

G.I.-30 SEPT. 1976

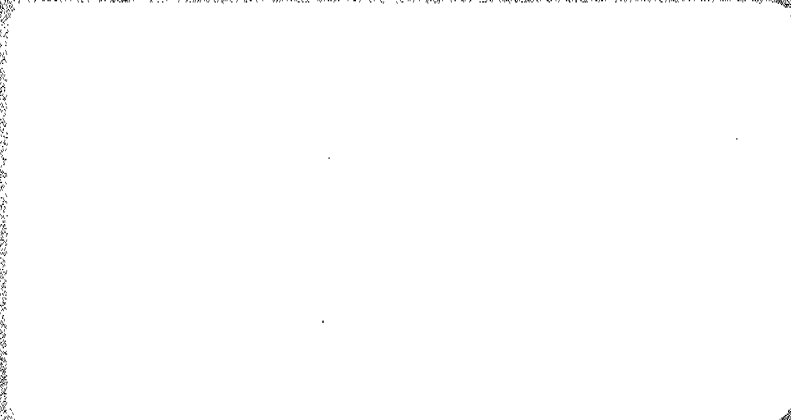
GEOCRES No. SIF-94DIST. 9 REGION W.P. No. 198-62-00CONT. No. 79-17W. O. No. STR. SITE No. 29-191HWY. No. 17NLOCATION Mada was Ee River
BridgeNo of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

CONT 79-17



Ministry of
Transportation and
Communications



foundation investigation and design report

3014

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 198-62-00 DIST 9

HWY 17N STR SITE 29-191

Madawaska River Bridge
(Arnprior Diversion)

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FOUNDATION INVESTIGATION REPORT

For

Madawaska River Bridge
(Arnprior Diversion)
Hwy. 17N, Dist. 9
W.P. 198-62-00 Site 29-191

INTRODUCTION

This report contains the results of our foundation investigations carried out at the sites of:

1. the proposed Madawaska River Bridge
2. a 4 ft. culvert at Sta. 777+75, Line 'C'

Investigations for the Madawaska River Bridge were done in various periods of time. Of the several investigations, the results of 18 borings pertinent to the structure are reported here. These borings were advanced by diamond drilling techniques to depths ranging from 11 ft. to 42 ft. below the ground surface. From these borings, rock core samples of NX size were recovered. In addition, on either side of the Madawaska River a field permeability test was carried out with the use of double packers.

The investigation for the design and construction of the embankment fill at the culvert site was carried out in March, 1977. It consisted of 4 sampled boreholes advanced by augering or washboring techniques, to depths ranging from 25 ft. to 45 ft. below ground surface.

SITE DESCRIPTION & GEOLOGY

The portion of the proposed Hwy. 17N under consideration is located due south of Arnprior, bounded on the east by the relocated CPR and on the west by Baskin Drive. The proposed bridge site is located approximately 550 ft. downstream (north) of the Ontario Hydro Dam. At the proposed crossing, Madawaska River is approximately 300 ft. wide and is deeply incised into the surrounding table lands. The river water level, which is controlled by the Hydro Dam, generally varies between elevations 254 ft. and 258 ft. According to available information the river is about 45 ft. deep at this location.

The river banks in this locale vary from moderately steep rockface on the east, to steeply shelving rockface on the west. In the vicinity of the proposed crossing, bedrock is generally exposed, except at certain locations where it exists at a shallow depth. Bedrock in this area is a crystalline limestone. The area east of the river is sparsely vegetated, whereas the area west of the river is heavily wooded, covered with spruces, pines, and cedars.

The culvert site is located some 1100 feet west of the Madawaska River. The surrounding area is drained by a creek which meanders in a northerly direction through a moderately undulating terrain. A flat table land some 40 ft. higher in relief and with an east facing moderate slope of about 3:1 is located approximately 200 ft. west of the creek. At the time of investigation, the creek was about 12 ft. wide and the water was about 1½ ft. deep. The surrounding area of the culvert site is cultivated for farming purposes. The overburden in this area consists of a marine clay deposited by the Champlain Sea when it inundated the Ottawa-St. Lawrence lowland.

Geologically, the area is located between the Precambrian Upland to the north and west, and the Ottawa lowland to the south and east. A depression, geologically known as the 'Ottawa-Bonnechere' graben, is located in the County of Renfrew. Within it are prominent east-west trending scarps (fault zones). One fault zone, mapped by Acres Ltd., geotechnical consultant for the Hydro Dam project, is located just upstream of the main dam area.

SUBSURFACE CONDITIONS

Bridge Site

At the proposed bridge site, bedrock either outcrops or exists at a very shallow depth. On the west bank of the Madawaska River, the overburden, wherever it exists, consists of a thin mantle of topsoil followed by clayey silt, up to 2.5 ft. in thickness. At certain locations on the east bank, rockfill up to 8 ft. thick was placed on the original ground after the construction of the Hydro Dam.

Bedrock in the project area is metamorphic in origin, comprising crystalline limestone of Precambrian Age. This limestone bedrock is light grey in colour,

with a coarse texture and generally hard. The beddings generally incline towards the river at 45° to 55° , but sometimes contorted or largely destroyed during metamorphism. Jointing is well developed in the bedrock. Two principal joint sets exist throughout the site, one being parallel to the beddings and the other perpendicular to the beddings. The joints are continuous, smooth, and moderately to widely spaced. In addition to the jointings, there are occasional discontinuous steep fractures. Some of these fractures are open and weathered. Detailed descriptions of the rock cores as described by Mr. B. Glassford, Geologist for MTC, are presented on the Diamond Drill Record Sheets included in the Appendix.

Rock Quality Designation (RQD) is used to judge the engineering quality of the rock mass. It is defined as the sum of the lengths of recovered core pieces which are 4 inches in length or longer divided by the total length of the rock core drilled. In the upper 15 ft. of the bedrock, RQD varies randomly from 25% to 100%, indicating a poor to excellent rock quality. At depths below 15 feet from the bedrock surface, the rock quality can be classified as excellent, as evidenced by the consistently high RQD values of 90% to 100%.

Field permeability tests using double packers were also performed to examine the tightness of the joints. The results are reported in the Record of Borehole Sheets. It can be inferred from these results that the joints in the bedrock on the west bank below a depth of 10 ft. are generally tight whereas those in the east bank are moderately open.

Culvert Site

The predominant deposit at the culvert site is a marine clay left by the Champlain Sea. The thickness of this deposit increases from rock outcrop in the southeast quadrant of the site to over 45 ft. in the northwest quadrant of the site. This marine clay is sensitive, brittle and fissured both horizontally and vertically. It also contains seams and pockets of silt or fine sand, up to $1\frac{1}{2}$ inch thick. The upper 12 to 15 ft. of the marine clay is brown and has a higher consistency than the underlying grey clay. This brown clay is generally considered to be a weathered crust of the marine clay deposit.

The engineering properties of the marine clay are summarized on the following page.

<u>Index Properties</u>	<u>Weathered Clay</u>	<u>Unweathered Clay</u>
	<u>Range</u>	<u>Range</u>
Natural Moisture Content	31% - 42%	35% - 41%
Liquid Limit	35% - 48%	31% - 40%
Plastic Limit	15% - 21%	15% - 22%
Bulk Unit Weight	115 pcf (One test)	112 pcf-115 pcf (Two tests)
<u>Undrained Shear Strengths</u>	<u>Range</u>	<u>Range</u>
In-Situ Vane Test	> 2000 psf	1200 psf -> 2000 psf
Unconfined Compression Test	1200 psf - 1600 psf (Two tests)	600 psf (One test)

The natural moisture content of the brown clay in the weathered crust is below the liquid limit, but that of the underlying unweathered grey clay is usually above the liquid limit. A liquidity index greater than unity is typical of the sensitive marine clay. In addition, the weathered clay has a higher plasticity index than the unweathered clay. The undrained shear strengths determined by field vane tests are higher than those obtained from unconfined compression tests. The discrepancy may be attributed to the degree of disturbance to the samples, the presence of fissures and sand seams in the clay and the strain rate effect of the tests. The undrained shear strength of the brown crust is generally greater than 2000 psf, while that of the grey clay is between 1200 psf to 2000 psf. There appears to be a gradual increase in undrained shear strength with depth for the grey clay.

A layer of gravelly sand (glacial till) up to 3 ft. thick is sandwiched between the marine clay and the bedrock.

Groundwater level is largely controlled by the creek water level. For construction purposes, the groundwater level can be assumed equal to the prevailing water level in the creek.

DISCUSSIONS AND RECOMMENDATIONS

The proposed Arnprior Bypass would require a structure at the crossing of Madawaska River and Hwy. 17N. Several structure schemes and alignment alternatives have been considered. The structural scheme which has been adopted is a three span bridge on Line 'C' with the footings positioned at the following locations:

<u>Footing</u>	<u>Station (Line 'C')</u>
West Abutment	786+25
West Pier	788+50
East Pier	792+50
East Abutment	794+75

The profile grade of the bridge is such that fills up to 32 ft. in height would be required at the west approach and fills up to 55 ft. high would be required at the east approach.

According to the centerline profile submitted to us by the Region, the profile grade at the culvert site (Sta. 777+75) will be at elevation 316, which will require an embankment about 30 ft. high.

Recommendations pertaining to the structure foundations and the required earthworks are as follows:

Madawaska River Bridge

Structure Foundations

West abutment (Sta. 786+25): Bedrock is exposed at this location varying from elevations 284 to 286 within the footing area. Spread footing founded on bedrock will be the most suitable foundation scheme. The footing should be founded at elevation 283.0, with a design load of up to 20 tsf. Sliding resistance of the footing will be derived from friction between concrete and bedrock, which can be estimated by assuming a coefficient of friction equal to 0.9.

West pier (Sta. 788+50): The bedrock is also exposed at this location, therefore the pier can be supported on spread footing founded on bedrock. However

certain measures will be required because of the close proximity of the pier to the steeply sloping surface of the bedrock near the riverbank. The pier footing should be positioned in such a manner that a 45° line drawn from any point of the base of the footing should not intersect with the free face of the steep rock slope. In addition a minimum horizontal distance of 5 ft. should be maintained between the outermost edge of the base of the footing and the steep rock slope. Furthermore, the footing should be located above the river water level in order to avoid any dewatering requirements during construction. Based on these considerations, it is recommended that the pier footing be founded at elevation 256.0. In view of the presence of the steep river bank, the bearing pressure imposed by the footing should be restricted to 10 tsf and the footing base should be inspected for any unfavourable jointing or fracturing before placing concrete. If the conditions are such, then it may be necessary to reinforce the rock mass with rock anchors. This aspect was fully discussed with the Structural Office and necessary provision will be made in the contract. Sliding friction between the concrete and the bedrock can be computed as mentioned previously.

East pier (Sta. 792+50): Rockfill up to 8 ft. thick was placed over the bedrock surface at this location. This rockfill should be removed to its full depth and the pier footing should be founded within the bedrock at elevation 250. At certain locations, the quality of the bedrock in the upper 10 ft. was found to be not completely satisfactory. In view of this, it is recommended that the footing be designed for a bearing pressure not greater than 10 tsf. Since the footing is located below the water level, a dewatering scheme will be required. One method to achieve dewatering would be the use of a coffer dam consisting of an impervious earth dyke around the perimeter of the footing.

East abutment (Sta. 794+75): The east abutment will be perched within the approach fill. The most economical type of foundation for the east abutment, considering the height of the approach fill, would be end-bearing piles driven through the fill to the bedrock surface. These piles can be designed for their maximum allowable capacities. Since rockfills will be used to construct the approaches, a well compacted granular core should be used where piles are to be driven. The granular core should be constructed with a side slope not steeper than 1.5:1 and should have a minimum horizontal distance of 10 ft. on the perimeter of the footing. This granular core should be free from boulders

and cobbles.

Approach Embankments

West approach: It is understood cohesive type of material will be used to construct the 32 ft. high approach embankments in this area. This embankment, for the height being contemplated, should be constructed with a slope in both transverse direction and forward direction not steeper than 2.5:1. The moisture content of the earthfill should be within $\pm 1\%$ of the optimum moisture content of the fill material as determined by Standard Proctor Compaction test.

East approach: The east approach will have a height in the order of 55 ft., and it is understood rockfill will be used to construct these embankments. If the rockfill is screened and does not contain an appreciable amount of fines and is compacted, the embankment can be constructed with $1\frac{1}{4}$:1 slopes incorporating a 15 ft. midheight berm. However if the rockfill is obtained from a stockpiled material and not being compacted, the embankment should be constructed with $1\frac{1}{4}$:1 slopes incorporating a midheight berm of 20 ft.

Other Considerations

According to available information, the berm will be used to support falsework during construction. To design the temporary support on the rockfill berm a bearing pressure of up to 2.5 tsf can be assumed. However, this temporary support system should be located at least 5 ft. from the edges of the berm.

It is also understood that the bridge will be built by segmental construction techniques. During construction, the piers will be subjected to large unbalanced forces. Such being the case, it may be necessary to use rock anchors to 'tie down' the pier footings.

Embankment at the Culvert Site

Stability Considerations

In view of the presence of fissures and sand and silt seams in the marine clay, and in order to account for the effect of strain rate on undrained shear

strength, a reduction in the undrained shear strengths measured by field vane tests has been made in our stability analyses for the proposed 30 ft. high embankment. The simplified subsoil stratigraphy and the result of our analyses are shown in Fig. 2. Furthermore, the natural slopes in the surrounding areas are found to be stable with a 3:1 slope. In view of the results of our slope stability analyses and visual observations made at the site, it is concluded that fills up to 20 ft. in height can be constructed with standard 2:1 slopes, but for fills between 30 and 35 ft. high the side slopes should not be steeper than 3:1. A smooth transition in side slopes should be provided for fills with different heights.

Settlement Considerations

Under the stresses induced by the 30 ft. high embankment, the underlying marine clay will undergo a consolidation settlement in the order of 12 inches. Half of this settlement will take place in the first year, and a majority of the remainder in the next 3 or 4 years. In view of this, it will be advisable that the fills be constructed as early as possible so that the post construction settlement can be minimized.

Design and Construction of the Culvert

The culvert should be placed on a compacted granular pad and backfilled with granular type material, as per MTC Standard DD-808-A. The backfill should be placed and compacted in 6" layers simultaneously on both sides of the culvert in order to avoid creating any unbalanced earth pressures on the pipe.

In view of the anticipated large differential settlements along the culvert, a 12 inch camber should be provided.

Unwatering during construction of the pipe can be achieved by constructing an impervious earth dyke enclosing the culvert and by diverting the creek temporarily.

MISCELLANEOUS

Investigations for the proposed Madawaska River Bridge were done in various periods of time. The investigations for feasibility studies were carried out

in April, 1969 and also in December, 1974. The findings together with recommendations were presented in foundation reports W.J. 69-F-19 and W.P. 197-62-00. During the preliminary design stage, several structural schemes and various alternative alignments were studied. In one of the structural schemes, it was proposed to position the east pier in the water course of Madawaska River closer to the east bank. In order to assess the feasibility of the various structure schemes and alignment alternatives, an investigation was carried out in June, 1976. The results of this investigation, together with alternative recommendations for these various structural schemes and alignments, were discussed in several meetings with the Structural Design Office and the Regional Structural Planning Section and subsequently submitted in a memorandum dated October 13, 1976. As a result of these meetings and discussions, an alignment known as Line 'C' and a three span structure with footings located at the following locations were adopted.

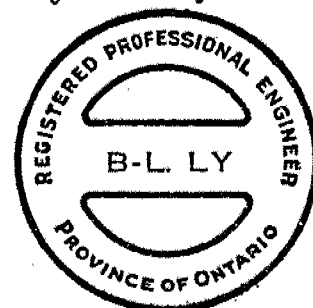
West Abutment	786+25
West Pier	788+50
East Pier	792+50
East Abutment	794+75

In order to provide detailed subsurface information and recommendations for the design and construction of the finalized scheme, a relatively comprehensive investigation was carried out in March, 1977. Of the several investigations done for the proposed Madawaska River Bridge, the results of 18 borings pertinent to the structure are reported here. These borings were advanced by diamond drilling techniques to depths ranging from 11 ft. to 42 ft. below ground surface. From these borings rock core samples of NX size were recovered. In addition, on either side of the Madawaska River at the proposed pier locations a field permeability test was carried out using double packers.

The recent investigation carried out in March, 1977 was done under the supervision of Mr. M. MacLean and Mr. B. Ly. This report was prepared by Mr. B. Ly and reviewed by Mr. M. Devata.

B. Ly
B. Ly
Senior Engineer

M. Devata
M. Devata
Supervising Engineer



MD/BL/bp
July, 1977

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 198-62-00 LOCATION Co-ords. N 16,505,730; E 1,037,603 ORIGINATED BY BL
 DIST 9 HWY 17N Line 'C' BORING DATE March 31, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE 3/4" Hollow Stem Auger CHECKED BY *[Signature]*

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 PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w _p	w	w _L		
289.2	Ground Level															
0.0	8" topsoil															
	Silty clay to clayey silt with random seams and/or pockets of silt and sand		1	SS	15											
			2	SS	13											
	Very stiff		3	TW	PH	280			σ						115	
	Firm to Stiff		4	SS	6	270			+ s=7							
	Brittle and sensitive		5	TW	PM				+ s=4						115	
			6	SS	2	260			+ s=6							
			7	SS	2				+ s=8							
			8	SS	1	250			+ s=11							
			9	SS	PM											
246.2																
43.0																
244.2	Glacial Till															
45.0	End of Borehole															
	Auger Refusal at 45 Ft. Probable Bedrock															

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 198-62-00 LOCATION Co-ords. N 16,505,610; E 1,037,597 ORIGINATED BY BL
 DIST 9 HWY 17N Line 'C' BORING DATE April 1, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE 3 1/2" Hollow Stem Auger CHECKED BY [Signature]

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 PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
292.1	Ground Level															
0.0	Silty clay to clayey silt with random seams and/or pockets of silt and sand		1	SS	11	290										
			2	SS	4	280										
	Very Stiff		3	TW	PM											
	Firm to Stiff		4	TW	PM	270										
			5	SS	PM											
	Sensitive and Brittle		6	SS	PM	260										
260.1																
32.0																
258.1	Glacial Till															
34.0	End of Borehole															
	Auger Refusal at 34', Probable Bedrock															

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 198-62-00 LOCATION Co-ords. N 16,505,726; E 1,037,674 ORIGINATED BY BL
 DIST 9 HWY 17N Line 'C' BORING DATE April 1, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE Washboring with NX Casing CHECKED BY *[Signature]*

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 PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
291.9	Ground Level															
0.0	Silty clay to clayey silt with random seams and/or pockets of silt and sand Very Stiff to Stiff Sensitive and Brittle		1	SS	12	290										
			2	TW	PM	280										
			3	TW	5											
			4	TW	PM	270										
263.9			5	SS	2											
262.4	Glacial Till															
29.5	End of Borehole Note: 1. Casing refusal at 29.5 ft, Probable Bedrock 2. GWL not established															

OFFICE REPORT ON SOIL *EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 198-62-00 LOCATION Co-ords. N 16,505,665; E 1,037,651 ORIGINATED BY BL
 DIST 9 HWY 17N Line 'C' BORING DATE April 1, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE Washboring with NX Casing CHECKED BY *CP*

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 PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
289.2	Ground Level															
0.0	Silty clay to clayey silt with random seams and/or pockets of silt and sand		1	SS	12											
	Very Stiff		2	SS	7	280										
	Firm to Stiff		3	TW	PM											
	Sensitive and Brittle		4	SS	1/18"	270										
265.6																
23.6	End of Borehole															
	Note:															
	1. Casing refusal at 23.6 ft., Probable Bedrock															
	2. GWL not established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 198-62-00

LOCATION Co-ords. N 16,505,627; E 1,038,463

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 31, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		RQD %	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p — w — w_L			
283.8	Ground Surface														
0.0	Topsoil & clayey silt														
281.2															
2.6	Crystalline Limestone Bedrock. Coarse texture, weathered joints at 6.4 ft. and 7.8 ft.		1	NX RC	Rec 100	280								100	
			2	NX RC	Rec 100									100	
272.2															
11.6	End of Borehole Note: GWL not established														

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 198-62-00 LOCATION Co-ords. N 16,505,580; E 1,038,472 ORIGINATED BY BL
 DIST 9 HWY 17N Line 'C' BORING DATE March 31, 1977 COMPILED BY BL
 DATUM Geodetic BOREHOLE TYPE NX Rock Coring CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w_L		
286.1	Ground Surface														
0.0	Crystalline Limestone Bedrock. Coarse texture, several joint fractures from 6 ft. to 10 ft.		1	NX RC	Rec 96%	280									
			2	NX RC	Rec 90%										
			3	NX RC	Rec 100%										
272.8															
13.3	End of Borehole Note: GWL not established														

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 198-62-00 LOCATION Co-ords. N 16,505,598; E 1,038,678 ORIGINATED BY BL
DIST 9 HWY 17N Line 'C' BORING DATE March 29, 1977 COMPILED BY BL
DATUM Geodetic BOREHOLE TYPE NX Rock Coring CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT %	RQD %	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
273.4	Ground Surface									
271.7	Topsoil & clayey silt									
1.7	Crystalline Limestone Bedrock. Coarse texture. Weathered bedding plane fractures at 1.7'-2.2' A vertical fracture at 4.5' to 9.5'		1	NX RC	Rec 75%	270			50	
			2	NX RC	Rec 95%				65	
			3	NX RC	Rec 100	260			95	
			4	NX RC	Rec 100				95	
253.9										
19.5	End of Borehole									

ROCK CORE DESCRIPTION

LEGEND


- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

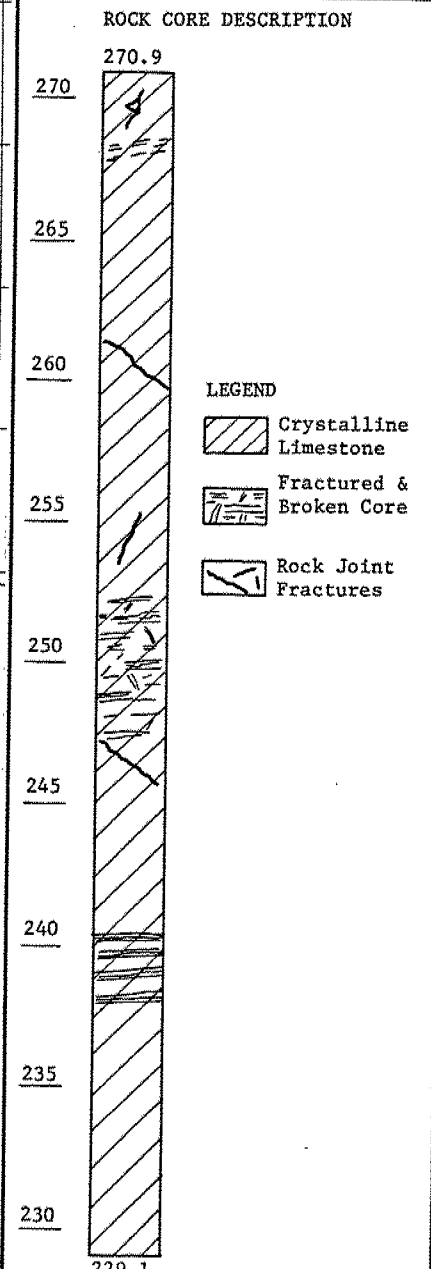
RECORD OF BOREHOLE NO 7A

WP 198-62-00 LOCATION Co-ords. N 16,505,600; E 1,038,686 ORIGINATED BY BL
DIST 9 HWY 17N Line 'C' BORING DATE March 30, 1977 COMPILED BY BL
DATUM Geodetic EBL BOREHOLE TYPE NX Coring & Packer Test CHECKED BY 




SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W		REMARKS Packer Test Results Pressure p Flow q (p.s.i.) (gal/min)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W_P W W_L	WATER CONTENT %	
272.0	Ground Surface										
270.9	Clayey silt with boulder		1	NX	50%	270					
1.1	Crystalline Limestone Bedrock. Coarse texture, hard.		2	NX	100						
			3	NX RC	Rec 100						
			4	NX RC	Rec 95%	260					
			5	NX RC	Rec 100						
			6	NX RC	Rec 100	250					
			7	NX RC	Rec 100						
			8	NX RC	Rec 98%	240					
			9	NX RC	Rec 100						
229.1			10	NX RC	Rec 100	230					
42.9	End of Borehole Note: GWL not established										

Joint fractures at 2 ft., 11 ft., 18 ft. and 26 ft.

