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GEOCRES No. 31 L-43

DIST. 13 REGION

W.P. No. 72-74-03/04

CONT. No. 83-210

W. O. No.

STR. SITE No. 43-204B

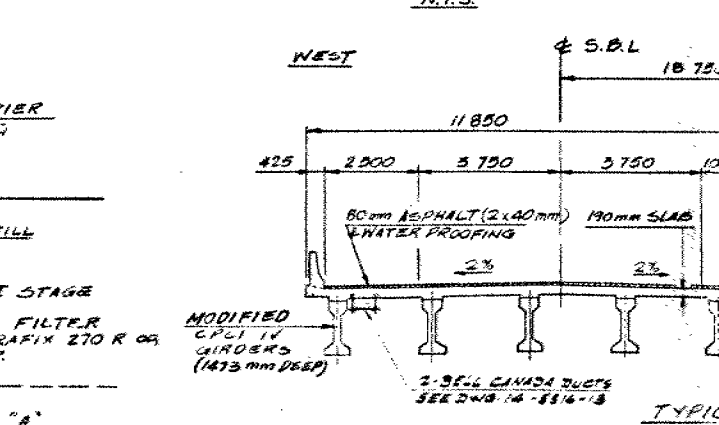
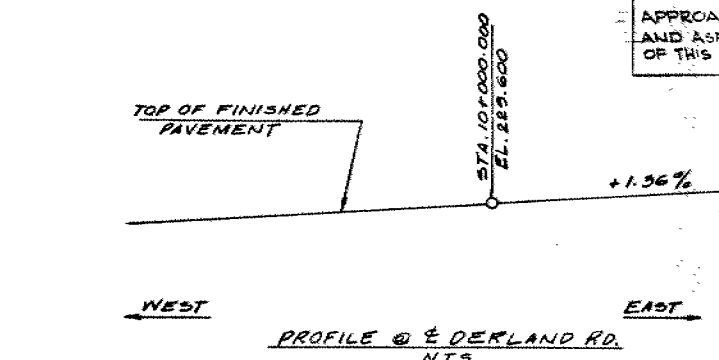
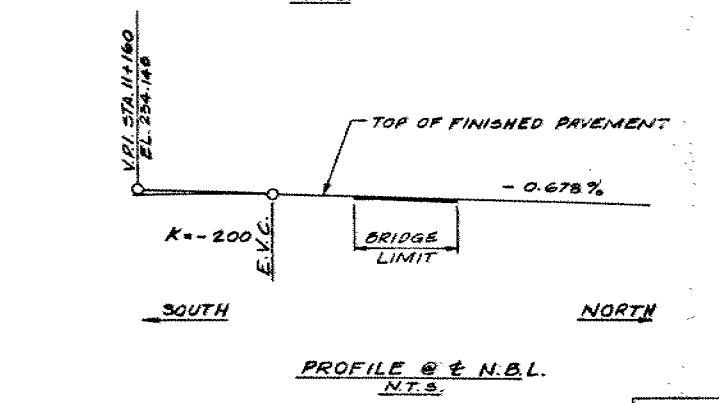
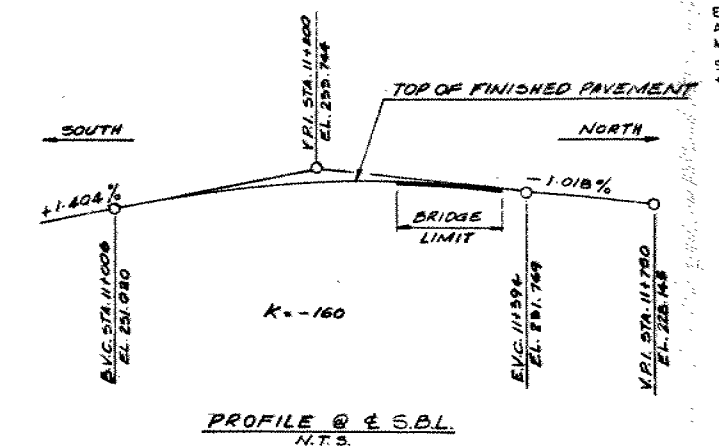
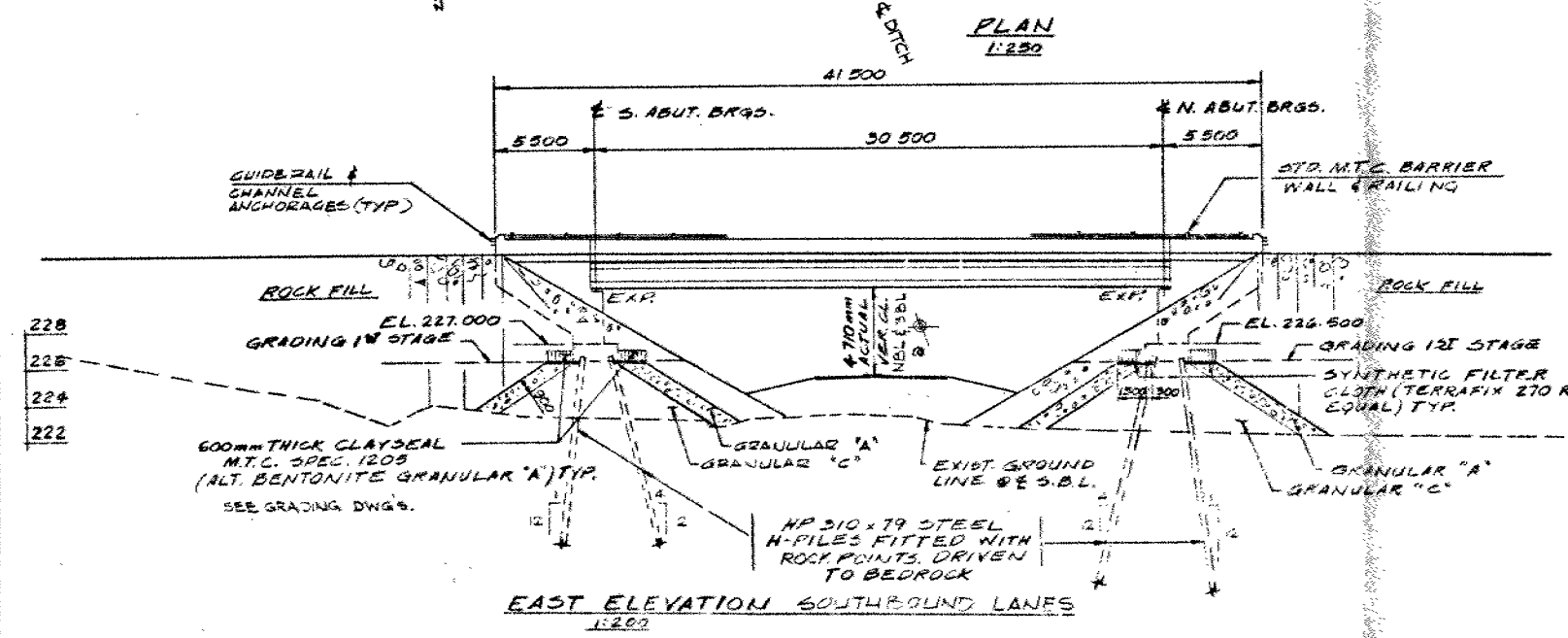
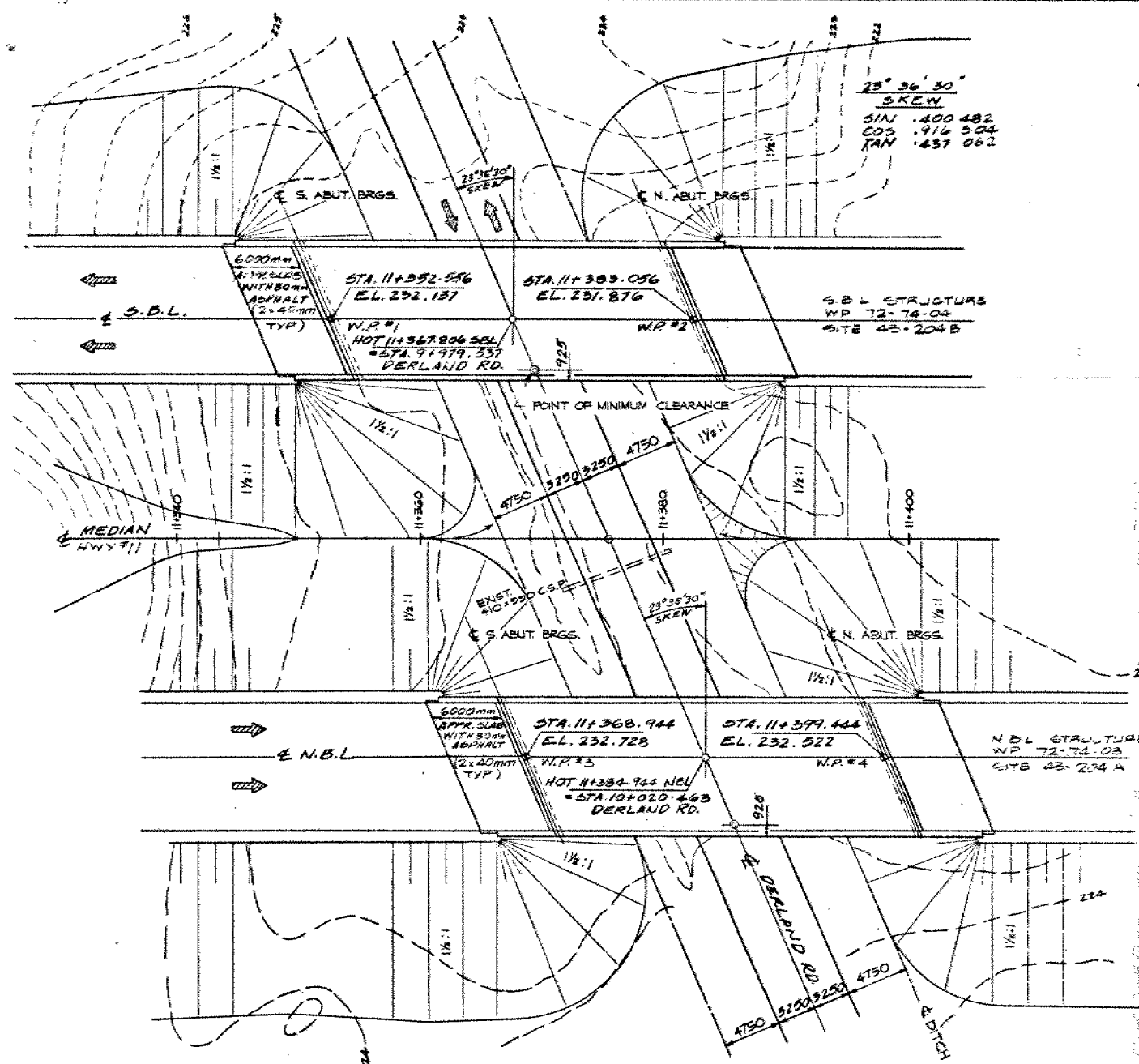
HWY. No. 11

LOCATION Derland Road Overpass

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



**METRIC**

DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN  
METRES.

