

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 410-1

DIST. 18 REGION

W.P. No. 371-65-01

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 129

LOCATION 8.5 MILES North of AUBREY FALLS

EMBANKMENT FAILURE

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

20  
15  $\pm$  5 % STRAIN AT FAILURE  
10

20  
15  $\pm$  5 % STRAIN AT FAILURE  
10

20  
15 + 5 % STRAIN AT FAILURE  
10

15-~~5~~ 5 % STRAIN AT FAILURE

20  
15  $\pm$  5 % STRAIN AT FAILURE  
10

20  
15  $\pm$  5 % STRAIN AT FAILURE  
10

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 59F38

LOCATION STA. 799+62 0/2 99' RT.

ORIGINATED BY AP

W.P. 371+65

BORING DATE JUNE 24 '69

COMPILED BY

DATUM GEODETIC

BOREHOLE TYPE WASH BORING, NY CASING & CONE

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w <sub>L</sub> PLASTIC LIMIT — w <sub>P</sub> WATER CONTENT — w			BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			
1294.7 0.0.	WATER LEVEL																
24.0																	
50.0	END OF BORE HOLE																

END OF CONE TEST

151  
150/8"

20  
15-5 % STRAIN AT FAILURE  
10



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69 F 38

LOCATION STA. 799 + 75 , 1/2 151 RT.

ORIGINATED BY AP

W.P. 371 - 65

BORING DATE JUNE 26, 1969

COMPILED BY

DATUM GEODETIC

BOREHOLE TYPE CONE

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w <sub>L</sub> PLASTIC LIMIT — w <sub>p</sub> WATER CONTENT — w				BULK DENSITY γ P.C.F.	REMARKS								
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.													
							20	40	60	80	100	w <sub>p</sub> — w — w <sub>L</sub>													
1294.7 0.0	WATER LEVEL																								
34.3																									
73.3																									

20  
15-5 % STRAIN AT FAILURE  
10

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 69 F 38

LOCATION STA. 796 + 47 9/8 YB RT.

ORIGINATED BY AP

W.P. 371-65

BORING DATE JUNE 26, 1969

COMPILED BY

DATUM GEODETIC

BOREHOLE TYPE WASHBORING, NX CASING & CONE

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w <sub>L</sub> PLASTIC LIMIT ——— w <sub>p</sub> WATER CONTENT ——— w				BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.								
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE								
1294.7 O.D.	WATER LEVEL																			
26.0																				
41.5	END OF BORE HOLE																			

20  
15-5 % STRAIN AT FAILURE  
10

20  
15  $\pm$  5 % STRAIN AT FAILURE  
10

15-5 % STRAIN AT FAILURE

20  
15 — 5 % STRAIN AT FAILURE  
10

10

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W <sub>L</sub>		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — W <sub>P</sub>	WATER CONTENT — W		
1316.1 0.0	GROUND LEVEL						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	W <sub>P</sub> — W — W <sub>L</sub>	WATER CONTENT %	P.C.F.	GR. SA. SI. CL.	
42.0	END OF BOREHOLE						END OF CONE TEST					

15- $\frac{20}{10}$  5 % STRAIN AT FAILURE

20  
15 — 5 % STRAIN AT FAILURE  
10

20  
15 — 5 % STRAIN AT FAILURE  
10

## AUBREY FALLS

ROCK FILL  $\gamma = 135$  PCF $\phi = 45^\circ$ 

PARTICULARS		F.S.	R	X <sub>c</sub>	Y <sub>c</sub>
<u>EXIST. EMBANKMENT WITHOUT BERM</u>					
N.L. 10' BELOW TOE OF SLOPE	EL. 1244	1.065	174	120	-126
N.L. LEVEL WITH TOE OF SLOPE	EL. 1254	1.065	174	20	-2
N.L. AT FINAL HEAD POND LEVEL	EL. 1295	0.991	123	100	-70
<u>EXIST. EMBANKMENT WITH 30 FT 2:1 BERM</u>					
DRY	EL. 1254	1.800	145	130	-60
		1.560	295	150	-160
SUBMERGED	EL. 1295	<del>1.695</del>	205	140	<del>-140</del>
DRAWDOWN		1.529	145	30	-60
<u>EXIST. EMBANKMENT WITH 30 FT 1.5:1 BERM</u>					
DRY	EL. 1254	1.569	160	130	-90
SUBMERGED	EL. 1295	1.428	145	120	-80
DRAWDOWN		1.149	105	100	-30
<u>EXIST. EMBANKMENT WITH 20 FT 2:1 BERM</u>					
DRY	EL. 1254	1.693	180	140	-110
SUBMERGED	EL. 1295	1.545	205	140	-140
DRAWDOWN		1.395	120	110	-40

# FIELD BORING LOG

DRILLING CO. <u>MASTER</u>	DATUM ELEV. _____	B.H. NO. <u>1</u>
DRILLER <u>DODG DICKIE</u>	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER <u>A.P.</u>	CASING SIZE <u>NX</u>	DATE <u>JUNE 19, 69</u>
SITE LOCATION <u>AUBREY FALLS - HWY 129</u>		
HOLE LOCATION <u>2+18, 7/8 SS 817+82 7/8 SS LT</u>		
REMARKS <u>W.L. 1294.7</u>		

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DEPTHS FROM WATER SURFACE		
0.0	4.0	WATER		
4.0	10.0	1-1-13-10-5		
10.0	20.0	8-5-3-3-2-6-10-3-6-12		
20.0	30.0	10-9-9-8-15-48-78-27-45-75		
30.0	31.8	41-200/9"		
		END OF CONE TEST		
0.0	3.0	WATER		
3.0	4.5	SPLIT SPOON - MED. TO COARSE SAND BROWN. PIECE OF STONE AT THE END OF SS	SS 1/4"	4, 10, 5
0.0	6.0	DRIVE NX CASING & WASH - SAME AS ABOVE. CASING GOING DOWN		
6.0	7.5	SPLIT SPOON - 33 BLOWS 1/6" CASING GOING DOWN. PULLED UP. NO REC.		
		CASING PULLED OUT - COARSE TO MED. SAND & GRAVEL PIECES OF STONES UP TO 2"		
0.0	6.0	DRIVE NX CASING & WASH		

# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. 1  
 DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
 ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE JUNE 19, 69  
 SITE LOCATION \_\_\_\_\_  
 HOLE LOCATION \_\_\_\_\_  
 REMARKS \_\_\_\_\_

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
6.0	7.5	SPLIT SPOON - CASING GOING DOWN. WASHER COARSE SAND	SS 2 1/2"	30 1/8"
		PULL OUT CASING - MAT. - COARSE TO MED SAND WITH GRAVEL	CS 3/1	
8.0	9.0	DRIVE NX CASING & WASH - VERY HARD WASHING. - PUT HAMMER ON. CASING GOING DOWN. FURTHER WASHING ALMOST IMPOSSIBLE		
JUNE 20, 69		PULL OUT CASING MOVE 1-2 FT		
6.0	9.0	DRIVE NX CASING & WASH - SAND & GRAVEL COMING OUT.	WS 4	
9.0	10.5	SPLIT SPOON - COARSE SAND & GRAVEL STONE AT BOTTOM. ANOTHER 2" STONE IN SPOON. REST WASH	SS 5/6"	18, 15, 20
9.0	10.5	SPLIT SPOON - NO REC 2ND ATT. - COARSE SAND & GRAVEL	SS 6 / 1 3"	5, 9, 9
9.0	12.0	DRIVE NX CASING & WASH - SAME AS ABOVE. STONE IN CASING AT 11 FT. V. HARD WASHING. PUT HAMMER ON.		

# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. 1  
 DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
 ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE JUNE 20, 69  
 SITE LOCATION \_\_\_\_\_  
 HOLE LOCATION \_\_\_\_\_  
 REMARKS \_\_\_\_\_

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
12.0	13.5	SPLIT SPOON - NO REC	SS7/	8, 4, 5
12.5	14.0	2ND ATT - "		
13.0	14.5	3RD ATT - "		
13.5	15.0	4TH ATT - "		
15.0	16.5	SPLIT SPOON - FINE TO MED SAND, GREY	SS8/4	17, 4, 2
12.0	18.0	DRIVE NX CASING & WASH		
18.0	19.5	SPLIT SPOON - FINE TO COARSE SAND GREY & BROWN	SS9/4	60, 17, 32
18.0	21.0	DRIVE NX CASING & WASH		
21.0	22.5	SPLIT SPOON - NO REC, 2ND ATT - NO REC. CASING GOING DOWN WITH SS. PULL CASING UP ABOUT 1'	SS10/	100/4 60/4
22.0	23.5	SPLIT SPOON - FINE SAND & SILT (2') BROWNISH YELLOWISH LAYER. SOME BLACK SPOTS. PIECE OF STONE. REST WASH	SS11/6	18, 5, 5
23.5	25.0	SPLIT SPOON - TOP 9" WASH 3" VERY LOOSE - SEMI FLUID	SS12/18 12A	3, 3, 5

# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. 1  
 DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
 ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE JUNE 20, 69  
 SITE LOCATION \_\_\_\_\_  
 HOLE LOCATION \_\_\_\_\_  
 REMARKS \_\_\_\_\_

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
		YELLOWISH BROWN V. FINE SAND & SILT.	1A	
		BOTTOM 6" V. FINE SAND & SILT RUSTY BROWN	12B	
21.0	25.0	DRIVE NX CASING & WASH - EASY DRIVING. HARD WASHING AT 24.5. PUT HAMMER ON.		
25.0	26.5	SPLIT SPOON - NO REC	SS 13/	9, 11, 13
26.5	28.0	SPLIT SPOON - FINE TO COARSE WITH S.T. SAND, SOME GRAVEL, BROWN	SS 14/18"	12, 10, 12
28.0	29.0	DRIVE NX CASING & WASH - BROWN WASH SAND.		
29.0	30.5	SPLIT SPOON - V. FINE SAND & SILT GREY	SS 15	58, 38, 47
29.0	29.5	WASH WITH SPLIT SPOON - COULD WASH ONLY UP TO 29.5 FT. W.L. IN CASING 1.0' HIGHER THAN RIVER W.L.		
29.5	31.0	SPLIT SPOON - BOTTOM 2" FINE TO COARSE SAND, SOME GRAVEL. COLOUR GRAY & BROWN (MULTI) REST WASH.	SS 16/18"	25, 38, 20

# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. 1  
DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE JUNE 20, 69  
SITE LOCATION \_\_\_\_\_  
HOLE LOCATION \_\_\_\_\_  
REMARKS \_\_\_\_\_

# FIELD BORING LOG

DRILLING CO. <u>MASTER</u>	DATUM ELEV. _____	B.H. NO. <u>2</u>
DRILLER <u>DOUG DICKE</u>	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER <u>A. P.</u>	CASING SIZE <u>NX</u>	DATE <u>JUNE 20, 69</u>
SITE LOCATION <u>2+22, H+ 0% LT, AUBREY FALLS.</u>		
HOLE LOCATION <u>817+78, 0% 111 LT</u>		
REMARKS <u>W.L. 1294.7</u>		

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
		ALL DEPTHS FROM WATER LEVEL		
0.0	17.0	WATER		
17.0	23.0	PUSHED BY HAND		
23.0	30.0	1-12-15-35-16-12-7-12		
30.0	40.0	13-11-15-8-17-20-17-14-22-23		
40.0	50.0	25-43-10-20-20-21-62-86-100-105		
50.0	53.3	90-49-60-150/3" BOUNCING		
		END OF CONE TEST		
JUNE 21, 69				
16.5	18.0	SPLIT SPOON WITH S.T. - NO REC.		5, 5, 5
16.5	21.0	2ND ATT - OVERDRIVE TO 19 FT. WITH S.T. THEREAFTER VERY SOFT ABOUT 2-3 BLOWS / FT. MAY: COARSE SAND, SOME GRAVEL - BROWN	SS 1/2"	5, 6, 6
16.5	21.0	SPLIT SPOON WITH S.T. - AS ABOVE BUT NO REC.		
JUNE 22, 69		CHANGED BUTTERFLY SAND TRAP TO ANOTHER BUTTERFLY		
17.0	21.0	SPLIT SPOON WITH S.T. - MED. TO COARSE SAND, SOME GRAVEL, BROWN	SS 2/3"	6, 6, 7
0.0	20.0	DRIVE NX CASING & WASH		
20.0	21.5	SPLIT SPOON WITH S.T. - CASING		

# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. 2  
 DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
 ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE JUNE 22, 69  
 SITE LOCATION \_\_\_\_\_  
 HOLE LOCATION \_\_\_\_\_  
 REMARKS \_\_\_\_\_

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
		SAND (AT 30 FT) WITH MED. TO COARSE SAND. SOME PIECES OF WOOD		
31.0	33.0	SPLIT SPOON WITH ST. - FINE TO MED. SAND. SOME GREY, SOME BROWN	SS 9	3, 1, 1
31.0	34.0	DRIVE NX CASING & WASH		
34.0	35.5	SPLIT SPOON WITH ST. - NO REC SIDE SAMPLER - FINE TO MED SAND (MORE FINES) GREY	SB 10	9, 5, 6
34.0	37.0	DRIVE NX CASING & WASH - FINE SAND, GREY (35-36) FINE TO FINE SAND, SILT, SOME ORG (36-37)	WS 11 WS 12	
37.0	39.0	SPLIT SPOON WITH ST. - NO REC SIDE SAMPLER - FINE TO COARSE SAND. A THIN LAYER OF SEMI FLUID SILT AT TOP	SB 13	9, 5, 5
40.0	42.0	SPLIT SPOON WITH 2 S.T. - HOLE - OPEN. - SILT & V. FINE SAND SOME FINE SAND. 1 PIECE OF STONE BETWEEN 2 ST. JELLY LIKE. GREY AT PLACES LIGHT BROWN. 1 BLOW / 3" THEN 3" WENT UNDER WEIGHT NO BANNER	SS 14/18	1, 6, 18, 12

# FIELD BORING LOG

DRILLING CO. _____	DATUM ELEV. _____	B.H. NO. <u>2</u>
DRILLER _____	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER _____	CASING SIZE _____	DATE <u>JUNE 22, 69</u>
SITE LOCATION _____		
HOLE LOCATION _____		
REMARKS _____		

# FIELD BORING LOG

DRILLING CO. <u>MASTER</u>	DATUM ELEV. _____	B.H. NO. <u>3</u>
DRILLER <u>DOUG DICKIE</u>	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER <u>A.P.</u>	CASING SIZE <u>NY</u>	DATE <u>JUNE 22, 69</u>
SITE LOCATION <u>B17+86</u>	<u>1</u>	<u>AUBREY FALLS</u>
HOLE LOCATION <u>B+14</u>	<u>0/5</u>	<u>83 LT</u>
REMARKS <u>W.L. 1294.7</u>		

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
0.0		DEPTH OF CONE MEASURED FROM TOP OF RAFT WHICH IS 1FT HIGHER THAN W.L. B.H. DEPTHS MEASURED FROM W.L.		
0.0	16.5	WATER		
16.5	20.0	3-7-0-1		
20.0	30.0	12-8-1-3-2-1-1-1-4-7		
30.0	40.0	26-21-17-21-24-46-92-65-52-68		
40.0	43.8	70-76-82-150/9"		
		END OF CONE TEST		
0.0	20.0	DRIVE NY CASING & WASH - 15.0 FT. OF WATER		
20.0	21.5	SPLIT SPOON WITH ST. - NO REC	SS1	9, 6, 14
		SIDE SAMPLER - MED TO COARSE SAND, BROWN	SB1	
20.0	25.0	DRIVE NY CASING & WASH - SAME AS ABOVE		
25.0	27.0	SPLIT SPOON - NO REC	SS2	11, 6, 4, 10
		SIDE SAMPLER - FINE TO MED SAND BROWN		

# FIELD BORING LOG

DRILLING CO. _____	DATUM ELEV. _____	B.H. NO. <u>3</u>
DRILLER _____	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER _____	CASING SIZE _____	DATE <u>JUNE 22, 69</u>
SITE LOCATION _____		
HOLE LOCATION _____		
REMARKS _____		

DEPTH FROM	FEET TO	DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
25.0	30.0	DRIVE NY CASING & WASH - WASH CHANGED TO GRAY AT 29.5 - 30 FT		
30.0	32.5	SPLIT SPOON WITH 2 ST. - TOP 18" FINE TO MED SAND - BROWN BOT 6" V. FINE SAND & SILT - GRAY	SS 3/24" 3A 3B	2, 2, 2, 3, 5
30.0	34.0	WASH AHEAD WITH CHIPPING BIT - SOME WOOD PIECES COMING OUT WITH LIGHT BROWN SILTY SAND		
34.0	36.5	SPLIT SPOON WITH 2 ST. - TOP 2' MED TO COARSE SAND BROWN BOT 2" V. FINE SAND & SILT - GRAY	SS 4/24" 4A 4B	4, 10, 11, 5
34.0	37.0	WASH AHEAD WITH SPLIT SPOON - NO FURTHER WASHING POSSIBLE BEYOND 37 FT.		
37.0	39.0	SPLIT SPOON WITH S.T. - 37.0 - 38.5 FINE TO V. FINE SAND LIGHT BROWN 38.5 - 39.0 MED TO COARSE SAND & GRAVEL -	SS 5/24" 5A	14, 20, 15, 25
		END OF BORABLE		

## FIELD BORING LOG

DRILLING CO. <u>MASTER</u>	DATUM ELEV. _____	B.H. NO. <u>4</u>
DRILLER <u>DOUG DICKIE</u>	GROUND ELEV. _____	JOB NO. <u>G9-F-38</u>
ENGINEER <u>AP</u>	CASING SIZE <u>NX</u>	DATE <u>JUNE 23, 69</u>
SITE LOCATION <u>AUBREY FALLS</u>		
HOLE LOCATION <u>817 + 72, 157 RT</u>		
REMARKS <u>W.L. 1294.7</u>		

