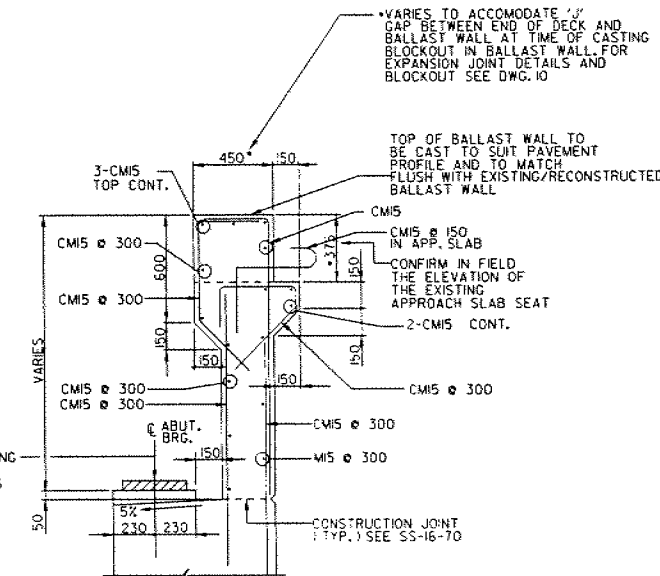
METRIC
DIMENSIONS ARE IN METRE
AND / OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST	CONT No	SHEET
WP	No	
O.E.W. WIDENING BARTLETT AVE. OVERPASS		
ABUTMENTS		

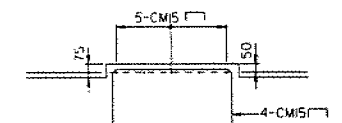
TREC

NOTES:

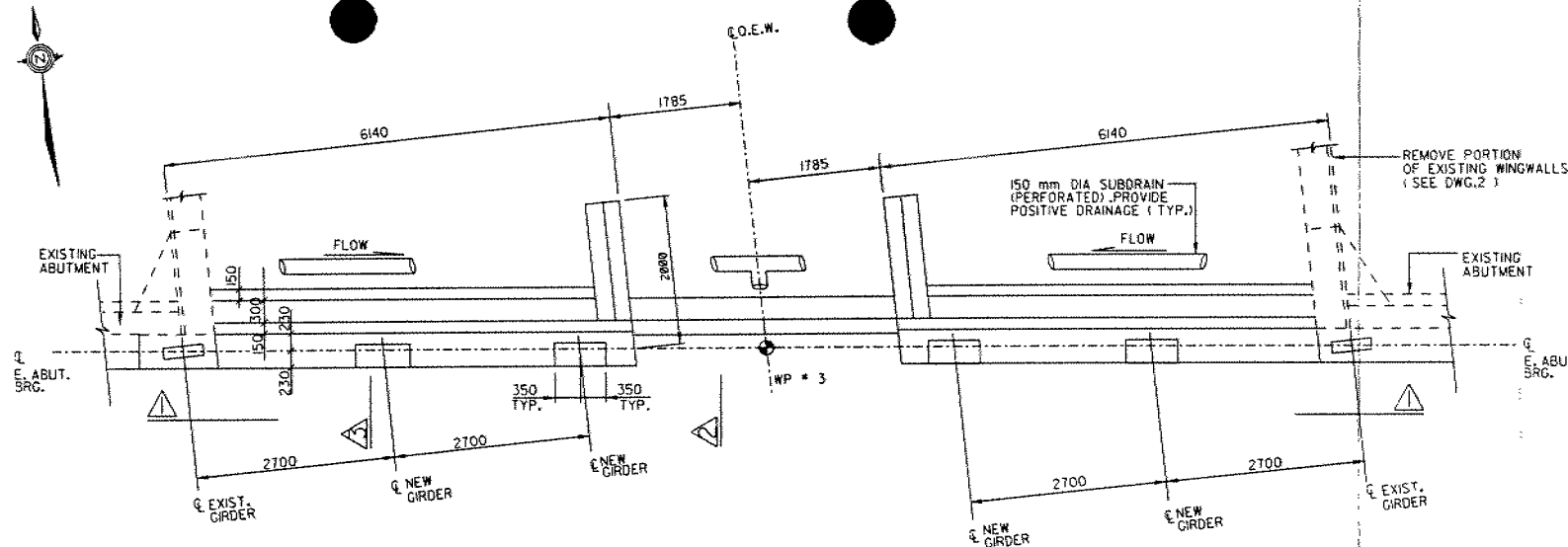
- BACKFILL TO THE ABUTMENT TO BE GRANULAR A TO THE REQUIREMENTS OF OPSS 1010
- BEARING SEAT ELEVATIONS- SEE NOTE ON DWG. 1
- B.F. DENOTES BACK FACE
F.F. DENOTES FRONT FACE
E.F. DENOTES EACH FACE
L. DENOTES EAST
W. DENOTES WEST



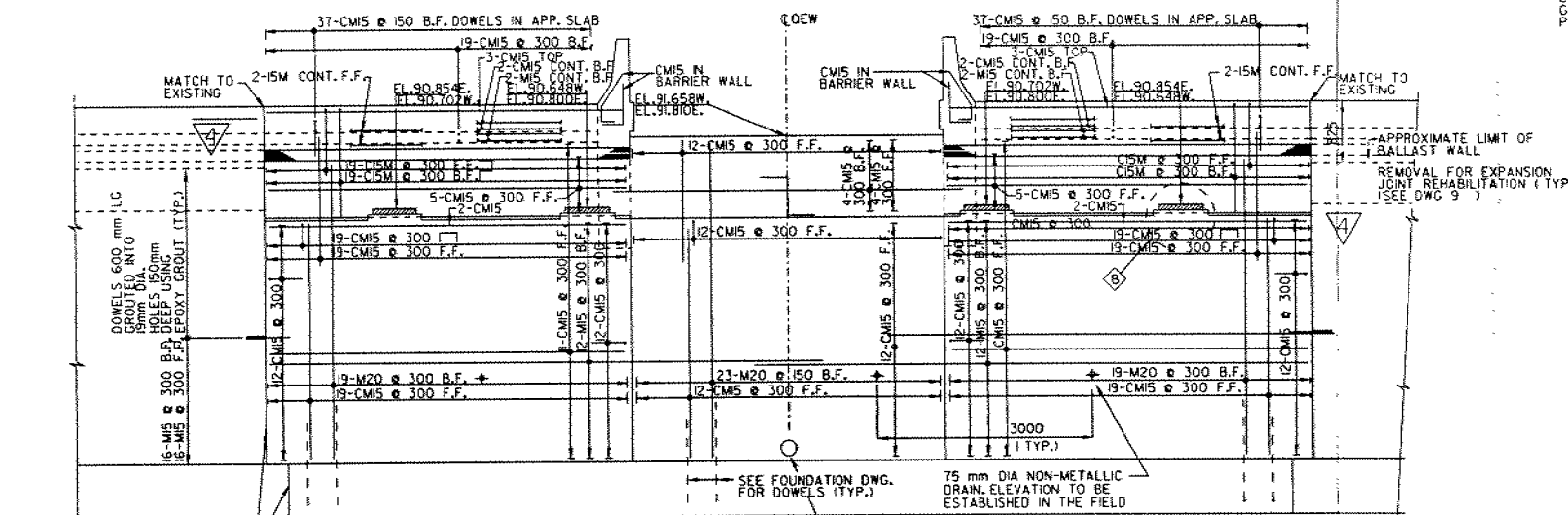
DETAIL A
SCALE 1:20



DETAIL B
SCALE 1:20
(TYPICAL BEARING SEAT)



PLAN (EAST ABUTMENT)
SCALE 1:50
(WEST ABUTMENT IS SIMILAR
EXCEPT OPPOSITE HAND)



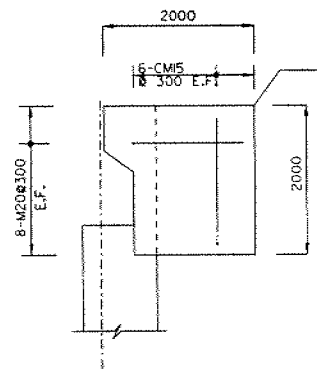
ELEVATION
SCALE 1:50

PREPARE EXISTING STRUCTURE
CONCRETE FOR PLACEMENT
OF NEW CONCRETE AS PER
OPSS 930. (TYP.)

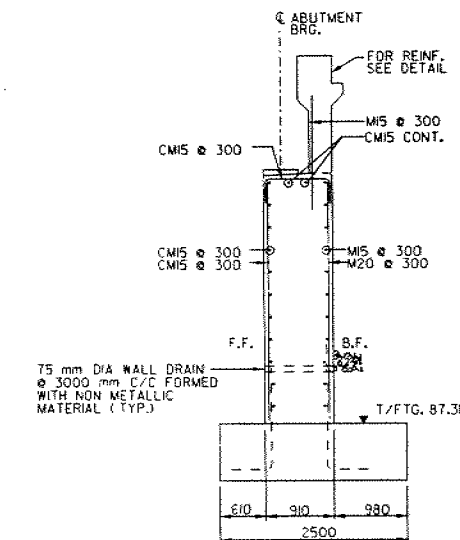
219 mm O.D. STEEL
SLEEVE PIPE (TYP.)
LOCATED IN THE FIELD
BY THE ENGINEER
SEE DD-3515

75 mm DIA NON-METALLIC
DRAIN ELEVATION TO BE
ESTABLISHED IN THE FIELD

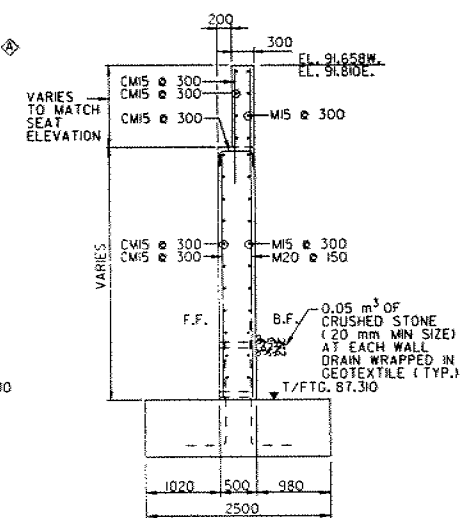
SEE FOUNDATION DWG.
FOR DOWELS (TYP.)



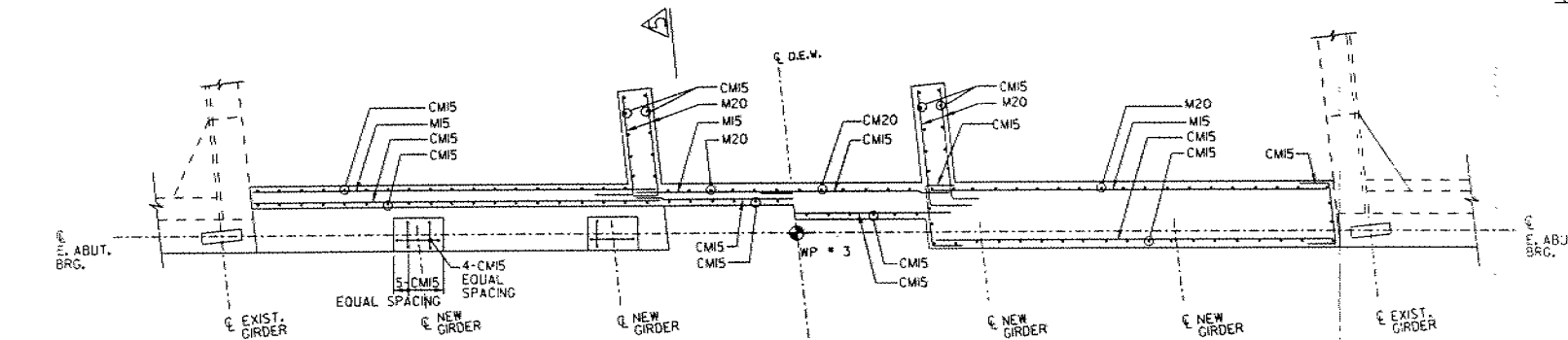
DETAIL 5
SCALE 1:50



DETAIL 3
SCALE 1:50



DETAIL 2
SCALE 1:50



ELEVATION 4
SCALE 1:50
(SHOWING REINFORCING)



DRAWING NOT TO BE SCALED
10mm ON ORIGINAL DRAWING

APPLICABLE STANDARD DRAWINGS:
OPSD 3501.00 GRANULAR BACKFILL REQUIREMENTS
- ABUTMENTS
OPSD 3506.00 RETAINING WALL AND ABUTMENT
GROOVE BELOW DRAINS

REVISIONS	DESCRIPTION	DATE
DESIGN D.G.D./CHK R.S.	CODE OHBDC 91	LOAD
DRAWN B.T.	CHK D.G.D./SITE 19 - 20	STRUCT
		SCHEME
		DWG 4

TREC

SHEET S-1

GENERAL NOTES

1. CLASS OF CONCRETE

DECK AND BARRIER WALLS	30 MPa
GRIDERS	40 MPa
REMAINDER	30 MPa

2. CLEAR COVER TO REINFORCING STEEL

FOOTINGS	100 ± 25
ABUTMENTS & WINGWALLS: FRONT FACE	80 ± 20
BACK FACE	70 ± 20
PIERS	80 ± 20
DECK	
TOP	70 ± 20
BOTTOM AND SIDES	50 ± 10
REMAINDER	70 ± 20

3. REINFORCING STEEL

- a) REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.
b) BAR MARKS WITH SUFFIX 'C' DENOTE COATED BARS.

4. CONSTRUCTION NOTES

- THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESS FROM THE TOP OF THE BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESS ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.
• THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS IN ACCORDANCE WITH OPSS 922.