ROCK CORE DESCRIPTION



LEGEND

-  Crystalline Limestone
-  Fractured & Broken Core
-  Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8A

WP 198-62-00 LOCATION Co-ords. N 16,505,571; E 1,038,683 ORIGINATED BY BL
 DIST 9 HWY 17N Line 'C' BORING DATE March 30, 1977 COMPILED BY BL
 DATUM Geodetic BOREHOLE TYPE NX Rock Coring CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WATER CONTENT % w_p — w — w_L		
275.5	Ground Surface													
274.2	Topsoil & clayey silt													
1.3	Crystalline Limestone Bedrock. Coarse texture. Weathered Joint fractures parallel to bedding at 10 ft., 15 ft., and 21 ft. Steep fractures at 2.5 ft. and 23 ft.		1	NX RC	Rec 75%	270 260 ↓								
			2	NX RC	Rec 90%									
			3	NX RC	Rec 73%									
			4	NX RC	Rec 100%									
			5	NX RC	Rec 99%									
250.1														
25.4	End of Borehole													

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 9

WP 198-62-00

LOCATION Co-ords. N 16,505,586; E 1,038,698

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 29 & 30, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W		ROD %	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	W _p — W — W _L	WATER CONTENT %	% GR SA SI CL		
272.3	Ground Surface											
270.2	Topsoil & clayey silt					270						
2.1	Crystalline Limestone Bedrock		1	NX RC	Rec 100%						100	
	Coarse texture.		2	NX RC	Rec 100%						100	
	Steep, weathered open fractures at 16' - 19.3'		3	NX RC	Rec 100%	260					100	
	Bedding plane fractures at 27 ft., 32 ft. and 35 ft.		4	NX RC	Rec 100%	250					60	
			5	NX RC	Rec 100%						95	
			6	NX RC	Rec 100%						95	
			7	NX RC	Rec 100%	240					95	
			8	NX RC	Rec 100%						95	
230.2												
42.1	End of Borehole											

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 10

WP 198-62-00

LOCATION Co-ords. N 16,505,565; E 1,038,706

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 29, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	
273.7	Ground Surface													
272.4	Topsoil & Clayey silt													
1.3	Crystalline Limestone. Bedrock		1	NX RC	Rec 99%	270								
	Coarse texture		2	NX RC	Rec 100%									
	Several Bedding plane fractures from 3 ft. to 5.7 ft. & from 11.7 ft. to 13.3 ft.		3	NX RC	Rec 100%	260								
252.1	End of Borehole		4	NX RC	Rec 100%									

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 11A

WP 198-62-00 LOCATION Co-ords. N 16,505,577; E 1,039,106 ORIGINATED BY MM
DIST 9 HWY 17N Line 'C' BORING DATE April 6, 1977 COMPILED BY BL
DATUM Geodetic BOREHOLE TYPE NX Rock Coring CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT —w _L PLASTIC LIMIT —w _p WATER CONTENT —w w _p — w — w _L WATER CONTENT %	RQD %	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
261.5	Ground Level					260				
0.0	Rockfill		1	NX	-					
253.0			2	NX RC	Rec 90%	250			50	
8.5	Crystalline Limestone Bedrock Coarse texture Vertical joint fractures at 13.5 ft - 14.5 ft. 16.7 ft. - 18.0 ft.		3	NX RC	Rec 100 %				50	
			4	NX RC	Rec 95%				75	
236.7			5	NX RC	Rec 100 %	240			100	
24.8	End of Borehole									

ROCK CORE DESCRIPTION

253.0

250

245

240

236.7

LEGEND


- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures


OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

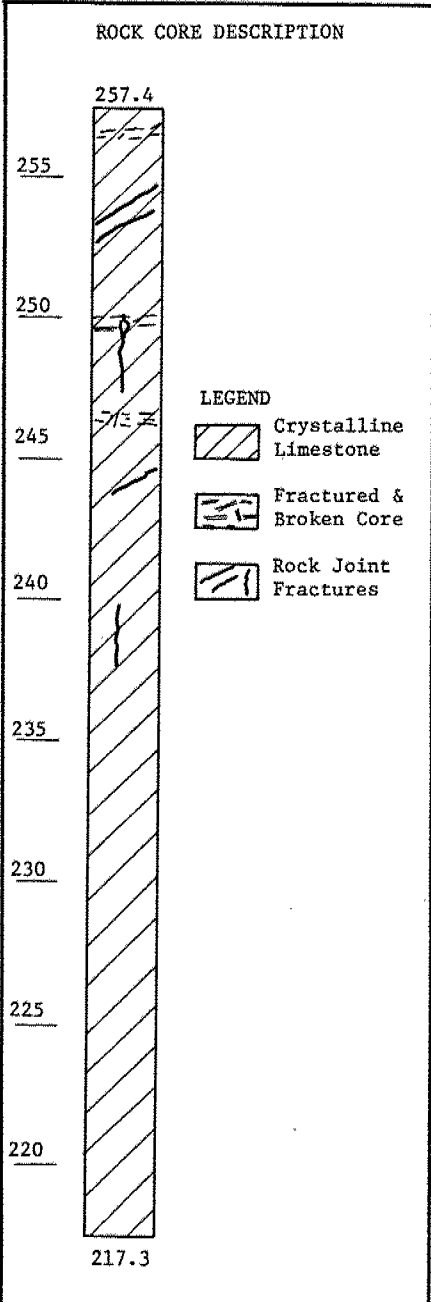
HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 12A




WP 198-62-00 LOCATION Co-ords. N 16,505,531; E 1,039,115 ORIGINATED BY MM
DIST 9 HWY 17N Line 'C' BORING DATE April 4, 1977 COMPILED BY BL
DATUM Geodetic BOREHOLE TYPE NX Rock Coring CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		RQD %	Packer Test Results	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	w_p w w_L	WATER CONTENT %		Pressure p (p.s.i.)	Flow q (gal/min)
257.4	Ground Level												
0.0	Crystalline Limestone		1	NX	100	%					85		
	Bedrock. Coarse texture Hard		2	NX	RC	100	%				91		
	Vertical joint at 8' - 10.8'		3	NX	RC	100	%				46	*	*
	Weathered vertical joint at 17 ft. - 18.5 ft.		4	NX	RC	100	%				100	22	4.0
	Bedding plane fractures at 3.5 ft, 4.5 ft., and 13.5 ft		5	NX	RC	100	%				40		
			6	NX	RC	100	%				100	32	4.5
			7	NX	RC	100	%				100	52	2.4
			8	NX	RC	100	%				94	52	2.4
			9	NX	RC	100	%				100	82	1
217.3													
40.1	End of Borehole												
	Note: GWL not established												

ROCK CORE DESCRIPTION



LEGEND

-  Crystalline Limestone
-  Fractured & Broken Core
-  Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 15

WP 198-62-00 LOCATION Co-ords. N 16,505,565; E 1,039,324 ORIGINATED BY MM
 DIST 9 HWY 17N Line 'C' BORING DATE April 4, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE NX Rock Coring CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	SHEAR STRENGTH	w_p w w_L	RQD %		
279.2	Ground Level											
0.0	Crystalline Limestone Bedrock Hard Soft weathered calcite seams at 4.2' - 5.6' and 7.3' - 8.1'		1	NX RC	Rec 100 %	270					75	
			2	NX RC	Rec 95 %							50
264.5			3	NX RC	Rec 100 %							100
14.7	End of Borehole						<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">ROCK CORE DESCRIPTION</p> <p style="text-align: center;">LEGEND</p> <ul style="list-style-type: none"> Crystalline Limestone Fractured & Broken Core Calcite Seam </div>					

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 16

WP 198-62-00 LOCATION Co-ords. N 16,505,505; E 1,039,319 ORIGINATED BY MM
 DIST 9 HWY 17N Line 'C' BORING DATE April 4, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE 3 1/2" Hollow Stem Auger & NX Rock Coring CHECKED BY *ef*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WATER CONTENT W	WATER CONTENT %	
273.1	Ground Level													
0.0	Some boulder & cobbles over clayey silt, trace to some sand, Brown, Stiff					270								
265.5														
7.6	Crystalline Limestone Bedrock Coarse texture Steep joint fracture at 17.5 ft.		1	NX RC	Rec 100 %	260							100	
254.8			2	NX RC	Rec 100 %								70	
18.3	End of Borehole Note: GWL not established													

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF PROBEHOLE NO 17 & 18

WP 198-62-00 LOCATION See Below ORIGINATED BY MM
 DIST 9 HWY 17N Line 'C' BORING DATE April 4, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE 3 1/2" Hollow Stem Auger CHECKED BY *CP*

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			
273.5	Ground Level													
272.0	Fill: sand with gravel													
1.5	End of Probehole Auger refusal on probable bedrock					270								
276.1	Ground Level													
274.6	Fill: sand with gravel													
1.5	End of Probehole Auger refusal on probable bedrock					270								

PROBEHOLE #17

Co-ords. N 16,505,520; E 1,039,320

PROBEHOLE #18


Co-ords N 16,505,590; E 1,039,322


OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 51

WP 198-62-00 LOCATION Co-ords. N 16,505,584; E 1,038,954 ORIGINATED BY HS
 DIST 9 HWY 17N Line 'C' BORING DATE June 22, 1976 COMPILED BY SM
 DATUM Geodetic BOREHOLE TYPE NX Rock Core CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		ROD %	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p — w — w_L	WATER CONTENT %		
254.4	Water Level														
0.0	Water					250									
245.5	River Bottom														
8.9	Crystalline Limestone Bedrock Sound		1	NX RC	Rec 100 %	240								81	
			2	NX RC	Rec 100 %									67	
			3	NX RC	Rec 100 %	230								93	
225.3			4	NX RC	Rec 100 %									100	
29.1	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 52

WP 198-62-00 LOCATION Co-ords. N 16,505,563; E 1,038,962 ORIGINATED BY HS
 DIST 9 HWY 17N Line 'C' BORING DATE June 23, 1976 COMPILED BY SM
 DATUM Geodetic EBL BOREHOLE TYPE NX Rock Core CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			ROD %	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
254.4	Water Level															
0.0	Water					250										
246.1	River Bottom															
8.3	Crystalline Limestone Bedrock		1	RC	84%										58	
			2	NX RC	98%	240									88	
	Sound		3	NX RC	99%										88	
			4	NX RC	100%	230									100	
229.6																
24.8	End of borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 53

WP 198-62-00 LOCATION Co-ords. N 16,505,605; E 1,038,941 ORIGINATED BY HS
 DIST 9 HWY 17N Line 'C' BORING DATE June 23 & 24, 1976 COMPILED BY SM
 DATUM Geodetic EBL BOREHOLE TYPE NX Rock Core CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L	
254.7	Water Level														
0.0	Water					250									
						240									
233.3	River Bottom														
21.4	Crystalline Limestone		1	NX RC	Rec 100 %	230									78
	Bedrock		2	NX RC	Rec 94 %										89
	Sound		3	NX RC	Rec 97 %	220									69
213.2	End of Borehole		4	NX RC	Rec 100 %										100
41.5															

OFFICE REPORT ON SOIL "EXPLORATION"

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 54

WP 198-62-00 LOCATION Co-ords. N 16,505,468; E 1,039,250 ORIGINATED BY SM
 DIST 9 HWY 17N Line 'C' BORING DATE July 13, 1976 COMPILED BY SM
 DATUM Geodetic EBL BOREHOLE TYPE Washboring, BX Rock Core & Cone Test CHECKED BY SP.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	ROD %	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES					
269.3	Ground Level		1	CS						
267.3	Road fill, gravel, sand rock boulders		2	SS	18					
2.0	Silty clay		3	TW	PM					
	with some fine		4	SS	15					
	sand seams		5	TW	PM					
	Very stiff		6	SS	9					
255.2	Bouldery material		7	SS	50/2					
14.1	Crystalline		8	BX	Rec					
250.6	Limestone Bedrock			RC	100				98	
	Sound									
18.7	End of Borehole									
	Note: Water level not established									

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE N^o 106

WP 198-62-00 LOCATION Co-ords. N 16,505,577; E 1,039,272 ORIGINATED BY VK
 DIST 9 HWY 17N Line 'C' BORING DATE December 11, 1974 COMPILED BY SO
 DATUM Geodetic EBL BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L	
272.2	Ground Level														
0.0	Topsoil														
268.2	Clayey silt, trace to some sand Brown Silt		1	SS	10	270							0		0 6 76 18
4.0	Crystalline Limestone														
263.0	Bedrock Sound Grey														
9.2	End of Borehole														

Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

DIP

90°

NX Core

TOTAL FOOTAGE 11'7"

HOLE NO. 5 SHEET NO.

283.8

Geodetic

ELEV. COLLAR

DATUM

DATE STARTED

DATE COMPLETED

DRILLED BY

LOGGED BY

PROPERTY W.P. 198-62-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE _____
DEPARTURE _____
BEARING _____

[illegible]

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



PROPERTY _____ W.P. 198-62-00
LOCATION _____ Madawaska River Bridge
_____ Arnprior By-Pass Hwy. 17

LATITUDE _____
DEPARTURE _____
BEARING _____

Q1P

90°	
NX Core	
TOTAL FOOTAGE	13'4"

ELEV. COLLAR 286.1
 DATUM Geodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

DATE OF EXAMINATION April 28, 1977

OB-MT-113

Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

包工包

HOLE NO. 7 SHEET NO.

PROPERTY	W.P. 198-62-00
LOCATION	Madawaska River Bridge Arnprior By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

90°	
NX Core	
TOTAL FOOTAGE	19'5"

ELEV. COLLAR 273.4
 DATUM Geodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION April 28, 1977

B.K. Glassford



HOLE NO. 7A SHEET NO.

90°

ELEV. COLLAR 272' 0
 DATUM Geodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

PROPERTY LOCATION W. P. 198-62-00
Madawaska River Bridge
Arnprior By-Pass Hwy. 17

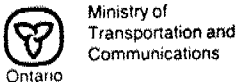
LATITUDE
DEPARTURE
BEARING

TOTAL FOOTAGE 42'11"

[illegible]

DATE OF EXAMINATION April 28, 1977

B.K. Glassford



DIAMOND DRILL RECORD

HOLE NO. 8A SHEET NO.

DIP

PROPERTY _____ W.P. 198-62-00
LOCATION _____ Madawaska River Bridge
_____ Arnprior By-Pass Hwy. 17

LATITUDE _____
DEPARTURE _____
BEARING _____

90°	
NX Core	
TOTAL FOOTAGE	25'4"

ELEV. COLLAR 276.00
 DATUM Geodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
1'4"	25'4"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 45°, sometimes contorted.			Broken core 1'4" - 4'4"
					" " 7'5" - 9'7"
					" " 18'
					Joint fracture 80° 1'4" - 4'4"
					open and weathered.
					Joint fracture 90° and inclined
					at 7'5" - 9'7" open and weathered
					with cavities.
		RQD 1'4" - 4'4" 0%			
		RQD 1'4" - 18'0" 50%			
		RQD 18'0" - 25'4" 95%			
					Fractures parallel to bedding
					planes at 15'10", 15'4" and 10'6".
					Joint fracture parallel to bedding
					inclined at 85° open and
					weathered with cavities.
					Two fracture joints at 90° to each
					other and each at 90° to bedding
					planes.
					Bedding plane fracture 45° at 21'7"
					Joint fracture 80° at 23'2"
					Horizontal fracture breakage appears
					fresh.

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



Ministry of
Transportation and
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DIAMOND DRILL RECORD

DIP

HOLE NO. 9 SHEET NO.

PROPERTY W. P. 198-62-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE
DEPARTURE
BEARING

90°
NX Core
42'11"
TOTAL FOOTAGE 42'11"

ELEV. COLLAR 272.3
DATUM Geodetic
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
2'1"	42'11"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 45°, sometimes contorted.				Joint fracture 85° at 16' - 19'3" parallel to Q, open and weathered.
						Joint fracture, 80° at 20'5"
						" " 50° at 38'3"
						" " 45° at 40'0"
						Bedding plane fractures at
						27'6"
						32'0"
						35'8"
						Broken Core at 38'3"
						" " " 40'0"
						Horizontal fractures appear fresh
						RQD - 2'1" - 16' 100%
						" 16' - 19' 0%
						" 19' - 42' 95%

DATE OF EXAMINATION April 28, 1977

B.K. Glassford



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

DIP

HOLE NO. 10 SHEET NO. _____

PROPERTY W.P. 198-62-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE _____
DEPARTURE _____
BEARING _____

90°
NX Core
TOTAL FOOTAGE 21'6"

ELEV. COLLAR 272.7
DATUM Geodetic
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
1'4"	21'6"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 45°, sometimes contorted.				Broken core at 5'8" - 6'11" at 8'9" - 10'8"
						Bedding plane fractures at 3'3" 4'7" 5'8" 11'9" 12'2" 13'4" 17'0"
		RQD 1'4" - 6'5" 70%				
		RQD 6'5" - 11'5" 60%				
		RQD 11'5" - 21'6" 100%				
						Horizontal fracture breakage appears fresh. Inclined fracture 85° at 2' - 3'3" open and weathered at 2'9". Inclined fracture 85° at 5'6" - 6'8" oriented 125° to G, open and weathered. Vertical fracture 11'3" - 11'9" open and weathered. Fractures open and weathered 8'10" 10'8" at 90° to bedding.

DATE OF EXAMINATION April 28, 1977

B.K. Glassford



HOLE NO. 11A SHEET NO. _____

900

261.50'

Geodetic

DATE COMPLETED

DRILLED BY

LOGGED BY

PROPERTY	W.P. 198-62-00
LOCATION	Madawaska River Bridge Araprior By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

TOTAL FOOTAGE 24'9"

[illegible]

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



DIAMOND DRILL RECORD

DIP

HOLE NO. 12A SHEET NO.

PROPERTY	W. P. 198-62-00
LOCATION	Madawaska River Bridge Arnprior By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

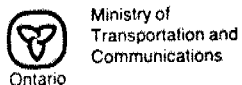
90°	
NX Core	
TOTAL FOOTAGE	40'2"

ELEV. COLLAR 257.40'
 DATUM Geodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



DIAMOND DRILL RECORD

HOLE NO. 15 SHEET NO.

PROPERTY W. P. 198-62-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE _____
DEPARTURE _____
BEARING _____

DIP

90°

NX Core	
TOTAL FOOTAGE	1418''

ELEV. COLLAR 279.21'
 DATUM Geodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION April 27, 1977

B.K. Glassford



HOLE NO. 16 SHEET NO. _____

90°

ELEV. COLLAR	273.11
DATUM	Geodetic
DATE STARTED	
DATE COMPLETED	
DRILLED BY	
LOGGED BY	

PROPERTY	W. P. 198-62-00
LOCATION	Madawaska River Bridge Arnprior By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

TOTAL FOOTAGE 18'4"

[illegible]

DATE OF EXAMINATION April 28, 1977

B.K. Glassford



Transportation and Communications

DIAMOND DRILL RECORD

DIP

90°

PROPERTY	W. P. 198-62-00
LOCATION	Madawaska River and Hwy. 17N
LATITUDE	
DEPARTURE	
BEARING	

TOTAL FOOTAGE 29.15'

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION Aug. 13/76

B. K. Glassford



DIAMOND DRILL RECORD.

HOLE NO. 52 SHEET NO.

DIP

PROPERTY _____ W. P. 198-62-00
LOCATION _____ Madawaska River and Hwy. 17N

LATITUDE _____
DEPARTURE _____
BEARING _____

90°	
TOTAL FOOTAGE	24.8'

ELEV. COLLAR. _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION Aug. 13/76

B.K. Glassford

Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

DIP

HOLE NO. 53 SHEET NO.

PROPERTY W. P. 198-62-00
LOCATION Madawaska River and Hwy. 17N

LATITUDE _____
DEPARTURE _____
BEARING _____

900	
TOTAL FOOTAGE	41.55'

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION Aug. 13/76

B. K. Glassford



HOLE NO. 54 SHEET NO.

 90°

LOGGED BY

Arnprior Bypass, Hwy. 17N

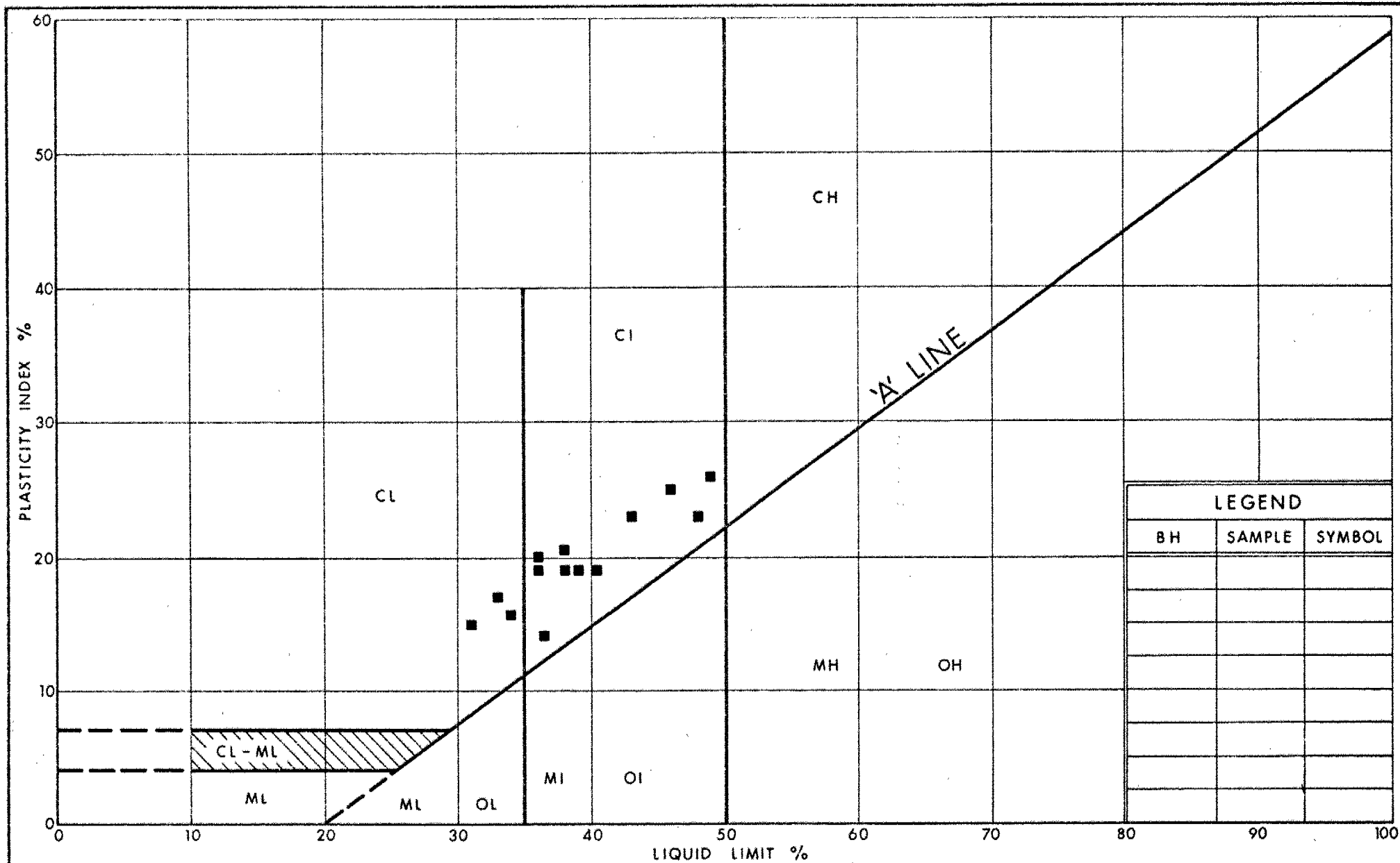
BEARING

TOTAL FOOTAGE

[illegible]

DATE OF EXAMINATION August 13, 1976

B. K. Glassford

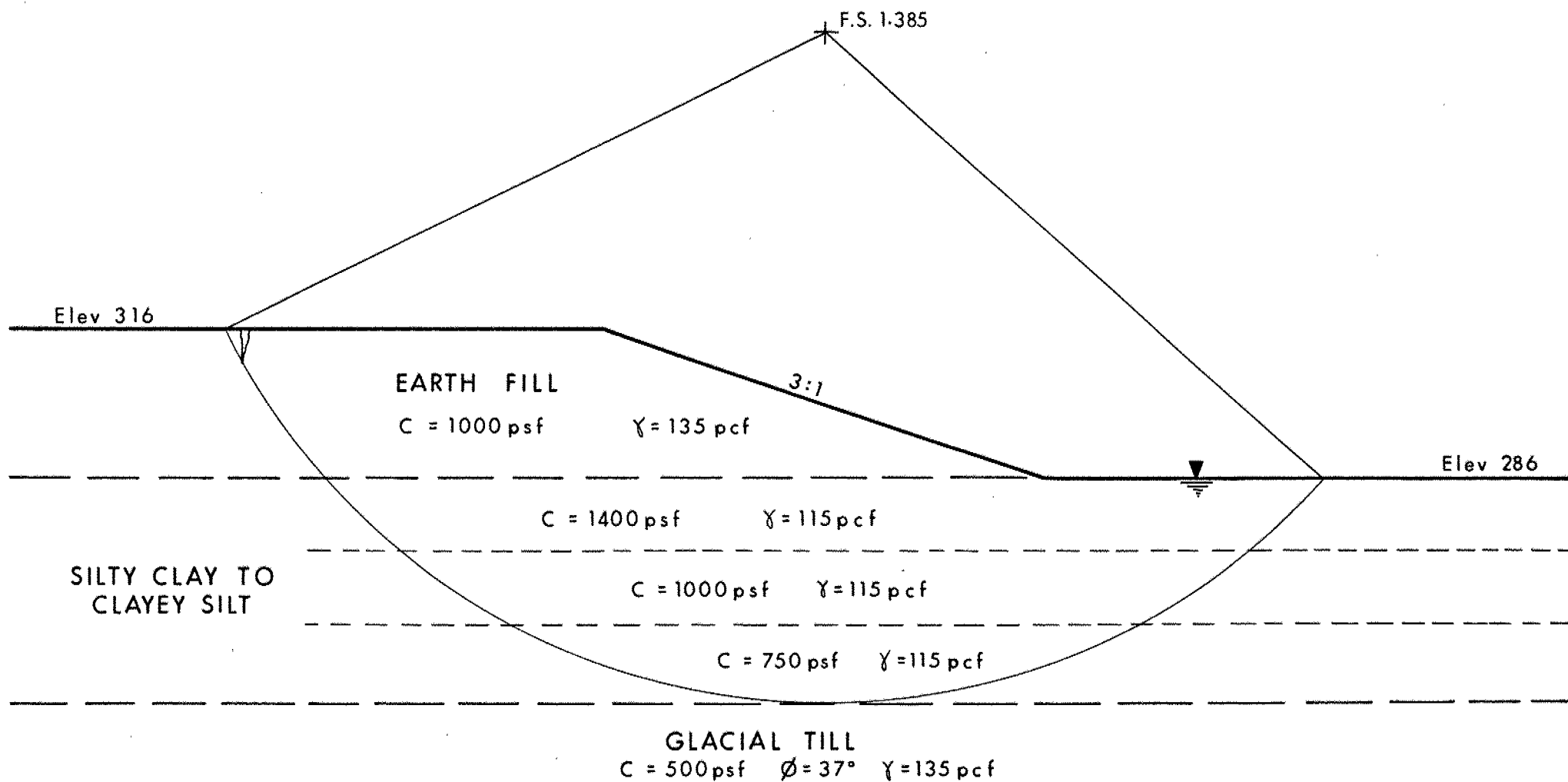


Ministry of
Transportation and
Communications

PLASTICITY CHART SILTY CLAY TO CLAYEY SILT

FIG No 1

W P 198-62-00



SIMPLIFIED SOIL STRATIGRAPHY AND LOCATION OF CRITICAL CIRCLE

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

R.Q.D. ROCK QUALITY DESIGNATION

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	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_e	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
$\bar{\sigma}$	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

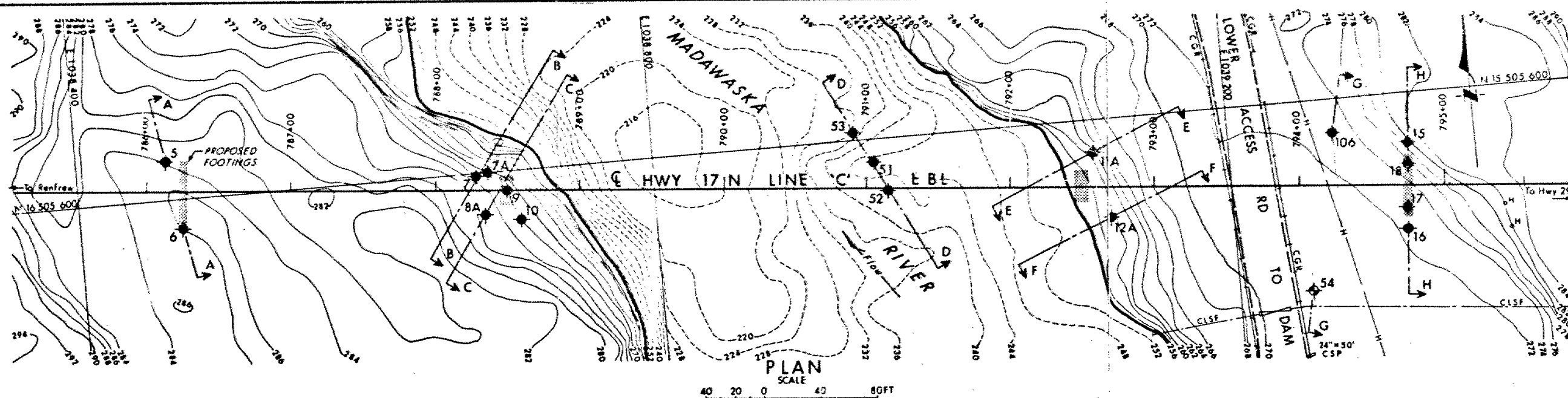
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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

