

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 317-85

DIST. 9 REGION

W.P. No. 1-67-03

CONT. No. 80-12

W. O. No.

STR. SITE No. ~~17N~~ 29-167

HWY. No. 17N

LOCATION Indian River Bridge
1.2 mi W of Hwy 41

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FORM SB-OS-35A

**MINISTRY
OF
TRANSPORTATION AND COMMUNICATIONS
ONTARIO**

FILE No. W.P. # 1-67-03

REMARKS SITE PHOTOS

DATE _____

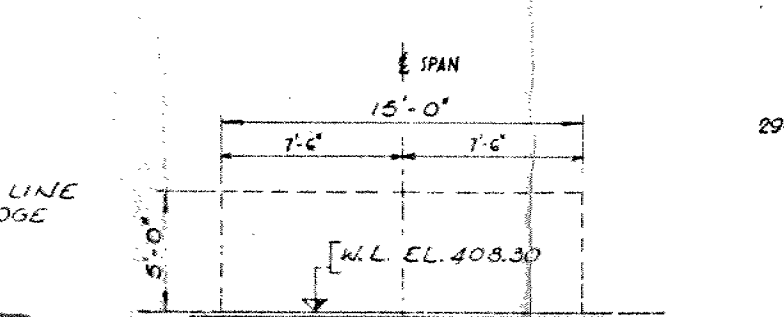
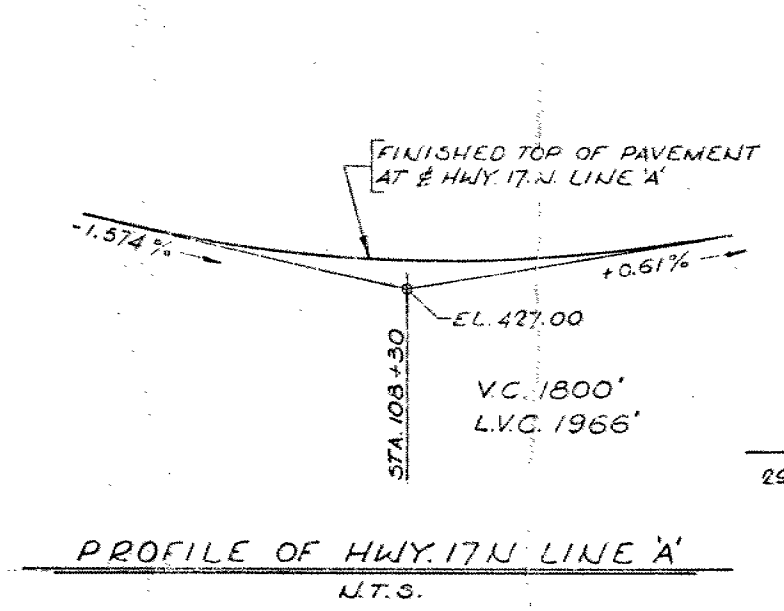
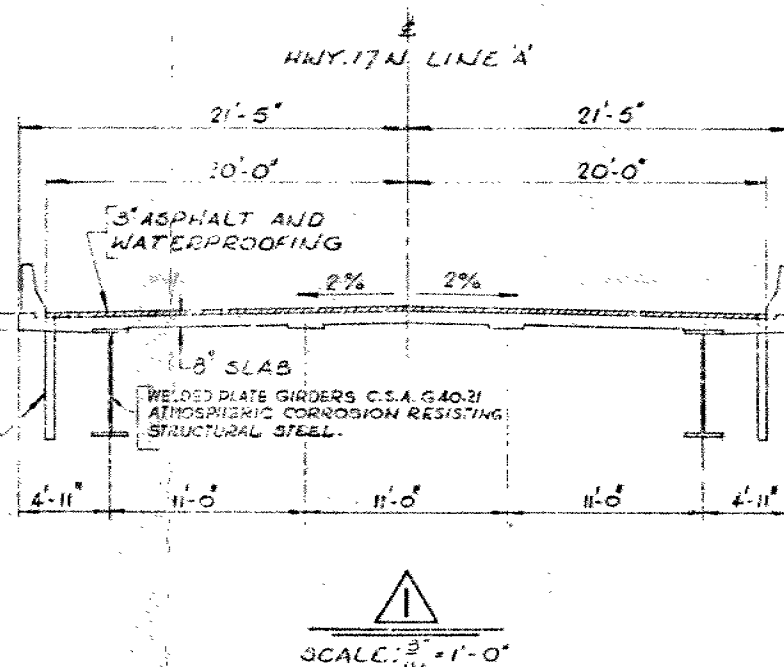
- NOTES:**
- CLASS OF CONCRETE:**
- DECK & BARRIER WALLS 4000 PSI
 - REMAINDER 3000 PSI
- REINFORCING STEEL GRADE:**
- GRADE 60
- CLEAR COVER TO REINF. STEEL:**
- FOOTINGS & ABUTMENTS 3"
 - DECK TOP 2", DECK BOTTOM 1 1/2"
 - BARRIER WALLS 1 1/2"
 - APPROACH SLABS 2"
- UNLESS OTHERWISE NOTED ON THE LINES

- CONSTRUCTION NOTES:**
- THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF $\pm \frac{1}{8}$ ".
 - NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.
 - TO ACHIEVE THE MIN. CLEAR COVER OF 2" SPECIFIED AT THE TOP OF DECK, THE TOP LAYER OF REINFORCEMENT SHALL BE PLACED, PRIOR TO CONCRETING WITH A CLEAR COVER OF $2 \frac{1}{2} \pm \frac{1}{2}$ " TOLERANCE.

- LIST OF DRAWINGS:**
- 29-167-1 GENERAL PLAN
 - 2 BOREHOLE LOCATIONS & SOIL STRATA
 - 3 FOUNDATION LAYOUT
 - 4 WEST ABUTMENT
 - 5 EAST ABUTMENT
 - 6 STRUCTURAL STEEL & BEARINGS
 - 7 DECK DETAILS & REINFORCING
 - 8 BARRIER WALL
 - 9 STEEL RAILING (SINGLE TUBE)
 - 10 20 FT. APPROACH SLAB
 - 11 STANDARD DETAILS I
 - 12 STANDARD DETAILS II
 - 29-167-13 AS CONSTRUCTED ELEV. & DIM.

- CONCRETE QUANTITIES**
- CONC. QUANTITIES ARE LISTED BELOW FOR APPROPRIATE CONC. LUMP SUM TENDER ITEMS.
- 1 CONC. IN ABUTS. & WING WALLS — 240.0 C.Y.
 - 2 CONC. IN DECK — 152.0 C.Y.
 - 3 CONC. IN BARRIER WALLS — 29.0 C.Y.
 - 4 CONC. IN APPROACH SLABS — 49.0 C.Y.

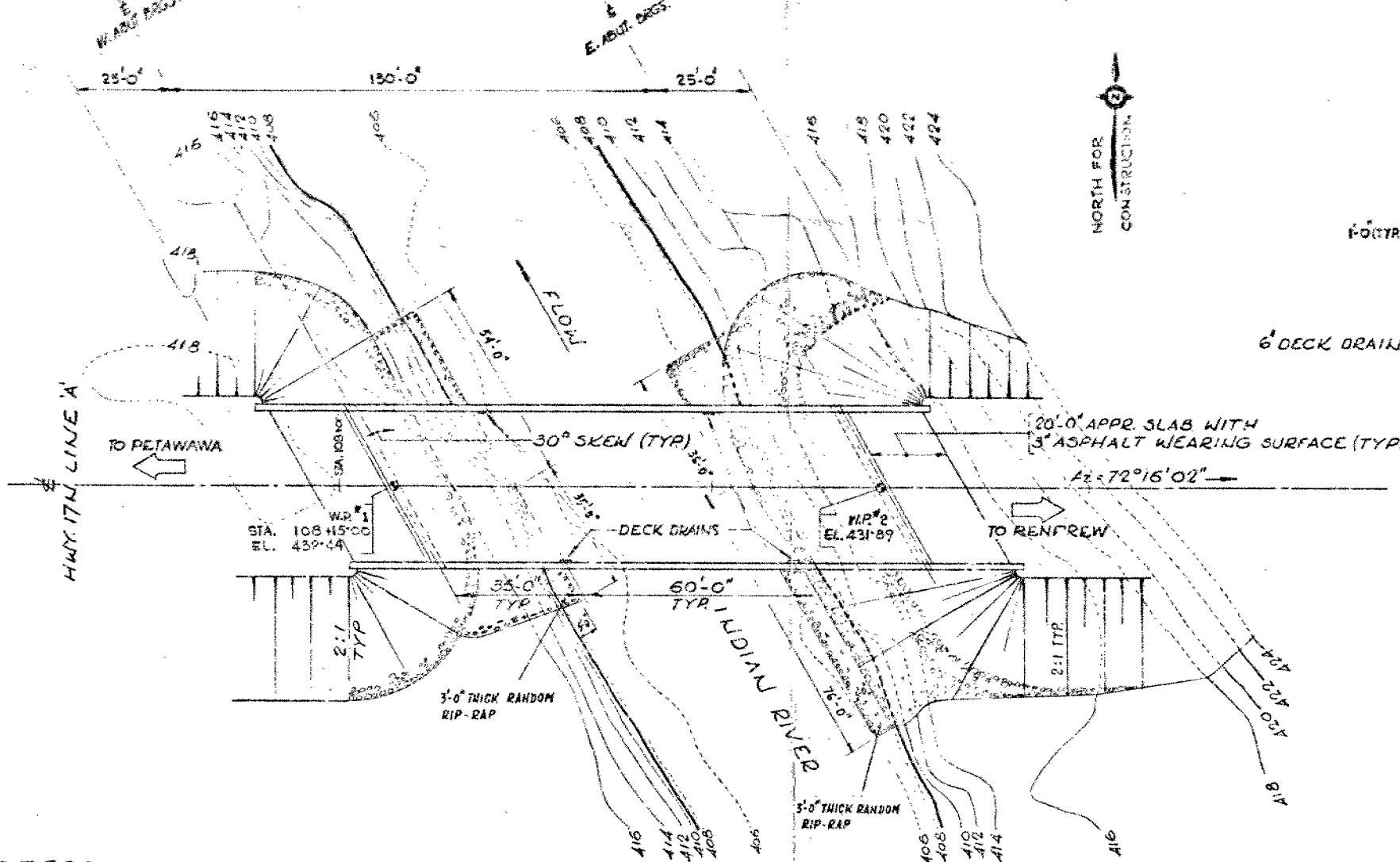
STRUCT. STEEL — 62 TONS	
DATE	DESCRIPTION
DESIGN	CHECK
DRAWING	CHECK



NAVIGATION CLEARANCE DIAGRAM
(FOR CONSTRUCTION)

RECEIVED
MAR 21 1978
SOIL MECHANICS
MINISTRY OF TRANSPORTATION & COMMUNICATIONS

FOR REDUCED PLAN
USE SCALE 1" = 1'-0"
1" = 3 INCHES ON ORIGINAL PLAN

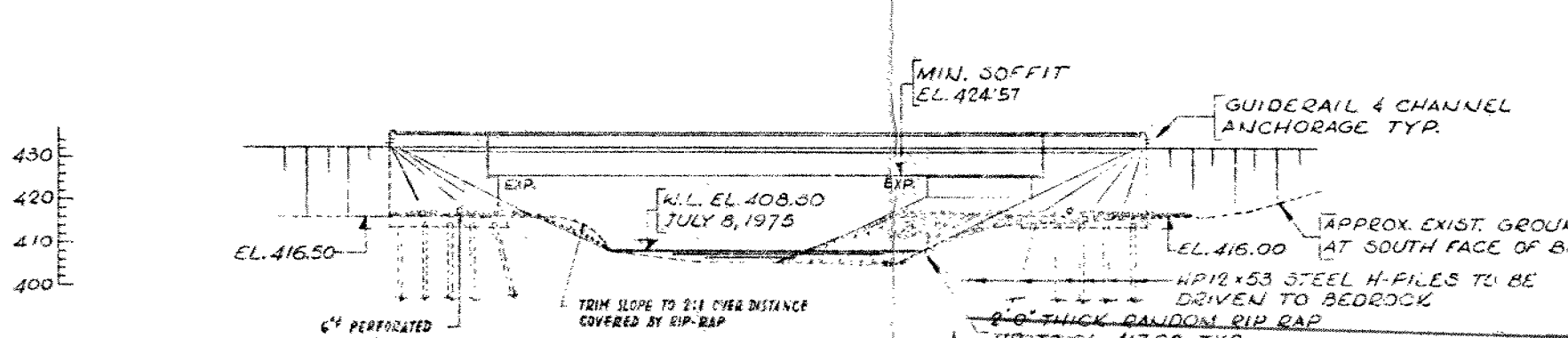


NOTES:

T/P DENOTE TOP OF FINISHED PAVEMENT.
W.P. DENOTE WORKING POINT.