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0.0	28.0	WATER		
28.0	30.0	4 - 8		
30.0	40.0	7-60-83-10-11-15-18-28-29-24		
40.0	50.0	27-23-31-36-46-52-51-38-41-33		
50.0	54.3	43-100-119-129-150/4"		
		END OF CONE TEST		
0.0	30.0	DRIVE NX CASING & WASH		
30.0	32.0	SPLIT SPOON - FINE TO COARSE SAND	SS1/18"	3, 2, 4, 4
30.0	35.0	DRIVE NX CASING & WASH		
35.0	37.0	SPLIT SPOON - MED TO COARSE SAND	SS2	8, 9, 12, 12
35.0	40.0	DRIVE NX CASING & WASH		
40.0	42.0	SPLIT SPOON - MU-REL	SS3	11, 17, 21, 20
		SIDE SAMPLER - FINE TO COARSE SAND	SB3	
40.0	45.0	DRIVE NX CASING & WASH		
45.0	47.0	SPLIT SPOON - MU REL	SS4	24, 14, 9, 10
		SIDE SAMPLER - V FINE TO FINE SAND & SILT, GRAY	SB4	

DRILLING CO. _____	DATUM ELEV. _____	B.H. NO. <u>4</u>
DRILLER _____	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER _____	CASING SIZE _____	DATE <u>JUNE 23, 69</u>
SITE LOCATION _____		
HOLE LOCATION _____		
REMARKS _____		

## FIELD BORING LOG

DRILLING CO.	MASTER	DATUM ELEV.		B.H. NO.	5
DRILLER	D DICKIE	GROUND ELEV.		JOB NO.	69-F-38
ENGINEER	A P	CASING SIZE	NY	DATE	JUNE 23, 69
SITE LOCATION	AUBREY FALLS				
HOLE LOCATION	799 + 68 , 62' RT				
REMARKS					

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
		ALL DEPTHS FROM W.L. 1294.7		
0.0	4.5	WATER		
4.5	10.0	Y <sub>2</sub> - 2 - 3 - 26 - 19 (5)		
10.0	18.6	1 Blow / 5' 9", 50 / 3", 31, 47, 200 / 7"		
		END OF CONE TEST		
		6' OF WATER		
6.0	8.5	SPLIT SPOON - NO REC	SS1	5, 3, 4, 2, 7
		SIDE SAMPLER - COARSE SAND & GRAVEL	SB1	
0.0	9.0	DRIVE NY CASING & WASH - BOULDER AT BOTTOM. TRIED TO GO DOWN WITH S.S. UNSUCCESSFUL. MOVED ABOUT 3'.		
0.0	9.0	DRIVE NY CASING & WASH		
9.0	11.6	SPLIT SPOON - NO REC	SS2	2, 6, 1, 5, 7
		SIDE SAMPLER - COARSE SAND & GRAVEL	SB2	
9.0	12.0	DRIVE NY CASING & WASH		
12.0	14.0	SPLIT SPOON - NO REC	SS3	27, 15, 2, 3
		SIDE SAMPLER - MED. TO COARSE SAND, SOME FINE SAND	SB3	



## FIELD BORING LOG

DRILLING CO. <u>MASTER</u>	DATUM ELEV. _____	B.H. NO. <u>66</u>
DRILLER <u>D. DICKIE</u>	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER <u>AP</u>	CASING SIZE <u>NX</u>	DATE <u>JUNE 24, 69</u>
SITE LOCATION <u>299 AUBREY FALLS</u>		
HOLE LOCATION <u>879 + 62, 199 RT.</u>		
REMARKS <u>ALL DEPTHS FROM W.L. 1294.7</u>		
<u>PAVEMENT E1 1316.0</u>		

DEPTH FEET FROM	TO	DESCRIPTION	SAMPLE TYPE, NO. & DEPTH	METHOD OR BLIND & DISTANCE
0.0	24.0	WATER		
25.0	30.0	9-10-7-5-6-7		
30.0	40.0	7-9-8-11-15-13-12-50-12-90		
40.0	50.0	45-35-43-36-35-52-30-29-27-28		
50.0	60.0	34-33-35-51-61-46-36-38-39-46		
60.0	65.7	37-38-51-91-151-150/8" NO BEDROCK		
		END OF CONE TEST		
0.0	25.0	DRIVE NX CASING TO 24' & WASH TO 25.0 FT		
25.0	27.0	SPLIT SPOON - NO REC. SIDE SAMPLER - FINE SAND & SILT, GRAY	SS1 SP1	3, 6, 7, 5
24.0	30.0	DRIVE NX CASING TO 29' & WASH TO 30 FT		
30.0	32.0	SPLIT SPOON WITH S.T. - FINE SAND WITH SILT, GRAY	SS2/6	1, 1/2, 1/2, 2
30.0	34.0	DRIVE NX CASING & WASH		
34.0	36.5	SPLIT SPOON WITH S.T. - FINE SAND. SOME SILT, TRACES OF MRD SAND	SS3/12	1, 1, 2, 2, 6
34.0	38.0	DRIVE NX CASING & WASH - HARDEN 38.0 FT		

## FIELD BORING LOG

DRILLING CO. MASTER      DATUM ELEV. \_\_\_\_\_      B.N. NO. 7  
 DRILLER D. DICKIE      GROUND ELEV. \_\_\_\_\_      JOB NO. 69-F-38  
 ENGINEER AP      CASING SIZE NX      DATE JUNE 24, 69  
 SITE LOCATION 70 85      AUBREY FALLS  
 HOLE LOCATION 799 + 65      72 RT  
 REMARKS \_\_\_\_\_

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR SLOW & DISTANCE
FROM	TO			
2.50	45.0	ALL DEPTHS FROM W. L.		
0.0	21.0	WATER		
21.0	30.0	34-12-18-21-23-16-33-15-16		
30.0	40.0	17-16-17-27-53-65-44-40-34-35	SS 4/1	100, 100%
40.0	50.0	41-42-43-43-61-38-36-40-44-40		
50.0	50.8	155/9"		
		END OF CONE TEST		
JUNE 25, 69				
0.0	21.0	WATER		
0.0	24.0	DRIVE NX CASING & WASH		
24.0	26.0	SPLIT SPOON - FINE TO MED SAND, BROWN	SS 1/18'	7, 7, 2.1
		NO FURTHER DRIVING POSSIBLE. MORE 5' WATER 23'		
20.0	30.0	DRIVE NX CASING TO 29 FT. WASH TO 30		
30.0	32.5	SPLIT SPOON - FINE SAND GREY	SS 2/18'	1, 2, 3, 5, 6
30.0	35.0	DRIVE NX CASING TO 34 FT & WASH TO 35'		
35.0	37.5	SPLIT SPOON - TO	SS 3/30	13, 10, 9, 9, 15
		TOP 18" - FINE SAND, GREY	3A	
		BY 12" - FINE TO MED SAND BROWN	3B	

# FIELD BORING LOG

DRILLING CO. MASTER DATUM ELEV. \_\_\_\_\_ B.H. NO. 9  
 DRILLER D. DICKIE GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
 ENGINEER A P CASING SIZE NY DATE JUNE 26, 69  
 SITE LOCATION AUBREY FALLS  
 HOLE LOCATION 796 + 47 , 78 RT  
 REMARKS \_\_\_\_\_





## FIELD BORING LOG

DRILLING CO. <u>MASTER</u>	DATUM ELEV. _____	B.H. NO. <u>12</u>
DRILLER <u>D. DICKIE</u>	GROUND ELEV. <u>1316.1</u>	JOB NO. <u>69-F-38</u>
ENGINEER <u>A.P.</u>	CASING SIZE <u>NX</u>	DATE <u>JUNE 27, 69</u>
SITE LOCATION <u>AUBREY FALLS</u>		
HOLE LOCATION <u>799 + 88, 9 8 RT</u>		
REMARKS _____		

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
		PAVEMENT		
0.0	10.0	46-70-69-41-44-26-113-65-43-42		
10.0	20.0	51-111-46-41-28-49-28-23-20-21		
20.0	30.0	25-19-14-11-9-10-11-14-32-30		
30.0	39.0	47-29-41-70-47-42-39-48-80		
		END OF CONE TEST		
0.0	5.0	DRIVE NX CASING & WASH - STONE IN CASING AT 3 FT. DROVE SS THROUGH CASING, 2'x3" STONE. WASH WITH HAMMER ON		
5.0	7.0	SPLIT SPOON WITH ST. - FINE SAND WITH 2 PCKS OF STONE, (TOP 6" GRAY FINE SAND-WASH.)	SSL/4"	14, 20, 18, 14
5.0	10.0	DRIVE NX CASING & WASH - WASH WITH HAMMER ON. VERY HARD AT 10.0 FT. NO WATER RETURNING		
10.0	12.0	SPLIT SPOON - SPLIT SPOON LOST DOWN THE HOLE.		
		MOVED 2' AND PUT ANOTHER HOLE		

## FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.M. NO. 12  
 DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. 69-F-38  
 ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE JUNE 28, 69  
 SITE LOCATION \_\_\_\_\_  
 HOLE LOCATION \_\_\_\_\_  
 REMARKS \_\_\_\_\_

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0.0	10.0	DRIVE NX CASING & WASH - SAND BROWN		
10.0	12.0	SPLIT SPOON - FINE TO MED SAND, BROWN	SS2/	26, 11, 13, 18
10.0	15.0	DRIVE NX CASING & WASH		
15.0	17.0	SPLIT SPOON - NO REC	SS3	23, 8, 11, 7
15.0	18.0	SPLIT SPOON - WASH - MED TO COARSE SAND	SA	
		SIDE SAMPLER - MED. TO COARSE SAND, BROWN.	SB.3 (B)	
15.0	20.0	DRIVE NX CASING & WASH		
20.0	24.5	SPLIT SPOON - FROM 22 TO 24.5 WITH S.T. TOOK ONLY 2 MORE BLOWS NO REC	SS4	6, 4, 1 1/2, 1 1/2
		SIDE SAMPLER - FINE TO MEDIUM SAND, SOME COARSE RUSTY BROWN (TAIN)	SB4	
20.0	25.0	DRIVE NX CASING & WASH - V. EASY DRIVING		
25.0	27.5	SPLIT SPOON - NO REC	SS5	7, 4, 3, 2, 1
		SIDE SAMPLER - SAME AS ABOVE	SB5	



## FIELD BORING LOG

DRILLING CO. MASTER      DATUM ELEV. \_\_\_\_\_      B.H. NO. 13  
 DRILLER REG DICKIE      GROUND ELEV. 1310.9      JOB NO. 69-F-38  
 ENGINEER A.P.      CASING SIZE NX      DATE JUNE 30, 59  
 SITE LOCATION AUBREY FALLS  
 HOLE LOCATION 817+57, 71 RT  
 REMARKS \_\_\_\_\_

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0.0	10.0	77-44-122-58-38-18-11-8-10-7		
10.0	11.0	60 HAMMER BOUNCING		
		MOVE		
0.0	10.0	80-38-70-62-32-15-11-6-10-11		
10.0	11.0	60 HAMMER BOUNCING		
		MOVE		
0.0	10.0	87-39-71-54-33-17-13-8-11-23		
10.0	11.5	8-50/6"		
		MOVE		
0.0	10.0	89-40-63-57-30-13-8-8-9-17		
10.0	13.4	9-3-100-220/5"		
		END OF CONE TEST		
		PAVEMENT		
0.0	5.0	DRIVE NX CASING & PULL OUT		
5.0	7.5	SPLIT SPOUT WITH S.T. - FINE SAND, GRAY	SSI /12"	6,10,7,7,6
5.0	10.0	DRIVE NX CASING & PULL OUT - SAME		
		AS ABOVE		

# FIELD BORING LOG



# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. \_\_\_\_\_  
DRILLER \_\_\_\_\_ GROUND ELEV. \_\_\_\_\_ JOB NO. G9-F-38  
ENGINEER \_\_\_\_\_ CASING SIZE \_\_\_\_\_ DATE June 28, 69  
SITE LOCATION \_\_\_\_\_  
HOLE LOCATION \_\_\_\_\_  
REMARKS Depth of water



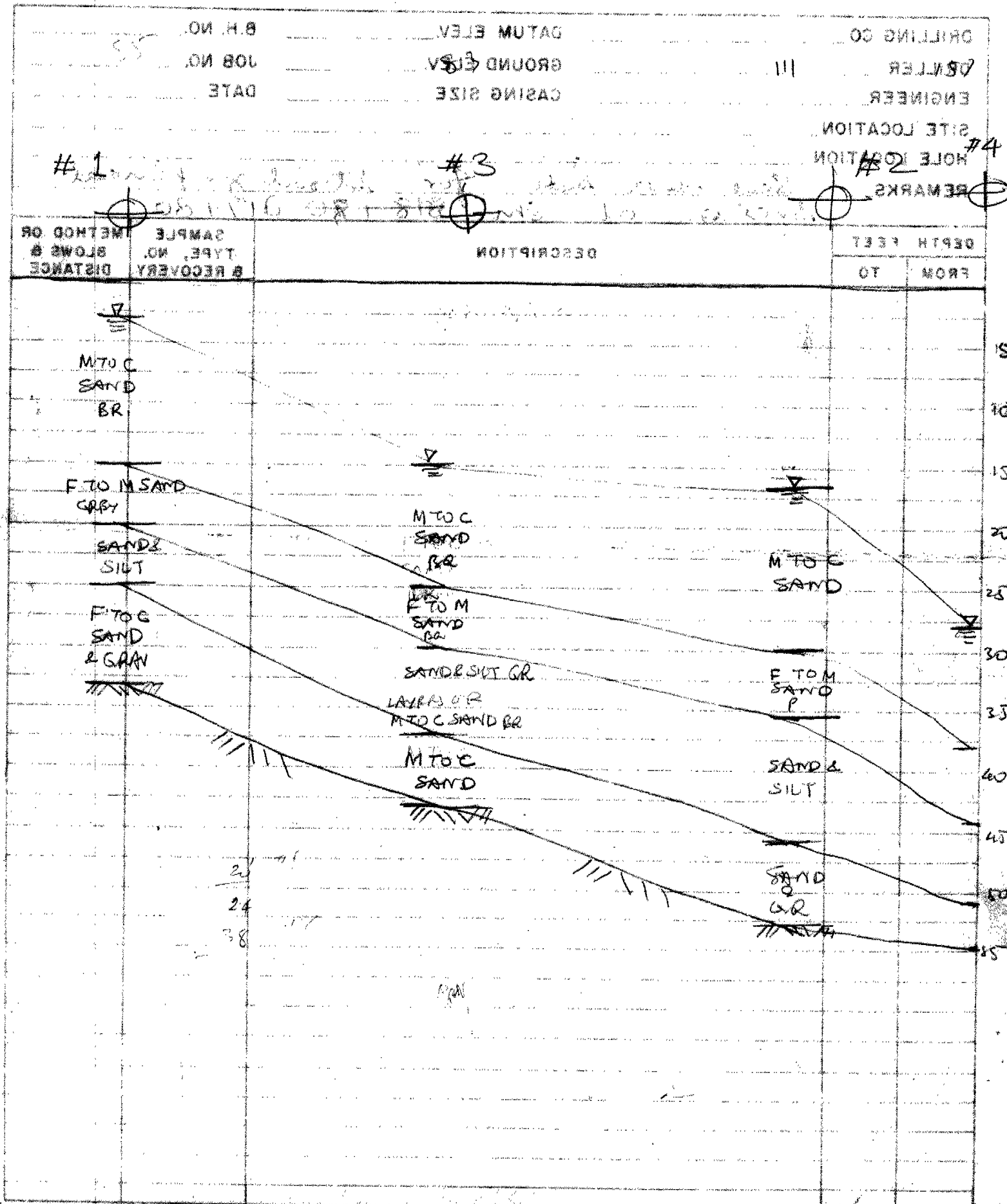


# FIELD BORING LOG

DRILLING CO. \_\_\_\_\_ DATUM ELEV. \_\_\_\_\_ B.H. NO. \_\_\_\_\_  
 DRILLER \_\_\_\_\_ GROUND ELEV. 1310.4 JOB NO. \_\_\_\_\_  
 ENGINEER \_\_\_\_\_ CASING SIZE (88) DATE JUNE 27, 69  
 SITE LOCATION \_\_\_\_\_  
 HOLE LOCATION 818 + 80  
 REMARKS AFTER THE SLIDE - Depth of water



FIELD BORING LOG



# FIELD BORING LOG

FIELD BORING LOG

DATE		TIME		LOCATION		HOLE LOCATION		REMARKS	
DAY	MONTH	YEAR	HOUR	MIN	SEC	SECTION	NO.	DEPTH	FEET
11	9	47	15	08					

# FIELD BORING LOG

DRILLING CO. _____	DATUM ELEV. _____	B.H. NO. _____
DRILLER _____	GROUND ELEV. _____	JOB NO. <u>69-F-38</u>
ENGINEER _____	CASING SIZE _____	DATE <u>June 28, 69</u>
SITE LOCATION _____		
HOLE LOCATION _____		
REMARKS _____		



# DO. SHIPBOARD LOG

(00 00)

