

G.I.-30 SEPT. 1976

GEOCRES No. 31L-38DIST. B REGION W.P. No. 71-74-03/04CONT. No. 79-53W. O. No. STR. SITE No. 43-199 A & BHWY. No. 11LOCATION Birch's Road OverpassNo of PAGES -OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO 3115 02010 4-73

DIST. 13
CONT No
WP No 71-74-04

BIRCH'S ROAD OVERPASS N.B.L.
2.3 MILES SOUTH OF HWY. 17
GENERAL LAYOUT

SHEET

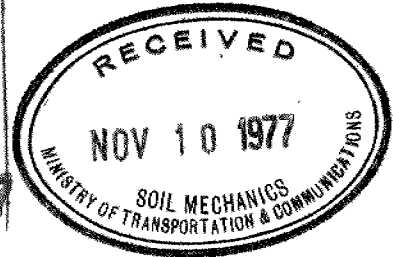
NOTE:
REINFORCING STEEL GRADE
PRECAST GIRDERS ----- 40 K.S.I.
REMAINDER ----- 50 K.S.I.
CLASS OF CONCRETE
DECK AND BARRIER WALLS ----- 4000 P.S.I.
REMAINDER ----- 3000 P.S.I.
FOR PRESTRESSED GIRDERS, SEE DWG. 6
CLEAR COVER TO REINFORCING STEEL
FOOTINGS & ABUTMENTS ----- 3"
DECK ----- 2" TOP, 1 1/2" B.T.
BARRIER WALLS & DIAPHRAGMS ----- 1 1/2"
APPROACH SLABS ----- 2"
AND/OR AS NOTED ON DRAWINGS

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm 1/8"$. NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED. TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED, THE TOP LAYER OF REINFORCING BARS SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF $2 1/2" \pm 1/2"$ TOLERANCE.

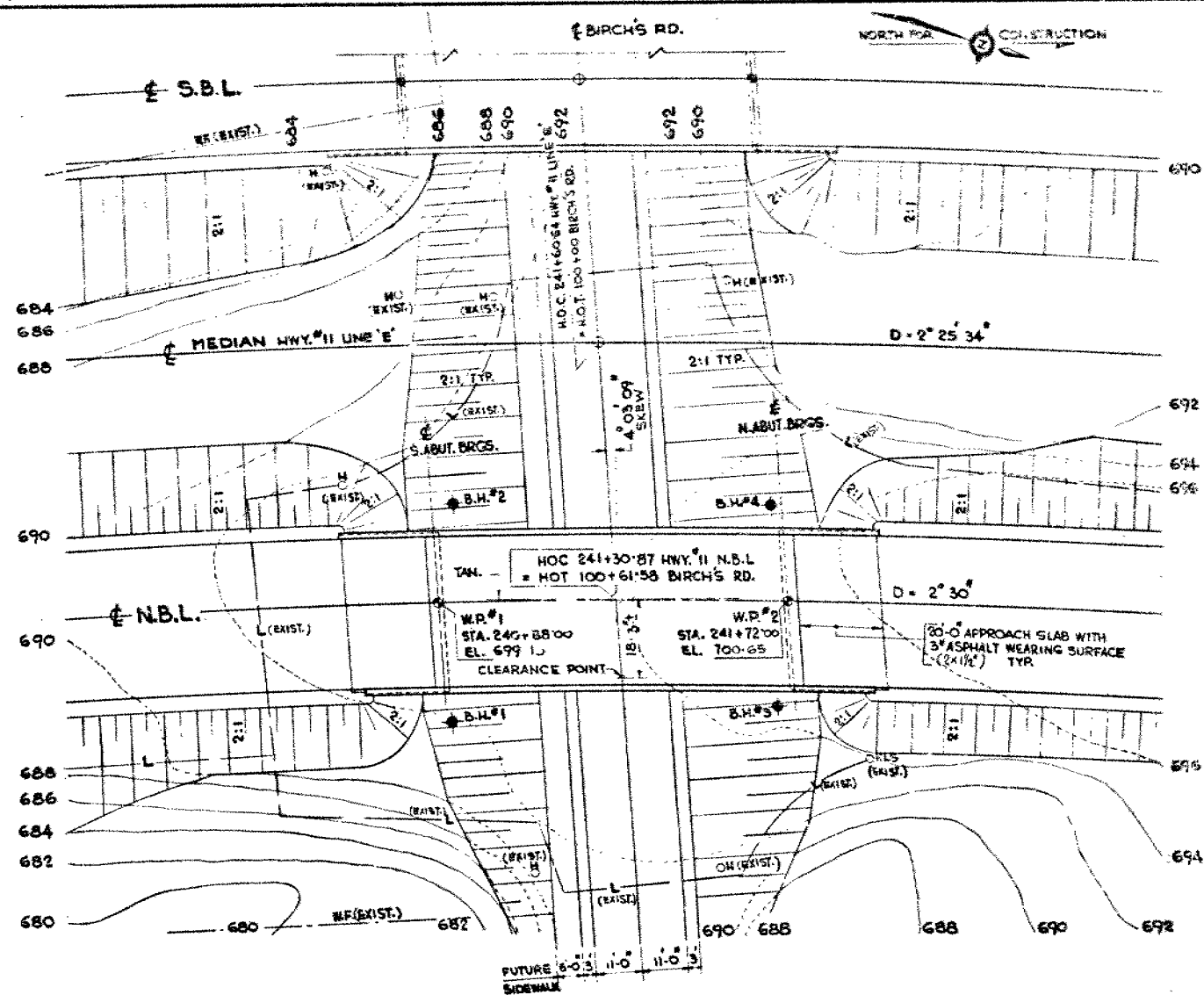
- LIST OF DRAWINGS
- 43-199B - 1 GENERAL LAYOUT
 - 2 BOREHOLE LOCATION & SOIL STRATA
 - 3 FOOTING LAYOUT
 - 4 SOUTH ABUTMENT
 - 5 NORTH ABUTMENT
 - 6 PRESTRESS GIRDERS & BEARINGS
 - 7 DECK DETAILS
 - 8 CONCRETE BARRIER WALL (2'-8" HIGH)
 - 9 STEEL PARAPET RAILING (SINGLE TUBE)
 - 10 20' APPROACH SLAB
 - 11 STANDARD DETAILS I
 - 12 STANDARD DETAILS II
 - 13 AS CONSTRUCTED ELEV'S. & DIM'S.

CONCRETE QUANTITIES

CONCRETE IN ABUTMENT & WINGWALLS	194	CU.YD.
CONCRETE IN DECK & DIAPHRAGMS	99	CU.YD.
CONCRETE IN BARRIER WALLS	19	CU.YD.
CONCRETE IN APPROACH SLABS	45	CU.YD.

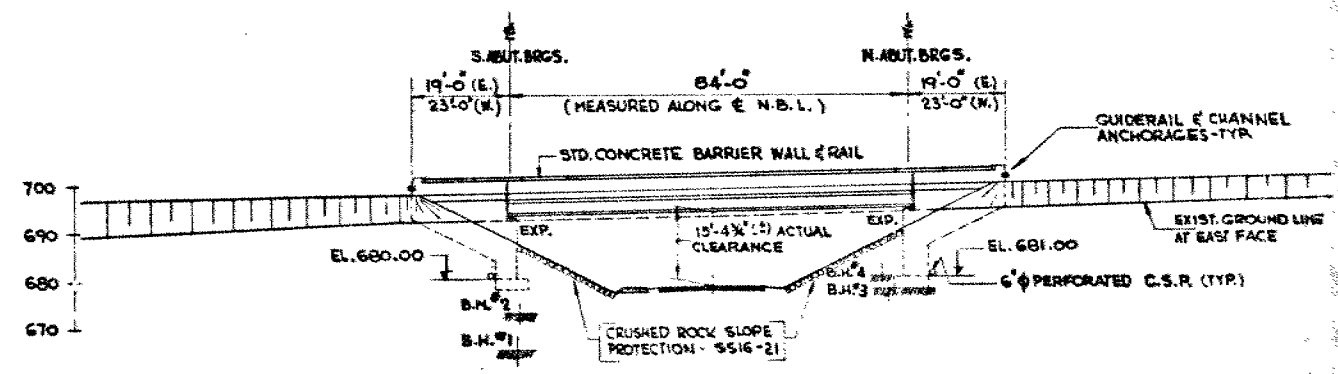


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING	DATE
DRAWING	CHECK	SITE	DWG



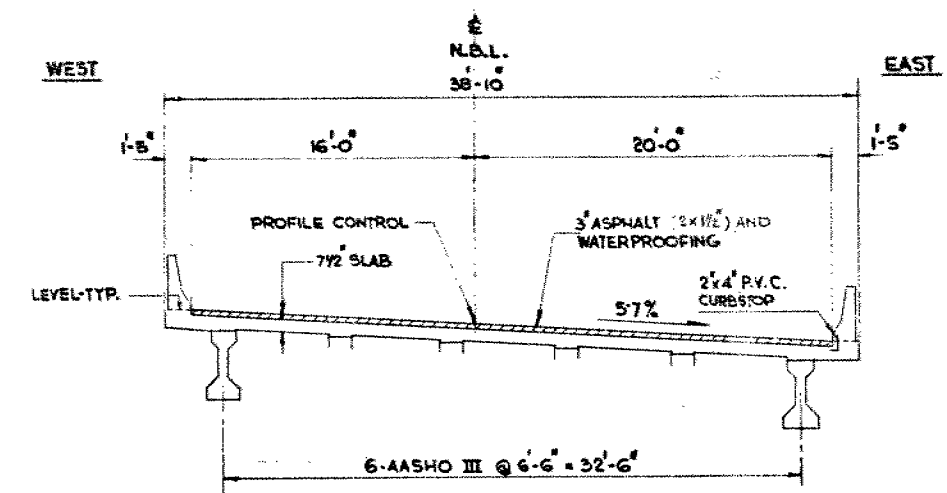
NOTES:
• W.P. DENOTES WORKING POINT
• • DENOTES BORE HOLE LOCATIONS

PLAN
SCALE: 1" = 20'-0"