STATIONS ARE IN KILOMETRES  
+ METRES

DISTRICT 13	CONT No	SHEET
WP No 72-74-03-04		
DERLAND ROAD OVERPASS 1.5 KM SOUTH OF HWY #17		
GENERAL LAYOUT		

**NOTES:**

**REINFORCING STEEL**  
PRECAST GIRDERS GRADE 400 W  
REMAINDER GRADE 400  
REINFORCING BARS WITH THE DESIGNATION  
'C' AT THE END OF BAR MARKS SHALL  
BE EPOXY COATED BARS

**CLASS OF CONCRETE**  
DECK & BARRIER WALLS 30 MPa  
REMAINDER 20 MPa  
FOR PRESTRESSED GIRDERS SEE  
DWG. 8

**CLEAR COVER ON REINFORCING STEEL**  
FOOTINGS & ABUTMENTS 75 mm  
DECK TOP 50 mm  
DECK BOT 40 mm  
BARRIER WALLS 40 mm  
APPROACH SLABS 50 mm  
AND/OR AS NOTED ON DRAWINGS

**CONSTRUCTION NOTES**  
THE CONTRACTOR SHALL FINISH THE  
BEARING SEATE DEAD LEVEL TO THE  
SPECIFIED ELEVATIONS WITH A TOLERANCE  
OF ± 3 mm  
NO CONCRETE SHALL BE PLACED ABOVE  
THE ABUTMENT BEARING SEATES UNTIL  
THE CONCRETE IN THE DECK HAS BEEN  
PLACED  
TO ACHIEVE THE MINIMUM CLEAR COVER OF  
50 mm SPECIFIED AT TOP OF DECK, THE TOP  
LAYER OF REINFORCEMENT SHALL BE PLACED  
PRIOR TO CONCRETING WITH A CLEAR  
COVER OF 65 mm ± 15 mm TOLERANCE

**LIST OF DRAWINGS**  
42-204-1. GENERAL LAYOUT  
2. BORE HOLE LOCATIONS & SOIL STRAT.  
3. FOOTING LAYOUT  
4. SOUTH ABUTMENT S.B.L.  
5. NORTH ABUTMENT S.B.L.  
6. SOUTH ABUTMENT N.B.L.  
7. NORTH ABUTMENT N.B.L.  
8. PRESTRESSED GIRDERS & BEARING  
9. DECK  
10. BARRIER WALL  
11. RAILING FOR BARRIER WALL  
12. 6000 APPROACH SLAB  
13. AS CONSTRUCTED ELEV & DIM  
14. STANDARDS I  
15. STANDARDS II  
16. STANDARDS III  
17. BRIDGE DATE & SITEMUMBER DATA

**CONCRETE QUANTITIES**

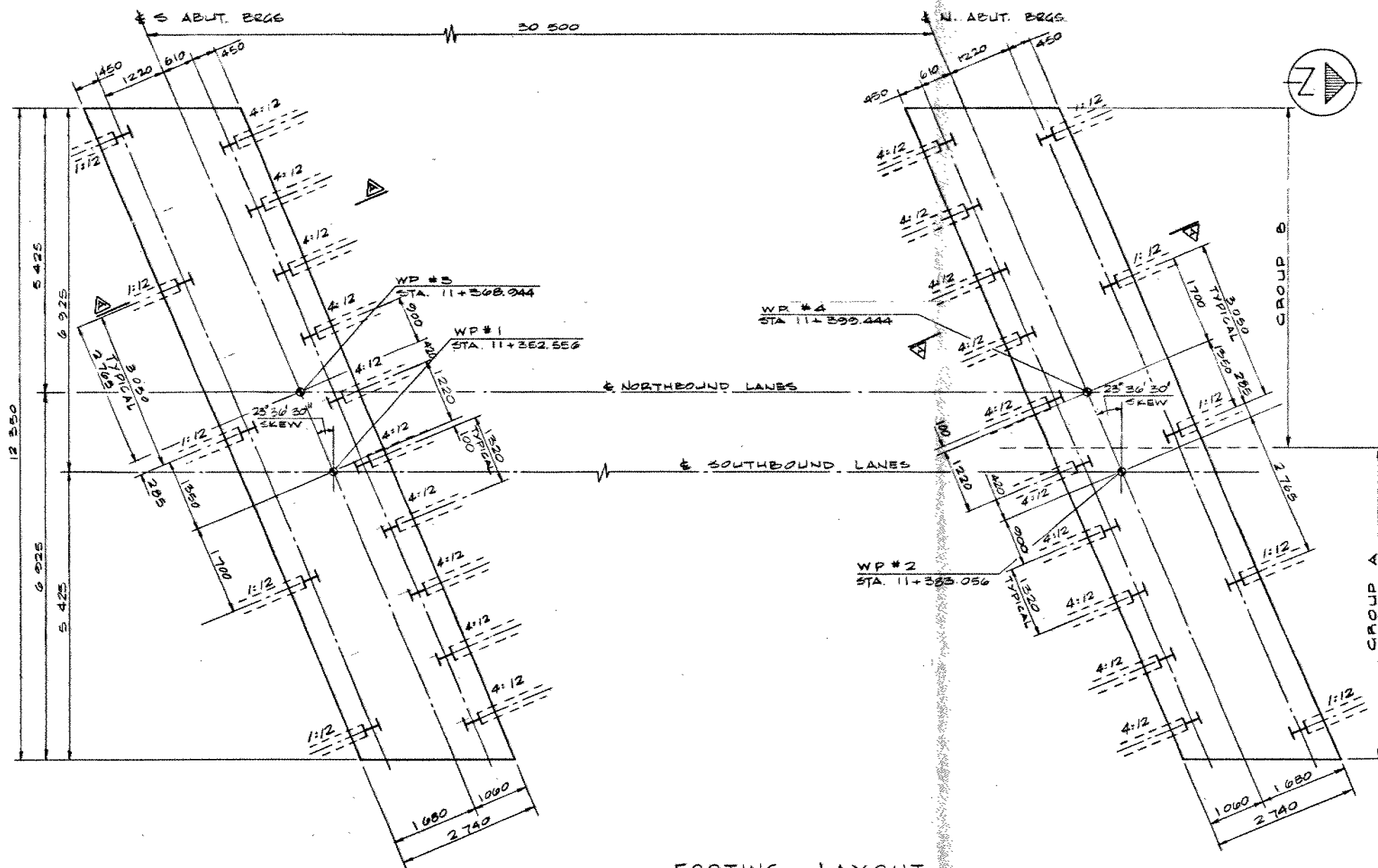
	EST	NBL
ABUTMENTS & WINGWALLS	193	193
DECK & DIAPHRAGMS	87	87
BARRIER WALLS	16	16
APPROACH SLABS (NOT IN CONTRACT)	23	23



2M 238.050  
GEODETIC DATUM  
BOLT SET IN BEDROCK  
412 BT 31-238.5

**Underwood McLellan (1977) Ltd.**  
Consulting Engineers and Planners

REVISIONS	DATE	BY	DESCRIPTION
DESIGN		BY	LOADING
CHECK		BY	DATE
DRAWING		BY	SITE No



# METRIC

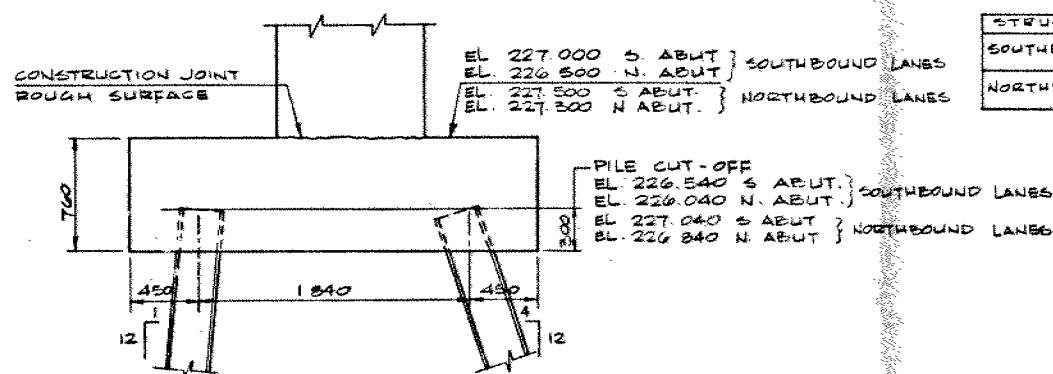
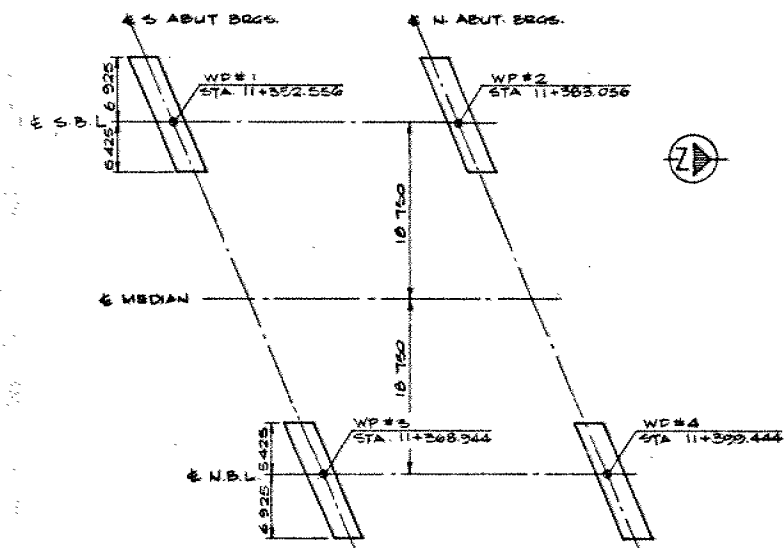
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METRES.  
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+ METRES

