0037

JOHN R. SELVAGE
RCE 21099
RTE 246

K. JEFF NELSON
RCE 31998

SELVAGE & HEBER, INC.
CONSULTING ENGINEERS
2389 MYRTLE AVENUE
EUREKA, CALIFORNIA 95501
(707) 445-0891

DUANE H. HEBER
RME 15063
RIE 3899

REFERENCE: 81-128

July 15, 1982

Mr. Frank Pero
Price River Coal Company
P.O. Box 629
Helper, UT 84526

SUBJECT: POST-CONSTRUCTION STABILITY CALCULATIONS
CRANDALL CANYON WIRE WALL

Dear Mr. Pero:

Per your request, I have checked the stability of the welded wire retaining wall near Sta. 17+00 of the Crandall Canyon Project. The wall in this area is approximately 30 feet high and as such, I have calculated factors of safety for overturning and sliding for wall heights of 28'-6" to 33'-0". The information you supplied on the material used for backfill indicated a unit weight of 124-127 pcf and a friction angle of 50-55°. For the basis of my calculations, I used a unit weight of 125 pcf and adjusted the friction angle to 45° and the equivalent soil pressure to 26 pcf (as practical maximum and minimum values respectively). The external factors of safety are listed below:

Wall Ht. Ft.	F.S. Overturning	F.S. Sliding
33'-0"	3.61	4.81
31'-6"	3.92	5.01
30'-0"	3.61	4.81
28'-6"	3.95	5.03

Also enclosed is the reproducible drawing you requested for Mr. Haub. If you have any questions or require additional information, please contact me at your convenience.

Sincerely,

SELVAGE & HEBER

K. Jeff Nelson

K. Jeff Nelson

tc

cc: Bill Hilfiker
enclosures

SELVAGE & HEBER, INC.
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JOB 81-102
SHEET NO 1 OF 4
CALCULATED BY JW DATE 7/12/82
CHECKED BY DATE
SCALE

WELDED WIRE WALL
PRICE RIVER COAL - CRANDALL CANYON

EXTERNAL STABILITY REVIEW
HILFIKER RETAINING WALLS

REGISTERED PROFESSIONAL ENGINEER
KENNETH JEFFREY NELSON
No. 31998
CIVIL
STATE OF CALIFORNIA

PRODUCT 204-1 NEBS Inc. Groton Mass. 01471

SELVAGE & HEBER, INC.
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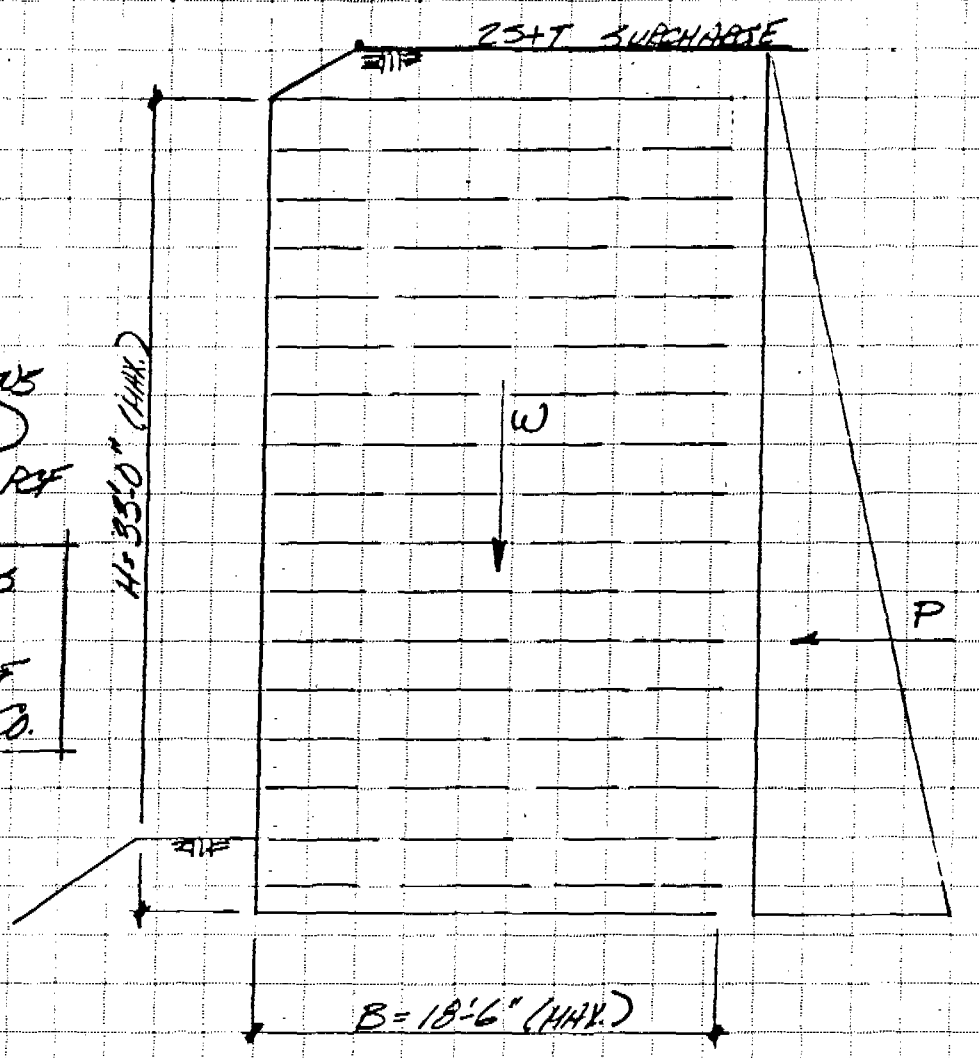
JOB 01-100
SHEET NO. 2 OF 4
CALCULATED BY JW DATE 7/12/82
CHECKED BY DATE
SCALE

REVIEW STABILITY OF WIRE WALL AS-BUILT

$H_{MAX} = 33'-0"$
$B/H_{MIN} = 0.56$
$\gamma = 125$ AVG
$\phi = 50°$

FOR BASIS OF CALCULATIONS USE $\phi = 45°$ ($\tan\phi = 1.0$)
9' EQ. FLUID PRESS. OF 26 PCF

NOTE: SOILS INFORMATION IS AS PROVIDED BY MR. FRANK REED OF PERCE RIVER COAL CO.



I. 33 FT. WALL:

$W = (33+4)(18.5)(0.125) = 85.56$ K
$P = \frac{1}{2}(33+4)^2(0.026) = 17.80$ K

OVERTURNING

$M_{OT} = 17.80(37)(1/3) = 219.50$ FT-KIPS
$M_{RES.} = 85.56(18.5)(1/2) = 719.43$ FT-KIPS

$F.S. = \frac{719.43}{219.50} = 3.61$ O.K.

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JOB 81-160
SHEET NO. 3 OF 4
CALCULATED BY JW DATE 7/12/82
CHECKED BY DATE
SCALE

SLIDING

$P = 17.80$ k
$R = 85.56 \tan 45° = 85.56$

$F.S. = \frac{85.56}{17.80} = 4.81 \gg 1.5$ O.K.

OVERTURNING

$M_{OT} = 17.80(1/3)(33+4) = 219.53$ FT-KIPS

$M_{RES} = 85.56(18.5)(1/2) = 791.43$

$F.S. = \frac{791.43}{219.53} = 3.61 \gg 1.5$ O.K.

II. 30 FT. WALL

$W = (30+4)(17)(0.125) = 72.25$
$P = 1/2(30+4)^2(0.026) = 15.03$

SLIDING

$P = 15.03$
$R = 72.25(\tan 45) = 72.25$

$F.S. = \frac{72.25}{15.03} = 4.81 \gg 1.5$ O.K.

OVERTURNING

$M_{OT} = 15.03(34)(1/3) = 170.34$
$M_{RES} = 72.25(17)(1/2) = 614.13$

$F.S. = \frac{614.13}{170.34} = 3.61 \gg 1.5$ O.K.

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JOB 81-160
SHEET NO. 4 OF 4
CALCULATED BY JW DATE 7/12/82
CHECKED BY DATE
SCALE

TI 59 PROGRAM PRINTS OUTS:

H=33'
33.00
125.00
45.00
26.00
4.00
0.00
0.56 B/H
0.00

F.S. 3.61 O.T.
F.S. 4.81 SLIDING
8473.00
12.00
9.00
30.00
7.00

H=31'-6"
31.50
125.00
45.00
26.00
4.00
0.00
0.59 B/H
0.00

F.S. 3.92 O.T.
F.S. 5.01 SLIDING
7836.22
12.00
9.00
30.00
7.00

H=30'
30.00
125.00
45.00
26.00
4.00
0.00
0.57 B/H
0.00

F.S. 3.61 O.T.
F.S. 4.81 SLIDING
7786.00
18.00
9.00
20.00
7.00

H=28'-6"
28.50
125.00
45.00
26.00
4.00
0.00
0.60 B/H
0.00

F.S. 3.95 O.T.
F.S. 5.03 SLIDING
7150.84
18.00
9.00
20.00
7.00

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CALIFORNIA BEARING RATIO TEST

Project Name: CRANDEL CANYON — Date: 3/13/81
Project No. — Sample No. 81-47 (#3 S. SIDE)

BATCHING

Size		Adj. Dry Wt.	Water for Batch
+ 4 ____ % Dry Wt. ____ gm.		____ gm.	Opt. Moist. 12 %
− 4 ____ % Dry Wt. ____ gm.		____ gm.	Less Hygro. 7.1 %
Batch 6000 gm.			Moisture 4.8 %
Amt. of Water Added 290 ml.			6000 (.048)
Wt. Sample + Mold 12234 gm.			= 290 gm
Mold No. #4 Tare Wt. 7192 gm.			
Wt. of Sample 5042 gm.		____ gm.	