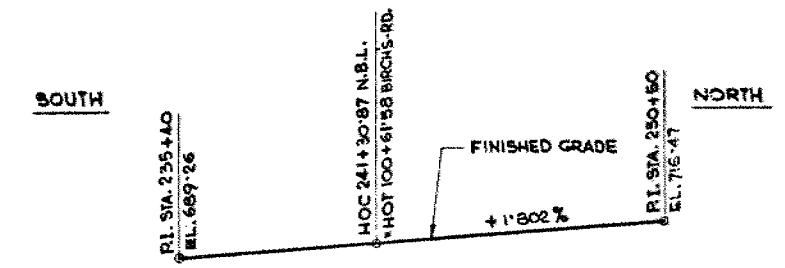


ELEVATION
SCALE: 1" = 20'-0"

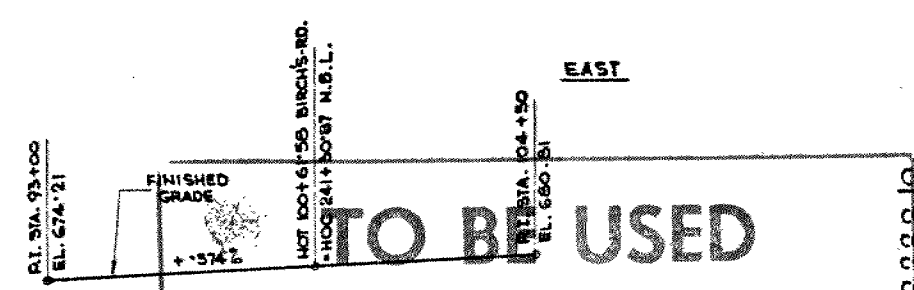
SKREW 4° 03' 09"
SIN. 0.07067
COS. 0.99750
TAN. 0.07085



TYP. DECK SECTION
SCALE: 3/16" = 1'-0"



PROFILE AT N.B.L.
N.T.S.

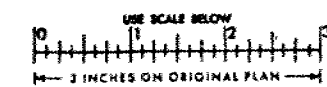


NOT TO BE USED
FOR ESTIMATING
PURPOSES ONLY

B.M. 685.14
GEODETIC DATUM
CC ON BED ROCK
268.5' Lt 242+02

DATE: NOV 8 1977

FOR REDUCED PLAN
USE SCALE BELOW



NOTE:
REINFORCING STEEL GRADE
PRECAST GIRDERS ----- 40 K.S.I.
REMAINDER ----- 50 K.S.I.

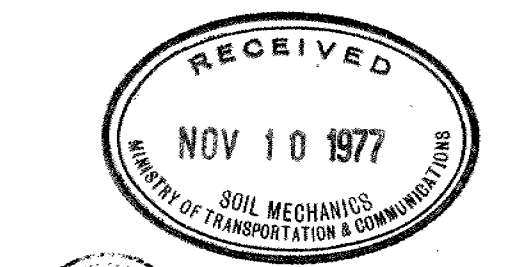
CLASS OF CONCRETE
DECK AND BARRIER WALLS ----- 4000 P.S.I.
REMAINDER ----- 3000 P.S.I.
FOR PRESTRESSED GIRDERS, SEE DWG. 8

CLEAR COVER TO REINFORCING STEEL
FOOTINGS & ABUTMENTS ----- 3"
DECK ----- 2" TOP 1 1/2" BOT.
BARRIER WALLS & DIAPHRAGMS ----- 1 1/2"
APPROACH SLABS ----- 2"
AND/OR AS NOTED ON DRAWINGS

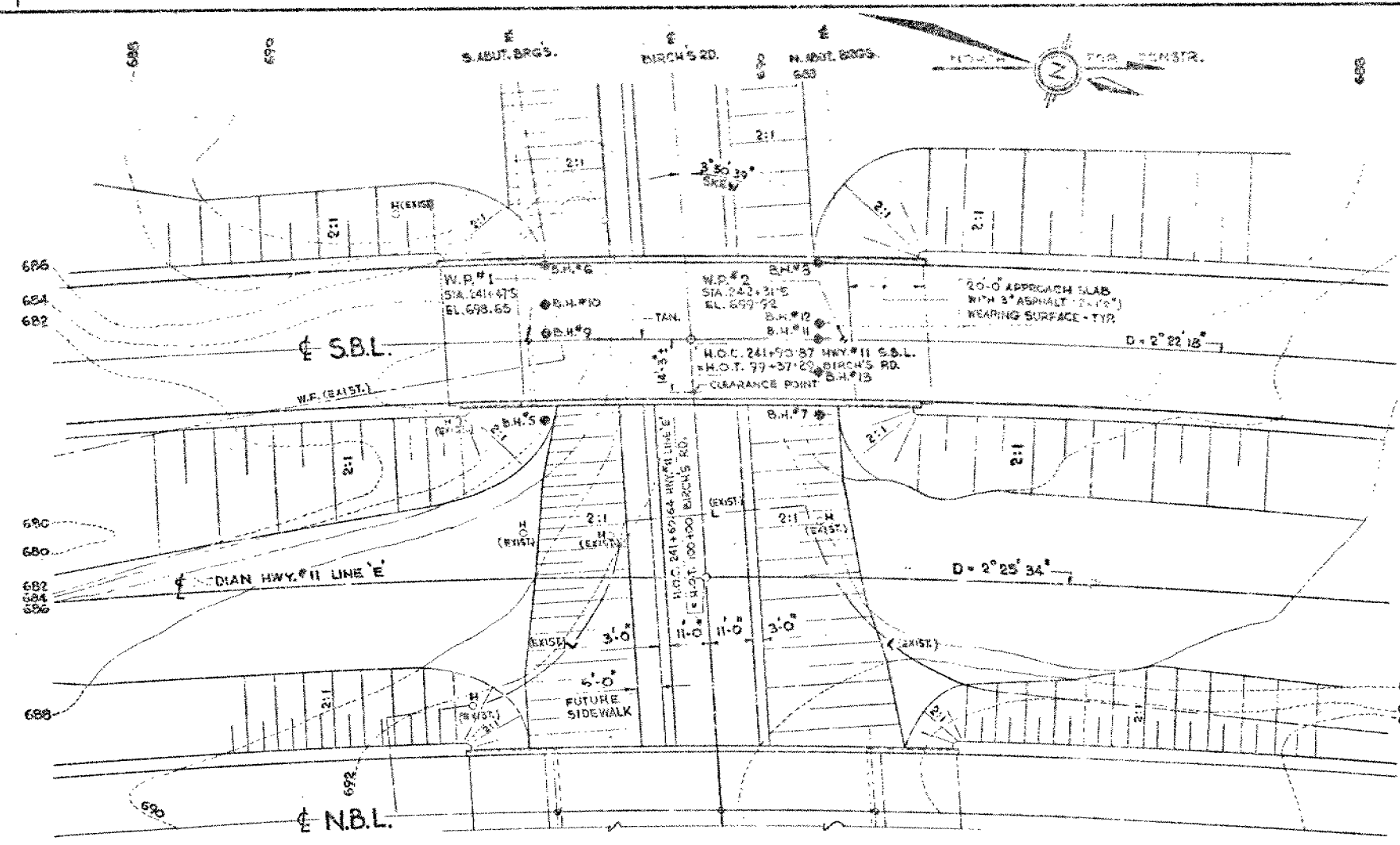
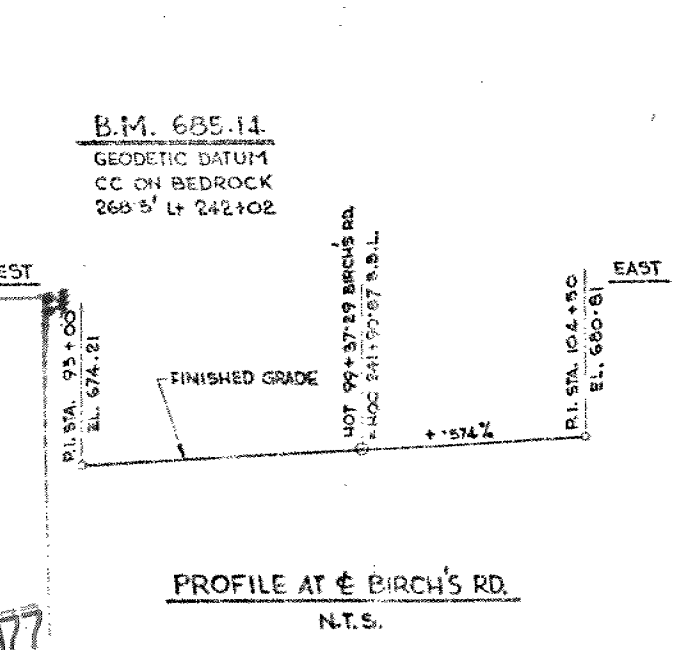
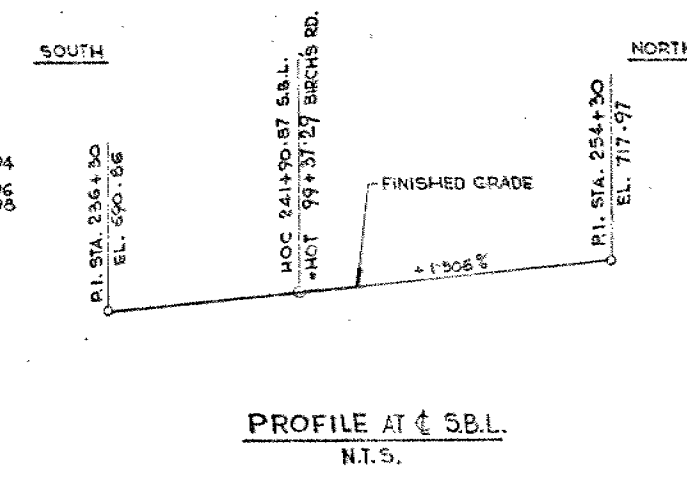
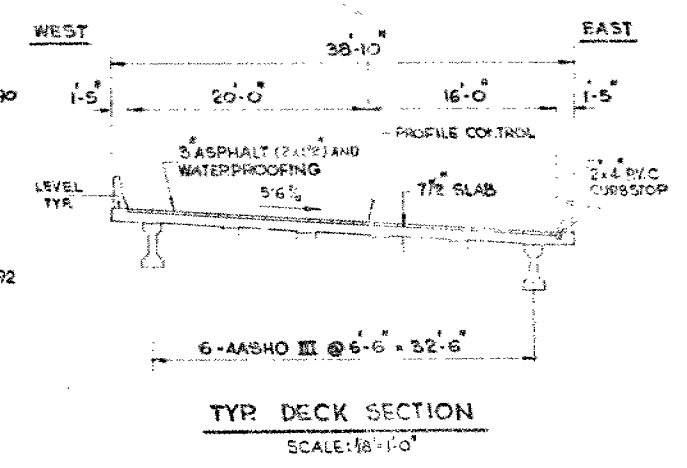
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LIST OF DRAWINGS
43-199A - 1 GENERAL LAYOUT
- 2 BOREHOLE LOCATION & SOIL STRATA
- 3 FOOTING LAYOUT
- 4 SOUTH ABUTMENT
- 5 NORTH ABUTMENT
- 6 PRESTRESSED GIRDERS & BEARINGS
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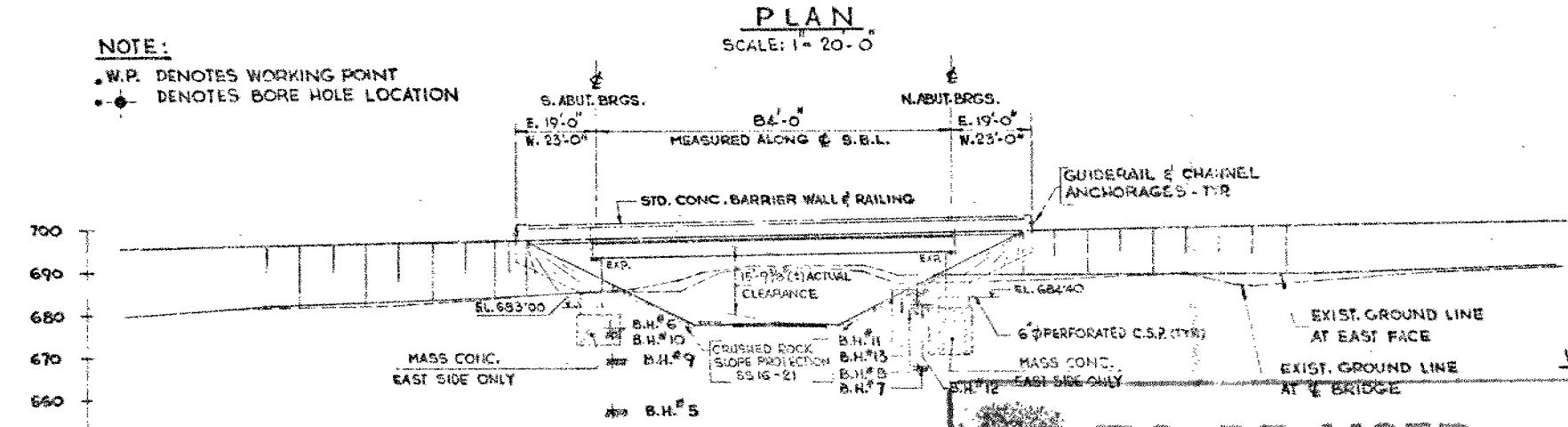
CONCRETE QUANTITIES
CONCRETE IN ABUTMENTS & WING WALLS 160 CU.YD.
CONCRETE IN DECK & DIAPHRAGMS 98 CU.YD.
CONCRETE IN BARRIER WALLS 19 CU.YD.
CONCRETE IN APPROACH SLABS 45 CU.YD.