5. STRUCTURE DESIGNED ACCORDING TO OHBOC 3-d. EDITION 1991 LOADING OHBOC CLASS 'A'

6. WP DENOTES WORKING POINT
T/P DENOTES TOP OF PAVEMENT

LIST OF DRAWINGS

- S-1. GENERAL ARRANGEMENT
S-2. STAGING I
S-3. STAGING II
S-4. STAGING III
S-5. FOUNDATION DETAILS
S-6. SOUTH STRUCTURE ABUTMENTS
S-7. SOUTH STRUCTURE ABUTMENT REINFORCEMENT
S-8. SOUTH STRUCTURE WINGWALLS
S-9. NORTH STRUCTURE ABUTMENTS
S-10. NORTH STRUCTURE ABUTMENT REINFORCEMENT
S-11. NORTH STRUCTURE WINGWALLS
S-12. SOUTH STRUCTURE PRESTRESSED GRIDERS AND BEARINGS
S-13. NORTH STRUCTURE PRESTRESSED GRIDERS AND BEARINGS
S-14. SOUTH STRUCTURE DECK DETAILS
S-15. SOUTH STRUCTURE DECK REINFORCEMENT
S-16. NORTH STRUCTURE DECK DETAILS
S-17. NORTH STRUCTURE DECK REINFORCING
S-18. DIAPHRAGM DETAILS
S-19. JOINT ANCHORAGE AND ARMOURING
S-20. SOUTH STRUCTURE BARRIER WALL
S-21. NORTH STRUCTURE BARRIER WALL
S-22. SOUTH STRUCTURE APPROACH SLAB
S-23. NORTH STRUCTURE APPROACH SLAB
S-24. STANDARD DETAILS I
S-25. STANDARD DETAILS II
S-26. SOUTH STRUCTURE - AS CONSTRUCTED ELEV'S & DIM'S
S-27. NORTH STRUCTURE - AS CONSTRUCTED ELEV'S & DIM'S

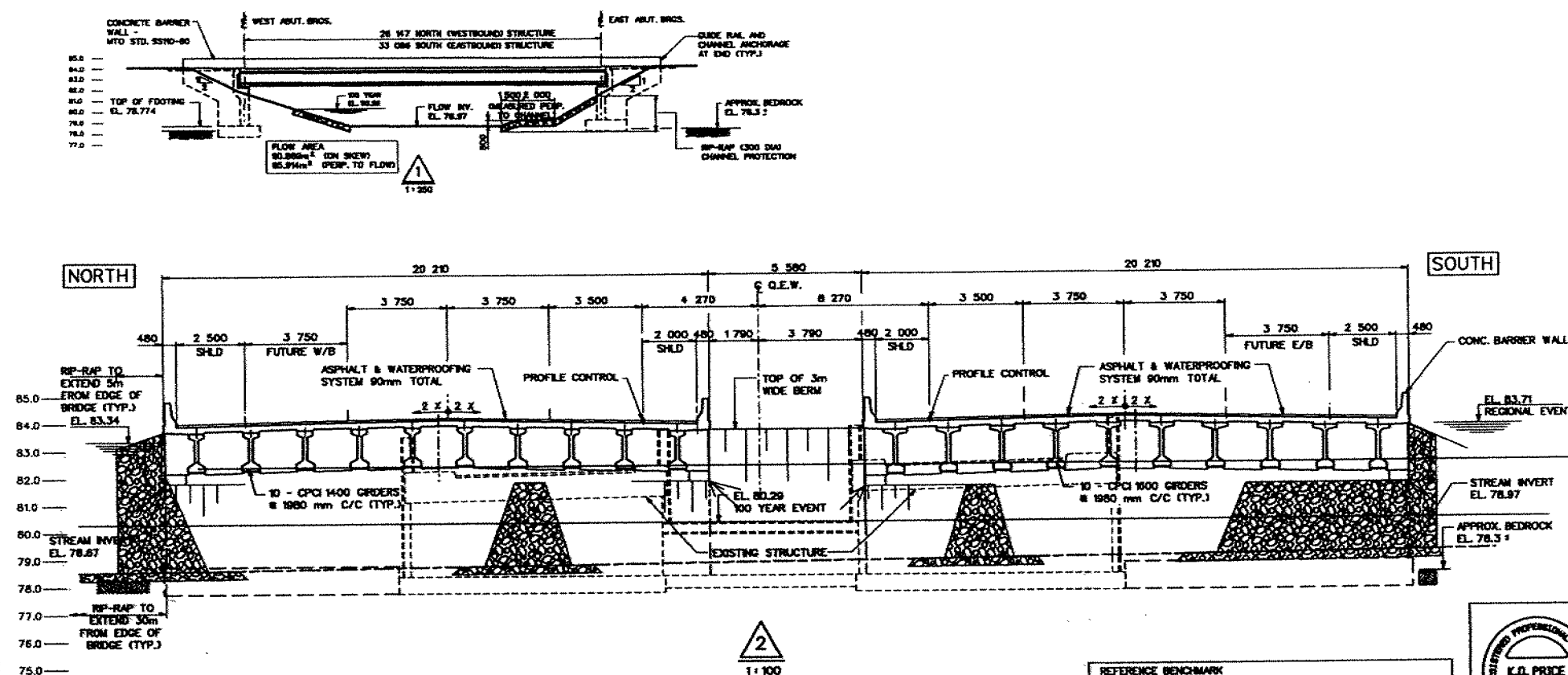
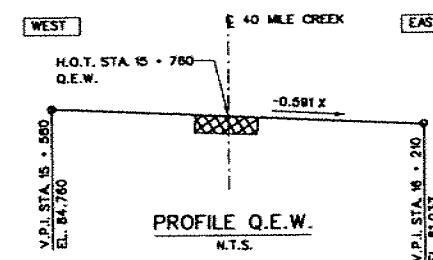
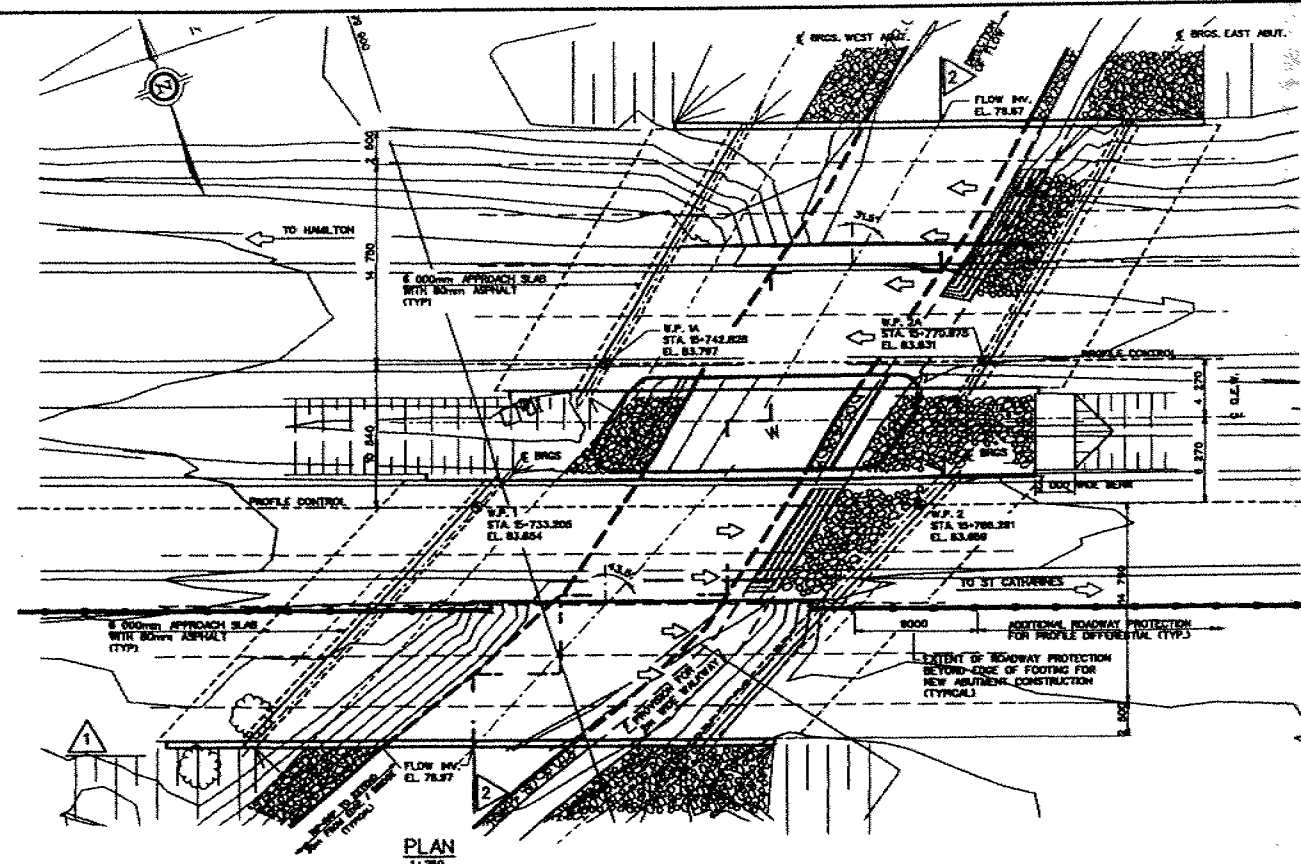
APPLICABLE STANDARD DRAWINGS

- SS10-60 BARRIER WALL w/o RAILING
SS13-11 JOINT ANCHORAGE AND ARMOURING
SS18-2 800mm APPROACH SLAB
SS9-50 DRAINAGE OF ASPHALT WEARING SURFACE