SWELL DATA

1st. Day ____
2nd. Day ____
3rd. Day ____
4th. Day ____
Start .000
Swell .003 in.
% Swell ____

COMPACTION: Method "____", ____ Layers, ____ Blows, ____ Hammer, ____ In. Drop

SAMPLE AFTER SOAK

Wt. Mold + Sample After Soak 12273 gm.
Wt. Mold + Sample Before Sock ____ gm.
Moisture Increase Due to Soak ____ gm.
Moisture Before Soak (Wet Wt.-Dry Wt.) ____ gm.
Total Moisture After Soak ____ gm.
Percent of Moisture After Soak ____ %

HEIGHT OF SAMPLE

Depth of Sample ____
Less Measuring Instr. ____
Corrected Depth ____
Decimal Equiv. ____
Mold Height ____
Less Decimal Equiv. ____
Sample Height ____ In

MOISTURE DETERMINATION

	Hygro. Moist.	At Compaction	Top Inch After Soak
Wt. Moist Soil + Container (gm.)	733.7	597.5	583.3
Wt. Dry Soil + Container (gm.)	691.9	553.3	540.0
Wt. of Moisture (gm.)	41.8	44.2	43.3
Wt. of Container (gm.)	107.4	181.4	181.2
Wt. of Dry Soil (gm.)	584.5	371.9	358.8
Percent Moisture (%)	7.1	11.9	12.1

C.B.R. DRY DENSITY

$$D.D. = \frac{\text{Dry Wt.} \times 0.1347}{\text{Height}}$$

D.D. = ____ P.C.F.

C.B.R. MOISTURE DATA

Moisture Set Up At ____ %
Moisture After Swell ____ %
Moisture of Top Inch ____ %

SOIL ANALYSIS

AASHO Class. A-2-4 (0)
LL 21 PI. 3
Proctor Comp. Method T-99
Proctor Opt. Moisture 12 %
Proctor Dry Density 121.9 P.C.F.

REMARKS:

BEARING VALUE DATA

Penetration	Total Load (Lbs.)	Total Load Corr.	P.S.I.	Standard	% of Standard
0.025					
0.050					
0.075					
0.100				1000	
0.125				1125	
0.150				1250	
0.175				1375	
0.200				1500	
0.300				1900	

ENGINEERS

Name CRANDEL CANYON - SOIL FOUNDATION TEST Date 5/4/81

No. Station #3 SOUTH SIDE

or SOIL CLASS Sample No. 81-47

AS RECEIVED GRADATION				SPECS.
...een ...ze	Weight (c)	Percent Retained	Percent Passing	
			100	
...2"	1766	10.9	89.1	
	1222	7.6	81.5	
...4"	287	1.8	79.7	
...2"	521	3.2	76.5	
...8"	380	2.4	74.1	
...4	967	6.0	68.1	
...t Wt. ...#4	11701			
...Wt. ...#4	10989	68.1		
...l Wt. ...ry	16132			

514.6
485.1
29.5

$\frac{29.5}{485.1} = 6.08\%\ H_2O$

...SHED GRADATION AFTER CRUSHING (2500 Gm. Dry Recombined Sample)					
...een ...ze	Weight Retained	Percent Retained	Percent Passing	Total % Passing	SPECS.
...4"					
...2"					
...8"					
...4			100	68.1	
...#10	39.4	8.0	92.0	62.7	
...#20					
...#50	52.2	10.8	81.2	55.3	
...200	173.7	35.8	45.4	30.9	
...200	1.4	.3	45.1		
...Wt.	485.1				

Wt. before washing 485.1
Wt. after washing 375.5

		A.S.H.O. Classification
L.L.	21	A-2-4 (0)
P.L.	18	
P.I.	3	

By Kelly J. McEntee

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LIQUID LIMIT AND PLASTICITY INDEX

PROJECT NAME _____ DATE 5/12/81
PROJECT No. 81-47

LIQUID LIMIT

SAMPLE No. 81-47

CAN 1	WET 39.22	DRY 34.99				
TAPS 35	DRY 34.99	CAN 14.60				
	H_2O 4.23	DRY WT. 20.39	% H_2O 20.7 A			
CAN 2	WET 38.43	DRY 34.23		LL A 21.7		
TAPS 30	DRY 34.23	CAN 14.62		LL B 21.9		
	H_2O 4.20	DRY WT. 19.61	% H_2O 21.4 B	LL C 22.2		
CAN 3	WET 38.32	DRY 34.01		3)	(22 L.L.	
TAPS 24	DRY 34.01	CAN 14.67			16 P.L.	
	H_2O 4.31	DRY WT. 19.34	% H_2O 22.3 C		6 P.I.	

PLASTIC LIMIT

CAN 4	WET 24.81	DRY 23.36	
	DRY 23.36	CAN 14.57	
	H_2O 1.45	DRY WT. 8.79	PL 16.5 (% H_2O)

LIQUID LIMIT

SAMPLE No. _____

CAN	WET	DRY				
TAPS	DRY	CAN				
	H_2O	DRY WT.	% H_2O A			
CAN	WET	DRY		LL A		
TAPS	DRY	CAN		LL B		
	H_2O	DRY WT.	% H_2O B	LL C		
CAN	WET	DRY		3)	(L.L.	
TAPS	DRY	CAN			P.L.	
	H_2O	DRY WT.	% H_2O C		P.I.	

PLASTIC LIMIT

CAN	WET	DRY	
	DRY	CAN	
	H_2O	DRY WT.	PL (% H_2O)

LIQUID LIMIT

SAMPLE No. _____

CAN	WET	DRY				
TAPS	DRY	CAN				
	H_2O	DRY WT.	% H_2O A			
CAN	WET	DRY		LL A		
TAPS	DRY	CAN		LL B		
	H_2O	DRY WT.	% H_2O B	LL C		
CAN	WET	DRY		3)	(L.L.	
TAPS	DRY	CAN			P.L.	
	H_2O	DRY WT.	% H_2O C		P.I.	

PLASTIC LIMIT

CAN	WET	DRY	
	DRY	CAN	
	H_2O	DRY WT.	PL (% H_2O)

NO. OF TAPS	CORRECT FACTO
16	0.947
17	0.954
18	0.962
19	0.967
20	0.973
21	0.978
22	0.983
23	0.990
24	0.995
25	1.000
26	1.00
27	1.00
28	1.01
29	1.01
30	1.02
31	1.02
32	1.03
33	1.03
34	1.03
35	1.04

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MOISTURE–DENSITY RELATIONS

PROJECT NAME Crandel Canyon DATE 5/7/81

PROJECT No. _____ SAMPLE No. 81-45 (#1 N. Side)

METHOD OF COMPACTION T-99

TEST No.	1	2	3	4	5	6	7	8
CYL. & WET EARTH IN GRAMS	9741	10100	10118	10110	10644			
CYLINDER WT. IN GRAMS	5550	5550	5550	5550	5550			
WET EARTH IN GRAMS	4191	4550	4568	4560	4494			
WET DENSITY IN LBS/CU. FT.	123.2	133.7	134.2	134.0	132.1			
DISH NUMBER								
DISH & WET SOIL WT. IN GRAMS	522.8	539.1	566.4	585.0	678.6			
DISH & DRY SOIL WT. IN GRAMS	487.9	492.5	513.3	523.8	611.7			
WATER WT. IN GRAMS	34.9	46.6	53.1	61.2	66.9			
DISH & DRY SOIL WT. IN GRAMS	487.9	492.5	513.3	523.8	611.7			
DISH WT. IN GRAMS	102.6	108.3	110.4	101.7	181.2			
DRY SOIL WT. IN GRAMS	385.3	384.2	402.9	422.1	430.5			
MOISTURE IN % OF DRY WT.	9.1	12.1	13.2	14.5	15.5			
DRY DENSITY IN LBS./CU. FT.	112.9	119.2	118.6	117.0	114.3			

119.3 pcf

12.2% OP MOISTURE

$$\text{DRY DENSITY} = \frac{\text{WET DENSITY}}{100 + \%\ \text{MOISTURE}} \times 100$$

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MOISTURE-DENSITY RELATIONS

PROJECT NAME Crandel Canyon DATE 5/5/81

PROJECT NO. _____ SAMPLE NO. 81-47 (#3 S. Side)

METHOD OF COMPACTION T-99

TEST NO.	1	2	3	4	5	6	7	8
CYL. & WET EARTH IN GRAMS	9669	9916	10056	10179	10149	10047		
CYLINDER WT. IN GRAMS	5556	5556	5556	5556	5556	5556		
WET EARTH IN GRAMS	4113	4360	4500	4623	4593	4491		
WET DENSITY IN LBS/CU. FT.	120.9	128.1	132.2	135.9	135.0	132.0		
DISH NUMBER								
DISH & WET SOIL WT. IN GRAMS	537.8	550.2	660.5	645.5	575.8	692.3		
DISH & DRY SOIL WT. IN GRAMS	507.3	510.3	613.7	589.0	530.2	624.6		
WATER WT. IN GRAMS	30.5	39.9	46.8	56.5	45.6	67.7		
DISH & DRY SOIL WT. IN GRAMS	507.3	510.3	613.7	589.0	530.2	624.6		
DISH WT. IN GRAMS	108.3	110.4	181.2	101.7	181.4	180.8		
DRY SOIL WT. IN GRAMS	399.0	399.9	432.5	487.3	348.8	443.8		
MOISTURE IN % OF DRY WT.	7.64	9.98	10.82	11.6	13.1	15.3		
DRY DENSITY IN LBS./CU. FT.	112.3	116.5	119.3	121.7	119.4	114.5		

121.9 pcf

12.0 % Op Moisture

$$\text{DRY DENSITY} = \frac{\text{WET DENSITY}}{100 + \%\ \text{MOISTURE}} \times 100$$