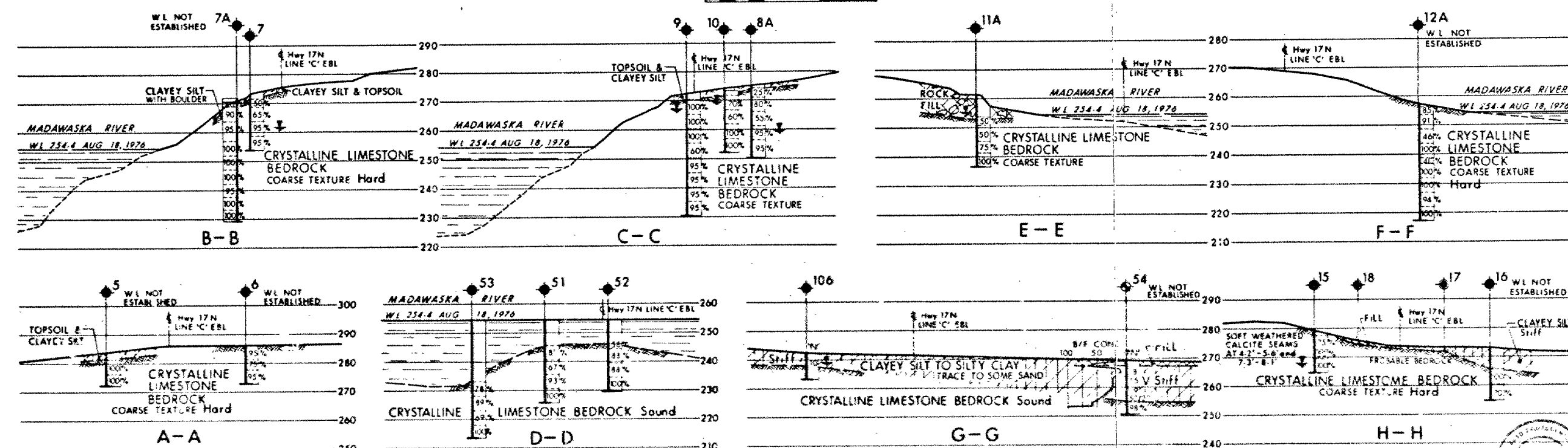
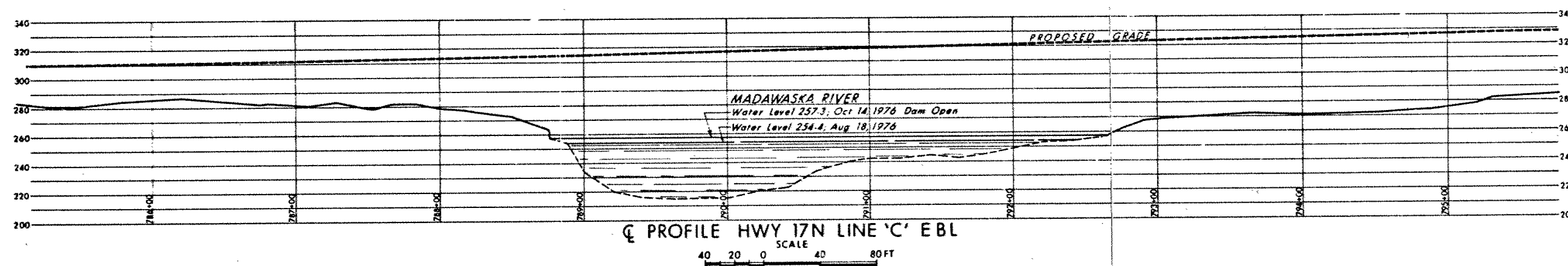
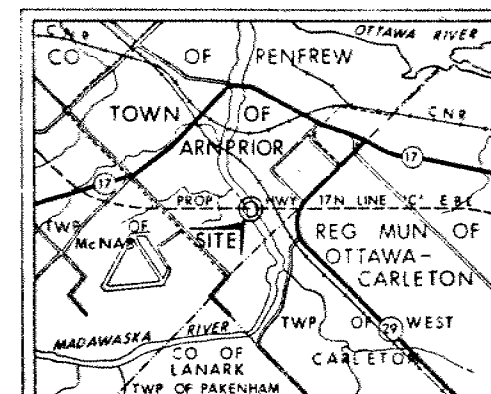


CONT No
WP No 198-62-70

MADAWASKA RIVER BRIDGE
(ARNPRIOR DIVERSION)
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- ⊖ Probe Hole
- 'N' Blows/ft (Std Pan Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- WL at time of investigation Apr 1977
- WL for Bore Hole 51, 52 & 53 June/76
- WL for Bore Hole 106 Dec 1974
- WL Not Established in Bore Hole 5, 6, 7A, 12A, 16 & 54
- 100% RQD Shown thus
- Rock Quality Designation

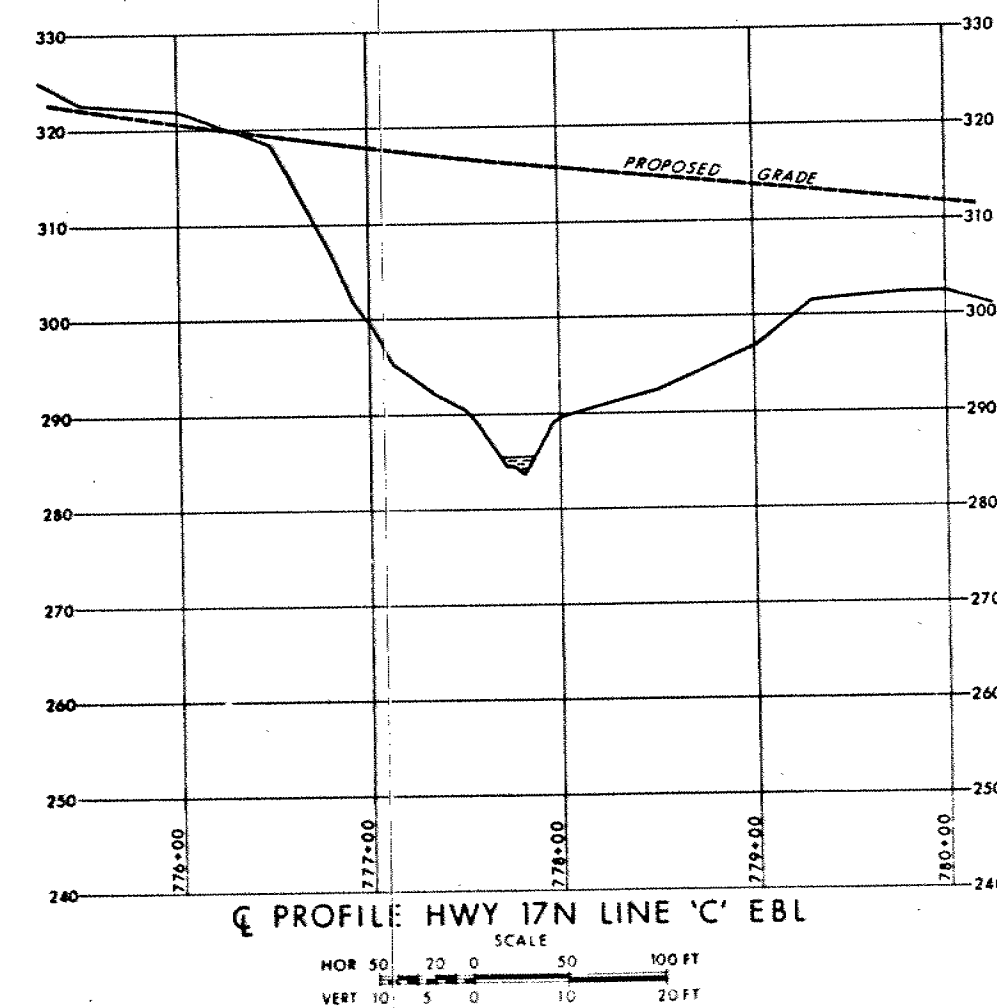
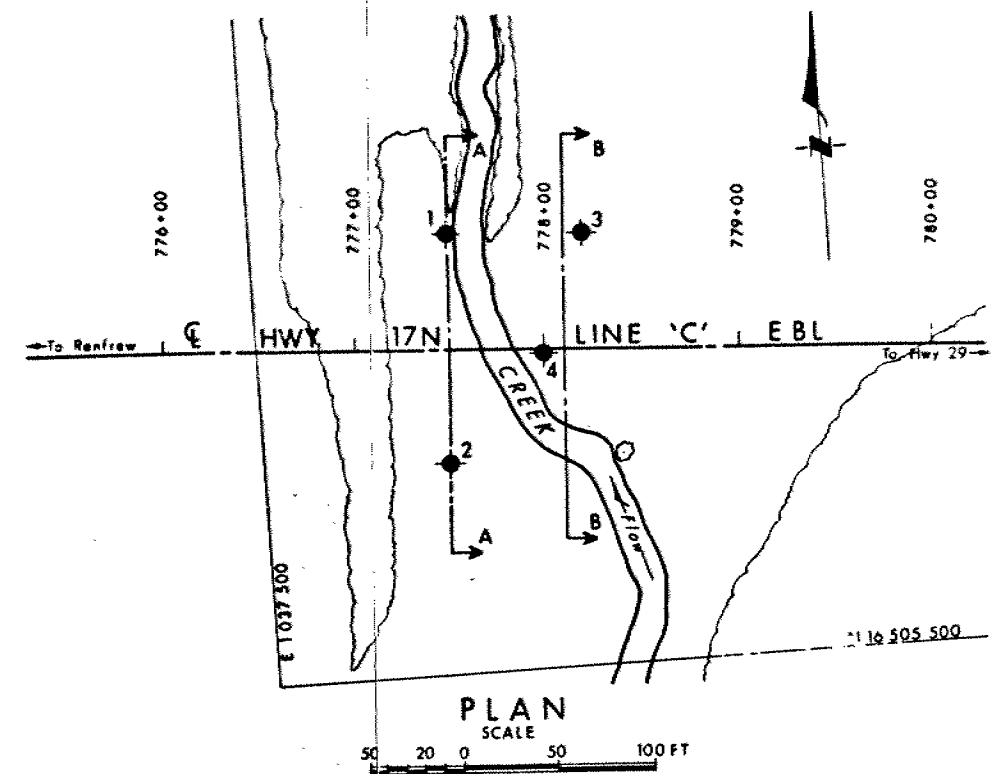
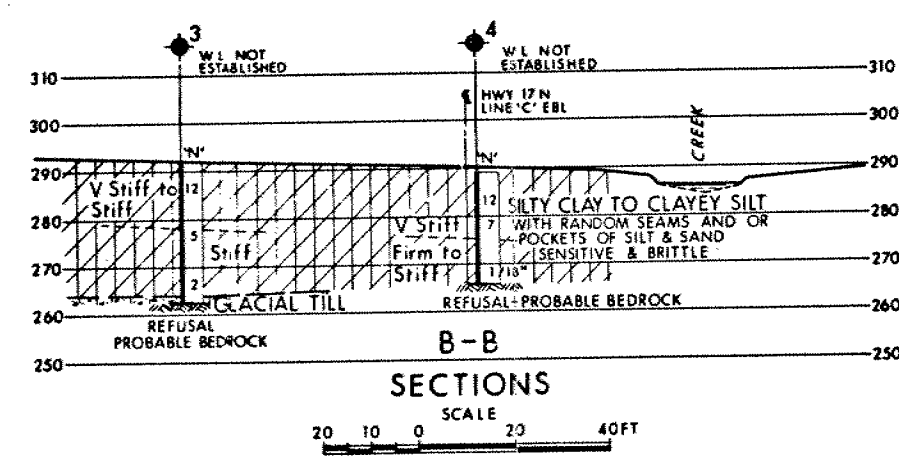
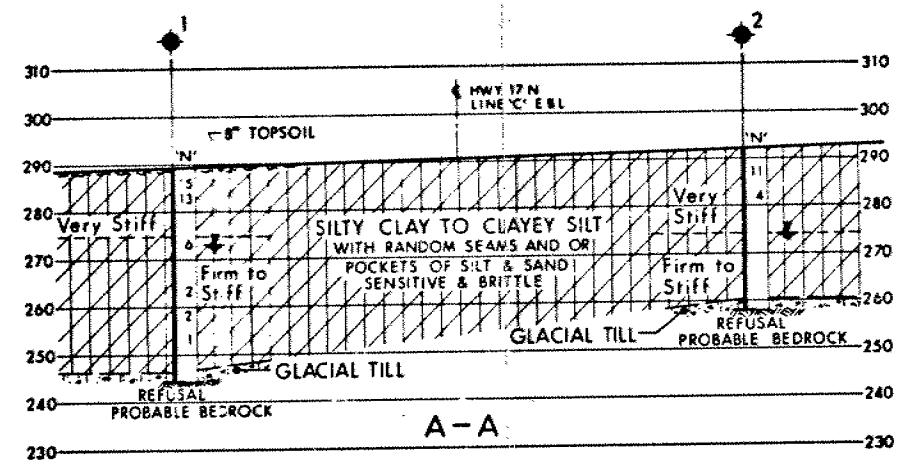
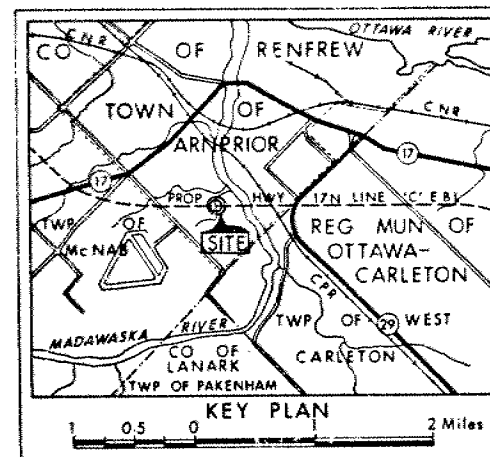
No	ELEVATION	CO-ORDINATES NORTH	EAST
5	283.8	16 505 627	1038 463
6	286.1	16 505 580	1038 472
7	273.4	16 505 598	1038 678
7A	272.0	16 505 600	1038 686
8A	275.5	16 505 571	1038 683
9	272.3	16 505 586	1038 698
10	273.7	16 505 565	1038 706
11A	261.5	16 505 577	1039 106
12A	257.4	16 505 531	1039 115
15	279.2	16 505 565	1039 324
16	273.1	16 505 505	1039 319
17	273.5	16 505 520	1039 320
18	276.1	16 505 550	1039 322
51	254.4	16 505 584	1038 954
52	254.4	16 505 563	1038 962
53	254.7	16 505 605	1038 941
54	269.3	16 505 468	1039 250
106	272.2	16 505 577	1039 272

-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	REVISION

Prop 17N LINE 'C' EBL
B.L. SHEET No. 198-62-70
Date July 13, 1977
Scale 1" = 40'

REF No E-5274-1, Nov 1976



- 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.L. at time of investigation April 1977
 - W.L. Not Established in B.H.#3 & 4

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	289.2	16 505 730	1037 603
2	292.1	16 505 610	1037 597
3	291.9	16 505 726	1037 674
4	289.2	16 505 665	1037 651

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

REVISIONS	DATE	BY	DESCRIPTION
1	1977



NOTES

CLASS OF CONCRETE

CAS-IN-PLACE POST-TENSIONED SEGMENTAL
 BOX GIRDER & BARRIER WALLS 5000 psi
 PIERS 4000 psi
 REMAINDER 3000 psi

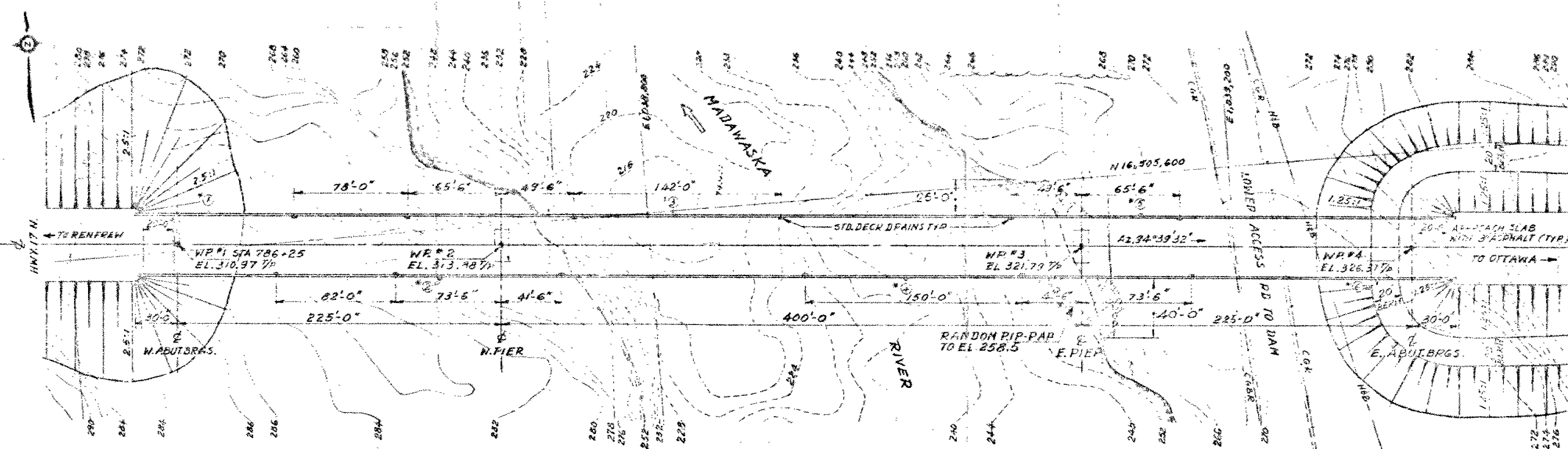
REINFORCING STEEL GRADE
 GRADE 60

CLEAR COVER TO REINFORCING STEEL

FOOTINGS 3", ABUTMENTS 3", PIER OUTSIDE
 FACES 2 1/2", PIER INSIDE FACES 1 1/2", DECK TOP 2",
 DECK BOT. 1 1/2"
 APPROACH SLABS 2"
 UNLESS NOTED OTHERWISE ON DRAWINGS.

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING
 THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED
 ELEVATIONS WITH A TOLERANCE OF ± 1/8"
 NO CONCRETE SHALL BE PLACED ABOVE THE
 ABUTMENT BEARING SEATS UNTIL THE CONCRETE
 IN THE DECK HAS BEEN PLACED, STRESSED AND
 GROUTED
 TO ACHIEVE THE MIN. CLEAR COVER OF 2"
 SPECIFIED AT TOP OF DECK. THE TOP LAYER OF
 REINFORCEMENT SHALL BE PLACED, PRIOR
 TO CONCRETING, WITH A CLEAR COVER OF
 2 1/2" ± 1/8" TOLERANCE.

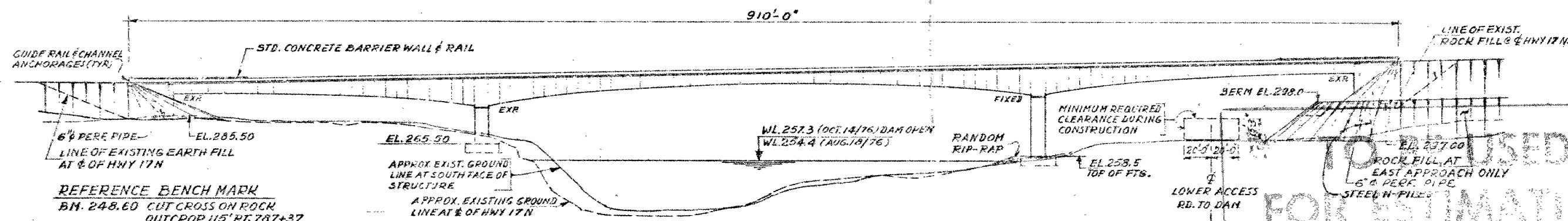


NOTE: 7/8" DENOTES TOP OF PAVEMENT
 ELEVATIONS
 • W.R. DENOTES WORKING POINT

PLAN
 SCALE: 1" = 40'-0"

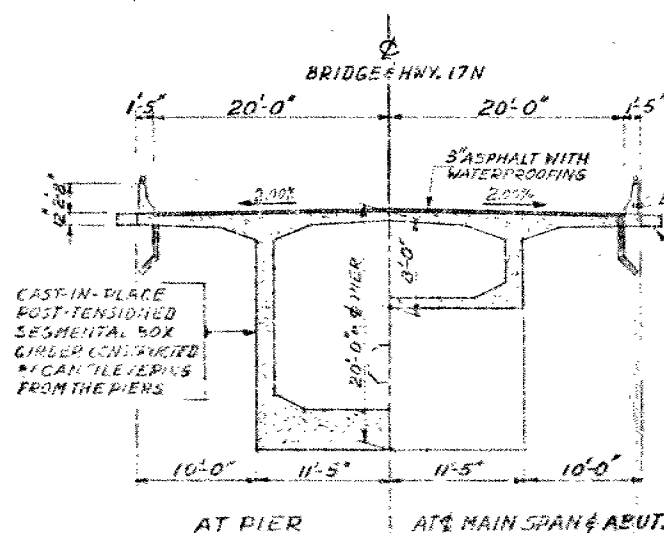
*** LOCATION OF LIGHTING POLE BASES**

- ① STA. 786+46.30 N. ④ STA. 791+30.50 S.
- ② STA. 788+08.50 S. ⑤ STA. 792+91.50 N.
- ③ STA. 789+69.50 N. ⑥ STA. 794+53.50 S.

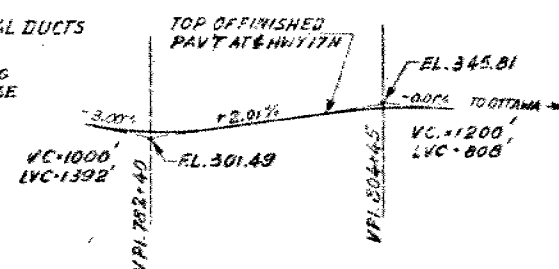


ELEVATION
 SCALE: 1" = 40'-0"

REFERENCE BENCH MARK
 B.M. 248.60 CUT CROSS ON ROCK
 OUTCROP 115' RT. 787+37



TYPICAL DECK SECTION
 SCALE: 1/8" = 1'-0"



PROFILE OF HIGHWAY 17N
 N.T.S.

LIST OF DRAWINGS

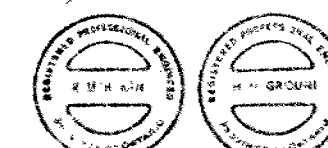
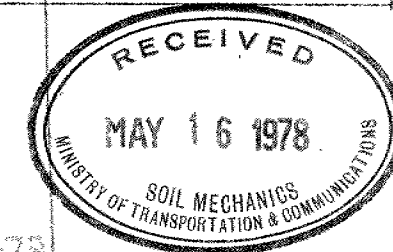
- 29-191-1 GENERAL LAYOUT
- 2 BOREHOLE LOCATIONS & SOIL STRATA
- 3 FOUNDATIONS
- 4 WEST ABUTMENT
- 5 EAST ABUTMENT
- 6 WEST PIER
- 7 EAST PIER
- 8 DEFLECTIONS
- 9 CONST. SEQUENCE, SCHEDULE & SIGN DATA
- 10 DECK DETAILS
- 11 CABLE DETAILS 1
- 12 CABLE DETAILS 2
- 13 CABLE DETAILS 3
- 14 CABLE DETAILS 4
- 15 CABLE DETAILS 5
- 16 CABLE DETAILS 6
- 17 TEMP. LONGIT. CABLE DETAILS
- 18 CONTINUITY & TEMP. VERT. CABLES
- 19 TRANSVERSE CABLES

- 29-191-20 DECK REINFORCEMENT 1
- 21 DECK REINFORCEMENT 2
- 22 DECK REINFORCEMENT 3
- 23 DECK REINFORCEMENT 4
- 24 EXPANSION JOINTS
- 25 BEARINGS
- 26 BARRIER WALL
- 27 STEEL RAILING (SINGLE TUBE)
- 28 AS CONSTRUCTED ELEV. & DIM.
- 29 BRIDGE ELECTRICAL DETAIL TYPE II
- 30 ELECTRICAL STANDARDS I
- 31 ELECTRICAL STANDARDS II
- 32 STANDARD DETAILS I
- 33 STANDARD DETAILS II
- 34 20' APPROACH SLAB

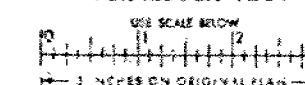
CONCRETE QUANTITIES

CONCRETE QUANTITIES ARE LISTED BELOW
 FOR THE APPROPRIATE CONCRETE LUMP SUM
 TENDER ITEMS.

