

G.I.-30 SEPT. 1976

GEOCRES No. 31L-40DIST. 13 REGION W.P. No. 71-74-07CONT. No. 79-53W. O. No. STR. SITE No. 43-201HWY. No. 11LOCATION Hwy 11B Interchange
UnderpassNo of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 71-74-07

DIST 13

HWY 11

STR SITE 43-201

Lakeshore Drive Underpass

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FOUNDATION INVESTIGATION REPORT

For

Lakeshore Drive Underpass
W.P. 71-74-07, Site 43-201
Hwy. 11, District 13, North Bay

INTRODUCTION

This report contains the results of a foundation investigation done at the site of the above mentioned project. The investigation was carried out during the period of October 26, 1977 to October 28, 1977 utilizing a track-mounted auger machine. The fieldwork consisted of six sampled boreholes advanced by means of 3½" I.D. hollow stem augers and six auger probing holes advanced by means of solid stem flight augers. The fieldwork also included five hand dug test pits and two hand dug trenches. The boreholes were advanced to depths ranging from 8.5 feet to 25 feet below the ground surface. In addition, bedrock was proven by recovering BX size rock core samples.

DESCRIPTION OF SITE AND GEOLOGY

The site is located some 750 feet northeast of the junction of Hwy. 11 and Dupont Road in the southern portion of the City of North Bay. A large part of the site is situated in a basin which is surrounded by undulating high ground. The low lying area in the basin is not well drained. At the time of investigation, it was inundated with 6 to 8 inches of water. Bedrock is exposed at the ground surface in several locations at this site. A large rock knob is located on the west side of Dupont Road in the southern portion of the site. The land in this area is covered with pine trees and spruces, with occasional poplars. Most of the trees in the vicinity of the site are not mature.

Geologically the area is located in the Canadian Shield, with bedrock of Precambrian age. The overburden at this site consists of granular glacio-fluvial deposits.

SUBSURFACE CONDITIONS

General

Subsoil at this site consists of a fine to medium sand with gravel. In the northern portion of the site the granular stratum also contains numerous cobbles and boulders below a depth of 16 feet below the ground surface. The bedrock surface

is irregular and due to this the thickness of the overburden is quite variable. In places in the centre portion of the site bedrock is exposed, or exists at a shallow depth. In the southern portion of the site the thickness of the overburden was found to be in the order of 16 feet; whereas in the northern portion of the site the thickness of the overburden was found to be in excess of 25 feet.

The locations and elevations of the borings, test pits and trenches are shown in Drawing 717407-A, together with the estimated stratigraphy. A description of the subsoil is as follows.

Sand With Gravel

This is the predominant deposit at the site. The material in this stratum is composed of fine to medium sand with gravel. Typical grain size distribution curves of the material are summarized in Figure 1 in an envelope form. In the northern portion of the site the granular stratum also contains numerous cobbles and boulders below a depth of 16 feet below the ground surface.

The thickness of this sand stratum is variable, largely due to the irregularity of the bedrock surface. In the centre portion of the site bedrock is exposed at the ground surface or is under a thin mantle of sand. In the southern portion of the site the thickness of the granular stratum ranges from about 15 feet to 17 feet. In the northern portion of the site the thickness of the granular stratum was found to be greater than 25 feet.

The full extent of the granular stratum in the northern portion of the site was not explored because of the presence of numerous cobbles and boulders below a depth of 16 feet.

The 'N' values recorded in this granular stratum range from 8 blows/foot to 37 blows/foot, generally increasing with depth. It is estimated from these 'N' values that the granular stratum has a relative density of loose to compact, generally increasing with depth.

Bedrock

Bedrock at this site is a granite, generally hard and sound. In the southern portion of the site bedrock surface varies between elevation 673 and elevation 676. In the centre portion of the site bedrock is exposed at the ground surface in certain locations or exists at a shallow depth. The bedrock surface in the centre portion of the site is relatively level being at about elevation 681.7 to elevation 682, except at one location where bedrock surface is sloping down westerly to about

elevation 677 at a slope angle of about 6(H):1(V). Bedrock was not proven in the northern portion of the site because of the presence of numerous cobbles and boulders.

Groundwater Conditions

During the course of fieldwork the groundwater level at this site was observed to be at approximately elevation 681.5.

DISCUSSION AND RECOMMENDATIONS

The geometry of the structure approaches is such that it would be advantageous to construct the proposed abutments within the approaches and support them on end bearing steel 'H' piles or spread footings on a compacted granular 'A' pad. As to the centre pier, it should be founded on spread footings on bedrock since at the centre pier location bedrock is exposed or exists at a shallow depth. Our recommendations with regard to the structure foundations are as follows.

Abutments

If the scheme of piled foundations is adopted we recommend that the piles at the south abutment be driven to bedrock and at the north abutment into the bouldery stratum. Furthermore, the piles at the north abutment should be driven in accordance with Hiley formula (SS-3-10, SS-3-11) and should be fitted with driving shoes. The estimated pile lengths at both abutments are given below.

<u>Location</u>	<u>Approximate Pile Tip Elevation</u>	<u>Remarks</u>
South Abutment	673	Piles driven to bedrock
North Abutment	650	Piles driven into the bouldery layer and driving controlled by Hiley formula

The design pile loads can be assumed as the allowable structural capacity of the particular sections chosen.

If the scheme of footings on granular 'A' pads is adopted, the design and construction of these granular pads and the footings should be as per our memorandum of February 17, 1977. Furthermore, in order to minimize settlements due to the underlying subsoil, we recommend that the granular pads be constructed and left in place for a period of at least one month prior to construction of the abutments.

Centre Pier

The pier can be supported on spread footings on bedrock. A bearing pressure of up to 20 t.s.f. can be assumed for design purposes. Because of the sloping nature of the bedrock surface in the western portion of the pier, it will be necessary to step down the footings or use dowels in order to ensure stability of the footings against sliding.

Other Considerations

If the abutments are perched within the approaches no major dewatering problems are anticipated during construction of the abutment footings.

In order to place concrete in the dry, dewatering will be required for the excavation of the western portion of the centre pier. In our opinion, dewatering can be achieved by pumping from sumps, while maintaining the sides of the excavation at a slope angle not steeper than 2 horizontal to 1 vertical.

The abutments should be designed to withstand an earth pressure equivalent to a fluid pressure of 40 psf. Resistance against sliding can be obtained from batter piles or from friction between the base of the footing and the granular 'A' pad. In calculating the frictional force a coefficient of friction of 0.7 can be assumed.

Approaches

The subsoil is competent to support the required approach fills without having stability problems if sideslopes are constructed not steeper than 2:1.

