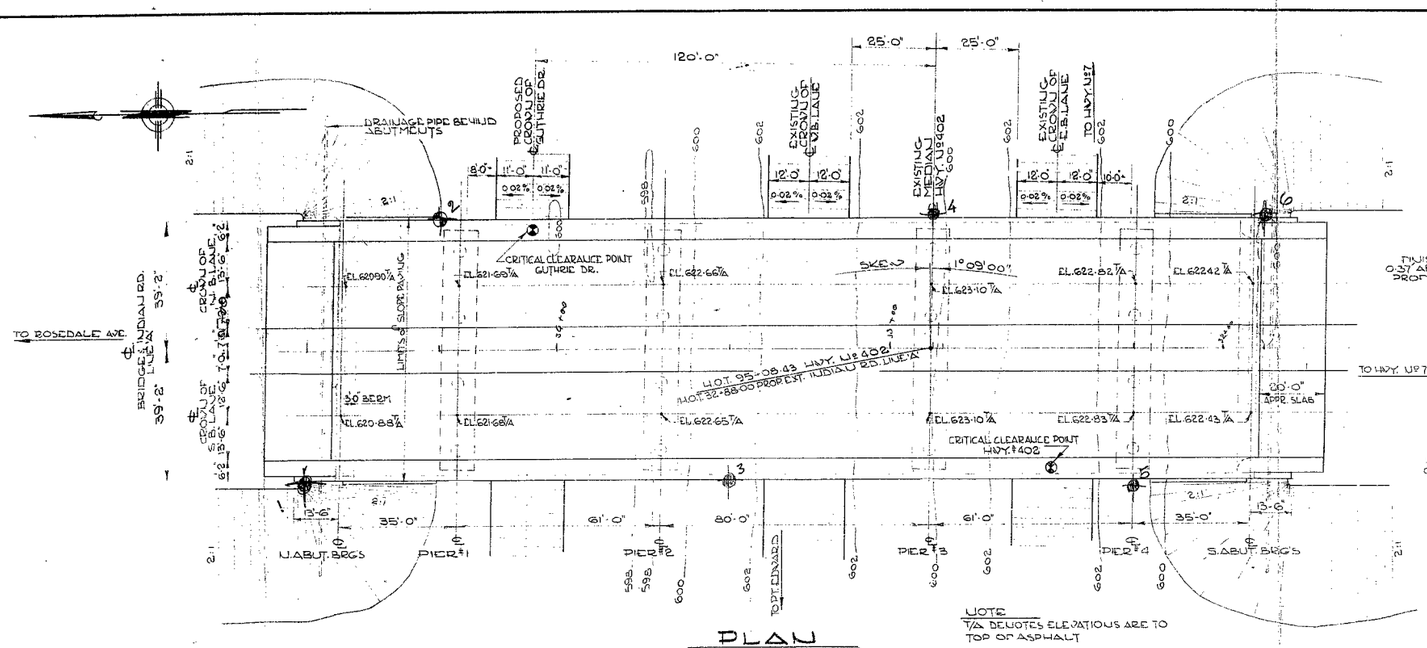
#63-F-11

W.P. #8-63

W.P. #176-67-02

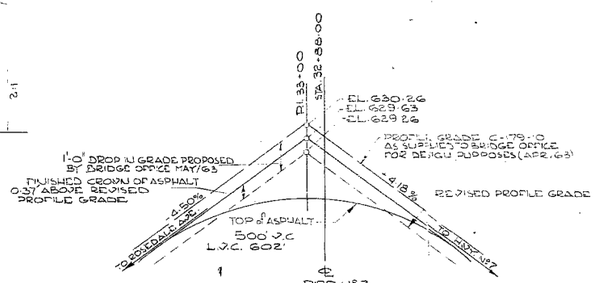
HWY #402

INDIAN ROAD

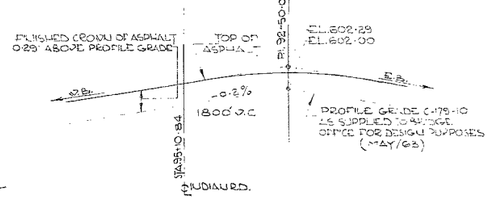


PLAN

SCALE: 1" = 20'-0"

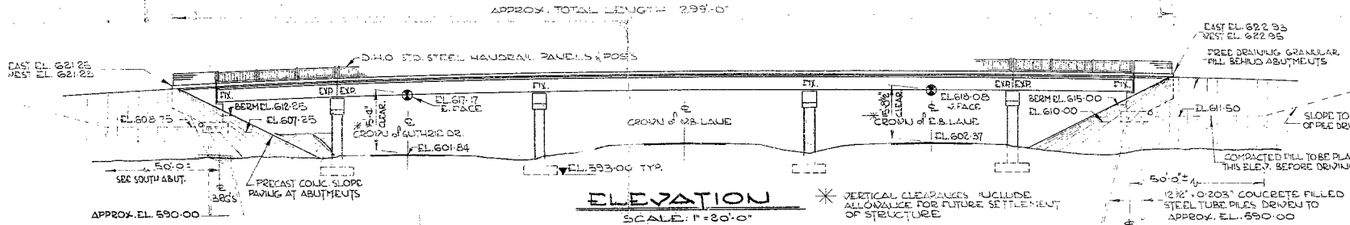


PROFILE of INDIAN R.D.



PROFILE GUTHRIE DRIVE

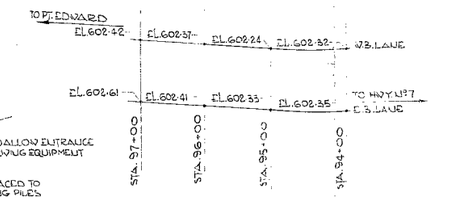
U.T.S



ELEVATION

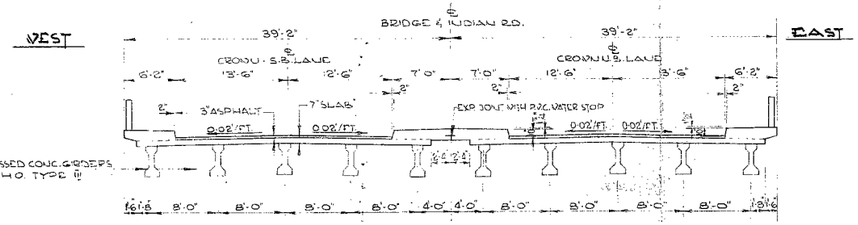
SCALE: 1" = 20'-0"

✳ VERTICAL CLEARANCES INCLUDE ALLOWANCE FOR FUTURE SETTLEMENT OF STRUCTURE



EXISTING CROWN of PAVEMENT ELEVATIONS - HWY. #402

U.T.S



TYPICAL DECK SECTION

SCALE: ¼" = 1'-0"

G.B.M. № I-R. Elev. 602.99

BRICK SCHOOLHOUSE (S.S. № 8 - 1921), 3 MILES E.E. OF POST OFFICE AT N.E. CORNER OF LOT 19, CON. VII, TWP. OF SARNIA. TABLET IN EAST CONC. FDN. WALL, MIDWAY BETWEEN BASEMENT WINDOWS AND 4 FEET BELOW BRICKWORK.
PUBLICATION № 19 Page 263 "SARNIA"

SKEW DATA 1°09'00"

SIN.	0.02007
COS.	0.99987
TAN.	0.02007
SEC.	1.00020

PRINT RECORD

No.	FOR	DATE

O.K. Mitchell
JUNE 13-1962.

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

INDIAN RD. UNDERPASS

CITY of SARNIA

KING'S HIGHWAY No. 402 DIST. No. 1

CO. LAMBTON

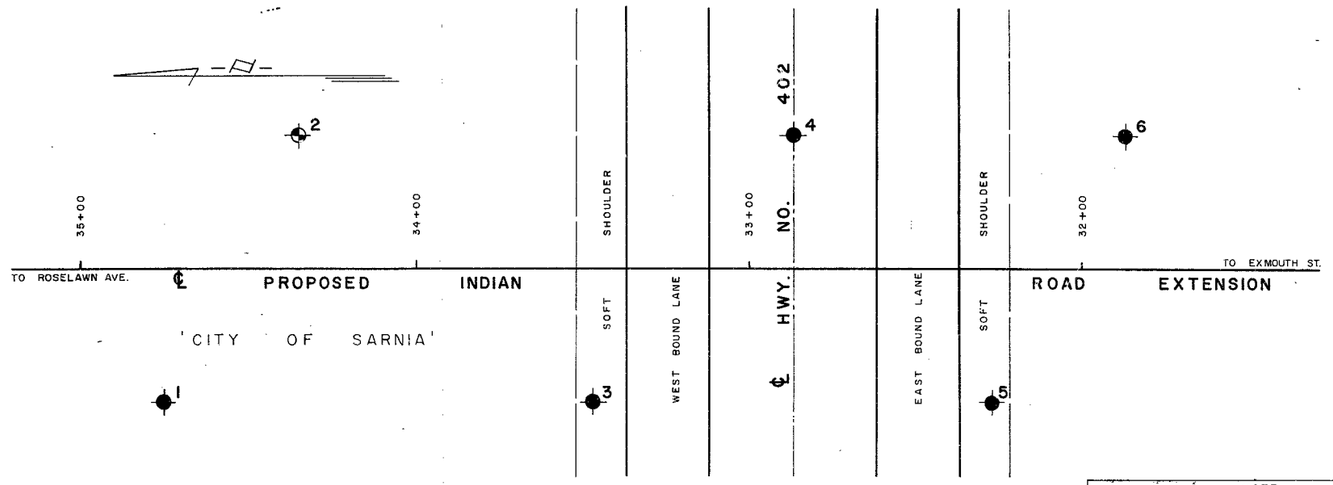
TWP. CITY OF SARNIA LOT CON.

PRELIMINARY

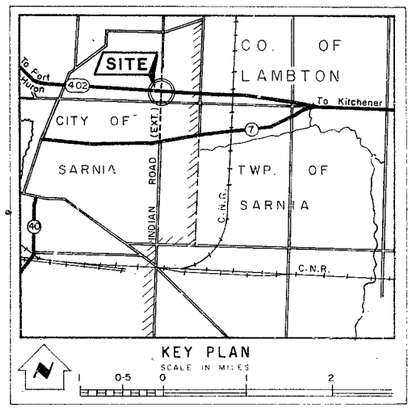
APPROVED ... BRIDGE ENGINEER				SITE No. 15-289	W.P. No. 8-63
DESIGN	K.G.B.	CHECK		CONTRACT Nos.	
DRAWING	E.A.	CHECK			
DATE	MAY 63	LOADING	H20 S16	DRAWING No.	D-5271-P1

338000 E
4760000 N

40 J16 W



PLAN
SCALE IN FEET
20 10 0 20 40 60



- NOTE -

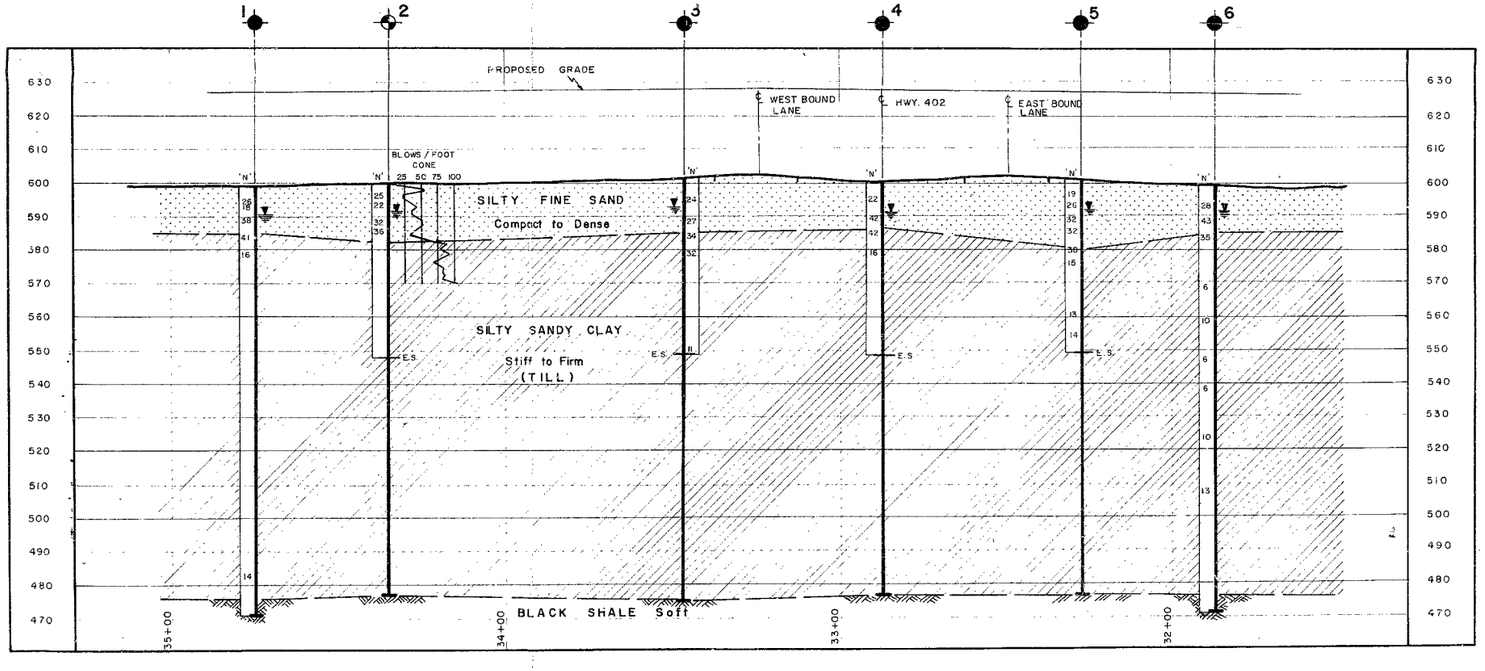
The complete soil investigation report for this structure may be examined at the Bridge Office and Foundation Office, Downsview, and at the CHATHAM District Office. The Department does not guarantee the accuracy of this report or the abridged version shown on these plans.