REVISIONS	DATE	BY	DESCRIPTION



NOTE:
W.P. DENOTES WORKING POINT
B.H. DENOTES BORE HOLE LOCATION



TO BE USED FOR ESTIMATING PURPOSES ONLY
DATE NOV 8 1977

FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 71-74-03/04

DIST. 13

HWY. 11

STR. SITE 43-199A/B

Birch's Road Overpass SB/NB
2.9 Miles South of Hwys. 17 and 11

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Files

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	24 K <i>Dim/77</i>	<i>M.S</i>
TUBES	"	"
ROCK CORES	<i>Cont. Fmmd</i>	"

GEOCRES

31 L-38
GEOCRES No.

DATE

FEB 24 1977

INTRODUCTION

It is proposed to reconstruct Hwy. 11 as a controlled access highway south of North Bay from Lakeshore Drive to Highway 17. Twin single span structures have been proposed for the crossing of Hwy. 11 over Birch's Road approximately 0.9 miles north of Lakeshore Drive.

In a memorandum dated October 27, 1976, Mr. J.C. McAllister of the Regional Planning and Design Office, Structural Section, requested the Soil Mechanics Section to carry out a foundation investigation at the site of the proposed twin structures at the crossing of Hwy. 11 and Birch's Road.

Following this request the Soil Mechanics Section carried out a field investigation to determine the subsoil, groundwater and bedrock conditions existing at the site.

This report contains the results of that investigation and recommendations pertaining to the design and construction of the foundations of the proposed structures and approaches.

SITE DESCRIPTION AND GEOLOGY

The site of the proposed crossing is approximately 2.9 miles south of the east junction of Hwy. 11 and Hwy. 17. At this location the proposed alignment of the northbound lanes is approximately the same as that of existing Hwy. 11, whereas the proposed alignment of the southbound lanes is offset about 125 feet west. At the location of the structures both northbound and southbound lanes of new Hwy. 11 are aligned on a gentle curve (southbound lane $D=2^{\circ}22'$, northbound lanes $D=2^{\circ}30'$). The skew angle of Birch's Road to the tangents of the northbound and southbound lanes is about 86° .

Land in the vicinity of the site is generally undeveloped due to the presence of rock outcrops, swamps and tree covered areas. However, on both sides of Hwy. 11 at Birch's Road there is light industrial development.

Topographically the site varies from flat to rolling. In the vicinity of the site the prominent features are the hilly gneiss bedrock outcrops. The

location of bedrock outcrops and swamp terrain in the general vicinity of the site are shown on the aerial photograph, Figure 4.

Physiographically the site is located in the region known as the Canadian Shield. The Shield is characterized by the effects of intense glaciation which has left scattered rounded rock outcrops and rocky ridges separated by glacial deposits and muskeg.

FIELD AND LABORATORY INVESTIGATION PROCEDURES

A field investigation was carried out from November 22 to November 27, 1976. For the proposed northbound and southbound lane structures a total of 13 boreholes, four of which were accompanied by dynamic cone penetration tests, were put down during the course of the investigation. The boreholes were advanced using track mounted auger machines, one equipped with hollow stem augers and the other one equipped with solid stem augers.

The locations and elevations of the boreholes were surveyed by personnel from the North Bay Regional Surveys and Plans Section. Locations and elevations of the boreholes are shown on Drawing No. 717403/04-A.

Disturbed samples were recovered by means of a 2 inch O.D. split spoon sampler driven in accordance with the Specifications of the Standard Penetration Test. Bedrock was proven in 9 of the boreholes by obtaining BXL size rock core samples.

Samples were visually examined and identified in the field and again in the laboratory. Laboratory testing was carried out on representative samples to determine:

- Natural Moisture Content
- Organic Content
- Grain Size Distribution

The results of the laboratory testing are summarized on the Record of Borehole Sheets and on the Grain Size Distribution envelopes shown on Figure 1, 2 and 3.

Groundwater elevations were noted at the time of the field investigation by measuring in the open boreholes and are shown on the Record of Borehole Sheets and on Drawing No. 717403/04-A.

SUBSURFACE CONDITIONS

General

The overburden at the site is generally comprised of a thin veneer of topsoil overlying a 1 to 11 foot thick deposit of compact silty sand to sandy silt with a trace to some gravel and a trace of clay which in turn is overlying a 3 to 16 foot thick stratum of compact to very dense glacial till. In some locations, on the northwest portion of the site, the glacial till is overlain directly by a thin mantle of sandy topsoil or by a 1 foot thick layer of organic material. At the location of the existing Hwy. 11 embankment, the glacial till is overlain by a 9 to 12 foot thick granular type of fill. In all locations the glacial till is underlain by gneiss bedrock.

The boundaries between the various soil strata as determined by this investigation, are shown on the Record of Borehole Sheets. The stratigraphical sections shown on Drawing No. 717403/04-A are inferred from this borehole data.

From the ground surface downwards the various soil strata and bedrock encountered are described in the following paragraphs.

Fill

At the location of the existing Hwy. 11 the roadway embankment fill was encountered immediately below a 3 to 4 inch thick asphalt pavement. The thickness of this stratum is estimated to range from 9 to 12 feet. The composition of the fill material is generally sand with gravel and some silt. At one location, the lower portion of the fill material contained a considerable amount of organics in a zone some 3 feet thick. Based on laboratory tests the organic content in this zone was found to be about about 9 percent by weight. The Standard Penetration Test 'N' values which generally vary randomly between 8 and 75 blows per foot, indicates that the fill material is poorly to well compacted.