- 1, CONCRETE IN PIERS, ABUTMENTS
 AND WING WALLS 3000 psi 400 cu yd
- 2, PRESTRESSED CONC. BRIDGE DECK 5000 psi 3647 cu yd
- 3, CONCRETE IN BARRIER WALLS 4000 psi 145 cu yd
- 4, CONCRETE IN APPROACH SLABS 3000 psi 69 cu yd



FOR REDUCED PLAN



DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING & UNLOADING
DRAWING	CHECK	SITE & FIELD

CONT No
WP No 138-52-00

MADAWASKA RIVER BRIDGE
ARMPRIOR BYPASS
FOUNDATIONS



SHEET

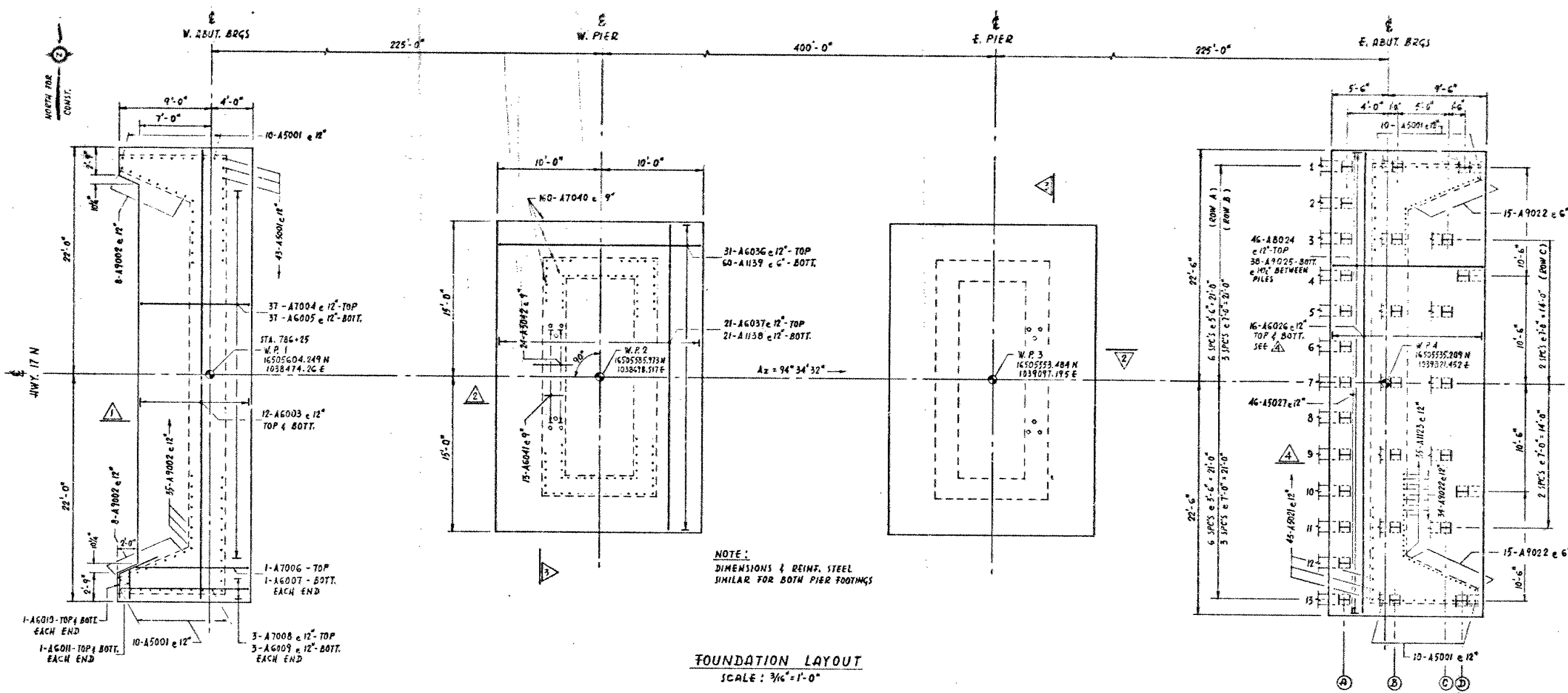
PRESTRESSED CONCRETE SCHEME

PILE DATA

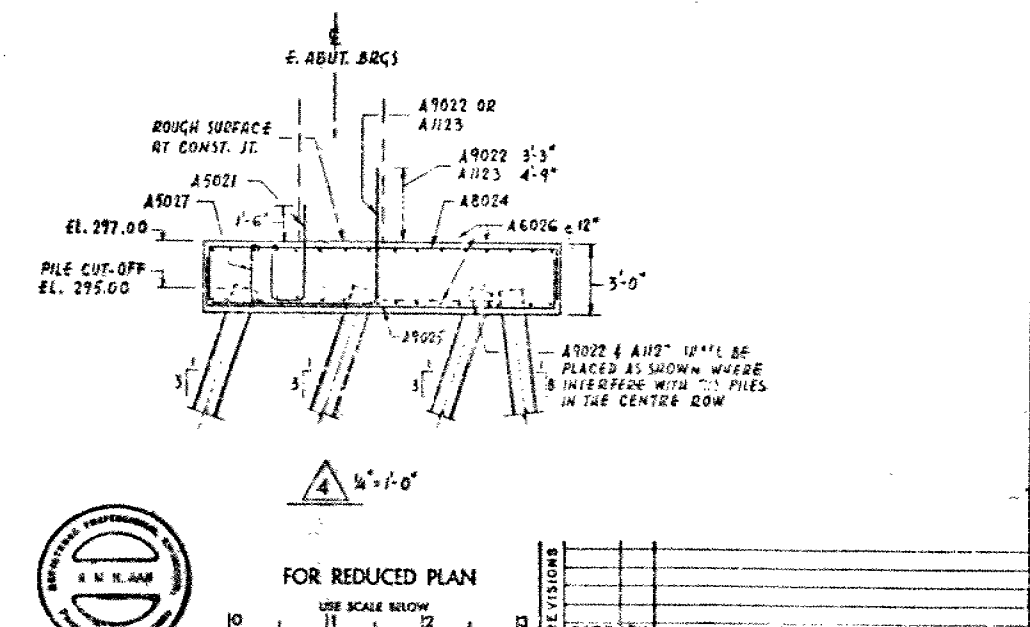
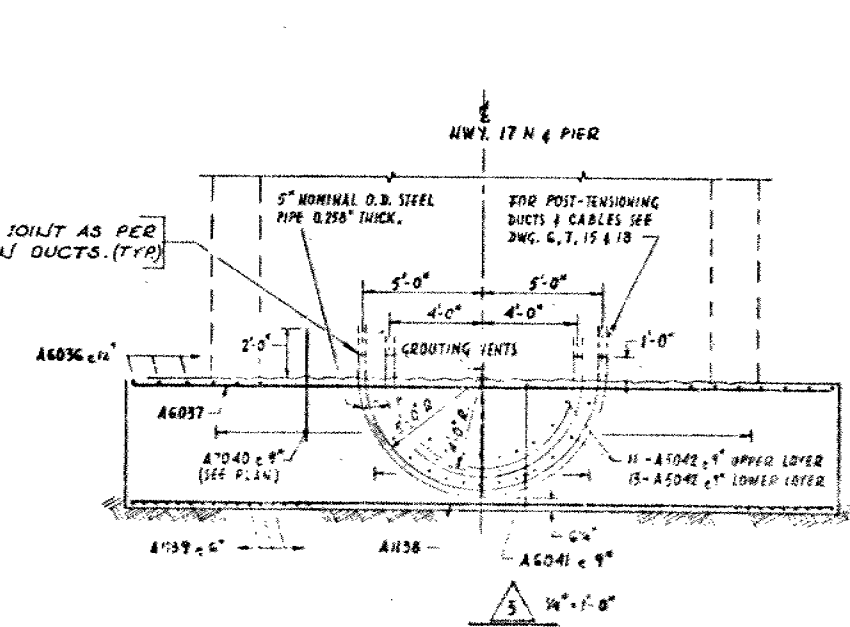
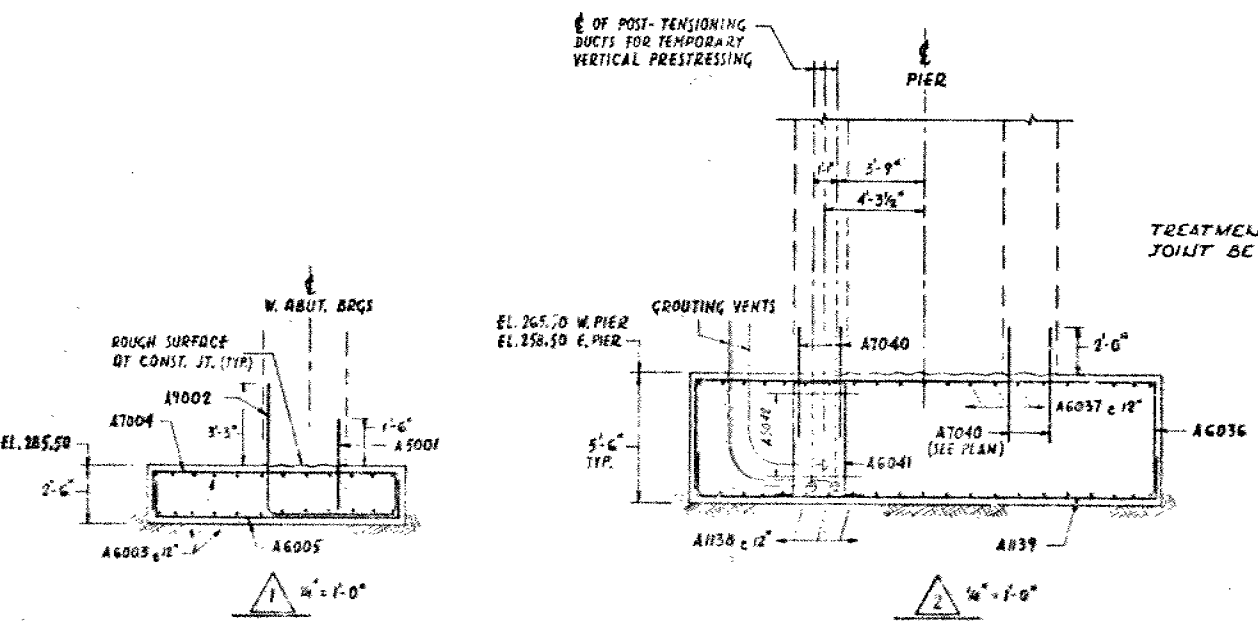
LOCATION	Nº REQ'D	TYPE	LENGTH
1A, 1B, 1C, 1D, 1E	5		25'-0"
2A, 2B, 2C, 2D, 2E	5		25'-0"
3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3I, 3J, 3K, 3L, 3M, 3N, 3O, 3P, 3Q, 3R, 3S, 3T, 3U, 3V, 3W, 3X, 3Y, 3Z	11	HP12x53	27'-0"
4A, 4B, 4C, 4D, 4E, 4F, 4G, 4H, 4I, 4J, 4K, 4L, 4M, 4N, 4O, 4P, 4Q, 4R, 4S, 4T, 4U, 4V, 4W, 4X, 4Y, 4Z	7		29'-0"
5A	1		31'-0"

NOTES:

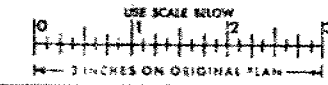
- PILE SPACING MEASURED AT UNDERSIDE OF FOOTING.
- PILES TO BE DRIVEN TO BEDROCK.
- FOOTINGS FOR W. ABUT. AND PIERS TO BE KEYED 6" INTO SOUND BEDROCK.



FOUNDATION LAYOUT
SCALE: 3/16"=1'-0"



FOR REDUCED PLAN
USE SCALE BELOW



REVISIONS	DATE	BY	DESCRIPTION
DESIGN			
CHECK			
DRAWING			

Mr. T.C. Kingsland
Head, Structural Section
Eastern Region, Kingston

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

78 08 11

Re: Proposed Instrumentation
at Madawaska River
Arnprior By-Pass, W.P. 198-62-00

Further to our discussion on 78 07 18 at Arnprior concerning the proposed instrumentation at Madawaska River (Arnprior By-Pass) please find enclosed the revised sequence of operations concerning the installation of one settlement profiler, five hydraulic overflow settlement cells and eight settlement plates.

H. Szymanski

For: M. Devata
Supervising Engineer

HS/MD/gs

Enclosure

cc: M. Batten
R. Franks
Files✓

PROPOSED INSTRUMENTATION
AT MADAWASKA RIVER, ARNPRIOR BYPASS
W.P. 198-62-00, Site 29-191, Hwy. 17N

<u>Sequence of Operations</u>	<u>To be Carried Out By</u>
From Sta. 795+45 Sta. 795+65 excavate the overburden down to the bare bedrock.	Contractor
Along Sta. 795+55 take as many elevation readings as it is necessary to establish a very accurate bedrock line (contour). Take precise elevations of the bedrock at the following points.	MTC
1. Sta. 795+55 78' LT. Ø 6. Sta. 795+65 23' RT. Ø 2. Sta. 795+55 74' RT. Ø 7. Sta. 795+65 23' RT. Ø 3. Sta. 795+55 23' LT. Ø 8. Sta. 795+65 Ø 4. Sta. 795+55 23' RT. Ø 9. Sta. 795+55 48' LT. Ø 5. Sta. 795+55 Ø 10. Sta. 795+55 48' RT. Ø	
Between Sta. 795+45 and Sta. 795+65 build the rock fill to elevation 296.0.	Contractor
Chink voids on the top with small rock fragments to prevent granular material from seeping into the voids of the rock fill. Place filtering cloth over the chinked area. (Supplied by MTC)	Contractor
Erect wooden shed supplied by the MTC at Sta. 795+55 73' LT. Ø with floor elevation not higher than 296.0. Insulate the ceiling and the walls with 2" styrofoam sheets.	Contractor
Install settlement plate #1 at Sta. 795+55 LT. Ø and take the elevation.	MTC
Install settlement plate #2 at Sta. 795+55 74' RT. Ø and take the elevation.	MTC
At Sta. 795+55 place granular fill using Granular 'A' up to elevation 597.0 a minimum of 10 feet wide and compact it well.	Contractor
On top of the granular 'A' fill place granular fill using Granular 'C' up to elevation 298.0 and compact it well.	Contractor
Excavate in the granular fill a trench approximately 5" wide at centre to elevation 297.5 and at the ends to elevation 298.0.	Contractor
Assemble profiler pipe and place it into the trench in the form of a smooth vertical curve low in the middle and with ends at a higher but equal elevation so that when the profiler pipe is buried, no air locks will form inside when it is filled with ethylene glycol.	MTC

Sequence of Operations

To Be Carried
Out By

Install at each end of the profiler pipe protective enclosures (C.S.P. - Supplied by MTC) with concrete supports for read out end and reel end reservoirs.

Contractor

Connect the read out and reel end reservoirs to the appropriate ends of the profiler pipe. Fill the profiler pipe with ethylene glycol and take a set of initial readings.

MTC

Build a concrete pedestal 6" thick and approximately 18" wide with embedded 1/2" thick and 24" high steel rod at Sta. 795+55 23' LT. \emptyset , Sta. 795+55 48' LT. at Sta. 795+55 on \emptyset and at Sta. 795+55 23' RT. \emptyset , Sta. 795+55 48' RT. \emptyset .

Contractor

Connect each overflow cell with three tubings (overflow, air, drain).

MTC

Insert the overflow cell upright in the formwork box and place it on the pedestal.

MTC

After all five overflow cells have been placed in position, bunch the tubings together and bring them out in a snaked form to the shed and connect them to the standpipe measuring units. The ground should be granular 'C' well compacted and should have a uniform gradient away from the cells in order to assist drainage and to avoid formation of air or water pockets in the tubing.

MTC

By means of the de-airing unit fill the overflow system with glycol ethylene and check for correct functioning of the system.

MTC

Take initial readings.

MTC

Fill the formwork boxes with concrete.

Contractor

Build the granular fill up to elevation 300.0 and around each concreted overflow cell up to elevation 302.0 to protect the tubings and the overflow cells from damage during construction of the rock fill.

Contractor

Sequence of Operations

To Be Carried
Out By

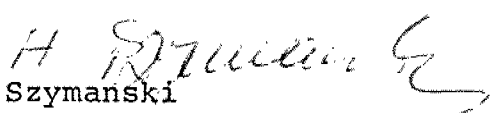
Build the embankment to the required grade and
1 foot below the grade install one settlement
plate at the following locations:

MTC

Sta. 795+55 at \emptyset
Sta. 795+55 23' LT. \emptyset
Sta. 795+55 23' RT. \emptyset
Sta. 795+65 at \emptyset
Sta. 795+65 23' LT. \emptyset
Sta. 795+65 23' RT. \emptyset

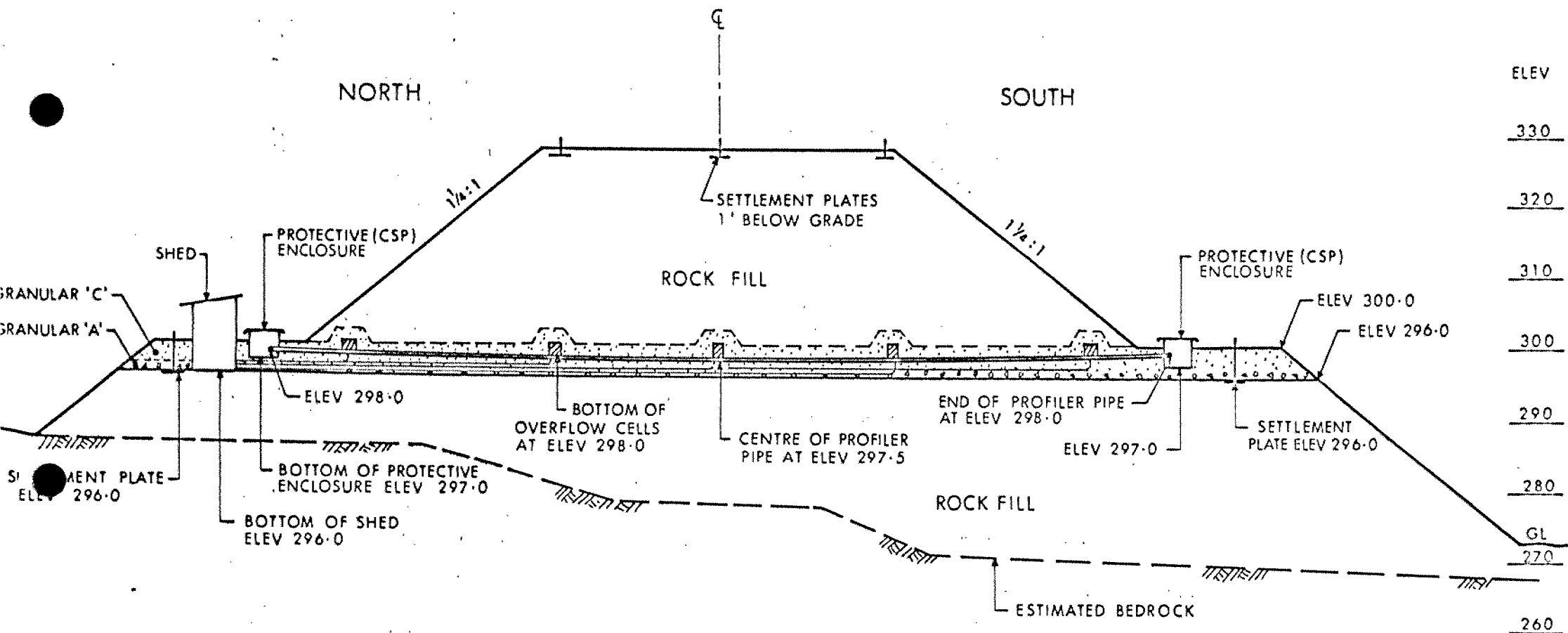
Take the elevation of the plates immediately.

NOTE: Contractor shall supply the necessary quantities of
granular fill material free from boulders and stones.


H. Szymanski

For: M. Devata
Supervising Engineer

HS/MD/gs



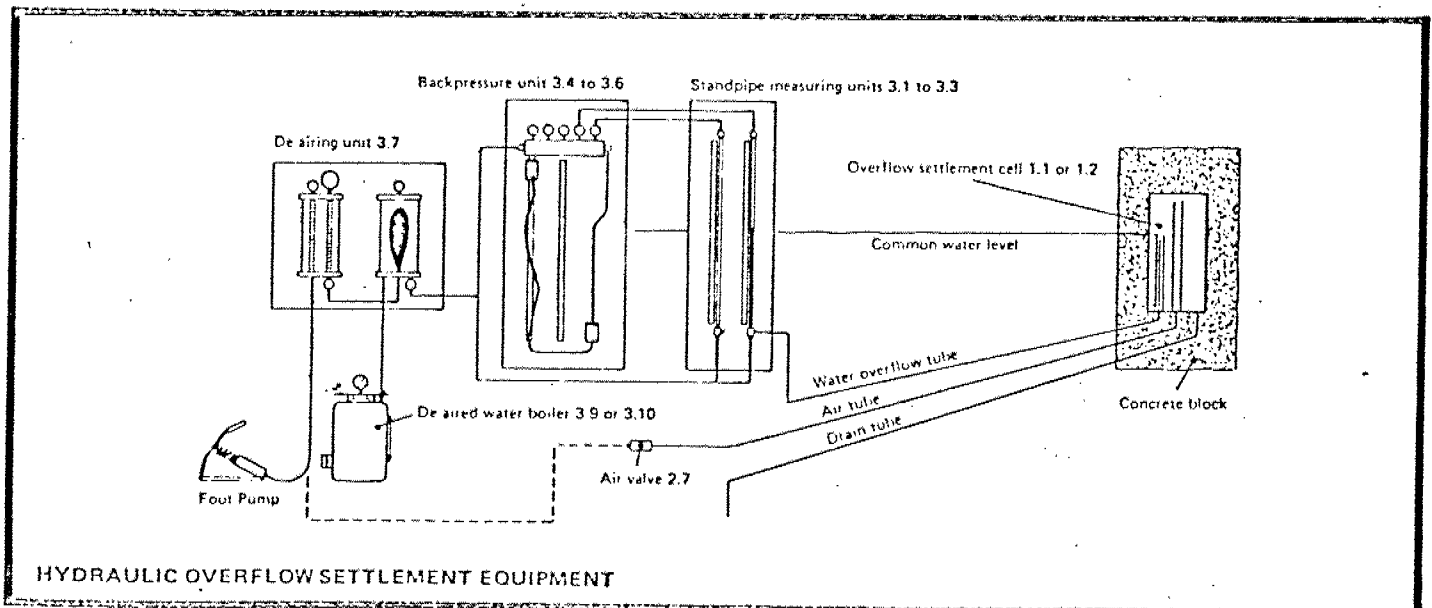
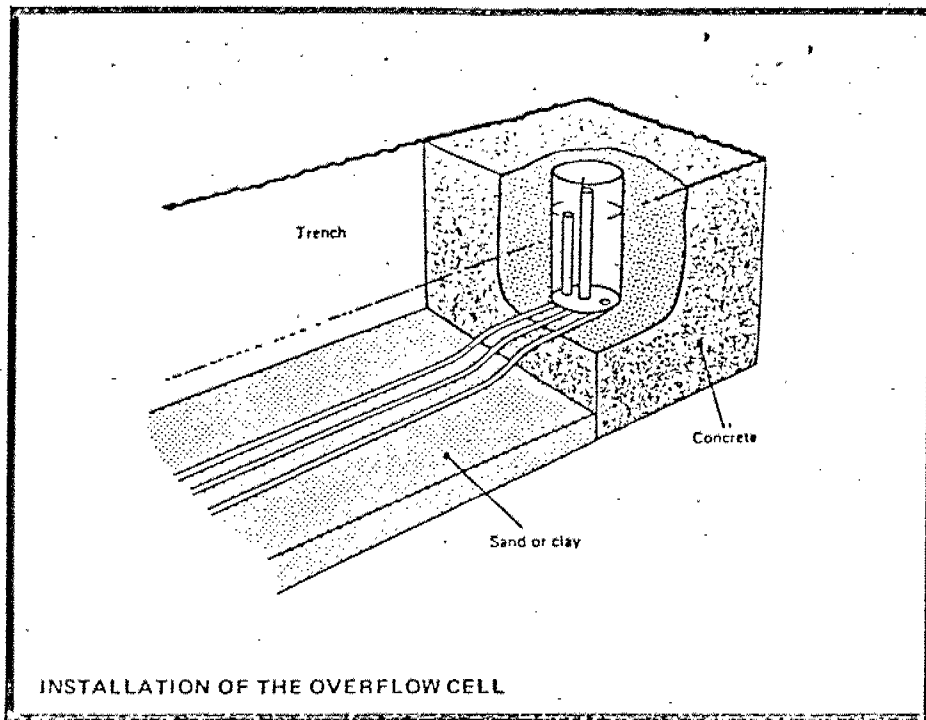
PROP INSTRUMENTATION AT MADAWASKA RIVER (ARNPRIOR BYPASS) STA 795+55

WP 198-62-00

DIST 9 OTTAWA

SITE 29-191

HYDROLIC OVERFLOW SETTLE. CELL



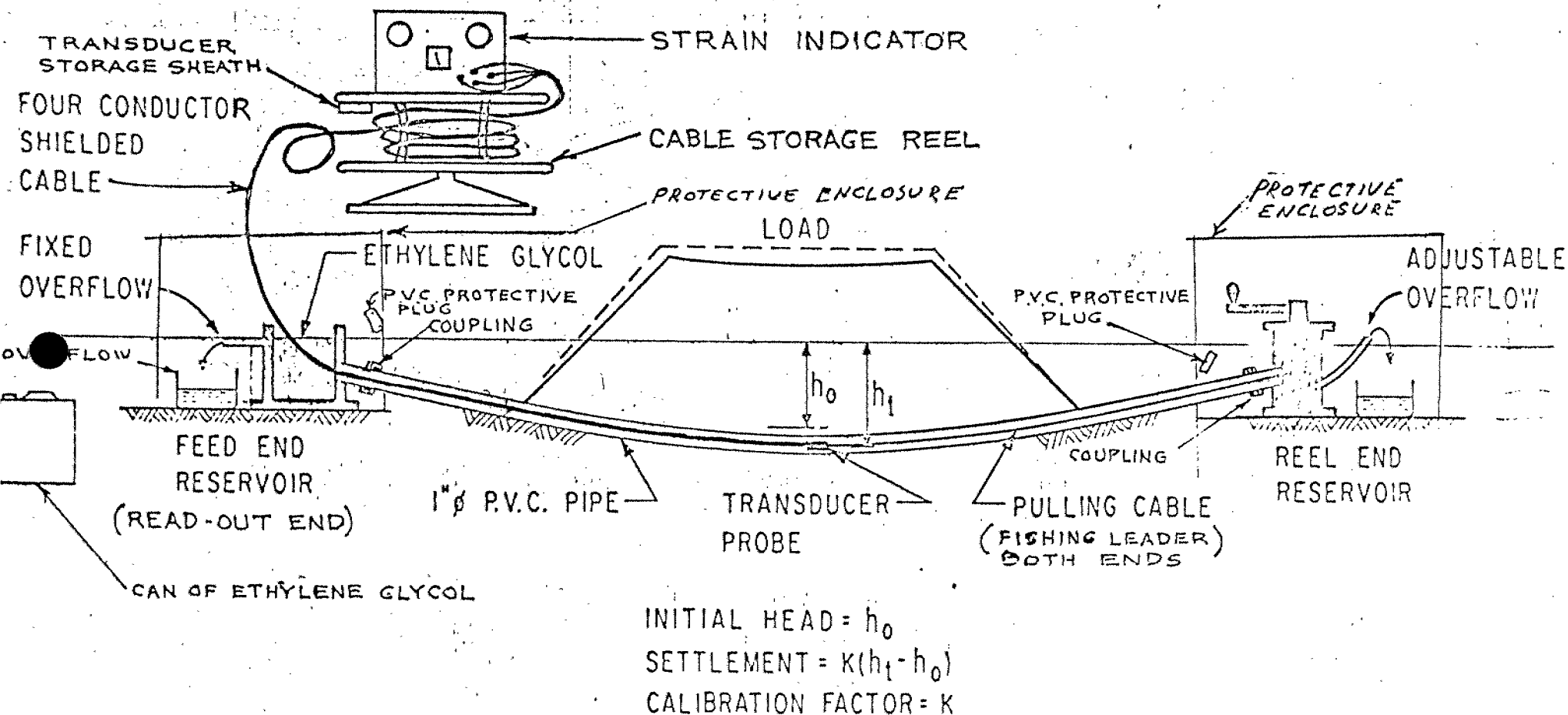
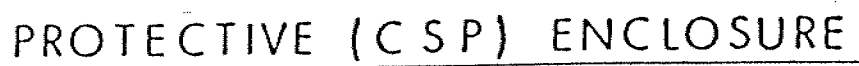


FIGURE 1 THE NRC-FLUID SETTLEMENT GAUGE
 SETTLEMENT PROFILER





Ministry of
Transportation and
Communications

Memorandum

To: Mr. K. Bassi
Structural Design Office
West Building
Downsview, Ontario

From: Structural Section
Eastern Region - Kingston

Attention:

Date: August 2, 1977

Our File Ref.