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, Feb. 1963

E.S. End of Sampling

NO.	ELEVATION	STATION	OFFSET
1	598·8	34+75	40'LT.
2	599·4	34+35	40'RT
3	600·5	33+47	40'LT.
4	600·0	32+87	40'RT.
5	600·6	32+27	40'LT.
6	599·7	31+87	40'RT



℄ PROFILE
SCALE IN FEET
20 10 0 20 40 60

- NOTE -

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PRINT RECORD		
NO	FOR	DATE

REVISIONS

DATE	BY	DESCRIPTION

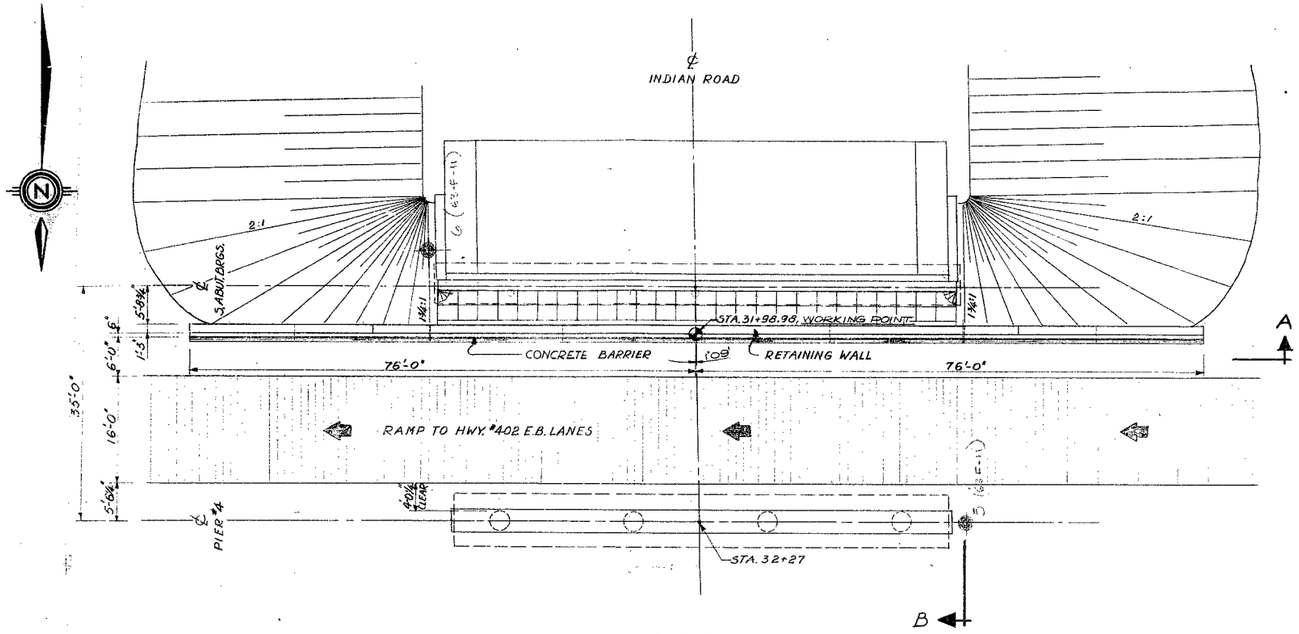
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

INDIAN ROAD EXTENSION

KING'S HIGHWAY NO. 402 DIST NO 1
CO. LAMBTON CITY OF SARNIA
TWP. SARNIA LOT CON.

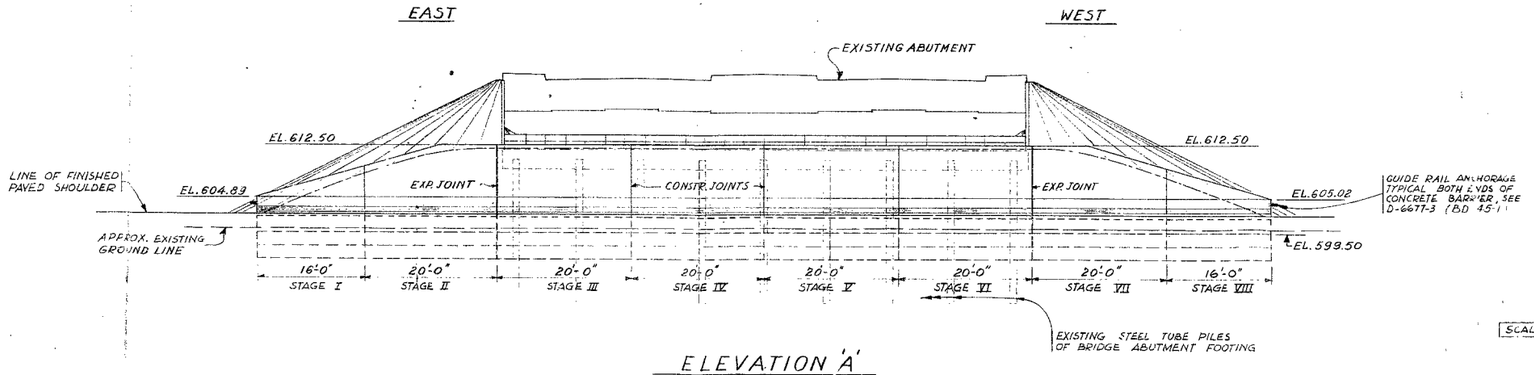
BORE HOLE LOCATIONS & SOIL STRATA

SUBMD W.K.M.	CHECKED	W.P. NO. ——	M&R DRAWING NO. 63-F-11A
DRAWN F.C.	CHECKED	JOB NO. 63-F-11	
DATE FEB. 28, 1963		SITE NO.	PLAN PROF DRAWN NO. N.
APPROVED		CONT NO.	

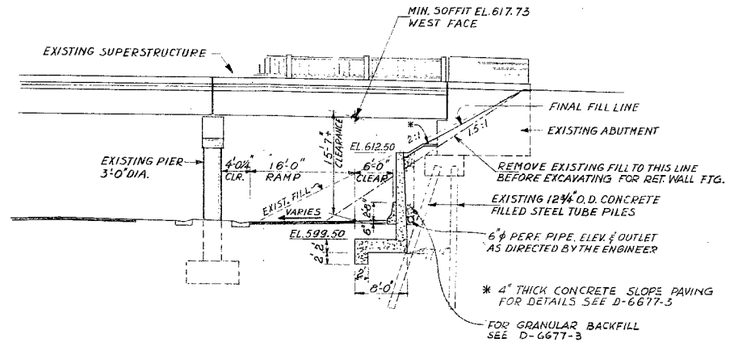


PLAN

NOTE: DECK NOT SHOWN ON PLAN AND ELEVATION 'A'



ELEVATION 'A'



SECTION 'B'

LIST OF DRAWINGS

NOTES

- CLASS OF CONCRETE : 4000 P.S.I.
- CLEAR COVER:

FOOTING	RETAINING WALL		BARRIER
	BACK FACE: 3"	FRONT FACE: 2"	
3"			1½"

- CONSTRUCTION SEQUENCE:
  1. REMOVE EXISTING FILL TO 1.5 : 1 SLOPE LINE AS SHOWN ON SECTION 'B' FOR ENTIRE LENGTH OF WALL.
  2. EXCAVATE FOR RETAINING WALL OF STAGE I, CONSTRUCT RETAINING WALL OF STAGE I AND BACKFILL TO 1.5 : 1 SLOPE LINE.
  3. COMPLETE SUCCESSIVE STAGES IN ORDER SIMILAR TO STEP 2 ABOVE. THE BACKFILL FOR STAGE III TO STAGE VI SHALL BE PLACED UP TO THE BOTTOM OF EXISTING ABUTMENT FOOTING.
  4. WHEN EXCAVATING FOR ANY ONE STAGE, THE CONTRACTOR SHALL MAINTAIN THE EXISTING FILLS ADJACENT EITHER SIDE OF THE PANEL CONSTRUCTION JOINTS IN THE UNDISTURBED STATE.
  5. COMPLETE ALL BACKFILL TO FINAL LINE AS SHOWN ON SECTION 'B'.
  6. COMPLETE GRANULAR BASE FOR RAMP AND CONSTRUCT CONCRETE BARRIER.

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

SCALE: 1" = 10'-0"

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

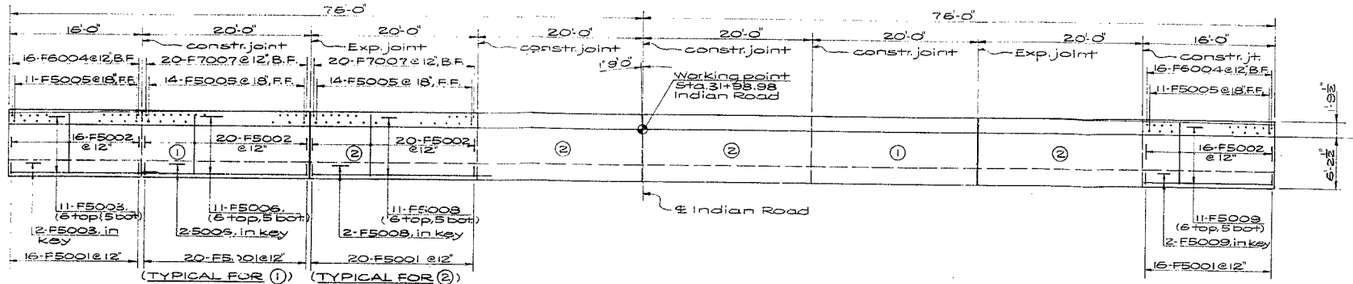
RETAINING WALL AT INDIAN RD. INTERCH.

CITY OF SARNIA

KING'S HIGHWAY No. 402 — DIST. No. 1
CO. LAMBTON
TWP. CITY OF SARNIA — LOT 20 — CON. VII

GENERAL LAYOUT

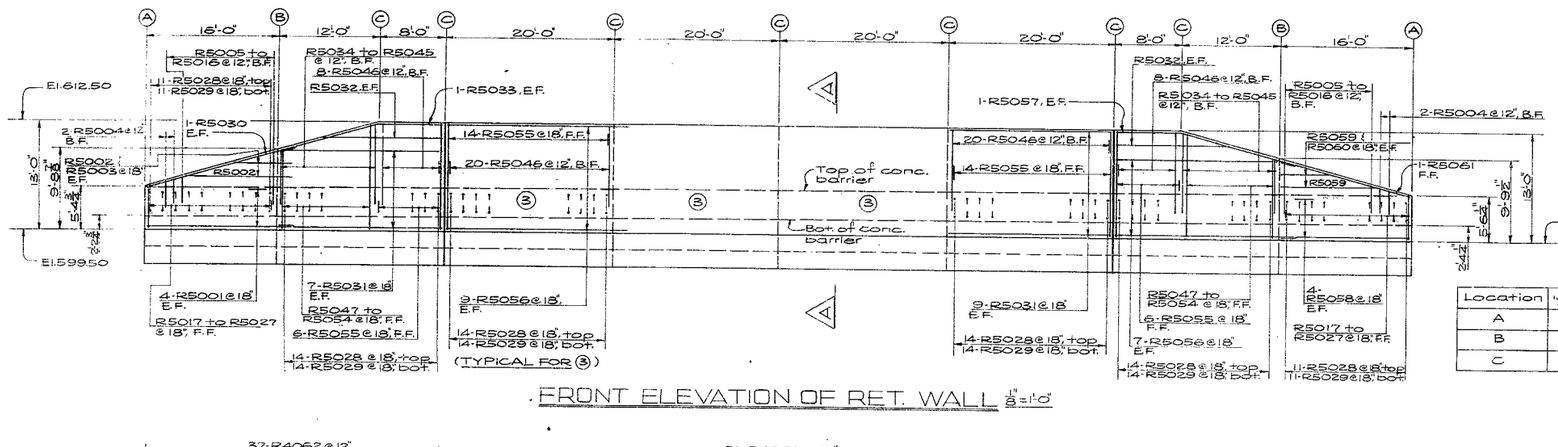
APPROVED	BRIDGE ENGINEER			SITE No. 14-289	W.P. No. 176-67-02
DESIGN	J.St.	CHECK	J.L.K.	CONTRACT Nos.	
DRAWING	J.St./H.M.	CHECK	J.L.K.	DRAWING No.	D-6677-1
DATE	SEP. 1969	LOADING			



EAST

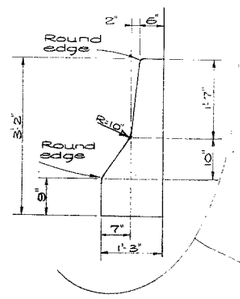
PLAN OF RET. WALL FOOTING 1/8"=1'-0"

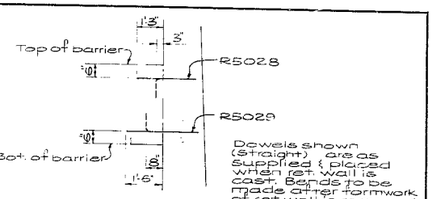
WEST



FRONT ELEVATION OF RET. WALL 1/8"=1'-0"

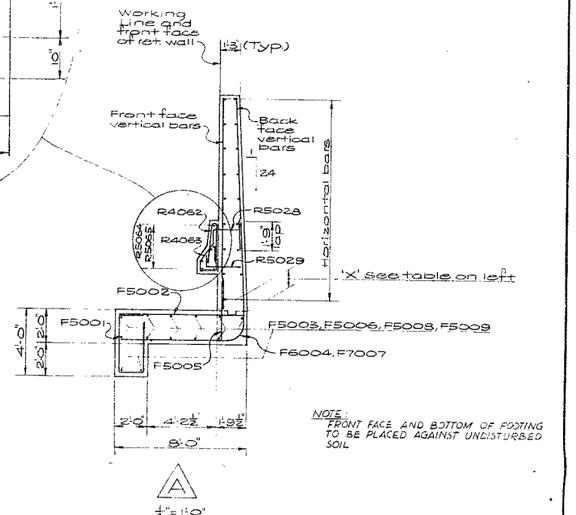
Location	'X' dimensions
A	1'-5 3/4"
B	1'-7 7/8"
C	1'-9 1/2"





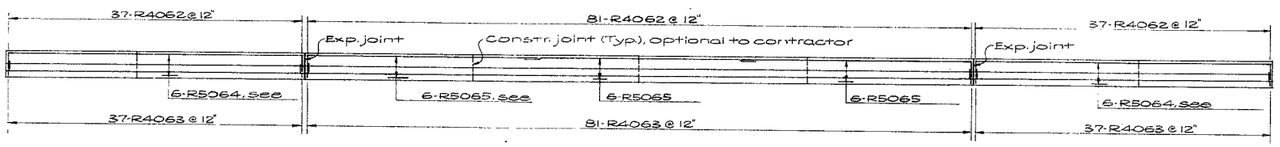
Dowels shown (Straight) are as supplied & placed when ret. wall is cast. Bends to be made after formwork of ret. wall is removed.