PLAN
SCALE: 1" = 20'-0"

APPROACH SLABS, ASPHALT AND WATERPROOFING ARE NOT PART OF THIS CONTRACT

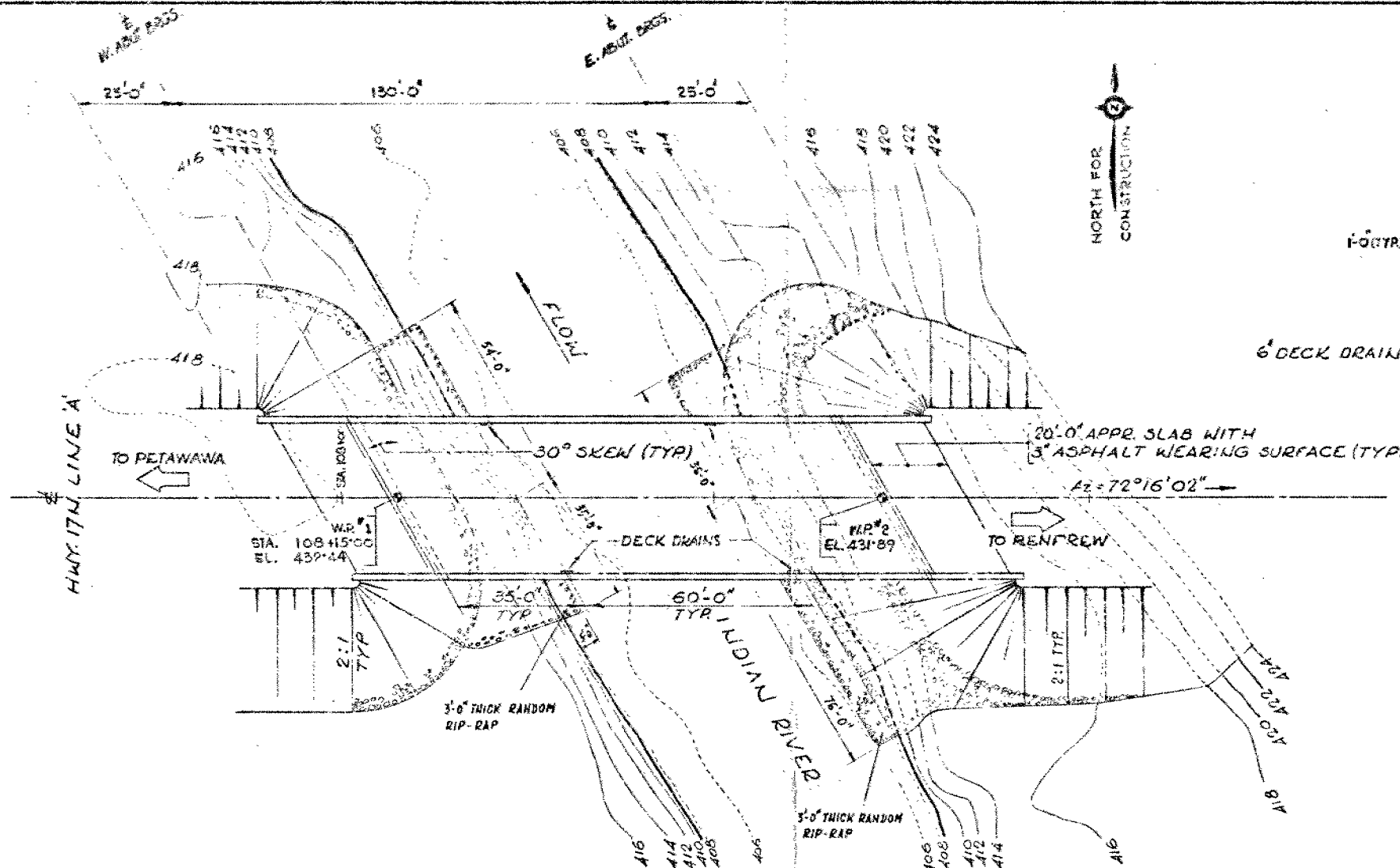


TO BE USED FOR ESTIMATING PURPOSES ONLY

ELEVATION
SCALE: 1" = 20'-0"

B.M. 418.75
GEODETTIC DATUM
N. & W. IN ROOT OF 1" SPR.
213' RT. 107+80

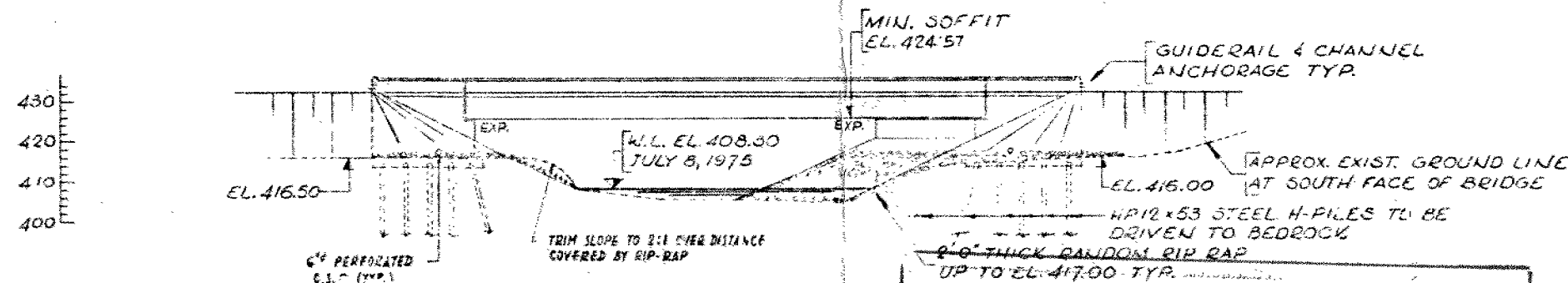
DATE MAR 21 1978



NOTES:
T/P DENOTE TOP OF FINISHED PAVEMENT.
W.P. DENOTE WORKING POINT.

PLAN
SCALE: 1" = 20'-0"

APPROACH SLABS, ASPHALT AND WATERPROOFING
ARE NOT PART OF THIS CONTRACT

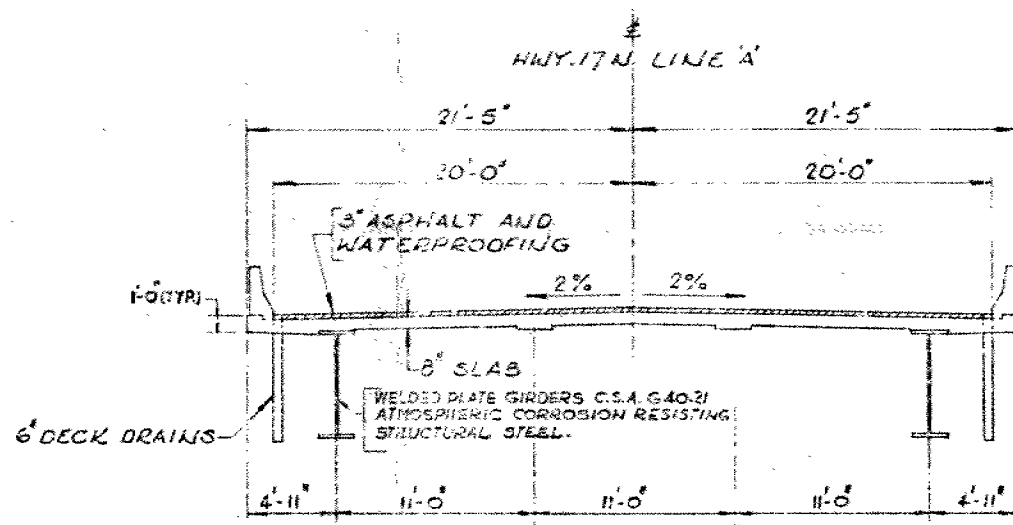


B.M. 418.75
GEODETIC DATUM
N. & W. IN 200' OF 1" SPR.
213' RT. 107+80

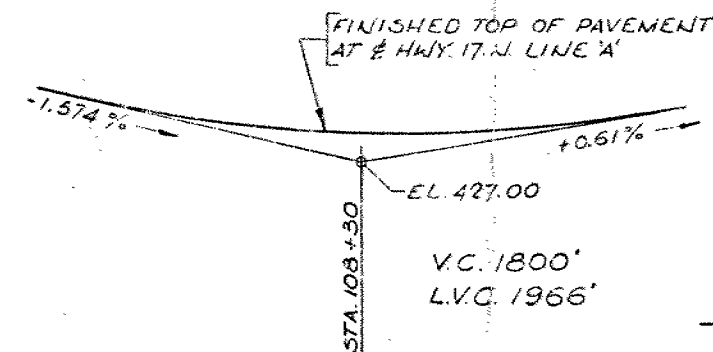
ELEVATION
SCALE: 1" = 20'-0"

**TO BE USED
FOR ESTIMATING
PURPOSES ONLY**

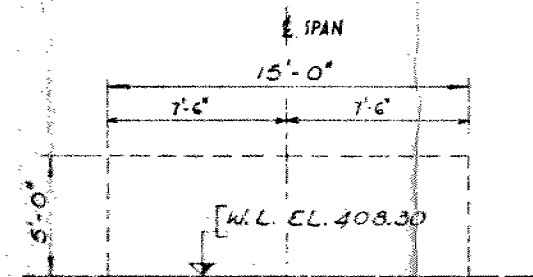
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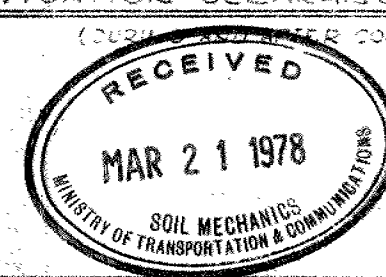
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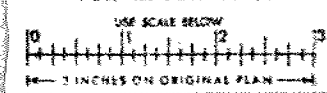
PROFILE OF HWY. 17N LINE 'A'
N.T.S.



NAVIGATION CLEARANCE DIAGRAM
(DURING AND AFTER CONSTRUCTION)



FOR REDUCED PLAN



DIST. 9	CONT No	SHEET
WP	No 1-67-03	
INDIAN RIVER BRIDGE Approx. 1 Mile West of Hwy. 41		GENERAL PLAN

NOTES:

CLASS OF CONCRETE:

- DECK & BARRIER WALLS 4000 PSI.
- REMAINDER 3000 PSI.

REINFORCING STEEL GRADE:

GRADE 50

CLEAR COVER TO REINF. STEEL:

- FOOTINGS & ABUTMENTS 3"
 - DECK TOP 2", DECK BOTTOM 1 1/2"
 - BARRIER WALLS 1 1/2"
 - APPROACH SLABS 2"
- UNLESS OTHERWISE NOTED ON THE DRAWING

CONSTRUCTION NOTES:

- THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF $\pm 1/8$ ".
- NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.
- TO ACHIEVE THE MIN. CLEAR COVER OF 2" SPECIFIED AT THE TOP OF DECK, THE TOP LAYER OF REINFORCEMENT SHALL BE PLACED, PRIOR TO CONCRETING, WITH A CLEAR COVER OF 2 1/2" $\pm 1/2$ " TOLERANCE.

LIST OF DRAWINGS:

- 29-167-1 GENERAL PLAN
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- 29-167-13 AS CONSTRUCTED ELEV. & DIM.

CONCRETE QUANTITIES

- CONC. QUANTITIES ARE LISTED BELOW FOR APPROPRIATE CONC. LUMP SUM TENDER ITEMS.
- 1 CONC. IN ABUTS. & WING WALLS — 240.0 C.Y.
 - 2 CONC. IN DECK — 142.0 C.Y.
 - 3 CONC. IN BARRIER WALLS — 29.0 C.Y.
 - 4 CONC. IN APPROACH SLABS — 49.0 C.Y.

STRUCT. STEEL — 82 TONS

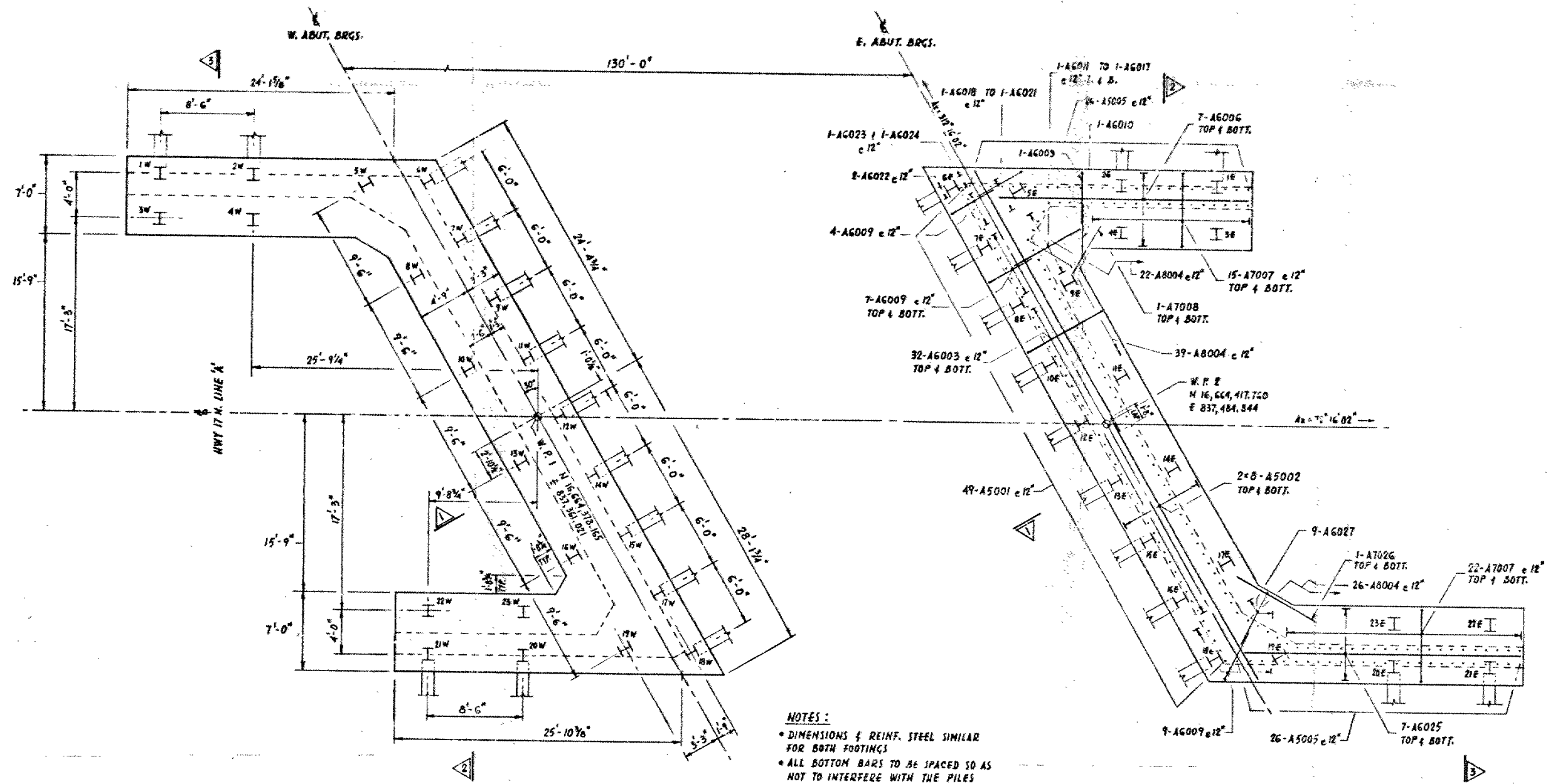
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DESIGN	CHECK	DESIGN	CHECK
DRAWING	CHECK	DRAWING	CHECK