In Reply to

Subject: W.P. 197-62-00, Amprior By-Pass Structures

This is to summarize the points discussed at the meeting with you in Downsview on Thursday, July 28, 1977. The meeting was attended also by M. Devata, B. Ly and myself.

C.P.R. Overhead Structure

It was agreed to proceed with the revised preliminary bridge drawings based on C.P.R.'s requirements for an extra track at the east of the existing track. The span of the bridge will be increased by 10' by this requirement at an extra cost of approximately \$15,000.00. C.P.R.'s other requirements for extra horizontal track clearances will not be incorporated.

No further design work is to be carried out at this stage on any three span alternative. It was seen that this type of design actually worsens the foundation soils situation at the bridge approaches. The revised preliminary bridge drawing will show the new grading limits at this location. The new preliminary drawings will not be issued to C.P.R. until a reply to my recent letter to them has been received.

Madawaska River Bridge

Soil Mechanics Section intends to instrument the approach rock fills at this structure. Provision for this should be included in the stage one contract. Details and specifications for the stage one granular core details will be sent to the Region shortly. A sketch was handed to the writer showing the stages of the approach fill at the east abutment.

Rock fill will be placed against the abutment in the third stage contract (Paving). Structural Office is to issue a new preliminary bridge drawing to the Region showing the steel bridge alternative plus a sketch plan showing the limits of the approach fills.

Soil Mechanics Section is to further investigate the possible sub-excavation of a clay area at the south west toe of the east approach fills.

.../2



West Approach Fills

The foundation investigation report recommendation for side slopes of $2\frac{1}{2}$ -1 for the west approach fill was based on the use of a cohesive material. Revised recommendations will be required if material of a different nature is used.

East Approach Fills

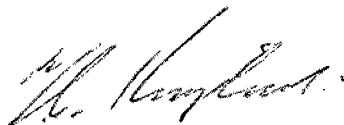
No special requirements for specifications are required for the imported rock fill for the east approach fills at the river bridge apart from a 12" size limitation for the relatively small quantity to be placed directly against the east abutment in the third contract.

Staging of Contracts

It was agreed that further discussion would be required in the Region with regard to the staging of the three contracts comprising the initial grading and drainage plus Upper Access Road Structure, the Structural contract including the river bridge and C.P.R. Structure and the final grading and paving contract.

The tentative date suggested by K. Bassi for the completion of placing of the first contract approach fills was 1 June 1978 (Both sides of the river preferably). The second contract comprising the structural work would then take place in the Summer of 1978. This work would be limited to the abutments and piers of the river bridge. The deck work for the river structure would take place during the following Summer. The time estimated to complete the concrete structure deck is 28 weeks.

The drawings for the concrete bridge design would be ready to issue on November 9, 1977. Drawings for the steel alternative would be ready by January 4, 1978. Both sets of drawings could be sent to the Region in early January 1978.



TCK/dn

T. C. Kingsland
Head, Structural Section

cc W. Wigle
S. Radbone
E. Pritchard, Att: D. Thomas
M. Devata
E. Saint
P. Kinnear

Mr. J. R. Bestvater
Design Services Supervisor
Planning and Design
Eastern Region

Construction Office
Eastern Region

April 24, 1978

Special Provision - Contract 78-42

On Page 1 of the Special Provisions on the above contract under "Extra Work", it states:

The Ministry will be placing instrumentation:

- a) Beneath the rock fill at the Madawaska River structure approach at Sta. 794+50+;
- b) on the structural plate pipe, Sta. 797+00, which work is to be completed within a period of five (5) working days following the assembly of the pipe and prior to the backfilling operations.

The Contractor shall assist in the installation of the instrumentation by performing such work as may be required and will be informed of the scope of the work at the pre-construction meeting with the Ministry.

The contractor shall, at all times, provide adequate access to the installations by Ministry personnel.

Payment for this work will be made in accordance with Form 100, Section 103-3, Extra Work.

With regards to (b) above, this phase of the work had been discussed with the Construction Office and the Special as written is acceptable.

With regards to (a) at the Regional Review Mr. M. Devata pointed out that the Soils Mechanics Research and Design Section intended to instrument the high rock fill at the east approach to the Madawaska River Bridge and the Upper Access Road Structure. Mr. Devata noted that the Soils Mechanics Section would prepare the necessary drawings and special provisions for this.

Nothing further was heard about the above until the Construction Office received an Action Slip of April 18, 1978,

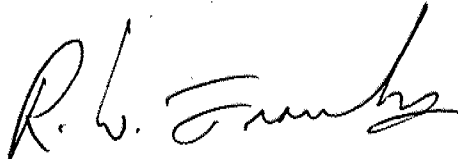
.../2



April 24, 1978

from Mr. T. Kingsland, Structural Planning, with a draft of Proposed Instrumentation at Madawaska River from Mr. M. Devata, Supervising Engineer, for our comments. Upon perusal of the draft, it was seen that there is extensive work to be done in stages and it is our feeling that this work should be indicated to the contractor at time of bidding. Due to the instrumentation, the contractor will have to appreciably change his normal construction sequence and will be delayed due to installation of the instrumentation and he should, therefore, be advised accordingly.

A Special Provision should be inserted by Addendum in the contract indicating the sequence of the work, the time required to do same, the work to be done by the contractor, and the work to be done by M.T.C.



R. W. FRANKS
Manager, Construction Office

RWF/ss

c.c.: M. Devata ✓
T. Kingsland

Mr. E.R. Saint
Head, Geotechnical Section
Eastern Region, Kingston

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 10 17

Mr. W.L. Ball

Re: Madawaska River Bridge
W.P. 198-62-00, Site 29-191
Hwy. 17N, District 9, Ottawa

In response to your memorandum of 77 10 11, we concur with you on the proposed gradation criteria for the filter material. However, we feel that these criteria could be simplified by specifying that the gradation of the filter material for Granular 'B' must fall within the shaded zone on the grading chart contained in our memorandum of 77 09 14. Our reasons are as follows:

1. For those Granular 'B' which have the same gradation as Granular 'A' or are coarser than Granular 'A', a filter is not required.
2. For those Granular 'B' which are finer than Granular 'A', the recommended grain size range of filter material is applicable.

We trust that this information will be satisfactory. If we can be of further assistance, please call.

B. Ly
B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/gs

cc: C.E. Pritchard
T.C. Kingsland
G.A. Wrong
R. Franks
K. Bassi
Files



Memorandum

To: C. E. Pritchard
Head, Planning & Design Section
Eastern Region, Kingston

From: Geotechnical Section
Eastern Region, Kingston

Attention: D. B. Thomas

Date: 77 10 11

Our File Ref.

In Reply to

Subject: W.P. 198-62-00, Site 29-191
Madawaska River Bridge
Highway 17N
District #9, Ottawa

It is recommended that the granular core on the East approach to the above structure be constructed of Granular 'B'. This material is available from a number of pits in the vicinity.

It is impossible to determine a relatively accurate gradation for the core material to be used, since the gradation will depend upon the source chosen and the method of processing. We, therefore, see no alternative but to specify that the contractor must supply a filter material which meets the following criteria.

- (1) ^{TSIS} (The maximum particle size of the smallest 15 percent) of the filter material must be at least five times as large ^{Dis} (as the maximum particle size of the smallest 15 percent of the granular core.
- (2) The maximum particle size of the smallest 15 percent of the filter material must be less than five times the size of the maximum particle size of the smallest 85 percent of the granular core.
- (3) The shape of the gradation curve for the filter material must be approximately parallel to the shape of the gradation curve of the granular core.

I trust that this information will be satisfactory. If we may be of further assistance, please call.

WLB:sh

c.c. G. A. Wrong
M. Devata
T. C. Kingsland
R. Franks

W. L. Ball
W. L. Ball
Soils Engineer



Bin. Do you agree with this

B.4
7th

Mr. C.S. Grebski
Structural Design Engineer
Structural Design Section
West Bldg., Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 09 20

Re: Madawaska River Bridge
Arnprior Bypass
(Structural Steel Scheme)
W.P. 198-62-00, Site 29-191
District #9, Ottawa

We have reviewed the Preliminary Plan of an alternate Structural Steel Design (Drawing 29-191-PIA) and discussed it with Mr. K. Bassi on 77 09 16. In this alternate scheme, the locations and elevations of the footings, as well as the designs of the approaches, were found to be in compliance with our recommendations and, therefore, are acceptable to us from a foundation point of view.

B. Ly

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/bh

cc: T.C. Kingsland
Files ✓



Memorandum

To: Mr. E.V. Saint
Head, Geotechnical Office
Eastern Region, Kingston

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

Attention:

Date: 77 09 14

Our File Ref.

In Reply to

Subject:

Re: Madawaska River Bridge
W.P. 198-62-00, Site 29-191
Hwy. 17N, District 9, Ottawa

Madawaska River Bridge is a structure sensitive to differential movements. In order to eliminate any differential movements between the piers and the abutments it was recommended that the east abutment be supported on end bearing piles driven to bedrock. Rockfill will be used to construct the east approach to the bridge and since the piles will not penetrate through the rockfill, this Section recommended that a granular core be constructed in the area where piles are to be driven.

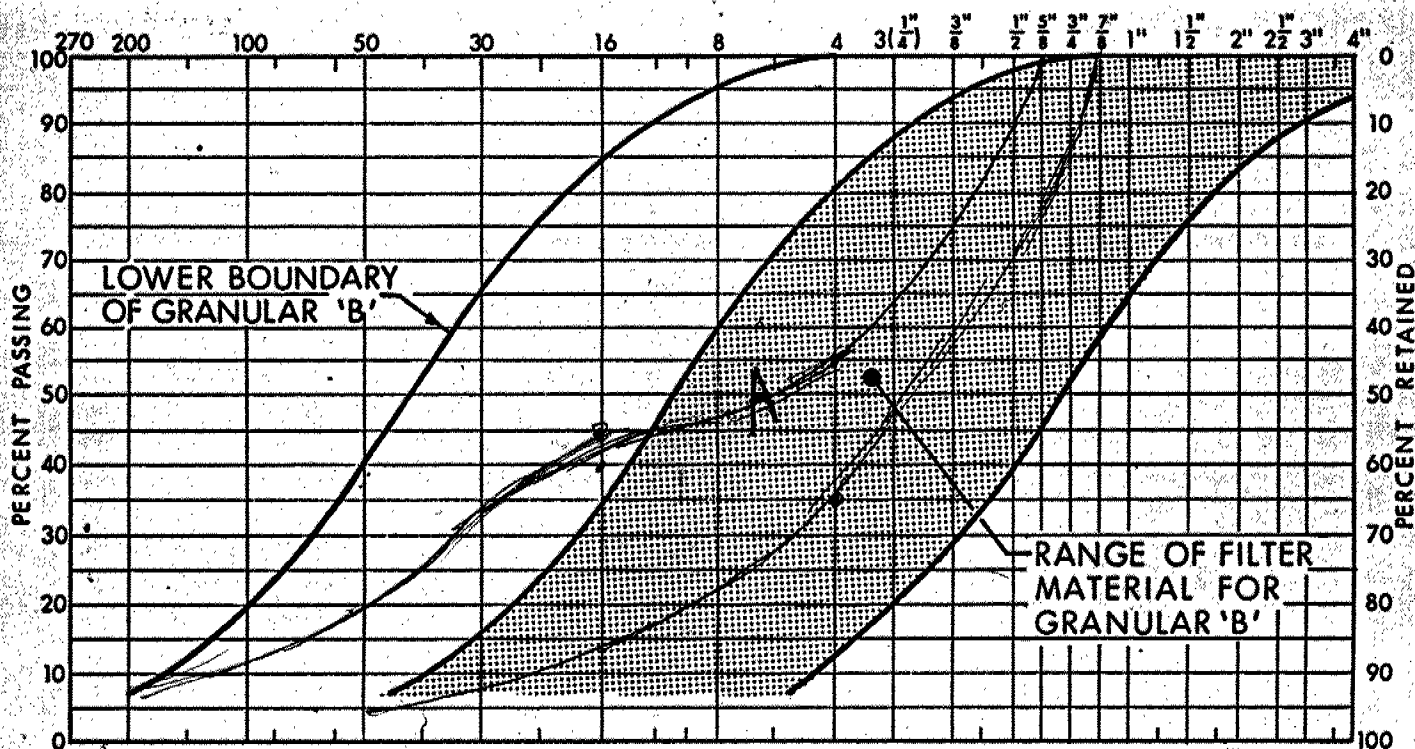
The performance of composite material consisting of rockfill and granular core was reviewed by this Section. The main concern is migration of fines from the granular core into the interstices of rockfill under seepage. If an adequate protective filter blanket is not provided between the granular core and the rockfill, subsidence of the granular core can be expected. In addition, a clay seal to prevent water from infiltrating into the granular core was also deemed necessary. As a result of this, this Section reviewed the current design criteria of constructing this composite fill, utilizing the various experience gained on composite sections of rockfill dams elsewhere. At this stage, the use of synthetic fabric as a means of protective filter was also considered. However, in view of the high embankment, placement sequence of rockfill and the compaction requirements of the granular core, it was felt that fabric may not be suitable for this project. Further, we have been advised that MIRAFL 140 is not the most suitable as a filter fabric for this type of construction (ref: enclosed memorandum from Mr. P. Korgemagi, Soils Engineer, Pavement Design and Management Section).

As you are aware, in the areas of the abutments any ground subsidence between the granular fill and the adjacent rockfill is not desirable. Our findings indicate that the filter fabric may induce sliding of the overlying rockfill due to lubrication of the fabric. Since the bridge requires some positive measures in order to ensure the integrity of the abutments and the piers, we feel such new concepts without any experience should not be experimented on a project of this cost. We are certainly interested to adopt these concepts on a simple project where the behaviour can be monitored without any detrimental effect to the structural elements. However, this Section will be very glad to receive any comments with case histories where fabric has been successfully used as a filter medium for a composite construction. If such information is available, we will be happy to reconsider such proposals.

cont'd.....

We hope our comments with regard to the granular filter blanket and the filter fabric may also answer the queries raised by Mr. A.M. Batten, Head, Regional Quality Assurance.

With regard to the design of the granular protective filter, if granular 'B' instead of granular 'C' is to be used to construct the granular core, the filter material should have a range of grain size distribution as shown below:



Should you have any queries, please contact this office.

B. Ly
B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/gs

cc: K. Bassi
S. Radbone
T.C. Kingsland
G.A. Wrong
A.M. Batten
Files



Memorandum

To: Mr. B. Ly,
Senior Engineer,
Soil Mechanics Section,
1st Floor, West Building.

From: Pav't Design & Management Section,
Room 108, Central Building.

Attention:

Date: 77 09 07

Our File Ref.

In Reply to

Subject: Madawaska River Bridge
W.P. 198-62-00, Site 29-191
Hwy. 17N, Ottawa

In response to your memo dated 77 08 29 concerning the above, we present the following recommendations. With respect to the use of the surplus Mirafi 140, Figure 1 attached, shows a plot of the pore size distribution of Mirafi 140 on Ministry grading chart. It has been recommended by filter fabric investigators that the average pore size of the fabric used to protect a soil should be greater than the D₃₀ of the soil. In this the majority of the grain size curve of Granular C is greater than the Mirafi pore size. The permeability criterion which has been suggested in the literature is that the coefficient of permeability (k) of the fabric should be twice the coefficient of permeability of the soil being filtered. Figure 2 shows the coarse limit of a soil which meets this criterion with Mirafi. The permeability of the fabric should be greater than that of the soil because of the danger of a build up of excess hydrostatic pore pressure within the granular core in the case of a sudden water draw down. For the use of Mirafi 140 as the filter fabric the gradation envelope (shaded) is shown on Figure 2. This is an extremely narrow band and it is recognized that material of this nature will be very difficult to compact.

In examining the gradation of material from nearby pits the envelope shown on Figure 3 may represent material available in the area. Assuming this material is used, the filter fabrics complying with both of the above described criteria is Permealiner, Grade M1197.

This material is available from -

Staff Industries Canada Limited,
200 Consumers Road, #200,
Willowdale, Ontario, M2J 1P8.
(416) 491-2769

The cost of this material is 24¢ per square foot.

Cont'd.../2

Madawaska River Bridge
W.P. 198-62-00, Site 29-191
Hwy. 17N, Ottawa

The fabric at the time of installation should be checked for defects, rips, holes, flaws, etc. and rejected if damaged. The surface to receive the fabric should be free of obstructions. The fabric should be placed smooth with the long dimension parallel to the centreline of the channel. The strips should be placed to provide a minimum width of 18 inches (0.5 m) of overlap for each joint. These strips may be held in place with securing pins and washers at intervals of about 2 feet (0.6 m). Stone slope protection should not be dropped on the fabric from a height greater than 1 foot (0.3 m). The last strip of fabric should be extended a minimum of 3 feet (1 m) over the top of the granular core and a similar distance beyond the toe of the slope as shown on Figure 3. There appears to be no need to place the fabric along the back of the granular core.

It was indicated in the conversation that a similar construction may be tried under water at some future date. A danger in placing filter fabric under water is the possibility of a lack of continuity if not properly placed. The fabric is extremely flexible and will bend, crease, fold and stretch. It must be placed loosely so that distortions from placement of heavy stones will not stretch it beyond its elastic limits. The irregularity of underwater placement requires more overlap between strips, about 3 feet (1 m).

One method of laying fabric under water which has been tried is by rolling two or three lengths of the fabric onto a spindle with a 3 foot (1 m) overlap. The widths of most fabrics vary from 6 (1.8 m) to 15 feet (4.6m). The strips may have to be sewn together. The fabric is then unrolled along the slope of the granular core into the water with the spindle being controlled from a crane.

The fabric may be held in place by placing rocks by hand. Proper anchoring in the water is important because if the fabric begins to lift and swirl in the water, it is difficult to catch and repeg it. Divers may be required in deep water. This Unit will be pleased to give further guidance during installation.

If you have any further questions, please contact us.


P. Korgemagi,
Soils Engineer.

PK/sd
Attached



AGGREGATE GRADING CHARTS MINISTRY SIEVE DESIGNATION

GRANULAR A & B

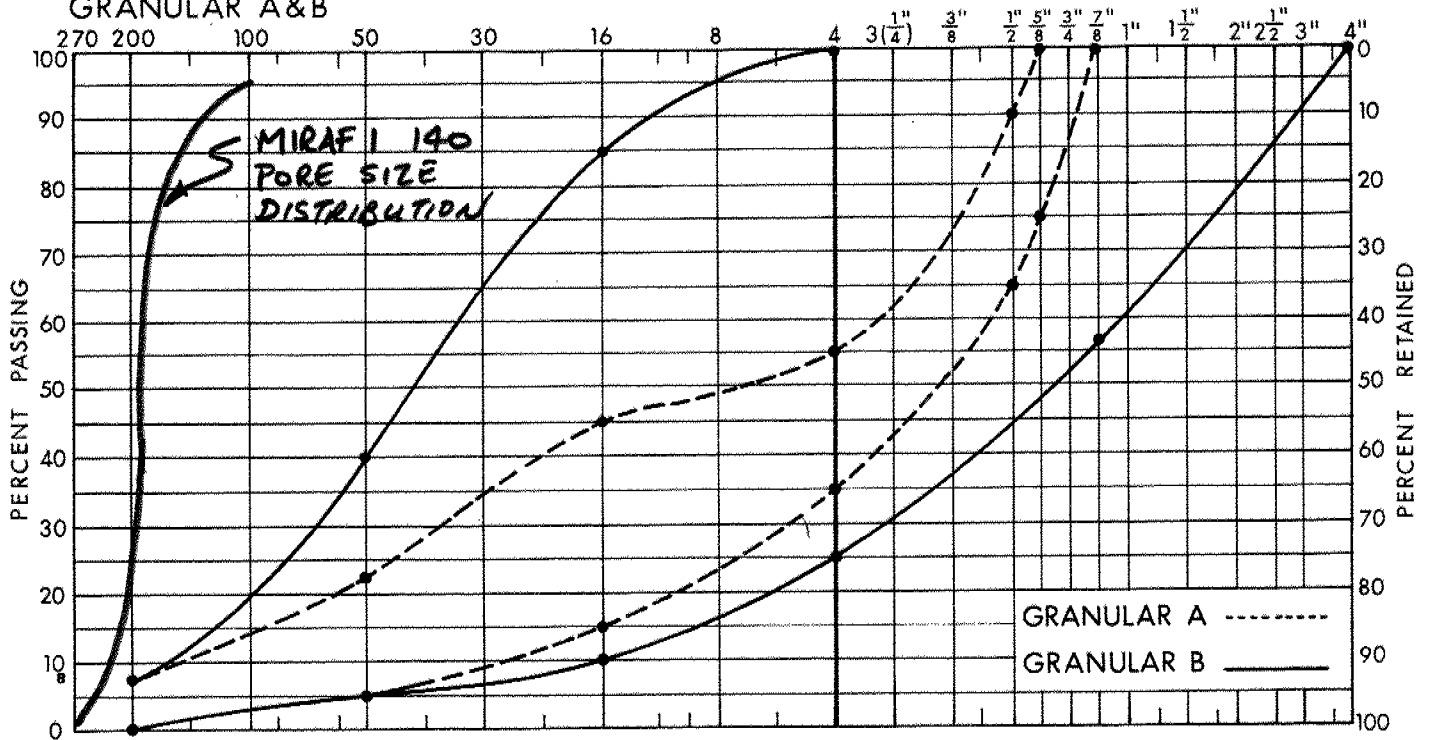


FIGURE 1

GRANULAR C & D

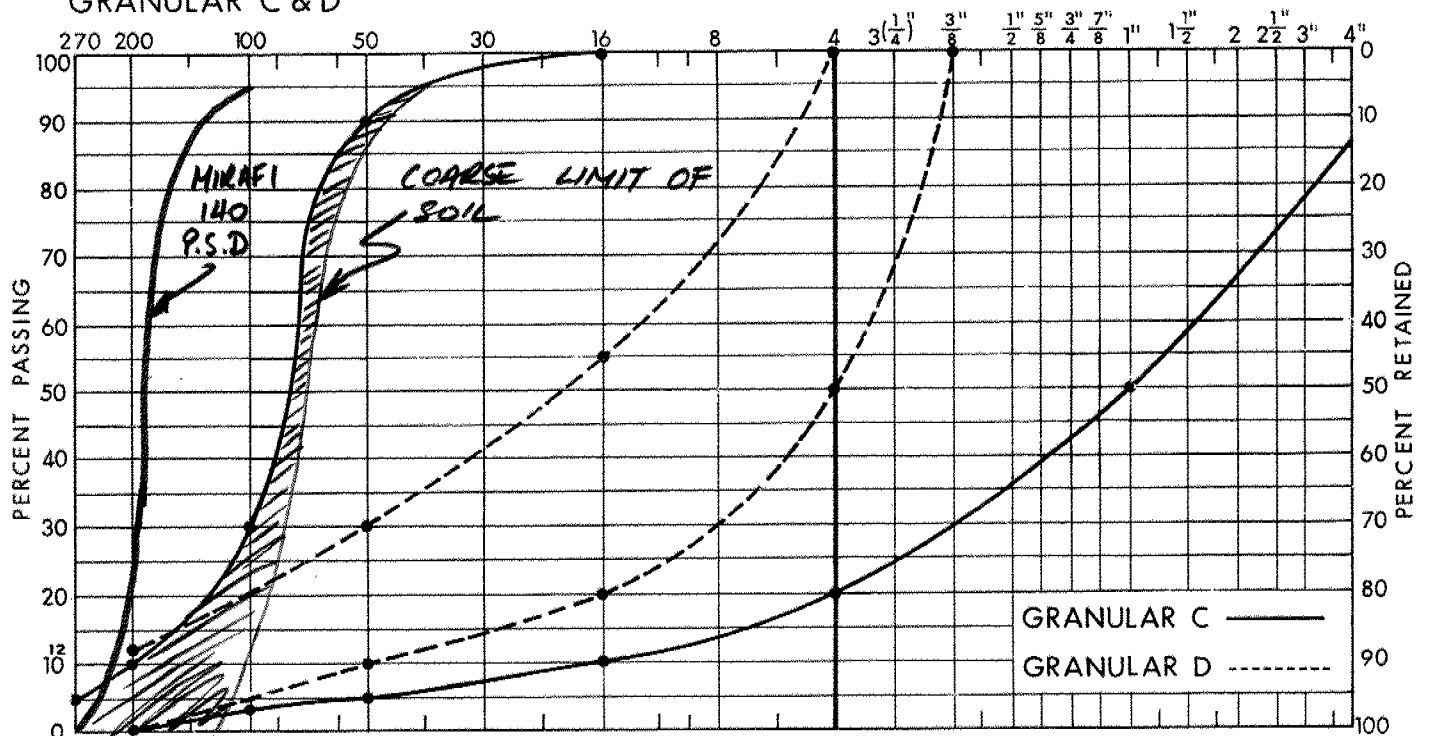
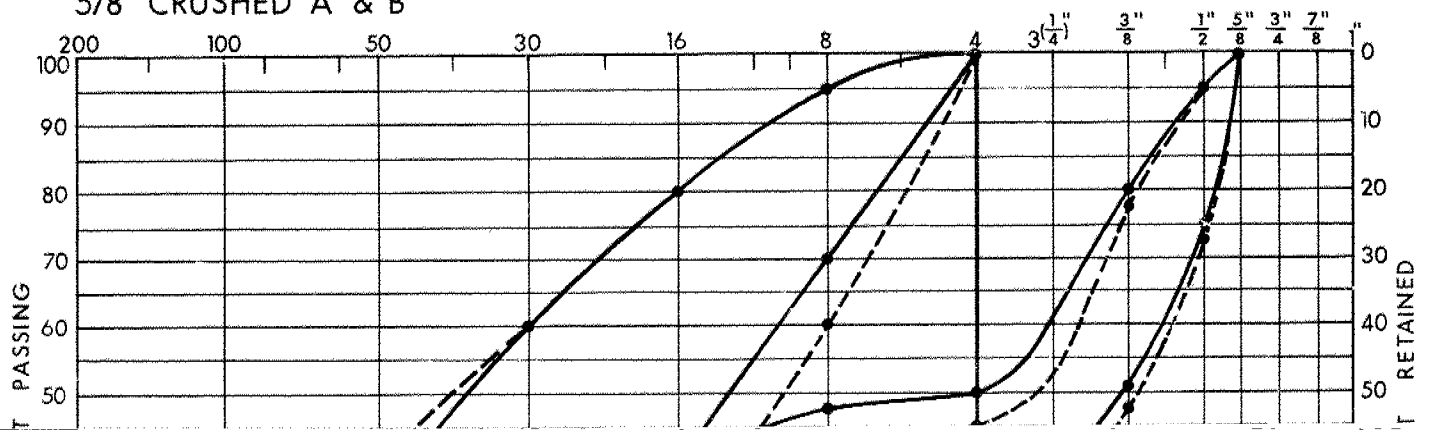