FIELD BENT DOWELS
For Conc. barrier



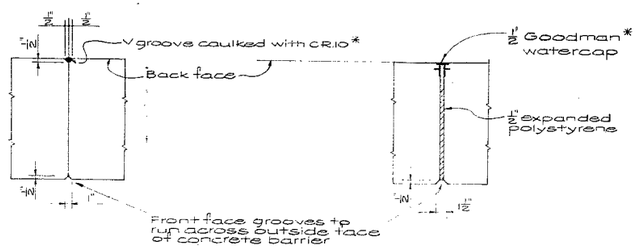
NOTE
FRONT FACE AND BOTTOM OF FOOTING TO BE PLACED AGAINST UNDISTURBED SOIL

A
1/4"=1'-0"



ELEVATION OF CONCRETE BARRIER 1"=1'-0"

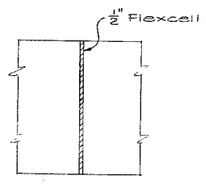
NOTE
F.F. denotes front face, B.F. denotes back face
E.F. denote each face



CONSTR. JOINT DETAIL
Ret. wall

EXP. JOINT DETAIL
Ret. wall

NOT TO SCALE



EXP. JOINT DETAIL
Footing

* NOT REQUIRED FOR CONCRETE BARRIER JOINTS

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

J. L. KEEN
CIVIL
PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

FOR REDUCED PLAN
USE SCALE BELOW
0 1 12 3
3 INCHES ON ORIGINAL PLAN

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

RETAINING WALL AT INDIAN RD. INTERCH

KING'S HIGHWAY No. 402 DIST. No. 1
CO. Lambton
TWP. City of Sarnia LOT 20 CON. VII

RETAINING WALL DETAILS

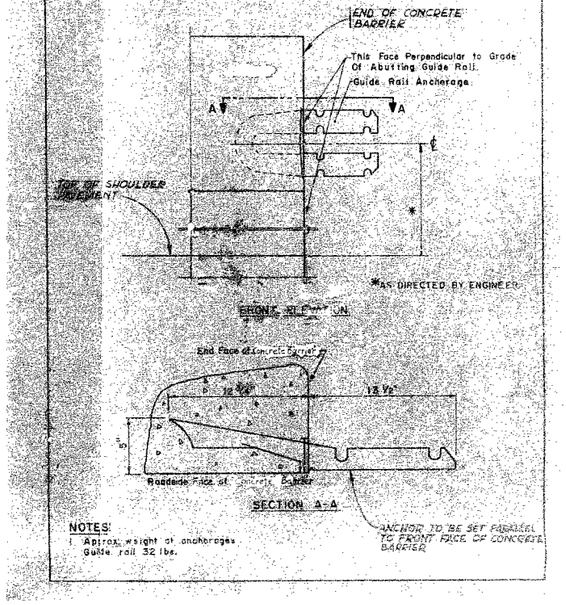
APPROVED _____ BRIDGE ENGINEER

DESIGN	J. Sz	CHECK	J. K.	SITE No. 12-289	W.P. No. 176-67-02
DRAWING	D.C.	CHECK	J. Sz.	CONTRACT Nos.	
DATE	SEP 1969	LOADING		DRAWING No.	D-6677-2

INSTALLATION OF GUIDE RAIL TO STRUCTURES

BD 45-1

REV. OCT 67



NOTES:

1. Approx. weight of anchorages. Guide rail 32 lbs.

FOR REDUCED F

REVISIONS

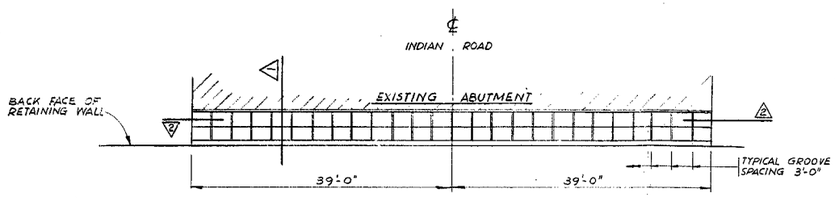
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

HIGHWAY No.

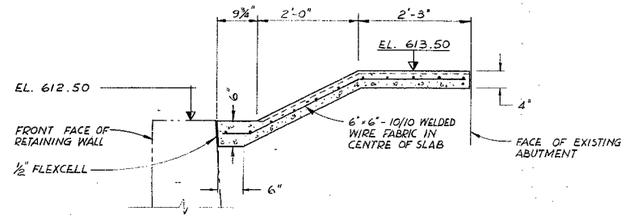
LOT

APPROVED



PLAN OF CONCRETE SLOPE PAVING

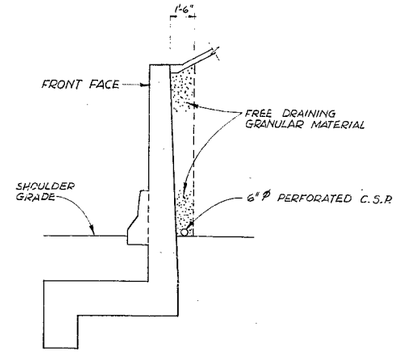
SCALE : 1" : 10'-0"



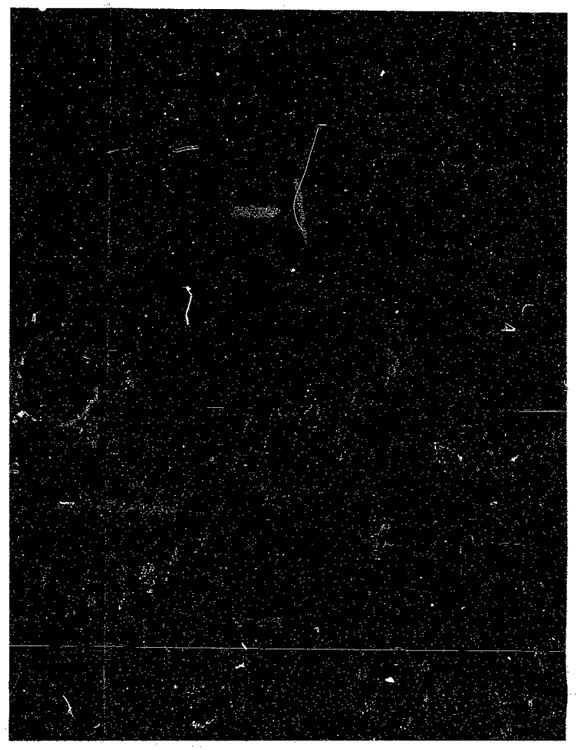
1

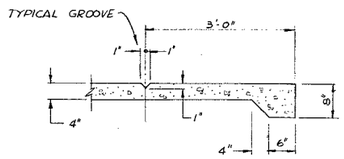
SCALE: ¾" = 1'-0"

NOTE:
CLASS OF CONCRETE 3000 P.S.I.



MINIMUM GRANULAR BACKFILL REQUIREMENTS





2

SCALE: ¾" = 1'-0"

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

J. L. KEEN — CIVIL — PROFESSIONAL ENGINEERS — PROVINCE OF ONTARIO

FOR REDUCED PLAN

USE SCALE BELOW

0 1 2 3

3 INCHES ON ORIGINAL PLAN

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

RETAINING WALL AT INDIAN ROAD INTERCHANGE

KING'S HIGHWAY No. 402 — DIST. No. 1

CO. LAMBTON

TWP. CITY OF SARNIA — LOT 20 — CON. VII

MISCELLANEOUS DETAILS

APPROVED _____ BRIDGE ENGINEER

DESIGN	J.SZ	CHECK	J.L.K
DRAWING	H.H.	CHECK	J.SZ
DATE	SEPT. 1969	LOADING	

SITE No. 14-289 — W.P. No. 176-67-02

CONTRACT Nos.

DRAWING No. D-6677-3

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

October 6, 1966

- Functional Planning Study -
C.A.E. 402 - Bluewater
Bridge to King's Hwy. No. 7
Proposed Indian Rd. Interchange
District #1 (Chatham)

With reference to the letter of July 4, 1966, from Messrs. Damas & Smith Ltd. to you regarding the above project, we wish to make the following comments:

The proposed retaining structure is quite adequate from the foundation point of view. For a finished structure, we cannot foresee any problems.

However, the building - i.e., construction of the proposed structure, could create certain problems due to the close proximity of the piled abutment.

The battered piles are driven to approx. elevation 590.0, while the bottom of the retaining wall footing is at elevation 596.6, with the key bottom at elevation 594.6. The pile tips are therefore, only some 4 - 6 ft. below the footing excavation. If exposed over the entire abutment width, we feel that the stability of those piles could be jeopardized.

Due to the presence of the bridge deck, it appears that the driving of interlocking steel sheet piling is impractical, and a sheeted excavation would consequently have to be ruled out.

We would, therefore, suggest that the proposed retaining wall be built in 10-ft. sections. A 10-ft. wide strip only, should be excavated, and the portion of the wall built. The next strip to be excavated should not be adjacent to the one completed, but rather, as far away as possible. Each section when completed, should immediately be backfilled in order to provide for the necessary passive resistance to the wall movement. In such a way, we feel, the wall can be built without endangering the existing abutment.

cont'd. /2 ...

Should you wish to discuss any detail of our proposal, please feel free to call on this Office.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF

cc: Mr. R. Gascoyne
Foundations Office
Gen. Files

FORM OB-ML-30
FEB., 1961

CALCULATIONS FOR Indian Road Interchange - Bluewater Bridge & Kings Hwy no 7

Feasibility of excavation of retaining wall

Soil properties

granular fill replaced by surcharge 12.5 x 14

Earth fill

Silty fine sand N > 18

El 596 max depth of excavation

Silty sand clay

Wood Lodan sheeting

Active pressure on strutted excavation

$H = 608 - 596 = 12'$

$P_a = 1.6 \frac{P_t}{H}$

Assume $\delta = 0$

P_a - for soil $= K_a \left(12.5 \times 14 \times 12 + \frac{1}{2} \times 12.5 \times 12 \times 12\right)$

$= K_a \times 12 \left(12.5 \times 14 + 12.5 \times 6\right)$

$K_a \times 12 \times 20 \times 12.5$

Assume $\phi = 35^\circ$ & $\delta = 0$ $K_a = \tan^2\left(45 - \frac{35}{2}\right) = 0.27$

Max P_a max $= \frac{1.6 \times \gamma_s \times 20 \times 12.5 \times 0.27}{12}$

$= 1.6 \times 0.27 \times 2500 = 1080$ lb/ft².

Max Active Thrust $= (0.6 p_t + 2 \times \frac{1}{2} \times 0.2 p_a) 12 = 0.8 p_a h$.

$= 0.8 \times 1080 \times 12 = 10,400$ lb/ft.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

MADE BY A.C. DATE 16th Aug JOB NO. 62-F-11
CHECKED BY _____ DATE _____ SECTION _____
SHEET NO. 2

CALCULATIONS FOR Indian Rd Interchange Bluewater bridge to Kings Hwy 7

FORM OB-ML-30
FEB. 1961

Max passive resistance.

Assume fill from excavation is placed horizontally behind sheeting & pier #4.

Assume $\phi' = 30°$ Take $\delta = 0$ initially

Then $K_p = 3.0$

Max passive resistance.

$= \frac{1}{2} K_p \gamma H^2$

$= \frac{1}{2} \times 3 \times 125 \times 12 \times 12$ lb/ft

Using $F = 3$

Safe passive resistance $= 125 \times 12 \times 6$ lb $= 9000$ lb/ft

If $\phi' = 35°$ $K_p = 3.70$

Safe passive resistance $= \frac{3.70}{3} \times 9000 = 11,100$ lb/ft

OK.

Using $\delta = -\phi/2$ & $\phi = 30°$ $K_p = 4.78$.

Safe passive load $= \frac{4.78}{3} \times 9000 = 14340$ lb/ft.

$\delta = -\phi$ is conservative Normally use $\frac{2}{3}\phi$.

Plane sheeting O.K.

For overall stability see calculation sheet

FF 21

India Rd Underpass · Hwy 7.

See diagram for circle

R tan φ = 24'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

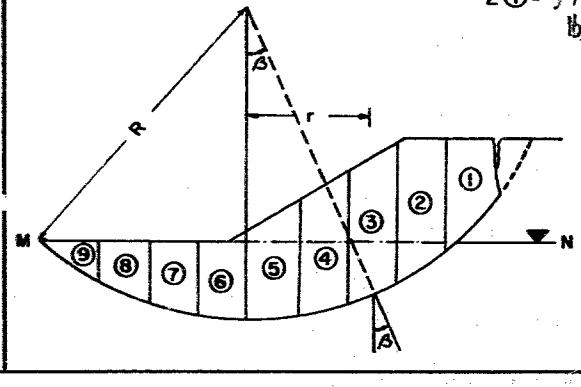
TOTAL STRESS ANALYSIS

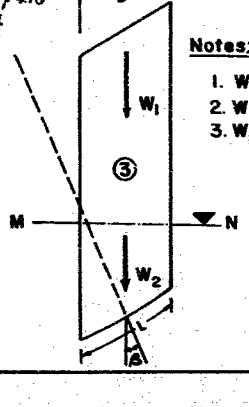
MADE BY: A.R.C.
LOCATION
CHECKED
CIRCLE LOCATION
DATE 24 Aug 22

CIRCLE NO.
RADIUS
JOB NO.
SHEET NO.

Slice No.	OVERTURNING MOMENT: γ or γ'	b	h	Area	× 1000 lb W = Weight	r	① $M_o = \Sigma \pm W_r$	RESISTING MOMENT: c	L	R	② c L R	tan φ (φ = 35°)	β°	cos β	③ ± WR cos β / tan φ	M_r = ② + ③
1	125	5	6.5	32.5	4.06	26.7	110	–	–	30.25	0	0.7	65	.423	36.4	
2	125	5	15.5	77.5	9.70	22.5	218				0	0.7	48	.67	137.8	
3	125	5	20.0	100.0	12.50	17.5	218				0	0.7	35	.82	216.0	
4	125	1.7	22.0	37.4	4.66	14.2	66.1				0	0.7	28	.88	87.0	
5	125	6'	10.5	63.0	7.86	10.3	81				0	0.7	20	.94	157.0	
6	125	3.3'	11.5	41.2	5.14	6.3	32.5				0	0.7	11.5	.98	102.5	
7	125	5.5'	12.0	66.0	8.24	-7.5	-61.9				0	0.7	15	.966	169.0	
8	125	5	9.0	45.0	5.63	-12.5	-70.4				0	0.7	24.5	.91	109.0	
9	125	6.5'	3.5	22.8	2.84	-17.5	-49.6				0	0.7	38	.79	47.5	
							+181.9								1062.2	
							+725.6								36	
							-181.9									
							543.7									

$\Sigma ① = 5437 \times 10^1$ lb/ft





Notes:–

1. $W = W_1 + W_2$
2. W_1 Weight of Slice above MN, computed from Bulk density
3. W_2 Weight of Slice above MN, computed from Submerged density

$\Sigma ② + ③ =$

$F = \frac{\Sigma ② + ③}{\Sigma ①} = \frac{1062.2}{543.7} = 1.96$

SOIL PROPERTIES				
TYPE	γ	γ'	c	φ

NOTE:

MAY 14th. 1968

W.P. 8-63 63-F-11

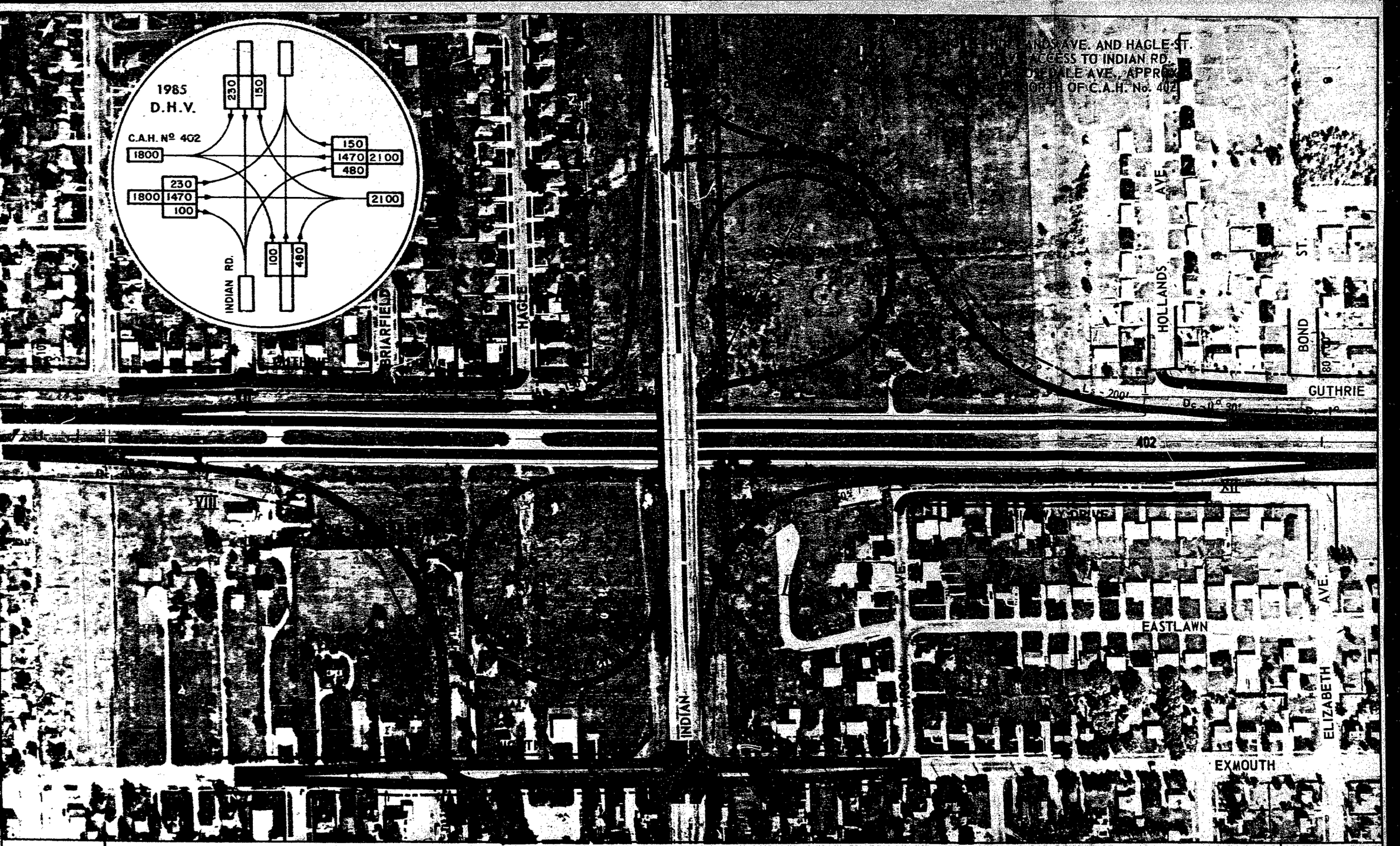
INDIAN ROAD & HWY 402

MR. R. FITZGIBBON - EXPEDITER LONDON REGION ASKED WHETHER SUBSOIL INVESTIGATION FOR THE RAMPS OF THE INTERCHANGE ARE NECESSARY

AFTER HAVING LOOKED AT THE ABOVE MENTIONED REPORT ADVISED MR FITZGIBBON THAT NO ADDITIONAL INVESTIGATION IS NECESSARY

SOIL IS UNIFORM AND KNOWN TO BE SUCH OVER A VERY WIDE AREA. PROPERTIES ARE SUCH THAT NO EMBANKMENT STABILITY PROBLEMS ARE ENVISAGED ∴ NO INVESTIGATION NECESSARY

ACh



SCALE
1" = 200

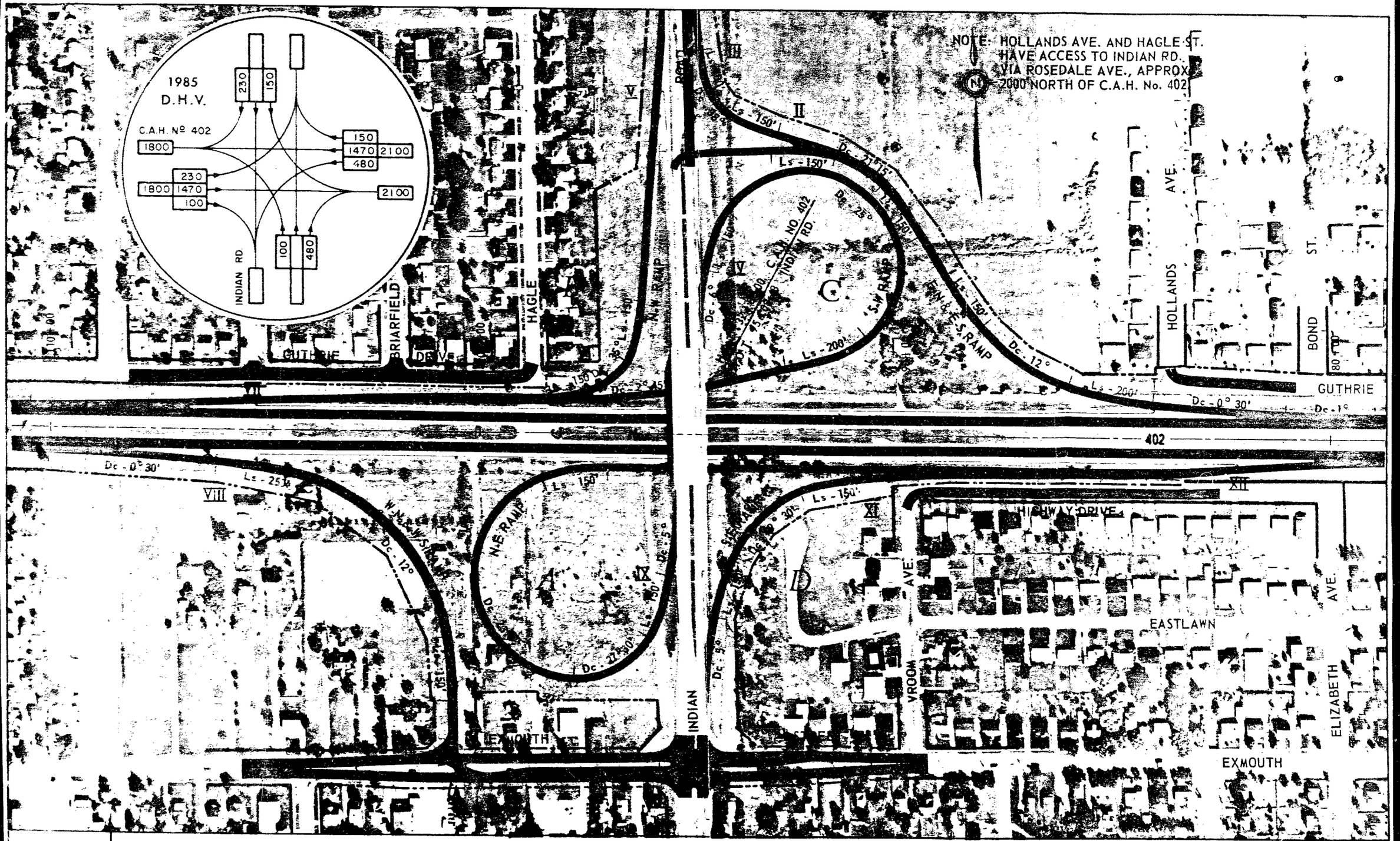
LEGEND
PROPOSED PAVEMENT
PROPERTY LIMIT (EXISTING R.O.W.)
PROPERTY LIMIT (PROPOSED R.O.W.)

W.P. 8-63

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

C.A.H. Nº 402
BLUEWATER BRIDGE PLAZA - EASTERLY 4.3 MILES
PLAN - STATION 110+00 to STATION 80+00

PLATE
14



SCALE

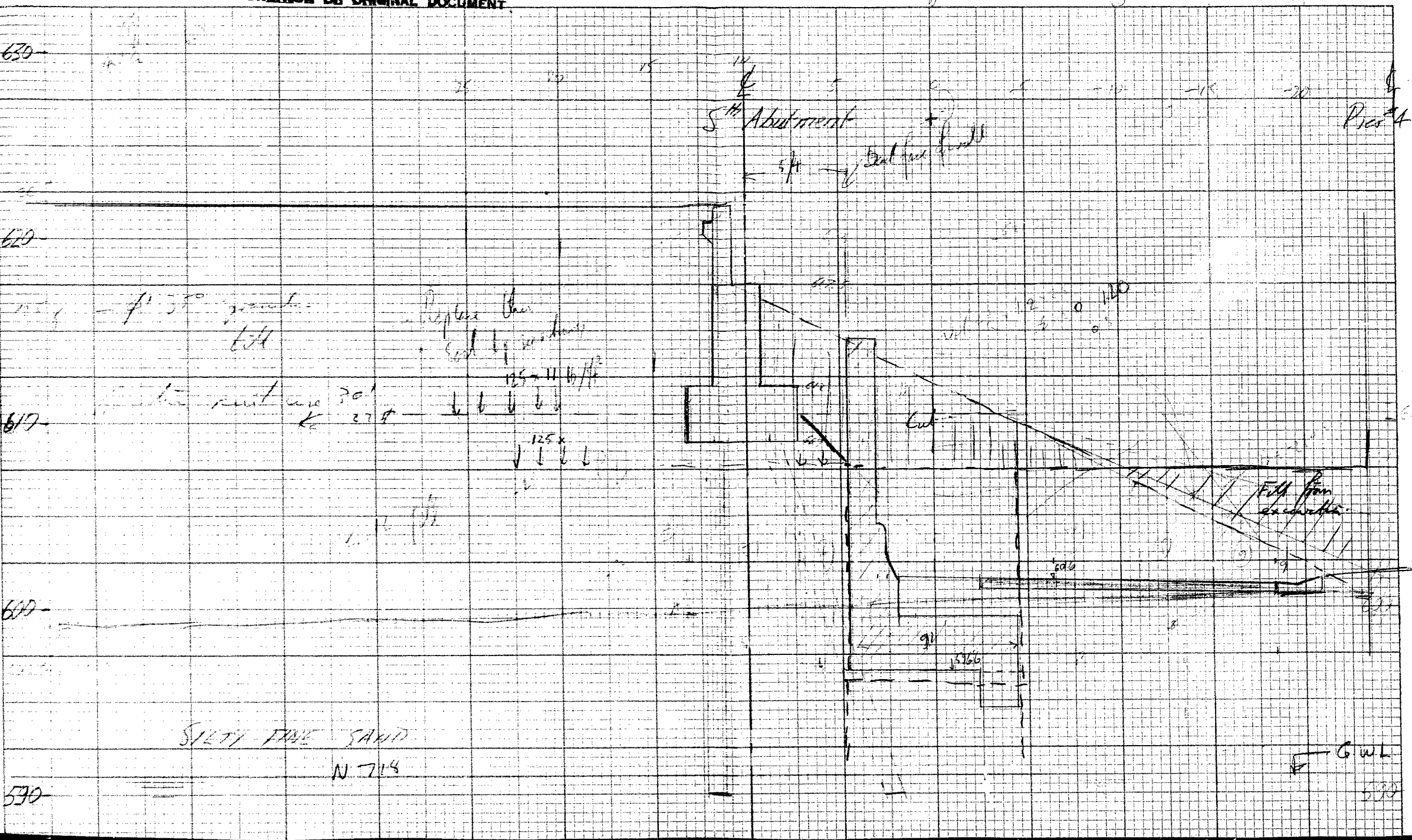
LEGEND
PROPOSED PAVEMENT
PROPERTY LIMIT (EXISTING R.O.W.)
PROPERTY LIMIT (PROPOSED R.O.W.)

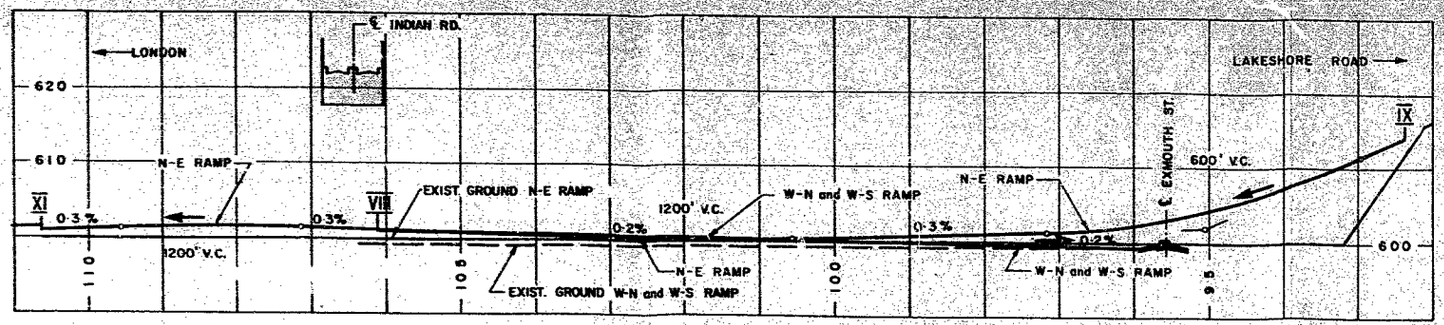
DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

C.A.H. Nº 402
BLUEWATER BRIDGE PLAZA - EASTERLY APPROACHES
PLAN - STATION 110+00 to STATION 80+00

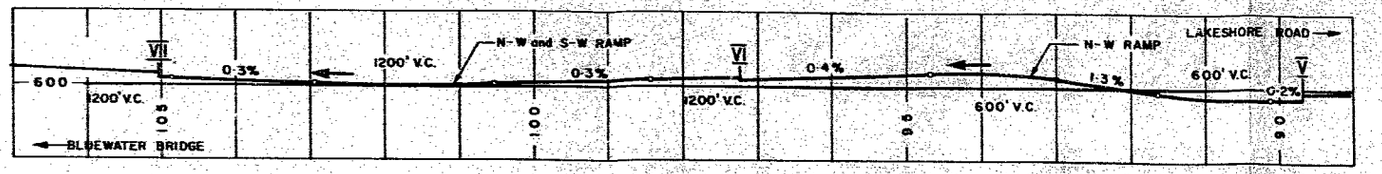
PLATE
14

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

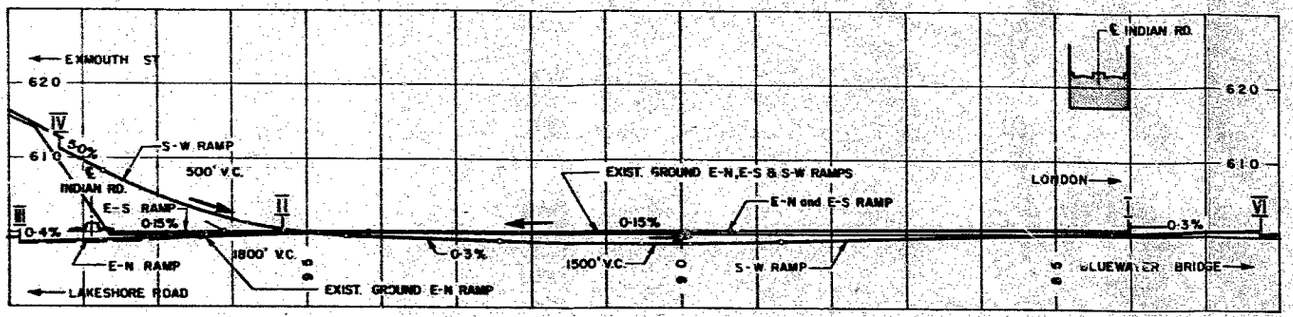




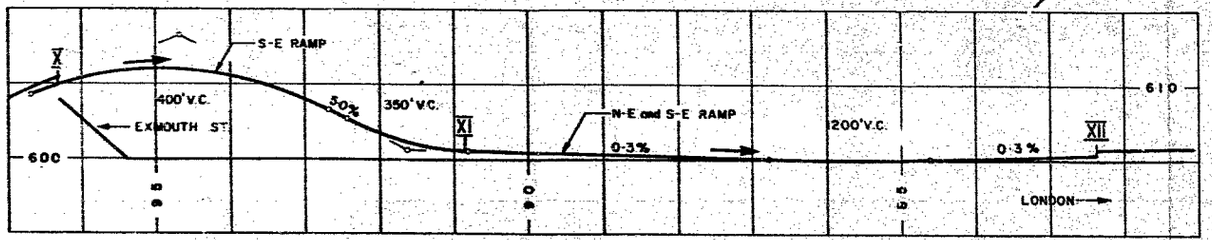
RAMPS - QUADRANT 'A'



