

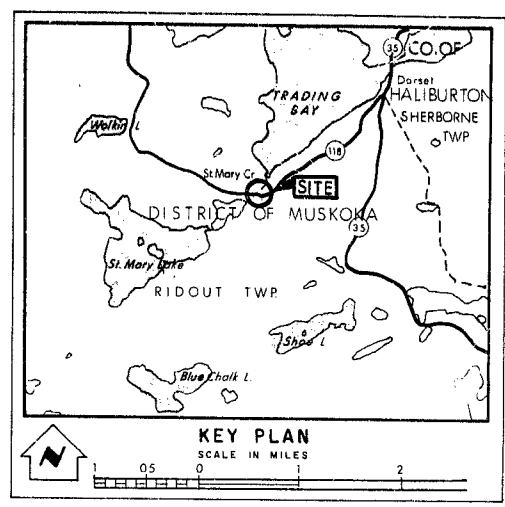
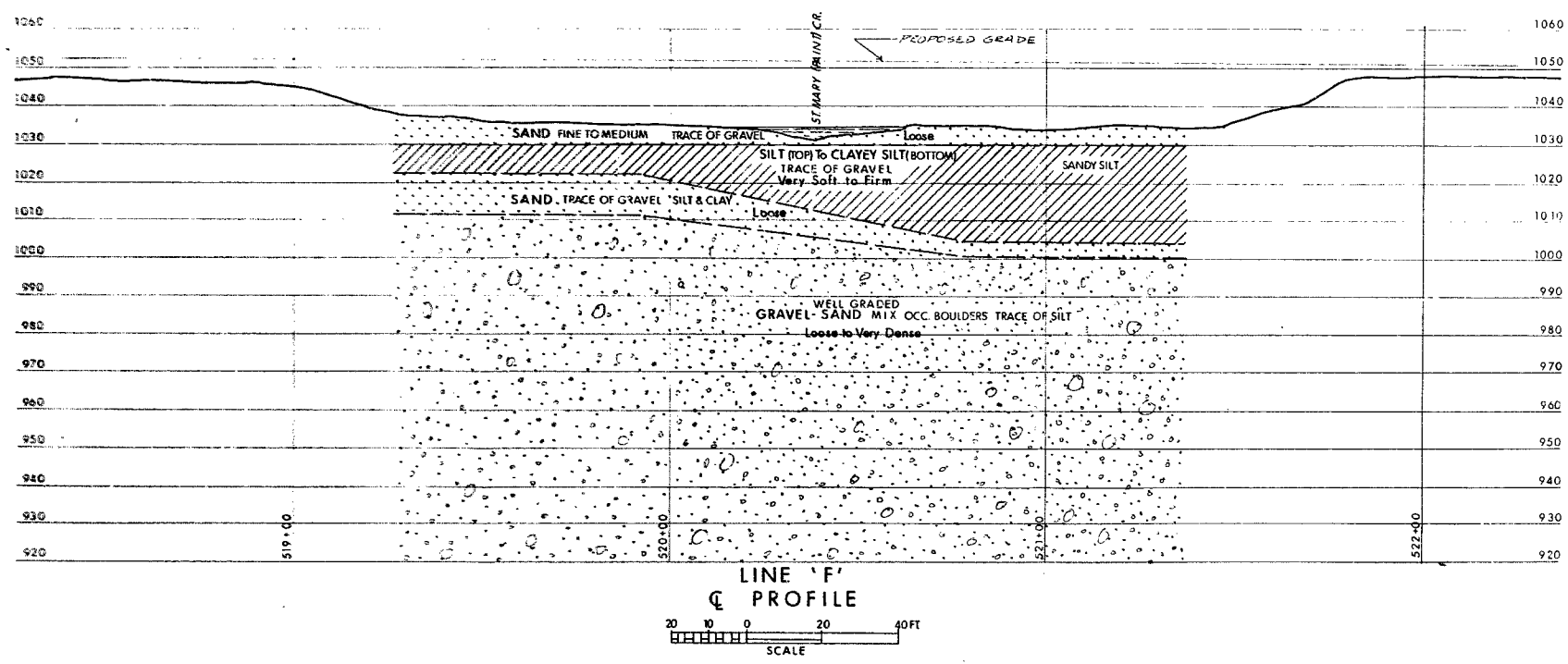
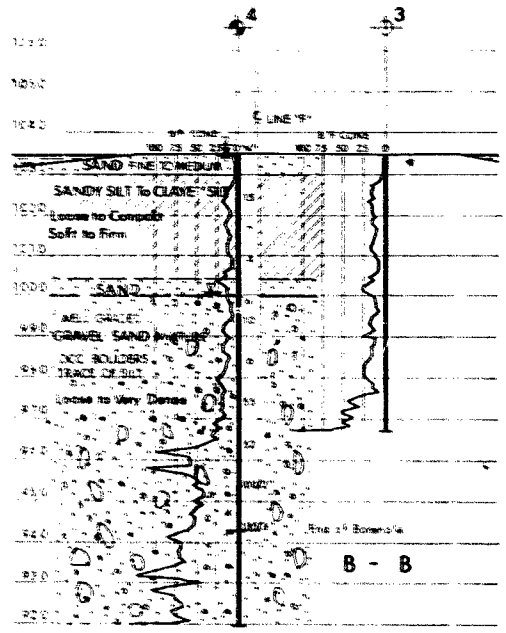