FIGURE 2

5/8" CRUSHED "A" & "B"



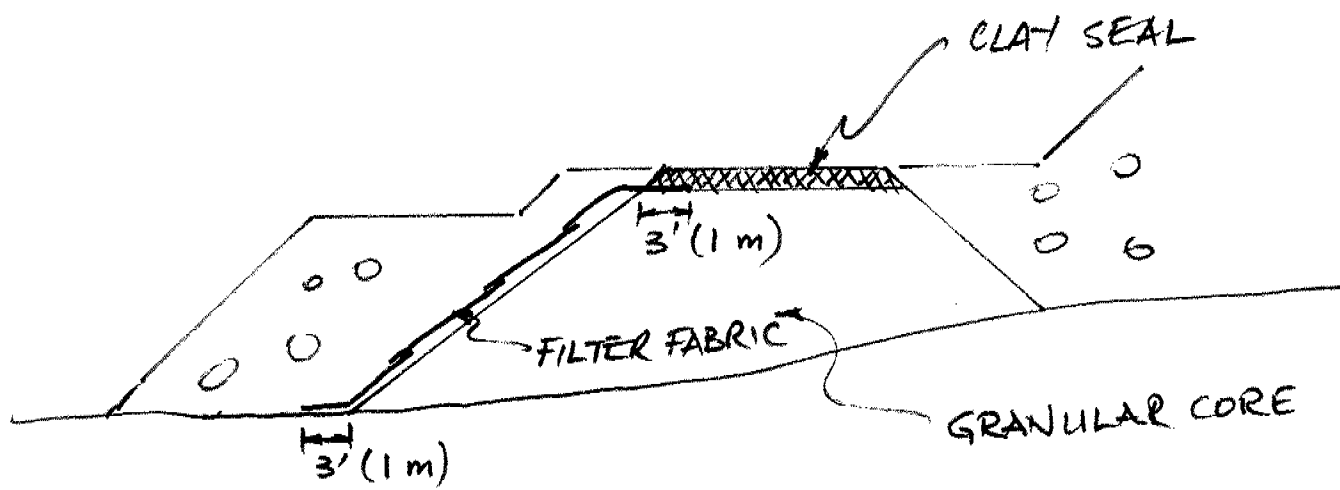


FIGURE 3



AGGREGATE GRADING CHARTS MINISTRY SIEVE DESIGNATION

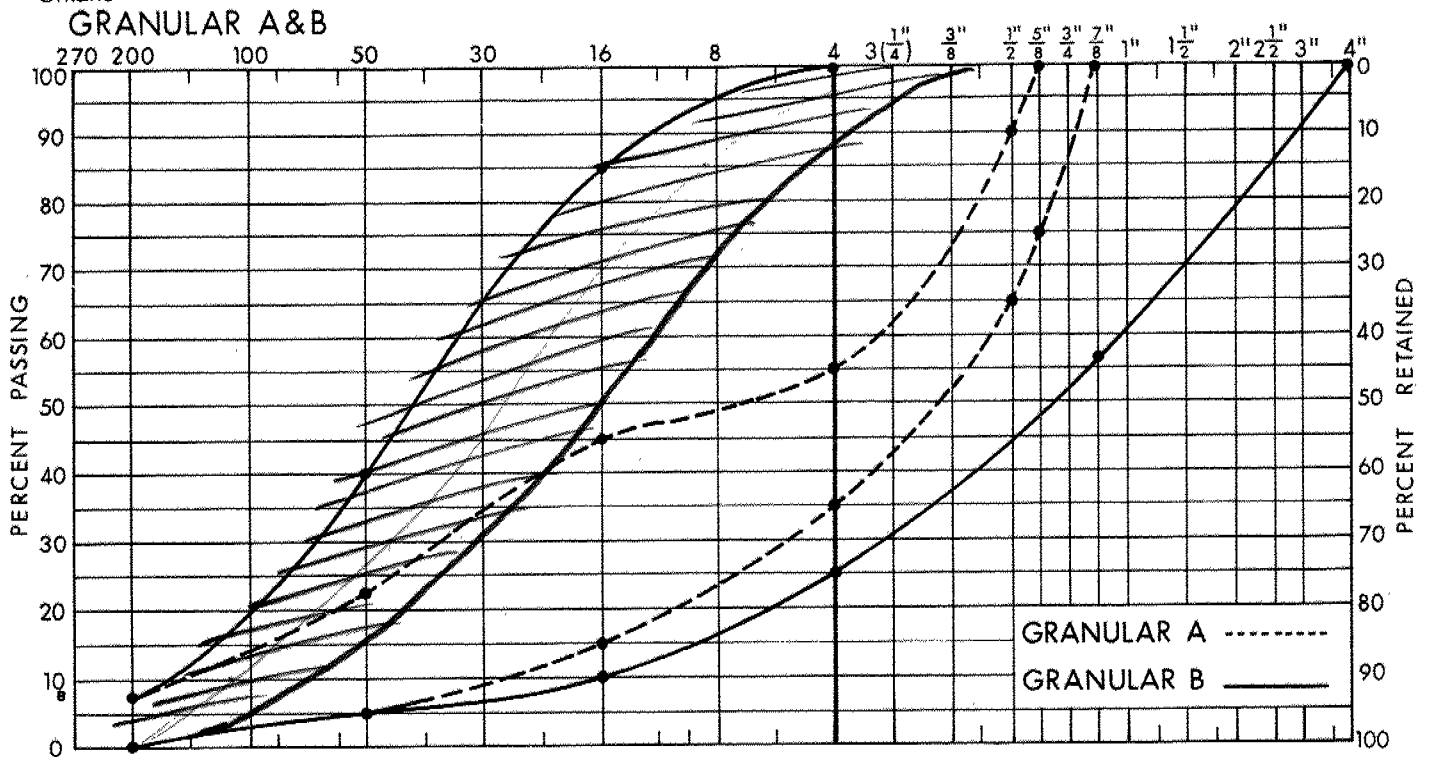
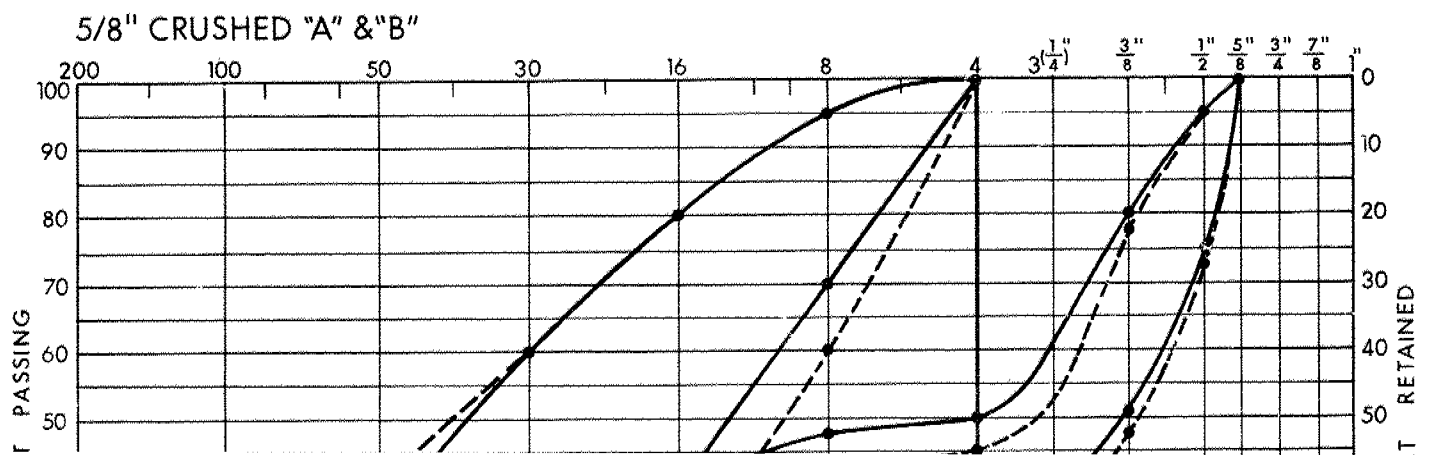
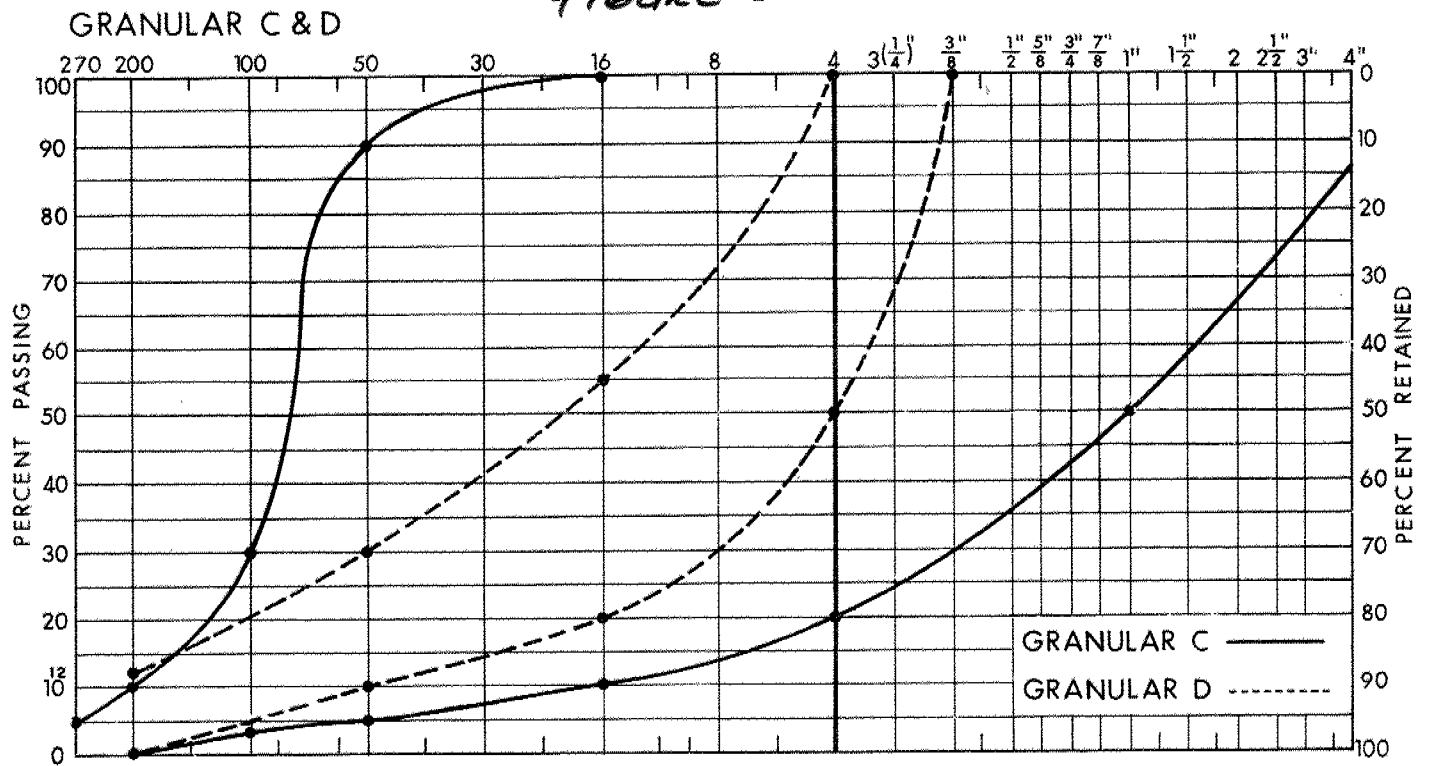


FIGURE 3



Mr. A.K. Barsvary
Head, Quality Assurance Section
Central Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 08 29

Re: Madawaska River Bridge
W.P. 198-62-00, Site 29-191
Hwy. 17N, Arnprior Bypass
District 9, Ottawa

The east approach to the Madawaska River Bridge is to be constructed of rockfill material and a granular core is to be constructed at the east abutment location where piles are to be driven. We deem it necessary that the granular core be protected with a graded granular filter blanket in order to prevent fines from the granular core from being washed into the rockfill. The Regional Quality Assurance Section has suggested to use MIRAFI 140 in lieu of the granular filter blanket. In view of the potential saving in cost, we will appreciate it if you would investigate whether the fabric filter is suitable to be used in this project and advise us accordingly.

A memorandum from the Regional Quality Assurance Section is attached for your information.

B. Ly
Senior Engineer

Attach.

BL/gs

cc: A.M. Batten
G.A. Wrong
E.R. Saint
K. Bassi
S.C.J. Radbone
T.C. Kingsland
Files



Memorandum

To: Mr. C. R. Mirza
Head, Soils Mechanics Section
Engineering Materials Office
Downsview

From: Quality Assurance Office
Eastern Region - Kingston

Attention:

Date: 77 08 17

Our File Ref.

In Reply to

Subject: W.P. 198-62-00, Site 29-191,
Madawaska River Bridge, Arnprior Bypass,
Hwy. #17N, District 9-Ottawa

I have just received a copy of Mr. Ly's memorandum to Mr. T. Kingsland dated August 4th, 1977, and outlining granular core construction proposals under the east abutment of the above-noted proposed structure.

Construction of the 3' thick filter as proposed can be achieved but would probably be expensive.

The area should be studied to ascertain available granular materials and the most suitable and economical designation for the granular core material. Perhaps a Granular "B" material would eliminate the need for a filter except on the area adjacent to the river flow up to the high water level. In this area a fabric filter may be more effective than one constructed from granular material.

There will probably be a surplus of MIRAFL 140 fabric material left from the grading job just west of Ottawa. This material can be retained at Ottawa District Stores. You can obtain more data on this material from Gerry Wrong. We can send you a sample if you wish.

The proposed clay seal wouldn't be difficult to construct. However, in view that most of the area will be covered by the structure, you may reconsider if it is needed, when the final granular core material and filter type have been selected.

For your consideration please.

A. M. Batten
A. M. BATTEN
Head, Quality Assurance

AMB/se
c.c.: G. A. Wrong
E. R. Saint
K. Bassi
S.C.J. Radbone
T. Kingsland





Memorandum



To: Mr. T. Kingsland
Regional Structural Planning Engineer
Eastern Region
Kingston, Ontario

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

Attention:

Date: 77 08 04

Our File Ref.

In Reply to

Subject:

Madawaska River Bridge - Arnprior Bypass
W.P. 198-62-00, Site 29-191
Hwy. 17 N, District #9 Ottawa

Further to the meeting held on 77 07 28 in the Structural Office, we have investigated the design details of the granular core, which is to be constructed at the east abutment location, as well as the possible subexcavation of a clay area at the southwest toe of the east approach fills. Our comments and recommendations are as follows:

1. The clay is desiccated and has a very stiff consistency. Therefore, it need not be subexcavated.
2. The granular core, including the clay seal and the filter, should be constructed to the dimensions as shown in Fig. 1.

The granular core should not contain material larger than 3 inches in size. Furthermore, material in the core should be placed and compacted as per current M.T.C. practice.

The clay seal should be designed and constructed as per M.T.C. special specification form 1205, a copy of which, together with a plasticity chart (Fig. 2) for the clay seal, is attached to this memorandum for your information.

The filter is to prevent fines in the granular core from being washed into the rockfill. Gradation of the filter therefore, should be conforming to the criteria given below:

- The 15% size of the filter (i.e., the particle size which is coarser than the finest 15% of the soil, D_{15}) should be at least five times as large as the D_{15} size of the soil being protected by the filter.
- The D_{15} size of the filter should not be larger than five times the D_{85} size of the protected soil.
- The gradation curve of the filter should have roughly the same shape as the gradation curve of the protected soil.
- Where the protected soil contains a large percentage of gravels, the filter should be designed on the basis of the gradation curve of the portion of the material which is finer than the 1-in. sieve.



- Filters should not contain more than about 5% of fines passing the No. 200 sieve, and the fines should be cohesionless.

For example, if Granular 'C' is used to construct the granular core the filter material would lie within the hatched area shown on Fig. 3. When the type of material to be used in the granular core is finalized, this Section will provide specific recommendations with regard to the gradation of the filter material.

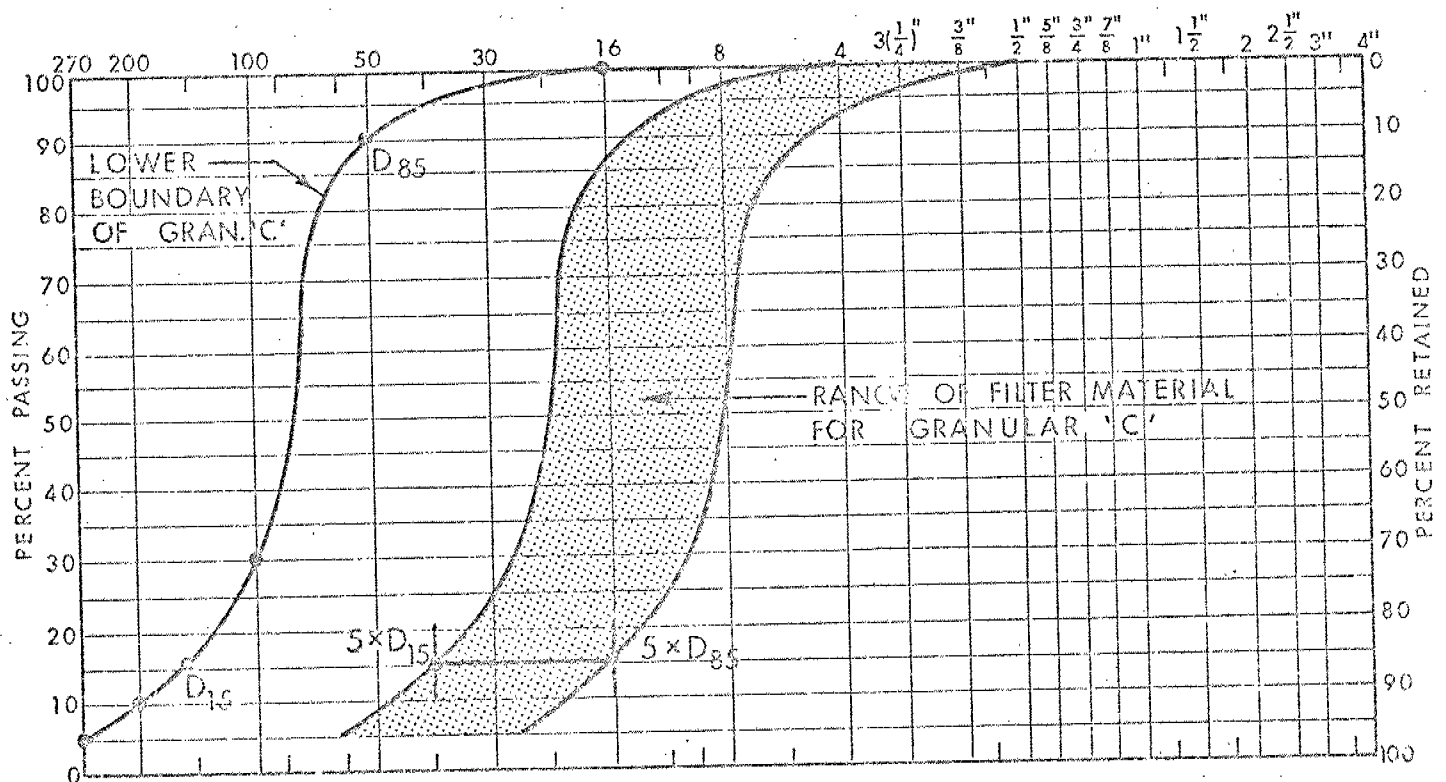


FIG. 3 GRAIN SIZE DISTRIBUTION ENVELOPE FOR FILTER MATERIAL

Filter material should also be placed and compacted as per current M.T.C. practice.

As discussed previously, The Soil Mechanics Section intends to instrument the east approach fills. This Section will appreciate it if the Region would make provisions for the instrumentation. Please contact this Section for the pertinent details.

B. Ly

B. Ly

for:

M. Devata
Supervising Engineer

BL/MD/kr

cc: Mr. Childs
G.A. Wrong
K. Bassi
E.V. Saint
Mr. R. Franks
S. Radbone
Files

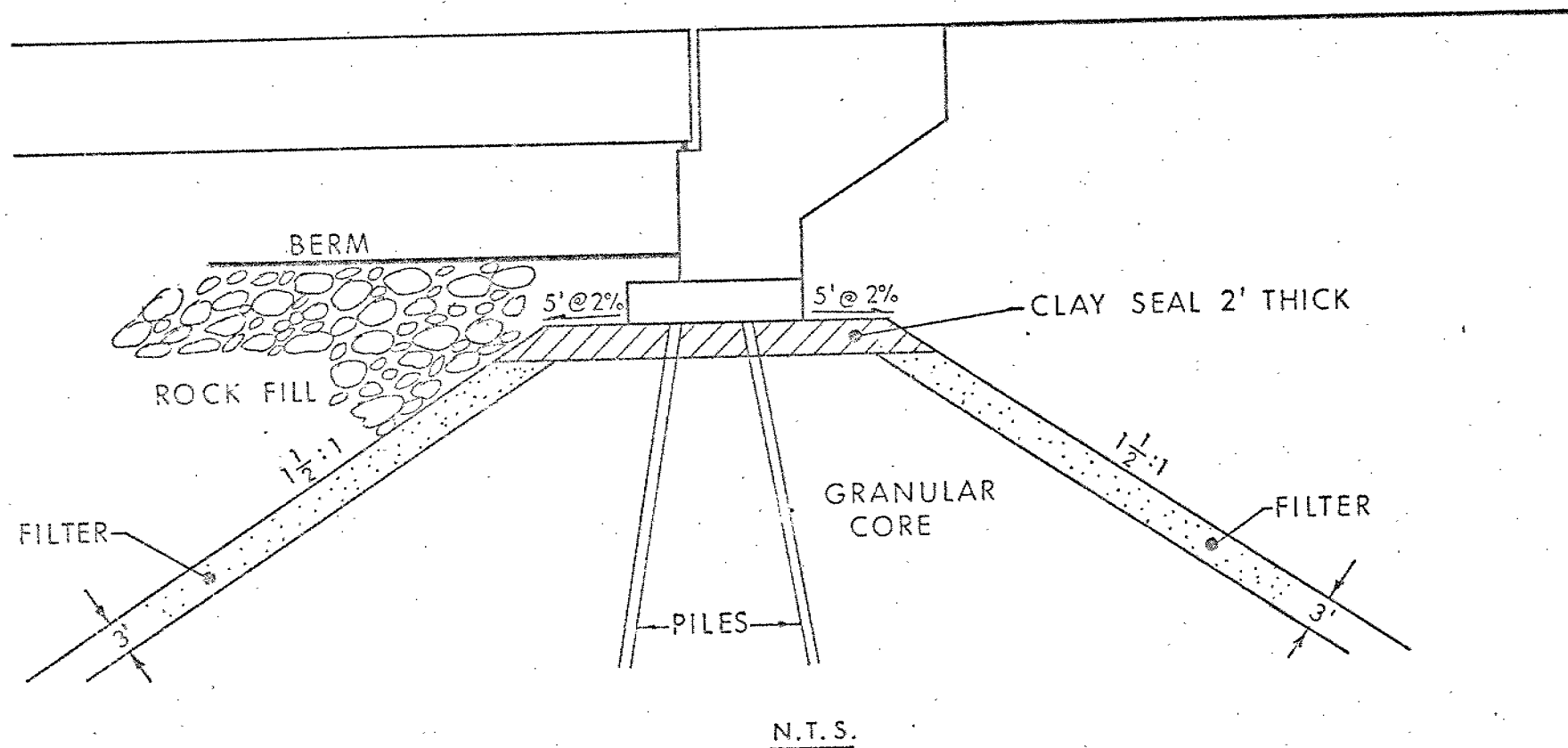


FIG. 1. DETAILS OF GRANULAR CORE (EAST ABUTMENT)

Mr. K.C. Bassi
Structural Engineer
Structural Office
West Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 08 11

Re: W.P. 199-62-00, Site 29-191, CPR Overhead
✓ W.P. 198-62-00, Site 29-200, Madawaska River Bridge
Arrnprior Bypass, Hwy. 17N
District 9, Ottawa

We have reviewed the design drawing of the first stage grading of these projects. Our comments are as follows:

1. Fill should not be placed on the existing slopes adjacent to the CPR tracks until the retaining walls have been constructed to their full heights. If surplus excavated material is available, this can be placed at the culvert site near Sta. 777+75. However, if this material is intended to be used subsequently as a roadway embankment fill, it should be of an acceptable quality.
2. The forward slope of the west approach to the Madawaska River Bridge should be maintained at 2.5:1.

B. Ly
B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/gs

cc: T.C. Kingsland
J. Childs
G. Wong
E.V. Saint
D.E. Moorhouse
S. Radbone
Files ✓



Memorandum

To: Mr. T. J. Kingsland,
Regional Structural Planning Engineer,
Kingston.

From: Materials and Testing Office,
Kingston.

Attention:

Date: October 25, 1976.

Our File Ref.

In Reply to

Subject: W. P. 198-62-00, Madawaska River Bridge,
Hwy. #17N, District 9, Ottawa

Reference your memorandum to file October 19, 1976. In a memorandum from T. R. Graham, it was outlined that limestone quarries are established at approximately 5 - 6 miles from the above-noted structure site.

Precambrian rock is situated approximately 2 to 3 miles west of the project. The bedrock is primarily crystalline limestone similar to that encountered in the cuts on Hwy. #17N West of Arnprior.

Sandy to sandy granular type borrow is available approximately 3 miles East of the site and sandy loam type borrow can be obtained from approximately 5 miles West of it.

The estimate for rock borrow indicated in your memorandum seems low to me. It would probably be of advantage to have our Estimating Office provide estimates for both earth and rock borrow on the basis of the availability indicated herein, the estimated quantity of borrow required and the unit prices that we are getting in the bids are for similar type of work. There will be considerable borrow required on the adjacent grading sections of the project.

For your consideration please.