DISTRICT 13  
CONT No  
WP No 72-74-03-04

DEERLAND ROAD OVERPASS  
1.5 km SOUTH HWY #17  
FOOTING LAYOUT

SHEET

Underwood McLellan (1977) Ltd.  
Consulting Engineers and Planners



## LIST OF STEEL H-PILES

STRUCTURE	LOCATION	TYPE	NUMBER & LENGTH REQUIRED	REMARKS
SOUTHBOUND	S. ABUTMENT	HP 310 x 79	GROUP A 7 @ 10.500 GROUP B 8 @ 8.500	WITH OGLO POINTS
	N. ABUTMENT	HP 310 x 79	GROUP A 7 @ 10.500 GROUP B 8 @ 11.500	
NORTHBOUND	S. ABUTMENT	HP 310 x 79	GROUP A 7 @ 22.250 GROUP B 8 @ 18.750	
	N. ABUTMENT	HP 310 x 79	GROUP A 7 @ 19.750 GROUP B 8 @ 19.750	

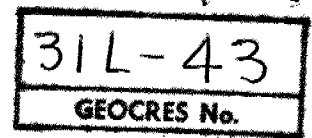
NOTE:  
PILE LENGTH SHOWN ON THE DRAWING IS  
THE THEORETICAL LENGTH BELOW CUT-OFF



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	J. W. T.	CHECK	J. W. T.
DRAWING	J. W. T.	CHECK	J. W. T.



## Memorandum



To: Mr. J.C. McAllister (2)  
Head, Structural Section  
Northern Region  
North Bay

From: Soil Mechanics Section  
Engineering Materials Office  
Room 315, Central Building

Attention:

Date: 79 02 02

Our File Ref.

In Reply to

Subject: Re: Foundation Investigation and Design Report For  
Derland Road Overpass Structures For N.B.L. and  
S.B.L. of Hwy. 11, W.P. 72-74-03/04, Site 43-204

Geocon (1975) Ltd., Consulting Geotechnical Engineers, has been retained by the Ministry to carry out a subsurface investigation at the site of the proposed Derland Road Overpass Structures for the N.B.L. and S.B.L. of new Hwy. 11. The purpose of this investigation was to obtain factual information and to provide recommendations for the design and construction of the foundations and related approaches.

A detailed foundation investigation and design report was submitted by the Geotechnical Consultant recently and our comments are as follows.

1. The factual data, together with the engineering properties of the subsoil strata, is quite satisfactory.
2. The report provided recommendations for foundations assuming perched abutments will be contemplated at this location. For this concept steel 'H' piles would be the most viable alternative for foundation support as discussed in this report. However, if closed type of abutments are contemplated, some foundation problems can be anticipated because of the steep sloping nature of the bedrock, specifically for S.B.L. structure abutments. Further, dewatering problems can also be anticipated due to the presence of high water level in the granular subsoil. If closed end abutments are to be adopted, this section will provide detailed recommendations for this alternative. However, for preliminary purposes the details indicated in one of our foundations reports, W.P. 71-74-03/04 would be suitable.

We believe that the aforementioned comments, together with the enclosed foundation report, would be adequate for your immediate needs.

*M. Devata*

M. Devata  
Supervising Engineer

Encl.

MD/gs

cc: W.J. Peck	E. Van Beilen	L. Argo )
S. McCombie	G.A. Wrong	J. Anderson) memo only
M.J. Bernhardt (2)	B.J. Giroux	G. Sloan )
R.S. Pillar	R. Hore	Files ✓

31L-43

GEOCREs No.

T10243

REPORT TO  
MINISTRY OF TRANSPORTATION & COMMUNICATIONS,  
ONTARIO

GEOTECHNICAL INVESTIGATION  
DERLAND OVERPASS  
NEW HIGHWAY 11

NORTH BAY

ONTARIO

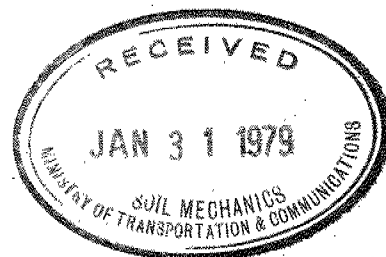
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WP 72-~~78~~-03/0A

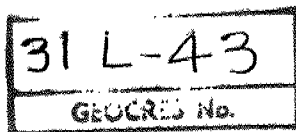
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January 30th, 1979

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Geotechnical Processes  
Earthworks

Rexdale, Ontario.  
January 30th, 1979

Ministry of Transportation  
and Communications, Ontario,  
1201 Wilson Avenue,  
Downsview, Ontario.  
M3M 1J8

Attention: Mr. M. Devata, P.Eng.,  
Supervising Engineer,  
Soil Mechanics Section

Re: Geotechnical Investigation  
Derland Overpass  
New Highway 11  
North Bay, Ontario

Dear Sirs:

This letter accompanies our report on the above work.

We find that the predominant overburden stratum at the proposed site is very loose to compact sands, beneath which is glacial till then bedrock, or bedrock directly. Groundwater level at the time of investigation, was at about ground surface.

Based on the results of this investigation, and design details available at this time, the most suitable foundation system for the proposed Overpass structures is considered to be piles end-bearing on the bedrock, with steel H-piles probably being the preferred type. Preliminary recommendations from a geotechnical standpoint are given in the report, and we would be pleased to make more specific comments as your needs arise.

The cooperation extended to us on this Project by the various M.T.C. representatives involved is gratefully acknowledged.

Yours very truly,

GEOCON (1975) LTD.

M.A.J. Matich, P.Eng.  
President


MAJM:bg  
T10243

**GEOCON (1975) LTD.**

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MONTREAL  
615 BELMONT STREET  
H3B 2L9  
TEL. 866-2963

 TORONTO  
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REXDALE, ONT.  
M9W 3A2  
TEL. 743-3031

SUDBURY  
1255 KINGSWAY AVE.  
P3B 2E9  
TEL. 566-8701

CALGARY  
301 PETRO CHEMICAL BLDG.  
805 - 8th. AVE. S.W.  
T2P 1H7  
TEL. 264-5031

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#### RECORDS OF BOREHOLES

### APPENDIX II

Figures - Laboratory Testing

M.T.C. DRAWING 72-74-03/04-A (At Rear of Report)

## 1.0 INTRODUCTION

Geocon (1975) Ltd. has been retained by the Ministry of Transportation and Communications (M.T.C.), Ontario, to carry out a geotechnical investigation of the site of the proposed Derland Road Overpass Structures for the Northbound and Southbound Lanes of a new Highway 11 alignment. The work was carried out in accordance with our proposal dated January 8th, 1979, with amendments to the field boring programme as discussed at meetings with the M.T.C. while the field work was in progress.

The purpose of the investigation was to obtain information on the subsurface conditions for use in design and construction of foundations for the proposed Overpass, and the Fill Embankment Approaches.

## 2.0 SUMMARIZED SOIL CONDITIONS

The boreholes put down during the investigation encountered a thin surface layer of organics overlying a stratum of mainly fine to medium sands, which was generally underlain by a stratum of sand and gravel till. The bedrock surface beneath the till stratum at the proposed Abutment locations, slopes upwards from east to west from a depth of greater than 16.0 m to a minimum of 2.9 m. In places, where the depth of bedrock was shallow, the till layer was very thin or absent. Coarse sizes were encountered within the till stratum ranging from coarse gravel to boulder sizes. In the majority of the boreholes in which bedrock was cored, the rock was very bad. However, in one borehole (Borehole 6) the bedrock is believed to be extensively fractured in the upper 8.7 m.

Groundwater levels are generally at or close to ground surface adjacent to Derland Road. Further north and north-eastwards, groundwater levels were 2.1 m and 1.8 m respectively below ground surface.

## 3.0 DISCUSSION

### 3.1 General

On the basis of information available to us, the proposed Derland Road Overpass for the New Highway 11 alignment will comprise



### 3.0 DISCUSSION (continued)

#### 3.1 General (continued)

two separate bridge structures with simply-supported spans carried on Abutments, one for the Northbound Lane and the other for the Southbound Lane. The bridges would have a span of 28.8 metres and a width of about 7.5 metres. The Abutments would be located in the fill.

The Approach Fill Embankments would have a maximum height of approximately 10 metres close to the Abutments and decrease in height northwards and southwards where existing higher ground approaches or intersects proposed grade on the new Highway 11 alignment. The proposed Embankments will have a crest width of about 12 metres.

The general outline of the proposed construction at the site is shown on M.T.C. Plan E-5082-1. In addition, we were supplied with preliminary longitudinal sections (dated November 14th, 1978) showing existing ground surface profiles and proposed new Highway 11 grade profiles for the Northbound and Southbound Lanes.

#### 3.2 Bridge Abutments

In view of the considerable variation in thickness of the main overburden stratum at the Abutment locations, viz. the medium to fine sand, and its variable and at times very loose state of compaction, the most suitable foundation type would appear to be the use of piles end-bearing on or within the bedrock. A variety of such end-bearing units would be suitable, including steel H or tube piles, timber or precast concrete piles, and expanded base cast-in-place concrete piles. The final choice would be a matter of design suitability and economic considerations. Concrete caissons socketted into bedrock would have to be used with caution, in view of the considerable depth of what is believed to be fractured bedrock encountered in Borehole 6. It is understood that from M.T.C. experience, the steel H-pile would likely be the most suitable on technical and economic grounds for this particular application and site.