RAMP - QUADRANT 'B'



RAMPS - QUADRANT 'C'



RAMP - QUADRANT 'D'

W.P. 8-63

PLATE 13

C.A.H. Nº 402

BLUEWATER BRIDGE PLAZA - EASTERLY 4.3 MILES

PROFILES OF INDIAN RD. INTERCHANGE RAMPS

LEGEND

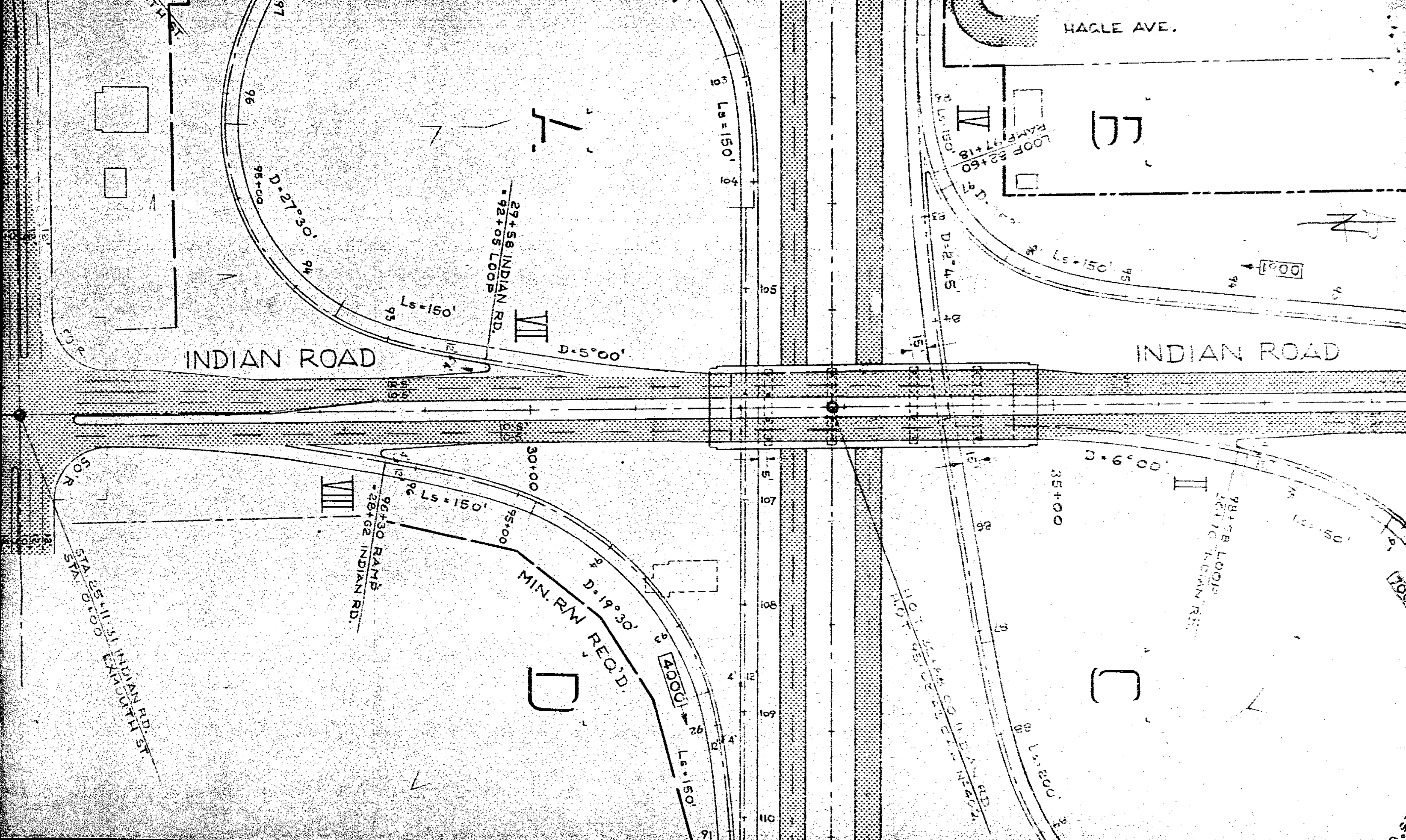
TOP OF PAVEMENT

EXISTING GROUND

SCALE

HORIZ. 1" = 200'

VERT. 1" = 20'



HAGLE AVE.
INDIAN ROAD
INDIAN ROAD
D=27°30'
Ls=150'
29+58 INDIAN RD.
=92+05 LOOP
D=5°00'
VII
VIII
IV
LOOP 82+60
RAMP 77+18
D=2°45'
D=6°00'
II
30+00
35+00
Ls=150'
95+00
D=19°30'
MIN. R/W REQ'D.
4000
96+30 RAMP
=28+62 INDIAN RD.
STA. 25+11.31 INDIAN RD.
STA. 0+00 EXMOUTH ST.
50'R
D
C
Ls=200'

Contract No 63-30 F
Job 63F-11

Indian Rd

CA H-402

Indian Rd Interchange. 20/7/66

Stability analysis.
Required scale drawing & soil conditions of existing bridge
Existing soil conditions taken from Dwg No D-5271-2.
up to EL 600.
Require properties of granular backfill and earth fill
Require geometry of Sth abutment.

Existing soil properties from foundation investigation Job 63F-11
Indian Road & Highway no 402.
Soil profile to be taken from ℄ East bound Lane.
Dwg No 63-F-11A.
Properties of Silty Fine Sand. 15-20' average N = 31
Compact to dense

Silty Sandy Clay. γbulk ≈ 115 lb/ft³ — 131 lb/ft³.
Stiff to Firm (till) strength Cu ≈ 880 lb/ft² — 2000 lb/ft².

Van tests = 5
26

Soft Black shale at EL 476' say · 125' below ground

Ground Water Level - See Borehole 4 5, 6. 591.3 592 591.3.
Elevation 591.0 - No artesian.

Properties of fill ?

DAMAS AND SMITH LIMITED

CONSULTING ENGINEERS

HEAD OFFICE
10 CODECO COURT
DON MILLS, ONTARIO
447-5137

WINNIPEG OFFICE
345 GERTRUDE AVENUE
WINNIPEG, MANITOBA
453-8759

LONDON OFFICE
66 CARLING STREET
LONDON, ONTARIO
434-0531

D.H.O.
TORONTO
RECEIVED
JUL 5 1966
BRIDGE
OFFICE

YOUR REF.

OUR REF. File: 847

Head Office
July 4, 1966.

Mr. C.S. Grebski,
Bridge Design Engineer,
Department of Highways of Ontario,
Downsview, Ontario.

Dear Mr. Grebski:

Re: Functional Planning Study
C.A.H. 402 - Bluewater
Bridge to King's Hwy.No.7
Proposed Indian Road
Interchange

Further to our telephone conversation we enclose herewith for your review and comments one copy each of our Drawings 847-E-22 and 847-E-27.

Subject to acceptance of the horizontal clearance provisions shown on Drawing 847-E-27 we believe that it would be possible to obviate the need of reconstructing and adding on to the south half of the existing bridge by constructing an L shaped retaining wall in front of the south abutment.

We have assumed that:

1. The front slope of the embankment will be temporarily changed to 1:1 from 2:1 to facilitate the construction of the wall.

2. The allowable maximum bearing pressure at El.596.60 is 4.5 kips per square foot given the characteristics of the soil and elevation of ground water as shown on the bridge drawings. Our calculated maximum pressure under the retaining wall footings is 3.5 kips per square foot and the factor of safety against sliding is 1.5.

The abutment piles are essentially end bearing and, therefore, the stability of the abutment will not be affected during the construction of the retaining wall. The cross-section of the wall as shown on the drawing is preliminary. However, we would recommend the treatment shown at shoulder level to ensure that a vehicle coming in contact with the wall is deflected back onto the pavement with minimum damage, if any.

Thank you for your assistance in this matter.

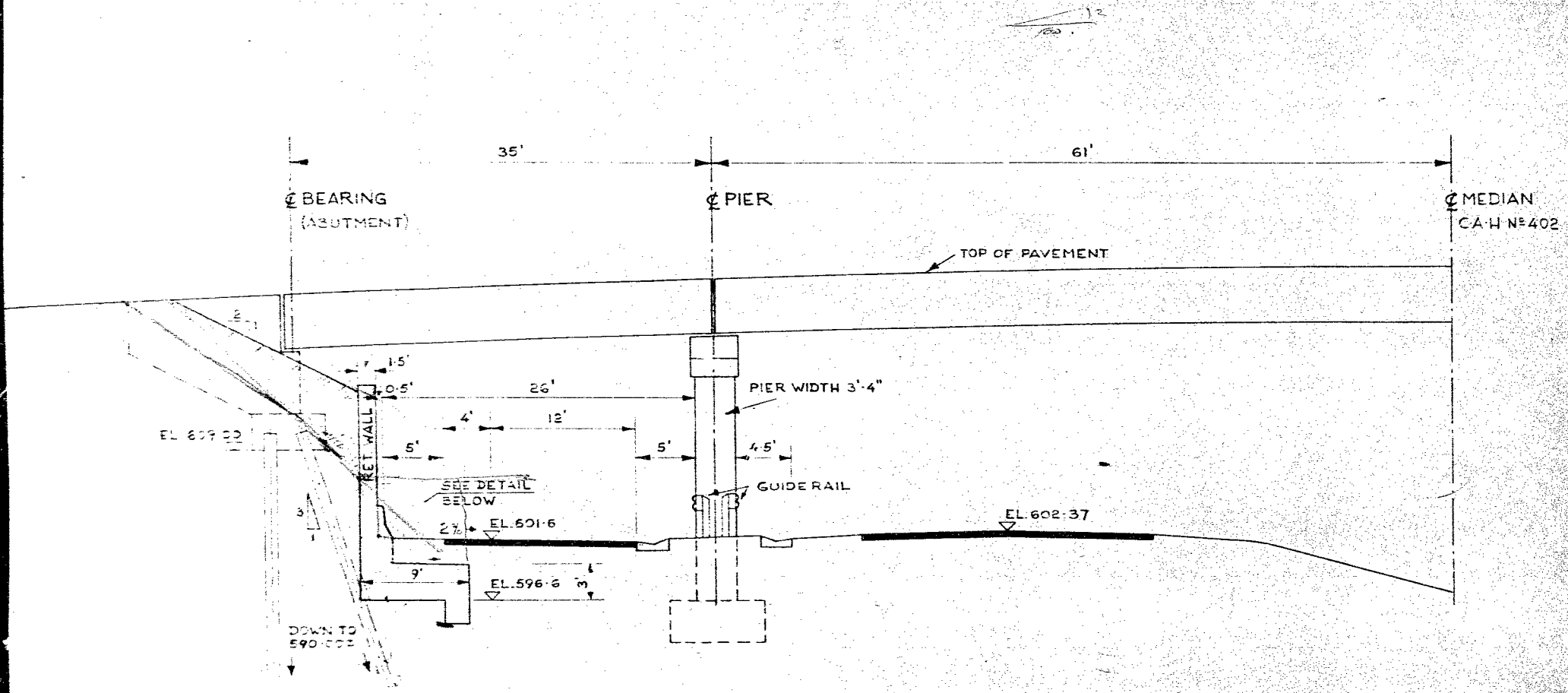
Yours very truly,

DAMAS AND SMITH LIMITED

N. E. Damas

NED:ed
encl. Dwg. 847-E-22
847-E-27

c.c. Mr. R. Gascoyne



PROPOSED RETAINING WALL AT SOUTH-END OF STRUCTURE

22-63-304.

Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie.

Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.
March 22, 1963

D.H.O. FOUNDATION INVESTIGATION REPORT -
Indian Road Underpass, Hwy. No. 402,
Twp. of Sarnia, Cty. of Lambton, Dist.#1.
W.J. 63-F-11 -- W.P. 8-63.

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe you will find the factual data and recommendations contained therein, adequate for your future design work. Should there be any queries with respect to this project, please do not hesitate to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
A. Gater
G. U. Howell
J. Roy
A. Watt

Foundations Office ✓
Gen. Files.

TABLE OF CONTENTS

FOUNDATION INVESTIGATION

For

Indian Road Underpass, Hwy. No. 402,
Twp. of Sarnia, County of Lambton,
District No. 1
W.J. 63-F-11 W.P. 8-63.

1. INTRODUCTION:

A request, to carry out a foundation investigation for the proposed new underpass at Indian Road and Hwy. #402, was received from Mr. G. Scott, Bridge Location Engineer, on January 17, 1963.

It is proposed to erect a new underpass, which would carry Indian Road over Hwy. #402. The site of the proposed underpass is located in the Twp. of Sarnia, County of Lambton. At this location, the chainage of Indian Road is from 31+87 to 34+75, and that of Hwy. #402, 95+05.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Results and the discussion of the field and laboratory investigations, as well as conclusions and recommendations for future design work, are contained in the following paragraphs of this report.

2. DESCRIPTION OF SITE:

The site of the propcsed underpass is located approx. .5 miles east of the Town of Sarnia. The surrounding area is fairly flat, and was previously used as a vegetable farm. Physiographically, the region is referred to as the Huron Fringe.

cont'd. /2 ...

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, a total of six sampled boreholes numbered 1 to 6, was carried out at this site. Conventional wash boring procedures were followed and samples of the overburden were taken at various depth intervals. Samples were taken by 2" O.D. split-spoons, and by 2" I.D. thin-walled samplers. In-situ vane tests were performed 18" below the bottom of the sampler, immediately after the samples were removed.

Boreholes No. 1 and 6 were put down through the overburden and 5 feet of bedrock core was taken in each borehole.

Boreholes No. 2, 3, 4 and 5 were terminated at bedrock elevation and the sampling was confined to the upper 50 feet only.

The locations and elevations of the boreholes, are given on Dwg. No. 63-F-11A, attached under Appendix I.

Tests were carried out in the laboratory on a selection of both disturbed and undisturbed samples to determine:

1. Natural Moisture Contents.
2. Bulk Densities.
3. Grain Size Distribution.
4. Atterberg Limits.
5. Undrained Shear Strengths.
6. Quick Triaxial Shear Strengths.