NO. 1000

NO. 1000

10 00

NO. 1000

NO. 1000

10 00

NO. 1000

NO. 1000

10

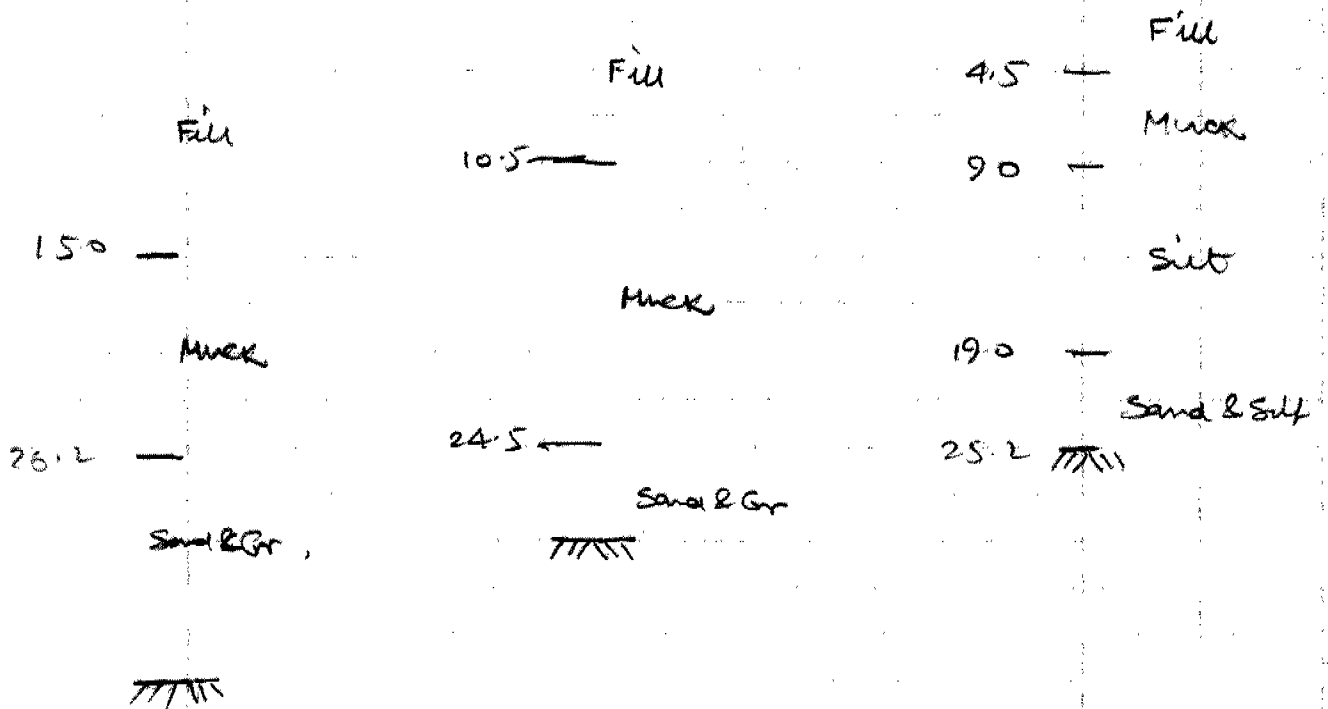
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3

NO. 1000  
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NO. 1000  
NO. 1000



#69-F-38

W.P. 371-65

H.W.Y. #129

EMBANKMENT

FAILURE

WORK PROJECT 371-65 - HIGHWAY 129

EMBANKMENT FAILURE

8.5 MILES NORTHERLY, AUBREY FALLS

*69-F-38*

MEMORANDUM

371-65  
O. STONEY  
R. W. STONEY  
R. W. STONEY  
R. W. STONEY  
R. W. STONEY

Mr. J. H. Elevins,  
District Engineer,  
SAULT STE. MARIE.

FROM: R. D. Gunter,  
Materials and Testing,  
PORT ARTHUR.

Att'n: Mr. W.G.H. Sawyer  
Maintenance Engineer

DATE: June 2, 1969.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Work Project 371-65 - Highway 129  
Embankment Failure 8.5 Miles Northerly, Aubrey Falls

On May 13, 1969, we visited the site of a large embankment failure along the Wenebagon River just north of the Hydro dam and power development project at Aubrey Falls.

Background Information

This portion of Highway 129 was reconstructed by day labour forces in 1968 in order to provide slope protection and/or grade raises required when the area was flooded to elevation 1,295 feet by the Hydro control dam.

Early in March, 1969, the dam was partially closed and the water level raised an estimated 7 feet by May 1 and to 12 feet by May 13. Information supplied by the Ontario Hydro indicates that a further 5-foot water raise is to be expected in the near future.

Site Description

The failure is located in a deep fill area, Station 817+80 to Station 819+50. The embankment failed along the east pavement edge in a section where the fill averages 30 feet in height and the water level, at the time of failure, was approximately 10 feet above the fill base.

Soil Information

The soil borings, as plotted on Soil's Profile 129N18-5, indicate that the fill material consists of a fine to medium sand overlain by shallow depths of sandy loam and pit run gravel. The textural classification was verified by visual examination on May 13.

As recommended in the Soil's Report for this section, shot rock rip-rap was placed along both sides of the embankment to an elevation exceeding the proposed headpond elevation of 1,295 feet. From visual observations of the fill section to the north of the failure zone, it

June 2, 1969

appears that the rip-rap was approximately 3 feet in thickness at the top.

The failure consisted of a shear and outward (eastward) slip of the entire embankment and rip-rap into the headpond water (See photos #1, #2, and #3). The area of failure showed a typical circular arc crack with the main area along the edge of the present pavement. From visual observations, the fill did not appear to be pushed upward at the outer edge but the depth of existing water precluded confirmation of this fact.

#### Information Evaluation and Conclusions

1. From the soil borings and visual observations at the site, it appears that the failure was caused by a loss of frictional strength in both the fine sand subsoil at the toe of slope and in the fill material.
2. This loss of frictional strength can be traced to the flooding of this area by the Hydro development. It would appear that the pore water pressure, with a corresponding loss of bearing strength, was considerably increased in both the fill and subsoil areas during the flooding operation.

Therefore, it is concluded that the embankment failure was a combined shear failure of both the fill material and the subsoil with the contributing factor being the loss of bearing strength due to the aforementioned Hydro flooding.

#### Recommendations

It was recommended verbally at the site and confirmed by this memo that the embankment be rebuilt to the following specifications:

1. Provide a coarse granular pit run material.
2. The area, 30 feet above proposed high water elevation, be built a minimum of 5 feet wider than the required 2:1 slope from the top of the fill.
3. Rebuild the shoulder to 3 feet and slope at 2:1 to the widened fill area.
4. Flatten and gravel sheet the portion of the existing stream bank that failed. This area is just south and east of Station 317+80.

Photo #4 shows the remedial treatment being carried out on May 15, 1969.

Should further information be required, please contact this office.

*M. G. G. f.*  
R. D. GUNTER,  
Project Soils Supervisor,

FCM:

W. MOYIN,  
Regional Materials Engineer.

## MEMORANDUM

**To:** Mr. A. G. Sternac,  
Principal Foundation Engineer,  
Materials & Testing Division,  
DOWNSVIEW, Ontario.

**FROM:** Mr. J. H. Blevins,  
District Engineer,  
Sault Ste. Marie, Ontario.

**ATTENTION:** Mr. K. G. Selby.

**DATE:** June 16, 1969.

OUR FILE REF.

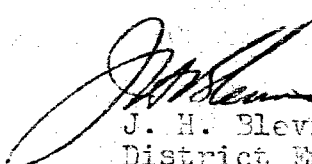
IN REPLY TO

**SUBJECT:** Embankment Failures, Highway 129  
Aubrey Falls

Further to our site meeting of June 13, 1969, attended by yourself; Mr. W. G. Sawyer, District Maintenance Engineer; Mr. B. Gunter, Project Soils Supervisor; and the writer. It would be appreciated if you would accept this letter as a request to arrange for a foundation investigation in the vicinity of the embankment failures at your earliest convenience. The investigation is required both to substantiate the proposed remedial work and as evidence for a claim to be submitted to the U.E.P.C. on the basis that the failures were caused by their flooding of the headpond of the recently constructed dam at Aubrey Falls.

As agreed at the time of the meeting, the District has initiated the construction of a rock berm along the face and adjacent to the embankments which have either failed or showing signs of distress. The proposed berms will be constructed with a 30' top and will be elevated some two to three feet above the high water level.

JHB:jc



J. H. Blevins,  
District Engineer.

cc. Mr. B. J. Orr.  
Mr. A. D. Gunter.  
Mr. W. G. Sawyer.

1969 JUL 4 AM 11:34

00242

DOWN SAUL 5 JULY 4/69 11:15

E J ORR MICE ENGR

C.C. K SELBY FOUNDATION SECTION

RE: EMBANKMENT FAILURES DUE TO FLOODING OF AUBREY FALLS HEADPOND  
WE HAVE BEEN ADVISED BY MR K SELBY (FOUNDATION SECTION) THAT THE  
PRELIMINARY RESULTS OF HIS SITE INVESTIGATION INDICATE THAT THE REMEDIAL  
WORK WILL FAR EXCEED OUR ORIGINAL ESTIMATES. THE STEEPNESS OF THE  
EMBANKMENT SLOPES AND DEPTH OF WATER INDICATE THAT A 40' BY 40' ROCK BERM  
MORE THAN 600' IN LENGTH WILL BE REQUIRED.