CONT No
WP No 1-57-03

INDIAN RIVER BRIDGE
Approx 1 Mile West of Hwy. 41
FOUNDATION LAYOUT

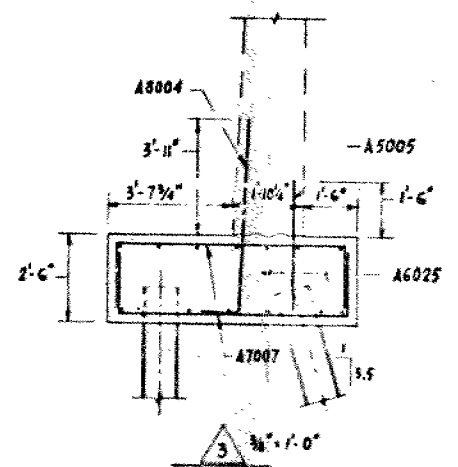
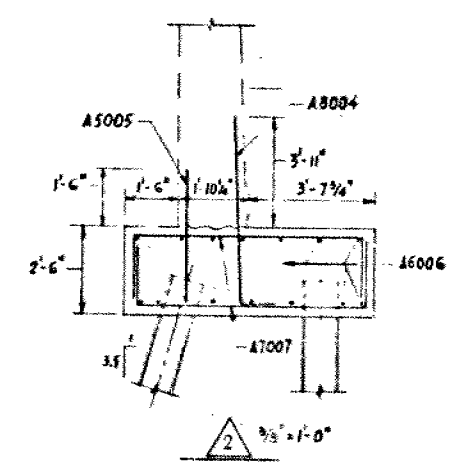
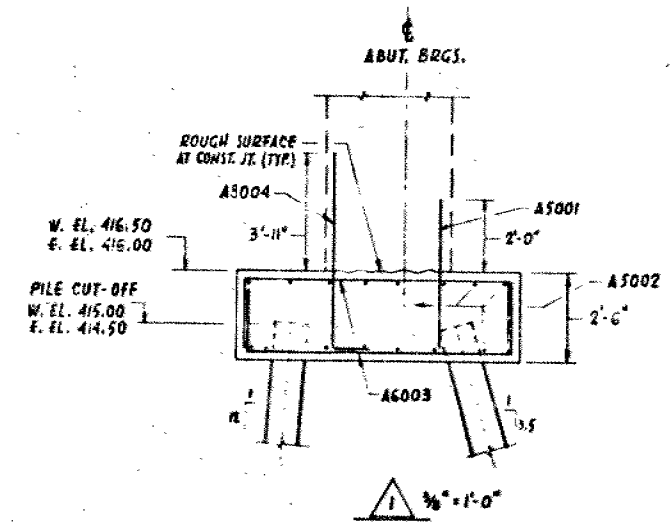


SHEET



NOTES:
• DIMENSIONS & REINF. STEEL SIMILAR FOR BOTH FOOTINGS
• ALL BOTTOM BARS TO BE SPACED SO AS NOT TO INTERFERE WITH THE PILES

PLAN
SCALE: 3/16" = 1'-0"



HP 12x53 PILE DATA

W. ABUTMENT

PILE NO	BATTER	LENGTH (FT)	REMARKS
1	3.5:1	78	NO OSLO PTS
2	3.5:1	80	
3	STR.	78	
4	STR.	78	
5	12:1	80	
6	3.5:1	86	
7	3.5:1	86	
8	12:1	80	
9	3.5:1	88	
10	12:1	82	
11	3.5:1	90	
12	3.5:1	90	
13	12:1	84	
14	3.5:1	90	
15	3.5:1	88	
16	12:1	86	
17	3.5:1	84	
18	3.5:1	80	
19	12:1	82	
20	3.5:1	86	
21	3.5:1	86	
22	STR.	84	
23	STR.	84	NO OSLO PTS

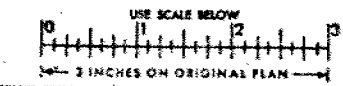
E. ABUTMENT

PILE NO	BATTER	LENGTH (FT)	REMARKS
1	3.5:1	60	OSLO POINTS
2	3.5:1	64	
3	STR.	48	
4	STR.	50	
5	12:1	56	
6	3.5:1	58	
7	3.5:1	56	
8	3.5:1	50	
9	12:1	50	
10	3.5:1	48	
11	12:1	46	
12	3.5:1	46	
13	3.5:1	44	
14	12:1	44	OSLO POINTS
15	3.5:1	44	NO OSLO PTS
16	3.5:1	44	
17	12:1	44	
18	3.5:1	44	
19	12:1	44	
20	3.5:1	44	
21	3.5:1	44	
22	STR.	44	
23	STR.	44	NO OSLO PTS

NOTES:
• PILES TO BE DRIVEN TO BEDROCK.
• PILE SPACINGS TO BE MEASURED AT UNDERSIDE OF FOOTINGS.

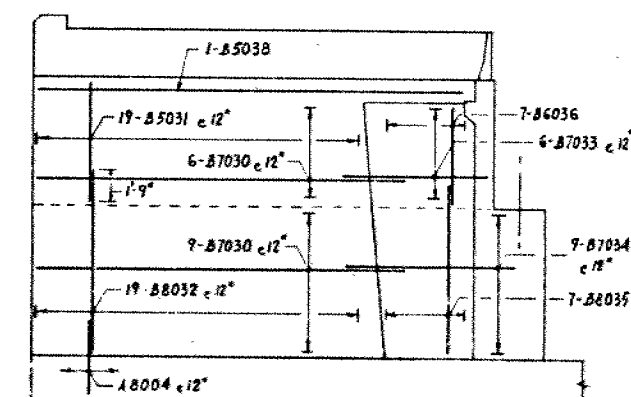
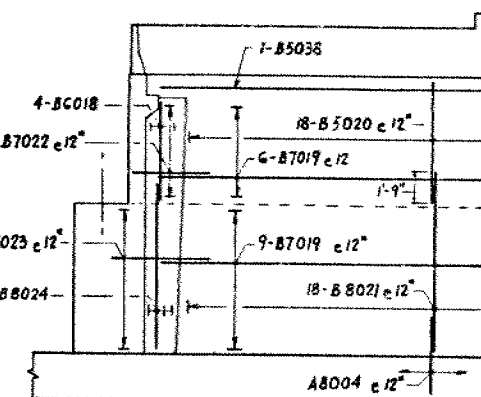
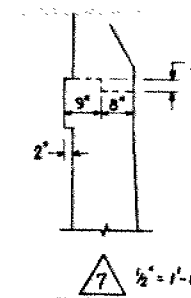


FOR REDUCED PLAN

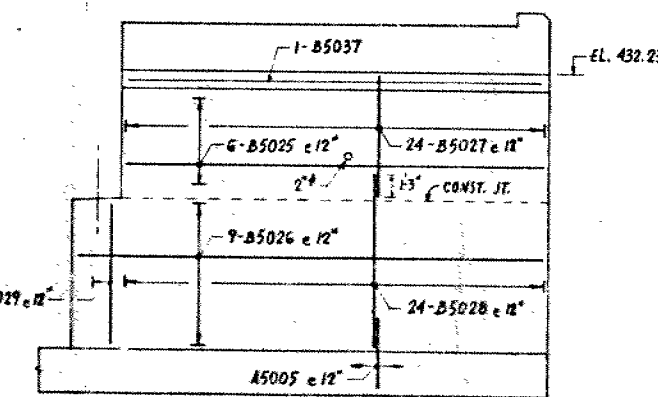
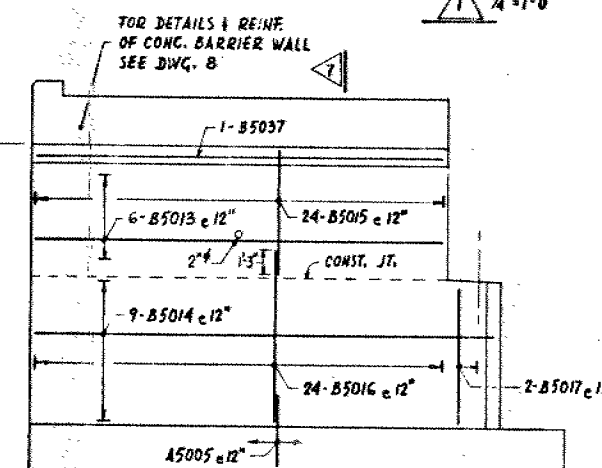
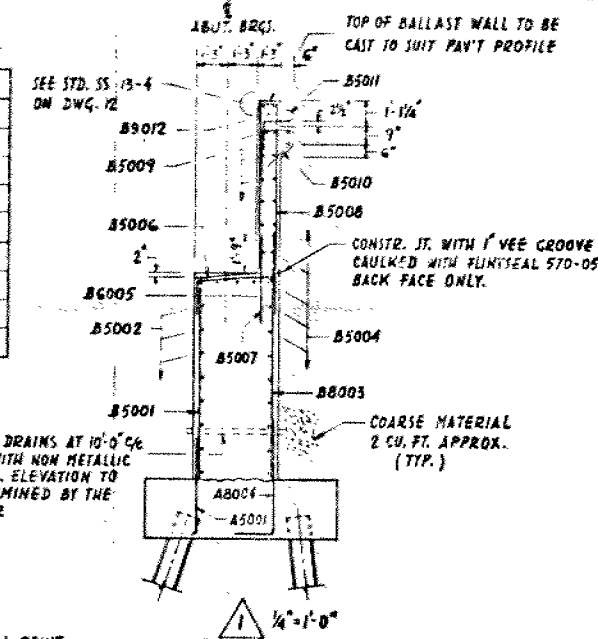


REVISION	DATE	BY	DESCRIPTION
DESIGN			
CHECK			
DRAWING			

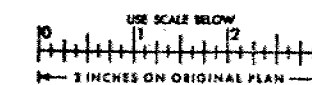
INDIAN RIVER BRIDGE
Approx 1 Mile West of Hwy 41
WEST ABUTMENT