AMB/mw

A. M. Batten
A. M. Batten,
Senior Soils Supervisor

c.c.: S. C. Radbone
M. Devata ✓



Mr. T.C. Kingsland
Regional Structural Planning Engineer
Eastern Region, Kingston

Soil Mechanics Section
Geotechnical Office
West Building, Downsview

October 13, 1976

Madawaska River Bridge and Lower Access Road
E.B.L. - Arnprior Bypass, Hwy. 17N
W.P. 198-62-00, Site 29-191
District #9, Ottawa

The Structural Planning Office of the Eastern Region initially proposed two structure schemes (scheme 1 and scheme 2) for the crossing of the EBL of Hwy. 17N at Madawaska River. A foundation investigation has been carried out by the Section in order to assess the feasibility of these schemes from a foundation point of view. In this study additional data pertaining to bedrock contours established by the Eastern Region were also utilized. The available data revealed quite variable bedrock surface at the structure site and specifically steeply shelving rock on the west river bank. This bedrock configuration will pose some difficulties in the design and construction of the pier footings. In order for the Region and the Structural Design Office to be able to proceed with their design work without any undue delay this Section will present our comments in this memorandum. A foundation report for preliminary design will follow in the near future. Our comments are as follows:

1. General Considerations

All structure schemes proposed by the Region for the Madawaska River crossing involve a three span structure. For the crossing at the Lower Access Road a structural plate culvert may be required if the east abutment of the Madawaska River Bridge is located to the west of the Lower Access Road. In general, the following two considerations are essential in determining the footing locations:

- (a) Locations of the east abutment and the west abutment will depend on the forward slope of the approaches. For rock fill in the order of 55 to 70 feet in height, the overall slope should not be constructed steeper than 1 3/4:1. For earth fill in the order of 60 to 70 feet high, the overall slope should not be steeper than 3:1. Recommended slopes for various fill heights are contained in our memorandum of June 15, 1976. It is advisable to provide a mid-height berm for the fill, while maintaining its overall slope at the recommended

cont'd.....

gradients. It should also be noted that a minimum horizontal clearance of 15 feet between the culvert and the piles of the east abutment should be maintained in order to protect the culvert from pile driving.

- (b) Footings of the east pier and the west pier should be located in such a manner that a 45° line drawn from any point of the base of the footing will not intersect with the free face of the rock slope and that a minimum of 5 feet horizontal distance will be maintained between the outermost edge of the base of the footing and the rock slope.

2. Comments on Structure Schemes and Footing Locations

Based on the above mentioned considerations our assessments of the various structure schemes and footing locations are as follows:

2.1 Scheme No. 1 (old alignment)

- West Abutment (Sta. 786+26): considered satisfactory.
- West Pier (Sta. 788+36): considered not desirable since the footing is too close to the steep face of the river bank. In our opinion, this footing should be located at least to the west of Sta. 788+25.
- East Pier (Sta. 792+16): satisfactory from a foundation point of view.
- East Abutment (Sta. 794+16): not satisfactory since the forward slope will interfere with Lower Access Road. Therefore the footing should be relocated.

2.2 Scheme No. 2 (old alignment)

- West Abutment (Sta. 786+55): considered satisfactory.
- West Pier (Sta. 788+36): comments same as per Scheme No. 1.
- East Pier (Sta. 791+05): consideration should be given to relocating this footing since bedrock is too steep and furthermore, extensive dewatering scheme will be required during construction.

In view of this we recommend the footing be relocated so that the footing will be founded on relatively level bedrock surface.

- East Abutment (Sta. 792+88): This location should be checked so that adequate clearance will be maintained between the piles and the culvert for the Lower Access Road.

In order to achieve an economical structure configuration which will not only resolve the foundation problems caused by the steep nature of the bedrock surface but also satisfy the constraints imposed by the close proximity of the Lower Access Road, this Section has been in close liaison with the Regional Structural Planning Office and the Structural Design Office.

cont'd.....

As a result of our discussions, the Regional Structural Planning Office has presented a new alignment 20 feet south of the original alignment with similar structure schemes, together with additional tentative locations of the west pier (locations A, B, C, D, X and Y) and requested this Section to comment on their feasibility. The new locations of the west pier are shown in Drawing No. 29-191 Sheet Sk #1-#4 prepared by the Eastern Region.

2.3 New Alignment

The new alignment is located 20 feet south of the old alignment. In general, we are in favour of the new alignment from a foundation point of view.

2.4 Footing Schemes for the West Pier

Footing of the west pier at the various proposed locations should be founded at or below the following elevations in accordance with consideration (b):

<u>Footing Scheme</u>	<u>Location</u>	<u>Elevation</u>
A	Sta. 288+25 (old alignment)	261.0
B	Sta. 288+60 (old alignment)	251.0
C	Sta. 288+25 (new alignment)	272.0
D	Sta. 288+70 (new alignment)	252.0
X	Sta. 288+45 (old alignment)	254.0
Y	Sta. 288+ 50 ₄₅ (new alignment)	265.0

Considerable amounts of rock excavation will be required for the west pier under footing schemes A, B, D and X. Therefore, footing schemes C and Y appear to be less expensive. However, the decision on the various schemes should be based on overall economical considerations.

3.1 Foundations

The piers can be supported on spread footings located on sound bedrock, while the abutments on end bearing piles driven to bedrock.

For design purposes a safe bearing capacity of 20 tsf can be assumed for footings on limestone bedrock. Keys or rock anchors may be required to provide the footings with sufficient resistance against sliding and overturning.

The end bearing piles to support the east and west abutment can be designed for their maximum allowable capacities. Since rock-fill will be used to construct the approaches a granular core should be constructed where piles are to be driven.

cont'd.....

No foundation problems are anticipated for the pipe culvert at the Lower Access Road. Types and placement of bedding material should be in accordance with pertinent MTC standards.

It should be noted that these are preliminary recommendations and that further investigation may be required when footing locations have been finalized.

B. Ly

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

MD/BL/gs

cc: C.S. Grebski
M. Batten
S.C. Radbone
A.G. Boucher
R.J. Forrest
Files ✓
Record Services

Mr. C.S. Grebski
Structural Design Engineer
Structural Design Section
West Building, Downsview

Soil Mechanics Section
Geotechnical Office
West Building, Downsview

October 26, 1976

Madawaska River Crossing and Related Approaches
Hwy. 17N, Arnprior Bypass
Site 29-198, W.P. 198-62-00
District #9, Ottawa

Concern was expressed by Mr. C.S. Grebski, Structural Design Engineer, in a memorandum dated October 8, 1976, with regard to slopes and berm requirements for the proposed 70 ft. high rock embankments at the above mentioned structure crossing. Due to the urgency of this project a meeting was held at the Structural Office on October 13, 1976, to discuss the various requirements. This meeting was attended by Messrs. C.S. Grebski, K. Bassi, M. Devata and B. Ly.

Minutes of the Meeting

Mr. Grebski was of the opinion that the rock fill approaches with a maximum height of 70 ft. could be constructed with standard $1\frac{1}{2}:1$ slopes since the approaches will be constructed on competent foundation base.

Mr. Devata indicated that the stability of rock fills on good foundations would depend on the mobilized ϕ (angle of shearing resistance) value. In rock embankments of less than 35 ft. height, it is normally taken as the angle of repose and as a result of this our M.T.C. standards indicate a slope of $1\frac{1}{2}:1$. For fills of higher magnitude such as 70 ft. in height contemplated at this project, the stability of slopes should be based on the rock properties, the gradation, as well as method of construction. According to available data the ϕ value tends to decrease depending upon the height of the embankment due to high internal stresses at the contact points. This will tend to break down point to point contact and increases in the magnitude of the settlement.

Mr. Grebski suggested that the data of the Burnstown Bridge over Madawaska River should be reviewed since the approach fills are composed of rock fill material of similar type and the heights are of the order of 80 ft. in height. However, the difference in two sites being at the Burnstown Bridge, half of the fill height is above water.

cont'd.....

Mr. Devata indicated that the Soil Mechanics Section had already communicated Golder and Associates in Ottawa and ascertained that they had difficulty in maintaining slopes of $1\frac{1}{2}:1$ with a midheight berm of 10 ft. At this location compaction was carefully achieved above the river water level by means of sophisticated equipment such as Vibro Plus. The final overall slopes were found to be somewhat flatter than $1\frac{1}{2}:1$ and steeper than $1\frac{3}{4}:1$.

After considerable discussion it was agreed that the properties of rock fill material and placement methods will have significant effect on the overall slopes. It is also understood that the stock piled rock fill material near the hydro dam may not be the cleanest rock fill. In view of this it was concluded at this meeting by the members present that the following slopes should be adopted for design requirements.

<u>Type and Placement</u>		
<u>Height of Embankment</u>	<u>Quality assurance of rock fill material</u>	<u>Stock piles rock fill material and uncompacted</u>
70 ft.	Overall slope $1\frac{1}{2}:1$ Alternatively $1\frac{1}{4}:1$ slopes with mid-height berm of 20 ft.	Overall slope $1\frac{3}{4}:1$ Alternatively $1\frac{1}{2}:1$ slopes with mid-height berm of 20 ft.
55 ft.	$1\frac{1}{4}:1$ slopes with 15 ft. midheight berm	Overall slope $1\frac{1}{2}:1$ Alternatively $1\frac{1}{4}:1$ slopes with mid-height berm of 20 ft.

Mr. Devata strongly recommended the use of midheight berm taking into consideration such factors as maintenance, safety and performance of the embankment.

B. Ly

B. Ly
Senior Engineer

BL/gs

cc: T.C. Kingsland
E.V. Saint
J.D. Harris
Files
Record Services



Memorandum

To: Mr. C. Mirza,
Head, Soil Mechanics Section,
West Building, Downsview.

From: Structural Office,
West Building, Downsview.

Attention:

Date: October 8, 1976.

Our File Ref.

In Reply to

Subject: Madawaska River Crossing and Related Approaches
Hwy. 17N, Arnprior Bypass
Site 29-198 District #9
WP/97-62-00


Attached herewith is a copy of a memo from your staff regarding preliminary foundation requirements at the above site.

Of concern to us are the requirements of slopes and berms for good fill material on firm ground. Due to this requirement additional costs will be incurred.

For the Madawaska River Bridge at the East abutment rock fill will be 70 feet high. According to the attached table the slope should be 1 1/2:1 with a 20 foot berm. If the previous criteria which proved adequate to us was used (ie. 1 1/4:1 with no berm) there would be a length saving in the bridge of 20 feet + 1/4 x 70 = 18 = 38 feet total. At a cost of \$70 per square foot this means \$133,000 extra bridge cost. The other abutment would also cost more. This figure does not include extra fill cost. Probably the total extra cost would approach \$200,000.

We request a review of these requirements in the light of the high costs. If the embankments moved, using previous standards, the repairs could be handled by our regular maintenance methods at relatively low costs.

CSG/cf
Attch.


C. S. Grebski,
Structural Design Engineer.





Memorandum

To: Mr. T.J. Kingsland
Structural Planning Office
Kingston, Ont.

From: Soil Mechanics Section
Geotechnical Office
West Bldg.

Attention:

Date: June 15, 1976

Our File Ref.

In Reply to

Subject:

Madawaska River Crossing & Related Approaches
Hwy. 17N, Arnprior Bypass, Dist. 9
W.P. 197-62-00

Site 29-198

We have reviewed our subsoil information at the proposed bridge site, and submit the following comments for your preliminary planning purposes.

In general, subsoil at the site consists of a deposit of stiff silty clay/clayey silt, overlying crystalline limestone bedrock. Thickness of the cohesive overburden is variable, ranging from rock outcrops to the order of 45 ft. Bedrock elevations in this locale also show considerable variations.

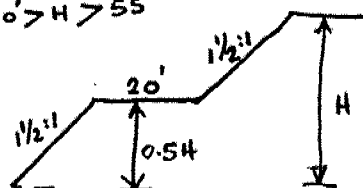
In view of the stiff consistency of the overburden, we do not foresee deep-seated failures for the approaches. In our opinion, safety of the embankments is likely to be governed by the stability of the fill itself. The following recommendations are presented so that decision on the preliminary structure layout can be made.

EARTH FILL		ROCK FILL	
Fill Ht.	Stable Configuration	Fill Ht.	Stable Configuration
Up to 30 Ft.	2:1	Up to 25 Ft.	1½:1
Up to 40 Ft.	2.5:1	Up to 35 Ft.	1½:1
50' > H > 40'	2:1 with 20' berm at mid-height	45' > H > 35'	1½:1 with 15' berm at mid-height
60' > H > 50'	2:1 with 25' berm at mid-height	55' > H > 45'	1½:1 with 20' berm at mid-height

A cut is also required for the upper road to the dam. Because the clay contains seams of sand and silt, it is recommended that a cut up to 20 ft. high should not be constructed steeper than 2:1 and a cut up to 25 ft. not steeper than 2.5:1.



Rock fill 70' > H > 55'



Oct 6/76

It should be noted that when the footing locations have been decided on, additional foundation investigation should be carried out to obtain detail subsurface information, for design and construction purposes. A foundation investigation is also required for the creek crossing in the vicinity of Sta. 777+50.

From our point of view, lowering of the profile grade at the Madawask River crossing is advisable, as far as economy and stability are concerned. Therefore, consideration should be given to lowering the grade at Sta. 771+00 to Sta. 776+00, where the road should be brought to bedrock elevations.

B. Ly

Bin Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/bp

cc: S. Redborne
E.V. Saint
C. Bassi ✓
Files
Record Services

FOUNDATION INVESTIGATION REPORT

For

Madawaska River Bridge

Arnprior Bypass

W.P. 198-62-00, Site 29-191

Hwy. 17N, District 9, Ottawa

INTRODUCTION

This report contains the results of our investigations of the subsurface conditions existing at this site. The fieldwork was done in various stages and the results of 18 borings pertinent to the proposed structure and the related approaches are presented. Borings on land were advanced by means of an auger machine or a diamond drill rig. Borings located in the river were done by means of a diamond drill rig mounted on a raft. The borings ranged in depth between 11 feet and 42 feet below ground surface or the prevailing river water level. Bedrock was proven by obtaining NX size rock core samples. In addition, a field permeability test using double packers was also performed in one of the boreholes on either side of the river.

SITE AND GEOLOGY

The site is located near the Town of Arnprior on Lot 1, Conc. B, Township of McNab, County of Renfrew and is situated some 550 feet downstream north of the existing Ontario Hydro Dam. At this location, Madawaska River is about 300 feet wide and is deeply incised into the surrounding tablelands. The river water level, which is controlled by the Hydro Dam, generally varies between elevations 254 feet and 258 feet. According to available information, the maximum depth of water in the river in the vicinity of the site is in the order of 45 feet.

The river banks in this locale vary from moderately steep rockface on the east to steeply shelving rockface on the west. In the vicinity of the site bedrock is generally exposed, except at certain locations where it exists at a shallow depth. The area east of the river is sparsely vegetated, whereas the area west of the river is heavily covered with spruces, pines and cedars. According to available information, the approaches to the structure have been constructed to their full height under MTC Contract 78-42.

Geologically, the area is located between the Precambrian Upland to the north and west and the Ottawa Lowland to the south and east. A depression geologically known as the 'Ottawa-Bonnechere' graben, is located in the County of Renfrew. Within it are prominent east-west trending scarps (fault zones). One fault zone is located just upstream of the main dam area. Bedrock here mainly consists of crystalline limestone and has been subjected to faulting, weathering and erosion. The overburden mainly consists of sensitive marine clays deposited by the Champlain Sea when it inundated the Ottawa-St. Lawrence lowland.

SUBSURFACE CONDITIONS

General

In the area under investigation, bedrock is exposed or exists at a shallow depth. The overburden, wherever it exists, mainly consists of a thin layer of clayey silt. On the east side of the river, the thickness of the overburden appears to be increasing towards the Hydro Dam. At certain locations on the east bank rockfill up to 8 feet thick was placed on the original ground after construction of the Hydro Dam. The locations and elevations of the borings are shown on Drawing No. 29-191-2, together with the estimated stratigraphical sections. It should be noted that the approach fills were already constructed under a separate contract. For details about the type of fill material and the geometry of the approaches, references should be made to Contract 78-42. A description of the subsoil and bedrock conditions encountered during the time of investigation is as follows.

Clayey Silt

This cohesive deposit has a variable thickness, being generally less than 2.5 feet thick on the west side of the river to about 12 feet thick at one location on the east side of the river. According to the geology of the area, the cohesive subsoil was deposited by the post-glacial Champlain Sea. The clayey silt is desiccated, brittle and fissured. The Standard Penetration Test 'N' values recorded in the cohesive deposit ranged from 9 blows/foot to 18 blows/foot and it is inferred from this that the consistency of the clayey silt is stiff to very stiff.

Bedrock

Bedrock, in general is exposed on both sides of the river banks and also within the river bed. Elsewhere in some locations, bedrock is covered with a thin layer of clayey silt.

Bedrock is a crystalline limestone of Precambrian Age. This metamorphic rock is light grey in color, with a coarse texture and generally hard. The beddings generally incline towards the river at 45° to 55°, but sometimes are contorted or largely destroyed during metamorphism. Jointing is well developed in the bedrock. Two principal joint sets exist throughout the site, one being parallel to the beddings and the other perpendicular to the beddings. The joints are continuous, smooth and moderately to widely spaced. In addition to the jointings, there are occasional discontinuous steep fractures. Some of these fractures are open and weathered.

In the upper 15 feet of the bedrock the Rock Quality Designation (RQD) varies randomly from 25% to 100%, indicating a poor to excellent rock quality. At depths below 15 feet from bedrock surface, the rock quality can be classified as excellent, as evidenced by the consistently high RQD values of 90% to 100%.

Detailed descriptions of the rock cores are given in the Record of Borehole Sheets and the Diamond Drill Record Sheets included in the Appendix.

Tightness of the joints were examined by means of borehole permeability tests using double packers. The results of the tests are reported in the Record of Borehole Sheets. It can be inferred from these results that the joints in the bedrock on the west bank below a depth of 10 feet are generally tight, whereas those in the east bank are moderately open for at least to a depth of 35 feet below the rock surface.

Groundwater Conditions

The results of groundwater observations are reported in the Record of Borehole Sheets. The groundwater level at the west bank appears to be influenced by the continuity of the joints and fractures in the bedrock and varies randomly between elevation 260 and elevation

268, considerably higher than the river water level. At the east bank where jointings in the bedrock are moderately open, the groundwater level descended gradually towards the river from elevation 269 in the high ground to elevation 255 near the river. The river water level at the time of investigation was found to be at elevation 255.

B. Ly

B. Ly, P. Eng.
Senior Engineer



M. Devata

M. Devata, P. Eng.
Supervising Engineer

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 198-62-00 LOCATION Co-ords. N 16,505,627; E 1,038,463 ORIGINATED BY RL
 DIST 9 HWY 17N Line 'C' BORING DATE March 31, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE NX Rock Coring CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES				
283.8	Ground Surface								
0.0	Topsoil & clayey silt								
281.2									
2.6	Crystalline Limestone Bedrock. Coarse texture, weathered joints at 6.4 ft. and 7.8 ft.		1	NX RC	Rec 100	280			
			2	NX RC	Rec 100				
272.2									
11.6	End of Borehole Note: GWL not established								

ROCK CORE DESCRIPTION

280
275
270

281.2
272.2

LEGEND

- Crystalline Limestone
- Rock Joint Fractures

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 198-62-00

LOCATION Co-ords. N 16,505,580; E 1,038,472


ORIGINATED BY BL


DIST 9 HWY 17N Line 28L BORING DATE March 31, 1977

COMPILED BY BL

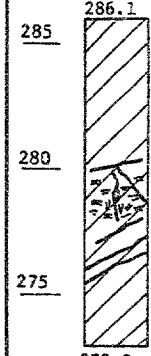
DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY 




SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			REMARKS			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT % w_p — w — w_L	RQD %	% GR SA SI CL
286.1	Ground Surface																	
0.0	Crystalline Limestone Bedrock. Coarse texture, several joint fractures from 6 ft. to 10 ft.		1	NX RC	Rec 96%	280										95		
			2	NX RC	Rec 90%												75	
272.8			3	NX RC	Rec 100%												95	
13.3	End of Borehole Note: GWL not established																	

ROCK CORE DESCRIPTION



286.1
285
280
275
272.8


LEGEND

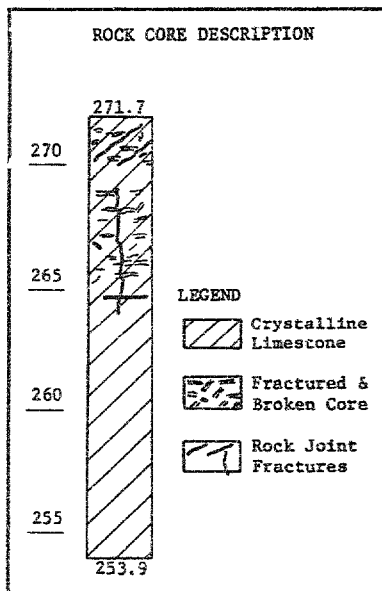
-  Crystalline Limestone
-  Fractured & Broken Core
-  Rock Joint Fractures

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 198-62-00 LOCATION Co-ords. N 16,505,598; E 1,038,678 ORIGINATED BY EL
 DIST 9 HWY 17N Line 'C' BORING DATE March 29, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE NX Rock Coring CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		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 %			
							w_p — w — w_L							
273.4	Ground Surface													
271.7	Topsoil & clayey silt													
1.7	Crystalline Limestone Bedrock. Coarse texture. Weathered bedding plane frac- tures at 1.7'-2.2' A vertical fracture at 4.5' to 9.5'		1	NX RC	Rec 75%	270								50
			2	NX RC	Rec 95%								65	
			3	NX RC	Rec 100%	260							95	
			4	NX RC	Rec 100%								95	
253.9														



OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7A

WP 198-62-00

LOCATION Co-ords. N 16,505,600; E 1,038,686

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 30, 1977

COMPILED BY BL

DATUM Geodetic EBL

BOREHOLE TYPE NX Coring & Packer Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT w_p PLASTIC LIMIT w_p WATER CONTENT w		REMARKS Packer Test Results Pressure p Flow q (p.s.i.) (gal/min)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20 40 60 80 100	SHEAR STRENGTH	w_p w w_L	WATER CONTENT %	
272.0	Ground Surface										
270.9	Clayey silt with boulders		1	NX	50%	270					
1.1	Crystalline Limestone		2	NX	100						
	Bedrock. Coarse texture, hard.		3	RC	100						
	Joint fractures at 2 ft., 11 ft., 18 ft. and 26 ft.		4	RC	95%						
			5	RC	100						
			6	RC	100						
			7	RC	100						
			8	RC	98%						
			9	RC	100						
229.1	End of Borehole		10	RC	100	230					
42.9	Note: GWL not established										

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

* Upper Packer could not seal

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8A

WP 198-62-00

LOCATION Co-ords. N 16,505,571; E 1,038,683

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 30, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
275.5	Ground Surface														
274.2	Topsoil & clayey silty														
1.3	Crystalline Limestone Bedrock. Coarse texture. Weathered Joint fractures parallel to bedding at 10 ft., 15 ft., and 21 ft. Steep fractures at 2.5 ft. and 23 ft.		1	NX RC	Rec 75%										
			2	NX RC	Rec 90%	270									
			3	NX RC	Rec 73%										
			4	NX RC	Rec 100%	260									
			5	NX RC	Rec 99%										
250.1	End of Borehole														

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 9

WP 198-62-00

LOCATION Co-ords. N 16,505,586; E 1,038,698

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 29 & 30, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY

PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	SHEAR STRENGTH	w_p w w_L	WATER CONTENT %	
272.3	Ground Surface										
270.2	Topsoil & clayey silt										
2.1	Crystalline Limestone Bedrock		1	NX RC	Rec 100%						
	Coarse texture.		2	NX RC	Rec 100%						
	Steep, weathered open fractures at 16' - 19.3'		3	NX RC	Rec 100%						
	Bedding plane fractures at 27 ft., 32 ft. and 35 ft.		4	NX RC	Rec 100%						
			5	NX RC	Rec 100%						
			6	NX RC	Rec 100%						
			7	NX RC	Rec 100%						
			8	NX RC	Rec 100%						
230.2	End of Borehole										

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Rock Joint Fractures

ROD	%
100	
100	
100	
60	
95	
95	
95	
95	

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 10

WP 198-62-00

LOCATION Co-ords. N 16,505,565; E 1,038,706

ORIGINATED BY BL

DIST 9 HWY 17N Line 'C'

BORING DATE March 29, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES				
273.7	Ground Surface								
272.4	Topsoil & Clayey silt								
1.3	Crystalline Limestone. Bedrock Coarse texture Several Bedding plane fractures from 3 ft. to 5.7 ft. & from 11.7 ft. to 13.3 ft.		1	NX RC	Rec 99%	270			70
			2	NX RC	Rec 100%				60
			3	NX RC	Rec 100%	260			100
			4	NX RC	Rec 100%				100
252.1	End of Borehole								

ROCK CORE DESCRIPTION

272.4

270

265

260

255

252.1

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 11A

WP 198-62-00 LOCATION Co-ords. N 16,505,577; E 1,039,106 ORIGINATED BY NH
 DIST 9 HWY 17N Line 'C' BORING DATE April 6, 1977 COMPILED BY BL
 DATUM Geodetic ENL BOREHOLE TYPE NK Rock Coring CHECKED BY CH

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		20 40 60 80 100	SHEAR STRENGTH	w_p w w_L	WATER CONTENT %	
261.5	Ground Level										
0.0	Rockfill										
253.0											
8.5	Crystalline Limestone Bedrock		2	NK RC	Rec 90%						50
	Coarse texture		3	NK RC	Rec 100%						50
	Vertical joint fractures at 13.5 ft. - 14.5 ft.		4	NK RC	Rec 95%						75
	16.7 ft. - 18.0 ft.		5	NK RC	Rec 100%						100
236.7											
24.8	End of Borehole										

ROCK CORE DESCRIPTION

253.0

250

245

240

236.7

LEGEND

Crystalline Limestone

Fractured & Broken Core

Rock Joint Fractures

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 12A

WP 198-62-00

LOCATION Co-ords. N 16,505,531; E 1,039,115

ORIGINATED BY NM

DIST 9 HWY 17N Line 'C'

BORING DATE April 4, 1977

COMPILE BY BL

DATUM Geodetic

BOREHOLE TYPE NX Rock Coring

CHECKED BY

SOIL PROFILE			SAMPLES		GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH O UNCONFINED + FIELD VANE * QUICK TRIAXIAL * LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	ROD Z	Packer Test Results Pressure P (p.s.i.) Flow Q (gpm)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE					
257.4	Ground Level								
0.0	Crystalline Limestone Bedrock. Coarse texture Hard		1	NX	100	%			
			2	NX	Rec	100	%		
			3	NX	Rec	100	%		
	Vertical joint at 8' - 10.8'		4	NX	Rec	100	%		
	Weathered vertical joint at 17 ft. - 18.5 ft.		5	NX	100	%			
	Bedding plane fractures at 3.5 ft., 4.5 ft., and 13.5 ft.		6	NX	Rec	100	%		
			7	NX	Rec	100	%		
			8	NX	Rec	100	%		
			9	NX	Rec	100	%		
217.3									
40.1	End of Borehole Note: GWL not established								