Silty Sand to Sandy Silt

The predominant surficial deposit across the site is a granular stratum of silty sand to sandy silt, some gravel and a trace of clay immediately below a thin mantle of topsoil. In certain locations this surficial deposit is overlain by highway fill material. The thickness of this surficial stratum fluctuates across the site from 1 to 11 feet. The colour of the stratum varies with alternate layers of reddish brown and grey of approximately 6 inches in thickness. Based on the Standard Penetration Test 'N' values which range from 7 to 29 blows per foot the relative density is estimated to be loose to compact.

Glacial Till

The glacial till stratum was encountered in all borehole locations across the site immediately below the silty sand to sandy silt stratum or the fill material or the organic material (swamp area). The upper boundary of this stratum was found to be approximately 1 to 13 feet below ground surface, whereas the lower boundary was found to be 3 to 28 feet below ground surface. The thickness of this stratum ranges from 3 to 16 feet. The glacial till is a heterogeneous mixture of silt, sand and gravel, trace of clay and occasional cobbles and boulders. In view of the presence of the boulders in the glacial till stratum at certain locations, diamond drilling techniques were employed. The Standard Penetration Test gave 'N' values ranging from 19 to over 100 blows per foot. Based on these it is estimated that the relative density of the glacial till deposit is compact to very dense.

Gneiss Bedrock

The overburden is underlain by bedrock which was proven in 9 of the boreholes by obtaining up to 10 feet of BXL size rock core samples at each location. The bedrock surface was found to range from elevation 657 (B.H. 5) to elevation 686 (B.H. 11) corresponding to depths ranging from 3 to 28 feet below ground surface.

In certain locations where the bedrock was found to be close to the surface and fluctuating across the site test pits were excavated to bedrock to confirm the elevation of the bedrock as determined by the coring operations.

The bedrock core samples were examined by Ms. Z. Konuiszy, Geologist, Ministry of Transportation and Communications. Ms. Konuiszy described the rock generally as a gneiss, pink-grey medium to coarse textured and hard.

In the vicinity of the structure abutments for the southbound lane some of the rock cores showed open joints and fractures dipping at 30° - 45° in the upper surface of the bedrock as described in the Record of Borehole Sheets. These openings, although generally not weathered, will allow water to flow through them. In some locations the upper portion of the bedrock is weathered to a depth of up to 2 feet.

The rock quality designation (RQD) classification gives an indication of the quality of the bedrock with respect to the number of fractures and amount of softening or alteration of the rock mass. The RQD is the total length of rock core pieces of 4 or more inches in length expressed as a percentage of

the total length of core drilled. The RQD for the rock cores varies from 80 to 100%.

Groundwater Observations

The groundwater elevation was observed in boreholes 2, 5, 6 and 8 by measuring in the open borehole during the field investigation. The groundwater level was encountered at elevations ranging from 679 to 685 corresponding to depths ranging from 1 to 15 feet below ground surface. The results of the readings are shown on the Record of Borehole Sheets, as well as on Drawing 717403/04-A.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to construct twin single span structures for the proposed crossing of reconstructed Hwy. 11 northbound lanes and southbound lanes over Birch's Road.

The proposed profile grade of Hwy. 11 in the vicinity will be approximately at elevation 698 for the northbound and southbound lanes, whereas the profile grade of Birch's Road will be about at elevation 678. In order to maintain the aforementioned, fills up to 13 feet and cuts up to 20 feet, in the longitudinal direction of Hwy. 11, will be required.

The parent overburden across this site is generally comprised of a thin mantle of topsoil overlying a 1 to 11 foot thick loose to compact silty sand to sandy silt overlying a 3 to 16 foot thick compact to very dense glacial till. The existing Hwy. 11 is constructed on an embankment up to 12 feet in height and the fill material is comprised of sand with gravel and some silt. The overburden is underlain by gneiss bedrock. Groundwater at the site was found to be at depths varying from 1 to 15 feet below ground surface.

The following recommendations pertain to the design and construction of the structure foundations and approaches.

Structure Foundations

Northbound lane structure: north abutment - refer B.H. 3 & 4: At this location the bedrock is relatively close to the ground surface and the north abutment may be founded on spread footings located on sound bedrock. An allowable load of up to 20 tsf. may be used for design purposes.

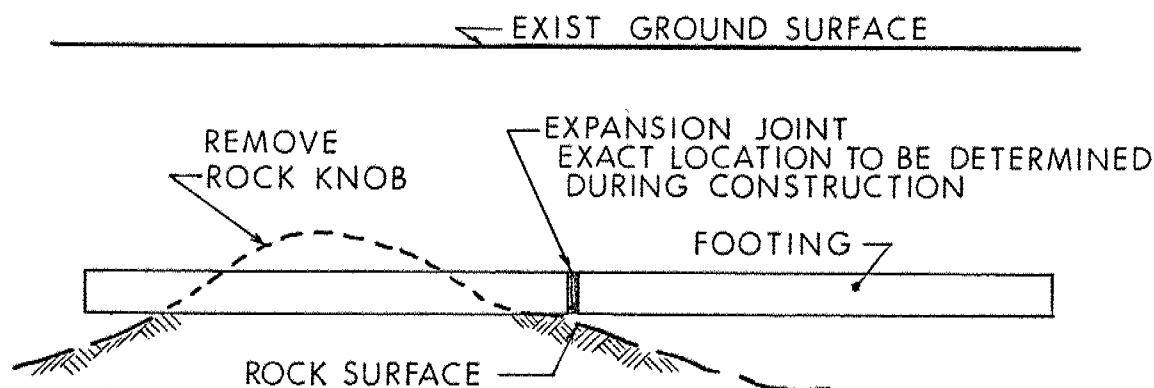
Northbound lanes structure: south abutment - refer B.H. 1 & 2: The overburden at this location is comprised of fill material overlying a competent glacial till stratum. The south abutment footings may be founded within the competent glacial till stratum with an allowable load of up to 5 tsf.

Footings founded on the glacial till should be provided with a minimum earth cover of 5 feet or equivalent insulation for frost protection purposes.

Since Birch's Road grade (elev. 678) and frost protection requirements will govern the founding elevation of the south abutment footing and the required elevation may be very close to bedrock, it may be advantageous to found the footing directly on bedrock with an allowable load of up to 20 tsf.

Southbound lanes: north abutment - refer B.H. 7, 8, 11 12 & 13
south abutment - refer B.H. 5, 6, 9 & 10 : At this location the surface of the bedrock is quite variable and is generally sloping down to the east at a slope of about 30-50°. For this reason the abutments may be founded on spread footings partially founded on sound bedrock and partially on the very dense portion of the glacial till stratum.

The footing should be articulated in such a manner to accommodate differential settlements between that portion of the footing founded on bedrock and that founded within the competent glacial till stratum. It will be necessary to provide expansion joints between those sections of the footing as shown in the sketch below.



The footing may be designed using an allowable load of up to 5 tsf. on the glacial till and up to 20 tsf. on the bedrock.

In view of the sloping nature of the bedrock it is extremely difficult to pre-determine the location of the expansion joints and consequentially this should be decided upon during construction. In some locations it may be necessary to bring up the rock surface to the footing founding elevation by means of mass concrete. Alternate provisions should be made for excavating additional rock knobs to the desired footing level.

The footing supported on glacial till should be provided with a minimum earth cover of 5 feet or equivalent insulation for frost protection purposes.

Other Considerations

The following comments are common to all the abutments discussed.

Earth Pressure: If the structures are designed as rigid frames, then a coefficient of earth pressure at rest (k_0) of 0.5 should be assumed for the granular material placed behind the abutments. However, if some movement of the top of the abutments is permitted, then a coefficient of active earth pressure (K_a) of 0.33 can be used. In order to relieve the build-up of excess hydrostatic pressure behind the abutments suitable drainage measures should be provided.

Resistance to Sliding: In computing the sliding resistance between the base of the footing and the subsoil or bedrock the following should be used.

- 1) Rough concrete and glacial till - coefficient of friction 0.6
- 2) Rough concrete and bedrock - coefficient of friction 0.8

Construction of Foundations

Excavation for footings founded on bedrock will not require any special measures, however, any seepage from the sides of the excavation or from the joints in the rock may be controlled by pumping from sumps. In addition, temporary shoring may be required to support the sides of the excavation within the overburden if the excavation extends to a depth of 4 feet or more.

APPROACH FILLS AND CUTS

As discussed previously some 13 feet of fill and 20 feet of cut will be required to achieve the proposed profile grades of Hwy. 11 and Birch's Road. No stability problems are anticipated with the proposed fills and cuts provided

the new fill is properly compacted and that the slopes (fill slopes, as well as cut slopes) are no steeper than 2 horizontal to 1 vertical.

MISCELLANEOUS

The fieldwork for the investigation was carried out during the period of November 22 to November 27, 1976 under the supervision of Mr. M. MacLean, Project Engineer. The equipment used was owned and operated by Atcost Soil Drilling Inc.

This report was written by Mr. M. MacLean and reviewed by Mr. M. Devata, Supervising Engineer.