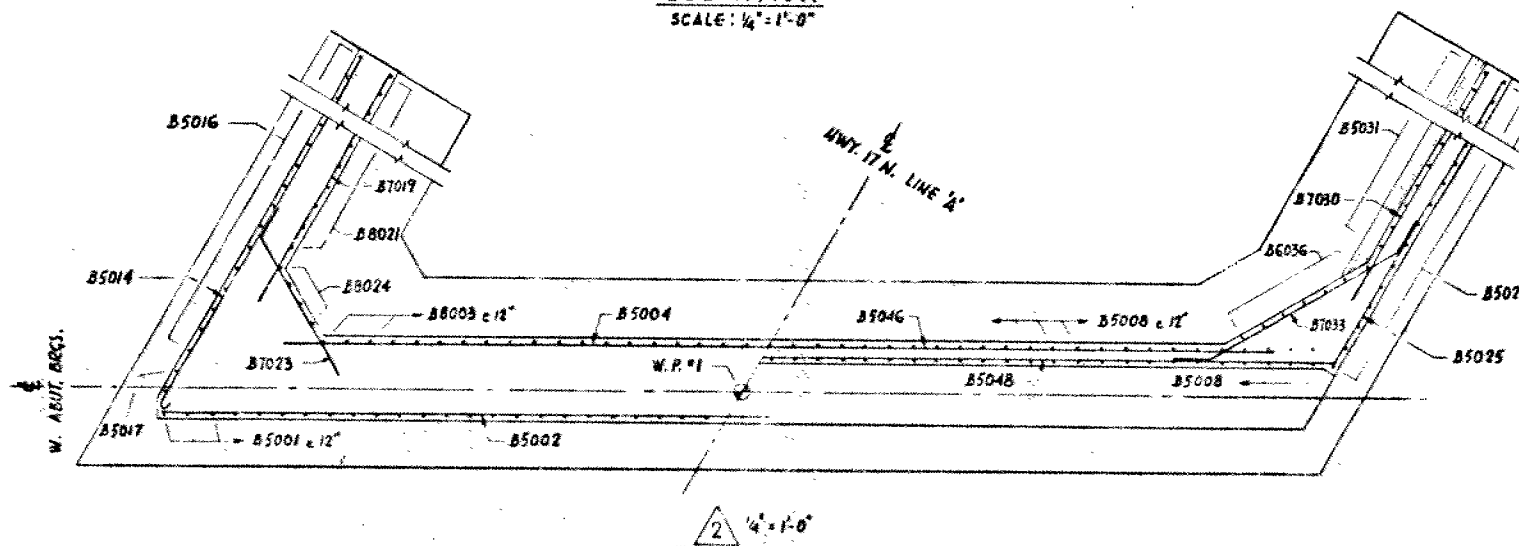
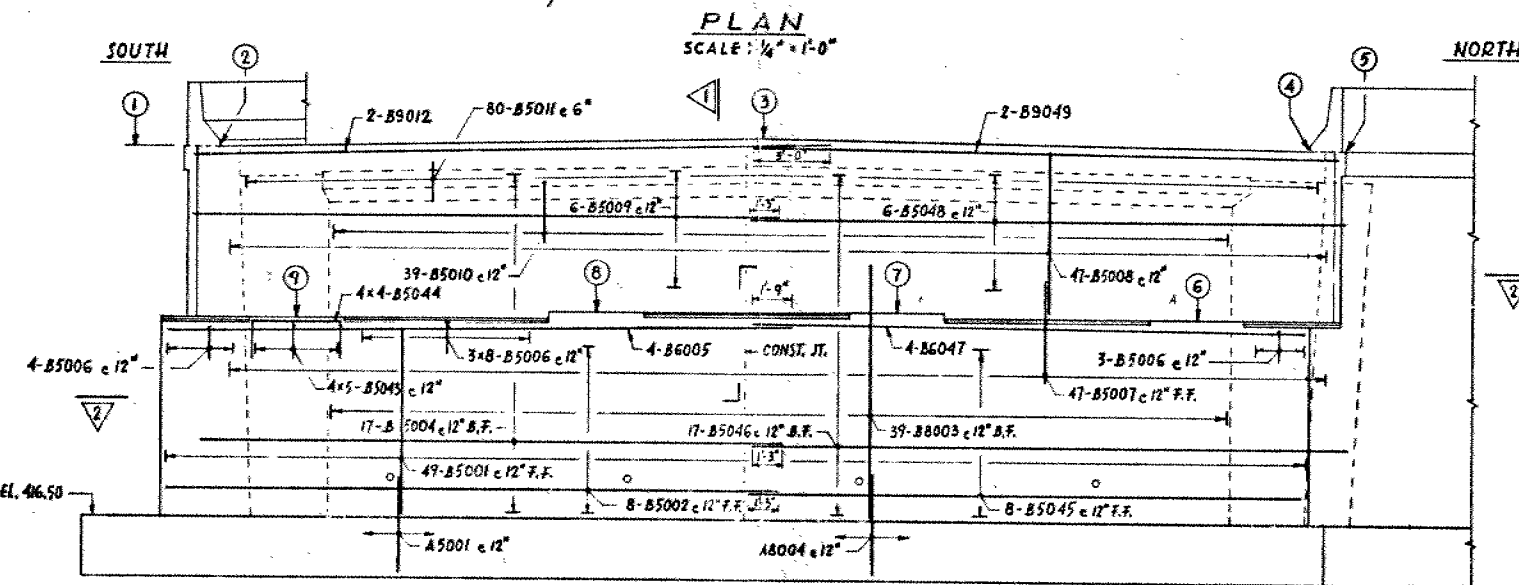
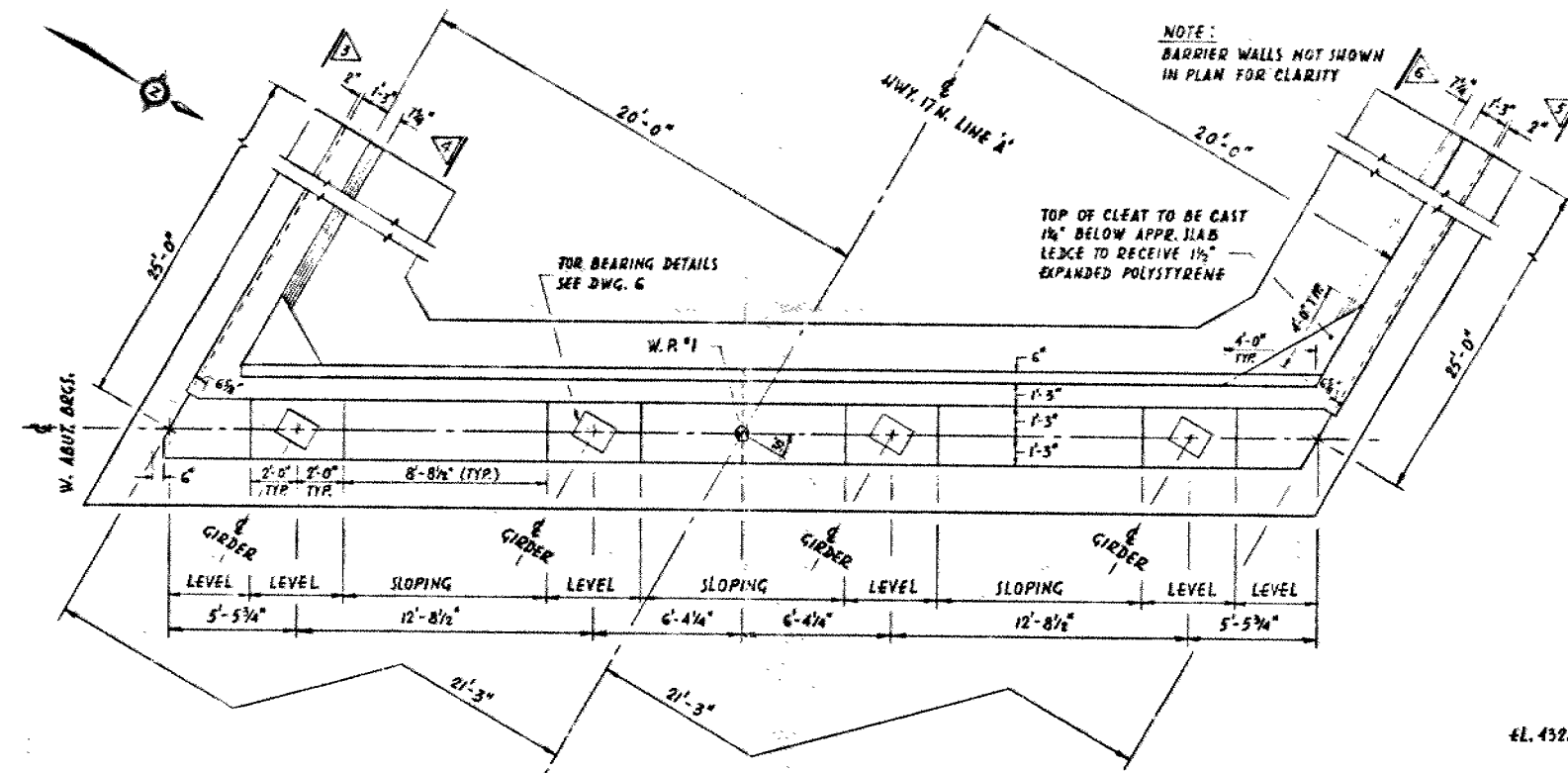
		<u>ELEVATIONS</u>	
		POINT	ELEV.
FRONT FACE OF BULLET WALL.		1	431.99
		2	431.99
		3	432.45
		4	432.11
		5	432.11
AT & ABOUT BRGS.		6	424.96
		7	425.15
		8	425.11
		9	424.86