### 3.0 DISCUSSION (continued)

#### 3.2 Bridge Abutments (continued)

In view of the variable depth to bedrock and the irregular nature of bedrock surface, it is recommended that steel H-piles, (or steel tube piles and precast concrete piles) be fitted with a suitable shoe or rock point, and driven carefully on contact with the bedrock, to ensure good seating on or within the latter. In the case of displacement piles, some jetting may be required to assist penetration to rock or adequate end-bearing in the dense till above bedrock. Refusal may in some cases be encountered on boulders within the till.

Steel H-pile sections should be selected compatible with design working loads and acceptable stresses during driving. Piles should be driven to the necessary resistance in end-bearing on or within the bedrock, (or in the dense till) using guidelines given in the Canadian Foundation Engineering Manual, Part 3. Careful observations should be maintained during pile installation, for possible evidence of sliding of pile tip on bedrock, and any suspect piles either withdrawn or test-loaded.

Lateral loads on the Abutments should be resisted by batter piles.

The Abutment foundations should be provided with at least 6 feet of earth cover (or other suitable insulation) for protection against frost action, unless the Embankment is constructed of non-frost susceptible fill and provided with effective year-round drainage.

Abutments should be backfilled with clean, well-compacted, select granular material and designed for a lateral earth pressure coefficient of 0.4, with due allowance for surcharge and lateral loads from traffic. Adequate positive drainage should be provided to the Abutments, and suitable erosion protection placed on the embankment fill at the Abutments.

## 3.0 DISCUSSION (continued)

3.3 Approach Embankments

It is recommended that all vegetation and topsoil be removed over at least the full toe-to-toe limits of the approach Embankments. This may require some surface drainage measures, in view of the high encountered groundwater level.

It is assumed that the Approach Embankments would be constructed with M.T.C. standard 2H to 1V side slopes, in which case there should be an adequate Factor of Safety against base failure through the sand overburden comprising the foundation stratum.

It is understood that rock fill from adjacent cuts would be used for Embankment construction, as well as select granular material for the parts closest to the Abutments. Compaction requirements and treatment of transition zones between cut in rock and fill, should be as per M.T.C. Standards. Suitable filter zones between the rock fill, and the foundation soil and granular fill should be provided, as required.

Settlement of the Embankments due to self weight and compression of the underlying soil will occur. Where maximum height of Embankment occurs over maximum thickness of overburden, total settlement of the Embankment surface would probably be in the range of 2 to 4 inches, the majority of which would occur during Embankment construction and in the subsequent year.

## 4.0 CLOSURE

We would be pleased to liaise with your Designers in developing more specific geotechnical recommendations as your needs arise.

This report was written by the undersigned and reviewed by Mr. M.A.J. Matich, P.Eng.

Yours very truly,

GEOCON (1975) LTD.



R.C. Sansom, P.Eng.  
Assistant District Manager

RCS:bg  
T10243

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## APPENDIX I

1.0 PROCEDURE AND FIELD EQUIPMENT

2.0 SITE

3.0 SOIL AND BEDROCK CONDITIONS

3.1 Topsoil (Pt)

3.2 Very Loose to Dense, Medium to Fine  
Sands, Trace to Some Silt (SM, SP, SP-SM)

3.3 Compact to Dense, Sand and Gravel to  
Silty Sand and Gravel (Till)

3.4 Bedrock

4.0 GROUNDWATER CONDITIONS

RECORDS OF BOREHOLES

## 1.0 PROCEDURE AND FIELD EQUIPMENT

The field work for this investigation was carried out during the period January 5th to January 23rd, 1979. A total of 10 boreholes were put down to depths ranging from 3.3 m to 23.8 m for a total cumulative depth of 113.8 m. In addition one uncased dynamic cone penetration test (pentest) was carried out adjacent to Borehole 1, using a 51 mm, 60 degree cone tip. Boreholes 1, 2 3 and part of 11 were put down using a skid-mounted Longyear 34 diamond drill using wash boring techniques to penetrate the overburden. The other boreholes were put down by a trailer-mounted Penndrill power auger, equipped for soil sampling and rock coring. A flat bed Bombardier was used to move the drills between boreholes and an attendant stake truck used for hauling water from Lake Nipissing to the site.

Sampling was carried out at intervals of not greater than 1.5 m, using a standard 51 mm diameter O.D. split spoon sampler in the non-cohesive soils encountered at Boreholes 1, 2, 3, 7 and 8. Standard Penetration Tests were performed in conjunction with the use of split spoon sampler. The main purpose of the remaining boreholes was to locate the probable bedrock surface by refusal to further advance of augers or by core drilling.

Thus, in Boreholes 4, 5, 6, 9 and 10 no sampling was carried out in the overburden, except between 12.1 m and 12.5 m depth in Borehole 6 when diamond coring techniques were used to penetrate boulders. The overburden soils in these boreholes was inferred from material brought to ground surface by the continuous flight augers (115 mm O.D.) and the presence of the sand and gravel till stratum was inferred from increased resistance to penetration by the augers or casing advance when washboring techniques were used. Rock was cored in 6 boreholes for depths ranging from 0.3 m to 8.7 m in BXL core size.

The recovered soil samples and rock core were transported to our Toronto Soil Mechanics Laboratory for re-examination and testing. The samples remaining after testing will be stored at this location pending your instructions regarding their retention or future disposal.

## 1.0 PROCEDURE AND FIELD EQUIPMENT (continued)

The locations of the boreholes were established in the field referenced to existing survey stakes by Ministry of Transportation and Communications (M.T.C.) survey personnel and our field technician. The M.T.C. survey crew also determined ground elevations at all the borehole locations and subsequently re-checked all the borehole locations and elevations after the boreholes were completed to accommodate minor changes in location due to trees, snow cover and the like. The enclosed MTC Drawing 72-74-03/04-A shows the location of the boreholes, on the supplied M.T.C. E-Plan (reduced to 1:400 scale), inferred stratigraphic profile sections and stratigraphic cross-sections at the proposed Abutment locations.

Details of stratigraphy, and results of field and laboratory testing are given on the individual Records of Boreholes in Appendix I and additional laboratory test results are presented on Figures 1 and 2 in Appendix II.

## 2.0 SITE

The site is located in Callander, Township of West Ferris, approximately 11.5 km south of the existing Highway 11 and Highway 17 intersection at North Bay. Derland Road runs across the site in a west-south-west/east-north-east direction, is gravel surfaced and continues for some distance north-eastwards after passing under a Canadian National Railways track embankment which is present near the eastern side of the area investigated. At the intersection of Derland Road and the new Highway 11 alignment, Derland Road crosses a small valley with a steep sided hill close to the south side of the Road and a flatter valley area to the north.

A fairly dense cover of mainly small trees is present on the lower hill slopes and in the valley area. From the north edge of the road and over a smaller area on the south side, the land appears swampy with groundwater level close to ground surface. The topography across the site indicates a general surface drainage to the north-west.

## 2.0 SITE (continued)

Available geological information (Ref. 1) shows the site is underlain by Grenville Province Precambrian metasedimentary rocks intruded by felsic plutonics. The majority of the metasedimentary rocks are gneisses of various mineralogical content. Numerous faults or lineaments cut the Precambrian shield rocks with several shown in the vicinity of Callander. Here the major fault lines trend approximately east-west a few small branch faults trending north-north-west/south-south-east. The intervening lower ground in Northern Ontario is commonly occupied by variable thicknesses of cohesive or non-cohesive soils either directly overlying the bedrock or with an intervening layer of glacial till. The steep sided hill to the south of Derland Road on the new Highway 11 alignment is a bedrock outcrop and reportedly a similar outcrop is present approximately 300 m northwards on the alignment. At the subject site, the overburden consists of sands underlain by a sand and gravel till with occasional boulder sizes, overlying the local bedrock. In places where the bedrock surface is close to existing ground surface the till layer is either thin or absent.

## 3.0 SOIL AND BEDROCK CONDITIONS

The principal soil types and the bedrock encountered by the boreholes of this investigation are described below. Unified Soil Classification symbols have been applied to the overburden soils, where applicable. Details of sampling, drilling techniques, stratigraphy, Standard Penetration Tests and laboratory testing are shown on the individual Records of Boreholes in Appendix I. Typically, the stratigraphy at the site comprises a thin organic layer at surface underlain by a stratum of fine to coarse sands followed by a stratum of sand and gravel till with occasional boulders overlying the bedrock.

### 3.1 Topsoil (Pt)

A surficial layer of topsoil was encountered at all boreholes ranging in thickness from 0.1 m to 0.3 m. The material was generally

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Ref. 1: Preliminary Geological Map No. P.381, North Bay Sheet,  
Ontario Dept. of Mines 1968

### 3.0 SOIL AND BEDROCK CONDITIONS (continued)

#### 3.1 Topsoil (Pt) (continued)

silty and mixed with black vegetable and humic matter. From visual observations, it was judged that a greater thickness of organic topsoil could be encountered locally at other locations across the site.

#### 3.2 Very Loose to Dense, Medium to Fine Sands, Trace to Some Silt (SM, SP, SP-SM)

Underlying the surficial topsoil, all the boreholes encountered a stratum of very loose to dense, brown to grey, sand. The stratum was predominantly comprised of medium to fine sands with some coarse sand sizes recognized in the field. Silt content was generally very low but occasional zones or layers of silty sand to sandy silt were present. In Boreholes 1 and 3 thin stratification was visible with 2 to 3 mm layers of silt interbedded with fine sand. Between 2.4 and 3.1 m depths in Borehole 7, a trace of decayed wood fragments was noted in a fine sand sample. The thickness of the sand stratum ranged from 2.9 m in Borehole 3 to 13.9 m in Borehole 1. Intermittent sampling was carried out in both of these boreholes.

Grain size distribution curves for representative 51 mm split spoon samples from this stratum are shown on Figures 1, 2, and 3, Appendix II. The curves show the variation from sandy silt to medium-fine sand, trace of silt. On this basis the applicable Unified Soils Classification symbols are SM, SP, SP-SM.