M MacLean

M. MacLean, P. Eng.
Project Engineer

M Devata

M. Devata, P. Eng.
Supervising Engineer



MD/MM/gs
February, 1977

APPENDIX

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 204 E 1,025,101 ORIGINATED BY M M
 DIST 13 HWY 11 NBL BORING DATE November 26, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Solid Stem Auger BX Casing CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					w_p w w_L				
							SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					20 40 60				
691.7	Ground Surface															
0.0	Asphalt					690										
	Fill Sand, with gravel and some silt, light brown		1	SS	22							○			29 56 (15)	
678.7	Black Organics Loose		2	SS	6	680						○			Org. 8.8%	
13.0	Het. mixture of silt, sand and gravel, trace of clay occ. cobbles and boulders (Glacial Till) Dense to very Dense		3	SS	34											
			4	SS	94	670						○			35 44 (21)	
665.2			5	SS	727											
26.5			6	RC	90%											
659.2	Gneiss bedrock Sound		7	RC	100%	660									RQD 80%	
32.5	End of Borehole															
	Note Ground Water Level not obtained															

RECORD OF BOREHOLE NO 2

WP 71 74 03/04 LOCATION Co-ords N 16, 816, 191 E 1,025,051 ORIGINATED BY M.M.
 DIST 13 HWY 11 NBL BORING DATE November 24 and 25, 1976 COMPILED BY M.M.
 DATUM Geodetic BOREHOLE TYPE Soild Stem Auger BX Casing and Cone CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
693.1	Ground Surface															GR SA SI CL
0.0	Asphalt															
	Fill		1	SS	75	690										4 84 (12)
	Sand Trace to some		2	SS	32											12 75 (13)
684.1	Gravel and some Silt		3	SS	57											3 34 61 2
	Lt. Brown															
9.0	Silty Sand to Sandy		4	SS	7											
681.1	Silt, trace of Gravel															
	& Clay Loose		5	SS	75	680										
12.0	Het. Mixture of Silt		6	SS	64	678.6										8 60 (32)
	Sand & Gravel, trace															
	of Clay occ. cobbles															
673.1	& boulders Glacial															
	fill Very Dense															
20.0	Weathered		7	RC	20%	670										
	Gneiss															
	Bedrock															
664.0	Sound		8	RC	100%											RQD 90%
29.1	End of Borehole															

RECORD OF BOREHOLE NO 3

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 279 E 1,025,077 ORIGINATED BY M M
 DIST 13 HWY 11 NBL BORING DATE November 25 and 26, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger, BX Casing and Cone CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W_P	W	W_L		
694.2	Ground Surface															GR SA SI CL
0.0	Asphalt															
	Fill															
	Sand, With Gravel and		1	SS	8	690										25 68 (7)
	Trace of Silt															
685.2	Light Brown															
9.0	Ret. mixture of silt		2	SS	54											8 43 48 1
	Sand and Gravel		3	RC	50%											
	Trace of Clay Occ.		4	RC	50%											
	Cobbles & Boulders:															
678.5	(Glacial Till) very															
	Dense															
15.7	Gneiss Bedrock		5	RC	100%	680										
673.4	Sound															RQD 90%
20.8	End of Borehole															
	Note															
	Ground Water Level															
	Not Obtained															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 264 E 1,025,031 ORIGINATED BY M M
DIST 13 HWY 11 BORING DATE November 27, 1976 COMPILED BY M M
DATUM Geodetic BOREHOLE TYPE Hollow Stem Augers, RX Casing CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W $W_P \quad W \quad W_L$ WATER CONTENT % 20 40 60	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100			
695.1	Ground Surface													
0.0	Asphalt													
	Fill Sand, Trace Gravel and some Silt Light Brown					690								
683.1			1	SS	32									8 81 (11)
681.9	Glacial Till													
13.8	Weathered		2	RC	80%	680								RQD 85%
676.8	Gneiss Bedrock Sound													
18.3	End of Borehole													
	Note: Ground Water Level not Obtained													

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 161 E 1, 024, 976 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 23 & 24, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Solid Stem Augers and BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
684.5	Ground Surface															GR SA SI CL
0.0	Topsoil															
	Silty Sand to Sandy Silt, trace to some Gravel, trace of Clay. Alternate Layers of Reddish Brown and Grey - Compact		1	SS	24	680.5						o				15 60 (25)
673.5			2	SS	28							o				5 58 (37)
11.0	Het. Mixture of Silt, Sand & Gravel, trace of Clay Occ. Cobbles and Boulders		3	SS	100/6											
	(Glacial Till) Very Dense		4	SS	72	670						o				4 60 31 5
			5	SS	82							o				8 55 27 10
657.0			6	SS	100/2	660										
27.5	Gneiss Bedrock (open joints at elev 654.5, 653.0, 650.2 and 649.7)		7	RC	90%											
648.5			8	RC	100%	650										RQD 80%
36.0	End of Borehole															

RECORD OF BOREHOLE NO 6

WP 71 74 03/04 LOCATION Co-ords N 16,816,149 E 1,024,937 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 22 and 23, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Solid Stem Augers, BX Casing, and Cone CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
684.9	Ground Surface													
0.0	Topsoil													
680.9	Silty Sand to Sandy Clay		1	SS	20									0 29 68 3
4.0	Het. Mixture of Silt, Sand & Gravel, Trace of Clay, Occ. Cobbles		2	SS	17									19 57 (24)
676.8	& Boulders Compact		3	SS	19									RQD 100%
8.1	Gneiss Bedrock Sound		4	RC	100%									
671.4														
13.5	End of Borehole					670								
Note: 45° Open Joint Every 6" From Depth 8.1' to 10.1' Below Ground Surface														

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 231 E 1, 024, 955 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 22 and 23, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger, BX Casing & Cone CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W_P	W	W_L		
688.7	Ground Surface															GR SA SI CL
0.0	Topsoil															
	Silty Sand to Sandy Silt. Trace to some Gravel. Trace of Clay. Compact. Alternate Layers of Reddish Brown and Grey		1	SS	29											19 61 (20)
			2	SS	25											7 57 26 10
679.7			3	SS	21											
9.0	Het. Mixture of Silt, Sand, & Gravel. Trace of Clay. Occ. Cobbles and Boulders		4	SS	80/3"											
	(Glacial Till)		5	RC	10%											32 60 (8)
	Very Dense		6	SS	94/9"											
667.7			7	SS	100/1"											
21.0	(Vertical Joints)		8	RC	100%											RQD 0
			9	RC	100%											RQD 100%
	Gneiss Bedrock		10	RC	100%											
658.0	Sound															
30.7	End of Borehole															
	Note Ground Water Level Not Obtained															

RECORD OF BOREHOLE NO 8

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 220 E 1, 024, 917 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 24, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Augers, and BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
685.9	Ground Surface													
684.9	Organic Mat'l Black													
1.0	Net. Mix. of Silt,													
681.4	Sand & Gravel, Coarse													
4.5	& Boulders (Glacial)													
676.9	Gneiss Bedrock (Open Joint at Elev. 678.1)		1	RC	100%	680								RQD 95%
9.0	End of Borehole													
						670								

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 9

WP 71-74-03/04

LOCATION Co-ords N 16, 816, 155 E 1, 024, 955

ORIGINATED BY M M

DIST 13 HWY 11 SBL

BORING DATE November 24, 1976

COMPILED BY M M

DATUM Geodetic

BOREHOLE TYPE Solid Stem Augers to Refusal

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					W_P W W_L				
							SHEAR STRENGTH									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %				
684.7	Ground Surface															
0.0	Silty Sand to Silty Clay															
681.2	Trace of Clay															
3.5	Het. Mixture of Silt, Sand & Gravel Trace of Clay. Occ. Cobbles and Boulders					680										
669.7						670										
15.0	Auger Refusal Probable Bedrock															
	Note Ground Water Level Not Obtained															

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 10

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 152 E 1, 024, 947 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 26, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Soild Stem Augers to Refusal CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p ——— w ——— w_L				
							SHEAR STRENGTH					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
684.8	Ground Surface															
	Silty Sand to Sandy Silt Silt Some Gravel & Trace of Clay					680										
5.0	Het. Mix. Silt, Sand & Gravel, Trace of Clay															
675.8	Occ. Cobbles and Boulders															
9.0	Auger Refusal Probable Bedrock					670										
	Note Ground Water Level not Obtained															

RECORD OF BOREHOLE NO 11

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 225 E 1, 024, 936 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 25, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Solid Stem Augers to Refusal CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %	
688.5	Ground Surface																	
685.5	Gravelly Sand with Small Boulders																	
3.0	Auger Refusal Probable Bedrock																	
	Note Ground Water Level Not Obtained					680												

RECORD OF BOREHOLE NO 12

WP 71-74-03/04 LOCATION Co ords N 16, 816, 224 E 1, 024, 933 ORIGINATED BY M M
 DIST 13 HWY 11 SBL BORING DATE November 25, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Solid Stem Augers and BX Casing CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
688.2	Ground Surface													
0.0	Het. Mix. of Topsoil, Sand & Gravel, Trace of Clay Occ. Cobbles & Boulders (Glacial Till)		1	RC	100%									
682.0														
6.2	Gneiss Bedrock (Open fractures at Elev. 675.3, 674.6 & 674.4 with weathered faces)		2	RC	80%	680								
671.9			3	RC	100%									RQD 90%
16.3	End of Borehole					670								
	Note Ground Water Level Not Obtained													