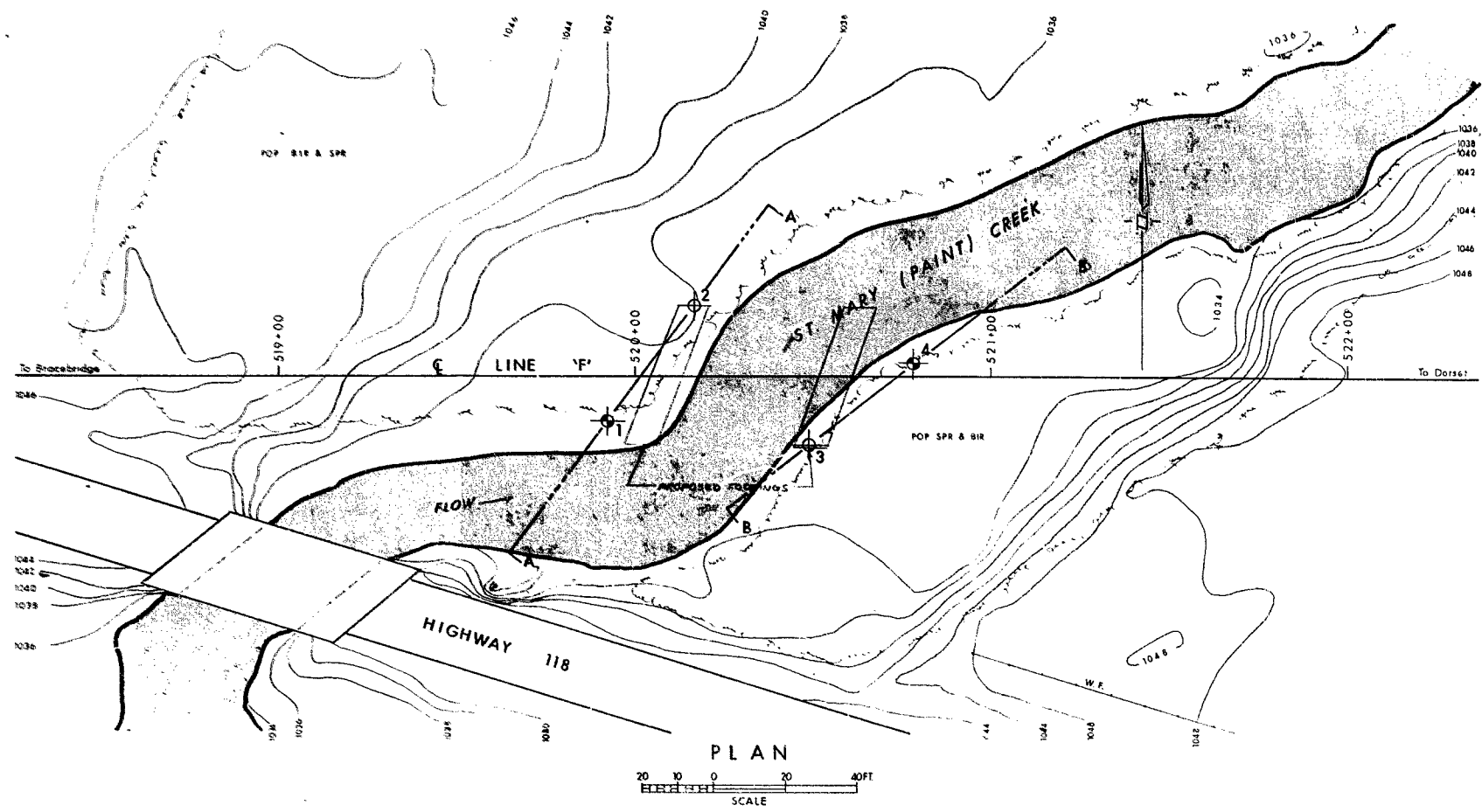
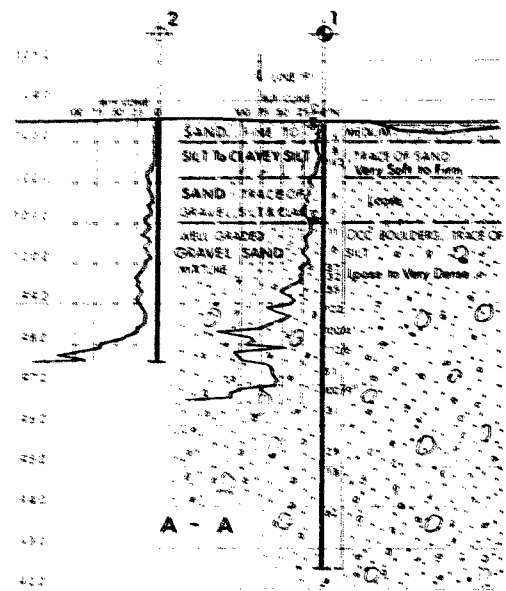
#67-F-43