Moisture content determinations of the selected samples from this stratum ranged from 13.0 percent to 25.3 percent. These values were probably influenced by the soil and groundwater conditions and method of drilling and sampling.

Standard Penetration Tests gave 'N' values ranging from 1 to 36 which indicate relative density from very loose to dense.



### 3.0 SOIL AND BEDROCK CONDITIONS (continued)

#### 3.2 Very Loose to Dense, Medium to Fine Sands, Trace to Some Silt (SM, SP, SP-SM) (continued)

Typically, 'N' values ranged from 1 to 22, inferring a very loose to compact relative density. The pentest carried out adjacent to Borehole 1 gave an average penetration resistance of about 20 blows per 0.3 m in the sand stratum.

#### 3.3 Compact to Dense, Sand and Gravel to Silty Sand and Gravel (Till)

A stratum of sand and gravel or silty sand and gravel was encountered underlying the sand stratum in the majority of the boreholes. From visual and tactile examination the stratum was identified as a glacial till. The thickness of the sand and gravel ranged from zero in Borehole 3 up to approximately 3.8 m in Borehole 6, where the top of till boundary was based on indirect evidence. In the case of Borehole 10, adjacent boreholes infer that the till stratum is present but no indication was observed while augering the borehole. No sand and gravel stratum was encountered in Boreholes 3 and 4.

Boulders were encountered in the stratum in Borehole 6 from 12.1 to 12.5 m depths and were penetrated by diamond core drilling. Full core recovery was obtained through two boulders, of approximately 180 mm and 230 mm comprising a micaceous gneiss and granitic rock type both dissimilar from the local bedrock, as described in Section 3.4 below.

Grain size distribution curves from three samples of the stratum are shown on Figure 4, Appendix II. The curves show a well graded material from coarse gravel to trace of clay comparable to gradations for granular glacial tills.

Moisture content determinations from selected till samples ranged from 7.5 percent to 14.4 percent, and an average value of close to 10.0 percent.

Standard Penetration Tests, gave 'N' values ranging from 29 to 39, indicating a compact to dense relative density.

### 3.0 SOIL AND BEDROCK CONDITIONS (continued)

#### 3.4 Bedrock

The bedrock surface underlies the sand and gravel till stratum and the bedrock was proven by core drilling for depths ranging from 2.4 m to 2.9 m in Boreholes 3 and 5. Bedrock penetration for a depth of 8.7 m was inferred in Borehole 6, as described below.

Other boreholes were terminated at a refusal or after penetrating rock for short distances and noted on the Records of Boreholes as probable bedrock or boulder. The refusal criteria and details of rock penetration are as follows:

Boreholes 1 and 9	Core samples of local bedrock type, to depths of 0.38 m and 0.4 m respectively.
Boreholes 2 and 10	Rock penetrated for 0.3 m by tri-cone bit before refusal in Borehole 2 and for 0.6 m using continuous flight solid stem augers in Borehole 10 before complete refusal.
Borehole 4	Refusal to augering.
Boreholes 7 and 8	Using 51 mm split-spoon sampler and 63.5 kg hammer, hammer bouncing after greater than 68 blows for penetration of 25 mm and 50 mm respectively.

The recovered core samples from Boreholes 3, 5 and 9 show that the local bedrock is a hard, fine to medium grained, well foliated or banded gneiss. The rock is mainly black and grey with some brown sections and bands. Joint spacing varies from very closely jointed to moderately spaced in the fresher rock core. In Boreholes 3 and 5, minor weathering is evidenced by opening of joints and fractures along the foliation with some brown staining in the top 0.8 m to 0.9 m.

### 3.0 SOIL AND BEDROCK CONDITIONS (continued)

#### 3.4 Bedrock (continued)

The 0.4 m of recovered rock core from Borehole 1 was closely fractured and jointed although some of the breaks were closed and a few infilled with quartz. In addition, the foliation in the rock was not readily visible.

The upper 1.0 m of recovered rock core in Borehole 6 is very closely fractured rock with some brown staining. The percentage recovery in the top 0.4 m was 100 percent from two short runs, decreasing to 39 and 25 percent in the two lower longer coring runs. A bi-cone bit was used to penetrate from 16.1 m to 22.6 m before uniform hard pressure was encountered.

During drilling operations, the bit achieved erratic penetration but required application of drill weight pressure continuously. Wash water was consistently 'milky', brownish grey in colour and showed no indication of any change of material. The BW casing was drilled into position behind the bi-cone bit and was on pressure all the time. On this evidence it is inferred that the unsampled interval of 6.5 m (16.1 m and 22.6 m depth) is a continuation of the very closely fractured bedrock recovered in the top 1.0 m. From a depth of 7.1 m in the rock to 8.3 m, three coring runs had 100 percent core recovery, although the rock was still fractured and jointed, the majority of the breaks were closed with possible fine quartz infilling. As in Borehole 1, the fracturing, with possible weathering effects has obscured the foliation or gneissic banding. From visual examinations of the core samples the rock has apparently been subjected to considerable compressive forces and may represent a crush zone or indicate proximity to a fault line in the bedrock.

The inferred stratigraphic sections shown on MTC Dwg. 72-74-03/04-A indicate the slope of the probable bedrock surface rising from east to west and notably between the pairs of boreholes at the two western proposed Abutment locations.

#### 4.0 GROUNDWATER CONDITIONS

Groundwater levels were recorded at the time of drilling and later in perforated plastic standpipes installed in Boreholes 1 to 9, inclusive. The latest water level readings, taken on January 23rd, 1979 are given on the Records of Boreholes in Appendix I and show that groundwater levels were either at or within 0.5 m of existing ground surface in the boreholes adjacent to Derland Road. In Boreholes 7 and 8, to the north of the Road, groundwater levels were 1.8 m and 2.1 m below ground surface.

Two water wells are present at the site, one located close to Borehole 6 and the other approximately 20 m to the east-north-east. Reportedly, both wells were dug to approximately 15 feet depth. At the time of the investigation the standing water level was approximately 0.3 m in the well near Borehole 6.

# EXPLANATION OF TERMS USED IN REPORT

**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

$c_u$ (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$kPa^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$m^2/s$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kn/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kn/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kn/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kn/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						



RECORD OF BOREHOLE No 1

METRIC

W P 72-74-03/04

LOCATION

N 5 120 266.0 E 316 375.0  
Derland Road Overpass, Callander

ORIGINATED BY W M G

DIST 13 HWY 11

BOREHOLE TYPE

Wash Boring, BW Casing, Bi-Cone, BXL Rock Core

COMPILED BY A E L

DATUM Geodetic

DATE

1979 01 06 to 09

CHECKED BY *AB*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20 40 60 80 100											
								SHEAR STRENGTH											
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE											
GROUND LEVEL							WATER CONTENT (%)					10	20	30					
223.0	0.1 m Organic Silt/ Topsoil		1	SS	5		WL-	1979	01	23							Method of Boring 0-15.5 m Wash Boring BW Casing 0 - 16.3 m B1-Cone 16.3-16.7 m BXL Core		
	Very Loose to Dense Greyish Brown to Brown Medium to Fine Sand, Trace of Silt.		2	SS	16		222												
			3	SS	9		220												
			4	SS	9		218										0 96 (4)		
			5	SS	7		216										0 98 (2)		
			6	SS	10		214												
			7	SS	18		212												
			8	SS	8		210												
			9	SS	3		208												
			10	SS	3														
			11	SS	39														
209.1	Dense Greyish Brown Sand and Gravel Till		12	SS	39														
13.9			13	RC BXL	80%												49 41 (10)		
206.7	Probable Bedrock or Boulder																		
206.3																			
16.7	End of Borehole																		

RECORD OF BOREHOLE No 2

METRIC

W P 72-74-03/04

LOCATION

N 5 120 261.5 E 316 363.0  
Derland Road Overpass, Callander

ORIGINATED BY W M G

DIST 13 HWY 11

BOREHOLE TYPE Wash Boring, NW Casing, Tri-Cone

COMPILED BY A E L

DATUM Geodetic

DATE 1979 01 09

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20	40	60	80	100					
223.0	Ground Level																
0.0	0.2 m Organic Silt/ Topsoil		1	SS	1		WL -	1979	01	23							Method of Boring
			2	SS	22												2 84 (14)
	Compact to Very Loose, Grey to Brown Medium to Fine Sand to Silty Fine Sand Occasional trace of Fine Gravel Sizes		3	SS	4												0-12.8 m Wash Boring NW Casing
			4	SS	7												
			5	SS	1												0 98 (2)
			6	SS	2												
			7	SS	4												
			8	SS	1												1 68 (31)
210.6	Compact Greyish Brown Silty Sand and Gravel Till		9	SS	26												12.8-13.2 m Tri-Cone
12.4																	
210.1																	
209.8																	
13.2	End of Borehole Probable Bedrock or Boulder																Boundary at 12.9 m Depth Inferred From Resistance To Tri-Cone.