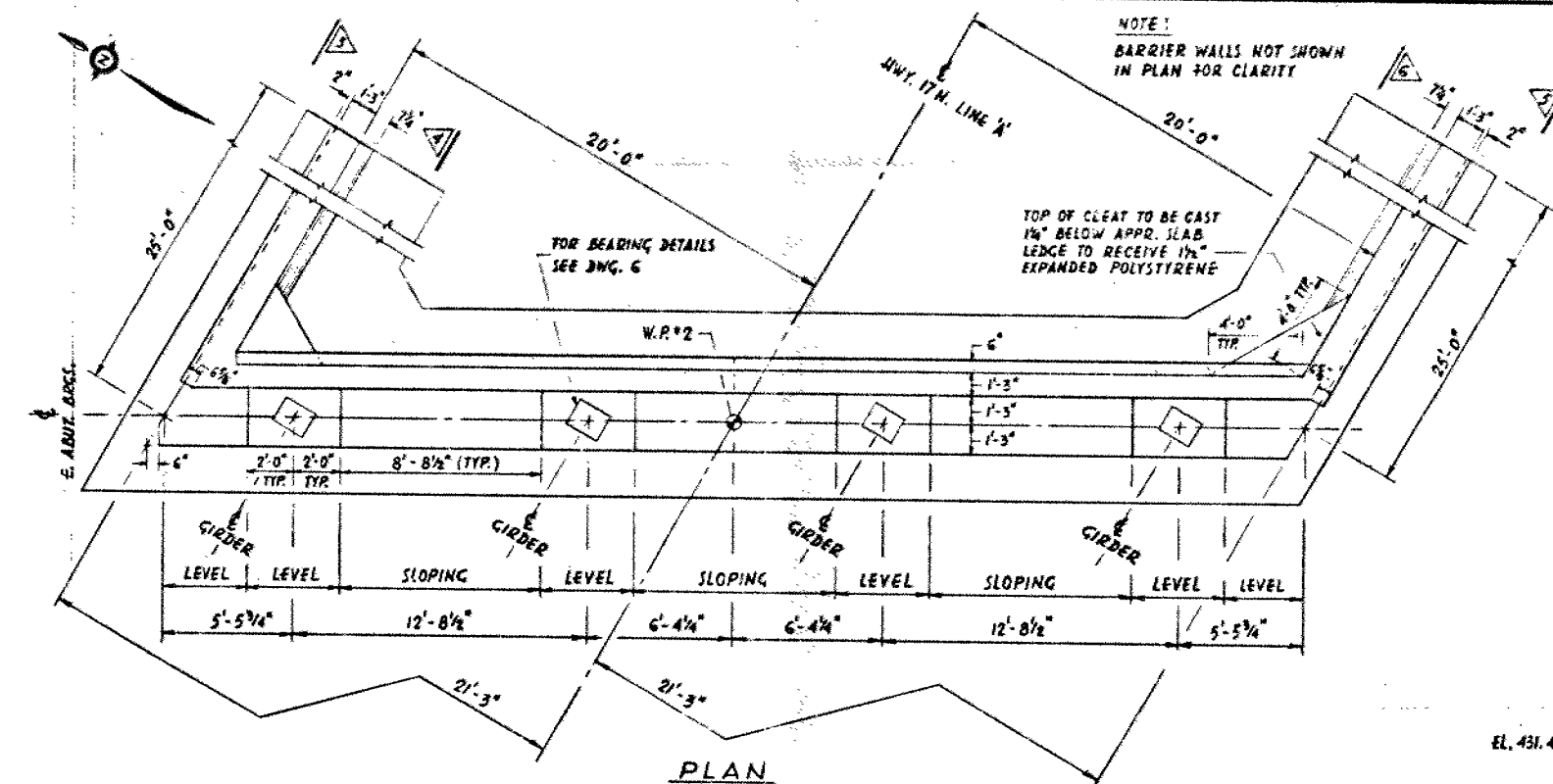


FOR REDUCED PLAN

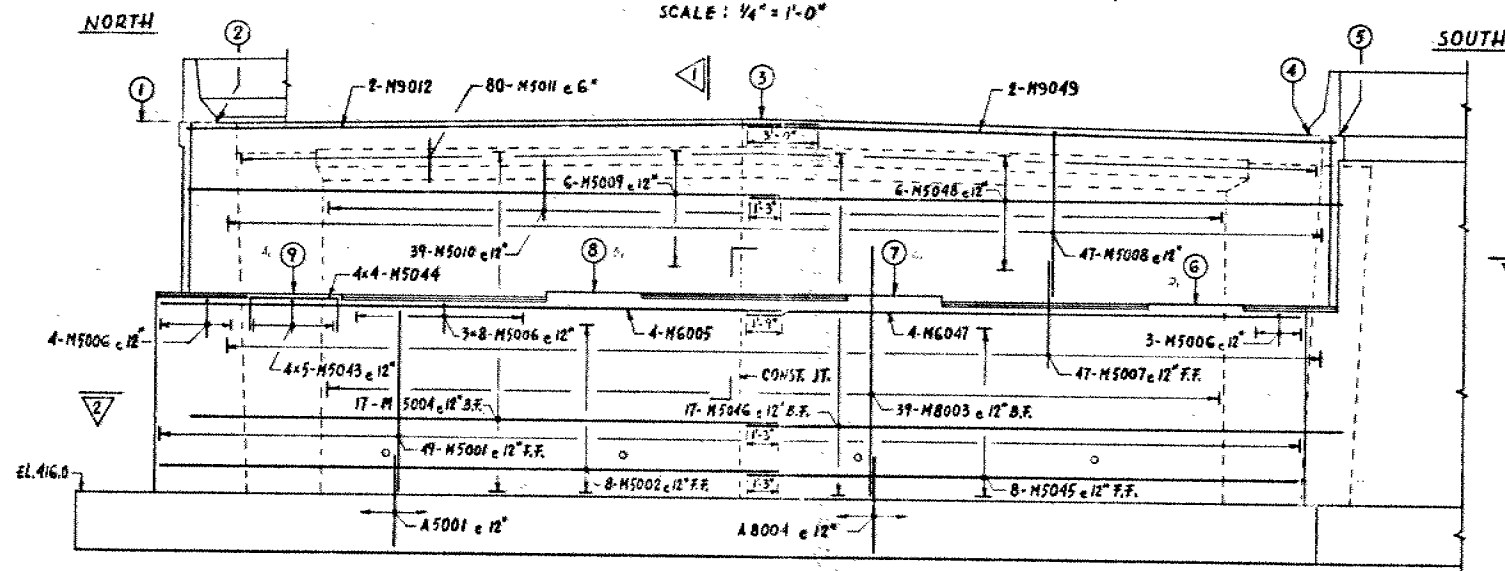


NOTES:
F.F. DENOTES FRONT FACE
B.F. DENOTES BACK FACE

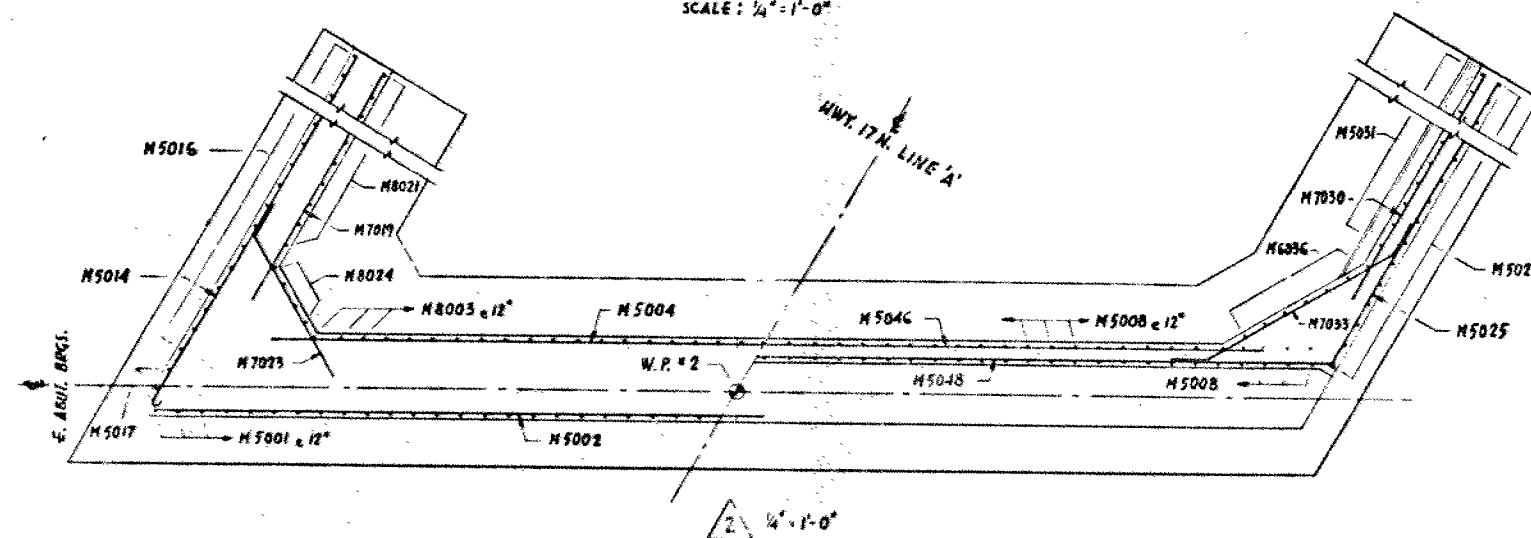
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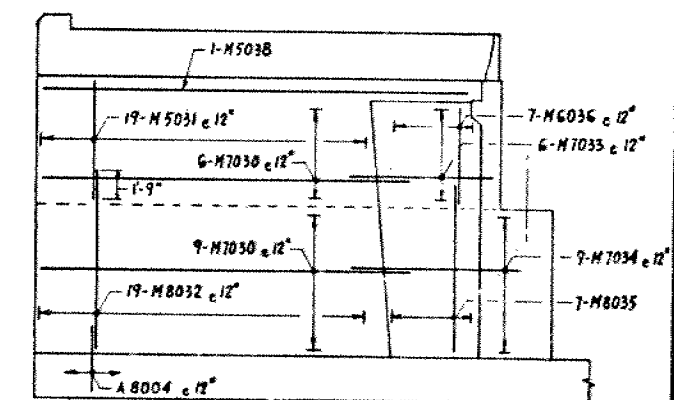
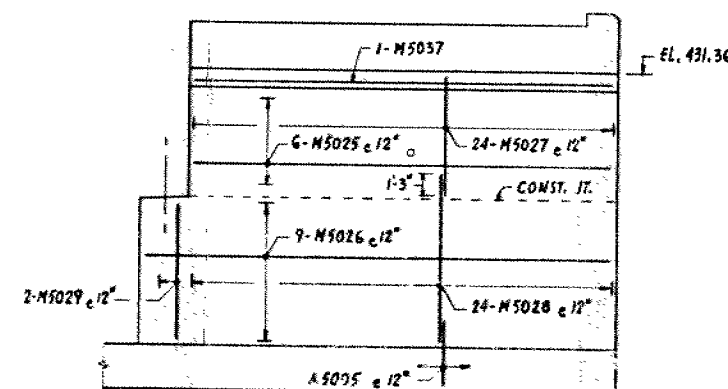
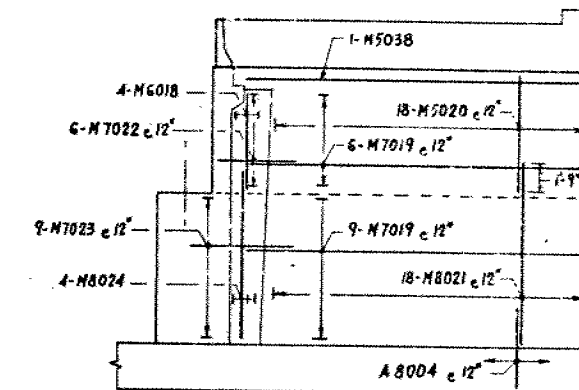
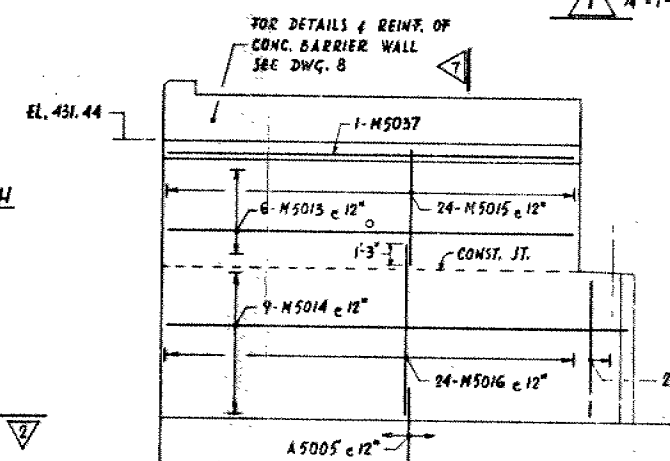
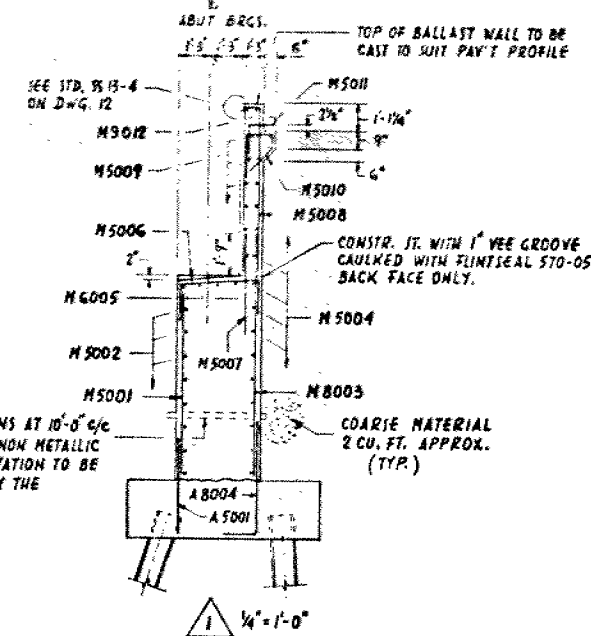
PLAN
SCALE: $\frac{1}{4}" = 1'-0"$



ELEVATION
SCALE: $\frac{1}{4}" = 1'-0"$



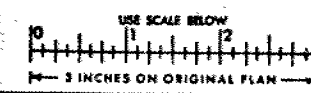
ELEVATIONS		
	POINT	ELEV.
FRONT FACE OF GULLAST WALL	1	431.53
	2	431.53
	3	431.89
	4	431.45
	5	431.45
AT & ABOUT ROCKS.	6	424.32
	7	424.57
	8	424.59
	9	424.39



NOTES :
F.F. DENOTES FRONT FACE
B.F. DENOTES BACK FACE



FOR REDUCED PLAN



REVISIONS					
DATE	BY	DESCRIPTION			
DESIGN	PK	CHECK	W	LOADING	4/20/44
DRAWING	PK	CHECK	F	SITE No	29-107
					DATE 4/20/44



Memorandum

31F - 85

GEOCRES No.

To: T.C. Kingsland (2)
Regional Structural Planning Engineer
Eastern Region, Kingston

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Attention:

Date: February 20, 1976

Our File Ref. W.P. 1-67-03

In Reply to

MAR 09 1976

Subject:

FOUNDATION INVESTIGATION REPORT

W.P. 1-67-03 Site No. 29-167
Hwy. 17N, District 9
Indian River Bridge

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your requirements. Should additional information be required, please do not hesitate to contact our Office.

M. DEVATA
Supervising Engineer

cc: R.S. Pillar
C.S. Grebski
B.J. Giroux
G.A. Wrong
S. Radbone
E.R. Saint
J.M. Childs
R. Hore
J. Anderson)
R. Forest) memo only
G. Sloan)
Files

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(4.2) Upper Granular Deposit

(4.3) Clayey Silt to Silty Clay

(4.4) Lower Granular Deposit

(4.5) Gneiss Bedrock

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6. FOUNDATIONS AND RECOMMENDATIONS

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7. STABILITY AND SETTLEMENT CONSIDERATIONS

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8. MISCELLANEOUS

FOUNDATION INVESTIGATION REPORT

for

W.P. 1-67-03
Hwy. 17N, District 9
Indian River Bridge
1.0 Miles West of Hwy. 41

1. INTRODUCTION

The Soil Mechanics Section was requested to carry out a subsurface investigation for the proposed new structure at the crossing of Line 'A', Hwy. 17N, and the Indian River. The request was contained in a memo dated September 10, 1975 from Mr. T.C. Kingsland, Regional Structural Planning Engineer, Eastern Region. This report discusses the results of the foundation investigation, together with our recommendations pertaining to the structure foundations and the settlement/stability considerations of the structure approaches.

2. SITE AND GEOLOGY

(2.1) Site

The site is located approximately 2 miles south of the town limit of Pembroke, Lot 30, Concession 2, in Stafford Township where the Indian River intersects the proposed Line 'A', Hwy. 17N. At this intersection the Indian River gradient is gentle, with a slight northward flow of water. In the immediate vicinity of the crossing, the water depth varies between 3.0 ft. (west side) and 4.0 ft. (east side).

A 6 ft. bluff is evident on the west bank of the Indian River where the land falls sharply to the river bed.

The area adjacent to the site is mixed agricultural and natural woodland, the predominant vegetation being pine and birch trees. The area west of the Indian River is generally flat with a ground surface elevation ranging from 416 to 420. In contrast, the area east of the river shows small ridge-like hills with ground surface elevations ranging from 414 to 434. Accordingly, the western area favours agricultural usage, but in the immediate vicinity of the site, the land is not cleared leaving large diameter pine and birch trees.

(2.2) Geology

The site lies on the approximate boundary of two physiographic regions, namely, the Petawawa Sand Plain and the Ottawa Valley Clay Plains. The former originated as a delta built in the Champlain Sea by the early Ottawa River, together with the Petawawa and Indian Rivers. The latter region was deposited in the geologic past in the Champlain Sea, leaving an extensive deposit of sensitive clay. The clay and sand overburden is generally underlain by granitic gneiss bedrock of the PreCambrian Age.

3. FIELD AND LABORATORY WORK

A total of 10 boreholes were put down by means of conventional soil sampling and diamond drilling techniques. Two types of drill rigs were used during the field investigation; a raft mounted diamond drill and a muskeg vehicle mounted auger machine. The former machine put holes down at the proposed location of the west pier, east pier, east abutment and east approach while the muskeg vehicle mounted mobile drill supplied complementary data at the proposed location of the west approach, west abutment and in the proximity of the west pier. The borehole type is listed below:

- 5 bored and cored holes with accompanying dynamic cone penetration test

- 3 washed and bored holes

- 2 auger holes

In addition, five dynamic cone penetration tests were carried out to complement the subsoil and bedrock data.

Samples of the overburden were obtained at required depths by means of a 2 in. O.D. split-spoon sampler, the sampling carried out according to the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Where cohesive deposits were encountered, the split-spoon sampling technique was supplemented by taking 2 in. O.D. Shelby tube samples which were pushed manually or hydraulically into the soil. In addition, field vane tests were carried out, where possible, to determine the in situ undrained shear strength of the soil. Bedrock was proven at eight locations by coring BXL samples of the rock. The groundwater conditions were observed by recording water levels in the open boreholes during the period of the field investigation.

The soil, bedrock and groundwater conditions encountered in the borings are presented on the Record of Borehole Sheets. Surveying of the borehole locations and elevations was carried out in the field under the direction of Mr. R. Denison, Party Chief, Eastern Region. The boring locations and elevations, together with the estimated stratigraphical sections are shown on Drawing No. 16703A.

All samples were subjected to a careful inspection and classification, both in the field and in the laboratory. Following this examination,

various laboratory tests were effected on representative soil samples to determine the physical properties of the overburden, namely:

Natural Moisture Contents

Atterberg Limits

Grain-size Distributions

Undrained Shear Strengths

Consolidation Properties

The results of this laboratory testing are plotted on the Record of Borehole Sheets and are summarized on Figs. 1, 2 and 3, all of which are contained in the Appendix of this report.

4. SUBSOIL CONDITIONS

(4.1) General

In general, the overburden at the site consists of three principal soil types. The upper granular layer is a deposit of loose to compact sand with silt to silty sand extending to a maximum depth of 9 ft. below the ground surface. Beneath this layer, a cohesive deposit of stiff to very stiff clayey silt to silty clay extends to depths ranging between 28 to 45 ft. below the ground surface. Below this stratum, a granular deposit consisting of silty sand to sandy silt displays a loose to compact relative density. The overburden is underlain by grey gneiss bedrock which is interbedded with grey chlorite schist.

(4.2) Upper Granular Deposit

The upper granular layer consists generally of sand with silt but the composition of the granular deposit varies randomly across the site. The thickness of this deposit ranges between 7.5 ft. in the western portion to 9.0 ft. at the eastern side of the site. In some areas the Indian River has scoured away this deposit leaving only a trace of sand on the river bed. In the vicinity of the east approach where the ground surface elevation rises to 430 ft. (B.H. No. 14), this upper granular layer was not encountered. The relative density of the granular material is loose to compact ('N' values, 3-28 blows per ft.). The range in grain size characteristics of this soil is illustrated in envelope form on Fig. 1 in the Appendix which shows that the deposit can be described as sand with silt to silty sand.