W.P. #186-66

Hwy. #118

ST. MARY

(PAINT) CREEK



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore B Cone Penetration Hole		
	Water Level established at time of field investigation, JUNE 1967		
	Artesian Condition		
	Encountered		
NO.	ELEVATION	STATION	OFFSET
1	1035.0	519+92	13'RT
2	1035.0	520+16	20'LT
3	1035.4	520+49	20'RT
4	1035.4	520+78	4'LT

- 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.

REVISIONS	DATE	BY	DESCRIPTION

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

ST. MARY (PAINT) CREEK

KING'S HIGHWAY NO. 118 LINE 'F' DIST. NO. 11
DIST. MUSKOKA
TWP. RIDOUT LOT 4 CON. III

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. A.P.	CHECKED A.P.	W.P. NO. 186-66	M.B.T. DRAWING NO.
DRAWN M.D.	CHECKED M.D.	JOB NO. 67-F-43	67-F-43A
DATE 28 JUNE 1967	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. B. Thomas</i>	CONT. NO.		

DEPARTMENT OF HIGHWAYS ONTARIO

W.P. 186-66.

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division,
Admin. Bldg.

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

Attention: Mr. S. McCombie

DATE: June 28, 1967

OUR FILE REF.

IN REPLY TO

JUL 7 1967

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Crossing at
St. Mary (Paint) Creek and Hwy. #118,
Twp. of Ridout, Lot 4, Con. II,
District No. 11 (Huntsville)

W.J. 67-F-43

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W.P. 186-66.

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/ndef
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
H. McArthur
W. S. Aitken
J. B. Curtis
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at
St. Mary (Paint) Creek and Hwy. #118,
Twp. of Ridout, Lot 4, Con. II,
District No. 11 (Huntsville)
W.J. 67-F-43 -- W.P. 186-66

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed new bridge to carry Hwy. #118 over St. Mary (Paint) Creek - connecting St. Mary (Paint) Lake and Lake of Bays - was received from Mr. J. B. Curtis, Regional Bridge Location Engineer, in a memo dated April 27, 1967.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed bridge.