IT HAS BEEN SUGGESTED THAT IT MAY BE MORE ECONOMICAL AT THIS PARTICULAR  
LOCATION TO REALIGN THE HIGHWAY AND BENCH IT INTO AN EXISTING ROCK SIDE  
HILL.

NORMALLY THE DISTRICT WOULD BE IN A POSITION TO CONSIDER THE TWO  
ALTERNATIVES; HOWEVER, IN VIEW OF THE RECENT WASHOUTS AND DAY LABOUR  
AND CONSTRUCTION PROGRAMS WE SIMPLY DO NOT HAVE THE STAFF AVAILABLE.

IT WOULD THEREFORE BE APPRECIATED IF THE PROBLEM COULD BE REFERRED TO  
OUR ROAD DESIGN BRANCH WITH A VIEW TO HAVING THEM INVESTIGATE THE MATTER  
AND SUBJECT TO THEIR RECOMMENDATIONS PREPARE A I.B. OR CONTRACT FOR THE  
REMEDIAL WORK.

THIS MATTER IS SOMEWHAT URGENT, AS THE EMBANKMENTS HAVE INDICATED  
SIGNS OF DISTRESS AND THERE IS THE DISTINCT POSSIBILITY OF A MAJOR  
FAILURE.

J H BLEVINS DIST ENGR

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## MEMORANDUM

To: Mr. J. H. Blevins,  
District Engineer,  
District #18,  
SAULT STE. MARIE, Ont.

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

DATE: July 9, 1969

Attn: Mr. W. G. Sawyer,  
Maintenance Engineer

OUR FILE REF.

IN REPLY TO

SUBJECT:

-- EMBANKMENT FAILURES --  
Sta. 795+00 - 801+00 & Sta. 817+00 - 821+00  
Hwy. 129, North of Aubrey Falls, Ontario  
W.P. 371-65 -- W.J. 69-F-38

On June 13, 1969, the above mentioned site was visited by yourself, Mr. J. H. Blevins, Mr. D. Gunter and the writer, the purpose being to inspect two sections of Hwy. 129 where the highway embankment showed signs of instability in the form of longitudinal cracks and differential settlements, and where one major failure had already occurred. Our conclusions at that time were that further failures were possible, and that remedial measures involving the construction of rock berms, should be implemented immediately. Our recommendations were to be confirmed or amended, subject to the findings of a soil boring programme which has since been completed. Our report is as follows:

History:

This portion of Hwy. 129 was constructed in 1953 and was reconstructed in 1968 to provide grade raises and slope protection required because of the intended flooding of the area by Ontario Hydro, to form the headpond for the Aubrey Falls Power Development Project. Flooding commenced in March 1969, and was completed in early June 1969. As the level of the water in the headpond rose above the toe of slope, the embankment started to show signs of instability along two sections, these being Sta. 795+00 - Sta. 801+00 and Sta. 817+00 - Sta. 821+00. Two major failures of the east shoulder have since occurred along the latter section.

Site Description:

Both sections of the highway under present consideration, were constructed adjacent to the original Wenebagon River. The normal water level in the river was about el. 1262.0. Since the water level in the headpond is now el. 1295.0, the groundwater level below the embankments has risen about 33 ft. Between Sta. 795+00 and Sta. 801+00 the highway is a sidehill embankment with a total height of about 55 to 60 ft. The water level in the

Mr. J. H. Blevins,  
District Engineer,  
Dist. #18 (Sault Ste. Marie)  
Attn: Mr. W. G. Sawyer, Maint. Engr.

2

July 9, 1969

Embankment Failures - Hwy. 129 - (cont'd.) ...

Site Description: (cont'd.) ...

headpond ranges from about 17 to 22 ft. below pavement level. The average side slope on the east side is slightly steeper than 1-1/2 horizontal to 1 vertical. Longitudinal cracks are visible at many locations in the pavement and east shoulder, and a considerable length of the shoulder has settled and is indicative of a major failure to occur. Between Sta. 817+00 and 821+00 the highway is on an embankment about 35 ft. high, the maximum height being on the east side. The average side slopes of the embankment are about 1-1/2 horizontal to 1 vertical. The pavement is about 15 ft. above the headpond level. As at the other location, longitudinal cracks in the pavement and east shoulder are visible, but two major failures of the east shoulder have already occurred.

Soil Conditions:

Borings which were recently carried out by the Foundation Section, show the original ground at the toe of slope to consist of 5 to 10 feet of loose silt and fine sand underlain by compact to dense deposits of fine to coarse sands. Borings within the embankment showed the fill material to consist of generally loose poorly compacted granular material ranging from fine to coarse sand with occasional boulders.

Discussion:

These sections of the highway performed satisfactorily for about 15 years up till March of this year when flooding and subsequent raising of the groundwater level below the embankments commenced. As mentioned above, the groundwater level has risen about 33 ft. and damage to the embankments has resulted. This raising of the water level has had three main effects:

(1) The entry of water into the voids of what is evidently poorly compacted granular material, has caused further compaction and hence, settlements of the embankment itself.

(2) The raising of the groundwater level, which was formerly below the toe of slope, has reduced the resisting moment of the soil mass by a greater amount than the reduction in the overturning moment with a net result of a reduction in safety factor against a slip failure.

..... 3

Mr. J. H. Blevins,  
District Engineer,  
Dist. #18 (Sault Ste. Marie)  
Attn: Mr. W. G. Sawyer, Maint. Engr.

3  
July 9, 1969

Embankment Failures - Hwy. 129 - (cont'd.) ...

Discussion: (cont'd.) ...

(3) The action of water against the sides of the embankments has eroded soil from the toe upwards hence, reducing overall stability.

Points Nos. (2) and (3) can be corrected by the construction of stabilizing berms. With regard to Point No. (1), some time may be required for the embankment to adjust to the new conditions hence, some maintenance of the pavement may be required in the future.

Recommendations:

Between Sta. 817+00 and Sta. 821+00, it is recommended that stabilizing berms with the following dimensions, be constructed:

Top of Berm at el. 1298.0 (3 ft. above W.L.)  
Length of Berm ..... 20 ft.  
Side Slope of Berm ..... 1-1/2 horizontal to 1 vertical

Between Sta. 795+00 and Sta. 801+00, stabilizing berms with the following dimensions, should be constructed:

Top of Berm at el. 1298.0 (3 ft. above W.L.)  
Length of Berm ..... 10 ft.  
Side Slope of Berm ..... 2 horizontal to 1 vertical

The following points with regard to the foregoing, should be noted:

- (a) Material in the berms must consist of clean rock fill.
- (b) A survey must be carried out to locate the exact position of the toes of the berms.
- (c) Berms must be constructed from the berm toes backwards in horizontal lifts to ensure that unstable conditions do not arise during construction.

Mr. J. H. Blevins,  
District Engineer,  
Dist. #18 (Sault Ste. Marie)  
Attn: Mr. W. G. Sawyer, Maint. Engr.

4

July 9, 1969

Embankment Failures - Hwy. 129 - (cont'd.) ...

Recommendations: (cont'd.) ...

(d) The aforementioned stations are approximate only, and should be established accurately in the field after the area is properly surveyed.

Following satisfactory construction of the berms, the failed portions of the embankment and the shoulders should be reconstructed with minimum side slopes of 1-1/2:1.

Alternatives to the foregoing remedial measures involving realignment of the highway, should be considered if economically feasible.

If we can be of any further assistance in this matter, please contact this Office.

KGS/MdeF

cc: Messrs. J. H. Blevins (2)  
E. J. Orr  
F. Norman  
H. W. Hurrell  
G. A. Wrong

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

Foundations Files  
Gen. Files

# AUBREY FALLS

69-F-38

ROCK FILL  $\gamma = 110$  PCF  $\phi = 45^\circ$   
 GRANULAR FILL  $\gamma = 120$  PCF  $\phi = 35^\circ$

PARTICULARS	F.S.	R	$X_c$	$Y_c$
<u>EXIST. EMBANKMENT WITHOUT BERM</u>				
W.L. 10' BELOW TOE OF SLOPE EL. 1244	1.065	174	120	- 126
W.L. LEVEL WITH TOE OF SLOPE EL. 1254	1.065	174	120	- 126
W.L. AT FINAL HEAD POND LEVEL EL. 1295	0.991	100	100	- 70
<u>EXIST. EMBANKMENT WITH 30 FT. 2:1 BERM</u>				
DRY W.L. EL. 1254	1.771	150	130	- 70
SUBMERGED W.L. EL. 1295	1.423	225	150	- 160
DRAWDOWN	1.471	150	130	- 70
<u>EXIST. EMBANKMENT WITH 30 FT. 1.5:1 BERM</u>				
DRY W.L. EL. 1254	1.515	145	120	- 80
SUBMERGED W.L. EL. 1295	1.292	145	120	- 80
DRAWDOWN	1.081	105	100	- 30
<u>EXIST. EMBANKMENT WITH 20 FT. 2:1 BERM</u>				
DRY W.L. EL. 1254	1.654	180	140	- 110
SUBMERGED W.L. EL. 1295	1.409	205	140	- 140
DRAWDOWN	1.320	120	110	- 40

Department of Highways Ontario

Copy for the information of  
Mr. K. Selby

~~Mr. B. J. Orr,~~  
Maintenance Engineer,  
Downsview, Ontario.