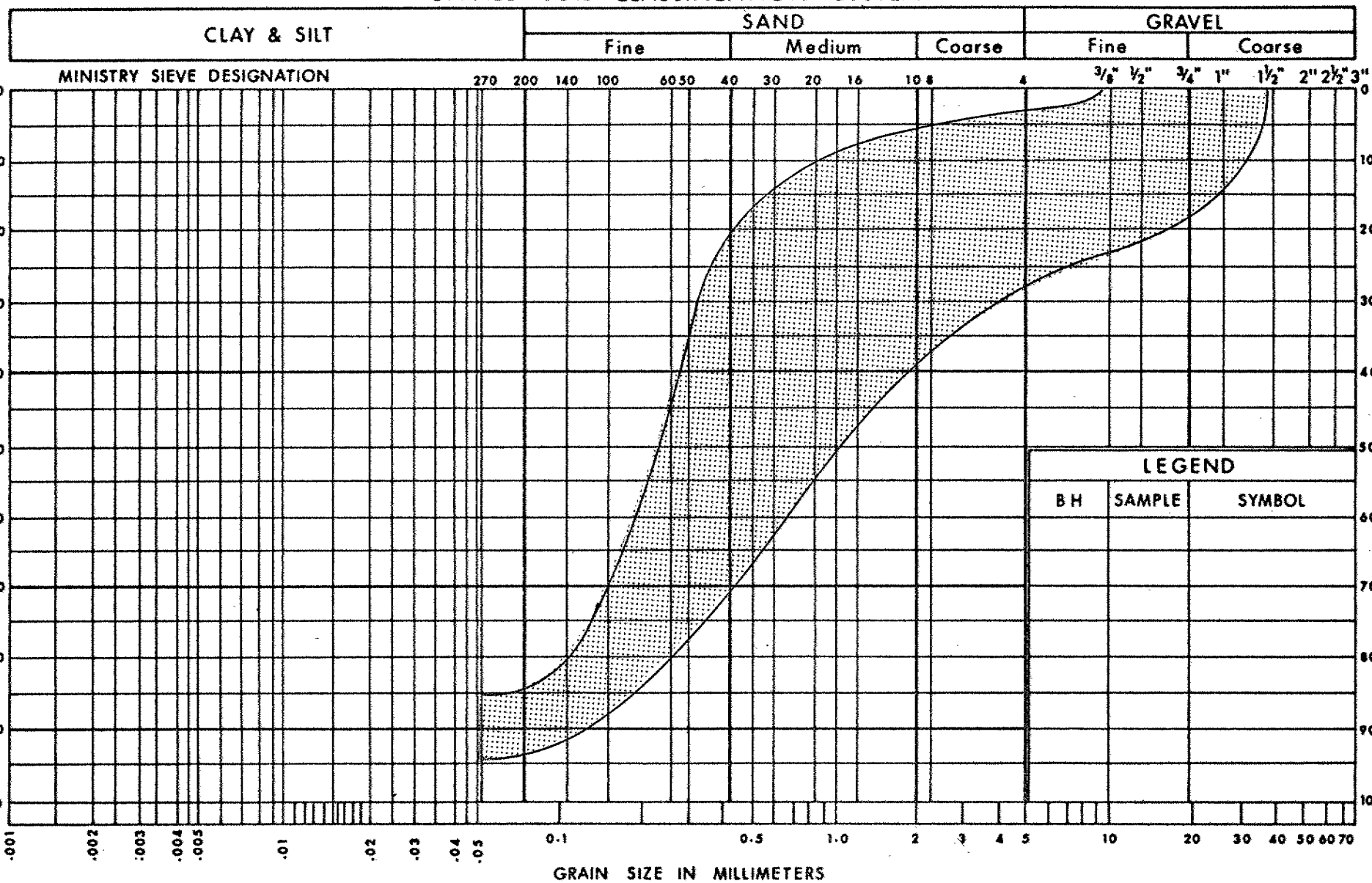
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 13

WP 71-74-03/04 LOCATION Co-ords N 16, 816, 228 E 1, 024, 944 ORIGINATED BY M M
 DIST 13 HWY 11 BORING DATE November 25, 1976 COMPILED BY M M
 DATUM Geodetic BOREHOLE TYPE Soild Stem Augers to Refusal CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
688.5	Ground Surface															
0.0	Het. Mixture of Silt Sand, & Gravel, trace of Clay, Occ. Cobbles and Boulders															
683.2																
5.3	Auger Refusal Probable Bedrock					680										
	Note Ground Water Level Not Obtained															