B. Ly
B. Ly, P. Eng.
Senior Engineer



M. Devata
M. Devata, P. Eng.
Supervising Engineer

MD/BL/gs
January, 1978

APPENDIX

RECORD OF BOREHOLE No 1

W P 71-74-07 LOCATION N 16 813 554; E 1 027 253 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BL
 DATUM Geodetic DATE Oct. 26, 1977 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
								SHEAR STRENGTH		WATER CONTENT (%)				
691.2	Ground Surface													GR SA SI CL
0.0	Sand: fine changing with depth to medium with gravel						690							0 97 (3)
	Loose to compact		1	SS	8									
			2	SS	29									
			3	SS	17									
			4	SS	33			680						
676.2	Auger refusal on probable bedrock		5	SS	37									15 88 (2)
15.0	End of Hole													

RECORD OF BOREHOLE No 2

W P 71-74-07 LOCATION N 16 813 528; E 1 027 283 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BL
 DATUM Geodetic DATE Oct. 26, 1977 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE							
690.7	Ground Surface															GR SA SI CL		
0.0	Sand: Fine changing with depth to medium with gravel		1	SS	18		690									11 87 (2)		
	Compact		2	SS	13		680									0 99 (1)		
	Auger refusal at 674.7																	
674.7																		
16.0	Granite: sound		3	RC	Rec	95%												
671.7					RQD	85%												
19.0	End of Hole																	

RECORD OF BOREHOLE No 3

W P 71-74-07 LOCATION N 16 813 647; E 1 027 312 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BL
 DATUM Geodetic DATE Oct. 27, 1977 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT Σ					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
681.2	Ground Surface																
0.0	Sand; fine to medium						680										
677.7	Some gravel																
3.5	Granite Bedrock:		1	RC	Rec	100%											
672.7	Sound				RQD	100%											
8.5	End of Hole						670										
AH 3A Solid Stem Auger																	
681.5	Ground Surface						N 16 813 657 E 1 027 311										
0.0	Sand						680										
675.3	Auger refusal on probable bedrock																
6.2	End of Hole						670										
AH 3B Solid Stem Auger																	
681.5	Ground Surface						N 16 813 648 E 1 027 321										
0.0	Sand						680										
677.3	Auger refusal on probable bedrock																
4.2	End of Hole						670										
AH 3C Solid Stem Auger																	
681.5	Ground Surface						N 16 813 645 E 1 027 303										
0.0	Sand						680										
676.0	Auger refusal on probable bedrock																
5.5	End of Hole						670										

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

W P 71-74-07 LOCATION N 16 813 740; E 1 027 372 ORIGINATED BY BL
DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BL
DATUM Geodetic DATE Oct. 27, 1977 CHECKED BY _____

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

W P 71-74-07 LOCATION N 16 813 712; E 1 027 400 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BL
 DATUM Geodetic DATE Oct. 28, 1977 CHECKED BY _____

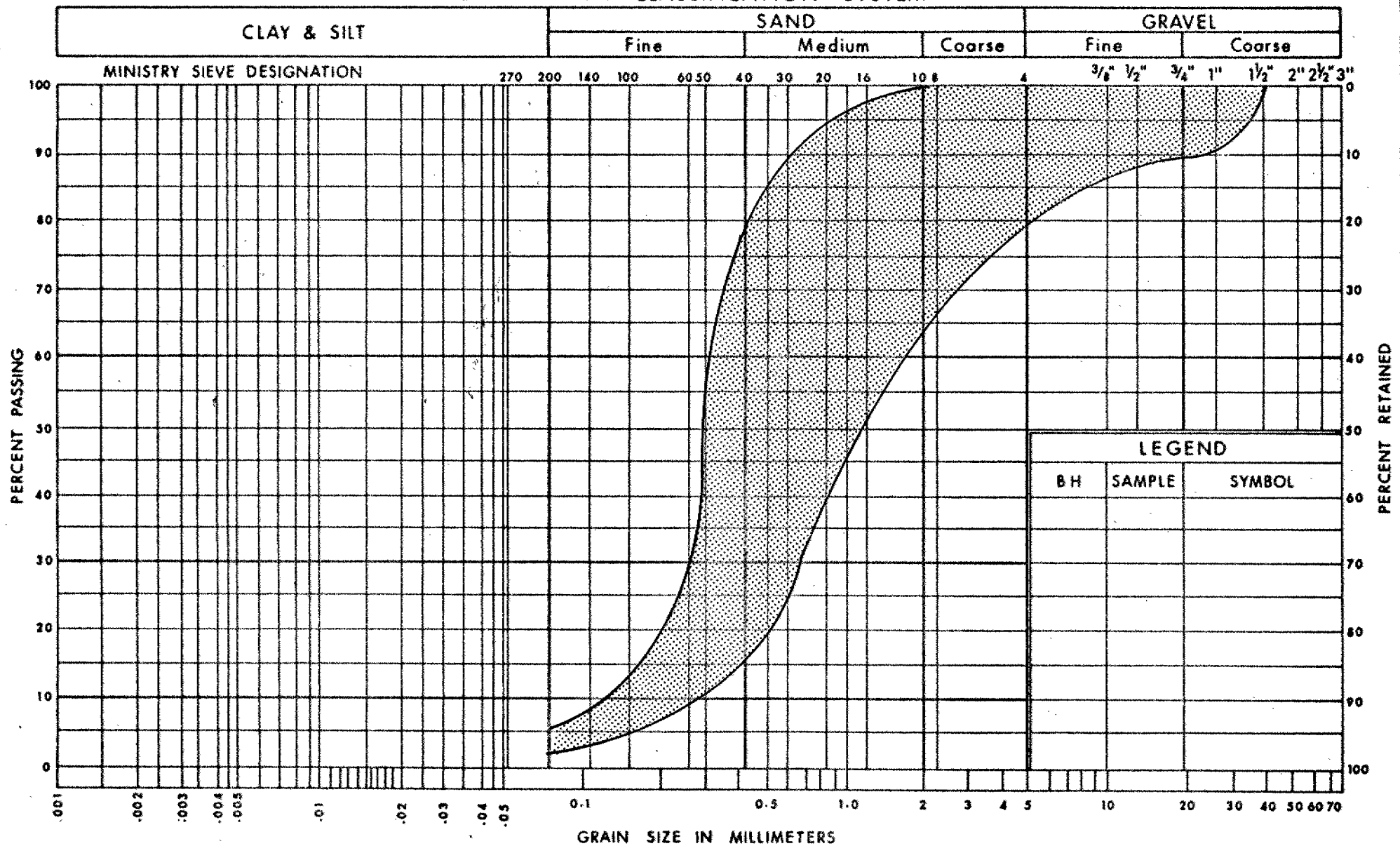
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					W _p	W	W _L		
680.9	Water Surface																
0.0	Sand: Medium, with gravel. Compact		1	SS	17		680										
			2	SS	25		670										
665.9 15.0	Bouldery																
662.9 18.0	End of Hole																
	AH 10 Solid Stem Auger																
690.4	Ground Surface																
0.0	Sand: Fine changing with depth to medium with gravel Occasional Cobbles.						690										
	Auger refusal on probable bedrock						680										
673.2 17.2	End of Hole																

RECORD OF BOREHOLE No 11

W P 71-74-07 LOCATION N 16 813 726; E 1 027 387 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE Hollow stem, BX Casing COMPILED BY BL
 DATUM Geodetic DATE Oct. 27, 1977 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
680.9	Water Surface																	
0.0	Sand Medium, with gravel loose to compact						680											
			1	SS	11													
			2	SS	10		670											
662.4			3	RC														
18.5	Boulders with sand and gravel		4	RC			660											
655.9			5	RC														
25.0	End of Hole	6	RC															
	AH 11A Solid Stem Auger					Oct. 28, 1977	N 16 813 720 E 1 027 382											
680.9	Water Surface																	
	Sand: medium, with gravel Loose to Compact						680											
664.9							670											
16.0	Boulders with sand and gravel						660											
658.4																		
22.5	End of Hole																	

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION SAND WITH GRAVEL

FIG No 1

WP 71-74-07

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}IU$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
W S WASH SAMPLE
S T SLOTTED TUBE SAMPLE
B S BLOCK SAMPLE
C S CHUNK SAMPLE
T W THINWALL OPEN
T P THINWALL PISTON
O S OSTERBERG SAMPLE
F S FOIL SAMPLE
R C ROCK CORE
P H T.W. ADVANCED HYDRAULICALLY
P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS: ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE; σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