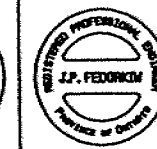
Q.E.W. DESIGN /BUILD PROJECT

FORTY MILE CREEK BRIDGE

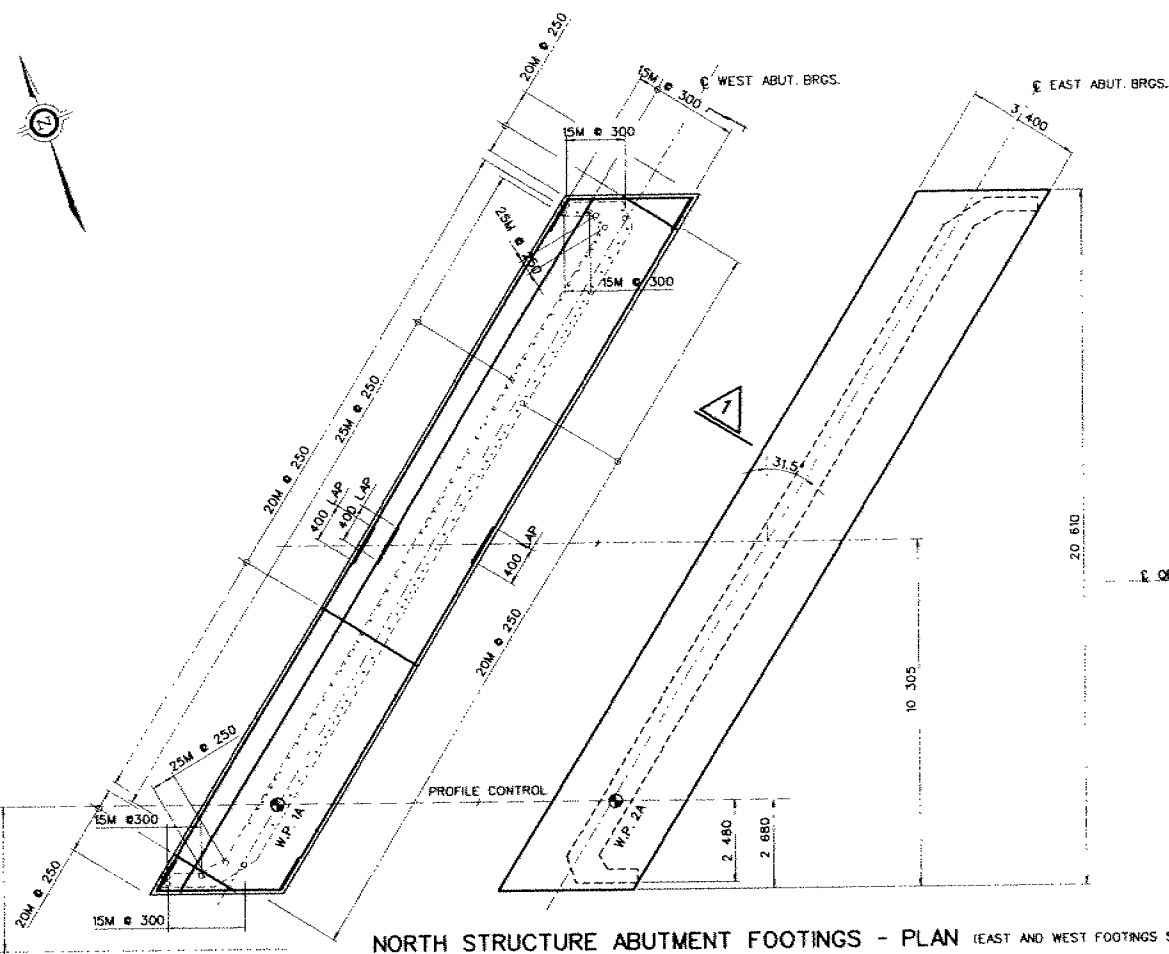
GENERAL ARRANGEMENT



REFERENCE BENCHMARK

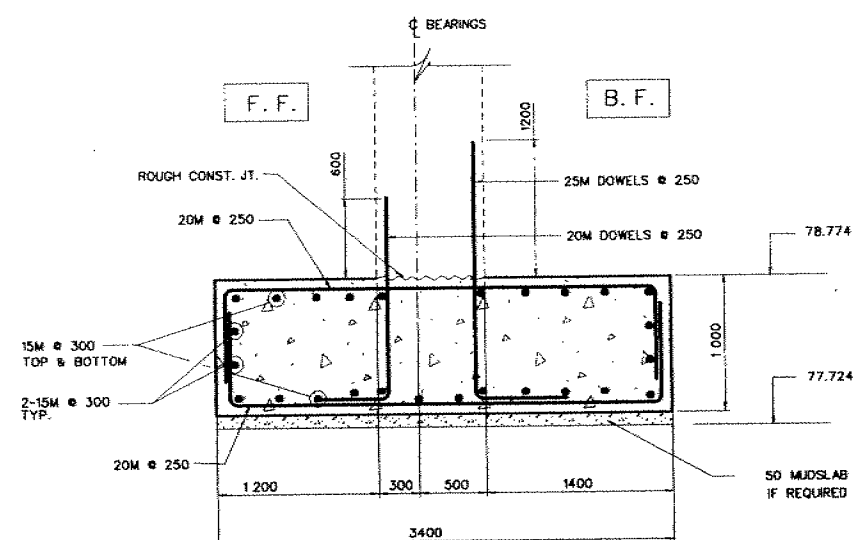
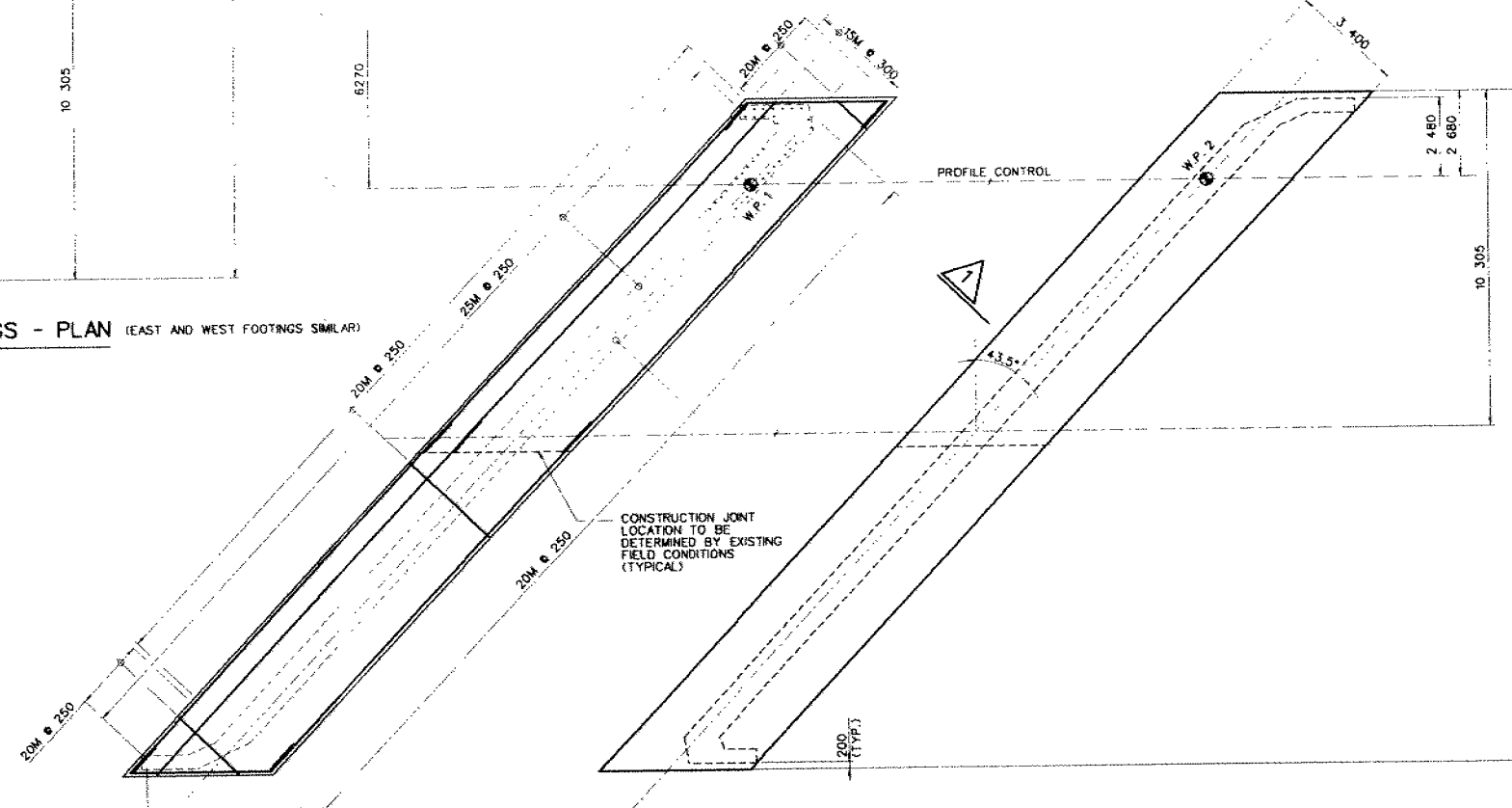


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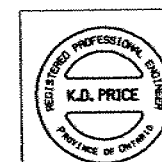
NORTH STRUCTURE ABUTMENT FOOTINGS - PLAN (EAST AND WEST FOOTINGS SIMILAR)

1:100

1
1:25

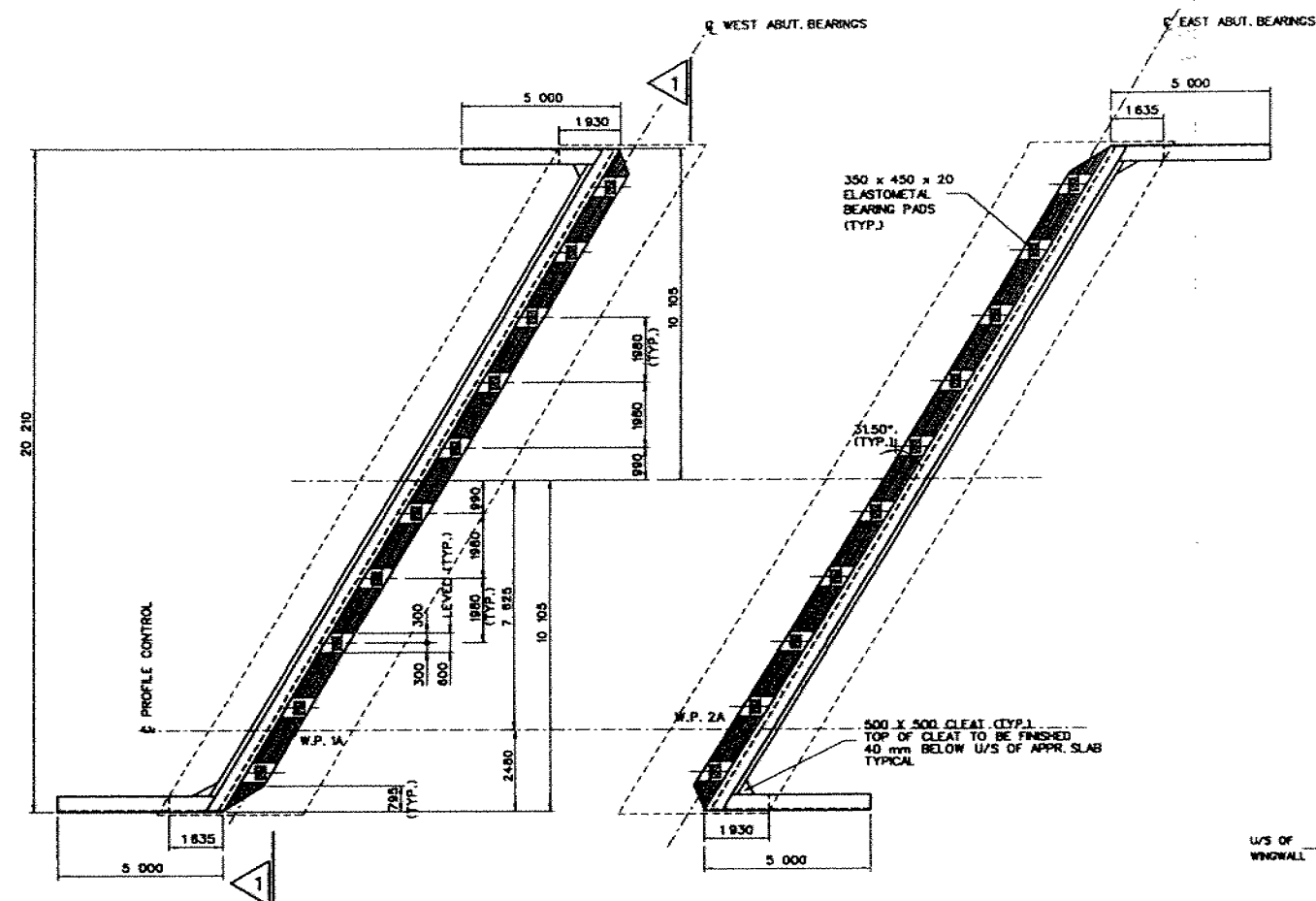
SOUTH STRUCTURE ABUTMENT FOOTINGS - PLAN (EAST AND WEST FOOTINGS SIMILAR)

1:100



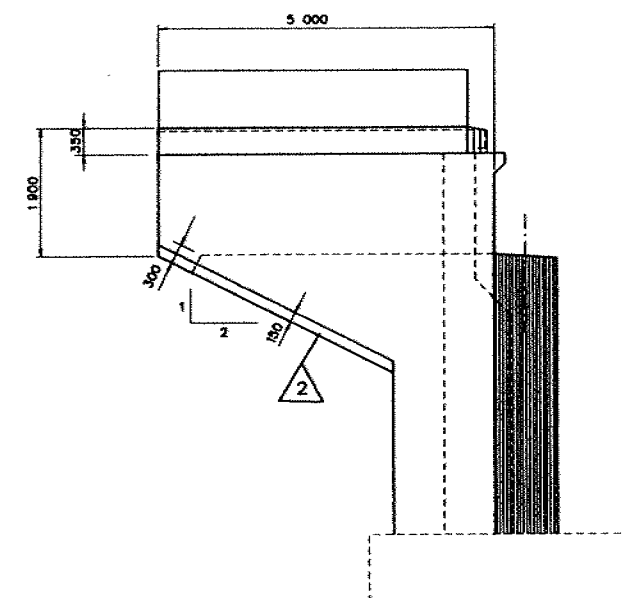
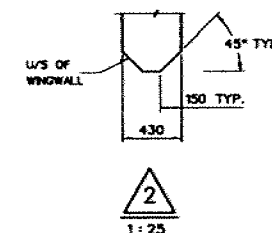
O.E.W. DESIGN /BUILD PROJECT

FORTY MILE CREEK BRIDGE
FOUNDATION DETAILS



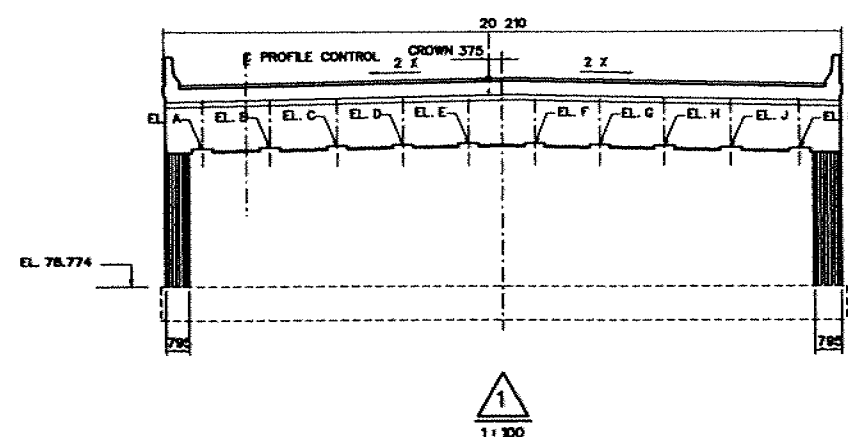
PLAN OF NORTH STRUCTURE ABUTMENTS

NOTE 1
1:100
WEST ABUTMENT - EAST ABUTMENT ARE SIMILAR

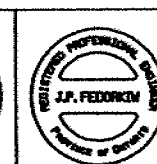


TYPICAL WINGWALL ELEVATION

1:50



TOP OF BEARING SEAT CONCRETE ELEVATION - TABLE										
LOCATION	EL. A	EL. B	EL. C	EL. D	EL. E	EL. F	EL. G	EL. H	EL. J	EL. K
EAST ABUTMENT	81.778	81.810	81.843	81.875	81.907	81.938	81.968	81.998	82.028	82.058
WEST ABUTMENT	81.944	81.976	82.008	82.041	82.074	82.106	82.138	82.170	82.202	82.234



O.E.W. DESIGN /BUILD PROJECT

FORTY MILE CREEK BRIDGE
NORTH STRUCTURE
ABUTMENTS

GEOCRES No 30M4-79



Golder Associates Ltd.

2180 Meadowvale Boulevard
Mississauga, Ontario, Canada L5N 5S3
Telephone (905) 567-4444
Fax (905) 567-6561



REPORT ON

WO 95-11008
DATA SUMMARY AND
GEOTECHNICAL RECOMMENDATIONS
40 MILE CREEK BRIDGE AND
BARTLETT AVENUE BRIDGE
PROPOSED QEW WIDENING
TOWNS OF GRIMSBY AND LINCOLN
ONTARIO

Submitted to:

Delcan Corporation
133 Wynford Drive
North York, Ontario
M3C 1K1

GEOCRES No 30M4-79

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Burlington, Ontario
- 2 copies - McCormick Rankin & Associates Ltd.
Mississauga, Ontario
- 2 copies - Golder Associates Ltd.
Mississauga, Ontario

June 1995

951-1300

LIST OF FIGURES

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- Figure 2 QEW Widening - Forty Mile Creek Bridge, General Arrangement and
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- Figure 4 QEW Widening - Forty Mile Creek Bridge, Schematic Cross-Sections,
Sections A-A and B-B
- Figure 3 QEW Widening - Bartlett Avenue Overpass, General Arrangement and
Borehole Location Plan
- Figures 5 QEW Widening - Bartlett Avenue Overpass, Schematic Cross-Sections,
Sections 1-1 and 2-2
- Figure 6 Design Lateral Earth Pressures, Braced Excavation

1.0 INTRODUCTION

Golder Associates Ltd. has been retained to carry out a geotechnical investigation for the proposed Forty Mile Creek bridge in Town of Grimsby and Bartlett Avenue bridge in Town of Lincoln, Ontario. The design and construction of the bridges are part of the QEW widening project. The terms of reference for this project are in general accordance with our proposal letters dated September 26, 1994 and May 17, 1995.

The purpose of this investigation is to summarize the available subsurface information to determine the subsurface soil, rock and groundwater conditions in the project area and to present recommendations and comments on the geotechnical aspects of design and construction of the works. The subsurface information includes data obtained during the current investigation and as well as data obtained during previous investigation carried out at the sites of the proposed bridge structures, provided by Delcan Corporation and McCormick Rankin.