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

ROD Z	Pressure P (p.s.i.)	Flow Q (gpm)
91	*	*
46	*	*
100	22	4.0
40	3	4.5
100	52	2.4
100	32	2.4
100	82	1

* Packers could not seal

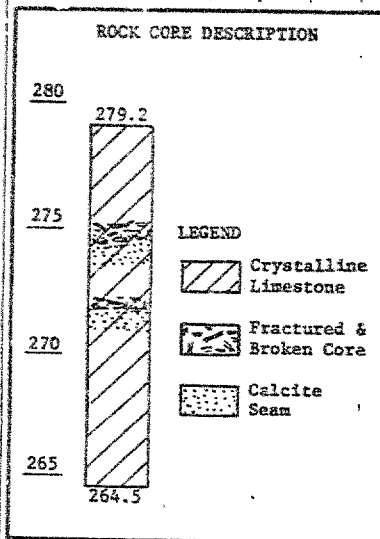
OFFICE REPC. ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 15

WP 198-62-00 LOCATION Co-ords. N 16,505,565; E 1,039,324 ORIGINATED BY MM
 DIST 9 HWY 17N Line 'C' BORING DATE April 4, 1977 COMPILE BY BL
 DATUM: Geodetic ERL BOREHOLE TYPE NX Rock Coring CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _P	W	W _L	
279.2	Ground Level														
0.0	Crystalline Limestone Bedrock		1	NX RC	Rec 100 %										
	Hard		2	NX RC	Rec 95 %	270									75
	Soft weathered calcite seams at 4.2' - 5.6' and 7.3' - 8.1'		3	NX RC	Rec 100 %										50
264.5															100
14.7	End of Borehole														



HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 16

WP 198-62-00

LOCATION Co-ords. N 16,505,505; E 1,039,319

ORIGINATED BY MM

DIST 9 HWY 17N Line 'C'

BORING DATE April 4, 1977

COMPILED BY BL

DATUM Geodetic

BOREHOLE TYPE 3 1/2" Hollow Stem Auger & NX Rock Coring

CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	
273.1	Ground Level													
0.0	Some boulder & cobbles over clayey silt, trace to some sand, Brown, Stiff					270								
265.5														
7.6	Crystalline Limestone Bedrock Coarse texture Steep joint fracture at 17.5 ft.		1	NX RC	Rec 100	260								100
			2	NX RC	Rec 100									
254.8														70
18.3	End of Borehole Note: GWL not established													

ROCK CORE DESCRIPTION

LEGEND

- Crystalline Limestone
- Fractured & Broken Core
- Rock Joint Fractures

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF PROBEHOLE NO 17 & 18

WP 198-62-00 LOCATION See Below ORIGINATED BY MM
 DIST 9 HWY 17N Line 'C' BORING DATE April 4, 1977 COMPILED BY BL
 DATUM Geodetic EBL BOREHOLE TYPE 3 1/2" Hollow Stem Auger CHECKED BY CP

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 % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W_L		
							SHEAR STRENGTH					WATER CONTENT %			
							O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
273.5	Ground Level						<u>PROBEHOLE #17</u>					<u>Co-ords. N 16,505,520; E 1,039,320</u>			
272.0	Fill: sand with gravel														
1.5	End of Probehole Auger refusal on probable bedrock					270									
276.1	Ground Level						<u>PROBEHOLE #18</u>					<u>Co-ords N 16,505,550; E 1,039,322</u>			
274.6	Fill: sand with gravel														
1.5	End of Probehole Auger refusal on probable bedrock					270									

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 51

WP 198-62-00

LOCATION Co-ords. N 16,505,584; E 1,038,954

ORIGINATED BY HS

DIST 9 HWY 17N Line 'C'

BORING DATE June 22, 1976

COMPILED BY SM

DATUM Geodetic

BOREHOLE TYPE NX Rock Core

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
254.4	Water Level														
0.0	Water					250									
245.5	River Bottom														
8.9	Crystalline Limestone Bedrock		1	NX RC	Rec 100	240									81
	Sound		2	NX RC	Rec 100										67
			2	NX RC	Rec 100	230									93
225.3			4	NX RC	Rec 100										100
29.1	End of Borehole														

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 52

WP 198-62-00 LOCATION Co-ords. N 16,505,563; E 1,038,962 ORIGINATED BY HS
 DIST 9 HWY 17N Line 'C' BORING DATE June 23, 1976 COMPILED BY SM
 DATUM Geodetic EBL BOREHOLE TYPE NX Rock Core CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p w w_L	WATER CONTENT %	
254.4	Water Level													
0.0	Water					250								
246.1	River Bottom													
8.3	Crystalline Limestone Bedrock		1	RC	84%								58	
			2	NX RC	Rec 98%	240							88	
	Sound		3	NX RC	Rec 99%								88	
			4	NX RC	Rec 100%	230							100	
229.6														
24.8	End of borehole													

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 53

WP 198-62-00 LOCATION Co-ords. N 16,505,605; E 1,038,941 ORIGINATED BY HS
 DIST 9 HWY 17N Line 'C' BORING DATE June 23 & 24, 1976 COMPILED BY SM
 DATUM Geodetic BOREHOLE TYPE NX Rock Core CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
254.7	Water Level														
0.0	Water					250									
						240									
233.3	River Bottom														
21.4	Crystalline Limestone Bedrock		1	NX RC	Rec 100 %	230									78
			2	NX RC	Rec 94 %										89
	Bedrock		3	NX RC	Rec 97 %	220									69
213.2	Sound		4	NX RC	Rec 100 %										100
41.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 54



WP 198-62-00 LOCATION Co-ords. N 16,505,468; E 1,039,250 ORIGINATED BY SM
 DIST 9 HWY 17N Line 'C' BORING DATE July 13, 1976 COMPILED BY SM
 DATUM Geodetic EBL BOREHOLE TYPE Washboring, BX Rock Core & Cone Test CHECKED BY CP

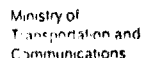
SOIL PROFILE		STRAT. PLOT	SAMPLES		GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT	LIQUID LIMIT W_L	PLASTIC LIMIT W_P	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		VALUES	20 40 60 80 100	WATER CONTENT W	
269.3	Ground Level								
267.3	Road fill, gravel, sand rock boulders		1	CS					
2.0	Silty clay		2	SS	18				
	with some fine		3	SW	EM				
	sand seams		4	SS	15				
	Very stiff		5	SW	EM				
			6	SS	9				
255.2	Bouldery material		7	SS	50/2				
14.1	Crystalline								
250.6	Limestone Bedrock Sound		8	BX RC	Rec 100 %				98
18.7	End of Borehole								
	Note: Water level not established								

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 106

WP 198-62-00 LOCATION Co-ords. N 16,505,577; E 1,039,272 ORIGINATED BY VK
 DIST 9 HWY 17N Line 'C' BORING DATE December 11, 1974 COMPILED BY SO
 DATUM Geodetic EBL BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core CHECKED BY *SP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			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											
272.2	Ground Level																	
0.0	TOPSOIL																	
268.2	Clayey silt, trace to some sand Brown Silty		1	SS	10	270						0			0 6 76 18			
4.0	Crystalline Limestone																	
253.0	Bedrock Sound Grey																	
2.2	End of Borehole																	



5
HOLE NO. 5 SHEET 10

203.8
Geodetic

PROPERTY	W 12 198-62-00
LOCATION	Madawaska River Bridge Acumpror By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

96°

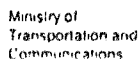
NX Core	
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TOTAL FOOTAGE 11'7"

[illegible]

DATE OF EXAMINATION April 28, 1977

B. K. Glasgford



04 PM

1. GLENDON, R. *et al.* 1981, *Journal of the Royal Society of Medicine*, **74**, 1011-1014.

PROPERTY W. P. 198-62-00
LOCATION Madawaska River Bridge
Approach By-Pass Hwy. 17
LATITUDE
DEPARTURE
BEARING

90°

NK Core

13'4"

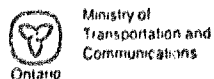
TOTAL FOOTAGE

ELEV. COLLAR	286.1
DATUM	Goodale
DATE STARTED	
DATE COMPLETED	
DRILLED BY	
LOGGED BY	

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
0'0"	13'4"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination at 50° sometimes conformed.				Broken core, 8'8" - 7'6" weathered, possibly a vertical or inclined joint fracture area
		RQD 0' - 5' 95%				Joint fracture 50° along bedding plane, open and weathered.
		RQD 5' - 8'4" 75%				Joint fracture 30° and at 90° to bedding planes at 5'11"
		RQD 8'4" - 13'4" 95%				Joint fracture 50° and parallel to bedding at 9'6" weathered, also at 9'5" and 10'1"
						Horizontal fracture breakage appears fresh

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



DIAMOND DRILL RECORD

NO. 1 NO. 2 FILE NO. 3

210

PROPERTY LOCATION W. P. 198-62-00
Mada Aska River Bridge
Arnprior By-Pass Hwy. 17

LATITUDE
DEPARTURE
BEARING

90°

NX Core

TOTAL FOOTAGE 101'11"

273.4
Geodetic

FOOTAGE		FORMATION	SAMPLE NUMBER	REMARKS
FROM	TO			
1'8"	19'5"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 40°, sometimes contorted.		Broken core 1'8" - 2'6" " 4'6" - 9'6" partly.
				Bedding plane fractures 1'8" - 2'6" weathered.
				Vertical joint fracture at 4'6" - 9'6" parallel to Q, to Hwy, open and weathered.
				NGD - 1'8" - 4'6" 50%
				NGD - 4'6" - 9'6" 50%
				NGD - 9'6" - 19'5" 95%
				Horizontal fracture breakage appears fresh.

DATE OF EXAMINATION April 28, 1977

D. K. Glasford



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. 7A

DIP

PROPERTY: W.P. 198-62-00
LOCATION: Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE:
DEPARTURE:
BEARING:

90°
TOTAL FOOTAGE 42'11"

ELEV. COLLAR: 272' 0"
JATUM: Geodetic
DATE STARTED:
DATE COMPLETED:
DRILLED BY:
LOGGED BY:

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
4"	1'2"	NX Casing Core				Broken core 3'4" - 4'0"
1'2"	42'11"	Crystalline limestone, coarse texture, hard, light grey colour, bedding inclination 40°, sometime contorted.				19'6" - 20'6" and at 32' - 39'8" broken horizontally into 3 sections.
						Joint fracture 80° at 2'0"
		R.O. 1'2" - 42'11" 90° - 95%				Joint fractures at 1'12" and 26'2" at 90° to bedding planes.
						Joint fracture 90° at 18'0"
						Strike of bedding is parallel to G.
						Horizontal fracture breakage appears fresh

DATE OF EXAMINATION: April 26, 1977

B.K. Glassford



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. 8A SHEET NO. 1

PROPERTY W.P. 188-62-00
LOCATION Madawaska River Bridge
Appropriation Hwy. 17
LATITUDE _____
DEPARTURE _____
BEARING _____

DIP
90°
NX Core
TOTAL FOOTAGE 25'4"

ELEV. COLLAR 278.00
DATUM Geodetic
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
1'4"	25'4"	crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 45°, sometimes contorted.				Broken core 1'4" - 4'4"
						" " 7'5" - 9'7"
						" " 18'
						Joint fracture 80° 1'4" - 4'4"
						open and weathered
						Joint fracture 90° and inclined at 7'5" - 9'7" open and weathered with cavities.
		RQD 1'4" - 4'4" 0%				
		RQD 1'4" - 18'0" 50%				
		RQD 18'0" - 25'4" 95%				
						Fractures parallel to bedding planes at 15'10", 15'4" and 10'6".
						Joint fracture parallel to bedding inclined at 85° open and weathered with cavities.
						Two fracture joints at 89° to each other and each at 90° to bedding planes.
						Bedding plane fracture 45° at 21'7"
						Joint fracture 80° at 23'2"
						Horizontal fracture breakage appears fresh.

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. 9 SHEET NO.

DIP

PROPERTY W.P. 198-52-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE
DEPARTURE
BEARING

90°
NX-Core
42'1"
TOTAL FOOTAGE 42'1"

ELEV. COLLAR 272.3
DATUM Geodetic
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
2'1"	42'1"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 45°, sometimes contorted.				Joint fracture 85° at 16' - 19'3" parallel to Q, open and weathered.
						Joint fracture, 80° at 20'6"
						" " 50° at 38'3"
						" " 45° at 40'0"
						Bedding plane fractures at 27'8"
						32'0"
						35'8"
						Broken Core at 38'3"
						" " " 40'0"
						Horizontal fractures appear fresh
						RQD - 2'1" - 16' 100%
						" 16' - 19' 0%
						" 19' - 42' 95%

DATE OF EXAMINATION April 28, 1977

H. K. Glassford



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. 10 SHEET NO. _____

DIP

PROPERTY W.P. 198-62-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE _____
DEPARTURE _____
BEARING _____

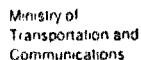
90°
NX Core
TOTAL FOOTAGE 21'6"

ELEV. COLLAR 272.7
DATUM Geodetic
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
1'4"	21'6"	Crystalline limestone, coarse texture, light grey colour, hard, bedding inclination 45°, sometimes contorted.				Broken core at 5'8" - 6'11" at 8'9" - 10'8"
						Bedding plane fractures at 3'3" 4'7" 5'8" 11'9" 12'2" 13'4" 17'0"
		RQD 1'4" - 6'5" 70%				
		RQD 6'5" - 11'5" 60%				
		RQD 11'5" - 21'6" 100%				
						Horizontal fracture breakage appears fresh, inclined fracture 85° at 2' - 3'3" open and weathered at 2'6".
						Inclined fracture 85° at 5'6" - 6'8" oriented 125° to G, open and weathered.
						Vertical fracture 11'3" - 11'9" open and weathered.
						Fractures open and weathered 8'10" 10'8" at 90° to bedding.

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



FORM NO. 11A DATE 7/10

PROPERTY	W. P. 198-62-00
LOCATION	Nadawaska River Bridge Arnprior By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

900
NX Core
TOTAL FOOTAGE 24'9"

ELEV. COLLAR

DATUM

DATE STARTED

DATE COMPLETED

DRILLED BY

LOGGED BY

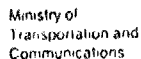
261.50'

Geodetic

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
4'6"	24'9"	Crystalline limestone, coarse texture, light grey colour, hard, bedding 40° inclination and contorted in some areas.			Broken and ground core at vertical joint fracture at 5'0"
					Broken core 4'10" - 5'3"
5'3"	7'6"	(no core log submitted)			Broken core 13'6" - 19'8"
7'6"	8'6"	foreign particles of rock of igneous and metamorphic origin			Vertical joint fracture indicated at 13'6" - 14'6"
					16'8" - 18'0"
					RQD 4'6" - 5'3" 50%
					RQD 7'6" - 8'6" 0%
					RQD 8'6" - 10'6" 50%
					RQD 10'6" - 19'8" 60%
					RQD 19'8" - 24'9" 100%
					Horizontal fracture breakage appears fresh.

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



□ □ □

HOLE NO. 12A SHEET NO. 1

PROPERTY LOCATION W. P. 198-62-00
Mudawaska River Bridge
Arnprior By-Pass Hwy. 11

LATITUDE
DEPARTURE
BEARING

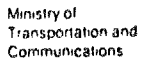
90°	
NX Core	
TOTAL FOOTAGE 40'2"	

ELEV. COLLAR 257.40'
 DATUM Cegadette
 DATE STARTED
 DATE COMPLETED
 DRILLED BY
 LOGGED BY

[illegible]

DATE OF EXAMINATION April 28, 1977

B. K. Glassford



FILE NO. 15 DATE NO.

912

PROPERTY W. P. 198-62-00
LOCATION Madawaska River Bridge
Arnprior By-Pass Hwy. 17
LATITUDE _____
DEPARTURE _____
BEARING _____

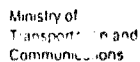
90°	
NX Core	
TOTAL FOOTAGE	14'8"

ELEV. COLLAR 279.21'
 DATUM Geodetic
 DAY - STARTED
 DATE COMPLETED
 DRILLED BY
 LOGGED BY

[illegible]

DATE OF EXAMINATION April 27, 1977

B. K. Glassford

HOLE NO. 16 SHEET NO. _____

DIP

PROPERTY	W. P. 198-62-00
LOCATION	Madawaska River Bridge
	Arnprior By-Pass Hwy. 17
LATITUDE	
DEPARTURE	
BEARING	

90°

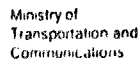
TOTAL FOOTAGE 1814"

ELEV. COLLAR 273.11
 DATUM Cicodetic
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION April 28, 1977

B.K. Glassford



0185

HOLE NO. 51 SHEET NO.

PROPERTY LOCATION W. P. 198-62-00
Madawaska River and Hwy. 17N

LATITUDE
DEPARTURE
BEARING

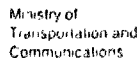
90°	
TOTAL FOOTAGE	29.15'

ELEV. COLLAR	
DATUM	
DATE STARTED	
DATE COMPLETED	
DRILLED BY	
LOGGED BY	

[illegible]

DATE OF EXAMINATION Aug. 13/76

B. K. Glassford



HOLE NO. 52 SHEET NO. _____

212

PROPERTY W. P. 198-62-00
LOCATION Nadawaska River and Hwy. 17N

LATITUDE _____
DEPARTURE _____
READING _____

000

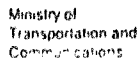
TOTAL PORTAGE 24.8'

ELEV. COLLAR	
DATUM	
DATE STARTED	
DAYS COMPLETED	
DRILLED BY	
LOGGED BY	

[illegible]

DATE OF EXAMINATION Aug. 13/76

B. K. Glassford



518

PROPERTY NO. W. P. 198-62-00
LOCATION Madawaska River and Hwy. 17N
LATITUDE _____
DEPARTURE _____
BEARING _____

900

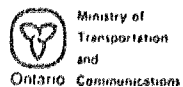
TOTAL PRORATE 41.55'

[illegible]

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
21.95'	41.55'	Crystalline limestone, light grey colour, medium to coarse texture, hard, lamination varies 45° to 75° slight weathering on some of the joints				21.95' - 27.9' core is fractured moderately to badly
						Joints 45° at 24.0' 45° at 24.5' 45° at 25.6' 45° at 28.0' 45° at 34.5' 45° at 36.0'
		All horizontal fracturing appears to have been caused by the drilling procedures				27.9' - 36.0' core is badly fractured
						36.0' - 37.5' broken and ground core
						37.5' - 41.55' core is moderately fractured

DATE OF EXAMINATION Aug. 13/76

B. K. Glasford



DIAMOND DRILL RECORD

54

PROPERTY LOCATION W.P. 198-62-00
Arnprior By-pass Hwy. 17N
LATITUDE
DEPARTURE
BEARING

800

TOTAL FOOTAGE

```

RELEV, CIPHER
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

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FOOTAGE		FORMATION	SAMPLE NUMBER	附註 (Remarks)
FROM	TO			
		Hole #54		
13.0'	14.15'	Limestone boulder		
14.15'	18.6'	Crystalline limestone, white grey colour, medium to large, hard.		70% of 15.0' open 40% at 15.4' open moderately fractured throughout

DATE OF EXAMINATION

August 13, 1970

B. K. Clifford

DOCUMENT WORK SHEET - INFORMATION

GEOCRES No. 31F-94

DIST. 9 REGION EASTERN

W.P. No. 198-62-00

CONT. No. 79-17

W. O. No. _____

STR. SITE No. 29-191

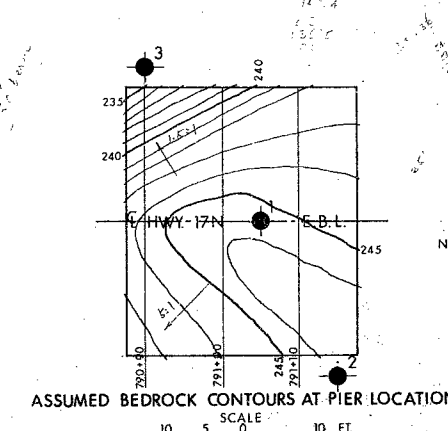
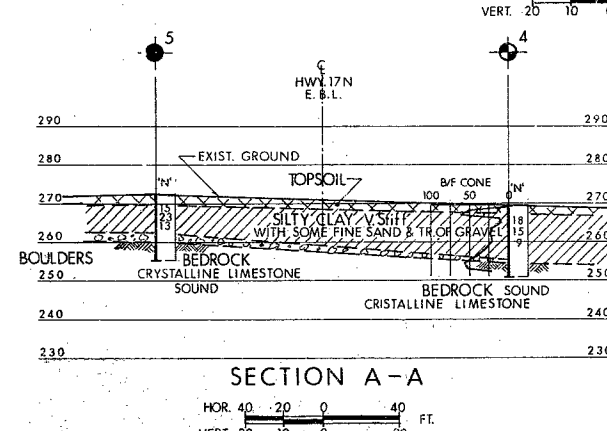
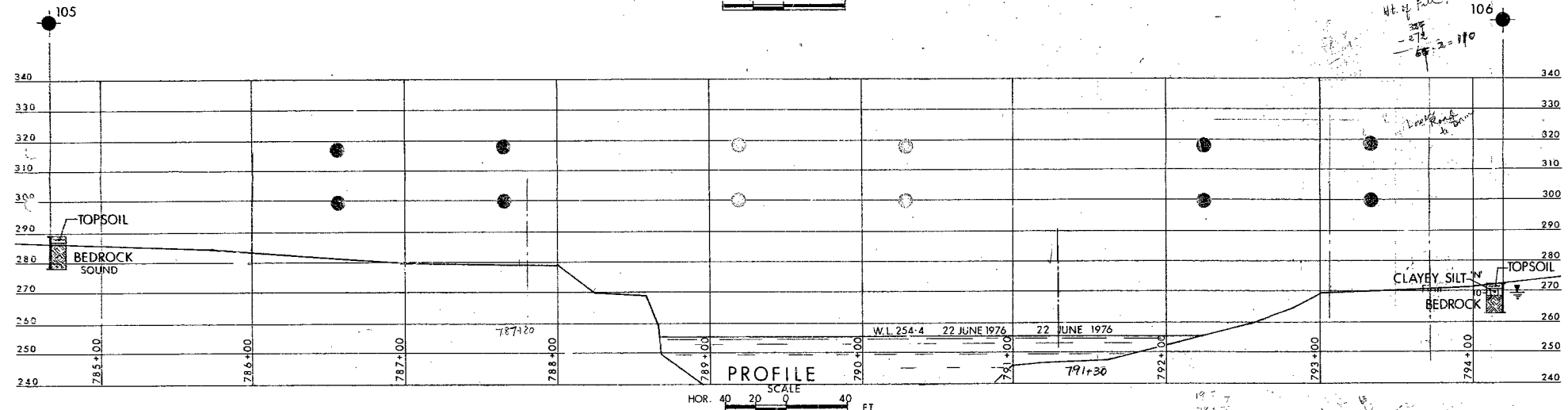
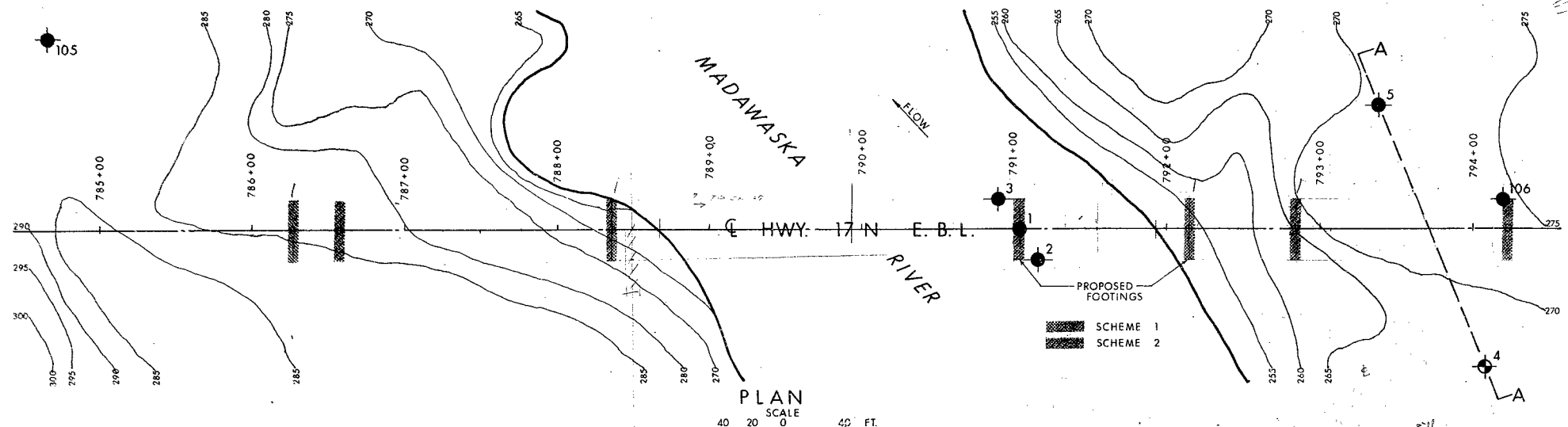
HWY. No. 17N

LOCATION MADAWASKA RIVER BRIDGE

ARNPRIOR BYPASS

OVERHEAD DRAWING TO BE INCLUDED IN THE REPORT /

REMARKS _____



NOTE: BEDROCK CONTOURS BASED ON SURVEYORS SOUNDINGS AND BOREHOLE RECORDS

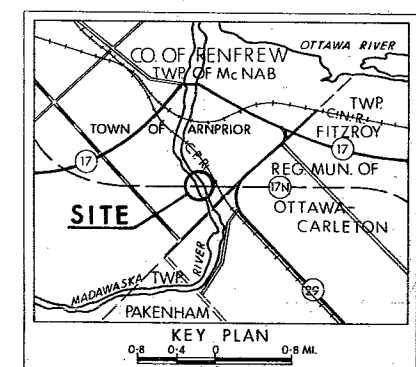
31F-94 (3/4) R 4 (12/11)

CONT No
WP No 198-62-00

MADAWASKA RIVER
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation

No	ELEVATION	STATION	OFFSET E.B.L.
1	254.4	791+05	0
2	254.4	791+15	20' RT.
3	254.7	790+90	20' LT.
4	269.3	794+10	90' RT.
5	272.5	793+40	81' LT.
105	289.6	784+60	124' LT.
106	272.2	794+23	20' LT.

East Bank
1. some sand
2. clay { stratified crust > 2000 ft
Below the crust > 2000 ft
Pa - p' = 3 to 4 tps t = 1700 tps
sand goes up to 1/2" thick.

West Bank
1. out crops as far as 1000 ft
2. Overblow only

-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 17N
SUBMITTAL CHECKED DATE 2 SEP 1976 SITE
DRAWING CHECKED DATE 1976 DWG 1986200-VA