Results of these laboratory tests are summarized in Appendix I of this report.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

The stratigraphy of the soil at the site was found to be generally uniform. A detailed description of various soil types encountered during the investigation, is shown in Appendix I of this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile, shown on Dwg. No. 63-F-11A, is based upon this information.

4.2) Compact to Dense Silty Fine Sand:

This layer, which extends to approx. El. 580.0 for a depth of about 15'-0" to 20'-0", starts right at the surface. The upper portion of this layer has been subjected to oxidation and exhibits a predominantly brownish colour. Moisture content determinations for this layer averaged about 19.3%. The overall layer was found in a compact to dense state with an average 'N' value of 31 blows/foot.

4.3) Firm to Stiff Silty, Sandy Clay:

Immediately below the compact to dense silty fine sand is a containing stratum of firm to stiff silty sandy clay, extending to about 122' to 126' below existing ground elevation.

Liquid limits for this stratum vary from 27.6% to 42.6%, while plastic limits range from 14.1% to 22.4%. Moisture content determinations for this stratum varied from about 14.8% to 36.9%. Bulk density measurements for this material gave values ranging from 115 P.C.F. to about 131 P.C.F. Two typical plasticity charts for B.H. #1 and B.H. #6 are given in Appendix I of this report.

cont'd. /4 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Firm to Stiff Silty, Sandy Clay: (cont'd.) ...

Grain size distribution curves indicated that the percentage of clay in this layer is 43%, silt forms 41%, and the rest of 16%, is sand and gravel. In-situ vane and unconfined shear tests carried out in this material, showed some disagreement. The vane results are considered to be more reliable and, in view of this, it is estimated that the shear strength of this stratum varies from about 880 P.S.F. to about 2000 P.S.F. The shear strength of this material increases with depth.

4.4) Soft Black Shale Bedrock:

Soft black shale bedrock was encountered beneath the overburden. Five feet of bedrock core was taken in B.H. #1 and B.H. #6.

As can be seen on Dwg. No. 63-F-11A, the bedrock is nearly horizontal.

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found at approx. elevation 591.0, about 8 - 9 feet below ground level. It may be assumed that the water level will vary with the seasons of the year.

No artesian water conditions were encountered.

cont'd. /5 ...

6. DISCUSSION AND RECOMMENDATIONS:

As can be seen from the previously described soil stratigraphy, the soil consists of compact to dense silty fine sand, followed by firm to stiff silty sandy clay which, in turn, is underlain by soft black shale bedrock. The investigation has revealed that the properties of the upper 20 ft. of the deposit are such that an adequate support for spread footings with an allowable net pressure of 2.0 T/sq.ft. can be obtained at approx. elev. 593.0. However, due primarily to the embankment loads, the lower, more compressible clay layer will consolidate, resulting in settlements of the footings of the structure. Settlement calculations indicate that approx. 7 inches could be expected under the centre of the abutments, and 4 inches and 1 inch under the centre of the first and second pier, respectively. Thus, the maximum differential settlement would be in the order of 6 inches between the abutment and second pier. The computed time for 50 per cent of settlements to take place, is 7 years. However, it is believed that the amount and rate of settlements are quite conservative.

Because of the fact that there will be settlements if spread footings are used, simply supported spans with provisions for jacking, are recommended for the structure. Abutment footings should be founded on short displacement piles driven through the fill, and 10 feet into the original ground. A safe load of 40 tons per pile can be taken if steel tube piles of 12¾ inches diameter are used.

cont'd. /6 ...

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

If, because of economic or any other reasons, settlements of the structure cannot be tolerated, steel H-piles driven to bedrock, are recommended. A safe load of 70 tons can be assigned to 14 BP 73 H-piles.

We were advised that most likely, only two lanes of the four-lane highway will be built at present. It has been pointed out earlier that the greatest part of the settlements will be due to the embankment loads, and we would therefore recommend that at least 200 feet of both embankment approaches adjacent to the bridge, be built for the full width of the ultimate four-lane highway. In this way, settlements of the existing structure, due to additional stresses caused by embankment widening, will be eliminated.

If planning permits, the construction of the fill 6 months or more ahead of the structure, is recommended.

Because of predicted settlements, a flexible pavement on the approach embankments is recommended.

7. SUMMARY:

The stratification of the subsoil at the site is relatively uniform. A 20-ft. sand stratum is underlain by a layer of firm to stiff silty sandy clay. At approx. 125 ft. below ground level, shale bedrock was encountered.

It is recommended that the structure be founded on spread footings taking an allowable net pressure of 2.0 T/sq.ft. Abutment footings should be founded on steel tube piles 12¾" diameter, driven through the fill and 10 ft. into the original ground. A safe load of forty tons can be assigned to each of these piles.

cont'd. /7 ...

7. SUMMARY: (cont'd.) ...

Due primarily to the embankment loads, differential settlement of up to 6 inches (believed to be conservative), is anticipated between the abutment and the second pier and, therefore, simply supported spans with provisions for jacking are recommended. It is understood that only two lanes of the four-lane highway will be built at present. We would recommend that 200 ft. of the embankments adjacent to the structure, be constructed for the full width - i.e., as a four-lane highway. In this manner, settlements of the existing structure due to future embankment widening, will be avoided.

If settlements of the structure cannot be tolerated, steel H-piles driven to bedrock, are recommended.

Because of embankment settlements, a flexible pavement is recommended.

No dewatering problems are expected during construction.

8. MISCELLANEOUS:

The field work, performed from February 1 to February 15, 1963, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas. The investigation was carried out under the general supervision of Mr. K. G. Selby, who reviewed the report.

Equipment used was owned and operated by Dominion Soil Investigation, Limited.

March 1963.

APPENDIX I.

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- 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 :-

CONSISTENCY	'N' BLOWS/FT.	c LB./SQ.FT.	DENSENESS	'N' BLOWS/FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Q_u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q_{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q_d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS 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
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
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS 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_o	COEFFICIENT OF EARTH PRESSURE AT REST

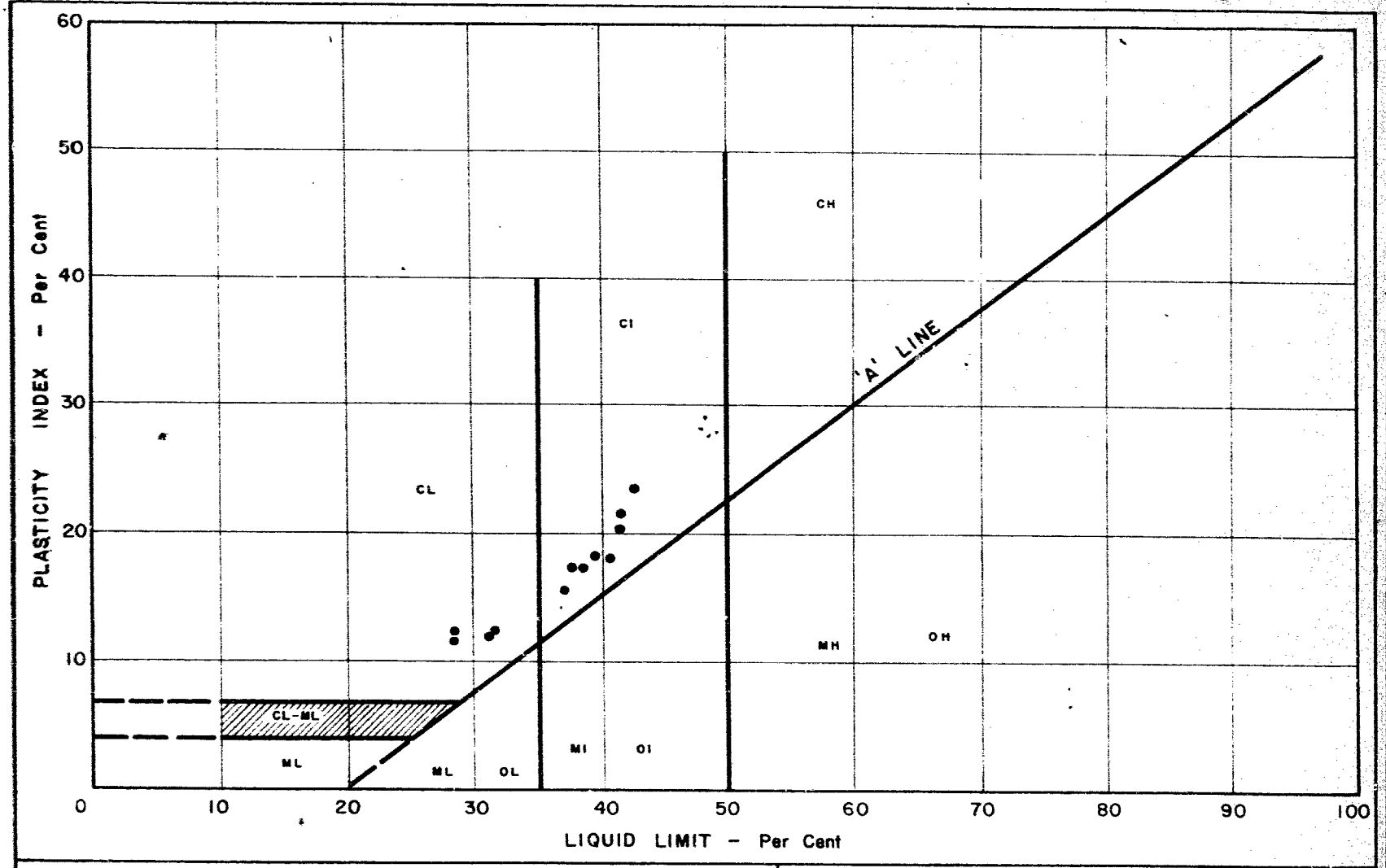
FOUNDATIONS

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

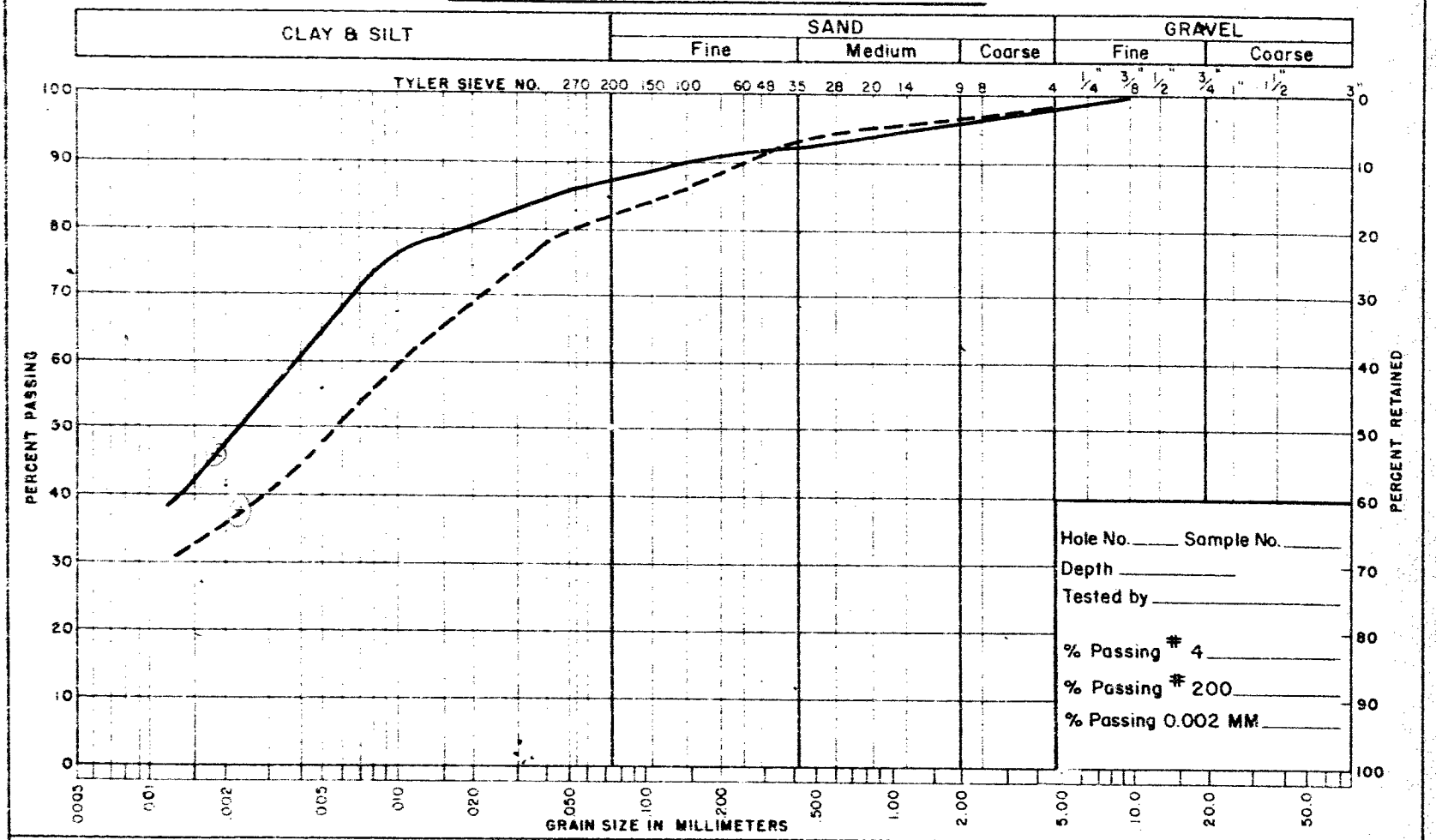
FORM OB-ML-252 (REV. MARCH 62)



NOTES ● - B.H. NO. 1

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART
Job No. 63-F-11 W.P. No. 8-63
Location HWY. NO. 402 & INDIAN RD. - SARNIA

UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES

——— B.H. NO. 1 SAMPLE NO. 17

– – – – – – – – B.H. NO. 6 SAMPLE NO. 4

DEPARTMENT OF HIGHWAYS - ONTARIO

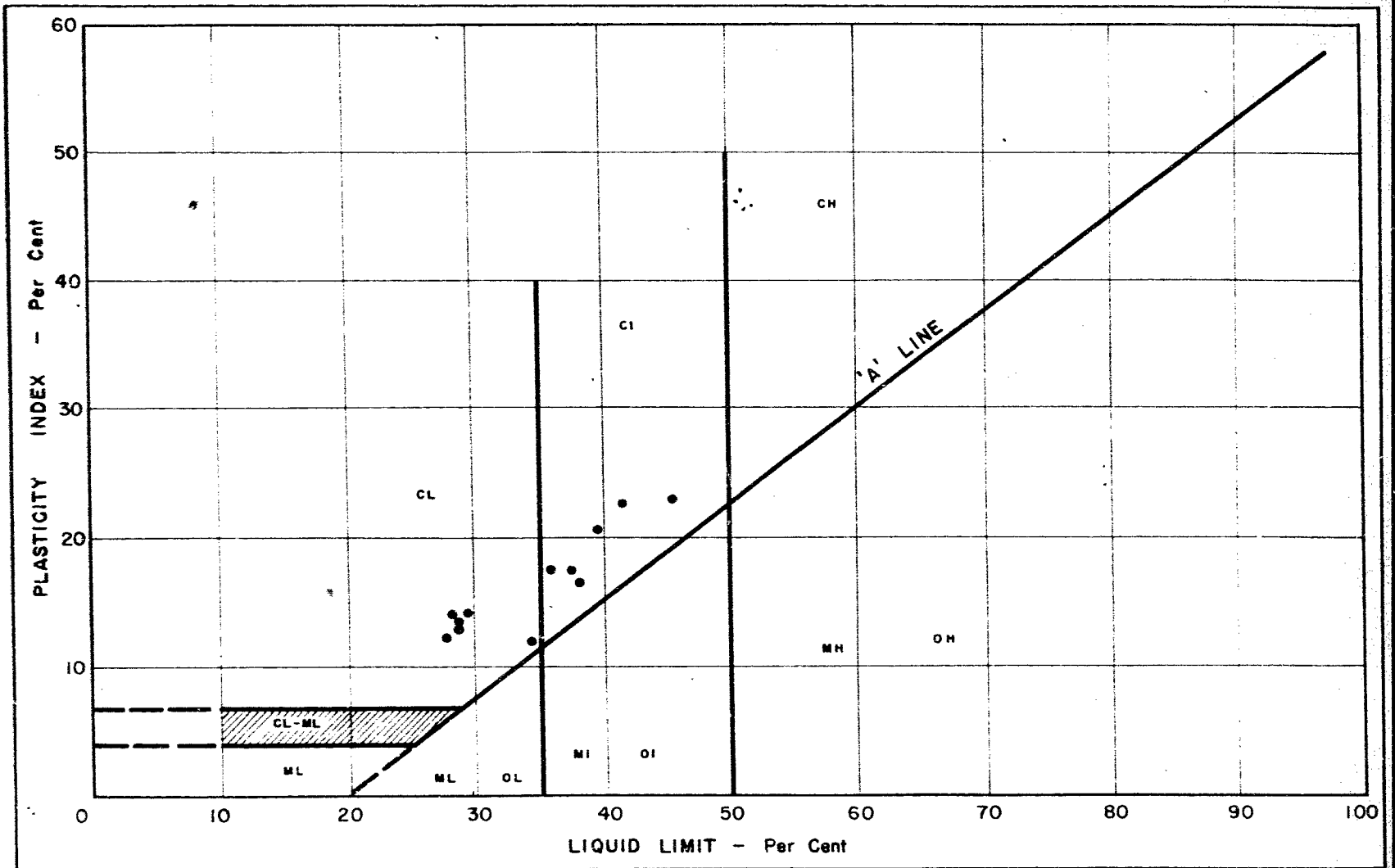
MATERIALS & RESEARCH SECTION

GRAIN SIZE DISTRIBUTION

Job No. 63-F-11 W.P. No. 8-63

Location HWY. NO. 402 & INDIAN ROAD - SARNIA

FORM OB-ML-252 (REV. MARCH 62)



NOTES • - B.H. NO. 6

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART
Job No. 63-F-11 W.P. No. 8-63
Location HWY. NO. 402 & INDIAN ROAD - SARNIA

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A.G. Stermac
Principal Foundation Engineer
Downsview, Ontario

From: A.P. Watt

Attention:

Date: February 18, 1969

Our File Ref.

In reply to:

Subject: W.P. 176-67-02, Bridge Site 14-289
Retaining Wall at Indian Road Interchange
Highway 402
District #1, Chatham

Attached please find a copy of the related correspondence of the above retaining Wall.

Would you kindly let me know what the allowable soil bearing pressure for the retaining wall footing is, assuming the bottom of the retaining wall footing at elevation 596.6 as shown on the attached sketch.

The foundation report for W.P. 8-63 Indian River Bridge, Bridge Site 14-289 is filed in the Document Section, Downsview under BA 1614. Your number for the Indian River Bridge foundation report is W.J. 63-F-11.

A.P. Watt
REGIONAL BRIDGE LOCATION ENGINEER

APW/gi
att.
c.c. J. L. Keen
S. McCombie
R. Fitzgibbon
D.D. Murray

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

From: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Date: October 6, 1966

Our File Ref.

In reply to:

Subject: - Functional Planning Study -
C.A.H. 402 - Bluewater
Bridge to King's Hwy. No. 7
Proposed Indian Rd. Interchange
District #1 (Chatham)

With reference to the letter of July 4, 1966, from Messrs. Damas & Smith Ltd. to you regarding the above project, we wish to make the following comments:

The proposed retaining structure is quite adequate from the foundation point of view. For a finished structure, we cannot foresee any problems.

However, the building - i.e., construction of the proposed structure, could create certain problems due to the close proximity of the piled abutment.

The battered piles are driven to approx. elevation 590.0, while the bottom of the retaining wall footing is at elevation 596.6, with the key bottom at elevation 594.6. The pile tips are therefore, only some 4 - 6 ft. below the footing excavation. If exposed over the entire abutment width, we feel that the stability of those piles could be jeopardized.

Due to the presence of the bridge deck, it appears that the driving of interlocking steel sheet piling is impractical, and a sheeted excavation would consequently have to be ruled out.

We would, therefore, suggest that the proposed retaining wall be built in 10-ft. sections. A 10-ft. wide strip only, s be excavated, and the portion of the wall built. The next to be excavated should not be adjacent to the one completed, ut rather, as far away as possible. Each section when completed should immediately be backfilled in order to provide for the ne- essary passive resistance to the wall movement. In such a way, we feel, the wall can be built without endangering the existing abutment.

cont'd. /2 ...

Should you wish to discuss any detail of our proposal, please feel free to call on this Office.

AGS/MdeF

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Mr. R. Gascoyne
Foundations Office
Gen. Files

DOWN CHAT TO OCT 27/66 3:29

MR J KIN BRIDGE OFFICE

RE: CONTRACT 66-304, W P 4-66, HWY 402, INDIAN ROAD UNDERPASS

YOUR TT OF OCTOBER 26TH.

THIS INFORMATION IS CONTAINED IN PILING REPORT FOR THIS CONTRACT OF WHICH A COPY IS SENT TO YOUR OFFICE. I AM NOT TOO SURE WHETHER YOU WANT THE TIP ELEVATION OF EACH INDIVIDUAL PILE OR MERELY THE AVERAGE. THE BATTERED PILE TIP ELEVATION VARIES SLIGHTLY ACCORDING TO THE AMOUNT OF CUT OFF BUT IS APPROXIMATELY 589.5 VARYING BETWEEN 589.13 AND 590.27. THE VERTICAL PILES HAVE A TIP ELEVATION AVERAGING 589.39 VARYING BETWEEN 588.7 AND 591.4.

I TRUST THIS WILL BE OF SOME ASSISTANCE TO YOU. IF YOU REQUIRE FURTHER INFORMATION PLEASE LET ME KNOW.

P H PEACOCK CONST ENGR

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

TELETYPE TELETYPE

DAMAS AND SMITH LIMITED

CONSULTING ENGINEERS

HEAD OFFICE
90 CODECO COURT
DON MILLS, ONTARIO
447-5137

WINNIPEG OFFICE
345 GERTRUDE AVENUE
WINNIPEG, MANITOBA
453-8759

LONDON OFFICE
66 CARLING STREET
LONDON, ONTARIO
434-0531

YOUR REF.

OUR REF.

D.H.O.
TORONTO
RECEIVED
JUL 5 1966
BRIDGE
OFFICE

Head Office
July 4, 1966.

File: 847

Mr. C.S. Grebski,
Bridge Design Engineer,
Department of Highways of Ontario,
Downsview, Ontario.

Dear Mr. Grebski:

Re: Functional Planning Study
C.A.H. 402 - Bluewater
Bridge to King's Hwy.No.7
Proposed Indian Road
Interchange

Further to our telephone conversation we enclose herewith for your review and comments one copy each of our Drawings 847-E-22 and 847-E-27.

Subject to acceptance of the horizontal clearance provisions shown on Drawing 847-E-27 we believe that it would be possible to obviate the need of reconstructing and adding on to the south half of the existing bridge by constructing an L shaped retaining wall in front of the south abutment.

We have assumed that:

1. The front slope of the embankment will be temporarily changed to 1:1 from 2:1 to facilitate the construction of the wall.

2. The allowable maximum bearing pressure at El. 596.60 is 4.5 kips per square foot given the characteristics of the soil and elevation of ground water as shown on the bridge drawings. Our calculated maximum pressure under the retaining wall footings is 4.3 kips per square foot and the factor of safety against sliding is 1.5.

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

The abutment piles are essentially end bearing and, therefore, the stability of the abutment will not be affected during the construction of the retaining walls. The cross-section of the wall as shown on the drawing is preliminary. However, we would recommend the treatment shown at shoulder level to ensure that a vehicle coming in contact with the wall is deflected back onto the pavement with minimum damage, if any.

Thank you for your assistance in this matter.

Yours very truly,

DAMAS AND SMITH LIMITED

N. E. Damas

NED:ed
encl. Dwg. 847-E-22
847-E-27

c.c. Mr. R. Gascoyne

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

Department of Highways Ontario

Copy for the information of
Mr. A.P. Watt, Regional Bridge Location Engineer,
London Regional Office, London, Ontario

Bridge Division,
Downsview, Ontario,
November 21, 1966

Damas and Smith Limited,
Consulting Engineers,
10 Codeco Court,
Don Mills, Ontario

Attention: Mr. N.E. Damas

RE: Functional Planning Study
C.A.H. 402 - Bluewater Bridge
to King's Highway No. 7
Proposed Indian Road Interchange
District No. 1

Dear Sir:

We have examined Drawings 847-E-22 and 847-E-27 prepared by your firm in connection with carrying the proposed ramp under the end span of the Indian Road Bridge, and wish to make the following comments:

The stability of the proposed scheme during and after construction is of paramount importance when considering the safety of those carrying out the construction and the traffic passing over the construction. In this regard we requested the Foundation Section to review the proposed scheme and provide us with their observations and comments. A copy of a memorandum from Mr. A.G. Sternac, Principal Foundation Engineer, summarizing their recommendations is attached.

..... 2

NOV 23 1966

RE: Functional Planning Study
C.A.H. 402 - Bluewater Bridge
to King's Highway No. 7
Proposed Indian Road Interchange

In brief, Mr. Stermac cannot foresee any problems with the completed structure, however, construction of the proposed structure could create certain problems due to the close proximity of the piled abutment, and he recommends certain precautions to be taken when carrying out the construction of the retaining wall. The reader is referred to Mr. Stermac's memo for the details involved.

In connection with the above, the District has supplied us with the "as driven" pile tip elevations for the south abutment. The front row battered piles have a tip elevation of approximately 589.5, varying between 589.13 and 590.27. The rear row of vertical piles have a tip elevation averaging 589.39, varying between 588.7 and 591.4. Therefore the actual pile tip elevations agree fairly closely to the pile tip elevation of 590.00 as shown on the Drawing 647-E-27.

The elevation and cross-section shown on the upper right corner of Drawing 647-E-27 shows the cross-fall of the roadway as 2% down towards the pier. The roadway at this location is very close to the end of the horizontal curve for the ramp which would be superelevated in the opposite direction, and would therefore necessitate an abrupt reversal in the cross-fall to attain the 2% cross-fall shown in the vicinity of the structure.

We would prefer to eliminate the barrier curb profile which appears to be cast integral with the front face of the retaining wall. We feel that the front face of the retaining wall should be a flat surface to simplify forming, thus lending itself to simpler construction. Also the ramp would likely have guiderail at the edge of both shoulders and the guiderail could be continuous under the structure. This would eliminate any problem of transitioning the guiderail to the concrete barrier profile at the end of the retaining walls.

Yours truly,

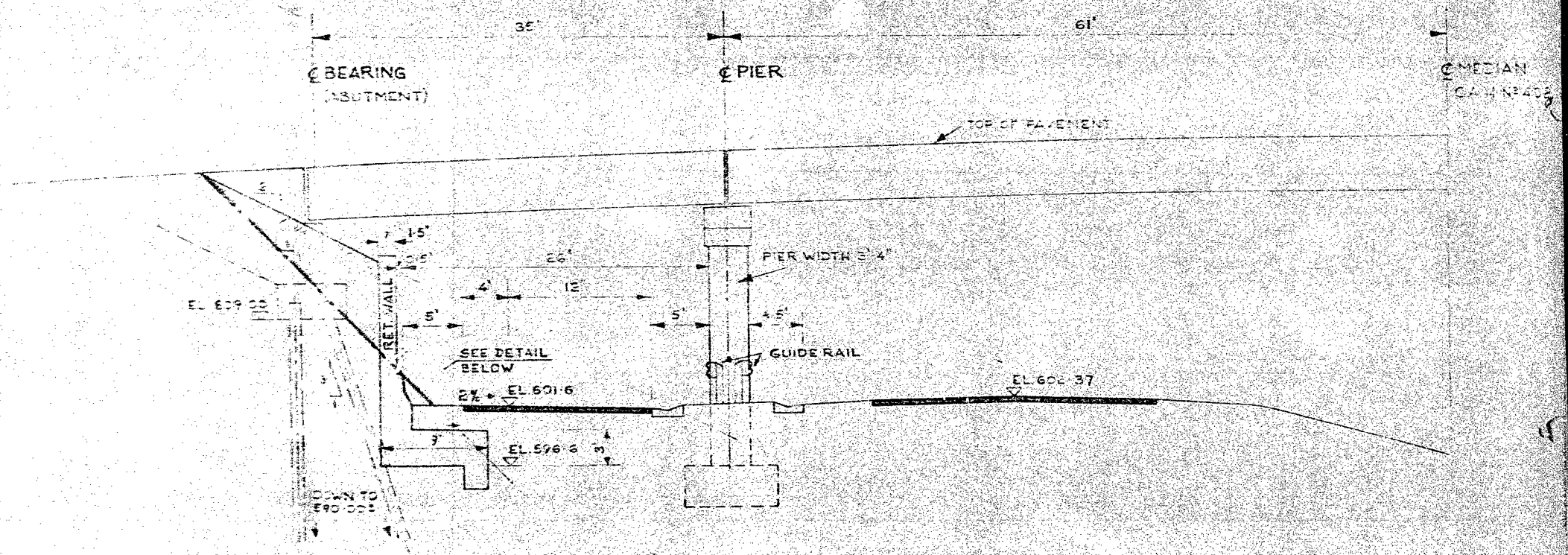
C.S. Grebski, P. Eng.,
Bridge Design Engineer

JLK:rd

Encls.

c.c. A.P. Watt

RECEIVED
NOV 23 1966
REGIONAL OFFICE



PROPOSED RETAINING WALL AT SOUTH END OF STRUCTURE

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

MEMORANDUM

To: Mr. A. E. Watt,
Regional Bridge Location Engr.,
Bridge Section,
LONDON, Ont.

From: Foundation Section,
Materials & Testing Office,
Rm. 107, Lab. Bldg.

Attention:

Date: February 21, 1969

Our File Ref:

In reply to

Subject: Re: W.P. 176-67-02 - Bridge Site 14-289
Retaining Wall at Indian Road Interchange
Hwy. #402 - District #1 (Chatham)
W.J. 63-F-11.

In reply to your memo dated February 18, 1969, we have reviewed our Foundation Report with regard to subsoil conditions existing at the location of the proposed retaining wall at the above mentioned site.

At the level of the footing el. 596.6 we estimate the net safe pressure to be 2.5 t.s.f.