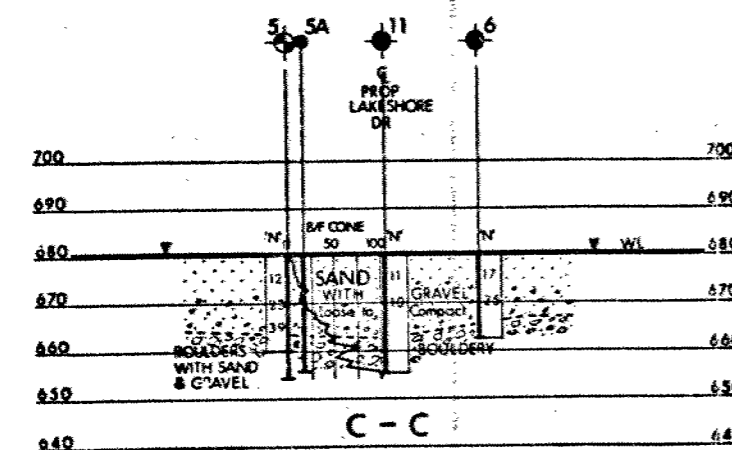
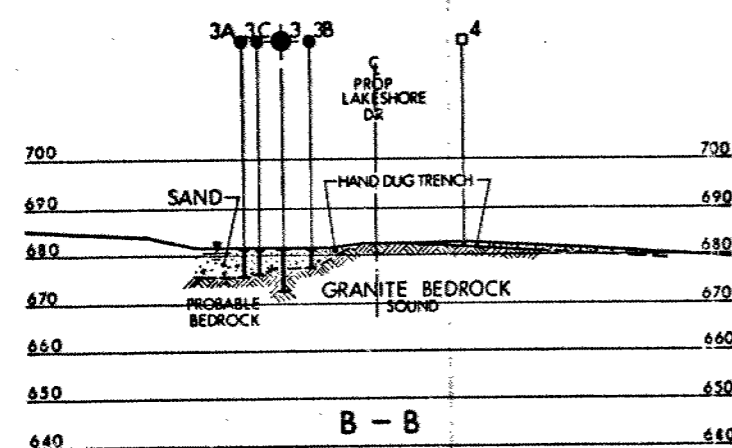
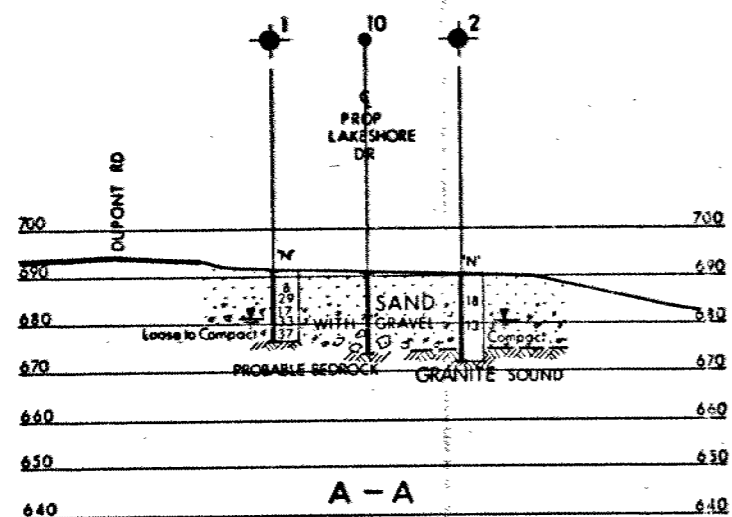
CONT No
WP No 71-74-07