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 3

METRIC

W P 72-74-03 /04

LOCATION

N 5 120 246.5 E 316 324.5  
Derland Road Overpass Callander

ORIGINATED BY W M G

DIST 13

HWY 11

BOREHOLE TYPE

Wash Boring,  
BW Casing, Bi-Cone, BXL Rock Core

COMPILED BY A E L

DATUM Geodetic

DATE 1979 01 10-12

CHECKED BY *AB*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			N VALUES	20 40 60 80 100								WATER CONTENT (%)	10 20 30	
								SHEAR STRENGTH										
					</													

OFFICE REPORT ON SOIL EXPLORATION





RECORD OF BOREHOLE No 4

METRIC

W P 72-74-03/04 LOCATION N 5 120 271.0 E 316 327.0  
Derland Road Overpass, Callander  
DIST 13 HWY 11 BOREHOLE TYPE Continuous Flight Auger  
Geodetic DATE 1979 01 19  
ORIGINATED BY WMG  
COMPILED BY AEL  
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20	40	60	80	100					
222.2	Ground Level																
0.0	0.1 m Organic Silt/ Topsoil						222 WL -	1979	01	23							Method of Boring
	Probable Brown Fine Sand						220										0-4.4 m Continuous Flight Auger
							Standpipe,	Perforated Below 1.5 m Depth									Some Resistance to Auger Penetration
217.8							218										at 4.3 m Refusal at 4.4 m Depth
4.4	End of Borehole																
	Probable Bedrock or Boulder																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 72-74-03 /04 LOCATION N 5 120 277.5 E 316 337.5  
Derland Road Overpass, Callander  
DIST 13 HWY 11 BOREHOLE TYPE Continuous Flight Auger, BXL RC ORIGINATED BY WMG  
DATUM Geodetic DATE 1979 01 17-18 COMPILED BY AEL  
CHECKED BY MS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20	40	60	80	100					
222.0	Ground Level																
0.0	0.1 m Organic Silt/ Topsoil						WL -	1979	01	23							Method of Boring
	Probable Greyish Brown Medium to Fine Sand																0-10.9 m Continuous Flight Auger
214.1																	
7.9	Probable Sand and Gravel Till																Boundary At 7.9 m Depth Inferred From Augering Resistance
211.1																	
10.9	Gneiss Bedrock Well-Foliated Joints closely spaced moderately weathered to 210.2		1	RC BXL	61%												
			2	RC BXL	82%												
			3	RC BXL	100%												
			4	RC BXL	100%												
208.2			5	RC BXL	94%												
13.8	End of Borehole																

+3, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

## METRIC

W P 72-74-03/04 LOCATION Derland Road Overpass, Callander ORIGINATED BY WNG  
DIST 13 HWY 11 BOREHOLE TYPE WashBoring, NW and BW Casing, Bi-Cone COMPILED BY AEL  
DATUM Geodetic DATE 1979 01 19-22 BXL Rock Core CHECKED BY [Signature]

[illegible]

+3, x<sup>5</sup>: Numbers refer to Sensitivity

20

15  $\pm$  5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 7

METRIC

W P 72-74-03/04 LOCATION N 5 120 348.5 E 316 335.0  
Derland Road Overpass, Callander  
DIST 13 HWY 11 BOREHOLE TYPE Continuous Flight Auger  
DYNAMIC CONE PENETRATION RESISTANCE PLOT  
20 40 60 80 100  
SHEAR STRENGTH  
O UNCONFINED + FIELD VANE  
● QUICK TRIAXIAL x LAB VANE  
DATUM Geodetic DATE 1979 01 16  
ORIGINATED BY W M G  
COMPILED BY A E L  
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20	40	60	80	100					
222.6	Ground Level																GR SA SI CL
0.0	0.1 m Organic Silt/ Topsoil						222										Method of Boring
	Very loose to Dense Grey and Brown Medium to Fine Sand with a Trace of Silt (Trace of Decayed Wood Encountered at 219.9		1	SS	9		WL -	1979	01	23				o			2 92 (6)
			2	SS	2		220										0-10.8 m Continuous Flight Auger
			3	SS	36									o			0 87 (13)
			4	SS	18		218										
			5	SS	14		216										
							214							o			0 93 (7)
212.8																	
9.8	Brown Silty Sand and Gravel Till						212										23 53 (24)
211.8			6	SS	1707	0.2 m											
10.8	End of Borehole Probable bedrock or Boulder																Boundary at 9.8 m Depth Inferred From Augering Resistance

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 8

METRIC

W P 72-74-03/04

LOCATION

N 5 120 401.5 E 316 391.0  
Derland Road Overpass, Callander

ORIGINATED BY WMG

DIST 13

HWY 11

BOREHOLE TYPE

Continuous Flight Auger

COMPILED BY AEL

DATUM Geodetic

DATE

1979 01 15 & 16

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
225.4	Ground Level																
0.0	0.1 m Organic Silt/ Topsoil																
	Compact Greyish Brown Fine Sand		1	SS	19												
223.3																	
2.1	Dense to very Dense Brown Silty Sand and Gravel Till		2	SS	39												
222.1																	
3.3	End of Borehole Probable Bedrock or Boulder																

RECORD OF BOREHOLE No 9

METRIC

W P 72-74-03/04 LOCATION N 5 120 252.5 E 316 335.5  
DIST 13 HWY 11 BOREHOLE TYPE NW Casing, Washboring, Tri-Cone  
Geodetic DATE 1979 01 12  
ORIGINATED BY WMG  
COMPILED BY AEL  
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20	40	60	80	100					
222.9	Ground Level																GR SA SI CL
0.0	0.2 m Organic Silt/ Topsoil						WL-	1979	01	23							Method of Boring
	Probable Greyish Brown Fine Sand																0-6.1 m NW Casing Washed Out
																	6.1-6.13 m Tri-Cone
																	0-6.9 m BW Casing
																	6.9-7.3 m BXL Core
216.7																	
6.2	Probable Sand and																
216.0	Gravel Till																
6.9	Probable Bedrock		1	RL	100%												
215.6	or Boulder			BXL	Rec												
7.3	End of Borehole																



RECORD OF BOREHOLE No 10

METRIC

W P 72-74-03/04 LOCATION N 5 120 291.0 E 316 364.5  
DIST 13 HWY 11 BOREHOLE TYPE Continuous Flight Auger  
DATUM Geodetic DATE 1979 01 23

ORIGINATED BY WMC  
COMPILED BY AEL  
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES			20	40	60	80	100					
222.4	Ground Level																GR SA SI CL
0.0	0.1 m Organic Silt/ Topsoil					WL -	222										Method of Boring
							1979	01	23								0-15.2 m Continuous Flight Auger
	Probable Coarse to Fine Sand						220										
							218										
							216										
							214										
							212										
							210										
							208										Refusal to Auger Advance
207.8	Probable Bedrock or Boulder																At 15.2 m Depth
207.2	End of Borehole																
15.2																	