Mr. A. C. Sawyer,  
District Maintenance Engineer,  
Sault Ste. Marie, Ontario.

July 22, 1969.

Embankment Failures - Highway 129 - District 18 -  
W.P. 371-65 - Station 795 to Station 801

This is to advise you that I have very thoroughly read Mr. Selby's report of July 9, 1969, and find that his recommendations as stated, are almost impossible to construct in the manner prescribed. I propose, therefore, to use the following construction procedures to construct the proposed berm from Station 795 to Station 801:

- a) We will measure approximately 33 feet from the toe of the fill at the water level. This will be considered the top edge of our rock berm.
- b) We will construct the rock berm from the 30 foot point for a width of 15 feet, approximately, towards the fill. This is approximately the width of our bulldozer blade and is the only way we can start the construction of the berm.
- c) We will push the 15 foot wide berm out in stages of approximately 50 feet in length, and then proceed to push rock from the top edge of the berm until we have attained what we hope will be 2:1 slope. This will presumably be when the rock stops disappearing into the water, and comes up against the outer edge of the berm, above the water level.
- d) We will then proceed to build the inner part of the berm which could be approximately 18 feet wide against the embankment of the slope.

I believe that this construction procedure will come as close as possible to Mr. Selby's recommendations and I can think of no other way of performing this work in a practical manner. I also stated that it looks like an endless process, which will take many weeks to perform. The probable cost will range from \$100,000.00 - \$150,000.00. This is for your information and any comments you may wish to make.

Continued.....

Section 4.....

July 22, 1960.

Mr. C. J. Orr

Re: Embankment Failures - Highway 129 - District 18  
S.P. 371-65 - Section 795 to Station 101

*W. G. Sawyer*

J. G. Sawyer,  
District Maintenance Engineer,

For J. H. Blowing,  
District Engineer.

C.C. W. H. Soling  
W. J. Christman

## MEMORANDUM

Mr. A. Rutka,  
Materials & Testing Engineer,  
Materials & Testing Office,  
Room 102, Lab. Bldg.

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

ATTENTION:

DATE: December 11, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 371, Highway 129  
Head Pond of H.E.P.C.  
Aubrey Falls Development

The Foundation Section was involved in the investigation of the failures that occurred along part of Hwy. 129 following the raising of the water level in the lake due to the erection of the Hydro control dam. The findings, as well as the recommendations for remedial measures, are contained in the memorandum of July 9, 1969, addressed to Mr. J. H. Blevins, District Engineer, Saint Ste. Marie.

The main conclusions at the time were:

(1) The entry of water into the voids of what is evidently poorly compacted granular material, has caused further compaction and hence, settlements of the embankment itself.

(2) The raising of the groundwater level, which was formed below the toe of the slope, has reduced the resisting moment of the soil mass by a greater amount than the reduction in the overturning moment with a net result of a reduction in safety factor against a slip failure, and

(3) The action of water against the sides of the embankments has eroded soil from the toe upwards - hence, reducing overall stability.

Stabilizing berms and rip-rap were suggested to counteract causes mentioned under (2) and (3), while precious little could have been recommended with respect to (1). This process has to come to rest with time and, therefore, certain maintenance may be required in the future.

Future drawdowns, which will have to be rather slow in view of the size of the body of water, should not cause any considerable problems within the investigated area. This is

Mr. A. Rutka,  
Materials & Testing Engineer

December 11, 1970

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Re: W.P. 371, Highway 129 -  
Head Pond of H.E.P.C.  
Aubrey Falls Development .....

based on the assumption (proven in certain areas) that the material is basically granular in nature and will consequently drain concurrently with the drawdown.

The amount of future maintenance is closely related to the extent to which the recommendations contained in our aforementioned memorandum to the District Engineer, have been complied with. In case of full compliance, we feel that future maintenance within the investigated area should not be excessive, but within normal limits.

AGS/MJef

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

cc: Foundations Files  
Gen. Files

## MEMORANDUM

TO: Mr. W. Wigle,  
Program Engineer.

FROM: A. Rutka,  
Materials and Testing Engineer.

ATTENTION:

DATE: December 15, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P.371-65, Highway 129, Head Pond of H.E.P.C.  
Aubrey Falls

With reference to your memorandum of December 9, 1970 to Mr. J.L. Soare of H.E.P.C., I have discussed the embankment failures with Mr. Stermac and have also reviewed the remedial measures we proposed under date of July 9, 1969, to Mr. J. H. Blevins.

The embankment failures occurred at two locations at approximately Stations 795 to 801 and 817 to 821. These failures occurred within a short section which was rebuilt under W.P.371-65 to raise the road above the level of the water in the reservoir. The embankment failures took place in May, 1969, as the reservoir was being filled and as the water level was rising on the embankment slope. The reasons for the failures can be attributed to:

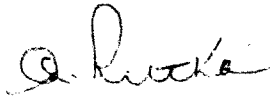
1. The entry of the water into the voids of the embankment material which was loose and not too densely compacted. The water caused densification of the embankment, hence the settlement of the embankment itself and of the road surface.
2. The rise in ground water level below the toe of the slope reduced the resisting moment of the soil mass by a greater amount than the reduction in the overturning moment. This resulted in a reduction in safety factor against a slip failure.
3. The wave action of the water against the sides of the embankment eroded some of the soil and hence reducing the overall stability.

These failures have since been repaired with rock stabilizing berms and they are considered to be quite safe against further failures. However, the densification of the soil in the embankment is expected to continue and we would expect minor surface settlements from time to time which will need levelling.

/cont'd....

There was some concern about the drawdown and the affect this drawdown would have on the stability of the embankment. The reservoir is very large and we would expect the drawdown to be very slow and to create no stability problem. The embankment materials consist of granular materials and rock and these are not particularly sensitive to drawdown problems inasmuch as water will drain from the embankments with the drawdown of the water.

It is difficult to predict the amount of future maintenance that will be required, however we would expect that because of the densification of the granular material in the embankment, about two levelling courses would be required over a five year period.



A. Rutka,  
Materials and Testing Engineer

AR/jm

cc: A. G. Stermac  
R. G. Gascoyne  
R. Morgenroth

Program Office,  
Downsview 484, Ontario,  
January 18th, 1971.

Mr. J. L. Sore,  
Hydraulic Generation Engineer,  
Hydro Electric Power Commission,  
520 University Avenue,  
Toronto, Ontario.

Attention: Mr. A. Forrester

Dear Sir:

Re: W.P. 871-85, Highway 129,  
Head Pond of H. E. P. C. Ambrey  
Falls G. S.

With reference to my letter to you dated December 8th, 1970 regarding the above you will recall that we requested our Materials and Testing Office to investigate future maintenance problems and prepare a report. This has now been done.

Densification of earth materials is expected to be a continuing problem for a number of years. This will result in the need for remedial repairs consisting of some grading work, levelling courses, and perhaps some embankment repairs to offset the settlement.

The Department considers five years a reasonable time period for which the H. E. P. C. would be responsible for the cost of repairs. Our estimate is in the area of \$10,000 per year for this purpose. However, we do not feel that a lump sum settlement should be considered because there are too many variables involved. It would be more appropriate to advise you of actual maintenance costs each year for a

continued... /2

January 18th, 1971.

period of five years from this date. In this way, actual rather than projected expenditures would be assigned to your Commission.

The "Total to Date" costs of \$255,527.67 illustrated in my letter dated December 24th, 1970 includes \$21,000 to grout the 10' x 1' concrete culvert in 1971. Actual costs will be charged when this work is completed.

I trust that with this additional data you will be able to obtain authorization to process our outstanding accounts.

Yours truly,

Orig. Signed by  
W. G. Wigle

W. G. Wigle,  
Program Engineer.

WGW/AIL/mc

c.c.