LAKESHORE DR UNDERPASS

BORE HOLE LOCATIONS & SOIL STRATA

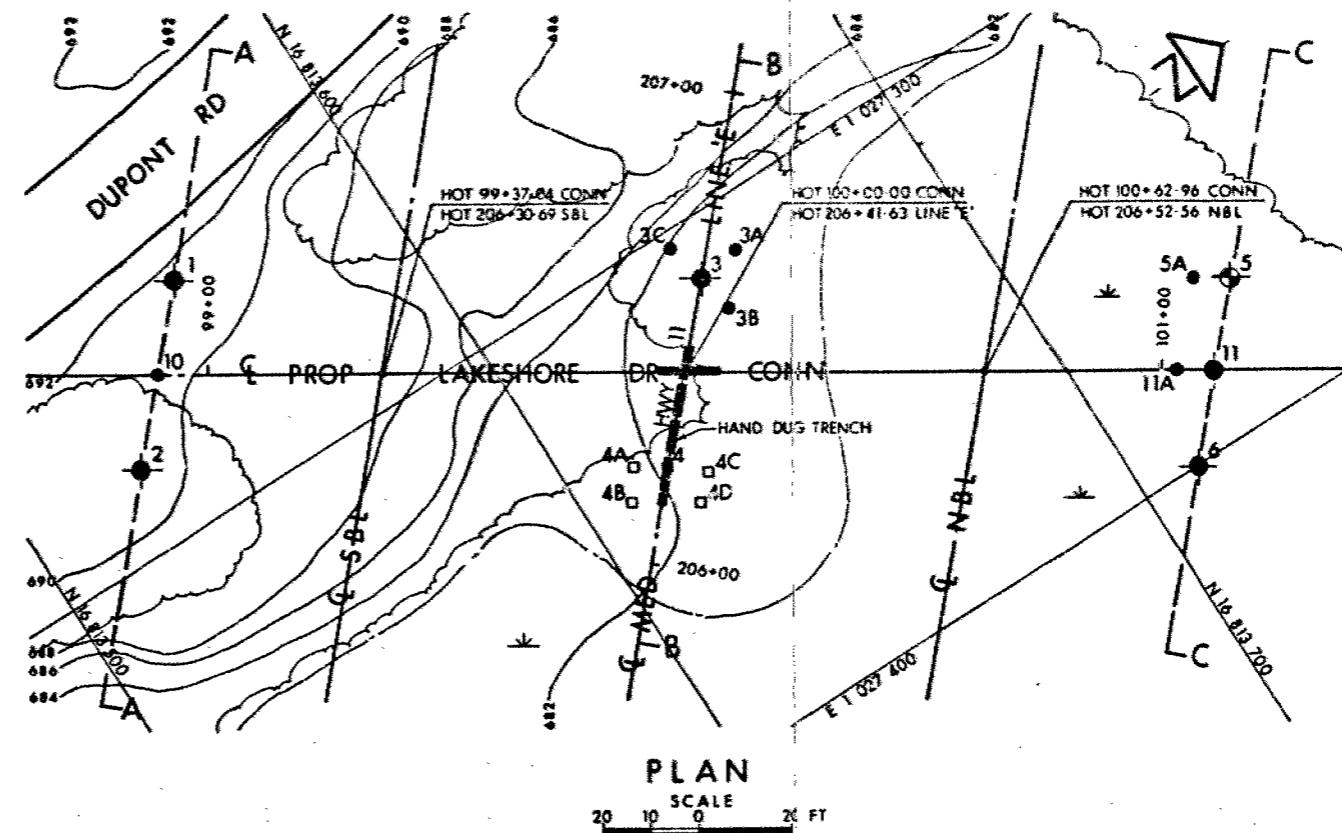


SHEET



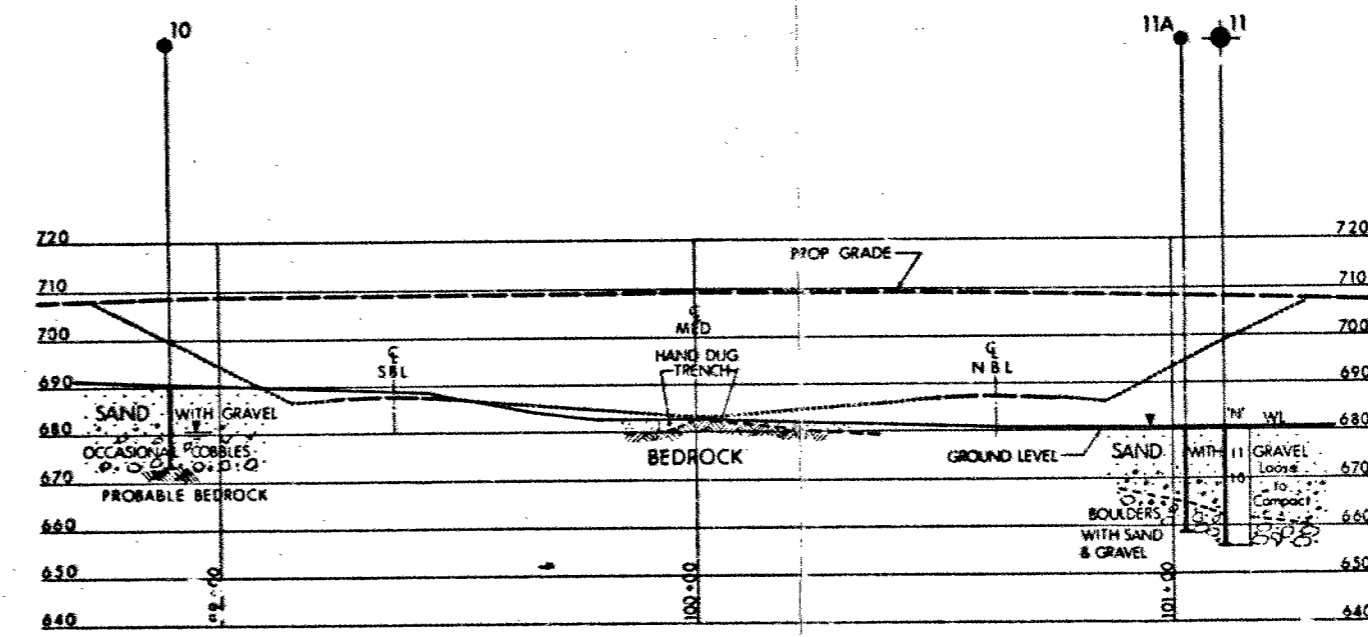
SECTIONS

SCALE
20 10 0 20 FT



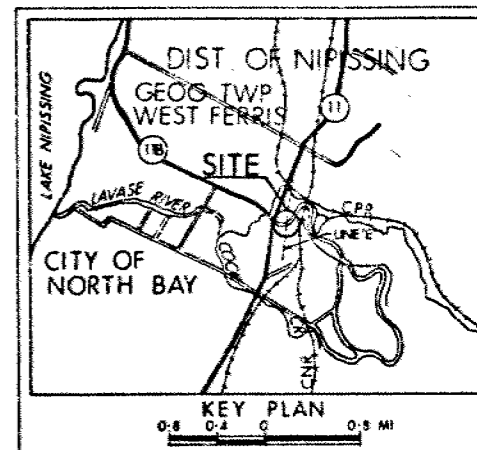
PLAN

SCALE
20 10 0 20 FT



PROFILE

SCALE
20 10 0 20 FT



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- W' WL at time of investigation OCT 1977
- AUGER PROBE HOLE
- TEST PIT
- HAND DUG TRENCH

BH No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	691.2	16 813 554	1 027 253
2	690.7	16 813 528	1 027 283
3	681.2	16 813 647	1 027 312
4	680.9	16 813 740	1 027 372
5	680.9	16 813 712	1 027 400
11	680.9	16 813 726	1 027 387
AH No			
3A	681.5	16 813 657	1 027 311
3B	681.5	16 813 648	1 027 321
3C	681.5	16 813 645	1 027 303
5A	680.9	16 813 733	1 027 368
10	690.4	16 813 542	1 027 267
11A	680.9	16 813 720	1 027 382
TP			
4	682.4	16 813 620	1 027 342
4A	682.5	16 813 614	1 027 338
4B	682.2	16 813 610	1 027 344
4C	682.3	16 813 627	1 027 347
4D	682.1	16 813 622	1 027 352