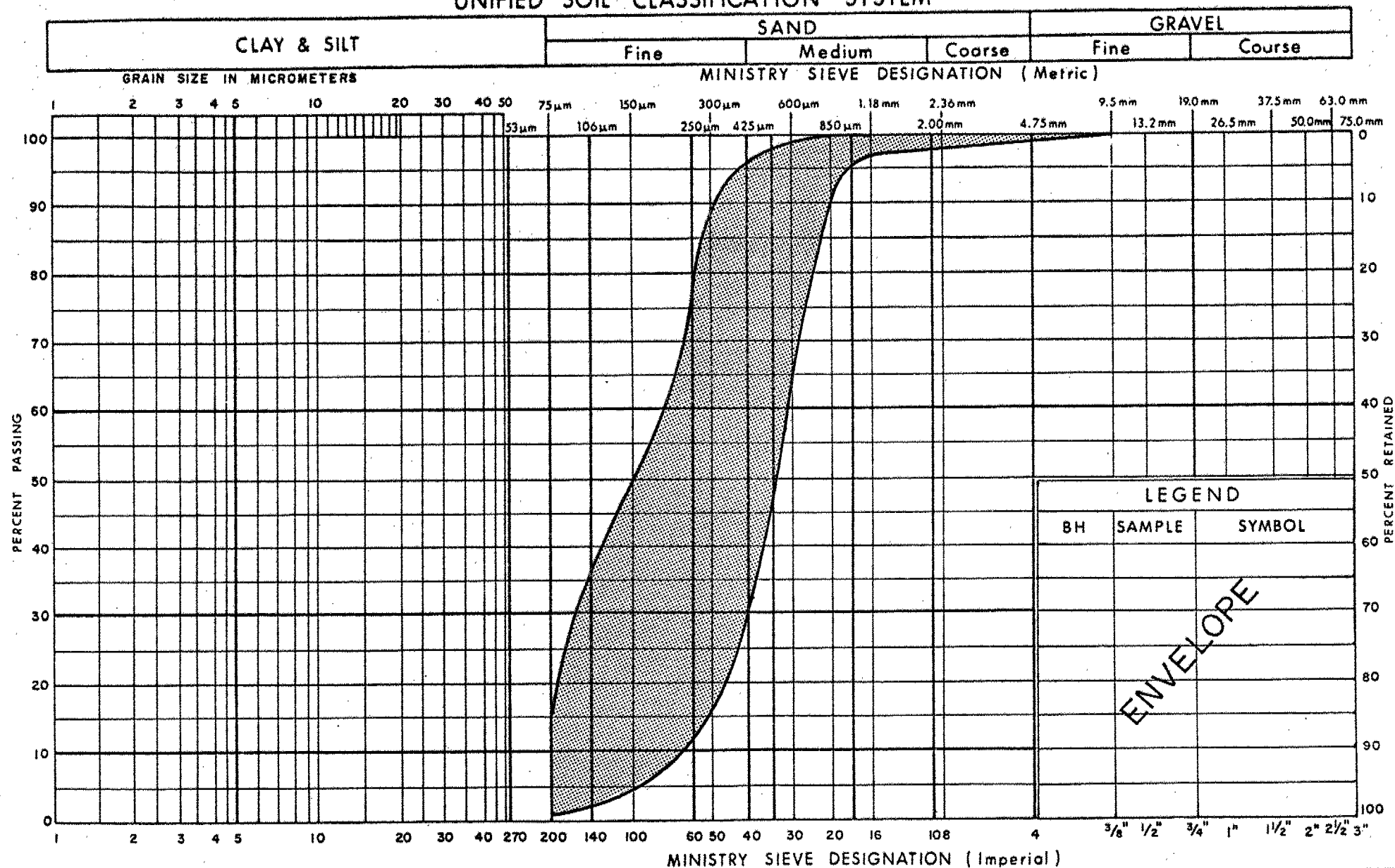
## **APPENDIX II**

**FIGURES — LABORATORY TESTING**

**GEOCON**



## UNIFIED SOIL CLASSIFICATION SYSTEM

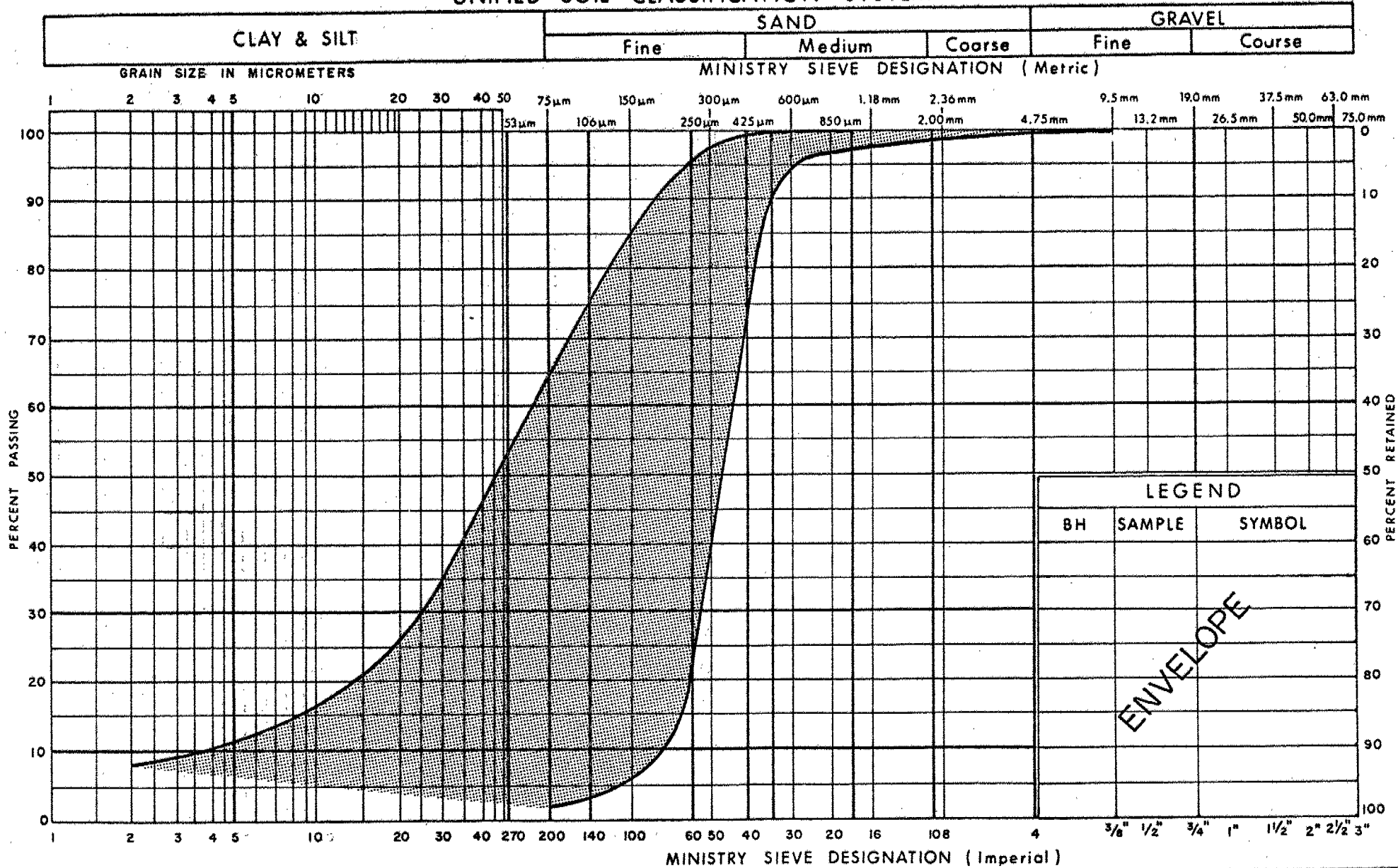


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GRAIN SIZE DISTRIBUTION  
SAND MED - FINE , TRACE SILT

FIG No 1  
W P 72-74-03 / 04

## UNIFIED SOIL CLASSIFICATION SYSTEM



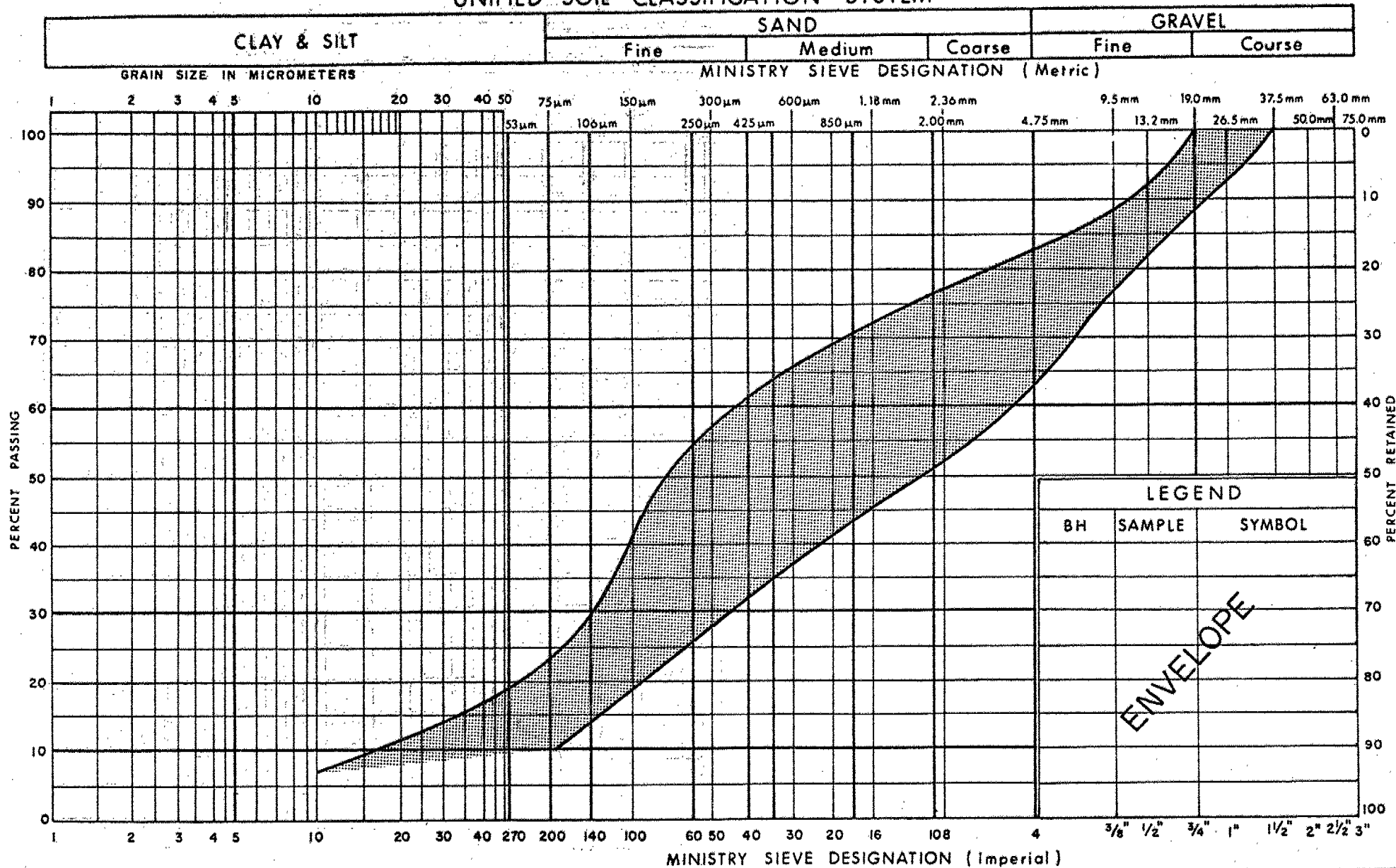
Ministry of  
Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
**SAND MED - FINE**  
TRACE SILT TO SANDY SILT, TRACE CLAY

FIG No 2

W P 72-74-03 / 04

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
SAND & GRAVEL TO SILTY SAND  
& GRAVEL (Glacial Till)