TESTED BY: Velda McCartney

HORROCKS ENGINEERS
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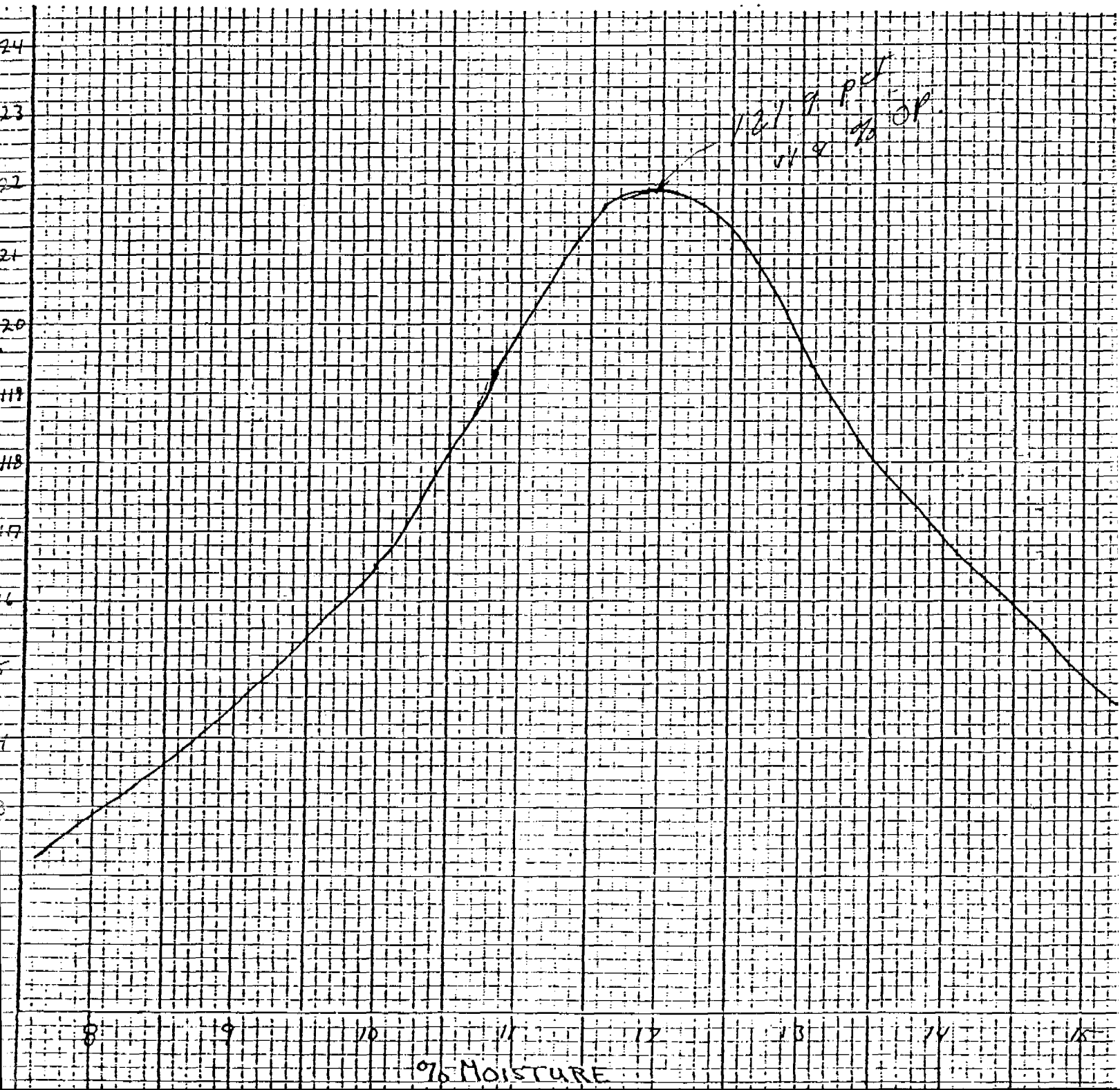
MOISTURE – DENSITY GRAPH

Project Name CRANDEL CANYON Date 5/6/81

Project No. Sample No. 81-47 (#3 S. SIDE)

Method of Compaction T-99



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CALIFORNIA BEARING RATIO TEST

Project Name: CRANDEL CANYON Date: 8/8/81
Project No. _____ Sample No. 81-45 (#1 N. SIDE)

BATCHING

Size		Adj. Dry Wt.	Water for Batch
+ 4 _____ % Dry Wt. _____ gm.		_____ gm.	Opt. Moist. 12.2%
− 4 _____ % Dry Wt. _____ gm.		_____ gm.	Less Hygro. 6.6%
Batch 6000 gm.			Moisture 5.6 %
Amt. of Water Added 334 ml.			6000 (5.6/100)
Wt. Sample + Mold 12349 gm.			= 334 ml
Mold No. #3 Tare Wt. 7280 gm.			
Wt. of Sample 5069 gm.		_____ gm.	

SWELL DATA

1st. Day _____
2nd. Day _____
3rd. Day _____
4th. Day _____
Start 0.000 9:00
Swell .005 9:00 a.m. In.
% Swell _____

COMPACTION: Method "_____", _____ Layers, _____ Blows, _____ Hammer, _____ In. Drop

SAMPLE AFTER SOAK

Wt. Mold + Sample After Soak 12376 gm.
Wt. Mold + Sample Before Sock _____ gm.
Moisture Increase Due to Soak _____ gm.
Moisture Before Soak (Wet Wt.-Dry Wt.) _____ gm.
Total Moisture After Soak _____ gm.
Percent of Moisture After Soak _____ %

HEIGHT OF SAMPLE

Depth of Sample _____
Less Measuring Instr. _____
Corrected Depth _____
Decimal Equiv. _____
Mold Height _____
Less Decimal Equiv. _____
Sample Height _____ In.

MOISTURE DETERMINATION

	Hygro. Moist.	At Compaction	Top Inch After Soak
Wt. Moist Soil + Container (gm.)	616.2	495.4	648.8
Wt. Dry Soil + Container (gm.)	584.6	452.3	593.4
Wt. of Moisture (gm.)	31.6	43.1	55.4
Wt. of Container (gm.)	108.3	108.3	180.8
Wt. of Dry Soil (gm.)	476.3	344.0	412.6
Percent Moisture (%)	6.6	12.5	13.4

C.B.R. DRY DENSITY

$$D.D. = \frac{\text{Dry Wt.} \times 0.1347}{\text{Height}}$$

D.D. = _____ P.C.F.

C.B.R. MOISTURE DATA

Moisture Set Up At _____ %
Moisture After Swell _____ %
Moisture of Top Inch _____ %

SOIL ANALYSIS

AASHO Class. A-1-b (0)
L.L. 19 P.I. 1
Proctor Comp. Method T-99
Proctor Opt. Moisture 12.2 %
Proctor Dry Density 119.3 P.C.F.

REMARKS:

BEARING VALUE DATA

Penetration	Total Load (Lbs.)	Total Load Corr.	P.S.I.	Standard	% of Standard
0.025					
0.050					
0.075					
0.100				1000	
0.125				1125	
0.150				1250	
0.175				1375	
0.200				1500	
0.300				1900	
0.400				2300	
0.500					

HORROCKS ENGINEERS

Project Name: CRANDEL CANYON - SOIL FOUNDATION TEST Date: 5/4/81

Project No.: Station: #1 N. SIDE

Test For: SOIL CLASS Sample No.: 81-45

AS RECEIVED GRADATION			
Screen Size	Weight (g)	Percent Retained	Percent Passing
3"			100
2"	1055	9.6	90.4
1"	506	4.6	85.8
3/4"	517	4.7	81.1
1/2"	496	4.5	76.6
3/8"	167	1.5	75.1
#4	356	3.2	71.9
Wet Wt. -#4	8562		
Dry Wt. -#4	7906	71.9	
Total Wt. Dry	11003		

SPECS.

528.8
491.2
37.6

$\frac{37.6}{491.2} = 7.65\%\ H_2$

WASHED GRADATION AFTER CRUSHING (2500 Gm. Dry Recombined Sample)					
Screen Size	Weight Retained	Percent Retained	Percent Passing	Total % Passing	SPECS.
1"					
3/4"					
1/2"					
3/8"					
#4			100	62.3	
~~#8~~ #10	38.6	7.9	92.1	57.4	
~~#16~~					
#40 ~~#50~~	79.2	16.1	76.0	47.4	
#200	177.3	36.1	39.9	24.9	
-#200	1.4	.3	39.6		
Total Wt.	491.2				

Wt. before washing 491.2
Wt. after washing 296.2

		A.S.H.O. Classification
L.L.	19	A-1-b (0)
P.L.	18	
P.I.	1	

Tested By: Volk AMPT

HORROCKS ENGINEERS
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LIQUID LIMIT AND PLASTICITY INDEX

PROJECT NAME CRANDEL CANYON - SOIL FOUNDATION TEST DATE 5/5/81
PROJECT No. _____

LIQUID LIMIT — SAMPLE No. 81-45 (#1)

CAN 5	WET 46.11	DRY 41.19				
TAPS 28	DRY 41.19	CAN 14.80				
	H_2O 4.92	DRY WT. 26.39	% H_2O 18.6 A			
CAN 7	WET 38.36	DRY 34.54		LL A 18.9		
TAPS 24	DRY 34.54	CAN 14.54		LL B 19.1		
	H_2O 3.82	DRY WT. 19.91	% H_2O 19.2 B	LL C 19.2		
CAN 8	WET 41.68	DRY 37.23		3)	19 L.L.	
TAPS 19	DRY 37.23	CAN 14.77			18 P.L.	
	H_2O 4.45	DRY WT. 22.46	% H_2O 19.8 C		1 P.I.	

PLASTIC LIMIT

CAN 9	WET 34.79	DRY 33.22	
	DRY 33.22	CAN 24.56	
	H_2O 1.57	DRY WT. 8.66	PL 18.1 (% H_2O)

LIQUID LIMIT — SAMPLE No. 81-46 (#2)

CAN 1	WET 43.55	DRY 38.86				
TAPS 34	DRY 38.86	CAN 14.67				
	H_2O 4.69	DRY WT. 24.19	% H_2O 19 A			
CAN 3	WET 42.79	DRY 38.17		LL A 20		
TAPS 30	DRY 38.17	CAN 14.73		LL B 20		
	H_2O 4.62	DRY WT. 23.44	% H_2O 20 B	LL C 20		
CAN 2	WET 42.33	DRY 37.82		3)	20 L.L.	
TAPS 17	DRY 37.62	CAN 14.77			19 P.L.	
	H_2O 4.71	DRY WT. 22.85	% H_2O 21 C		1 P.I.	

PLASTIC LIMIT

CAN 4	WET 21.28	DRY 20.23	
	DRY 20.23	CAN 14.69	
	H_2O 1.05	DRY WT. 5.54	PL 19 (% H_2O)

LIQUID LIMIT — SAMPLE No. 81-47 (#3)

CAN 13	WET 47.31	DRY 42.06				
TAPS 27	DRY 42.06	CAN 17.26				
	H_2O 5.25	DRY WT. 24.80	% H_2O 21.2 A			
CAN 17	WET 40.10	DRY 35.67		LL A 21.4		
TAPS 26	DRY 35.67	CAN 14.79		LL B 21.3		
	H_2O 4.43	DRY WT. 20.88	% H_2O 21.2 B	LL C 21.7		
CAN 19	WET 39.23	DRY 34.87		3)	21 L.L.	
TAPS 25	DRY 34.87	CAN 14.74			18 P.I.	
	H_2O 4.36	DRY WT. 20.13	% H_2O 21.7 C		3 P.I.	