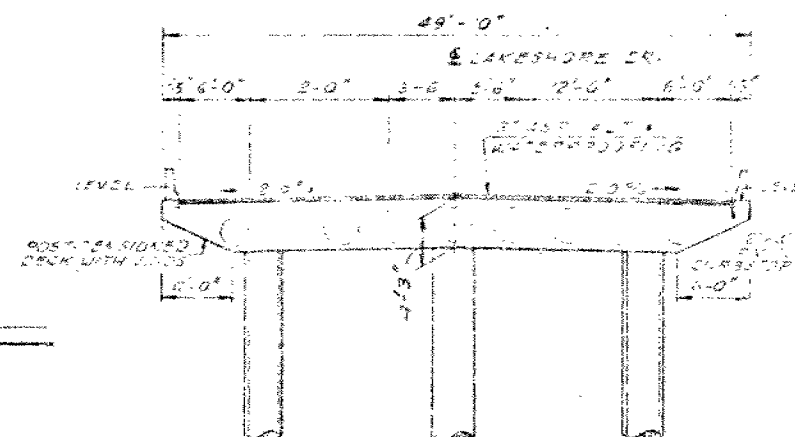
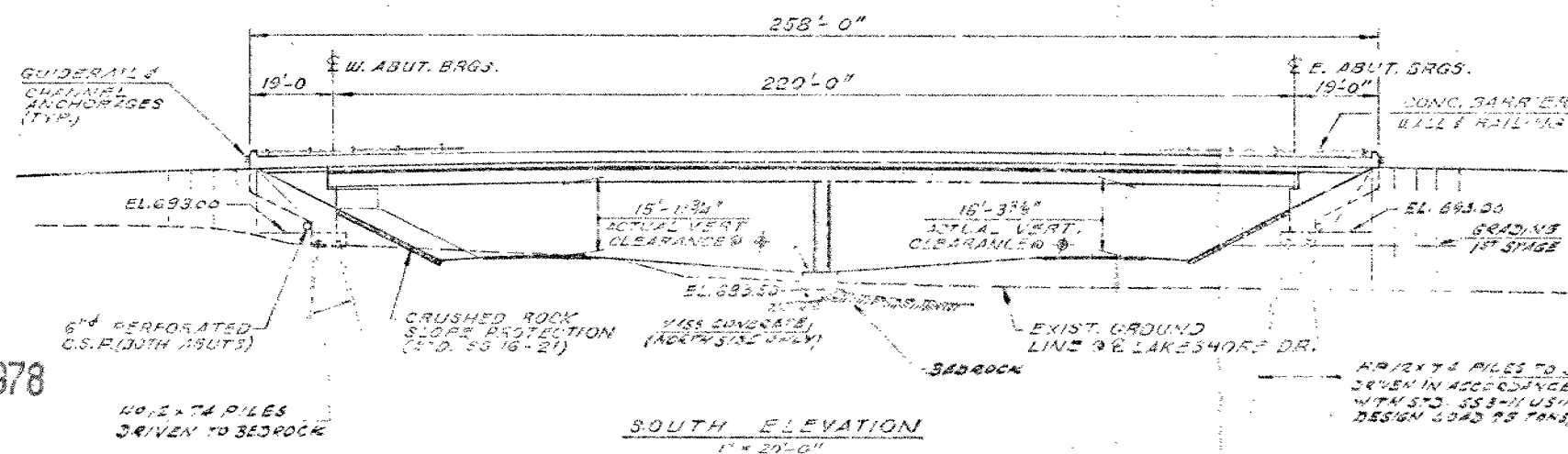
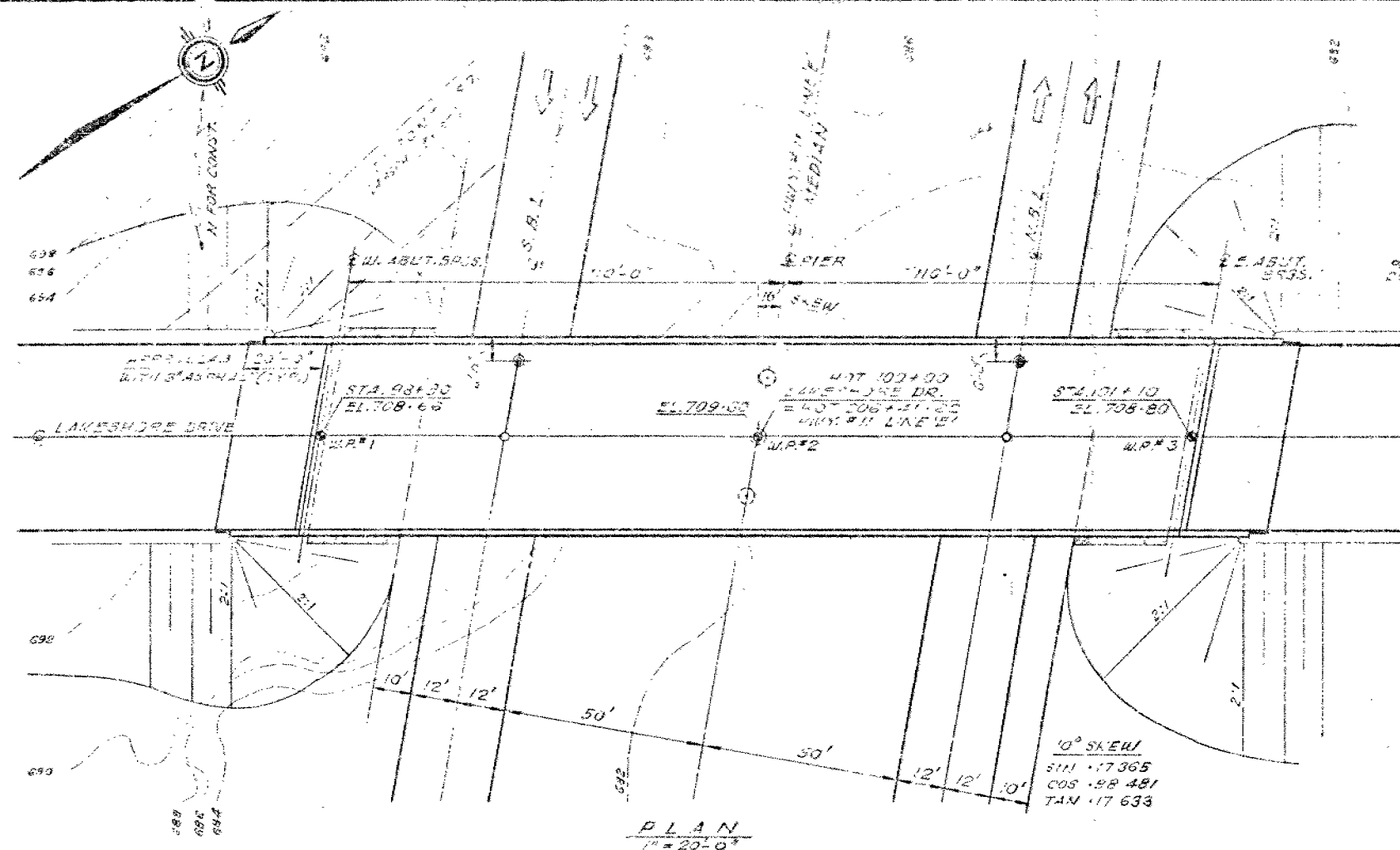
-NOTE-

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

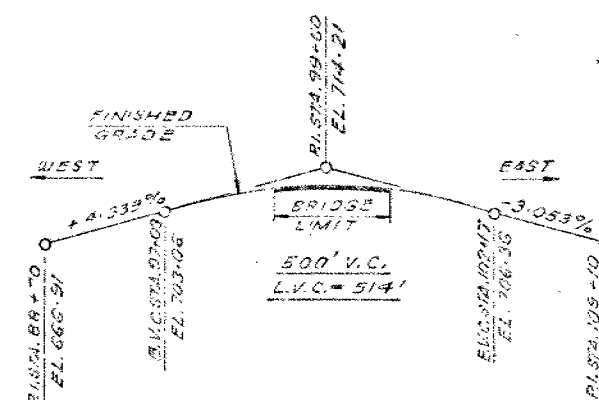
REVISIONS	DATE	BY	DESCRIPTION

REF PLAN E-5071-1 JAN 1977

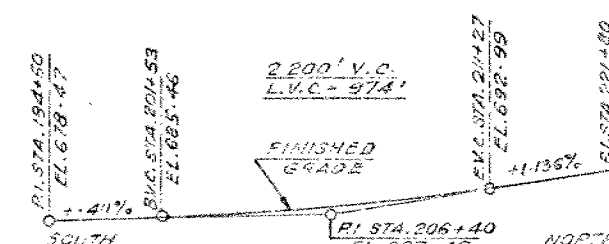
HWY No 11
SUBMITTAL CHECKED DATE 14 NOV 1977 SITE 43-201
DRAWN BY J. CHECKED BY J. APPROVED BY J. 717407-A



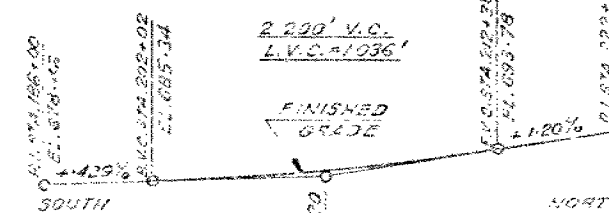
TYP. DECK SECTION



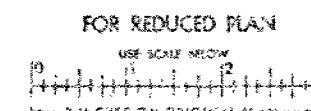
PROFILE @ E LAKESHORE DR
N.T.S.



PROFILE @ E.S.B.L. - HWY. #11
N.T.S.



PROFILE 25 V.31-4849
475



NOTES:

REINFORCING STEEL GRIDS

SEE THIS BOOK FOR REMAINDER SCHEDULE

CLASS OF CONCRETE

DECK 4 BARRERED SLOES 4500 PSI
PIER COLUMNS 5000 PSI
REMAINDER 3000 PSI

CLEAN COVER FOR REINFORCING STEEL

FOOTINGS 4" BOTTOM 4" S 4"

PIER COLUMNS 2 1/2" S 2"

DECK TOP 2" S 2"

DECK BOTTOM 1 1/2" S 1 1/2"

APPROACH SLABS 2" S 2"

AND/OR AS NOTED ON DRAWINGS.