FIG No 3

WP 72-74-03 / 04

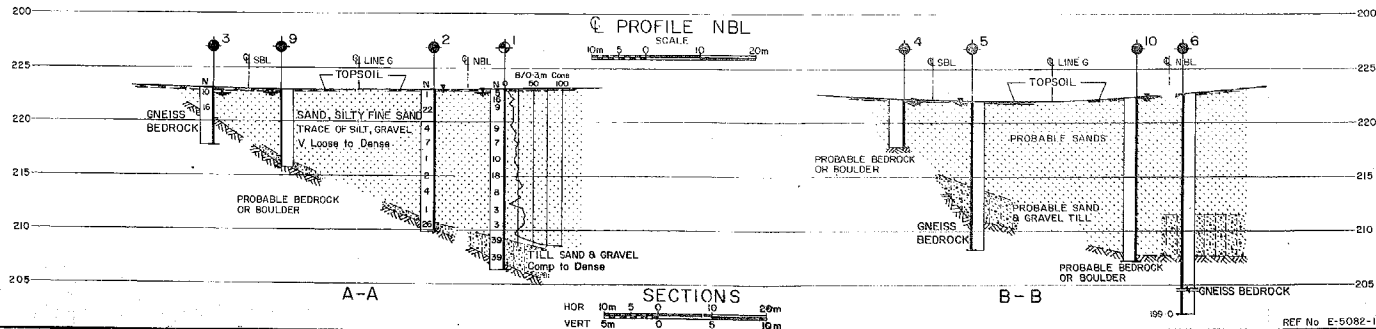
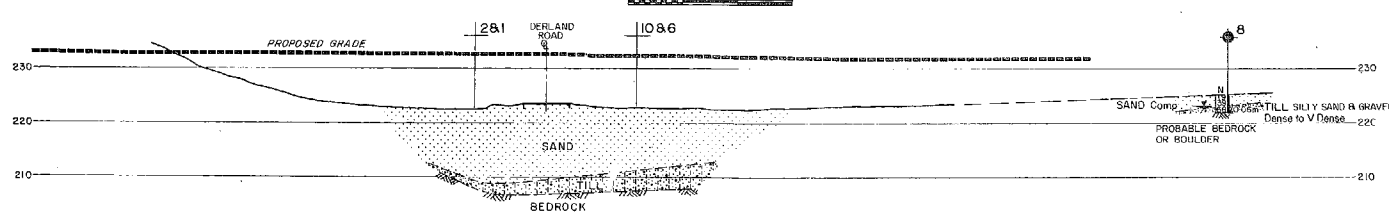
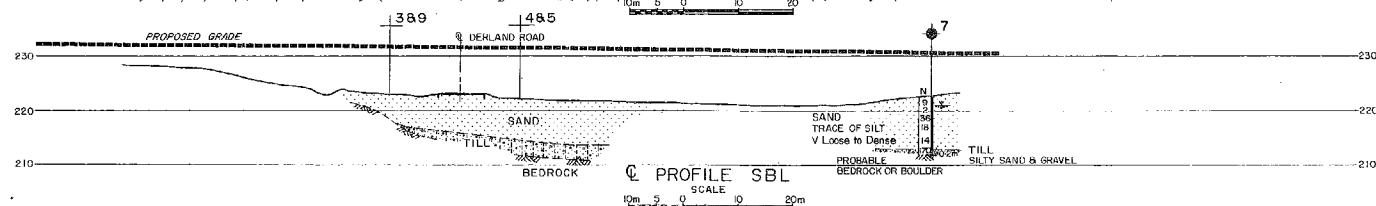
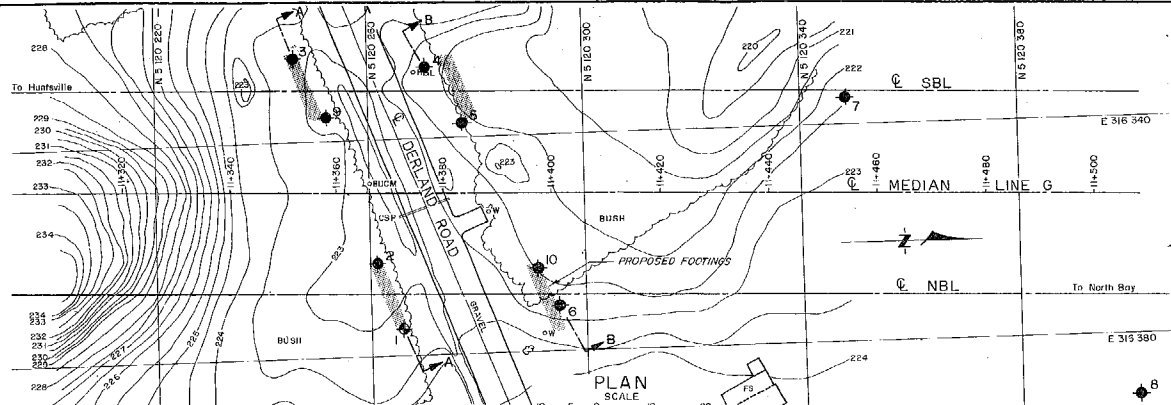
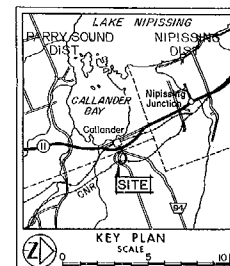
METRIC

CONT No  
WP No 72-74-03/04

DERLAND ROAD OVERPASS  
(11.5 km South of Hwy No 17)  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

GEOCON (1975) LTD.



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)
- ↓ W.L. at time of investigation 1979 01

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	223.0	5 120 266.0	316 375.0
2	223.0	5 120 261.5	316 363.0
3	223.1	5 120 246.5	316 324.5
4	222.2	5 120 271.0	316 327.0
5	222.0	5 120 277.5	316 337.5
6	222.8	5 120 295.0	316 371.5
7	222.6	5 120 348.5	316 335.0
8	225.4	5 120 401.5	316 391.0
9	222.9	5 120 282.5	316 335.5
10	222.4	5 120 291.0	316 364.5

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

DATE	BY	DESCRIPTION
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS
1979 01 26	13	DERLAND ROAD OVERPASS

REF No E-5082-1

METRIC

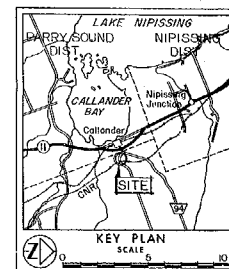
CONT No  
WP No 72-74-03/04

DERLAND ROAD OVERPASS  
(11.5 km South of Hwy No 17)  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

GEOCON (1975) LTD.



KEY PLAN  
SCALE 1:10,000

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test [Cone]
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation (1979/01)

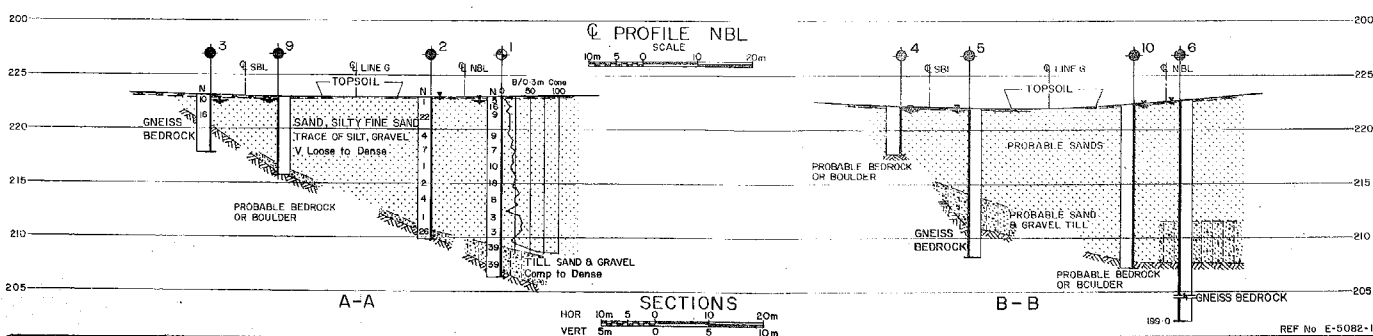
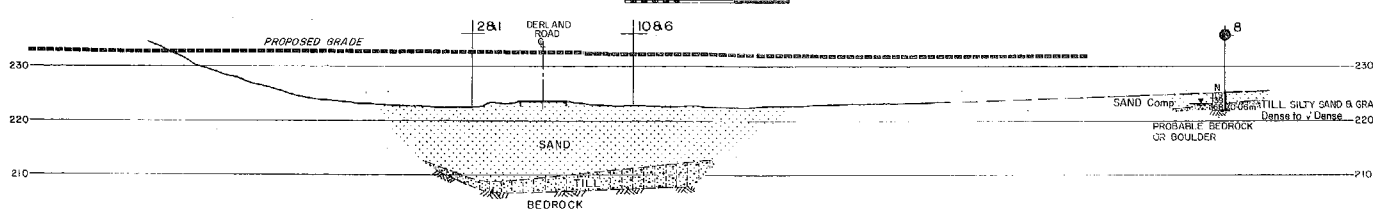
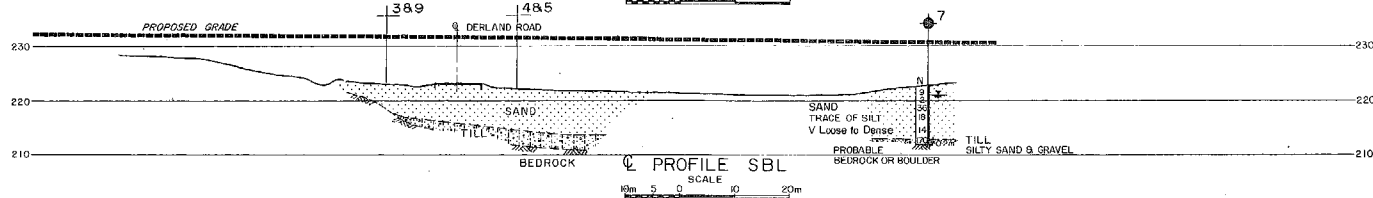
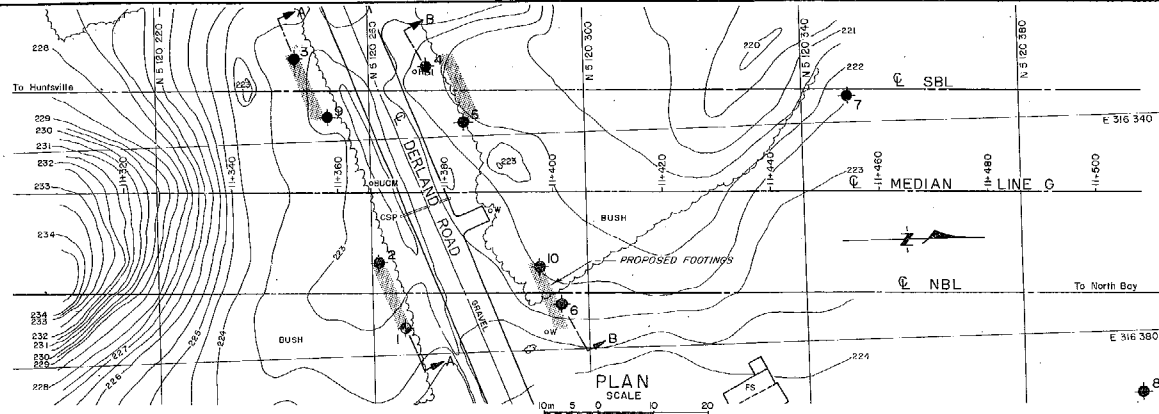
No	ELEVATION	CO-ORDINATES NORTH	EAST
1	223.0	5120 268.0	316 376.0
2	223.0	5120 261.5	316 363.0
3	223.1	5120 249.3	316 324.9
4	222.2	5120 271.0	316 327.0
5	222.0	5120 277.5	316 337.5
6	222.8	5120 295.0	316 371.5
7	222.6	5120 348.5	316 335.0
8	225.4	5120 421.5	316 391.0
9	222.9	5120 252.5	316 335.5
10	222.4	5120 291.0	316 364.9

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

DATE	BY	DESCRIPTION

Geocore No 31L-43

HWY No 11 LINE G DIST 13  
SUMMARY CHECKED IN DATE 1979 01 28 SITE 43-204  
DRAWN AEL CHECKED IN DATE 1979 01 28 DATE 72-74-03/04



SECTIONS

HOR 10m 0 10 20m  
VERT 5m 0 5 10m

199.0

REF No E-5082-1