PLASTIC LIMIT

CAN 20	WET 23.97	DRY 22.58	
	DRY 22.58	CAN 14.19	
	H_2O 1.39	DRY WT. 7.89	PL 18 (% H_2O)

NO. OF TAPS	CORRECT FACTO
16	0.94
17	0.954
18	0.96
19	0.967
20	0.97
21	0.97
22	0.98
23	0.99
24	0.99
25	1.00
26	1.00
27	1.00
28	1.01
29	1.01
30	1.02
31	1.02
32	1.03
33	1.03
34	1.03
35	1.04
36	1.04

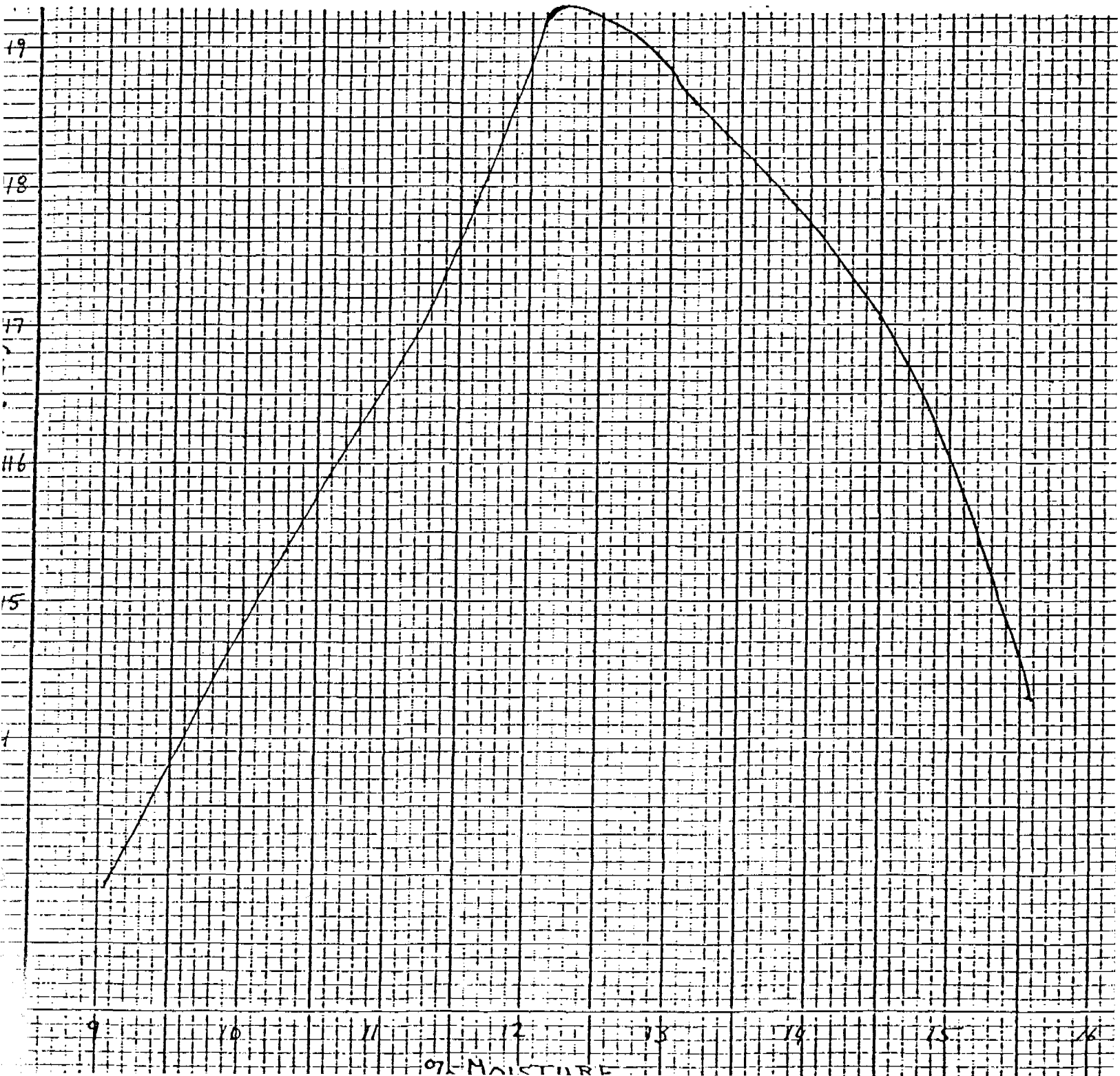
HORROCKS ENGINEERS
One West Main
P.O. Box 377
American Fork, Utah 84003
Telephone (801) 756-7628

MOISTURE – DENSITY GRAPH

Project Name CRANDEL CANYON Date 5/8/81

Project No. _____ Sample No. 81-45 (#1 N. SIDE)

Method of Compaction T-199



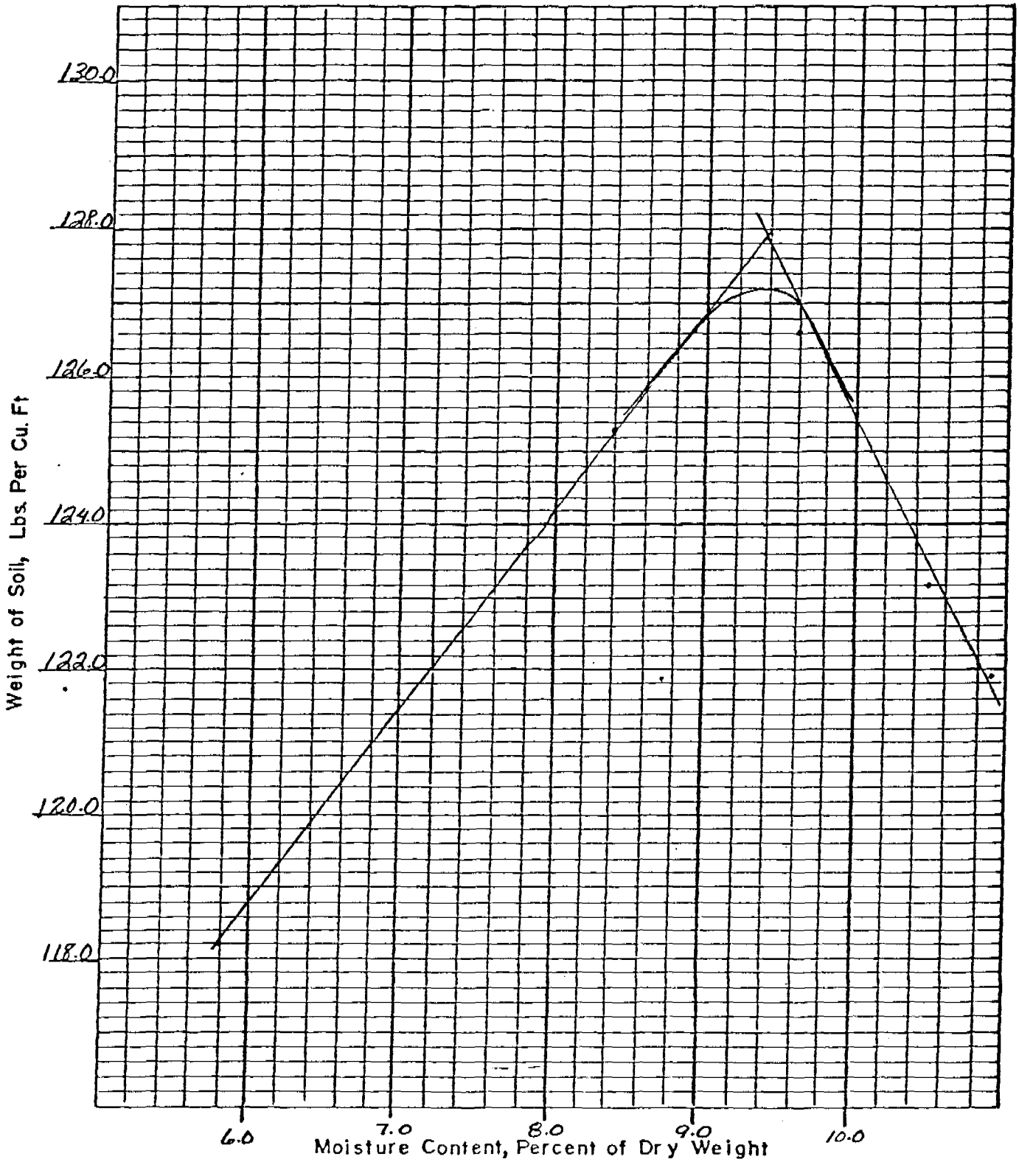
HORROCKS ENGINEERS

MOISTURE – DENSITY GRAPH

Project Name CRANDAL CANYON Date 4/20/82

Project No. 8107-81 Sample No J-81-021 SHAFT COURSE MATERAIL

Method of Compaction T-99 METHOD "D" P.C.F. 127.2 Optimum Moisture 9.4



MATERIALS AND TESTS DIVISION

MOISTURE-DENSITY RELATIONS

PROJECT NAME CRANDAL CANYON DATE 4/20/82

PROJECT NO. 8107-81 SAMPLE NO. J-81-021 SHAFT-COURSE

METHOD OF COMPACTION T-99 METHOD "D"