1.0 INTRODUCTION

Golder Associates Ltd. has been retained to carry out a geotechnical investigation for the proposed Forty Mile Creek bridge in Town of Grimsby and Bartlett Avenue bridge in Town of Lincoln, Ontario. The design and construction of the bridges are part of the QEW widening project. The terms of reference for this project are in general accordance with our proposal letters dated September 26, 1994 and May 17, 1995.

The purpose of this investigation is to summarize the available subsurface information to determine the subsurface soil, rock and groundwater conditions in the project area and to present recommendations and comments on the geotechnical aspects of design and construction of the works. The subsurface information includes data obtained during the current investigation and as well as data obtained during previous investigation carried out at the sites of the proposed bridge structures, provided by Delcan Corporation and McCormick Rankin.

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In order following
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Table 1 Point Load Test Results

Figures 1 to 6

APPENDIX A RECORD OF BOREHOLES

Golder Associates Ltd.: Boreholes 1-95 and 2-95

Geo-Canada Ltd.: Boreholes 111, 112, 131 and 132

Department of Highways, W.P. 370-65-01: Boreholes 1
to 3, 3A, 4 to 7, 7A and 8 to 10

2.0 BACKGROUND INFORMATION

The subsurface information obtained during current and previous investigations carried out for the QEW widening project has been utilized in the preparation of this report. The relevant geotechnical investigation data obtained from the previous investigation carried out for the proposed bridges include the results of Boreholes 111, 112, 131, 132 and Borehole 1 to 3, 3A, 4 to 7, 7A, 8 to 10, contained in the following reports and/or presented on the drawings, as provided to us by Delcan Corporation and McCormick Rankin:

- Geo-Canada Ltd. report entitled "Preliminary Geotechnical Investigation, Culvert and Bridge Structures, Queen Elizabeth Way, Roberts Road to Ontario St., Grimsby, Ontario, MTO W.P.80-76-00," dated March 1994.
- Record of Boreholes 1 to 10 and Drawing No. 69-F-12A titled "Bartlett Avenue Revision, King's Highway No. QEW, Dist. No.4, Co. Lincoln, Twn. Grimsby, Lot 2, Con.1, Borehole Locations and Soil Strata", by Department of Highways of Ontario dated June 24, 1969.

Based on the present investigation and available subsurface information in the bridge areas, in general, the sites of the proposed Forty Mile bridge and Bartlett Avenue bridge are underlain by a cover of overburden materials consisting of fill materials up to about 4.5 m in thickness and silty clay till/residual soil overlying shale bedrock. The bedrock is red-brown shale of Queenston Formation which contains with grey-green siltstone interlayers.

3.0 FIELD WORK PROCEDURES - FORTY MILE CREEK BRIDGE

The field work for this investigation was carried out on May 18, 1995, at which time two sampled boreholes (Boreholes 1-95 and 2-95) were drilled to depths of 4.2 m and 7.3 m at the bridge site. Borehole 1-95 was located in the north-east quadrant of the site and Borehole 2-95 was located in the south-west quadrant of the proposed bridge widening (Figure 2). The borehole locations were established in the field by members of our staff relative to existing site features.

The boreholes were put down using a bombardier mounted CME 45 drill rig, supplied and operated by a local specialist drilling contractor. In each boring, samples of the overburden were obtained at 0.75 m intervals of depth as part of the Standard Penetration Test using conventional 50 mm diameter split spoon sampler. Bedrock was cored in NQ core size in both boreholes to a depth of approximately 4.2 m and 7.3 m below the ground surface. A piezometer was sealed into Borehole 2-95 to permit monitoring of the groundwater levels at the borehole location. The groundwater levels were observed during the drilling operations and for several days following completion of the drilling. Details of the groundwater conditions during and subsequent to drilling and the piezometer installations are shown on the attached Record of Borehole sheets.

The field work was supervised throughout by a member of our engineering staff who cleared site services, directed the drilling, sampling and piezometer installation operations, logged the boreholes and placed the soil samples in labelled airtight containers. The samples obtained during the investigation were identified in the field and transported to our laboratory for further examination and testing.

The ground surface elevations of the completed boreholes were surveyed by our staff. The ground surface elevations at the borehole locations are referenced to local datum using temporary benchmarks established on the top of the ends of the existing north-east and south-west wingwalls. The general arrangement plan provided indicates that the top of the walls are at Elevation 82.00 m assumed relative to Geodetic datum.

4.0 SUBSURFACE CONDITIONS

4.1 Forty Mile Creek Bridge Site

Four boreholes are relevant to the Forty Mile Creek bridge; Boreholes 1-95 and 2-95 put down during present investigation by Golder Associates and Boreholes 111 and 112 put down by Geo-Canada during the previous investigation carried out in 1994. The locations of the boreholes are shown on Figure 2. Simplified stratigraphic cross-sections along the west and east bridge abutments are shown on Figure 3.

In general, the site is underlain by relatively shallow overburden consisting of topsoil underlain by fill and silty clay till/residual soil deposits. Shale bedrock of the Queenston Formation was encountered at the depths between 1.4 m and 3.4 m. The following is a description of the subsoil and groundwater conditions encountered at the borehole locations.

4.1.1 Overburden

About 30 mm to 130 mm of topsoil was encountered at the ground surface at all of the borehole locations, except Borehole 111. About 1.4 m to 3.4 m of fill material was encountered underlying the topsoil in Borehole 2-95 and ground surface at Borehole 111. The fill consists of stiff to very stiff silty clay to clayey silt with some sand, trace gravel, frequent shale fragments and trace of organic matter (root fragments). About 1.4 m of fill consisting of compact sand and gravel with some clay was encountered in Borehole 112. These fill materials probably result from reworking of the native silty clay till/residual soil deposits during QEW construction.

The topsoil in Borehole 1-95 and the fill materials in Borehole 2-95 are underlain by about 1.6 m to 2.0 m of firm to stiff, red-brown silty clay till grading to residual soil. Some sand, trace of gravel, occasional to frequent weathered shale fragments and occasional silty sand seams were noted within this deposit. The transitional zone between the silty clay till and highly weathered shale is referred to as residual soil, where the state of weathering has reduced the original rock structure into a soil mass. The base of the residual soil was encountered at depths of about 1.6 m to 3.4 m below the ground surface (between Elevation 78.3 m and Elevation 77.5 m) in Boreholes 1-95 and 2-95. About 2.4 m of hard, red clayey silt with some sand and gravel encountered in Borehole 111 below Elevation 78.6 m, is likely residual soil grading to weathered shale.

4.1.2 Bedrock

All of the boreholes were terminated within Queenston Shale bedrock. The elevations of the bedrock surface as encountered at the borehole locations are summarized below:

Current Boreholes (1995)

Borehole 1-95 - Elevation 77.5 m,

Borehole 2-95 - Elevation 78.3 m.

Previous Boreholes (1994)

Borehole 111 - Elevation 78.6 m (assuming the 2.4 m thick deposit referred to as clayey silt is completely weathered shale)

Borehole 112 - Elevation 78.1 m

Rock coring was carried out in the current Boreholes 1-95 and 2-95 with core samples obtained to Elevation 75 m in Borehole 1-95, and to Elevation 71.9 m in Borehole 2-95. The bedrock samples obtained consist of fine grained, thinly bedded, red-brown shale with bands of fresh, light grey, crystalline limestone. Limestone bands are typically 25 mm to 75 mm thick and comprise about 7 to 8 per cent of total core length in both boreholes. The upper 0.3 m to 0.4 m of cored rock extending to Elevations 77.3 m and 77.6 m in Boreholes 1-95 and 2-95, is highly to moderately weathered; below these elevations, the rock grades to fresh. Rock Quality Designation (RQD) values of 83 per cent to 100 per cent were measured on core samples obtained.

Point load tests were carried out on the core samples retrieved from the boreholes. The diametral Point Load Indices $Is_{(50)}$ measured on the shale samples ranged from about 0.12 MPa to 0.69 MPa. The results of point load tests carried out on the core samples obtained are summarized in Table 1.

Based on an empirical relationship between point load index and uniaxial compressive strength, these results correspond to unconfined compressive strengths of about 9.6 MPa for the fresh shale obtained below Elevation 77.3 m and 77.6 m, at the locations of Boreholes 1-95 and 2-95, respectively.

4.1.3 Groundwater Conditions

The water levels in the open Boreholes 1-95 and 112 during drilling operations were at about Elevations 78.0 m and at Elevation 79.0 m, some 1.2 m and 0.5 m, respectively, below the existing ground surface. The water level in the piezometer sealed into the bedrock in Borehole 2-95 was at Elevation 78.3 m. These levels reflect/coincide with the water level in Forty Mile Creek. Details of the piezometer installation in the borehole and of the water level measurements are shown on the attached Record of Borehole sheets.

4.2 Bartlett Avenue Bridge Site

The results of fourteen boreholes drilled by others at the Bartlett Avenue Bridge site have been used in this study. Two boreholes (numbered 131 and 132) were put down on the east and west sides of the bridge by Geo-Canada during the investigation carried out in 1994, and twelve boreholes (numbered 1 to 3, 3A, 4 to 7, 7A and 8 to 10) were put down in 1969 for the Bartlett Avenue Revision by the Department of Highways (see Figure 4). Boreholes 3, 3A, 4 and 7, 7A and 8 are relevant to the proposed bridge widening. Simplified stratigraphic profiles along the west and east bridge abutments are shown on Figure 5. In general, the subsoils encountered consist of variable thickness of fill materials overlain by red-brown shale of Queenston Formation.

In Borehole 131 and 132, about 4 m to 4.6 m of fill materials were encountered extending to about Elevations 87.4 m to 88.1 m. Fill materials encountered in the 1969 boreholes were found to extend to about 0.3 m to 0.9 m depth corresponding to about Elevations 87.5 m to 88.6 m. A layer of 1.1 m to 1.6 m of a hard clayey silt deposit is noted underlying the fill in Boreholes 131 and 132; this material could be interpreted as completely weathered shale.

Shale bedrock of the Queenston Formation was encountered in all of the boreholes below Elevations 87.0 m to 88.6 m. Rock coring in AXL and BXL core sizes was carried out in the all of the 1969 boreholes with core samples obtained to Elevation 73 m to 81 m. The upper portion of the bedrock extending to depths of 2.8 m to 4.6 m (to Elevations 84 m to 86 m) is described as weathered shale. Rock Quality Designation (RQD) values measured on the core samples obtained below Elevations 84 m to 86 m varied from 81 per cent to 100 per cent. No

rock coring was carried out in Boreholes 131 and 132 and the rock on the Record of Borehole sheets is described as "red shale, completely to highly weathered, slightly plastic, very weak".

The water levels measured in the 1969 boreholes generally ranged between about Elevations 87 m and 90 m. It is assumed that these measurements were made in the open holes; however, there are periods of up to one week between the date of water level measurement and the date of drilling. Groundwater was encountered in the open Borehole 132 during drilling and the measured water level is indicated to be at about Elevation 81.0 m. Borehole 131 was dry on completion of drilling.

5.0 GEOTECHNICAL RECOMMENDATIONS

This section of the report provides recommendations on the geotechnical aspects of the design of the works based on our interpretation of the factual information obtained during the present investigation and the information obtained by others at the two bridge sites.

5.1 Project Description

The locations of the two bridge sites are illustrated on Figure 1. It is understood that the project involves the widening of the existing bridge structures as part of the QEW widening project.

The existing Forty Mile Creek bridge is located between Ontario Street and Christie Street in Town of Grimsby. It is understood that the existing single span bridge over Forty Mile Creek is to be widened to the north and south. The existing bridge abutments are supported on spread footings founded at Elevation 77.6 m which, based on the available information, is within the hard clayey silt deposit and/or the completely to highly weathered shale bedrock. The existing creek invert is at about Elevation 79 m and the grade of the QEW will be raised by about 1.2 m from its current grade at Elevation 82.5 m.

The Bartlett Avenue bridge carries QEW over Bartlett Avenue in Lincoln, Ontario. It is understood that the existing two span bridge is to be widened into the current median area. The existing bridge is supported on spread footings founded at Elevation 86.7 m at the abutments and at Elevation 84.2 m at the pier. Based on the available information, the existing footings are founded on hard clayey silt till and/or shale bedrock. The existing Bartlett Avenue is at Elevation 86 m and the QEW grade is at Elevation 92 m.

5.2 Foundations

5.2.1 Forty Mile Creek Bridge

It is considered that the footings for the widened structure should be maintained at the same founding level as the existing footings. For design of shallow foundations placed on undisturbed, hard clayey silt or weathered shale at about Elevation 77.6 m, a factored bearing resistance at ULS of 650 kPa may be assumed. Since the base of the footing will be on an unyielding soil, Serviceability Limit States may not be the governing criterion. A coefficient of friction

(unfactored) equal to 0.43 may be assumed between the concrete and the underlying founding soils assuming they have not been softened or disturbed.

The founding materials are sensitive to disturbance/softening due to water flow or ponding and construction traffic. The footing excavations will be extended to below the groundwater and adjacent creek water levels and there may be some water flow into the excavation through the granular fills and at the overburden/bedrock interface. Some form of cut-off will be required for control of water inflow from the adjacent creek; this may require use of a cofferdam. Interception of the groundwater inflow may be accomplished by cut-off trenches formed at the fill/clayey silt interface. Alternatively or in combination, pumping from sumps located at the base of the excavation may be utilized for groundwater control; sumps must be located outside the footing area. A mud coat should be placed on the prepared subgrade at the founding level immediately following cleaning and inspection. If the subgrade is left unprotected for more than a few hours, subexcavation of the softened soils will be required which may result in localized undermining of the footing.

5.2.2 Bartlett Avenue Bridge

The footings for the proposed widening should be maintained at the same founding level as the existing footings. For design of shallow foundations placed on hard, undisturbed clayey silt till or weathered bedrock at or below Elevation 86.7 m, a factored bearing resistance at ULS of 650 kPa may be used. A coefficient of friction (unfactored) equal to 0.43 may be assumed between the concrete and the underlying founding soils assuming that they have not been softened or disturbed.