E. J. Orr,  
W. Sawyer,  
D. A. Crosbie,  
A. Rutka,  
H. Adamson,

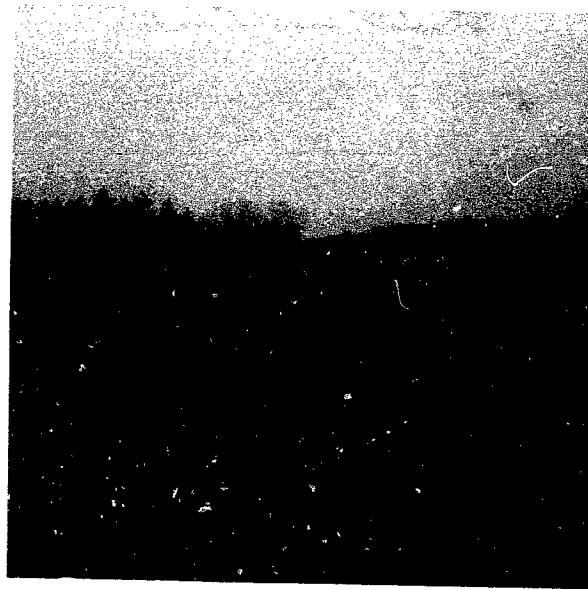
WP 371-65 HWY 129  
NORTH OF AUBREY FALLS  
REMEDIAL TREATMENT - EAST SIDE  
STA 818+00 TO 819+75



MAP 41/0/3  
ZONE 17  
333850 E  
5208250 N

MAY 15/69

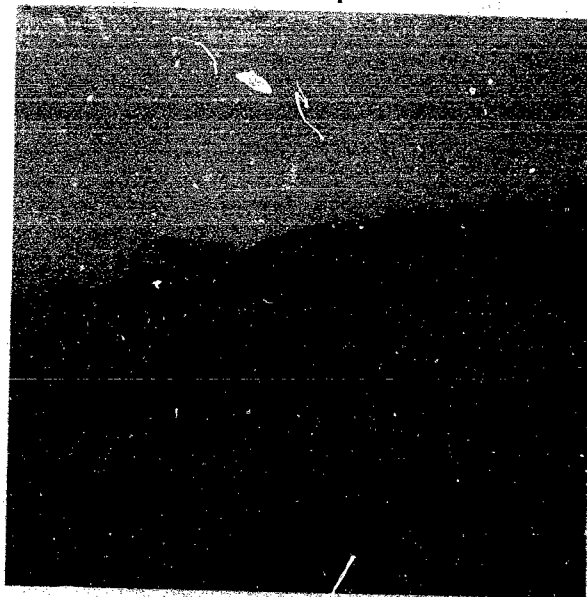
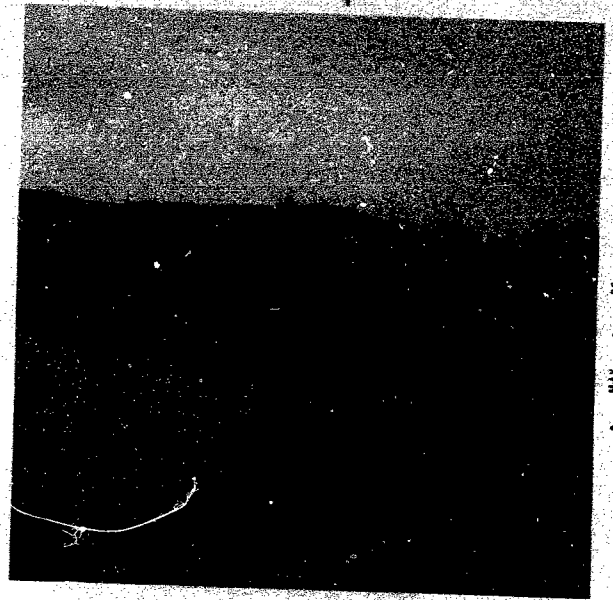
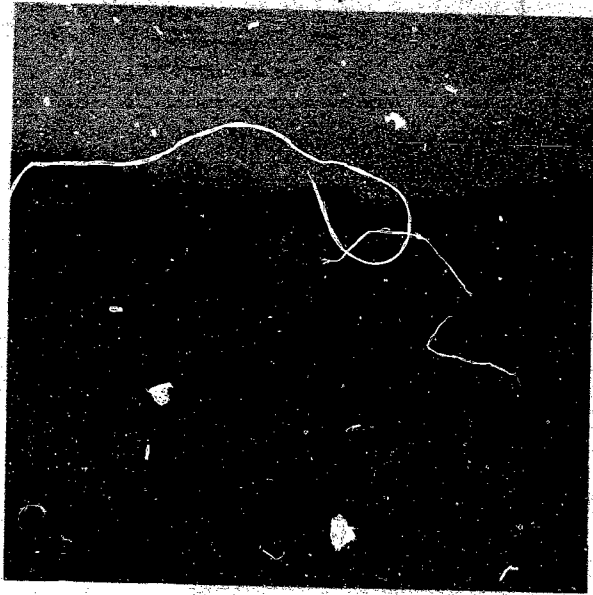
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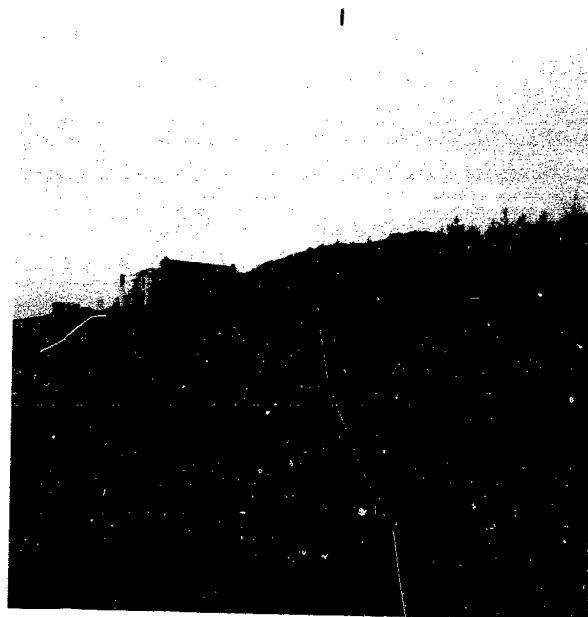
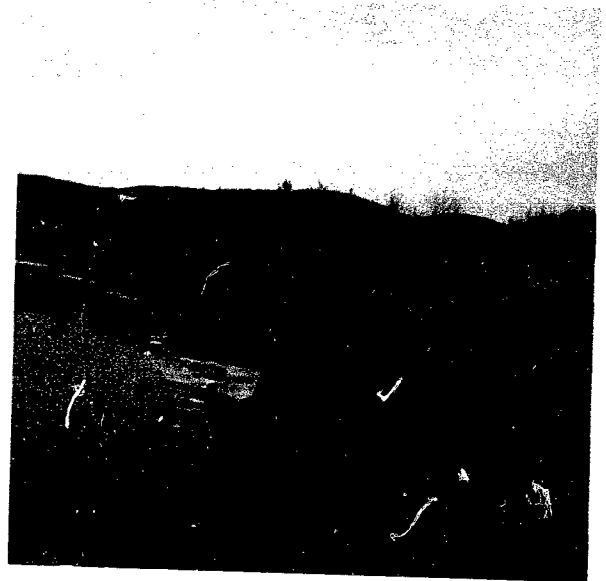
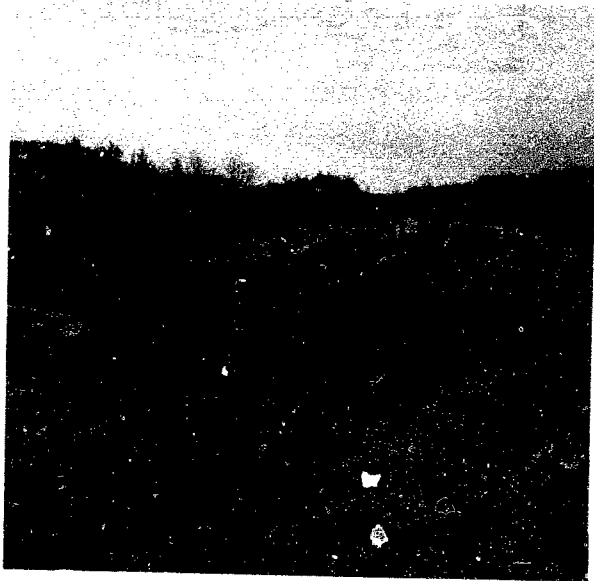
MAP 41/C/3  
ZONE 17  
333850 E  
5208250 N

MAY 15/07

WP 371-65 HWY 129  
NORTH OF AUBREY FALLS  
FAILURE - EAST SIDE  
STA 818+00 TO 819+75



WP 371-65 HWY 129  
NORTH OF AUBREY FALLS  
FAILURE - EAST SIDE  
STA 818+00 TO 819+75



MAY 13/69

Department of Highways Ontario

Copy for the information of  
Mr. K. Selby

69-F-38

~~Mr. B. J. Orr,~~  
Maintenance Engineer,  
Downsview, Ontario.

Mr. W. G. Sawyer,  
District Maintenance Engineer,  
Sault Ste. Marie, Ontario.

July 22, 1969.

Embankment Failures - Highway 129 - District 18 -  
W.P. 371-65 - Station 795 to Station 801

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Continued.....

Continued.....

July 22, 1969.

Mr. E. J. Orr

Re: Embankment Failures - Highway 129 - District 18  
W.P. 371-65 - Station 795 to Station 801

*W. G. Sawyer*

W. G. Sawyer,  
District Maintenance Engineer,

for J. H. Blevins,  
District Engineer.

GS:my

c.c. Mr. K. Selby  
Mr. J. Chisholm