TEST NO.	1	2	3	4	5	6	7	8
CYL. & WET EARTH IN GRAMS	9788	10156	10,257	10165	10134			
CYLINDER WT. IN GRAMS	5534	5534	5534	5534	5534			
WET EARTH IN GRAMS	4254	4622	4723	4631	4,600			
WET DENSITY IN LBS/CU. FT.	125.0	135.8	138.8	136.1	135.2			
DISH NUMBER	~	~	~	~	~			
DISH & WET SOIL WT. IN GRAMS	982.7	1105.0	1162.1	1178.1	1244.1			
DISH & DRY SOIL WT. IN GRAMS	938.5	1027.1	1072.4	1076.5	1132.4			
WATER WT. IN GRAMS	44.2	77.9	89.7	101.6	111.7			
DISH & DRY SOIL WT. IN GRAMS	938.5	1027.1	1072.4	1076.5	1132.4			
DISH WT. IN GRAMS	180.8	101.7	137.6	108.3	108.3			
DRY SOIL WT. IN GRAMS	757.7	925.4	934.8	968.2	1024.1			
MOISTURE IN % OF DRY WT.	5.8	8.4	9.6	10.5	10.9			
DRY DENSITY IN LBS./CU. FT.	118.2	125.3	126.6	123.2	121.9			

$$\text{DRY DENSITY} = \frac{\text{WET DENSITY}}{100 + \%\ \text{MOISTURE}} \times 100$$

TESTED BY L. Darrell Kenyon

MATERIALS ENGINEER

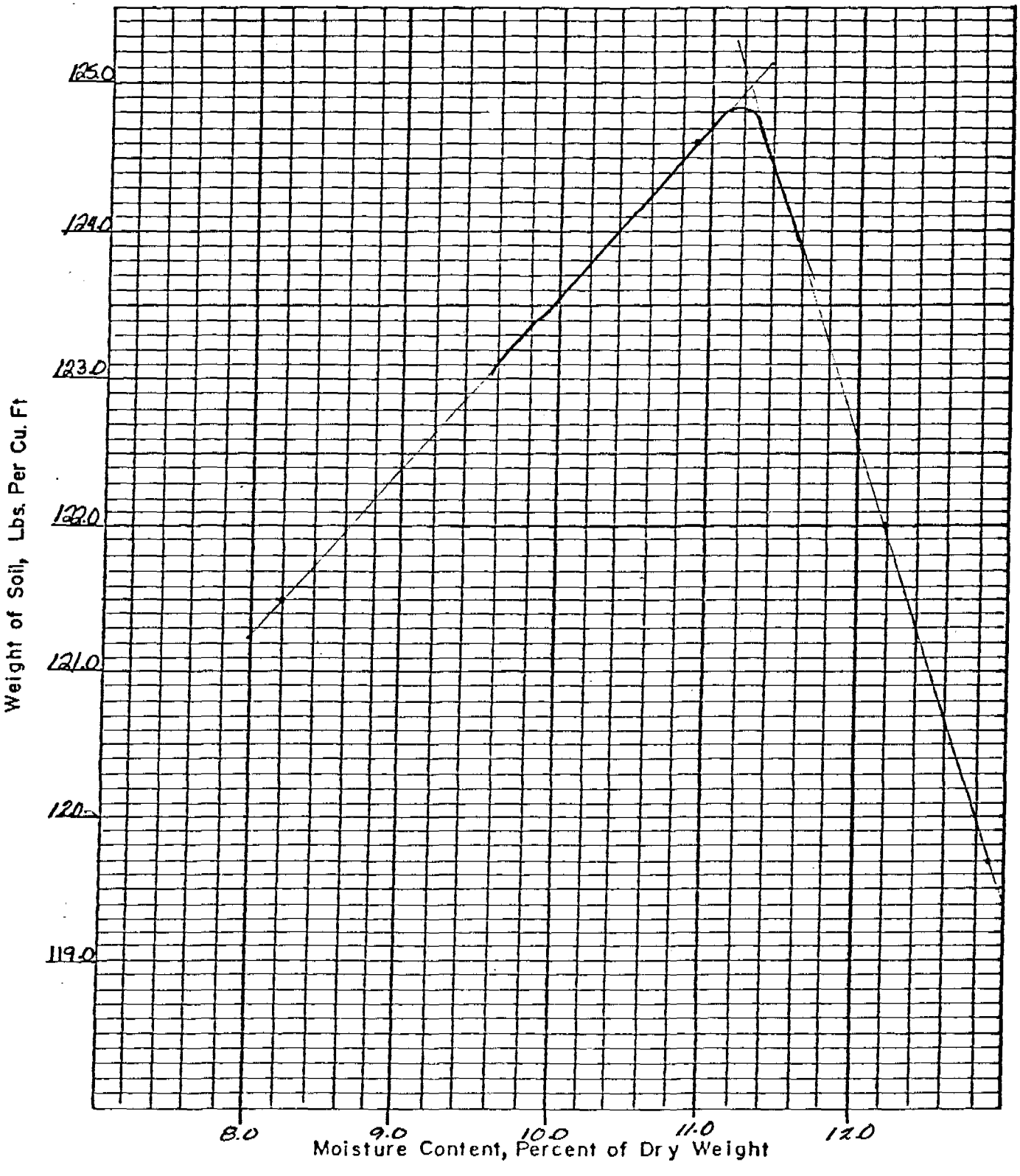
HORROCKS ENGINEERS

MOISTURE – DENSITY GRAPH

Project Name CRANDAL CANYON Date 4/20/82

Project No. 8107-81 Sample No J-81-022 SHAFT-FINER MATE

Method of Compaction T-99 METHOD "D" P.C.F. 124.8 Optimum Moisture 11.2



MATERIALS AND TESTS DIVISION

MOISTURE-DENSITY RELATIONS

PROJECT NAME CRANDAL CANYON DATE 4/20/82

PROJECT NO. 8107-81 SAMPLE NO. J-81-022 SHAFT-FINER

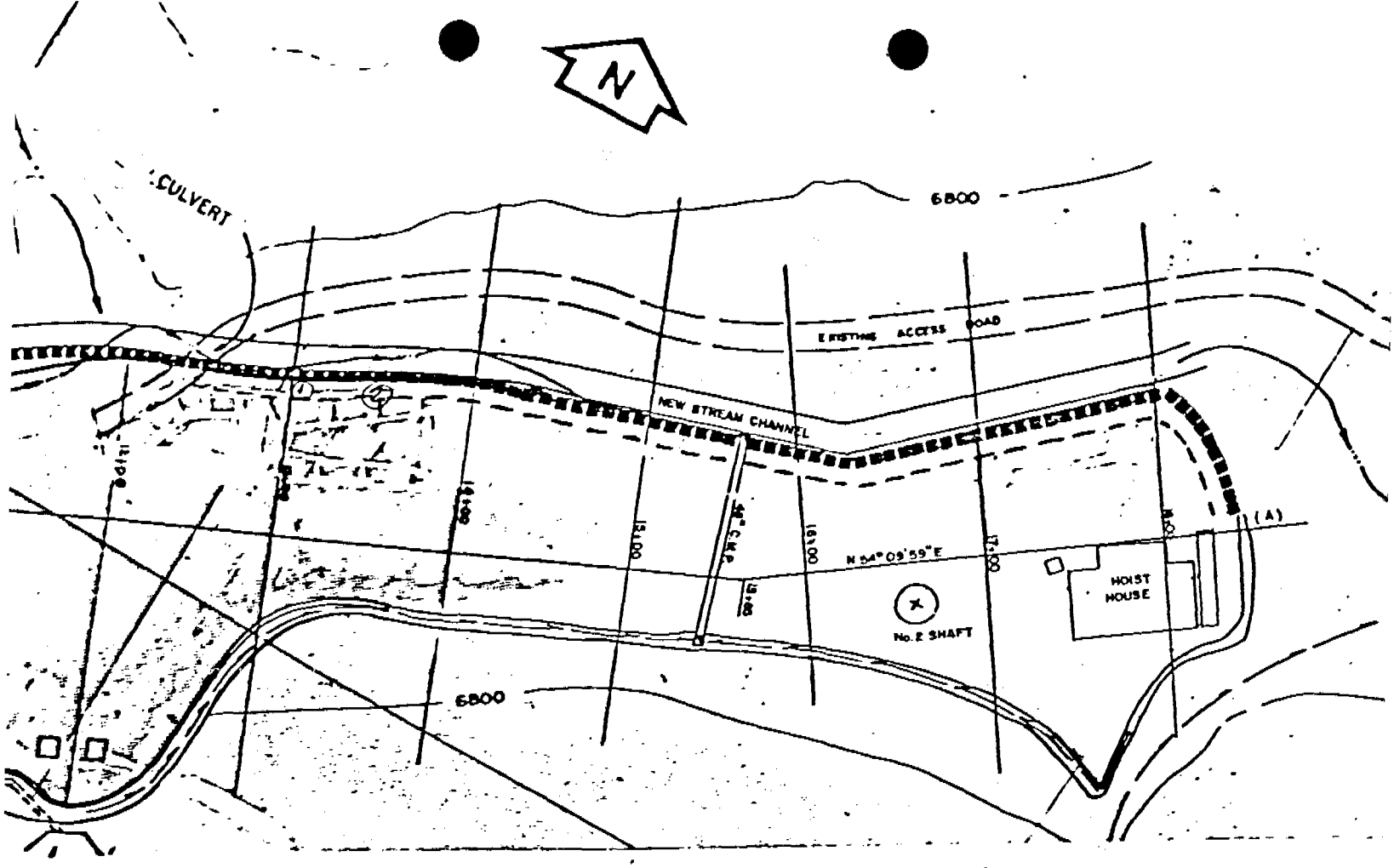
METHOD OF COMPACTION T-99 METHOD "D"

TEST NO.	1	2	3	4	5	6	7	8
CYL. & WET EARTH IN GRAMS	10008	10239	10192	10135				
CYLINDER WT. IN GRAMS	5534	5534	5534	5534				
WET EARTH IN GRAMS	4474	4705	4658	4601				
WET DENSITY IN LBS/CU. FT.	131.5	138.7	136.8	135.2				
DISH NUMBER	~	~	~	~				
DISH & WET SOIL WT. IN GRAMS	923.0	1295.9	1572.7	1305.2				
DISH & DRY SOIL WT. IN GRAMS	861.0	1177.9	1420.9	1168.2				
WATER WT. IN GRAMS	62.0	118.0	151.8	137.0				
DISH & DRY SOIL WT. IN GRAMS	861.0	1177.9	1420.9	1168.2				
DISH WT. IN GRAMS	108.3	101.7	180.8	110.4				
DRY SOIL WT. IN GRAMS	752.7	1076.2	1240.1	1057.8				
MOISTURE IN % OF DRY WT.	8.2	10.9	12.2	12.9				
DRY DENSITY IN LBS./CU. FT.	121.5	129.6	122.0	119.7				

$$\text{DRY DENSITY} = \frac{\text{WET DENSITY}}{100 + \%\ \text{MOISTURE}} \times 100$$