The considerations with respect to groundwater flow into the excavations and protection of the founding strata given above for the Forty Creek bridge are also applicable to this site. The pier footing excavations will be extended up to about 5 m below the groundwater level and considerable water inflow could occur through the fractured portions of the bedrock.

5.3 Lateral Earth Pressures on Abutment or Retaining Walls

The lateral pressures acting on the abutments will depend on the type and method of placement of the backfill materials, of the nature of the soils behind the backfill and other the subsequent lateral movement of the structure. The following recommendations are made concerning the design of the abutment.

- Selected free-draining granular fill meeting the specifications of OPSS Granular A or B should be used as backfill behind the abutments. All granular fill should be compacted in lifts of loose thickness not greater than 200 mm to 95 per cent of the material's Standard Proctor maximum dry density.
- Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill.
- The granular fill may be placed either in a zone with width equal to at least 1.2 m behind the back of the stem (Case I) or within the wedge-shaped zone defined by a 60 degree line extending up and back from the bottom of the rear face of the footing (Case II).
- If the abutment support allows lateral yielding of the stem (unrestrained structure), active earth pressures may be used in the geotechnical design of the structure. If the abutment support does not allow lateral yielding (restrained structure), at-rest pressures should be assumed for geotechnical design.
- A compaction surcharge equal to 16 kPa should be included in the lateral earth pressures for the structural design of the abutment wall in accordance with OHBDC Figure 6.7.4.3.
- For Case I, the pressures are based on the in situ soils and the following parameters (unfactored) may be assumed:

Soil Unit Weight $\gamma = 21 \text{ kN/m}^3$

Coefficient of lateral earth pressure

'active' 0.36 for unrestrained structure

'at rest' 0.53

- For Case II, the pressures are based on the granular fill as placed and the following parameters unfactored may be assumed:

	Granular A	Granular B
Soil Unit Weight	22 kN/m ³	21 kN/m ³
Coefficient of lateral earth pressure		
- 'active' 0.27		0.31
- 'at rest' 0.43		0.47

5.4 Excavations

Excavations for footing construction may be made in open cut, where space permits, maintaining side slopes no steeper than 1 horizontal to 1 vertical through the overburden as well as in the weathered shale. Excavations made into the underlying bedrock may be made in vertical cut. Alternatively, temporary support to the excavations may be provided in the form of a braced soldier pile and lagging wall. The soldier piles should be socketed into the bedrock below the base of the excavation. The temporary support wall should be designed to resist the lateral pressures shown in Figure 6.

5.5 Embankment Construction

The extensions to the existing embankment may be constructed of a clean earth borrow fill material free of organic and oversize cobbles (greater than 200 mm in size) and placed at a suitable water content for compaction. Embankment constructed with 2 to 1 slopes will be stable, provided all organic material is removed. The topsoil and other organic material should be stripped to its full depth to the full base width of the proposed embankment area. The native subgrade should be proof-rolled prior to placing fill and any apparent softened zones should be sub-excavated and replaced with compacted fill (compacted as described below). The surface of the existing road embankment should also be stripped of topsoil and as filling operations proceed, the embankment should be keyed into the new embankment by benching. The benches cut into the existing embankment should have a bench width of 1.25 m in accordance with OPSD - 208.01. Some differential settlement should be anticipated between the existing road embankment and the new embankment since settlement at the existing embankment is probably completed. The settlement will be essentially from consolidation of the newly placed fill materials. The impact of differential settlement cracking developing at the road surface can be minimized by extending the final bench at the embankment crest to a non-settlement sensitive location.

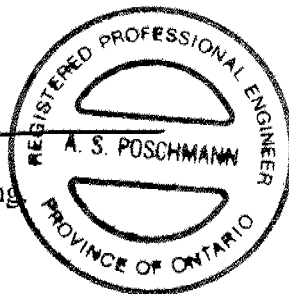
The earth fill should be placed at a suitable water content for compaction (within about $\pm 2\%$ of optimum water content) in regular lifts with loose thickness not exceeding 200 mm and should be compacted to 95% of the materials Standard Proctor maximum dry density.

GOLDER ASSOCIATES LTD.

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Principal



AMP/ASP/pds

TABLE 1
POINT LOAD TEST ON ROCK SAMPLES
FORTY MILE CREEK BRIDGE

Borehole Number	Ground Surface Elevation (m)	Sample Depth	Sample Elevation	Diametral Index Is(50)
1	79.14	1.90	77.24	0.293
		1.95	77.19	0.480
		2.05	77.09	0.480
		2.15	76.99	0.400
		2.30	76.84	0.384
		2.40	76.74	0.441
		2.45	76.69	0.307
		2.50	76.64	0.620
		2.60	76.54	0.244
		2.70	76.44	0.580
		2.80	76.34	0.226
		2.85	76.29	0.540
		2.90	76.24	0.289
		3.10	76.04	0.660
		3.30	75.84	0.247
		3.35	75.79	0.414
		3.40	75.74	0.158
		3.50	75.64	0.660
		3.60	75.54	0.224
		3.70	75.44	0.551
		3.80	75.34	0.296
		3.90	75.24	0.496
		4.00	75.14	0.201
		4.10	75.04	0.662
		4.20	74.94	0.247
		4.30	74.84	0.689
2-95	81.6	3.70	77.90	0.120
		3.80	77.80	0.276
		4.00	77.60	0.221
		4.20	77.40	0.496
		4.30	77.30	0.278
		4.40	77.20	0.496
		4.50	77.10	0.551
		4.60	77.00	0.634
		4.70	76.90	0.236
		4.8	76.80	0.551
		5.1	76.50	0.225
		5.7	75.90	0.551
		5.90	75.70	0.203
		6	75.60	0.607
		6.1	75.50	0.325
		6.20	75.40	0.634
		6.30	75.30	0.231
		6.40	75.20	0.551

APPENDIX A
RECORD OF BOREHOLES

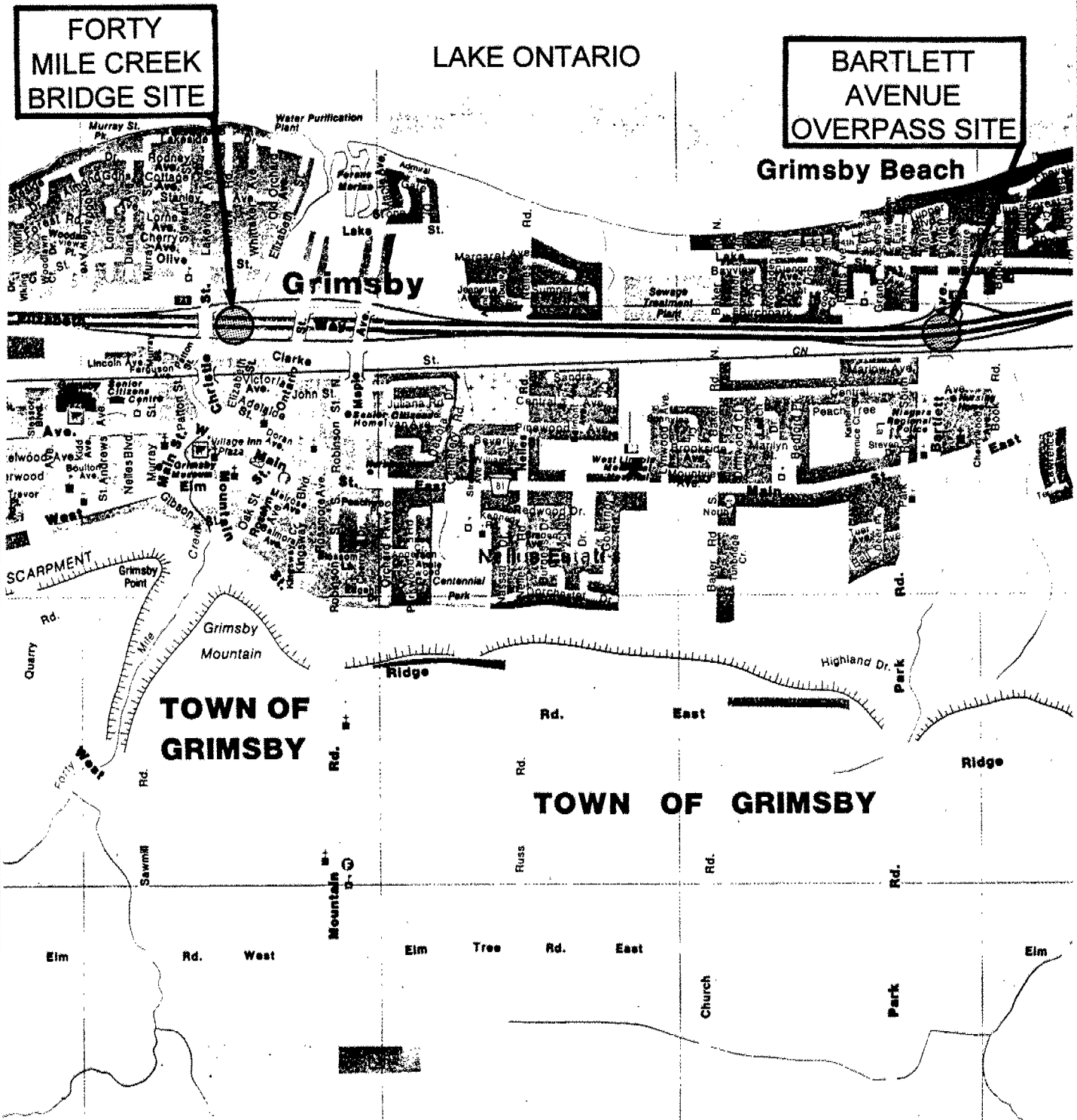
GOLDER ASSOCIATES LTD.: BOREHOLES 1-95 AND 2-95

GEO-CANADA LTD.: BOREHOLES 111, 112, 131 AND 132

DEPARTMENT OF HIGHWAYS, W.P. 370-65-01: BOREHOLES 1
TO 3, 3A, 4 TO 7, 7A AND 8 TO 10

SITE LOCATION PLAN

FIGURE 1



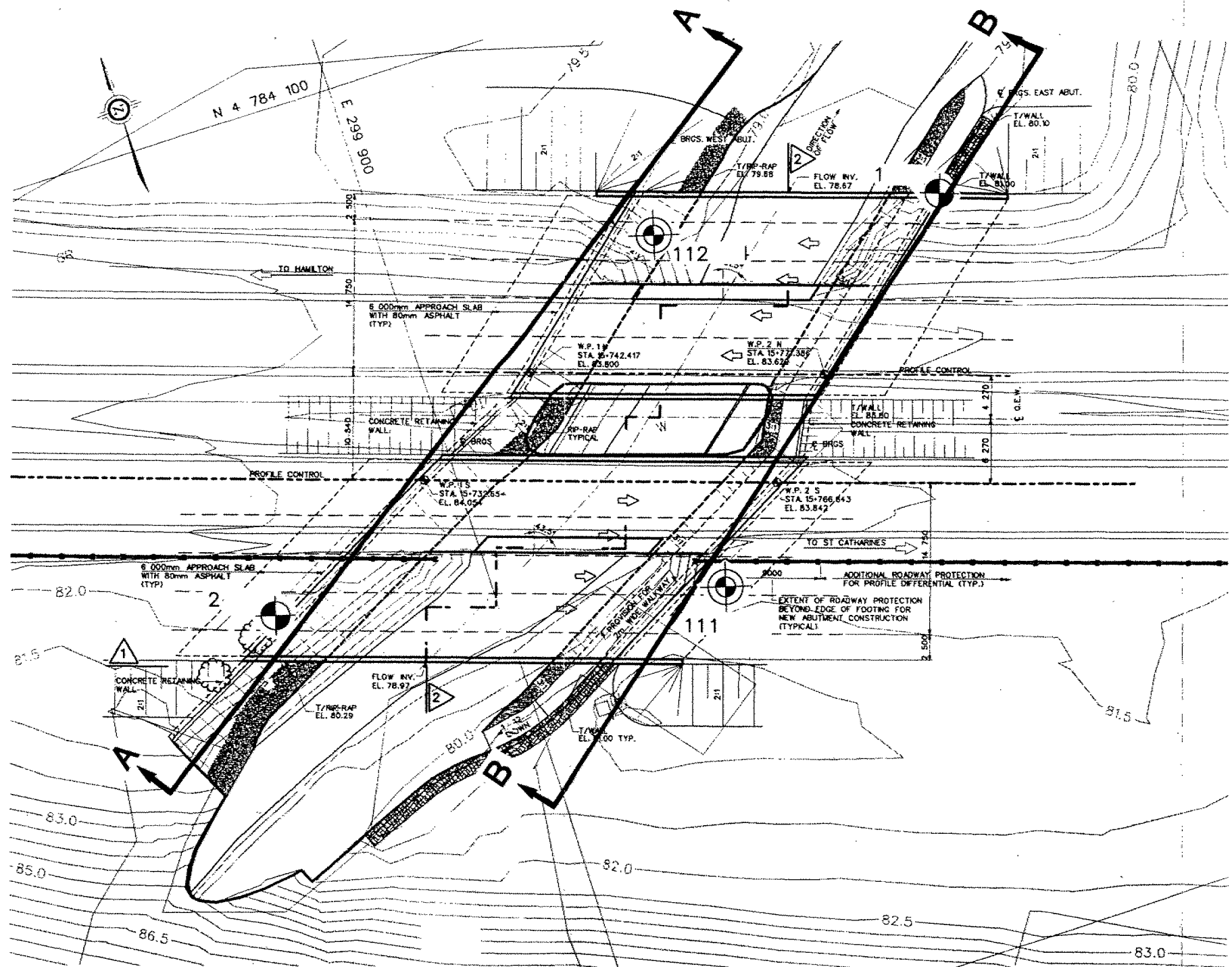
Date JUNE 1995
Project 951-1300

Golder Associates

Drawn KD
Chkd. JH

QEW WIDENING-FORTY MILE CREEK BRIDGE GENERAL ARRANGEMENT AND BOREHOLE LOCATION PLAN

FIGURE 2



LEGEND

111



BOREHOLE LOCATION (APPROX.) IN PLAN - PREVIOUS INVESTIGATION
GEO-CANADA LTD. REPORT TITLED "PRELIMINARY GEOTECHNICAL
INVESTIGATION, CULVERT AND BRIDGE STRUCTURES, QUEEN ELIZABETH
WAY, ROBERTS ROAD TO ONTARIO STREET, GRIMSBY, ONTARIO, MTO
W.P. 80-76-00", DATED MARCH 1994.