UNIFIED SOIL CLASSIFICATION SYSTEM



**GRAIN SIZE DISTRIBUTION
FILL MATERIAL**

FIG No 1

W P 71-74-03/04

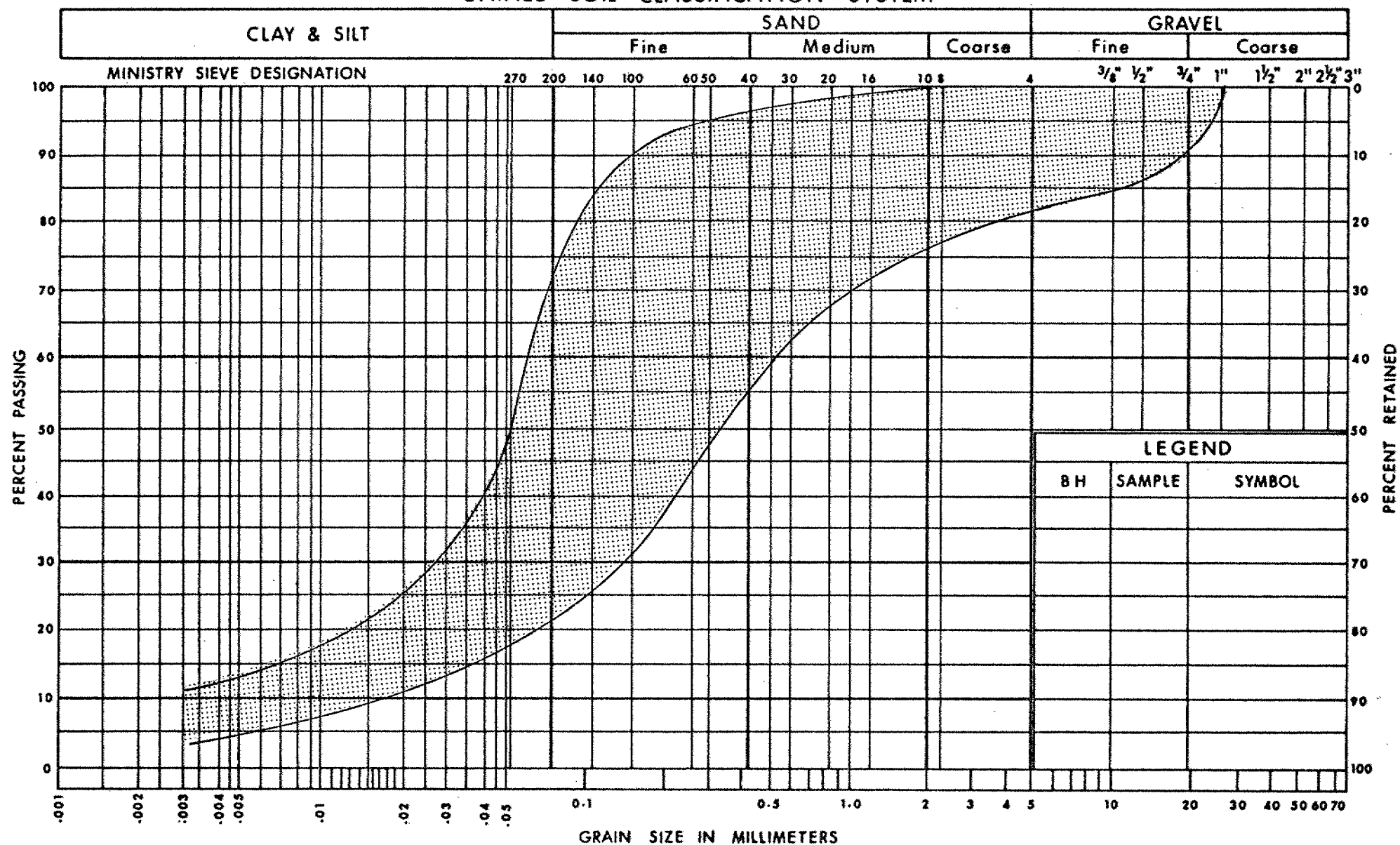


Ministry of
Transportation and
Communications

Ontario

ENGINEERING SERVICES BRANCH

UNIFIED SOIL CLASSIFICATION SYSTEM



**Ministry of
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Ontario

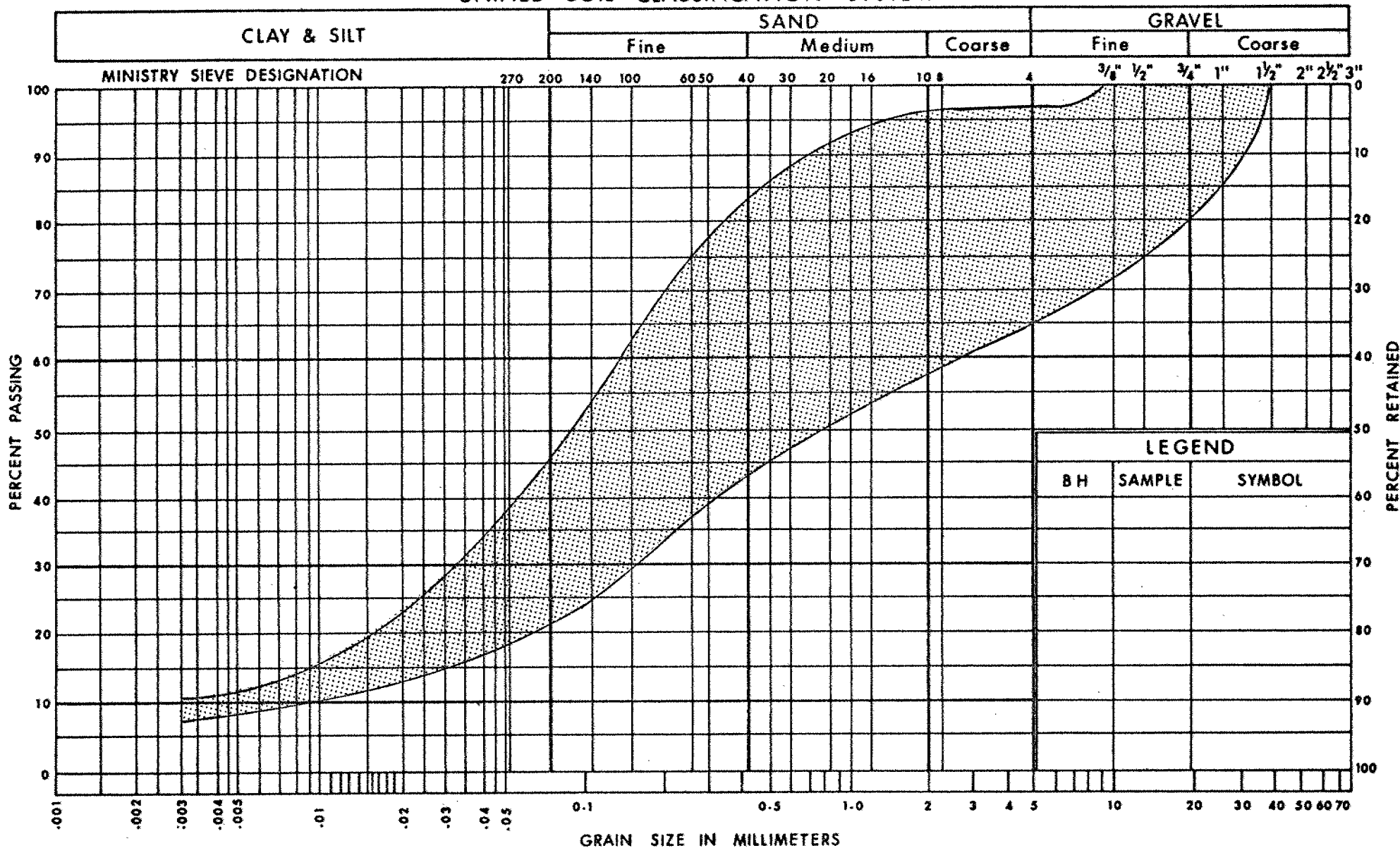
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION SILTY SAND TO SANDY SILT

FIG No 2

W P 71-74-03/04

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

Ontario

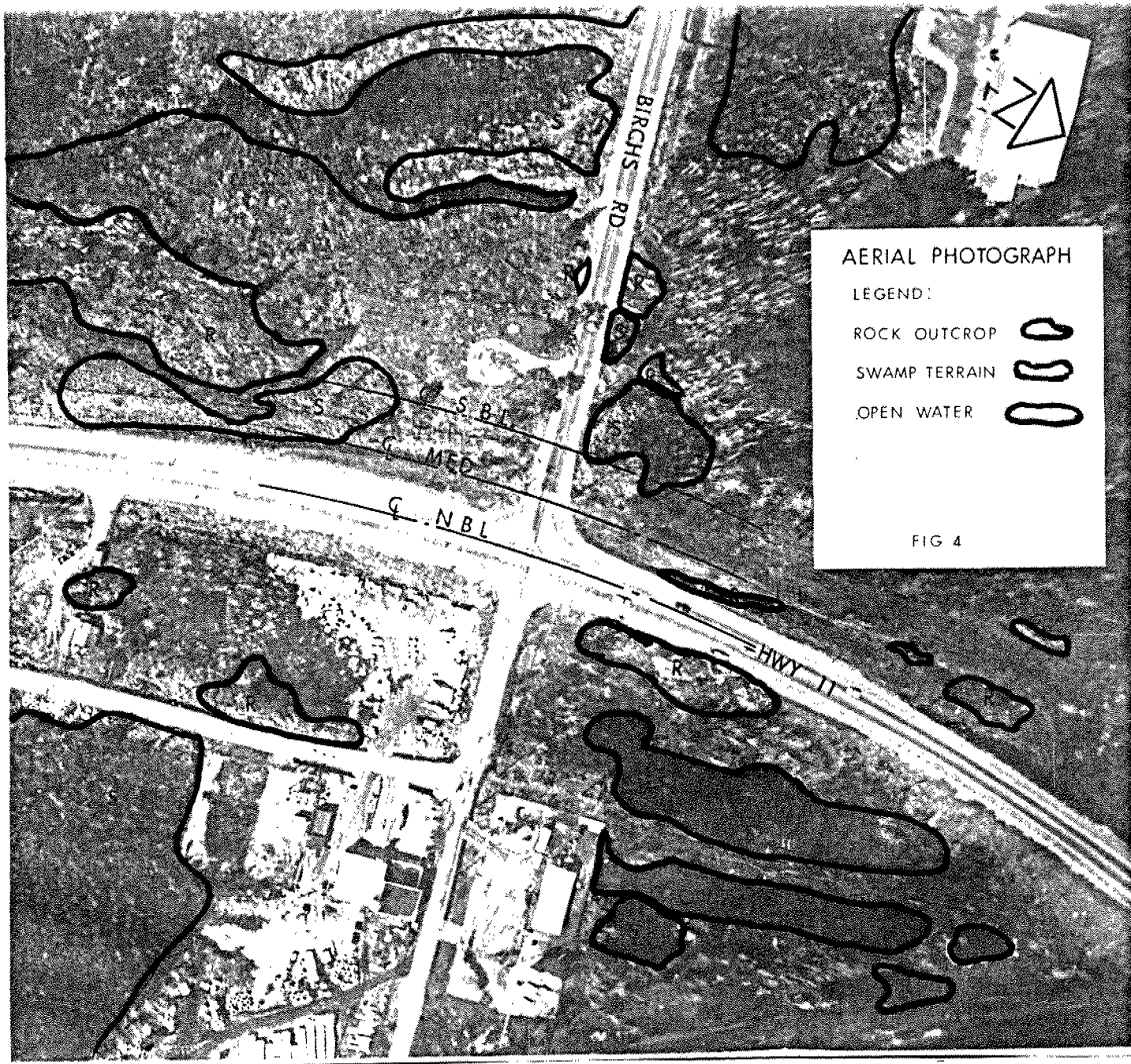
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION GLACIAL TILL

HET MIX OF SILT SAND & GRAVEL TRACE OF CLAY

FIG No 3

WP 71-74-03/04



ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

'N' = STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>c LB/SQ FT</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.T	SLOTTED TUBE SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V	FIELD VANE
CU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

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	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
w_s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
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
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
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_t	SENSITIVITY

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

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	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

EARTH PRESSURE

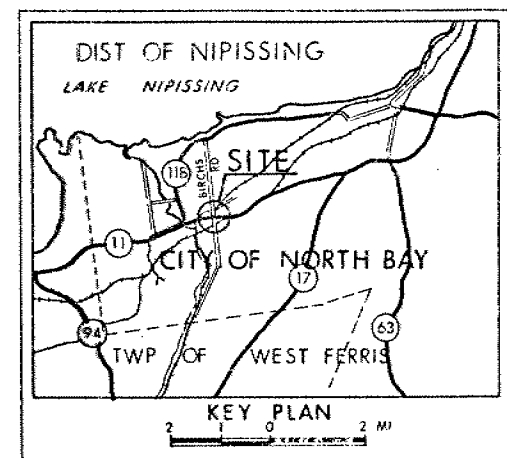
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



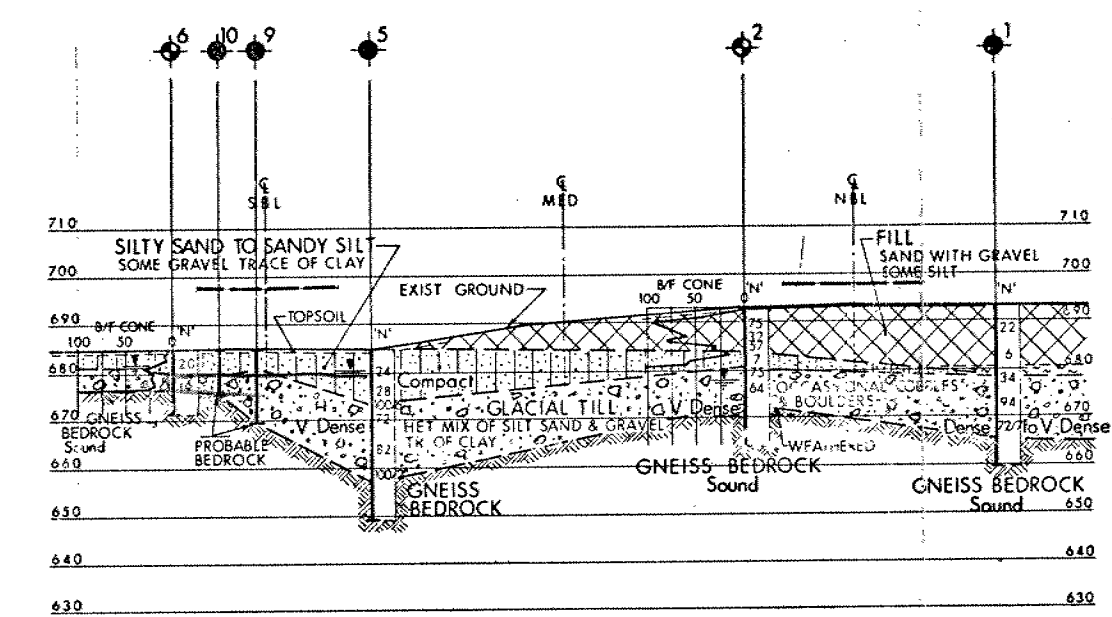
LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Test (Cone)		
	Bore Hole & Cone		
	Blows/ft (Std Pen Test 350 ft lbs energy)		
	Blows/ft (60° Cone, 350 ft lbs energy)		
	WL at time of investigation NOV 1976 NO WL established in BH No 1 3 4 7 9 10 11 12 & 13		