TESTED BY L. Darrell Lanyon

MATERIALS ENGINEER



T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	9"	88.9	11.0 %	6/10/82	JP	"NORM" TIME
1	4"	89.7	"	"	"	" " (112 PCF)
2	9"	91.7	9.6 %	"	JC	SLOW (DD 114.5)
2		93.4	9.5 %			NORM" (DD 116.7)

-NUCLEAR TESTING SERVICES-

NUCLEAR MOISTURE-DENSITY DETERMINATION

Project Name _____ Date _____
Project Number _____ Authority Number _____
Instrument Used and Number _____ Material Type _____

DENSITY		MOISTURE	
Air Gap ☐ 4" D.P. ☐ 6" D.P. ☐ 8" D.P. ☐			
Before	After	Before	After
1	1	1	1
2	2	2	2
3	3	3	3
Total	Total	Total	Total
Average	Average	Average	Average

Test No.	Station Ft. Rt. or Lt. of Line	Final	Progress		Air Gap Read. or Standard Counts	Direct Contact Reading	Count Ratio	Lbs. Ft.^{3}	Dry Den.	Proctor	T-180 T-99	% Comp.
1	8" Sta 15+00± Road Bed			Density	456	315	0.691	138				
				Moisture	425	274	0.645	13				
1	4"			Density		753	1.651	140				
				Moisture		274	0.645	13				
				Density								
				Moisture								
2	Sta 14+50± 8" Road Bed			Density		331	0.726	135				
				Moisture		238	0.56	11				
2	4"			Density		825	1.809	132				
				Moisture		238	0.56	11				
				Density								
				Moisture								
				Density								
				Moisture								
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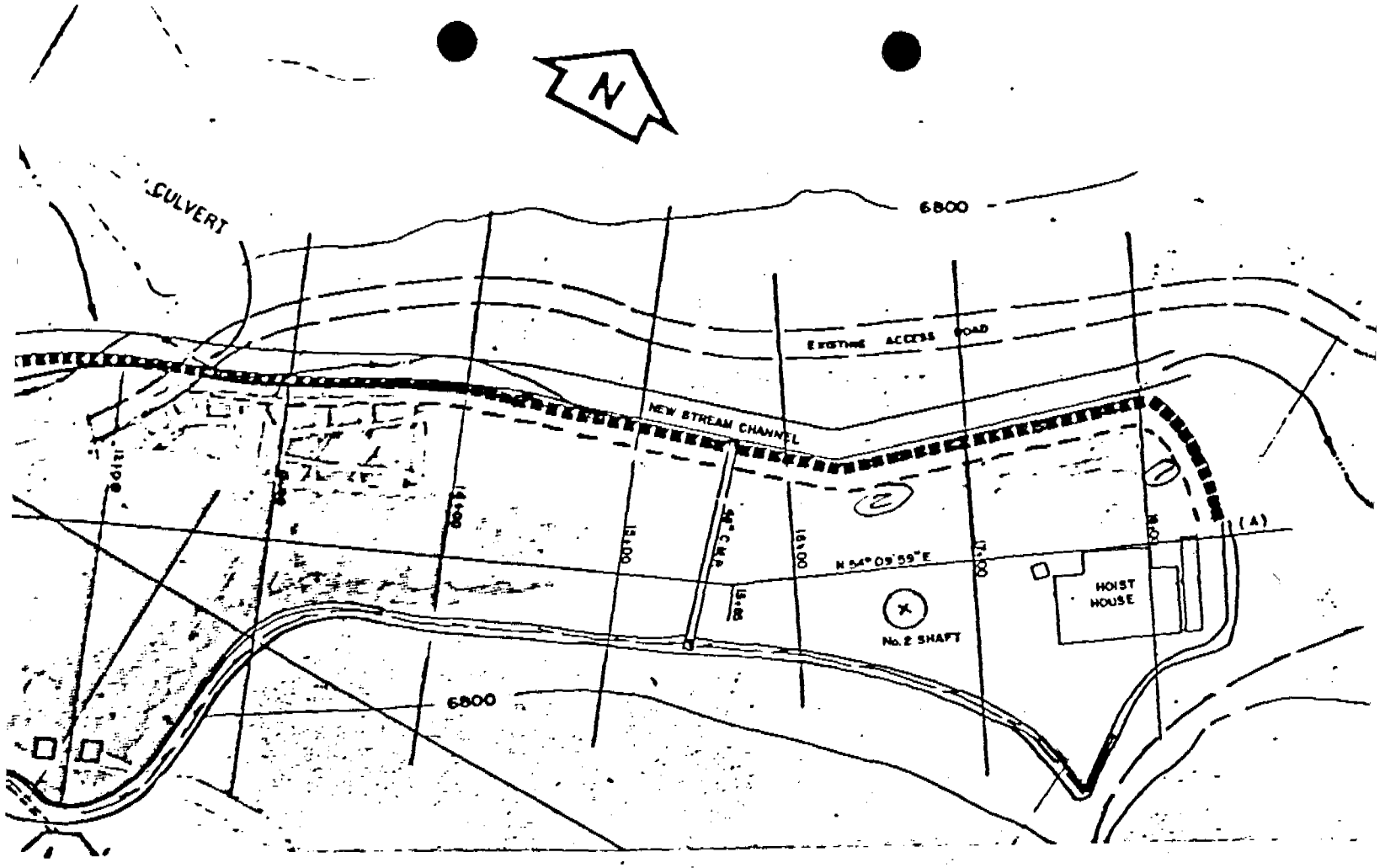
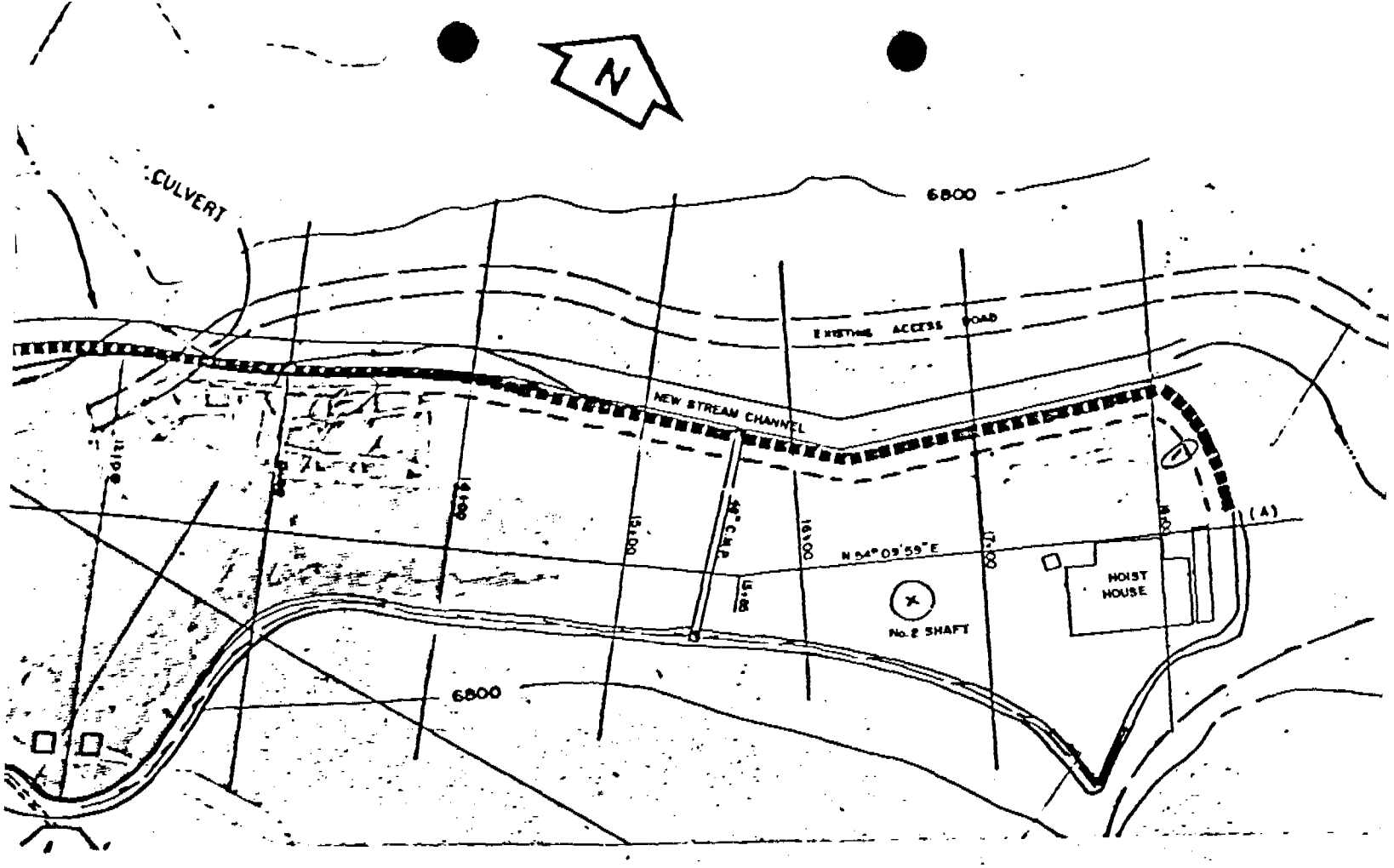
For Moisture: $\frac{\text{Contact Counts}}{\text{Standard Counts}}$ = Count Ratio; For Density Air Gap. or Depth Probe $\frac{\text{Direct Contact Reading}}{\text{Air Gap or Standard Count Read.}}$ = Count Ratio