CONSTRUCTION NOTES

THE CONTRACTOR SHALL FINISH THE BEARING SEATS OF ALL LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm .05"$.

NO CONCRETE SHALL BE PLACED ABOVE THE BEARING SEATS UNTIL THE SEATS HAVE BEEN PLACED, STRESSED AND CURED.

LIST OF DRAWINGS

43-201- GENERAL NOTES

- ELEVATIONS AND SIDE ELEVATIONS
- SECTION THROUGH CURB DETAILS
- DETAIL THROUGH CURB REINFORCEMENT
- CURB JOINTS AND TERMINATION
- ELEVATION THROUGH CURB AND SIDE ELEVATIONS
- LONGITUDINAL CURB DETAILS
- TRANSVERSE CURB DETAILS
- CURB DETAIL SECTION I
- CURB DETAIL SECTION II
- CURB DETAIL SECTION III
- CURB DETAIL SECTION IV
- CURB DETAIL SECTION V (SINGLE TURN)
- CURB DETAIL SECTION VI
- ELEVATION DETAILS I
- ELEVATION DETAILS II
- ELEVATION DETAILS III
- ELEVATION DETAILS IV

43-201- AS CONSTRUCTION ELEVATIONS

CONCRETE QUANTITIES

CONCRETE IN PIER	28,000.000000
18.0' DIAMETER X 42.0' H	28,000.000000
PRESTRESSED CONCRETE	
39,000.000000	
CONCRETE IN BRACKET	
4,000.000000	39,000.000000
CONCRETE IN BRACKET	