(4.3) Clayey Silt to Silty Clay

A cohesive deposit of grey clayey silt to silty clay underlies the upper granular layer. Generally, the thickness of the stratum varies between 22 and 34 ft. However, this stratum expands to a thickness of approximately 50 ft. in the vicinity of the east approach where the ground surface elevation increases from 415 to 430 ft. Atterberg limits were obtained for the cohesive samples; the results are plotted on Fig. 2 contained in the Appendix of this report.

The results of this plot indicate that the majority of soil types tested from this stratum were classified as clayey silt, the remainder silty clay. Occasional very thin horizontal bands of sand are evident throughout the deposit. The index properties of this deposit are tabulated below:

	<u>Clayey Silt</u>	<u>Silty Clay</u>
Liquid Limit	19-34	35-42
Plastic Limit	13-23	18-22
Moisture Content	31-64	38-59

Tests were performed, both in situ and the laboratory, to determine the undrained shear strength of the cohesive soil; the results are tabulated below.

Clayey Silt to Silty Clay

Test	Range of Shear Strength (psf)	Avg. Shear Strength (psf)
Field Vane	1640-2000	2000
Lab Vane	1005-2000	2400
Unconfined	720- 1920	1100
Quick Triaxial	1085- 1865	1500

From the data, the consistency of the cohesive stratum varies between stiff and very stiff. The in situ sensitivity of the cohesive deposit as determined by the ratio of the undrained shear strength to the remoulded shear strength ranges between 5 and 11, that is, the soil is sensitive.

(4.4) Lower Granular Deposit

Below the cohesive stratum, a granular deposit consisting of fine grained grey silty sand to sandy silt extends to the bedrock surface. The thickness of this layer varies between 46 ft. on the western portion of the site to 6 ft. on the east, that is, the thickness of the deposit diminishes as the bedrock elevation rises to approximately elev. 375 and pinches out the granular soil type. 'N' values ranging from 4-31 blows per foot, as determined by the Standard Penetration Test, indicated that the deposit had a

loose to compact relative density. The typical grain size distribution curves within this layer are illustrated in an envelope form on Fig. 3, contained in the Appendix of this Report. As shown on the Figure, a dense sand, some gravel layer was encountered in BH#6 which forms a 2 ft. thick blanket covering the bedrock surface in the vicinity of the east bank of the Indian River.

(4.5) Gneiss Bedrock

Bedrock was proven at eight locations by obtaining BXL rock core samples ranging in length from 2.5 to 5.5 feet. The bedrock type is grey, medium to coarse grained, hard gneiss interbedded with medium grained hard chlorite schist. The bedrock profile across the site is quite variable as indicated on Drawing No. 16703-A. However, the Sections A-A through D-D shown on the same drawing describe a more accurate picture of the bedrock surface. Along Line 'A', the bedrock surface undulates considerably.

The depth to bedrock is summarized in the following table:

<u>LOCATION</u>	<u>DEPTH TO BEDROCK (FT)</u>
West Abutment Vicinity	76 - 85
West Pier Vicinity	52 - 78
East Pier Vicinity	37 - 54
East Abutment Vicinity	42 - 43

In general, the bedrock is sound with areas of occasional minor fracturing evident.

5. GROUNDWATER CONDITIONS

During the course of the foundation investigation, the Indian River water level was established at elev. 408.8. Water levels were recorded in the boreholes where possible. In a few cases, typically B.H.#2, the boreholes caved in negating any attempts to record stable groundwater conditions. Generally the water levels across the site follows the hydraulic gradient towards the Indian River.

Artesian water was encountered in the boreholes located within the river bed once boring operations penetrated the clayey silt to silty clay stratum into the lower granular layer at B.H. #3, #4 and #5. The head of water inside the BX casing rose to 9.5 ft. above the Indian River water level. Similar conditions were not found elsewhere.

The water levels including artesian conditions are plotted on the Record of Borehole Sheets and on Drawing 16703-A.

6. FOUNDATIONS AND RECOMMENDATIONS

(6.1) General

It is proposed to construct a three span structure to carry Hwy. 17N, Line 'A', over the Indian River. The structure will consist of a 70 ft. centre span and two 50 ft. end spans supported on two piers and two abutments. The proposed elevation of Hwy. 17N at the river crossing is elevation 435.

The upper soil strata encountered at the site is a sand with silt layer averaging 9 ft. in thickness. This soil type is characteristic of the river banks but has generally been eroded and scoured away within the Indian River bed. Beneath this soil type, a clayey silt to silty clay stratum extends to approximate elevation 380. The deposit thickness averages 25 ft. in the western and central portions of the site but expands to a thickness of 50 ft. in the eastern extreme of the site where the ground elevation rises from 415 to 432. The lower granular deposit randomly varies from silty sand to sandy silt across the site and extends to the undulating sound gneiss bedrock surface.

(6.2) Foundation Considerations

Both the upper granular deposit and the cohesive clayey silt to silty clay stratum are not competent soil types on which to found a spread footing type of support.

It is recommended that both the abutments and piers be founded on steel 'H' piles driven to the sound gneiss bedrock surface. For a steel 'H' pile, 12BP74, the allowable design load per pile is 95 tons.

The bedrock condition across the site is illustrated in the following table;

<u>Location</u>	<u>Bedrock Elevation North to South Along Prop. Ftg.</u>	<u>Dip and Dip Direction</u>	<u>Ground Elevation North to South Along Prop. Ftg.</u>
West Abutment	341.8 - 333.3	10°S	417.8
West Pier	330.8 - 356.3	25°N	405.8
East Pier	354.8 - 376.0	25°N	404.8 - 412.5
East Abutment	372.3 - 374.3	7°N	415.3 - 415.8

As illustrated in the above table, the bedrock surface dips fairly steeply in a northward direction within the vicinity of the proposed west and east pier locations. This sloping nature of the bedrock may necessitate the keying of the pile tips into the bedrock surface, i.e. Oslo points may be desirable. This aspect of the pile foundations will be discussed further upon completion of the preliminary structure drawings.

Dewatering schemes will be required for the construction of pile caps located within the Indian River bed.

7. STABILITY AND SETTLEMENT CONSIDERATIONS

(7.1) Stability Considerations

The proposed grade of Hwy. 17N is approximately elev. 435 at the crossing with the Indian River. The maximum height of fill above the existing ground surface for both the east and west approaches to the structure is 20 ft. However, in the longitudinal direction, from the river bed upward, the maximum fill height is 30 ft. Stability analyses, in terms of total stresses, were carried out to determine the stability of the east approach fill. The following soil parameters were used in the analysis:

Soil Type	Elevation	ϕ°	Cu (PSF)	γ (PCF)
Fill	435-417	30	0	130
Upper Granular Layer	417-410	30	0	120
Clayey Silt to Silty Clay	410-400	0	1000	115
Clayey Silt to Silty Clay	400-385	0	2000	115
Lower Granular Layer	385-Bedrock Surface	30°	0	120

Groundwater table elevation: 410

No stability problems are anticipated in the longitudinal or transverse directions of the approaches, provided the fills are constructed with well compacted earth material with two horizontal and one vertical slopes.

Some undermining of both the west and east Indian River banks is evident, particularly the west bank where a 6 ft. bluff has been eroded by the combined action of surface runoff and the river. It is recommended that both the west and east forward slopes be protected by rip-rap up to the high high water level.

(7.2) Settlement Considerations

Settlement calculations were carried out for the loading conditions induced by the proposed 20 ft. fills following the Purdue Method of stress distribution beneath an embankment. The results

indicated that the settlement of the subsoil due to the embankment load should not exceed 4 inches.

8. MISCELLANEOUS

The field work performed during the period of November 18 to December 3, 1975 inclusive, was carried out under the immediate supervision of R.W. Barnes, Project Engineer.

The drilling equipment was owned and operated by Master Soil Investigation Ltd., Toronto, and Atcost Soil Drilling Inc., Concord.

This report was prepared by R.W. Barnes under the general supervision of Mr. M. Devata, Supervising Engineer, who also reviewed this report.

R.W. Barnes

R.W. BARNES
Project Engineer

M. Devata

M. DEVATA
Supervising Engineer

February, 1976



APPENDIX

WP 1-67-03 LOCATION Co-ords. 16,644,593 N; 837,321 E. ORIGINATED BY RWB
DIST 9 HWY 17N BORING DATE November 26, 1975 COMPILED BY RWB
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Pen. Test CHECKED BY N.J.

[illegible]

15 ϕ 5 % STRAIN AT FAILURE

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

RECORD OF BOREHOLE NO 2

WP 1-67-03 LOCATION Co-ords. 16,644,556 N; 837,361 E. ORIGINATED BY RWB
DIST 9 HWY 17N BORING DATE November 20, 21, 24, 25, 1975 COMPILED BY RWB
DATUM Geodetic BOREHOLE TYPE CME (5.1) MV.H.S. CHECKED BY MJ

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 % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
417.8	Ground Level															
0.0	Sand with silt, some clay.		1	SS	28											0 62 27 11
	Compact		2	SS	5	410									108.5	
410.3			3	TW	PH				ox							
7.5	Clayey silt to silty clay.		4	TW	PH											
	Stiff to Very Stiff		5	TW	PH										109	
	occasional thin horizontal sand seams		6	TW	PH										120	
			7	TW	PH											0 7 63 30
			8	SS	10											
379.8			9	SS	7	380										0 32 53 15
38.0																
	Silty sand to sandy silt, trace clay		10	SS	8	370										0 84 (16)
			11	SS	8											
	Loose to Compact															
			12	SS	11	360										
			13	SS	15	350										0 43 48 9
			14	SS	10	340										
333.3																
84.5	Gneiss/Chlorite Schist		15	BC	100%	330										
330.8	Bedrock Sound			BXL												
87.0	End of Borehole															
325.3																
92.5	End of Cone Test					320										

RECORD OF BOREHOLE NO 3

WP 1-67-03

LOCATION Co-ords. 16,644,608 N; 837,382 E.

ORIGINATED BY RWB

DIST 9 HWY 17N

BORING DATE November 18, 19, 20, 1975

COMPILED BY RWB

DATUM Geodetic

BOREHOLE TYPE Washboring, NX, BX Casing

CHECKED BY *M.D.*

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 % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20	40	60	80	100	W_P	W	W_L		
408.8	River Water Level															
0.0	River Bed															
405.8	sand with silt		1	SS	6											0 92 (8)
3.0	Clayey silt to silty clay		2	SS	4											0 37 38 25
			3	TW	PM											
	Stiff to Very Stiff		4	TW	PM											
	occ. thin horizontal sand seams		5	TW	PM											
383.8			6	SS	3											0 87 (13)
25.0	Silty sand to sandy silt, trace to some clay		7	SS	10											0 88 (12)
			8	SS	5											
			9	SS	14											
			10	SS	3											
	Loose to Compact		11	SS	2											
			12	SS	3											0 26 59 15
			13	SS	10											
330.8																
78.0	Gneiss Bedrock Sound		14	RC BXL	Rec 100%											
325.8																
83.0	End of Borehole															

WP 1-67-03 LOCATION Co-ords. 16,644,576 N; 837,427 E. ORIGINATED BY RWB
DIST 9 HWY 17N BORING DATE November 21, 25, 1975 COMPILED BY RWB
DATUM Geodetic BOREHOLE TYPE Washboring, NX BX Casing CHECKED BY H.T.

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION *	STRAT. PLOT	NUMBER	TYPE	'N' VALUES				
408.8	River Water Level					GROUND WATER ELEV			
0.0									
405.8	River Bed								
3.0									
	Clayey silt to silty clay								
381.8									
27.0									
	Silty sand to sandy silt								
356.8									
52.0	Gneiss/Chlorite Schist		1	RC EXL	Rec 100%				
352.3	Bedrock Sound								
56.5	End of Borehole * Soil types inferred from wash water during boring operations, only bedrock samples were taken					350			

15 ϕ 5 % STRAIN AT FAILURE

ORIGINATED BY RWB
COMPILED BY RWB
CHECKED BY M. J.

15 ϕ 5 % STRAIN AT FAILURE

RECORD OF BOREHOLE NO 6

WP 1-67-03

LOCATION Co-ords. 16,644,599 N; 837,474 E.

ORIGINATED BY RWB

DIST 9 HWY 17N

BORING DATE November 28, 29, 1975

COMPILED BY RWB

DATUM Geodetic

BOREHOLE TYPE Washboring NX BX Casing

CHECKED BY M.J.

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		
412.5	Ground Level															
0.0	Silty sand to sand with silt, traces of clay, organics		1	SS	13	410										0 50 45 5
			2	SS	12											0 71 27 2
402.5	Compact		3	SS	7											*obstructed by tree roots
10.0	Clayey silt to silty clay		4	TW	PM	400									112	
	Stiff to Very Stiff		5	TW	PM											
	occ. thin horizontal sand seams		6	TW	PM	390									119	
			7	TW	PM										116	
384.5																
28.0	Silty sand to sandy silt, trace to some clay Loose		8	SS	5	380										0 33 49 18
	changing to sand, some silt, trace clay. Dense		9	SS	31											16 69 13 2
376.0																
36.5	Gneiss Bedrock															
371.5	Sound		10	RC BXL	Rec 100%											
41.0	End of Borehole					370										

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

RECORD OF BOREHOLE NO 7

WP 1-67-03 LOCATION Co-ords. 16,644,632 N; 837,491 E. ORIGINATED BY RWB
 DIST 9 HWY 17N BORING DATE December 1, 2, 1975 COMPILED BY RWB
 DATUM Geodetic BOREHOLE TYPE Washboring NX BX Casing CHECKED BY H.T.