K. G. Selby

KGS/MdeF

cc: Foundations Files
Gen. Files

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

RECEIVED
FEB 24 1969
REGIONAL OFFICE

Department of Highways Ontario
Copy for the information of

Foundation Section

Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

C.S. Grebski,
Bridge Office

September 10, 1969

Retaining Wall at Indian Rd. Interchange
W.P. 176-67-02, Site 14-289
Highway 402, District No. 1

Attached herewith we are submitting the final bridge drawings which show the foundation design for this structure.

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Section

FORM OB-ML-126 REV. 4/61 — OFFICE REPORT — MATERIALS RESEARCH DIVISION

81-4391

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 63-F-11 — LOCATION Hwy. #402 & Indian Road Ch. 34+75 - 40'-0" Lt. — ORIGINATED BY W.W.K.

W P 8-63 — BORING DATE Jan. 30 to Feb. 4, 1963. — COMPILED BY W.W.K.

DATUM 598.8 — BOREHOLE TYPE BX Casing - Washboring — CHECKED BY HR

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F. ● - Unconfined ○ - Quick Triax. ⊕ - Lab. Vane + - Field Vane (500 1000 1500 2000 2500)	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w (w_P w w_L) — WATER CONTENT % (15 30 45)	BULK DENSITY P.C.F.	REMARKS
598.8	Ground Elevation									
0.0	Compact to dense Silty, fine sand.		1	SS	26			○		
			2	SS	18	590		○		WL El. 590.7 Observed in Casing.
			3	SS	38					
584.3										
14.5			4	SS	41	580				
			5	SS	16					
			6	TW	P	570	+ 1.9			
			7	TW	P		⊕ 4.3 + 2		130.0	
	Firm to stiff silty, sandy clay (Till)		8	TW	P	560	+2	○		
			9	TW	P		2.8 ⊕ +2.3			
			10	TW	P	550	+ 2.4			
			11	TW	P		● ⊕ 4.4 +2.7		122.0	
			12	SS	P	540	+2.3			
			13	TW	P		3.8 ⊕ ● +2.5		121.0	
			14	TW	P	530				
			15	TW	P					
			16	TW	P	520	⊕ ●		115.0	
			17	SS	P					
			18	TW	P	510				
			19	SS	P					
			20	TW	P	500				
			21	TW	P					
			22	TW	P	490	⊕ ●			
			23	TW	P					
			24	SS	14	480				
475.8			25	SS	P					
123.0	Soft, black shale bedrock.					470				
470.8										
128.0	End of borehole.									

FORM OB - ML - 126 REV 3/61 OFFICE REPORT ON SOIL EXPLORATION

61-4391

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 63-F-11 LOCATION Hwy. #402 and Indian Road Ch. 34+35 - 40'-0" Rt. ORIGINATED BY W.W.K.

W P 8-63 BORING DATE Feb. 5 & 6, 1963. COMPILED BY W.W.K.

DATUM 599.4 BOREHOLE TYPE BX Casing - Washboring CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100; SHEAR STRENGTH P S F ● - Unconfined ○ - Quick Triax. ⊕ - Lab. Vane + - Field Vane 500 1000 1500 2000 2500	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_P WATER CONTENT ——— w; w_P w w_L WATER CONTENT % 15 30 45	BULK DENSITY γ P.C.F.	REMARKS
599.4	Ground Elevation					600				
0.0	Compact to dense Silty, fine sand.		1	SS	25					
			2	SS	22	590				WL El.591.0
			3	SS	32					Observed in Casing
581.7			4	SS	36					
17.7			5	TW	P	580	+1.8		131.0	
			6	TW	P		+1.9			
			7	TW	P	570	2.3 ⊕●		127.0	
			8	TW	P		+ 1.4			
			9	TW	P	560	5.3 ⊕●		130.0	
	Firm to stiff silty, sandy clay.		10	TW	P		+			
			11	TW	P	550	+			
						540				
						530				
						520				
						510				
						500				
						490				
						480				
476.7	End of borehole									
122.7	Soft, black shale									

FORM OB - ML - 108 REV 9[illegible]

61-4391

OFFICE REPORT - IN SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 63-F-11 LOCATION Hwy. #402 and Indian Road Ch. 33+47 - 40'-0" Lt. ORIGINATED BY W.W.K.

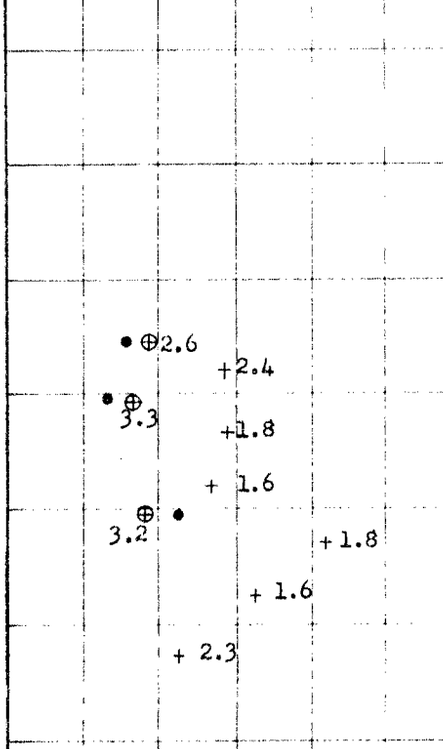
W P 8-63 BORING DATE Feb. 12 & 13, 1963. COMPILED BY W.W.K.

DATUM 600.5 BOREHOLE TYPE BX Casing - Washboring CHECKED BY [illegible]

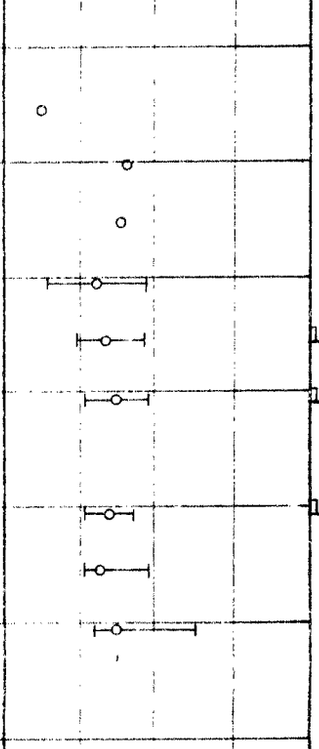
ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV SCALE
600.5	Ground Elevation					600
0.0	Compact to dense Silty, fine sand.		1	SS	24	
			2	SS	27	590
581.7						
18.8			3	SS	34	
			4	SS	32	580
			5	TW	P	
			6	TW	P	570
			7	TW	P	
	Firm to stiff silty, sandy clay (Till)		8	TW	P	560
			9	TW	P	
			10	SS	11	550
						540
						530
						520
						510
						500
						490
						480
476.7	End of borehole					
123.8	Soft, black shale					470

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT

SHEAR STRENGTH P S F
● - Unconfined ○ - Quick Triax.
⊕ - Lab. Vane + - Field Vane
500 1000 1500 2000 2500



LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT - - - w



BULK DENSITY γ P C F.	REMARKS
	w_L El. 591.8
	Observed in Casing
131.0	
131.0	
131.0	

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 4

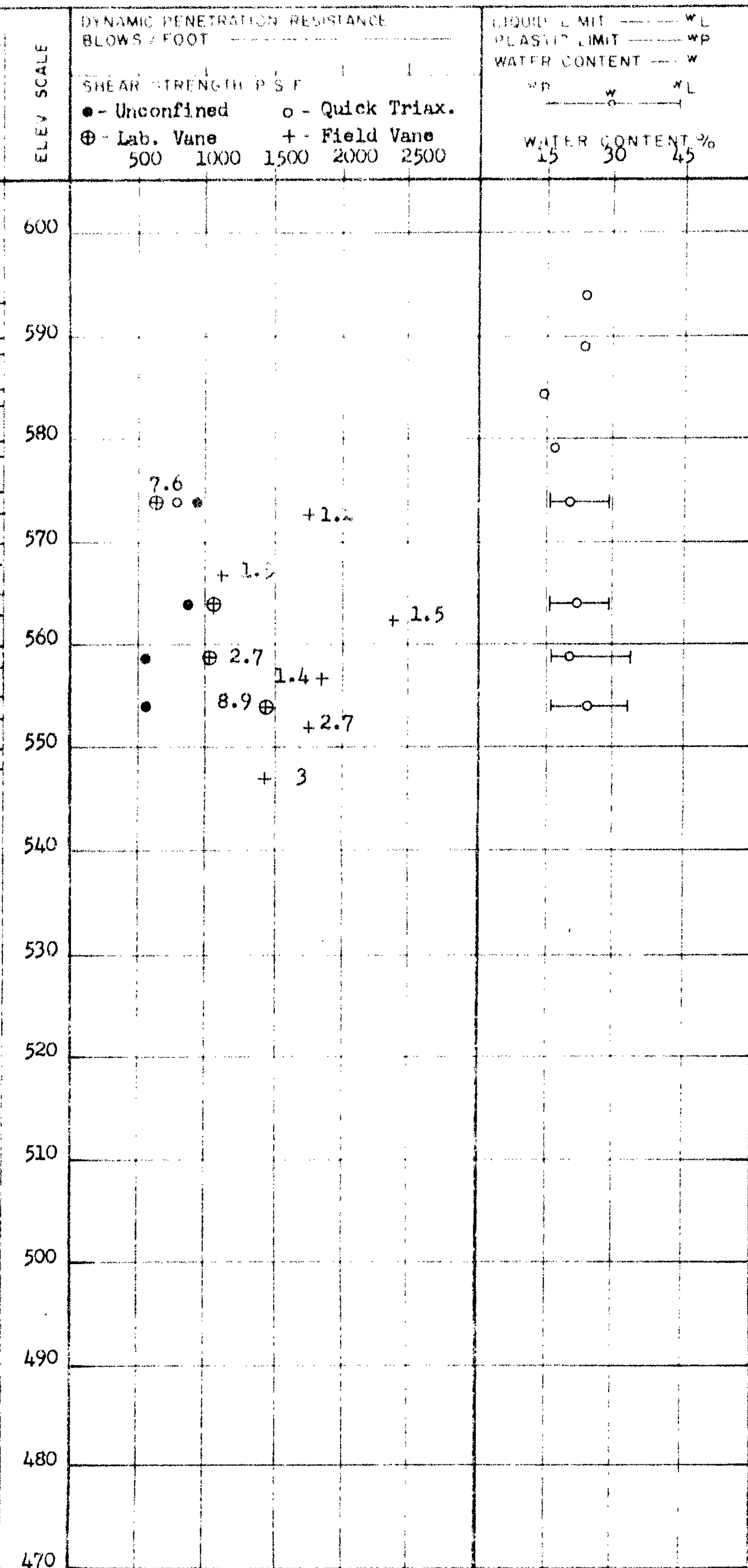
FOUNDATION SECTION

JOB 63-F-11
W.P. 8-63
DATUM 600.0

LOCATION Hwy. #402 and Indian Road Ch.32+87 - 40'-0" Rt.
BORING DATE Feb. 6 & 7, 1963.
BOREHOLE TYPE BX Casing - Washboring

ORIGINATED BY W.W.K.
COMPILED BY W.W.K.
CHECKED BY AR

ELEV. DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FOOT	BULK DENSITY γ P.C.F.	REMARKS
600.0	Ground Elevation					
0.0	Compact to dense Silty, fine sand.	1	SS	22		WL El. 591.3 Observed in Casing
		2	SS	42		
586.0 / 14.0	Firm to stiff silty, sandy clay.	3	SS	42		
		4	SS	15		
		5	TW	P	131.0	
		6	TW	P		
		7	TW	P	131.0	
		8	TW	P	128.0	
		9	TW	P	128.0	
		10	TW	P		
476.8	End of borehole					
123.2	Soft, black shale					



FORM OB ML [illegible] REV. [illegible] OFFICE REPORT [illegible] EXPLORATION

61-439J

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 63-F-11 LOCATION Hwy. #402 and Indian Road Ch.32+27-40'-0" Lt. ORIGINATED BY W.W.K.

W P 8-63 BORING DATE Feb. 14 & 15, 1963. COMPILED BY W.W.K.

DATUM 600.8 BOREHOLE TYPE BX Casing - Washboring CHECKED BY [illegible]

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS / FOOT; SHEAR STRENGTH P.S.F. ● - Unconfined ○ - Quick Triax. ⊕ - Lab. Vane + - Field Vane (500 1000 1500 2000 2500)	LIQUID LIMIT w_L, PLASTIC LIMIT w_P, WATER CONTENT w; WATER CONTENT % (15 30 45)	BULK DENSITY γ P.C.F.	REMARKS
600.8	Ground Elevation					600				
0.0	Compact to dense Silty, fine sand.		1	SS	19			○		WL El. 592.0 — Observed in Casing
			2	SS	26			○		
			3	SS	32	590		○		
			4	SS	32			○		
580.8			5	SS	38	580		○		
20.0			7	TW	P		2.6 ⊕ ○ ● + 1.2		132.0	
			8	TW	P	570	+ 1.2			
			9	TW	P		2.1 ⊕ ○ ● + 1.2		130.0	
			10	SS	13	560				
			11	SS	14		+ 1.3			
	Firm to stiff silty, sandy clay (Till)		12	TW	P	550	+ 1.4			
						540				
						530				
						520				
						510				
						500				
						490				
						480				
476.6	End of borehole									
124.2	Soft, black shale					470				

FORM OB-ML-126 REV 65

61-4391

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 63-F-11 LOCATION Hwy. #402 and Indian Road Ch. 31+87-40'-0" Rt. ORIGINATED BY W.W.K.

W.P 8-63 BORING DATE Feb. 5 to 12, 1963. COMPILED BY W.W.K.

DATUM 599.7 BOREHOLE TYPE BX Casing - Washboring CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F. • - Unconfined ○ - Quick Triax. ⊕ - Lab. Vane + - Field Vane 500 1000 1500 2000 2500	LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w WATER CONTENT % 15 30 45	BULK DENSITY γ P.C.F.	REMARKS
599.7	Ground Elevation					600				
0.0	Compact to dense. Silty, fine sand.		1	SS	28					WL El. 591.3 Observed in Casing
			2	SS	43	590				
584.5			3	SS	40					
15.2			4	SS	12	580	+1.9			
			5	TW	P		• +1.5		119.0	
			6	SS	6	570				
			7	TW	P					
			8	SS	10	560	+1.9			
			10	TW	P		+1.8 ○⊕ 5.3		131.0	
	Firm to stiff silty, sandy clay (Till)		11	SS	6	550	+1.8			
			12	TW	P		+2.4 •⊕ +1.6		120.0	
			13	SS	6	540				
			14	TW	P		+ 1.6			
			15	TW	P	530	+1.2 • ⊕3.8 + 1.5		120.0	
			16	SS	10					
			17	TW	P	520	+ 2			
			18	TW	P		• ○ ⊕ 3.8		121.0	
			19	SS	13	510	+2			
			20	TW	P		5.3 ⊕ •			
						500	+1.7			
			21	SS	P					
						490	+1.1			
			22	TW	P		• ○⊕		118.0	
						480	+2.4			
476.6	End of borehole									
123.1	Soft, black shale					470				