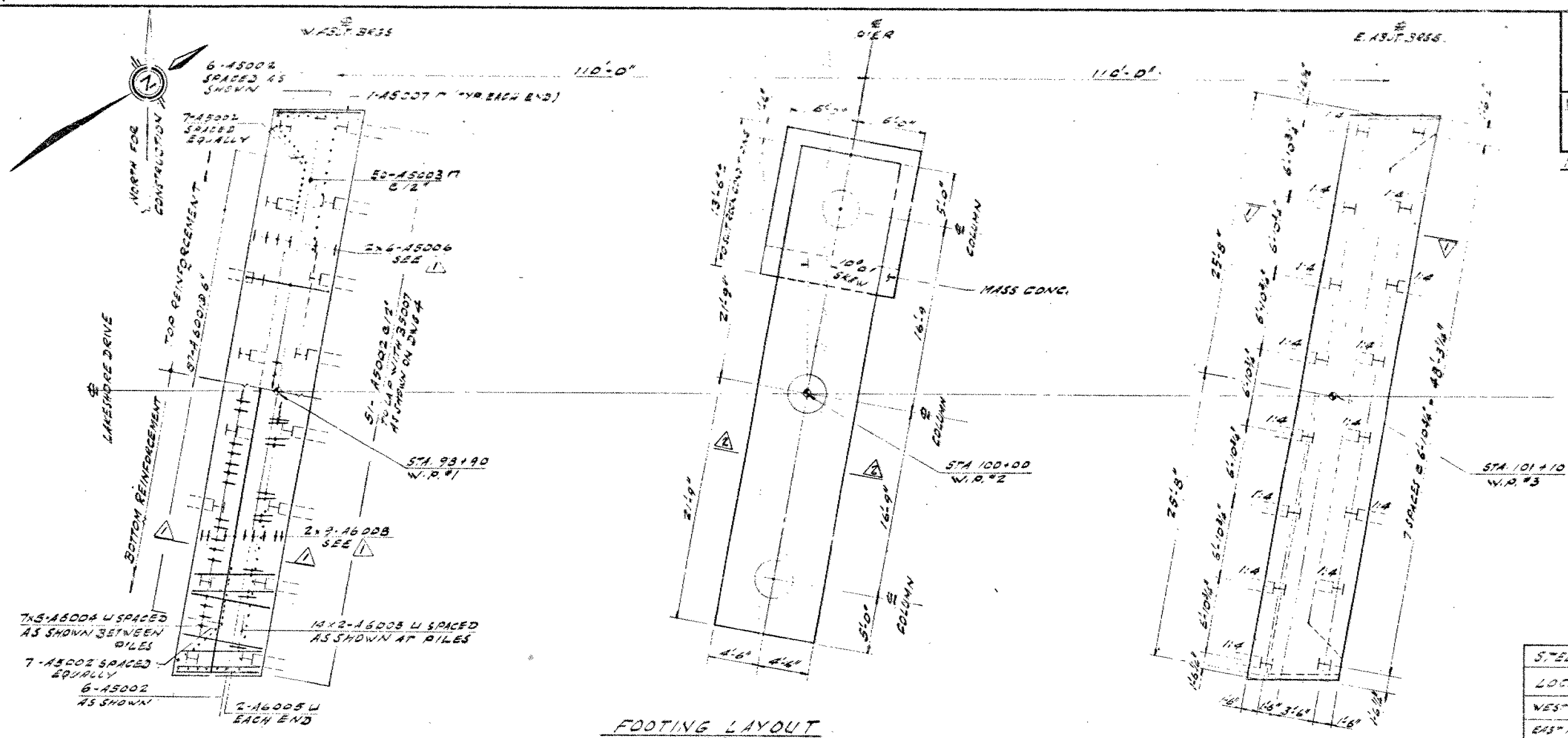
JAN 31 1978

TO BE USED
FOR ESTIMATING
PURPOSES ONLY

DATE _____

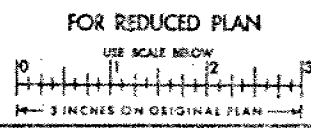
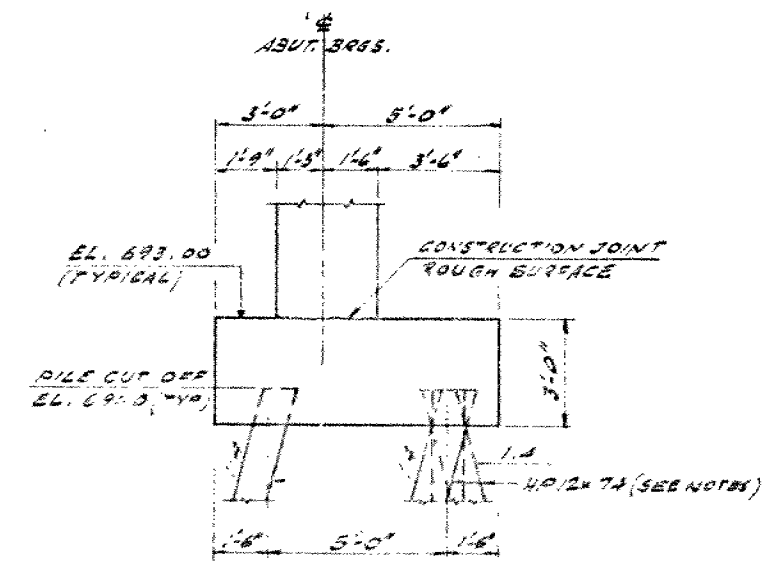
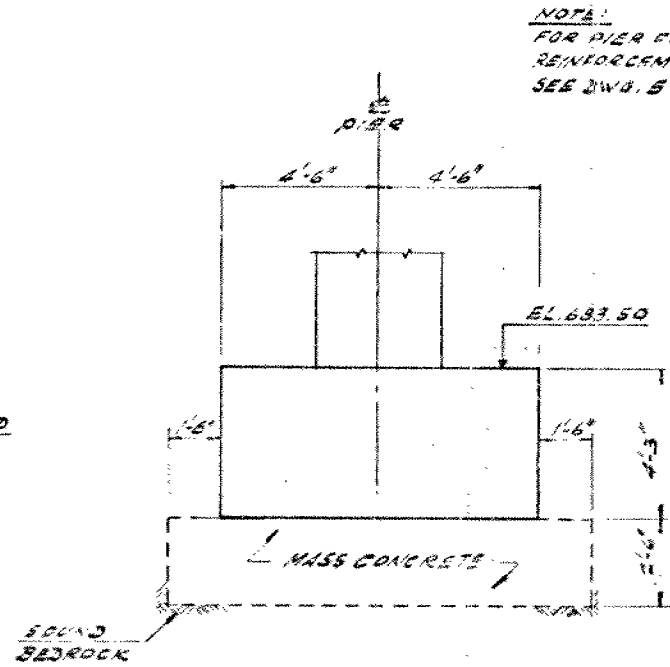
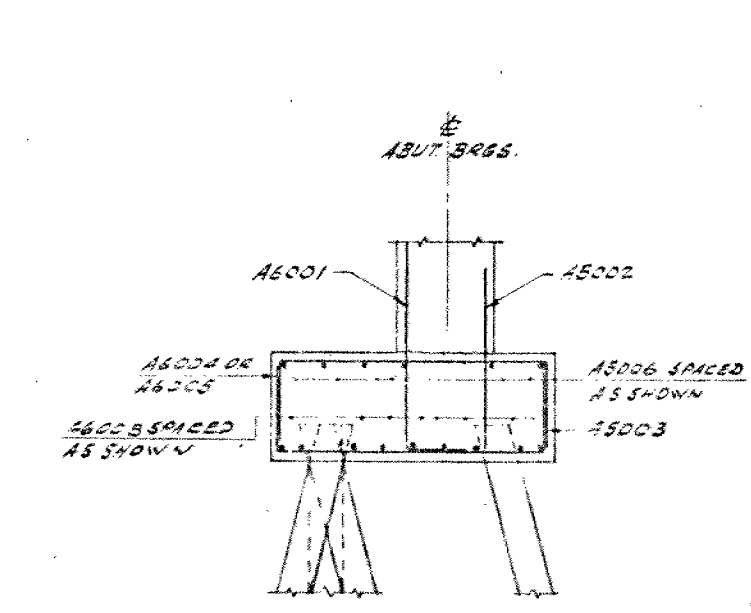
RECEIVED
FEB 01 1978
MINISTRY OF TRANSPORTATION & COMMUNICATIONS
SOIL MECHANICS

CONT No		SHEET
WP No 71-74-07		
SHEET		



STEEL PILES-HP 12 x 74		
LOCATION	NO	PILE LENGTH
WEST ABUTMENT	16	20'-0"
EAST ABUTMENT	16	45'-0"

- NOTES:
1. WEST ABUTMENT - PILES TO BE DRIVEN TO BEDROCK.
 2. EAST ABUTMENT - PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD 553-11 USING DESIGN LOAD 95 TONS. PILE BUT MUST BE DRIVEN BELOW EL. 655.0
 3. PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTINGS.
 4. STEEL PILES TO BE BATTERED AS SHOWN AND TO HAVE DRIVING SHOES AS SHOWN ON STD. 553-1 DWG. 16
 5. PIER FOOTING SHALL BE PLACED ON SOUND BEDROCK.



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHECK	LOADING	DATE
DRAWING	CHECK	SITE	DWG



Mr. E. Van Beilen
Head, Northern and NW Section
Structural Office
West Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

78 02 16

Mr. A. Radkowski

Re: Lake Shore Drive Underpass
W.P. 71-74-07, Site 43-201
Hwy. 11B, District 13, North Bay

We have reviewed the final bridge drawings for the above mentioned structure. Our comments are as follows:

1. The piles at the north abutment should be 45 feet long instead of 43 feet long.
2. The bedrock surface at the centre pier as shown in the Elevation View in Drawing #1 is not in accordance with our subsurface information. Please revise the bedrock surface in the drawing accordingly.
3. The statement "But should be below elevation 650", contained in the NOTES in Drawing #3 should be deleted.

The above comments have been discussed with Mr. S. Kryzevicius of your Office.

B. Ly
B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

MD/BL/gs

cc: Files ✓



Memorandum

To: Mr. J. McAllister, Head
Structural Section
Northern Region, North Bay

From: Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

Attention:

Date: 77 11 14

Our File Ref.

In Reply to

Subject: Re: Lakeshore Drive Underpass
W.P. 71-74-07, Site 43-201
Hwy. 11, District 13, North Bay

In a memorandum from our Office to the Regional Structural Section dated 77 02 17, we provided preliminary recommendations and agreed to carry out a subsurface investigation when the preliminary structural drawings are completed. We have now finished the necessary investigation. Due to the urgency of this project we summarize herein our findings and recommendations so that the final structural design can be carried out without any undue delay. A detailed report, together with borehole logsheets and drawings will follow shortly.

Subsurface Conditions

The subsurface conditions at this site with regard to the overburden thickness are quite variable. In places, particularly at the centre pier location, bedrock is exposed at the ground surface; elsewhere, the thickness of the overburden was found to be in excess of 25 feet. The full extent of the overburden at the north abutment location was not explored due to the presence of a bouldery layer.

The overburden is composed of uniform fine sand which changes with depth to medium sand with gravel. At the north abutment location, a bouldery layer was intercepted at a depth of about 16 feet below the ground and was investigated to a thickness of about 9 feet. According to the 'N' values which range from 8 blows/ft. to 37 blows/ft., the relative density of the sandy stratum is assessed as loose to compact, generally improving with depth.

Bedrock at this site is a granite, proven at the centre pier and the south abutment locations by recovering rock core samples. Bedrock was not proven at the north abutment location because of the presence of the bouldery layer. At the south abutment location, bedrock surface varies between elevation 673.2± and elevation 676.2±, slightly concaving toward the centre line of the proposed Lakeshore Drive. At the centre pier location the bedrock surface is relatively level in the eastern portion of the footing, being at elevation 681.7± to 682.0± but slopes down westerly to elevation 677.5± near the western boundary of the footing. The bedrock surface is also sloping down to the north, as well as to the south in the western portion of the centre pier (see attached sketches).

cont'd.....

Groundwater at this site was observed to be at approximately elevation 681.0.

Recommendations

The geometry of the structure approaches is such that it would be advantageous to construct the proposed abutments within the approaches and support them on end bearing steel 'H' piles or spread footings on a compacted granular 'A' pad. As to the centre pier, it should be founded on spread footings on bedrock since at the centre pier location bedrock is exposed or exists at shallow depths. Our recommendations with regard to the structure foundations are as follows:

Abutments: If the scheme of piled foundations is adopted, we recommend that the piles at the south abutment be driven to bedrock and at the north abutment into the bouldery stratum. Furthermore, the piles at the north abutment should be driven in accordance with the Hiley formula and should be fitted with driving shoes. The estimated pile lengths at both abutments are given below:

<u>Location</u>	<u>Approximate Pile Tip Elevation</u>	<u>Remarks</u>
South Abutment	673	Piles driven to bedrock
North Abutment	650	Piles driven into the bouldery layer and driving controlled by Hiley formula

The design pile loads can be assumed as the allowable structural capacity of the particular sections chosen.