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 % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N _v VALUES		20	40	60	80	100	W_P	W	W_L		
415.3	Ground Level															
0.0	Sandy silt, trace clay		1	SS	10	410										0 44 49 7
	Loose to Compact		2	SS	3											0 40 48 12
406.3			3	TW	PM											
9.0	Clayey silt to silty clay		4	TW	PM											
			5	TW	PM											
	Stiff to Very Stiff occ. thin horizontal sand seams		6	SS	4	390										
			7	TW	PM											
	with sand		8	SS	6	380										0 38 39 23
			9	SS	8											
372.3																
43.0	Gneiss/chlorite schist															
368.3	Bedrock Sound		10	RC BXL	Rec 100%	370										
47.0	End of Borehole															
						360										

20
15 \div 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 1-67-03 LOCATION Co-ords. 16,644,608 N; 837,525 E. ORIGINATED BY RWB
 DIST 9 HWY 17N BORING DATE November 30, December 1, 1975 COMPILED BY RWB
 DATUM Geodetic BOREHOLE TYPE Washboring, NX BX Casing CHECKED BY H.T.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION *	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH				
												○ UNCONFINED + FIELD VANE				
												● QUICK TRIAXIAL x LAB VANE				
						WATER CONTENT %					W_P W W_L					
415.8	Ground Level															
0.0	Topsoil															
	Sand with silt					410										
406.8																
9.0	Clayey silt to silty clay					400										
						390										
						380										
379.8																
36.0	Silty sand to sandy silt															
374.3																
41.5	Gneiss/chlorite schist			RC	Rec											
	Bedrock Sound		1	BXL	100%	370										
369.3																
46.5	End of Borehole															
	* Soil types inferred from wash water during boring operations only bedrock samples were taken.					360										

RECORD OF BOREHOLE No 9

ORIGINATED BY RWB
COMPILED BY RWB
CHECKED BY M.T.

15 ϕ 5 % STRAIN AT FAILURE

RECORD OF BOREHOLE NO 10

WP 1-67-03

LOCATION Co-ords. 16,644,611 N; 837,463 E.

ORIGINATED BY RWB

DIST 9 HWY 17N

BORING DATE November 29, 1975

COMPILED BY RWB

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY M. J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION *	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					w_p w w_L				
							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %				
411.9																
0.0	Probable sand with silty clay					410										
	Probable Clayey silt to silty clay					400										
						390										
389.9																
28.0	Probable Silty sand to sandy silt changing to prob. sand, some gravel					380										
370.8																
41.1	End of Cone Test Probable Bedrock * Soil types inferred from dynamic cone penetration test.					370										

CHECKED BY 72

15 $\overset{20}{\underset{10}{\phi}}$ 5 % STRAIN AT FAILURE

RECORD OF BOREHOLE No 12

WP 1-67-03 LOCATION Co-ords. 16,644,573 N; 837,344 E. ORIGINATED BY RWB
 DIST 9 HWY 17N BORING DATE December 2, 1975 COMPILED BY RWB
 DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY M. J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION *	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					W_P W W_L				
							SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
418.3	Ground Level															
0.0	Probable sand with silt															
412.3																
6.0	Probable Clayey silt to silty clay					410										
						400										
394.3																
24.0	Probable Silty sand to sandy silt					390										
						380										
						370										
						360										
						350										
						340										
337.3	End of Cone Test Probable Bedrock															
81.0	* Soil types inferred from dynamic cone test.															

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

RECORD OF BOREHOLE NO 13

WP 1-67-03 LOCATION Co-ords. 16,644,623 N; 837,503 E. ORIGINATED BY RWB
DIST 9 HWY 17N BORING DATE December 2, 1975 COMPILED BY RWB
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Test CHECKED BY MD

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION *	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_p	W	W_L		
415.5	Ground Level															
0.0	Probable sand with silt															
412.0																
3.5																
	Probable															
	Clayey silt to															
	silty clay															
384.5																
31.0	Probable silty sand to sandy silt															
375.5																
40.0	End of Cone Test Probable Bedrock															
	* Soil types inferred from dynamic cone test															

RECORD OF BOREHOLE NO 14

WP 1-67-03
DIST 9 HWY 17N
DATUM Geodetic

LOCATION Co-ords .16,644,653 N; 837,593 E.
BORING DATE December 3, 1975
BOREHOLE TYPE Washboring NX BX Casing

ORIGINATED BY RWB
COMPILED BY RWB
CHECKED BY *M.T.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
430.9	Ground Level															
0.0	Clayey silt to silty clay		1	SS	12	430										
			2	SS	10											
			3	SS	3	420										
	Stiff to Very Stiff		4	TW	PM											
			5	TW	PM											
	occ. thin horizontal sand seams		6	TW	PM	410										
			7	TW	PM											
			8	SS	5	400										
			9	SS	4	390										
			10	SS	4											
378.9						380										
52.0	Silty sand to sandy silt		11	Wash												
372.9																
58.0	End of Borehole					370										

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

RECORD OF BOREHOLE NO 15

WP 1-67-03 LOCATION Co-ords. 16,644,543 N; 837,251 E. ORIGINATED BY RWB
DIST 9 HWY 17N BORING DATE December 2, 1975 COMPILED BY RWB
DATUM Geodetic BOREHOLE TYPE CME (t.l) M.V.H.S. CHECKED BY H.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W_P	W	W_L		
415.8	Ground Level															
0.0	Silt, some sand, clay															
411.5	Compact		1	SS	12											0 15 65 20
4.3	Clayey silt to		2	SS	5	410										
	silty clay		3	TW	PH										109	
	Stiff to Very Stiff		4	TW	PH	400									113	
	occ. thin horizontal		5	SS	10											
	sand seams		6	TW	PH	390										
385.5	Silty sand to sandy		7	SS	10											
384.0	Stiff, Compact															
31.8	End of Borehole					380										

[illegible]

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Communications**

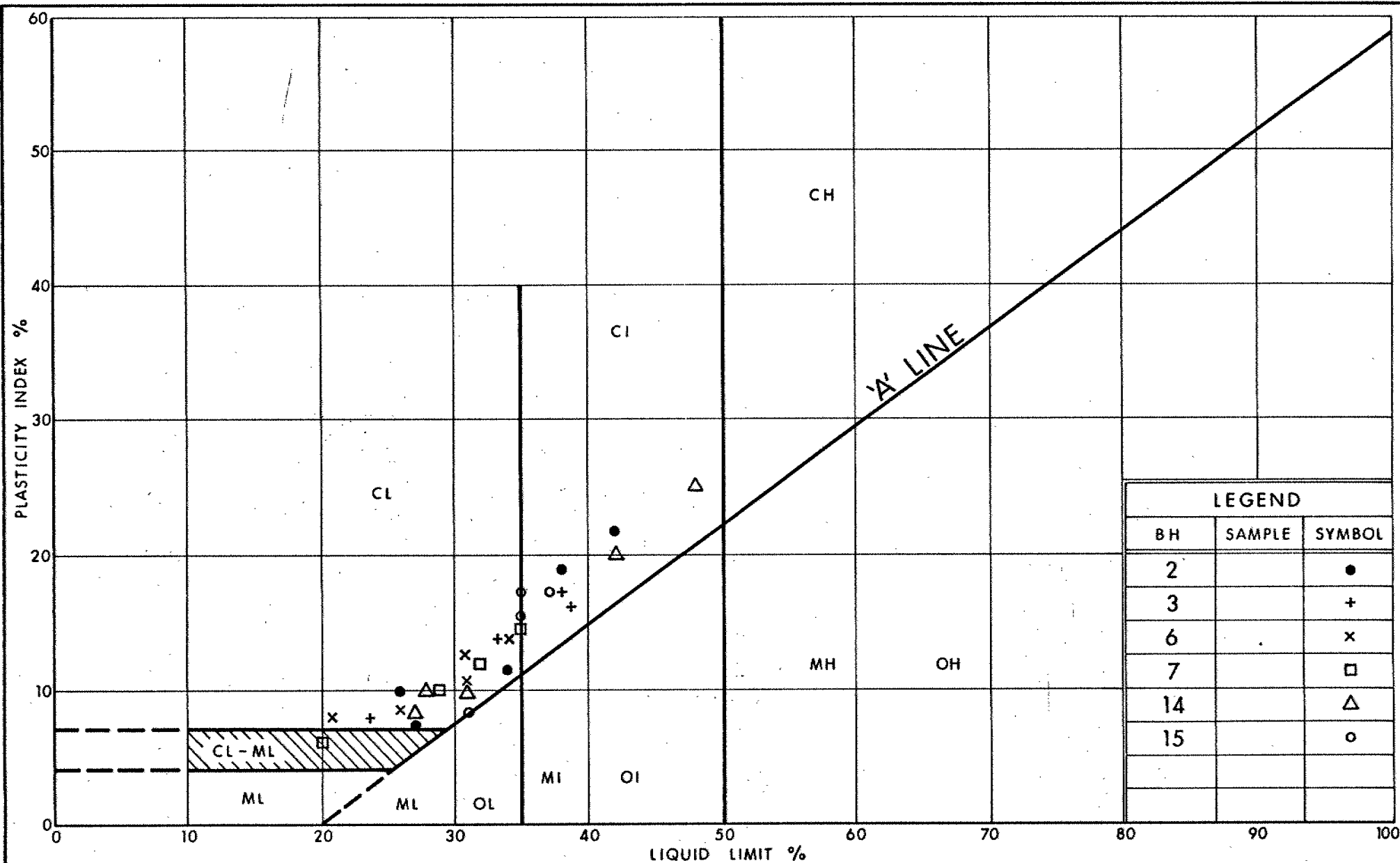
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GRAIN SIZE DISTRIBUTION
UPPER GRANULAR DEPOSIT

FIG No 1

W P 1 - 67 - 03



Ontario
ENGINEERING SERVICES BRANCH

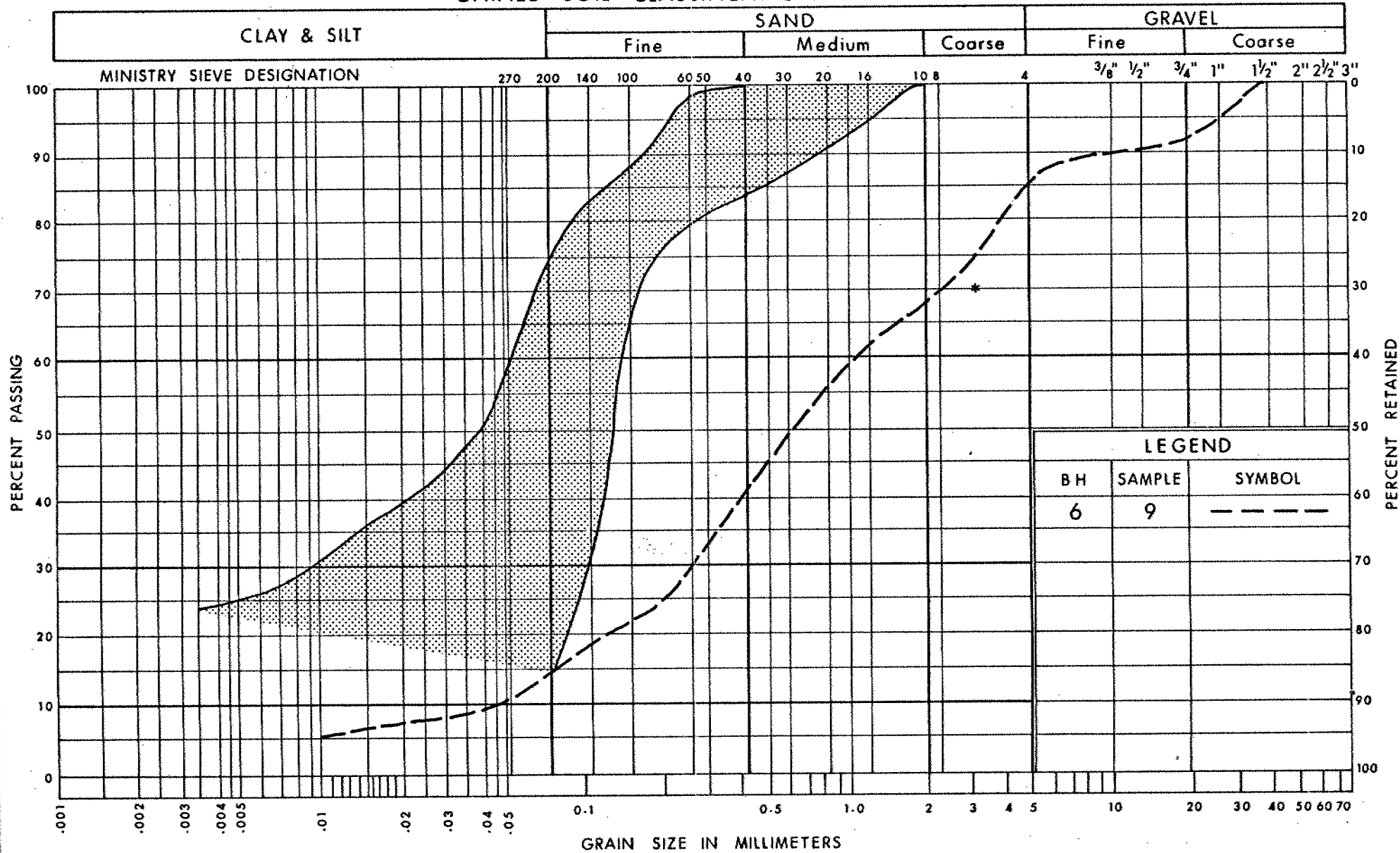
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PLASTICITY CHART COHESIVE DEPOSIT CLAYEY SILT TO SILTY CLAY

FIG No 2

W P 1 - 67 - 03

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
LOWER GRANULAR DEPOSIT
 *SAND WITH GRAVEL AND SILT

FIG No 3

W P 1 - 67 - 03



Ministry of
Transportation and
Communications

Ontario
ENGINEERING SERVICES BRANCH

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TERMS TO BE USED IN DESCRIBING SOILS:-