This report contains the results of our field and laboratory investigation, together with our recommendations for the foundations of the new structure.

2. DESCRIPTION OF SITE:

The proposed bridge site is some 60 ft. North and 120 ft. East of the existing bridge at the crossing of Paint Creek and Hwy. #118, some 2 miles South-West of Dorset, Ontario. The proposed bridge is skewed at an angle of 20° to the centre line. The bed of the creek is 12 to 15 ft. below the surrounding level ground. The creek itself, is forested with mixed bush. The land to the West is hilly and forested, while the land to the East is farmland.

3. FIELD AND LABORATORY WORK:

The field work at the proposed bridge location consisted of two sampled boreholes and four dynamic cone penetration tests.

cont'd. /2 ...

3. FIELD AND LABORATORY WORK: (cont'd.) ...

All holes were advanced using conventional diamond drilling equipment adapted for soil sampling purposes. A driving energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

Disturbed samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration test. Undisturbed samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil manually. Boulder samples were obtained in Borehole 1 using BXT coring equipment.

In-situ vane tests were carried out wherever possible, at elevations 12 inches below various sample depths.

Samples were visually examined in the field and subsequently in the laboratory. Grain-size distribution curves and Atterberg limits were carried out on selected samples.

Artesian water conditions were encountered at elevations of 1010.5 in Borehole 1 and 1000.4 in Borehole 4. The artesian water rose 2 ft. above the ground level.

The results of field and laboratory tests are summarized in the Record of Borehole sheets, which are contained in the appendix to the report.

The locations and the elevations of boreholes are given on Drawing No. 67-F-43A, which is also contained in the appendix to this report.

The borehole elevations were provided by the Huntsville District Office of the D.H.O.

4. SUBSOIL CONDITIONS:

4.1) General:

In general, the subsoil was found to consist of deep deposits of well graded gravel-sand mixtures overlain by relatively thin sandy silt to clayey silt layers.

cont'd. /3 ...

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

4.1) General: (cont'd.) ...

The boundaries between the different deposits are shown on the attached Record of Borehole sheets. The estimated stratigraphical profiles shown on Drawing No. 67-F-43A, are based upon this information.

From ground level downwards, the different soil deposits are described as follows:

4.2) Sand, Fine to Medium:

This deposit occurred in both boreholes from the ground surface to approximate elevation 1030.0. It is a loose, fine to medium sand with traces of gravel and silt. It contains some pieces of decayed wood also. The average grain-size distribution was found to be: gravel 3%, sand 90%, silt and clay 7%.

4.3) Sandy Silt to Clayey Silt:

This deposit occurred from El. 1030.0 to 1021.5 in Borehole 2 and 1030.4 to 1004.4 in Borehole 4. It is mainly silt with some clay and a little sand in Borehole 4. The consistency varies from very soft to stiff. In Borehole 1, it can be classified as clayey silt with average Atterberg limits as below:

Liquid Limit	:	29%
Plastic Limit	:	20%

In Borehole 4, the material changes from sandy silt - with average grain-size distribution showing sand 11%, silt 87%, and clay 2% - at the top of the stratum, to clayey silt at the bottom of it.

4.4) Sand:

This deposit was found to be 11 ft. in thickness in Borehole 1 and 4 ft. in Borehole 4. It is mainly fine to coarse sand with traces of gravel, silt and clay. The average grain-size

cont'd. /4 ...

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

4.4) Sand:

distribution is: gravel 2%, sand 81%, silt and clay 17%. Standard Penetration tests gave 'N' values from 6 to 8 blows/ft., indicating a loose denseness.

4.5) Gravel-Sand Mixture:

This is the predominant soil deposit at the site and extends down to the depth the borings were carried out, i.e., 109.5 ft. in Borehole 1 and 91.2 ft. in Borehole 4 below the ground surface. The material consists of a well graded gravel-sand mixture with traces of silt and occasional boulders. Mechanical analyses indicate the following ranges of grain-size distribution: gravel 35 - 48%, sand 45 - 68%, silt and clay 0 - 10%. Occasional boulders were encountered which may be up to 2 - 3 ft. in diameter. 'N' values obtained from Standard Penetration tests ranged from 6 blows/ft. to 100 blows/2 in., indicating a loose to very dense material. No bedrock was found.