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	691.7	16 816 204	1 025 101
2	693.1	816 191	025 051
3	694.2	816 279	025 077
4	695.1	816 264	025 031
5	684.5	816 151	024 976
6	681.9	816 149	024 937
7	688.7	816 231	024 955
8	685.9	816 220	024 917
9	684.7	816 155	024 955
10	684.8	816 152	024 947
11	688.5	816 225	024 936
12	688.2	816 224	024 933
13	688.5	816 228	024 944

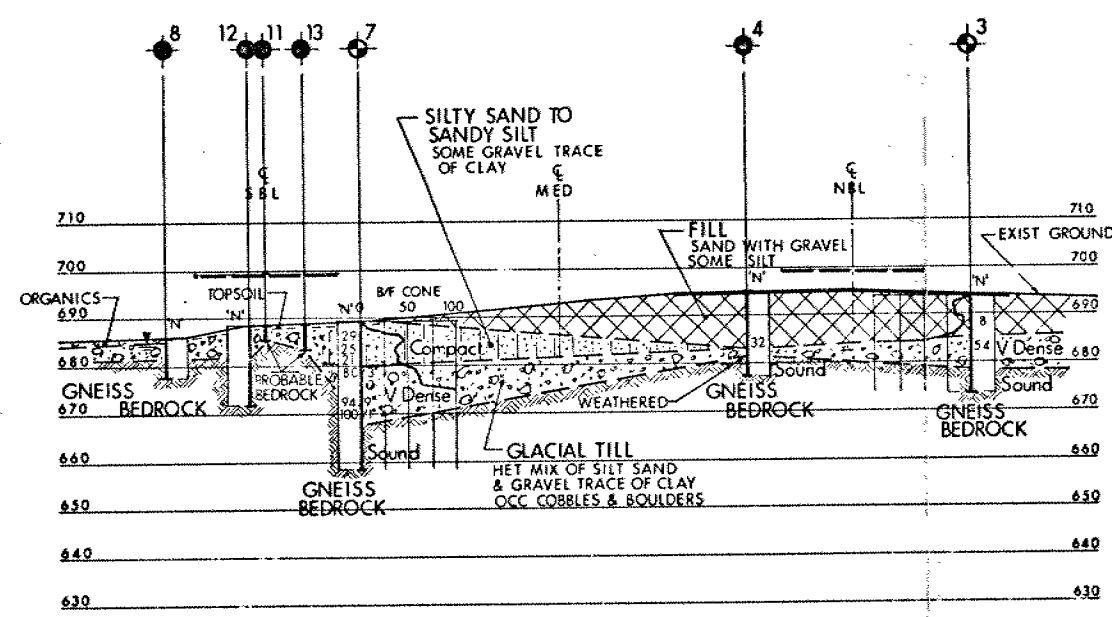
-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

HWY No 11	CHECKED	DATE 26 01 77	DIST 13
SUBMITTAL M	CHECKED	DATE 26 01 77	SHEET 43-99
GRAPHIC J	CHECKED	DATE 26 01 77	CW 5717403554-A

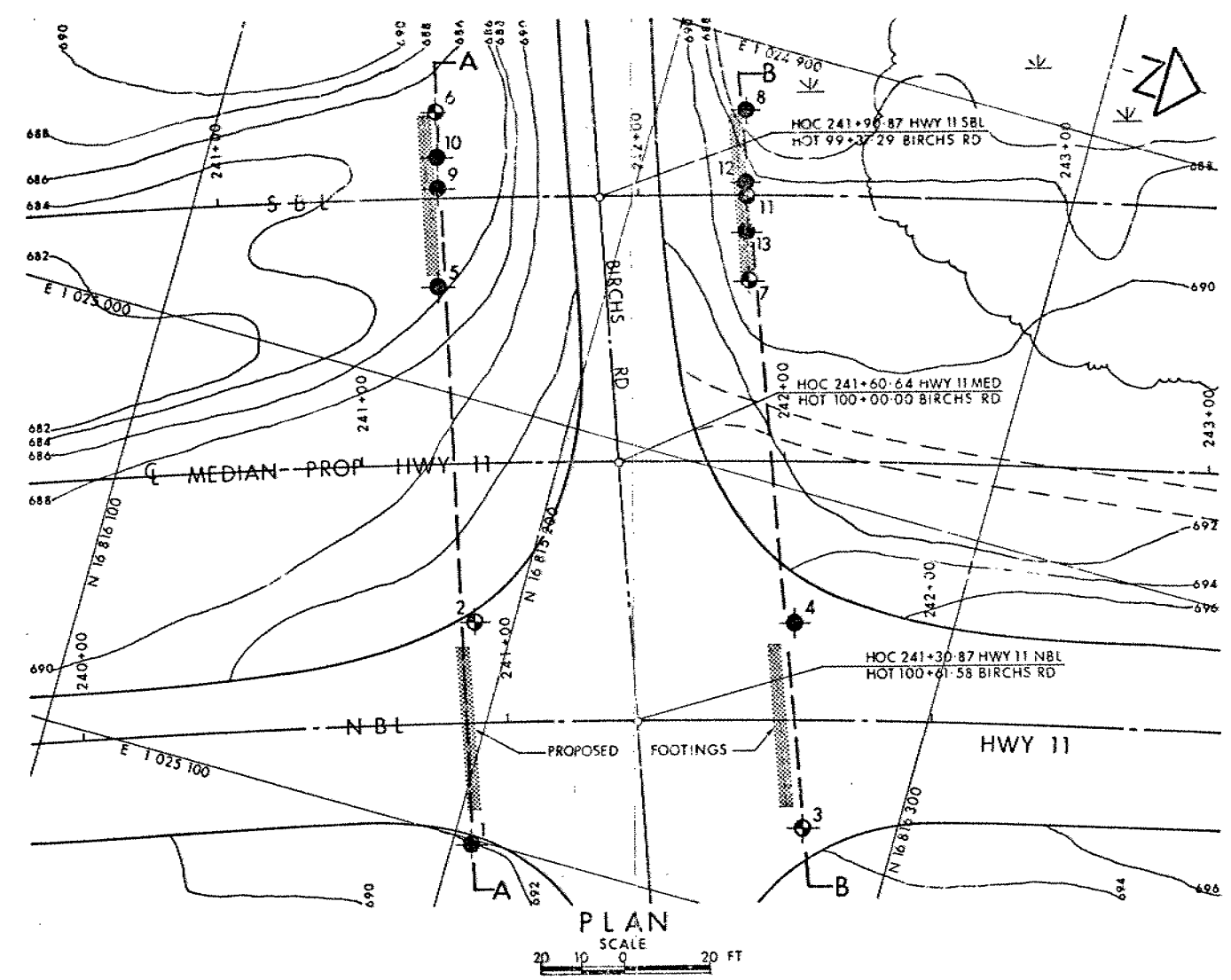


SECTION A-A

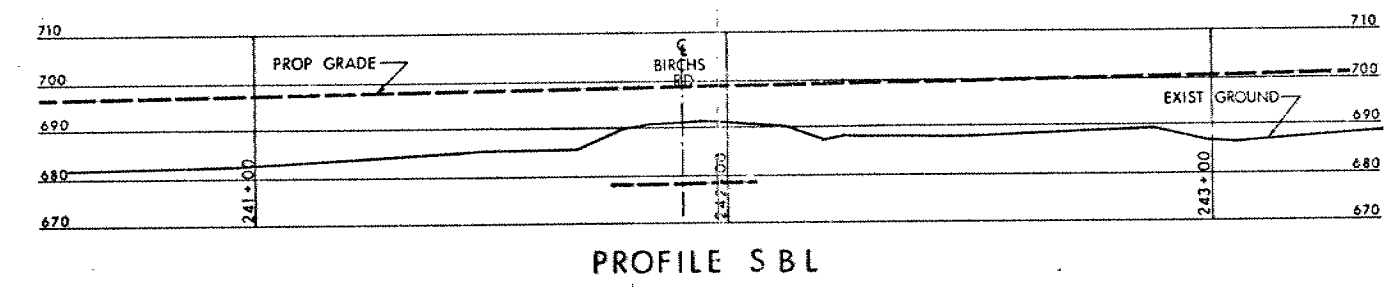


SECTION B-B

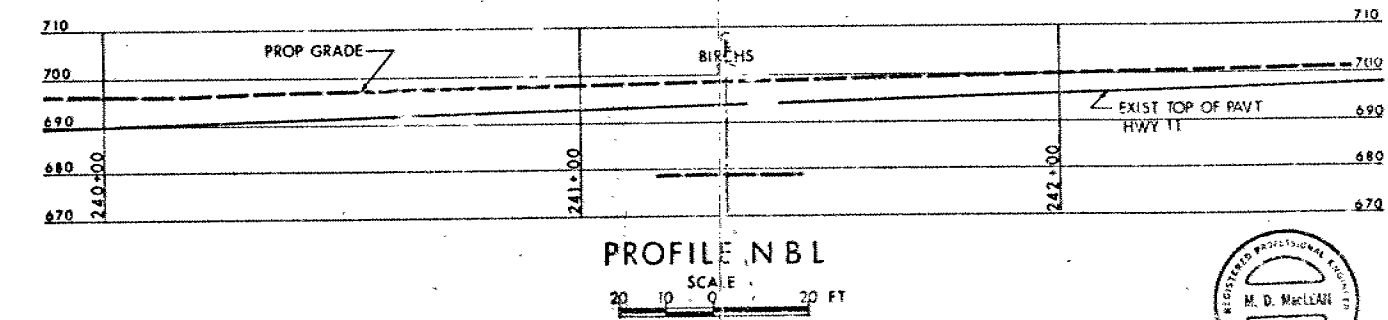
SCALE 20 10 0 20 FT



PLAN
SCALE 20 10 0 20 FT



PROFILE SBL



PROFILE NBL
SCALE 20 10 0 20 FT