Remarks _____
Tested By _____ Engineer _____

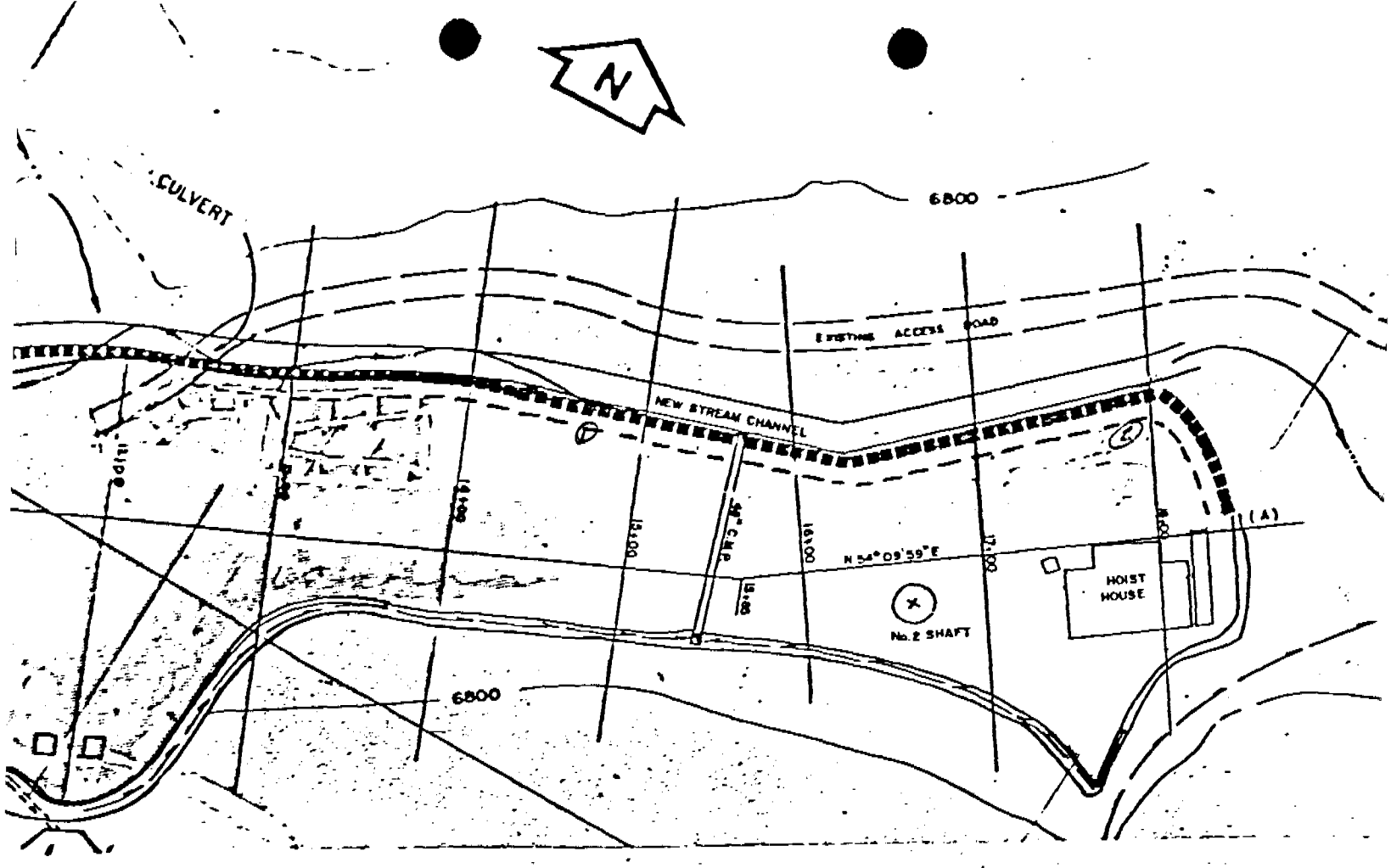
NTS



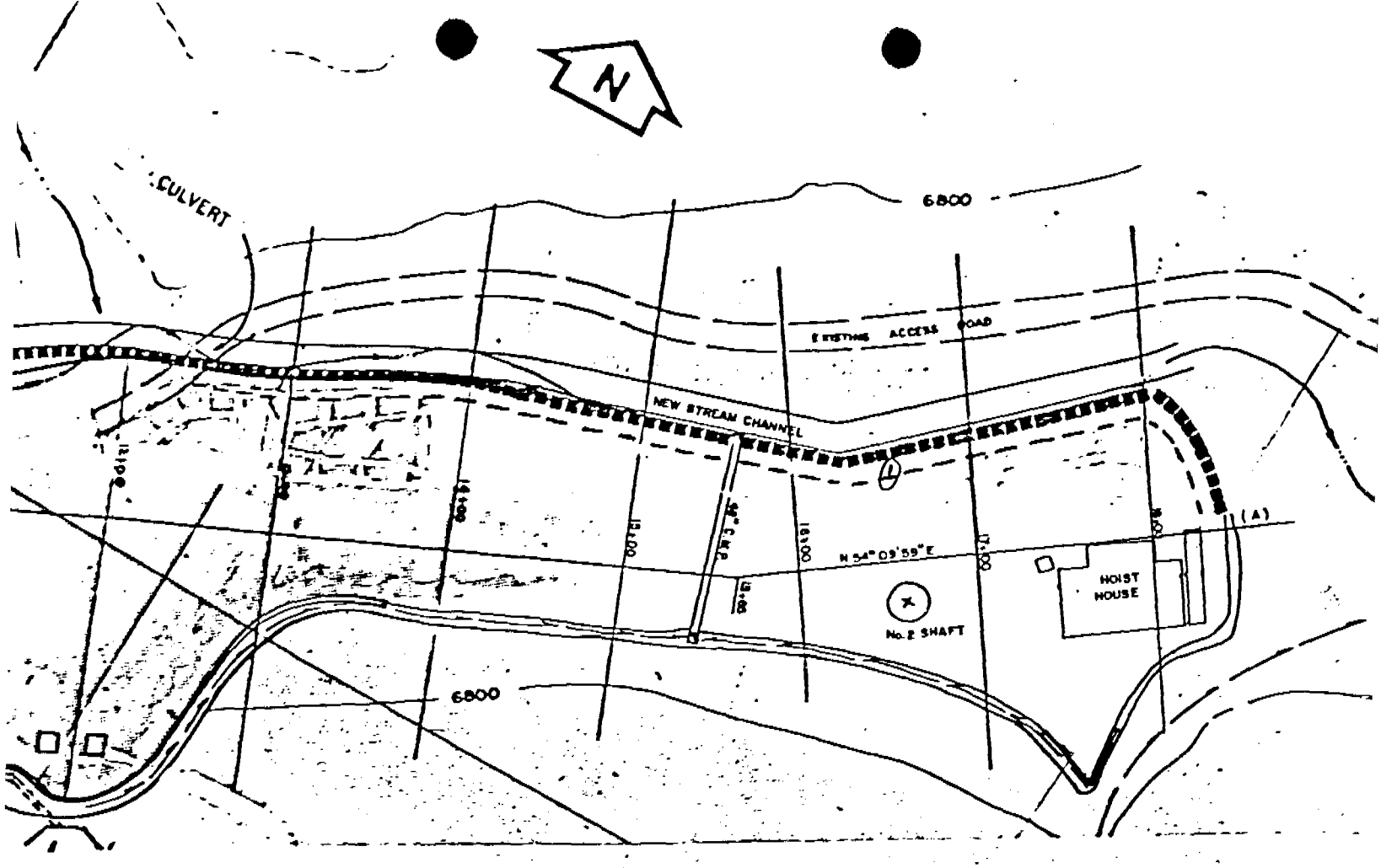
T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	6"	90±	11±	5/14/82	[illegible]	
2	8"	94	12±			



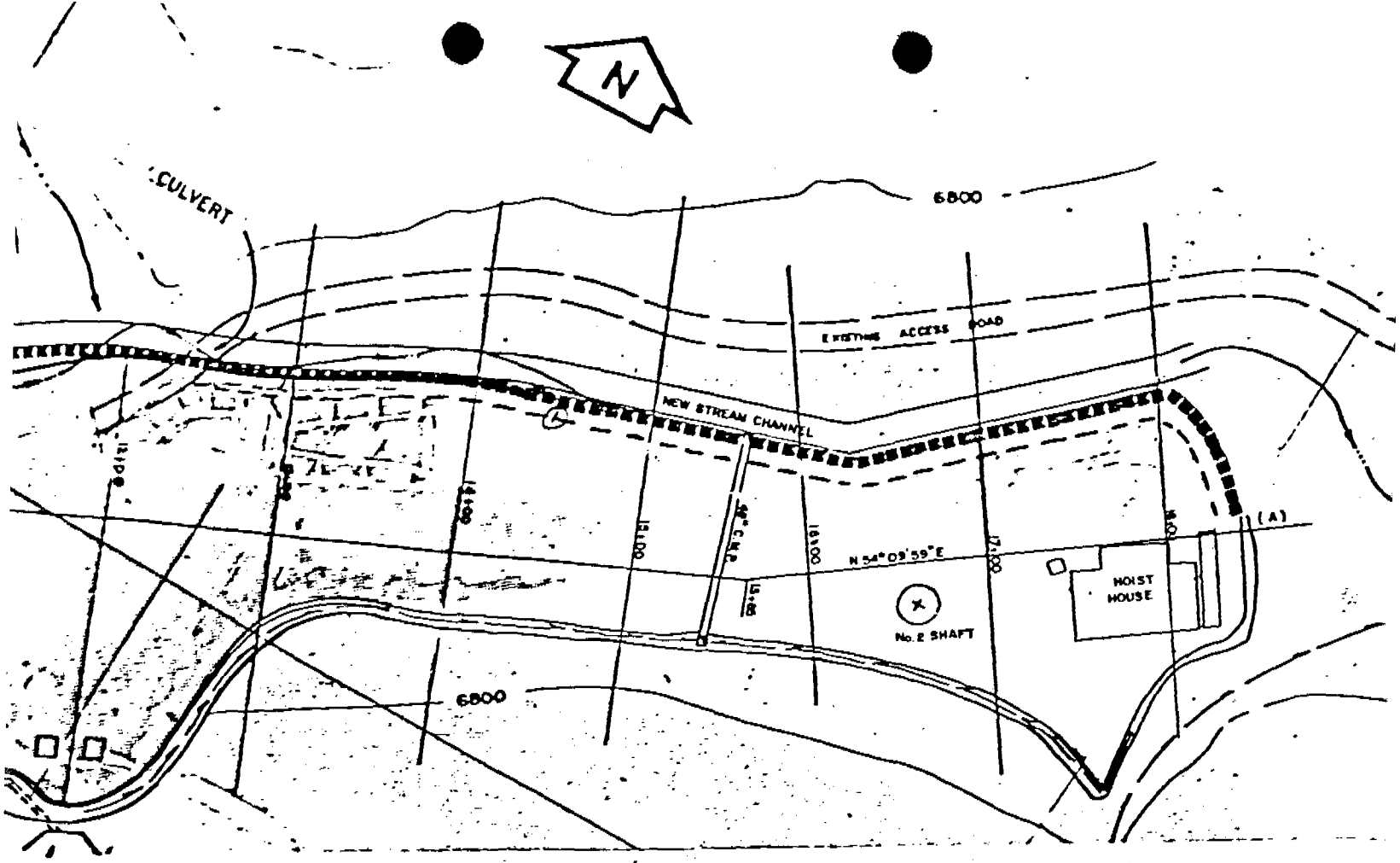
T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	6"	90	14±	5/13/82	JP	WET WEATHER
2	6"	91	13.5			