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

TYPE OF SAMPLE

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

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
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_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	$= 3.1416$
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

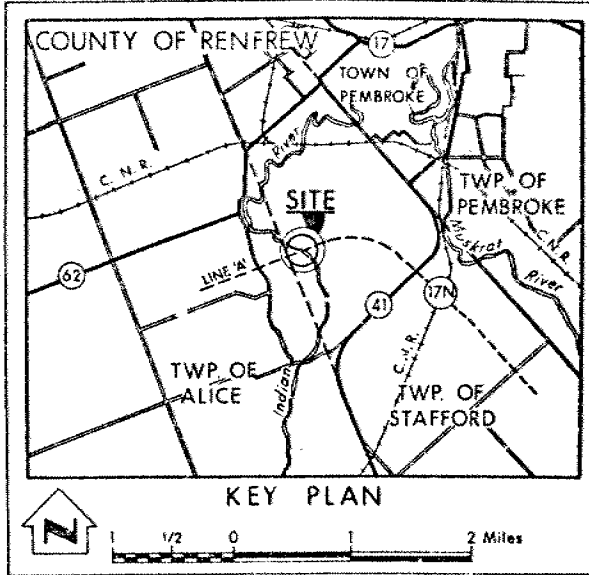
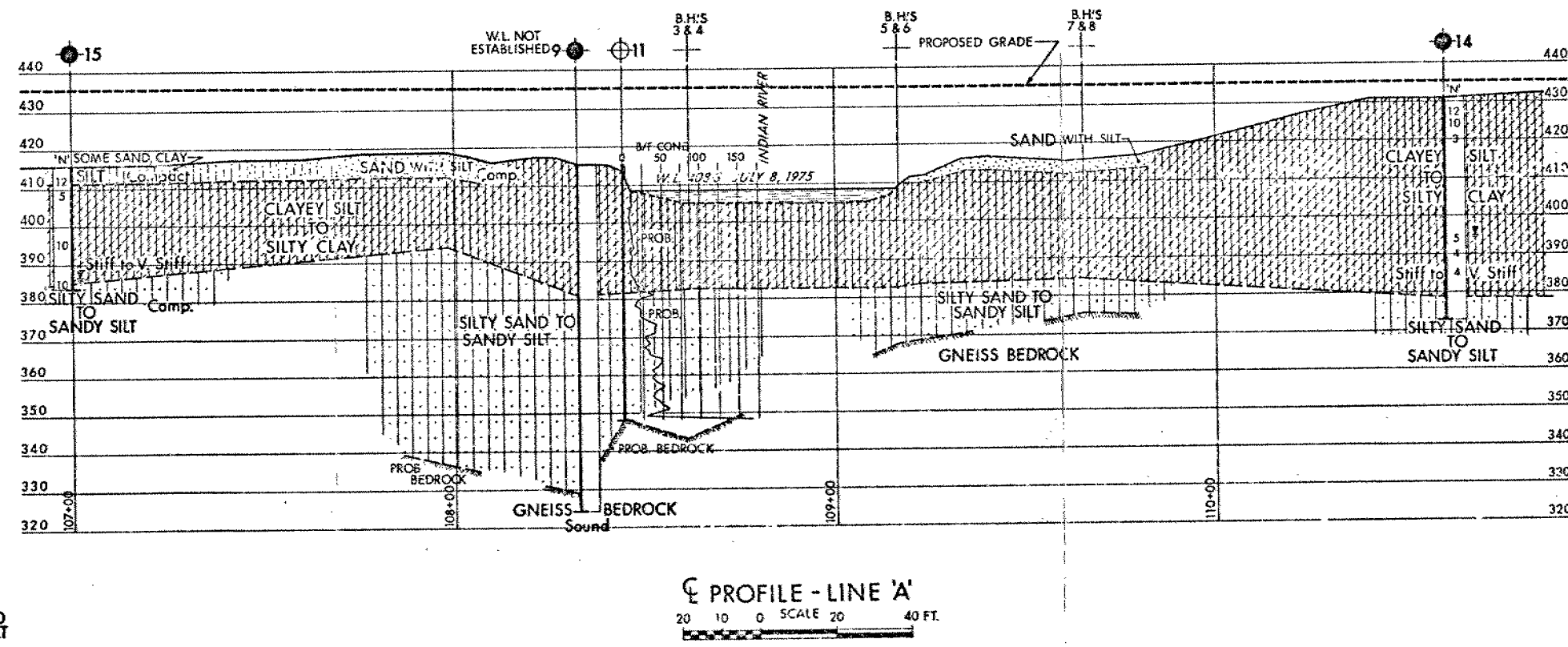
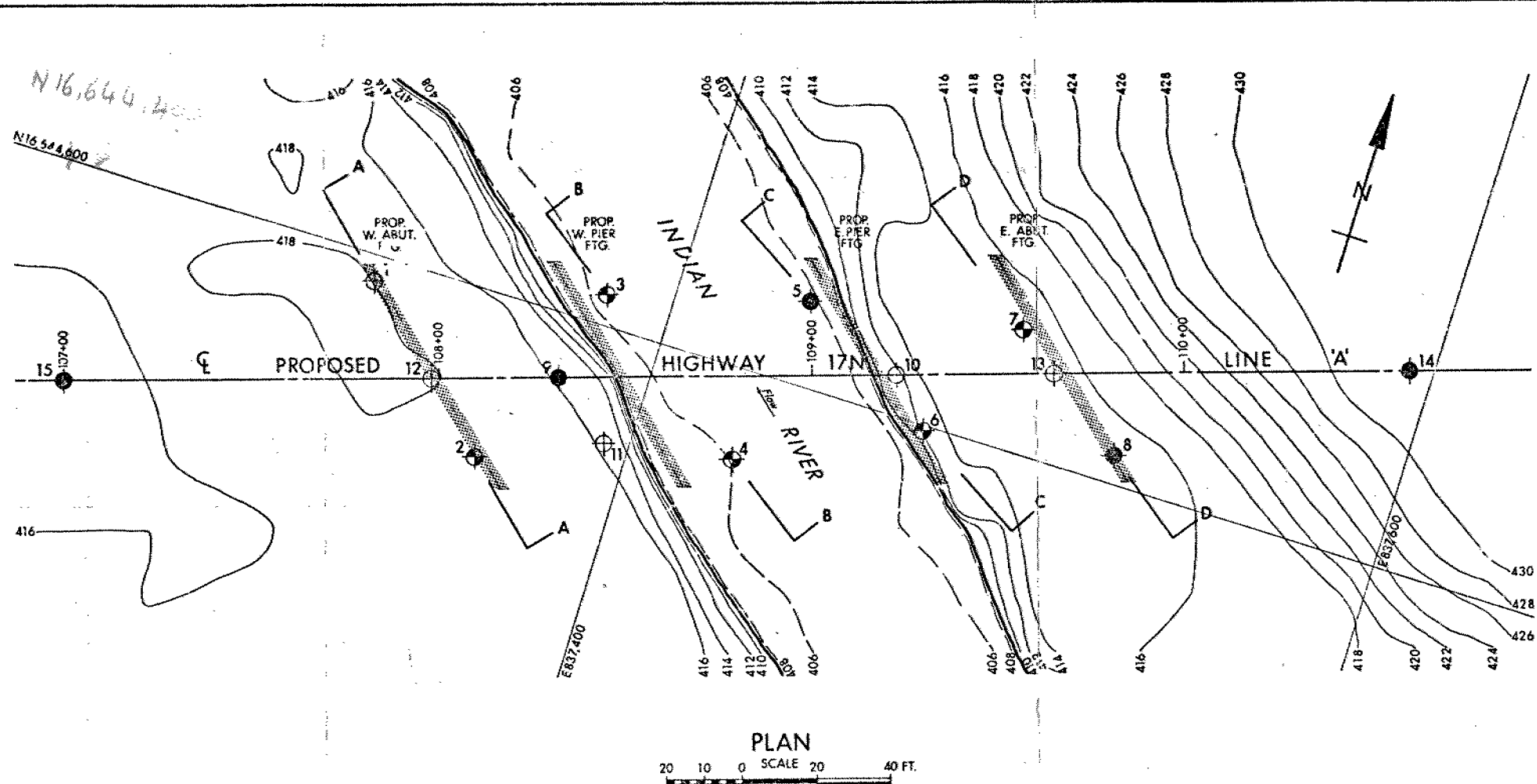
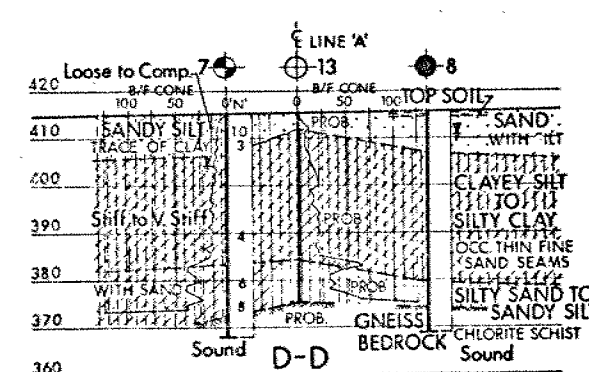
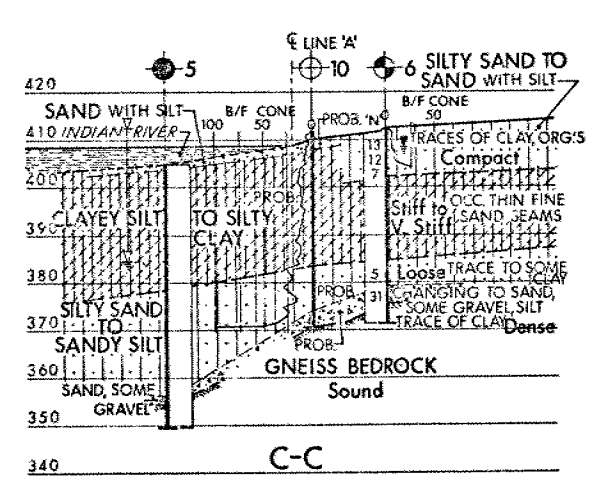
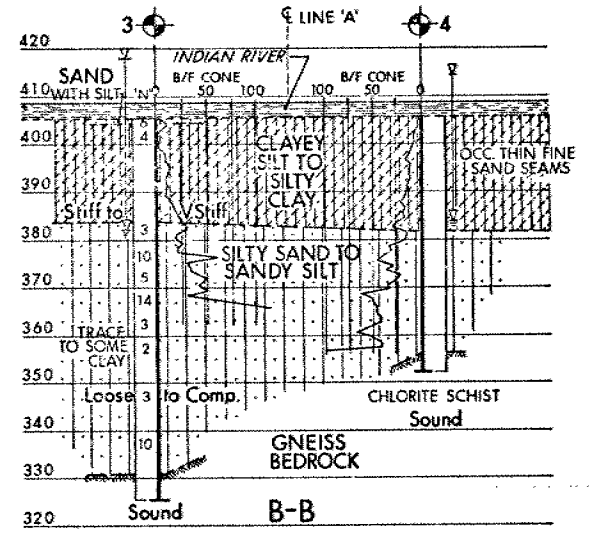
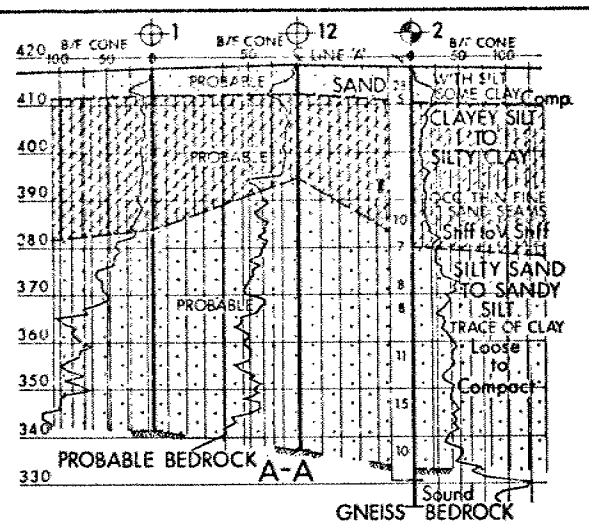
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

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

SLOPES

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



LEGEND

Bore Hole

Dynamic Cone Penetration Resistance Test
B/F CONE - Blows/Ft. Cone Test (350 ft. lbs. energy/blow)

Bore Hole & Cone Test

Water Levels established at time
of field investigation, NOV. & DEC. 1975

HEAD

Artesian Water

ENCOUNTERED

NO.

ELEVATION

CO-ORDINATES

NORTH

EAST

1

417.8

16,644,593

837,321

2

417.8

16,644,556

837,361

3

405.8*

16,644,608

837,382

4

405.8*

16,644,576

837,427

5

404.8*

16,644,623

837,434

6

412.5

16,644,599

837,474

7

415.3

16,644,632

837,491

8

415.8

16,644,608

837,525

9

415.6

16,644,583

837,376

10

411.9

16,644,611

837,463

11

415.7

16,644,570

837,393

12

418.3

16,644,573

837,344

13

415.5

16,644,623

837,503

14

430.9

16,644,653

837,593

15

415.8

16,644,543

837,251

*RIVER BED ELEVATION

*RIVER BED ELEVATION

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

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

INDIAN RIVER

HIGHWAY NO 17N, LINE 'A' DIST. NO 9
CO RENFREW
TWP STAFFORD LOT 30 CON 2

BORE HOLE LOCATIONS & SOIL STRATA

SUBDRW.B. CHECKED	W.F. NO 1-67-03	DRAWING NO
DRAWN N.T. CHECKED	W.C. NO	16703-A
DATE 20 FEBRUARY 1976	SITE NO 29-167	BRIDGE DRAWING NO
APPROVED	CONF. NO	