1



BOREHOLE LOCATION IN PLAN - PRESENT INVESTIGATION.

NOTE:

FOR SCHEMATIC CROSS-SECTIONS A-A AND B-B REFER TO FIGURE 3

SCALE

1 : 500 (APPROX.)

REFERENCE:

DRAWING PROVIDED BY DELCAN CORPORATION, TITLED "QEW
DESIGN/BUILD PROJECT, FORTY MILE CREEK BRIDGE, GENERAL
ARRANGEMENT", ISSUED MAY 12, 1995.

Date JUNE 1995.....

Project 951-1300.....

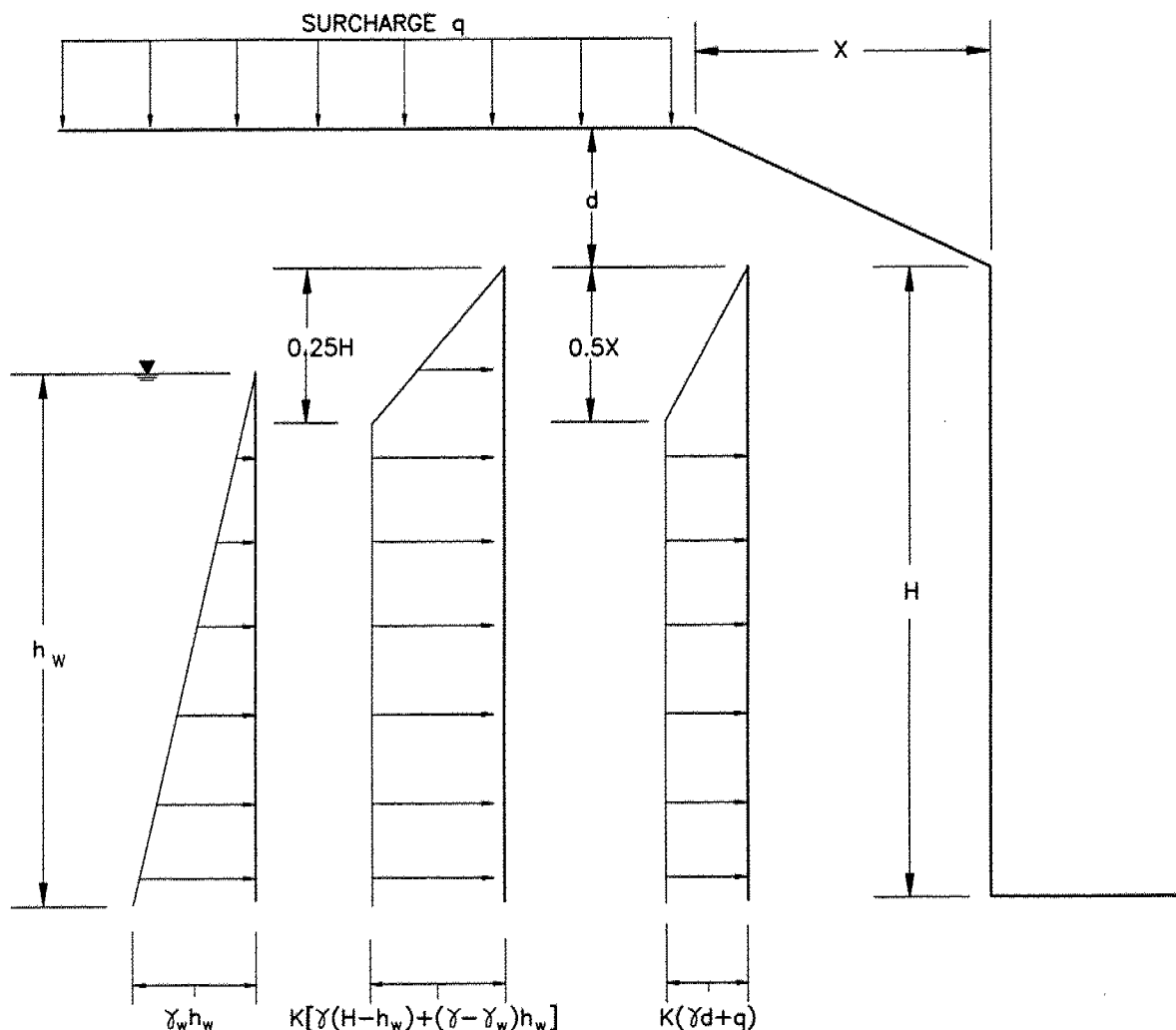
Golder Associates

Drawn ..KD.....

Chkd ..AP.....

DESIGN LATERAL EARTH PRESSURE DISTRIBUTION BRACED EXCAVATIONS IN COHESIVE SOILS

FIGURE 6



γ = UNIT WEIGHT OF SOIL

γ_w = UNIT WEIGHT OF WATER

K = EARTH PRESSURE COEFFICIENT

REFER TO TEXT OF REPORT FOR DESIGN VALUES

NOTES

1. FOR INTACT CLAY, USE $h_w = 0$.
2. FOR HORIZONTAL GROUND BEHIND WALL, $x=0$

Date JUNE 1995.....

Project 951-1300...

Golder Associates

Drawn ..KD.....

Chkd *HP*.....

LIST OF ABBREVIATIONS

The abbreviation commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 0.3 m (12 in.).

Standard Penetration Resistance, *N*:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 0.3 m (12 in.).

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) <i>Cohesionless Soils</i>	
	' <i>N</i> '
<i>Relative Density</i>	<u>Blows/0.30m</u> <u>or Blows/ft.</u>
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

<i>Consistency</i>	<u>kPa</u>	' <i>Cu</i> ' <u>psf.</u>
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer¹
Q undrained triaxial²
R consolidated undrained triaxial²
S drained triaxial
U unconfined compression
V field vane test

NOTES:

¹Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

²Undrained triaxial tests in which pore pressures are measured are shown as \bar{Q} or \bar{R} .

LIST OF SYMBOLS

I. GENERAL

π	= 3.1416
e	= base of natural logarithms 2.7183
$\log_e a$ or $\ln a$	natural logarithm of a
$\log_{10} a$ or $\log a$	logarithm of a to base 10
t	time
g	acceleration due to gravity
V	volume
W	weight
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	shear strain
ν	Poisson's ratio (μ is also used)
E	modulus of linear deformation (Young's modulus)
G	modulus of shear deformation
K	modulus of compressibility
η	coefficient of viscosity

III. SOIL PROPERTIES

(a) Unit weight

γ	unit weight of soil (bulk density)
γ_s	unit weight of solid particles
γ_w	unit weight of water
γ_d	unit dry weight of soil (dry density)
γ'	unit weight of submerged soil
G_s	specific gravity of solid particles $G_s = \gamma_s / \gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) Consistency

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density = $(e_{max} - e) / (e_{max} - e_{min})$

(c) Permeability

h	hydraulic head or potential
q	rate of discharge
v	velocity of flow
i	hydraulic gradient
k	coefficient of permeability
j	seepage force per unit volume

(d) Consolidation (one-dimensional)

m_v	coefficient of volume change = $-\Delta e / (1+e) \Delta \sigma'$
C_c	compression index = $-\Delta e / \Delta \log_{10} \sigma'$
c_c	coefficient of consolidation
T_v	time factor = $c_v t / d^2$ (d , drainage path)
U	degree of consolidation

(e) Shear strength

τ_f	shear strength
c'	effective cohesion
ϕ'	effective angle of shearing resistance, or friction
c_u	apparent cohesion*
ϕ_u	apparent angle of shearing resistance, or friction
μ	coefficient of friction
S_i	sensitivity

$\left. \begin{array}{l} \text{in terms of effective stress} \\ \tau_f = c' + \sigma' \tan \phi' \end{array} \right\}$

$\left. \begin{array}{l} \text{in terms of total stress} \\ \tau_f = c_u + \sigma \tan \phi_u \end{array} \right\}$

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the as half the undrained compressive strength.

strength $\tau_f = c_u$ is taken

PROJECT: 951-1300

RECORD OF BOREHOLE BH1-95

SHEET 1 OF 1



LOCATION: SEE FIGURE 2

BORING DATE: MAY 18, 1995

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

K130001.BHS

DATA INPUT: KD MAY 31, 1995

SOILM6

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, k, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER TYPE	SHEAR STRENGTH Cu, kPa	nat V - + Q - ● rem V - ⊗ U - ○	WATER CONTENT, PERCENT Wp ——— W ——— Wl			
0	100mm OD SOLID STEM AUGERS CME-45	GROUND SURFACE		79.14							
		TOPSOIL		0.03	1	50 DO 7					
1		Firm to stiff, red-brown, SILTY CLAY, some sand, trace gravel, occ. shale fragments, trace roots, occ. silty sand lenses. (TILL)			2	50 DO 13					
					3	50 DO 14					
2		BOREHOLE CONTINUED; FOR BEDROCK CORING DESCRIPTION REFER TO SHEET 2.		77.51 1.63							WATER LEVEL DURING DRILLING IN OVERBURDEN AT ELEV. 78.0m.
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: S.P

CHECKED: A.P

PROJECT: 951-1300

RECORD OF BOREHOLE DH1-95

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

DRILLING DATE: MAY 18, 1995

DATUM: LOCAL

INCLINATION: -90 AZIMUTH:

DRILL RIG: CME-45

DRILLING CONTRACTOR: MALONES SOIL SAMPLES LTD.



DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (m/min.)	FLUSH % RETURN	FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN	F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED	SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR	FL-FLEXURED UE-UNEVEN W-WAVY C-CURVED	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION					
				DEPTH										RECOVERY	R.Q.D.	FRACT.	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY k, cm/sec
				(m)										TOTAL CORE %	SOLID CORE %	INDEX	TYPE AND SURFACE DESCRIPTION	
0				77.51														
1				77.32														
2	CASING	Highly to moderately weathered, red brown, fine grained, thinly bedded SHALE. (QUEENSTON FORMATION)		1.82	1	0.037	RED-BROWN 100											
3	NXL	Fresh, red-brown, fine grained, thinly bedded SHALE, occ. light grey limestone band. Limestone bands generally 25mm to 75mm thick and comprising about 8% of total length cored. (QUEENSTON FORMATION)			2	0.039	RED-BROWN 100											
4	MAY 18, 1995	END OF HOLE		74.95														
5				4.19														
6																		
7																		
8																		
9																		
10																		

DEPTH SCALE:

1 to 50

Golder Associates

LOGGED: S.P

DATE:

CHECKED: A.P

DATA INPUT: KO MAY 30, 1995

PROJECT: 951-1300

RECORD OF BOREHOLE BH2-95

SHEET 1 OF 1



LOCATION: SEE FIGURE 2

BORING DATE: MAY 18, 1995

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP: 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP: 760mm

K130002 BHS

DATA INPUT: KD MAY 31, 1995

SOLM6

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT					
				DEPTH (m)				Cu, kPa	nat V - rem V -	+ ⊕	Q - ● U - ○	Wp	W	Wi			
0	POWER AUGER CME-45 BARDIER	GROUND SURFACE		81.60													
		TOPSOIL		81.47													
		Very stiff, red-brown, silty clay, some sand, trace gravel, frequent weathered shale fragments, occ. dark brown silty sand seam, trace roots. (FILL)		0.13	1	50 DO	20										
1				2	50 DO	16											
		Firm to stiff, red-brown SILTY CLAY, some sand, trace gravel, frequent shale fragments, occ. wet sand seams. (TILL)		80.23													
				1.37													
2					3	50 DO	7										
					4	50 DO	8										
3																	
					5	50 DO	14/ 0.0										
		Weathered, red-brown shale.		78.25													
4		BOREHOLE CONTINUED. FOR BEDROCK CORING DESCRIPTION REFER TO SHEET 2.		78.10													
				3.50													
5																	
6																	
7																	
8																	
9																	
10																	

BACKFILL

WATER LEVEL
DURING DRILLING
IN OVERBURDEN AT
ELEV. 78.4m

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: S.P.

CHECKED: A.P.

PROJECT: 951-1300

RECORD OF BOREHOLE BH2-95

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

DRILLING DATE: MAY 18, 1995

DATUM: LOCAL

INCLINATION: 90 AZIMUTH:

DRILL RIG: CME-45

DRILLING CONTRACTOR: MALONES SOIL SAMPLES LTD.



DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH % RETURN	COLOUR % RETURN	FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN			F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED			SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR			FL-FLEXURED UE-UNEVEN W-WAVY C-CURVED			DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
									RECOVERY		R.Q.D. %	FRACT. INDEX PER 3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY k, cm/sec						
									TOTAL CORE %	SOLID CORE %			DEP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION								
0																						
1																						
2																						
3																						
4		Highly to moderately weathered, red-brown, fine grained, thinly bedded SHALE. (QUEENSTON FORMATION)		78.10 3.50																		
5				77.64 3.96	1	0.0381	100										UN PL, SM					BENTONITE SEAL
6		Faintly weathered to fresh, red-brown, fine grained, thinly bedded SHALE, occ. light grey, fresh crystalline limestone bands generally 25mm to 75mm thick and comprising about 7% of total length cored. (QUEENSTON FORMATION)			2	0.0348	100										PL, SM UN, R					SAND
7					3	0.0347	100										PL, SM					
8		END OF HOLE		74.31 7.29																		
9																						
10																						

MAY 18, 1995

NXL

WATER LEVEL IN
PIEZOMETER AT
ELEV. 78.3m ON
MAY 30, 1995.