If the scheme of footings on granular 'A' pads is adopted, the design and construction of these granular pads and the footings should be as per our memorandum of 77 02 17. Furthermore, in order to minimize settlements due to the underlying subsoil, we recommend that the granular pads be constructed and left in place for a period of at least one month prior to construction of the abutments.

Centre Pier: The pier can be supported on spread footings on bedrock. A bearing pressure of up to 20 t.s.f. can be assumed for design purposes. Because of the sloping nature of the bedrock surface in the western portion of the pier, it will be necessary to step down the footings or use dowels in order to ensure stability of the footings against sliding.

cont'd.....

Approaches: The subsoil is competent to support the required approach fills without having stability problems if 2:1 side slopes are adopted.

B. Ly

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/gs

cc: W.J. Peck
S. McCombie
J.M. Bernhardt

E. Van Beilen
G.A. Wrong
B.J. Giroux
R.S. Pillar

R. Hore

Files ✓

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. J.C. McAllister
Head Structural Section
North Bay

FROM: Soil Mechanics Section
Engineering Materials Office
West Bldg. Downsview

ATTENTION:

DATE: February 17, 1977

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 71-74-07, Site 43-201
Hwy. 11B, Interchange Underpass
Hwy. #11, District #13

A site visit was made by Mr. McAllister, Mr. Verhulst and Mr. Devata on November 4, 1976 at the above mentioned location to review the general site conditions. The site visit revealed the presence of various bedrock outcrops in the immediate area. According to available local geological data the overburden is shallow in the vicinity of the proposed structural complex.

At the time of the site visit, due to the difficulty in obtaining property requirements it was felt it was not necessary to carry out a complete foundation investigation at the same time as other investigations were being done in conjunction with the reconstruction of this portion of Hwy. 11. Recently we have been advised by your office that the above site should be investigated. At this time of the year, low temperatures and snow conditions are such that the investigation may take a longer period of time. It is advisable to carry out a detailed foundation investigation when the location of the footings are finalized.

As agreed by our offices the necessary investigation will be initiated upon the completion of the preliminary structural drawings. The following recommendations may be used for preliminary design purposes.

1. Pier - At this location bedrock may be encountered at a shallow depth below the ground surface. Therefore, footings may be founded on sound bedrock using an allowable load of up to 20 tsf.
2. West Abutment - The bedrock at this location is expected to be slightly higher than the grade of the south bound lanes. If closed abutments are used the footing may be supported on sound bedrock using an allowable load of up to 20 tsf. Alternatively the abutment may be perched within the fills and founded on end bearing piles driven to bedrock using the maximum allowable load per pile (i.e. a 12 BP 74 Steel 'H' pile may be designed using an allowable load of 95 tons per pile) or alternatively the abutment may be founded on a compacted Granular 'A' pad using an allowable load of 2.5 tsf. For the abutments supported on the Granular 'A' pad see sketch Fig. 1 for the details of construction.
3. East Abutment - Bedrock at this location is expected to be approximately at ground surface or about 5 feet below the north bound lane grade. Closed abutment may be founded on sound bedrock using an allowable load of up to 20 tsf. Alternatively the abutment may be perched within the fill and founded on piles driven to sound bedrock or alternatively supported on spread footings founded on a compacted Granular 'A' pad as mentioned above.

A MacLean

M. MacLean
Project Engineer

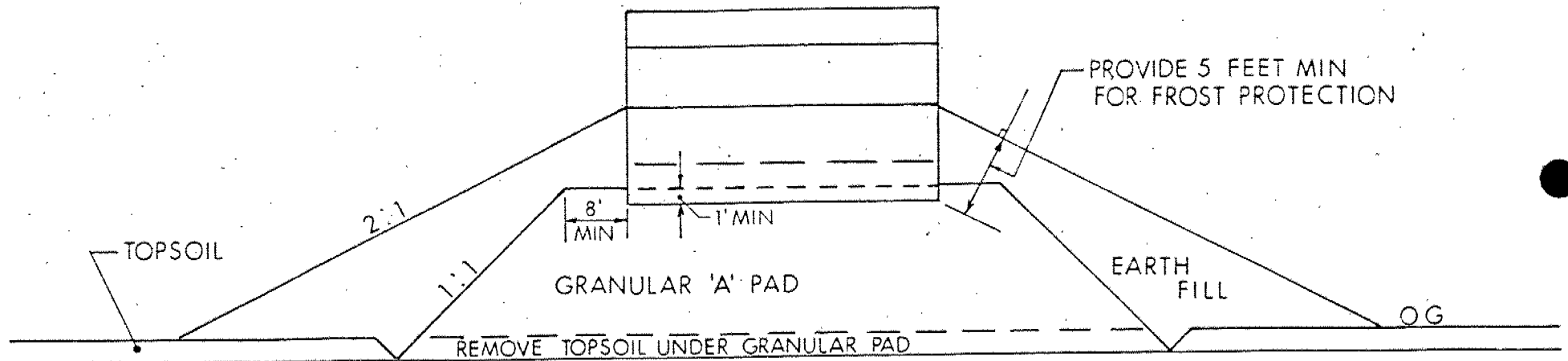
For: M. Devata
Supervising Engineer

MM/bp

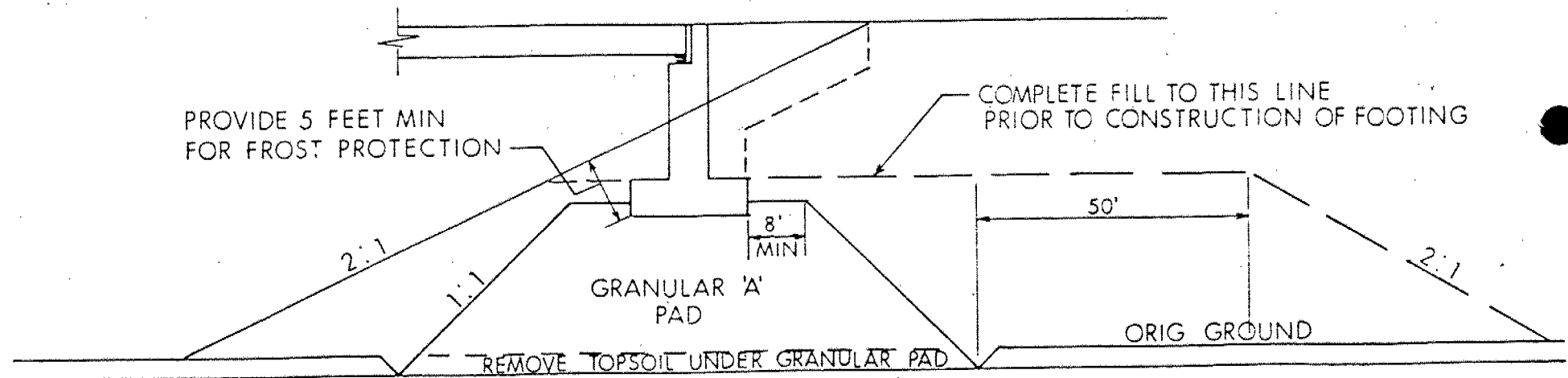
cc: W.J. Peck
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E. Van Beilen
G.A. Wrong
B.J. Giroux

R.S. Pillar
R. Hore
L. Argo
J. Anderson
G. Sloan
Files
Record Services

SKETCH SHOWING REQUIREMENTS FOR ABUTMENTS
FOUNDED ON GRANULAR PAD



X SECTION AT FACE OF ABUTMENT



LONGITUDINAL SECTION AT FACE OF WINGWALL