5. GROUNDWATER:

Artesian pressure was found to exist when the sand-gravel mixture stratum was intersected. The water rose 2 ft. above the ground surface in the casing. Normal groundwater level prevailing at the time of investigation was 1 ft. below the ground level.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new bridge to carry Hwy. #118 over St. Mary (Paint) Creek. The presently proposed bridge is a single 40-ft. span structure, with an approach fill which is approximately 17 ft. above the ground level.

Due to the layers of soft silty material and loose sand at the top, a spread footing foundation is considered to be unsuitable. The bedrock is too deep and could not be established.

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

It is recommended that the proposed structure be supported on 12-3/4" O.D. x 1/4" wall steel tube piles driven to elevations between 960.0 and 970.0. A maximum safe load of 50 tons/pile may be assumed for design purposes. Pile driving should be controlled in the field by means of the Hiley formula and D.H.O. Standards DD 1218 and 1219.

Pile caps should be founded at sufficient depth to ensure frost protection. A dewatering scheme will be necessary to ensure that the concrete can be poured in the dry.

Because of the presence of very soft silty layers underlying the top layer of loose sand with organic material, some stability problems of the forward slopes of the proposed embankments are anticipated; therefore, it is recommended that the soft material lying between the abutments above elevation 1025.0 and above a plane sloping at 3:1 back from the abutment footings, be removed and replaced with suitable granular fill. This procedure should be carried out for a width of about 25 feet each side of centre line.

7. SUMMARY:

A foundation investigation at the site of the proposed new structure at Hwy. #118 and St. Mary (Paint) Creek is reported.

Subsoil conditions at the site consist of 5 ft. of loose sand followed by 8 ft. to 26 ft. of very soft to stiff sandy silt to clayey silt which overlies 4 ft. to 11 ft. of loose sand followed by deep deposits of well graded gravel-sand mixtures in a loose to very dense state, with occasional boulders. Borings were terminated in this stratum. No bedrock was encountered.

Slight artesian pressure was present in the gravel-sand layer for its entire depth.

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

It is recommended that the proposed structure be supported on 12-3/4" O. D. x 1/4" wall steel tube piles and driven to elevations between 960.0 and 970.0.

A dewatering scheme is required to found the pile caps.

Some stability problems of the forward slopes of the proposed embankments are anticipated; therefore, the soft material between the abutments and above El. 1025.0 and above a plane sloping at 3:1 back from the abutment footings, should be removed and replaced with suitable granular fill, for a width of 25 feet each side of centre line.

8. MISCELLANEOUS:


The field work for this project was carried out during the period May 25 - June 2, 1967, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by Master Soil Investigations Ltd., and F. E. Johnston Drilling Co. Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

June 1967

APPENDIX I

CHECKED BY 

FOUNDATION SECTION

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 67-F-43 LOCATION St. Mary (Paint) Creek & Hwy. 118, Sta. 520 + 16, 20' Lt. ORIGINATED BY AP
W.P. 186-66 BORING DATE June 2, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	WATER CONTENT %			
1035.0	GROUND LEVEL										
0.0											
						1030					
						1020					
						1010					
						1000					
						990					
						980					
975.6											
59.4	End of Cone Test					970					

Dynamic Penetration Resistance Scale: 20, 40, 60, 80, 100
Shear Strength P.S.F. Scale: 0, 2, 4, 6, 8, 10
Water Content % Scale: 0, 20, 40, 60, 80, 100
Liquid Limit (WL) and Plastic Limit (WP) lines are shown on the right side of the chart.

At elevation 975.6, the test results are 150/5*.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-43

LOCATION St. Mary (Paint) Creek, & Hwy. 118; Sta. 520 + 49, 20' Rt.

ORIGINATED BY AP

W.P. 186-66

BORING DATE June 2, 1967

COMPILED BY AP

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W				BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.				WATER CONTENT %				
1035.4	GROUND LEVEL														
0.0															
							1030								
							1020								
							1010								
							1000								
							990								
							980								
							970								
967.5															
57.9	End of Cone Test														
							960								

200/11"

[illegible]

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 :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
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
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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