DATA INPUT: KD MAY 30, 1995

DEPTH SCALE:

1 to 50

Golder Associates

LOGGED: S.P

DATE:

CHECKED: A.P

RECORD OF BOREHOLE No III

METRIC

W P 80-76-00 LOCATION Co-ords. 4,784,042 N; 299,922 E WC 136-21 ORIGINATED BY PD
DIST 4 HWY QEW BOREHOLE TYPE Augering & Cone Test COMPILED BY JN
DATUM Geodetic DATE 1994.02.03 CHECKED BY IPL

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
82.0	Ground Level							SHEAR STRENGTH kPa						
								O UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL x LAB VANE						
								WATER CONTENT (%)						
								PLASTIC LIMIT Wp NATURAL MOISTURE CONTENT W LIQUID LIMIT Wl						
								10 20 30						
0.0	FILL - mixture of clayey silt some sand trace of gravel red stiff		1	SS	9		82							Frozen to 20 cm
78.6			2	SS	64/22	cm	80							1 26 51 22
3.4	CLAYEY SILT some sand, gravel red, hard possibly weathered shale		3	SS	100/6	cm	78							0 16 63 21
76.2			4	SS	85/15	cm	76							0 17 66 17
5.8	SHALE completely to highly weathered		5	SS	100/6	cm	74							
			6	SS	100/8	cm	72							
			7	SS	100/6	cm	70							
			8	SS	100/0	cm	68							
			9	SS	100/0	cm								
			10	SS	100/0	cm								
66.8			11	SS	100/0	cm								No recovery for Samples 7 to 11
15.2	END OF BOREHOLE													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 112

METRIC

W P 80-76-00 LOCATION CO-ords. 4,784,077 N: 299,925 E WC 136-21 ORIGINATED BY PD
 DIST 4 HWY QEW BOREHOLE TYPE Augering & Cone Test COMPILED BY JN
 DATUM Geodetic DATE 1994.02.28 CHECKED BY IPL

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
79.5	Ground Level												
0.0	10 cm topsoil												
78.1	FILL - mixture of sand and gravel, some clay, red, compact		1	SS	13								
1.4	SHALE completely to highly weathered slightly plastic red very weak		2	SS	100/15 cm								
			3	SS	100/8 cm								
			4	SS	100/6 cm								
			5	SS	100/6 cm								
			6	SS	100/5 cm								
			7	SS	100/4 cm								
			8	SS	100/9 cm								
			9	SS	100/4 cm								
			10	SS	100/4 cm								
			11	SS	100/4 cm								
			12	SS	100/5 cm								
65.7	END OF BOREHOLE.												
13.8													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 131

METRIC

W P 80-76-00 LOCATION Co-ords. 4,783,133 N; 302,815 E ORIGINATED BY PD
DIST 4 HWY QEW BOREHOLE TYPE Augering & Cone Test COMPILED BY JN
DATUM Geodetic DATE 1994.02.15 CHECKED BY IPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
91.8	Ground Level																
0.0	8 cm topsoil FILL mixture of silty clay and silty sand trace of gravel red/brown/black firm		1	SS	7											Frozen to 23 cm.	
			2	SS	7												
87.4	pieces of concrete																
4.4	CLAYEY SILT red, hard, possibly weathered shale		3	SS	78/	25 cm											
86.3																	
5.5	SHALE completely to highly weathered red very weak		4	SS	100	/1 cm											
			5	SS	100	/1 cm											
			6	SS	100	/8 cm											
			7	SS	100	/3 cm											
			8	SS	100	/1 cm											
			9	SS	100	/5 cm											
			10	SS	100	/3 cm											
			11	SS	100	/6 cm											
			12	SS	100	/6 cm											
75.0			13	SS	100	/5 cm											
16.8	END OF BOREHOLE. *Borehole dry on completion but caved to 14.8 m															No recovery for Samples 4, 5, 7, 8, 9, 10 and 13	

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 132

METRIC

W P 80-76-00 LOCATION Co-ords. 4,783,119 N; 302,877 E ORIGINATED BY PD
 DIST 4 HWY QEW BOREHOLE TYPE Augering & Cone Test COMPILED BY JN
 DATUM Geodetic DATE 1994.02. CHECKED BY IPL

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					
92.1	Ground Level						92										
0.0	18 cm topsoil FILL mixture of clayey sil trace of gravel red/grey very stiff to stiff		1	SS	25		90										Frozen to 25 cm.
88.1			2	SS	8		88										
4.0	CLAYEY SILT red, hard, possibly weathered shale		3	SS	58		86										0 14 60 26
86.5			4	SS	100/	1 cm	84										
5.6	SHALES completely to highly weathered red very weak		5	SS	100/	4 cm	82										No recovery for Samples 6 and 7.
			6	SS	100/	6 cm	80										
			7	SS	100/	5 cm	78										
			8	SS	100/	10 cm	76										
			9	AS	100/	5 cm											
			10	SS	100/	4 cm											
			11	SS	100/	4 cm											
75.3			12	SS	100/	3 cm											
16.8	END OF BOREHOLE.																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

LOCATION Sta 288 + 39 @ Prop. Q.E.W. Rev'n. o/s 81.' Rt.

ORIGINATED BY VK

BORING DATE April 21, 1969

COMPILED BY WH & CM

BIDREHOLE TYPE Washboring - NX Casing Cone

CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %			BULK DENSITY P.C.F.	REMARKS	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
						20	40	60	80	100	UNCONFINED	FIELD VANE	QUICK TRIAXIAL			
287.5	Ground Level														▽286.5	
285.5	Fill Material	◇													Apr.30/69	
2.0			1	SS 100/6"												
	Weathered		2	SS 100/1"	280											
277.5			3	SS 100/1"												
10.0	Shale Bedrock		4	BXL 80%												
	Sound		5	BXL 95%	270											
			6	BXL 100%												
262.5																
25.0	End of Borehole				260											

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-P-12 LOCATION Sta. 288+56 \varnothing Prop. Q.E.W. Rev'n. o/s 88.5' Lt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 24, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone CHECKED BY [Signature]

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT					SHEAR STRENGTH PSF			
296.1	Ground Level													
0.0	Topsoil & Fill Material													
293.1														
3.0			1	SS	38									
	Weathered		2	SS	100/6"	290								
			3	SS	100/4"									
			4	SS	100/2"									
281.0			5	SS	100/1"	280								
15.1			6	BXL	87%									
	Shale Bedrock		7	BXL	83%									
	Sound		8	BXL	100%	270								
			9	BXL	100%									
261.1						260								
35.0	End of Borehole													

▼ 287.4
Apr. 30/69

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY WH & C

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit — % Plastic Limit — % Water Content — %	BULK DENSITY γ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	WATER CONTENT %		
290.3	Ground level									
0.0	Fill Material	X/X				290				GR SA SI CL
1.0			1	SS 100/4"						▼ 288.3
			2	SS 100/4"						June 19/69
	Weathered		3	SS 100/3"		280				
			4	SS 100/3"						
275.2			5	SS 100/A"						
15.1	Shale Bedrock		6	BXL 90%		270				
	Sound		7	BXL 100%						
265.3										
25.0	End of Borehole					260				

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3A

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 289+04.0 Prop. Q.E.W. Rev'n. 9/s 13.0' Lt. ORIGINATED BY VK
W.P. 370-65-C1 BORING DATE April 24, 1969 COMPILED BY WH & CM
DATUM Geodetic BOREHOLE TYPE Washboring NX Casing CHECKED BY

SOIL PROFILE			SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — %		BULK DENSITY Y	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT					PLASTIC LIMIT — %			
							20	40	60	80	100	WATER CONTENT — %			
						SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE									
						● QUICK TRIAXIAL x LAB. VANE									
289.5	Ground Level														
0.0															
1.0	Weathered		1	SS	100/6"										
			2	SS	100/5"										
280.4			3	SS	100/1"	280									
9.1			4	AXT	100%										
	Shale Bedrock		5	AXT	90%										
	Sound		6	AXT	100%	270									
			7	AXT	100%										
260.5						260									
29.0	End of Borehole														

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 289+12 & Prop. Q.E.W. Rev'n. o/s 88.5' Lt.
 W.P. 370-65-01 BORING DATE April 28, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone

ORIGINATED BY VK
 COMPILED BY WH & CH
 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT _____ PLASTIC LIMIT _____ WATER CONTENT _____		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLCT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.			
							20	40	60	80	100	○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE		
294.4	Ground Level														
0.0	Topsoil & Fill														
291.4	Material														
3.0			1	SS	18	290									
			2	SS	100/6"										
	Weathered		3	SS	100/6"										
			4	SS	100/3"										
279.4						280									
15.0			5	BXL	100%										
	Shale Bedrock														
	Sound		6	BXL	83%	270									
			7	BXL	93%										
264.4															
30.0	End of Borehole					260									

268.0

June 19/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 289 + 51 E Prop. Q.E.W. Rev'n. o/s 89.5' Rt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 23, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY JK

SOIL PROFILE		STRATUM	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L		BULK DENSITY γ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	PLASTIC LIMIT — w_p		
291.3	Ground Level										GR. SA. SI. CL.
289.0	Fill Material				290						▼ 289.3
2.3	Weathered		1	SS-100/6"							Apr. 30/69
			2	SS-100/5"							
281.3			3	SS-100/2"							
10.0	Shale Bedrock Sound		4	BXL 90%	280						
			5	BXL 90%							
			6	BXL 40%	270						
			7	BXL 100%							
261.3	End of Borehole				260						
30.0											

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 289 + 67 & Prop. Q.E.W. Rev'n. o/s 88.5' Lt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 29, 1969 COMPILED BY WH & CY
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casings; Cone CHECKED BY EK

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK DENSITY Y P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.			
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL < LAB. VANE	WATER CONTENT %		
293.8	Ground Level														
291.8	Topsoil & Fill Material														
2.0	Weathered	E	1	SS	90	290								287.3 Apr. 30/69	
			2	SS	100/6"										
284.6			3	SS	100/2"										
9.2	Shale Bedrock Sound	E	4	AXT	83%	280									
			5	AXT	80%										
			6	AXT	100%	270									
			7	AXT	100%										
			8	AXT	100%	260									
259.8															
34.0	End of Borehole														

▼ 287.3
Apr. 30/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 290+10 @ Prop. Q.E.W. Rev'n. o/s 91.0' Rt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 22, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY EL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT _____ % PLASTIC LIMIT _____ % WATER CONTENT _____ %		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		WATER CONTENT %			
292.0	Ground Level											
0.0	Fill Material	X				290						288.7
1.0	Weathered		1	SS 100/6"								June 19/69
			2	SS 100/5"								
			3	SS 100/1"								
282.9	Shale Bedrock		4	BXL 81%		280						
9.1			5	AXT 100%								
			6	AXT 100%		270						
			7	AXT 100%								
		Sound										
263.0	End of Borehole					260						
29.0												

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE No. 7A

FOUNDATION SECTION

MATERIALS & TESTING OFFICE

JOB 69-F-12

LOCATION Sta. 290 + 19 ϕ Prop. Q.B.W. Rev'n. o/s 6.0' Lt.

ORIGINATED BY VK

W.P. 370-65-01

BORING DATE April 23, 1969

COMPILED BY

WH & CH

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		STRAT. PLT.	SAMPLES		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE			SHEAR STRENGTH P.S.F.		WATER CONTENT %			
291.5	Ground Level						<input type="radio"/> UNCONFINED <input type="radio"/> FIELD VANE <input checked="" type="radio"/> QUICK TRIAXIAL <input type="radio"/> LAB VANE					
0.0	Fill Material	X				290						▼ 289.1
1.0	weathered		1	SS 100/6"								Apr. 30/69
			2	SS 100/3"								
282.3			3	SS 100/2"								
9.2	Shale Bedrock Sound		4	AXT 50%		280						
			5	AXT 100%								
			6	AXT 100%		270						
			7	AXT 100%								
262.5												
29.0	End of Borehole					260						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 290 + 28 $\frac{1}{2}$ Prop. Q.E.W. Rev'n. o/s 88.5' Lt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 24, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone CHECKED BY

SOIL PROFILE		STRAT. PROF.	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT --- % PLASTIC LIMIT --- % WATER CONTENT --- %		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		
292.1	Ground Level													
0.0	Topsoil & Fill	X	1	SS 150	290									285.8 Apr. 30/69
289.1	Material		2	SS 100/3"										
3.0	Weathered		3	SS 100/1"										
283.0			4	AXT 82%	280									
9.1			5	AXT 90%										
	Shale Bedrock		6	AXT 100%	270									
	Sound		7	AXT 100%										
			8	AXT 100%	260									
258.1														
34.0	End of Borehole													
					250									

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 290 + 64 1/2 PROP. Q.E.W. Rev'n. o/s 91.0' Rt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 21, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY

SOIL PROFILE		STRAT. PT.	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _p WATER CONTENT ——— w		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH PSF O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		WATER CONTENT % w _p ——— w _L ——— w		
293.5	Ground Level										
291.5	Fill Material										
2.0			1	SS 100/6"	290						
	Weathered		2	SS 100/5"							
			3	SS 100/4"							
281.5											
12.0			4	BXL 100%	280						
	Shale Bedrock										
	Sound		5	BXL 100%							
271.5											
22.0	End of Borehole				270						

289.5

June.19/69

289.5
June.19/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

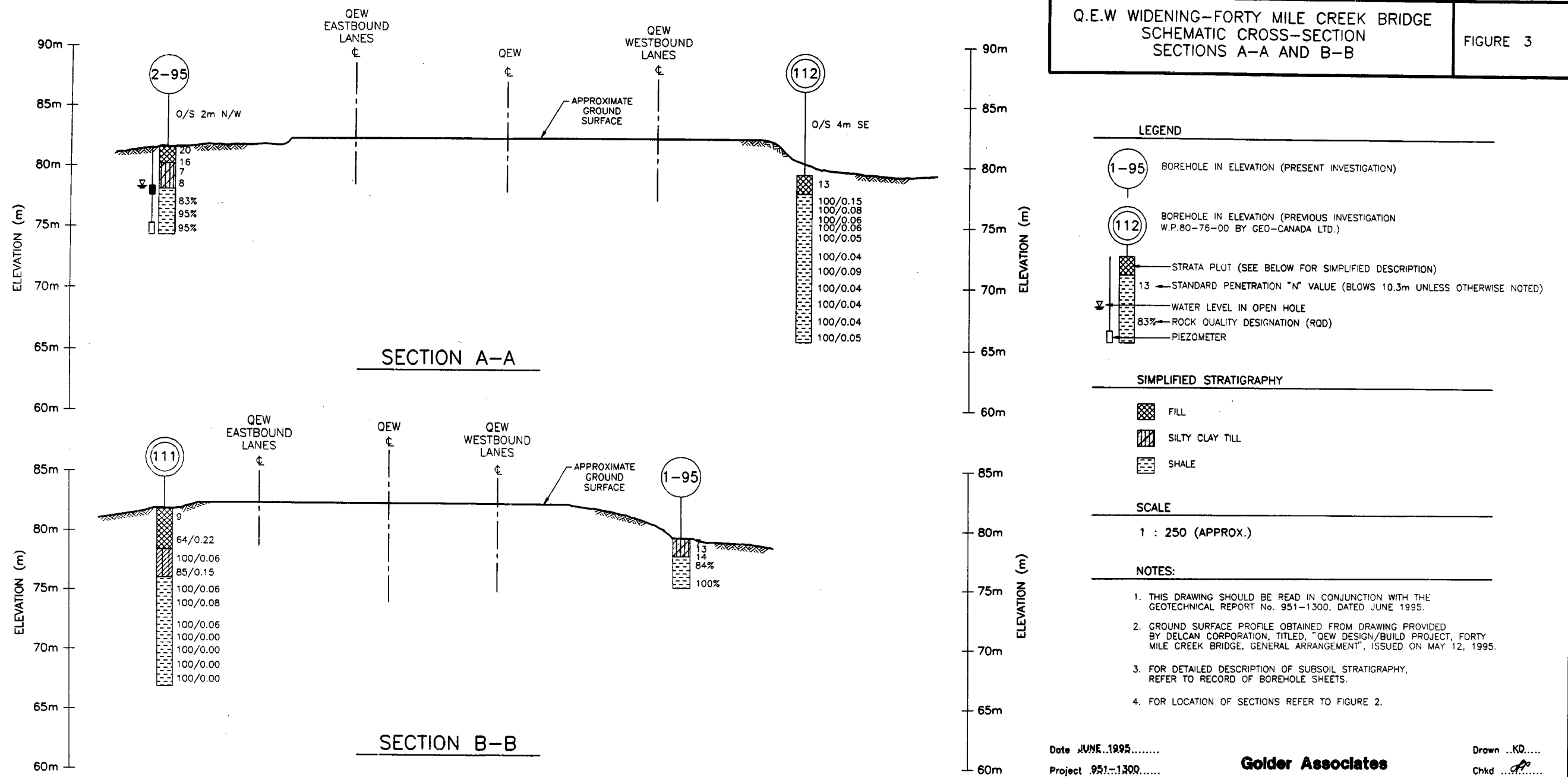
RECORD OF BOREHOLE No. 10

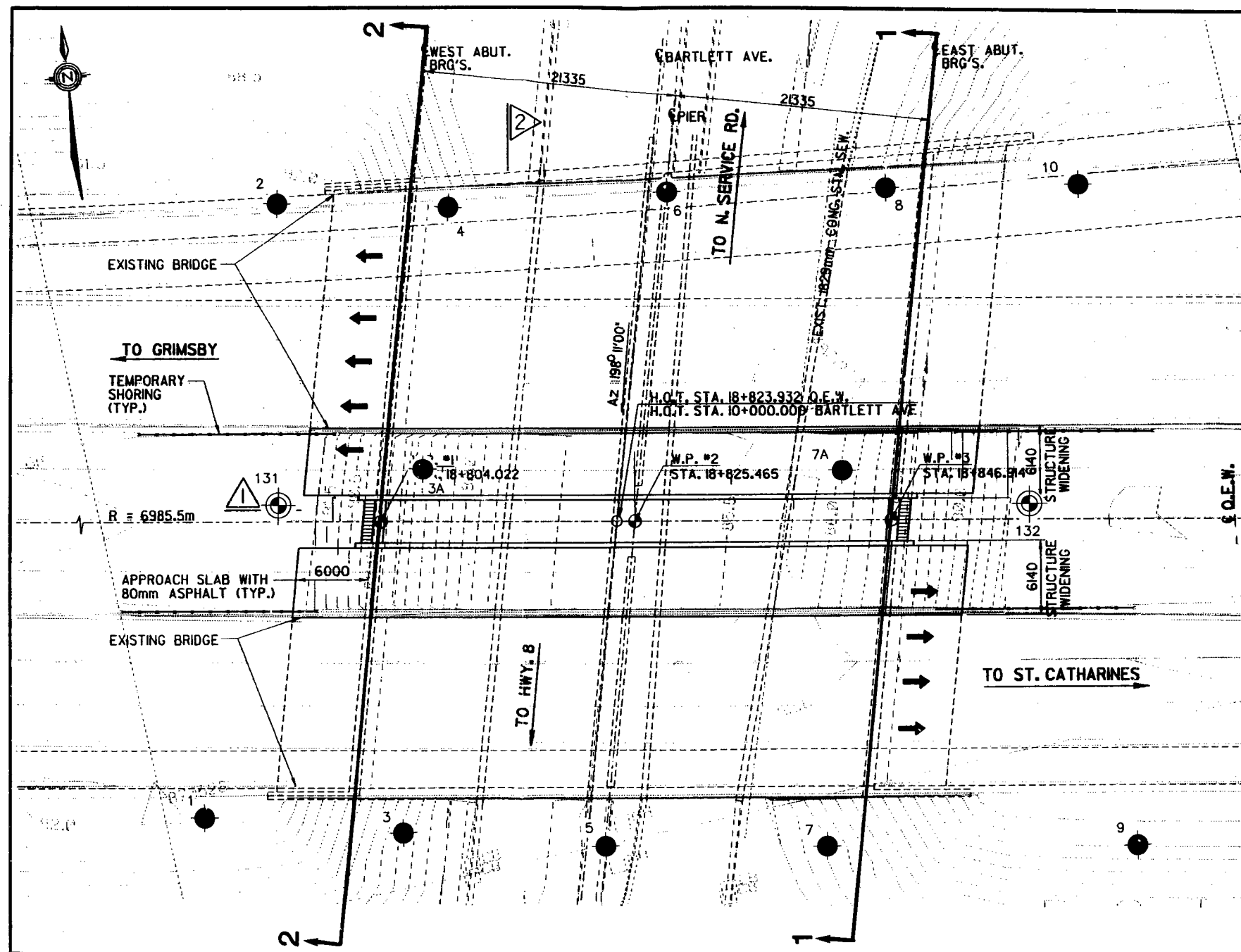
FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 290 + 83 \varnothing Prop. Q.E.W. Rev'n. o/s 88.5' Lt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 25, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone CHECKED BY

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT					SHEAR STRENGTH P.S.F.				
						20	40	60	80	100	○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	WATER CONTENT %		
290.2	Ground Level														
0.0 288.2	Topsoil & Fill Material	◇			290										
2.0			1	SS 74											
	Weathered		2	SS 100/4"											
281.1			3	SS 100/1"											
9.1			4	AXT 80%	280										
			5	AXT 80%											
	Shale Bedrock		6	AXT 80%	270										
	Sound		7	AXT 100%											
			8	AXT 100%	260										
256.2															
34.0	End of Borehole				250										

285.5
Apr. 30/69





QEW WIDENING-BARTLETT AVENUE
OVERPASS, GENERAL ARRANGEMENT AND
BOREHOLE LOCATION PLAN

FIGURE 4

LEGEND

- 1 BOREHOLE LOCATION (APPROX.) IN PLAN - PREVIOUS INVESTIGATION: DEPARTMENT OF HIGHWAYS W.P. 370-65-01 DRAWING No. 69-F-12A TITLED "BARTLETT AVENUE REVISION, KING'S HIGHWAY No. QEW, DIST. No. 4, CO. LINCOLN, TWN. GRIMSBY, LOT 2, CON. 1, BOREHOLE LOCATIONS AND SOIL STRATA", DATED JUNE 24, 1969.
- 131 BOREHOLE LOCATION (APPROX.) IN PLAN - PREVIOUS INVESTIGATION: GEO-CANADA LTD. REPORT TITLED "PRELIMINARY GEOTECHNICAL INVESTIGATION, CULVERT AND BRIDGE STRUCTURES, QUEEN ELIZABETH WAY, ROBERTS ROAD TO ONTARIO STREET, GRIMSBY, ONTARIO, MTO W.P. 80-76-00", DATED MARCH 1994.

NOTE:

FOR SCHEMATIC CROSS-SECTIONS 1-1 AND 2-2, REFER TO FIGURE 5.

SCALE

1 : 300

REFERENCE:

DRAWING PROVIDED BY MCCORMICK RANKIN, TITLED "QEW WIDENING, BARTLETT AVENUE OVERPASS, GENERAL ARRANGEMENT", DATED FEB. 1995.

Date JUNE 1995.....

Project 951-1300.....

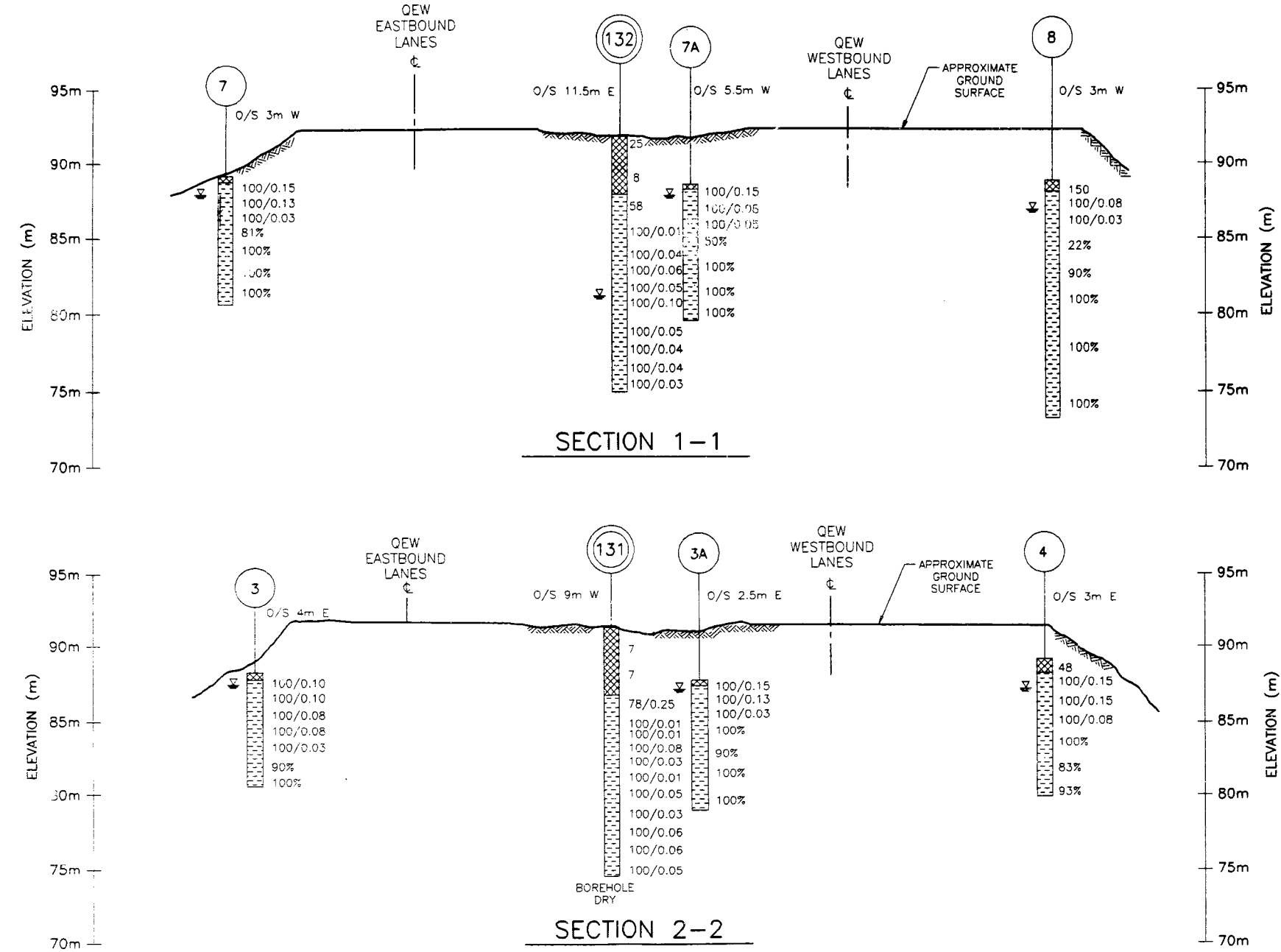
Golder Associates

Drawn ..KD.....

Chkd ..P.....

Q.E.W WIDENING-BARTLET AVENUE OVERPASS
SCHEMATIC CROSS-SECTIONS
SECTIONS 1-1 AND 2-2

FIGURE 5



LEGEND

8 BOREHOLE IN ELEVATION (PREVIOUS INVESTIGATION- W.P. 370-65-01 BY DEPARTMENT OF HIGHWAYS)

131 BOREHOLE IN ELEVATION (PREVIOUS INVESTIGATION W.P.80-76-00 BY GEO-CANADA LTD.)

STRATA PLOT (SEE BELOW FOR SIMPLIFIED DESCRIPTION)

13 STANDARD PENETRATION "N" VALUE (BLOWS 10.3m UNLESS OTHERWISE NOTED)

WATER LEVEL IN OPEN HOLE

83% ROCK QUALITY DESIGNATION (RQD)

SIMPLIFIED STRATIGRAPHY

FILL

SILTY CLAY TILL

SHALE

SCALE

1 : 250 (APPROX.)

NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE GEOTECHNICAL REPORT No. 951-1300, DATED JUNE 1995.
- GROUND SURFACE PROFILE OBTAINED FROM DRAWING PROVIDED BY MCCORMICK RANKIN TITLED "QEW WIDENING BARTLETT AVENUE OVERPASS, GENERAL ARRANGEMENT", DATED FEB. 1995.
- FOR DETAILED DESCRIPTION OF SUBSOIL STRATIGRAPHY, REFER TO RECORD OF BOREHOLE SHEETS.
- FOR LOCATION OF SECTIONS REFER TO FIGURE 4.

Date JUNE 1995.....

Project 951-1300.....

Golder Associates

Drawn ..KD.....

Chkd ..JP.....

P:\K130005.DWG 1:250