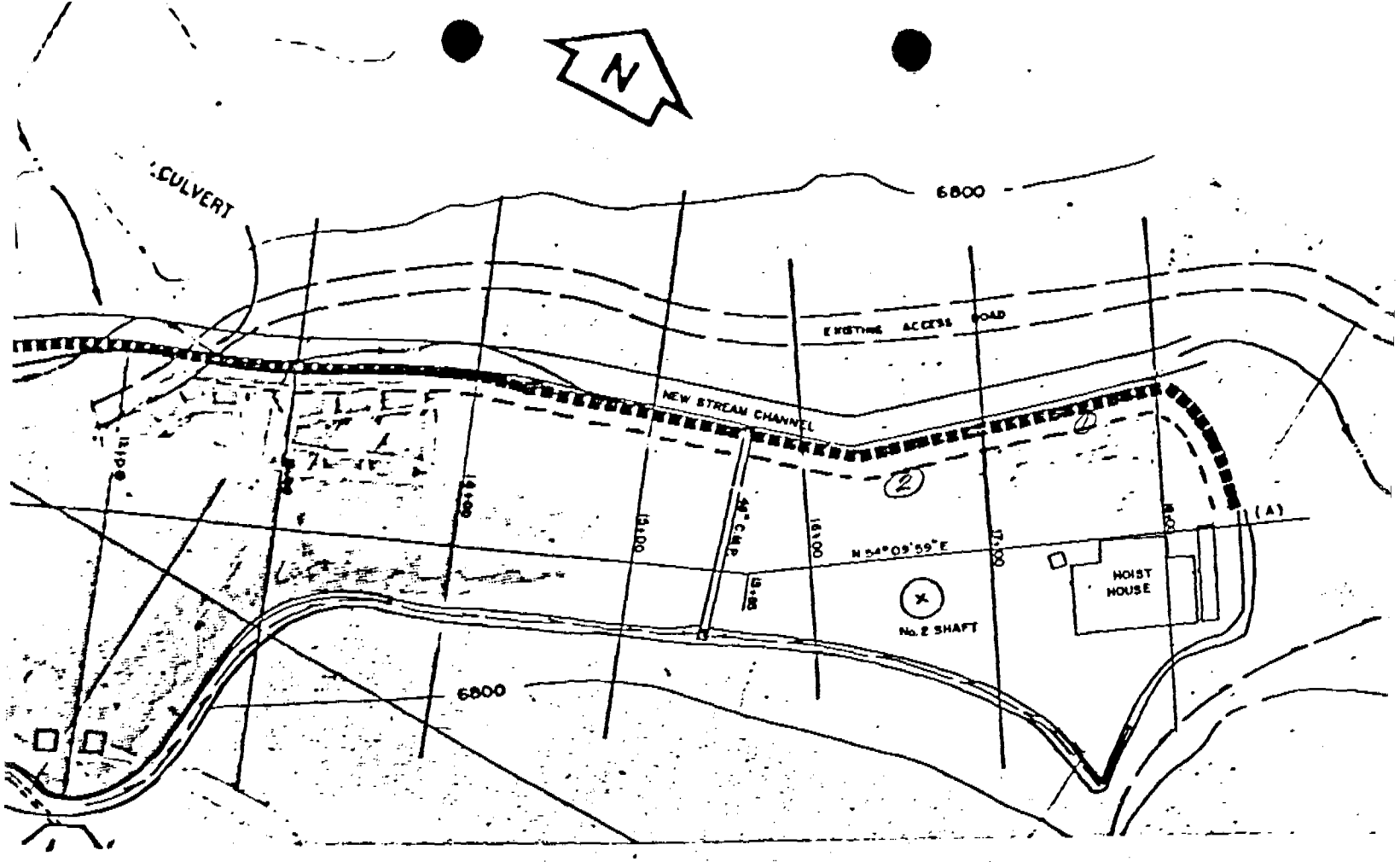
T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	8"	91	13.5	5/11/82	JP	WET!! (WEATHER)
2	4"	91.5	12.8	/	/	
2	8"	91	/	/	/	



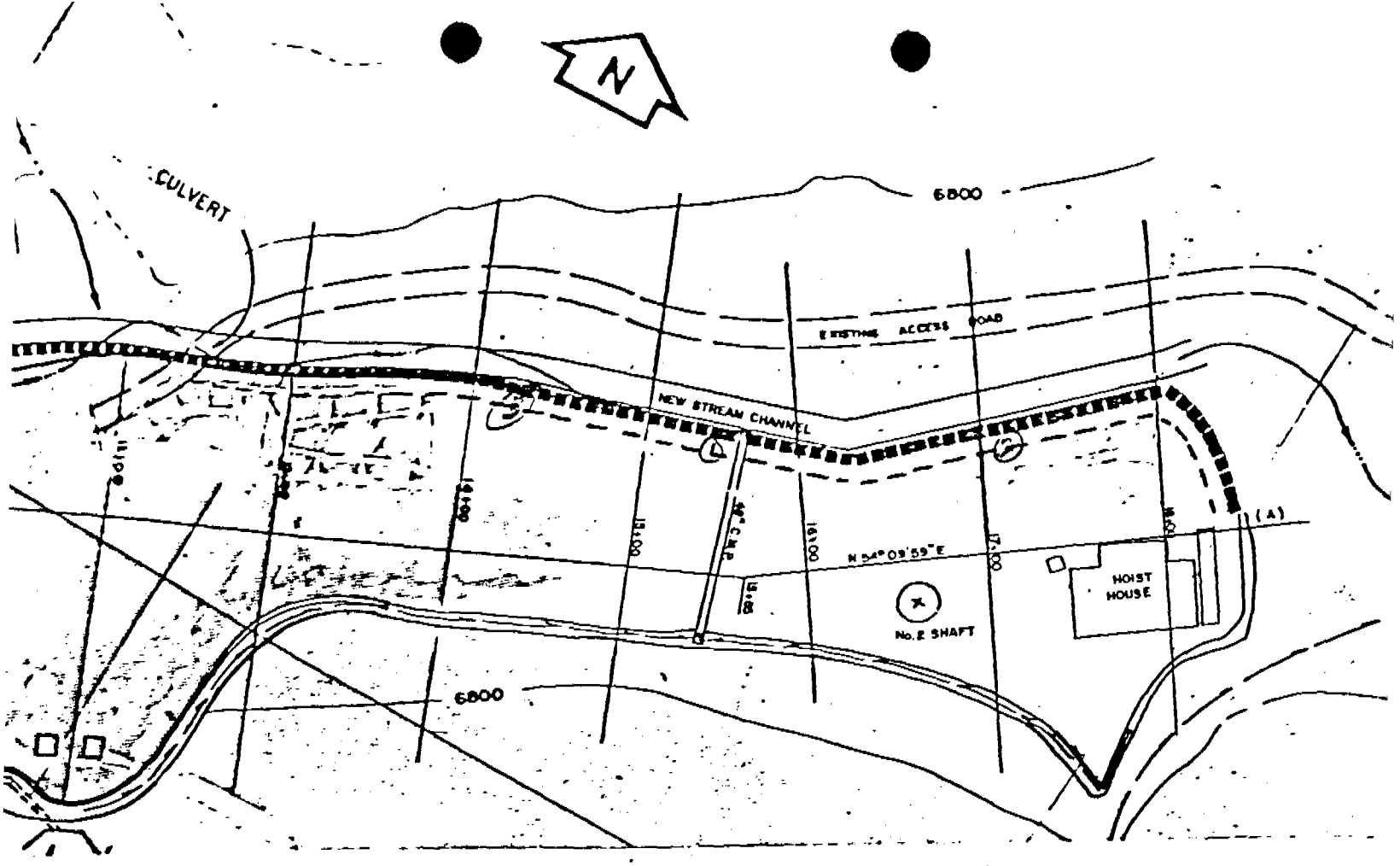
T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	4"	92	12.5	5/7/82	JP	
1	6"	91	/			
1	8"	93	/			



T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	8"	94	11.5	5/5/82	[illegible]	



T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	6"	90 ±	11 ±	5/9/82	JP	
2	6"	89 ±	13			
2	8"	91	"			



T NO.	DEPTH	% COMPACTION	% MOISTURE	DATE	BY	REMARKS
1	4"	91	11 5	5/3/82	JP	
1	6"	93	"	"	"	
2	4"	92	13 1	"	"	
2	6"	92 2	"	"	"	
3	6"	92	9	"	"	
3	8"	92 5	"	"	"	

-NUCLEAR TESTING SERVICES-

NUCLEAR MOISTURE-DENSITY DETERMINATION

Project Name: ROAD - SUBGRADE Date: 4/28/82
Project Number: Authority Number:
Instrument Used and Number: 2401 # 1819 Material Type:

DENSITY		MOISTURE	
Air Gap ☐ 4"D.P. ☐ 6"D.P. ☐ 8"D.P. ☐			
Before	After	Before	After
1	1	1	1
2	2	2	2
3	3	3	3
Total	Total	Total	Total
Average	Average	Average	Average

	Test No.	Station Ft. Rt. or Lt. of Line	Final	Progress		Air Gap Read. or Standard Counts	Direct Contact Reading	Count Ratio	Lbs. Ft.^{3}	Dry Den.	Proctor	T-180 T-99	% Comp.
8"	1	NEAR WOOD-PILE			Density	456	279	0.612	145		121		
					Moisture	424	211	0.498	91				
4"	1				Density		755	1.656	139.1				
					Moisture								
					Density								
					Moisture								
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For Moisture: $\frac{\text{Contact Counts}}{\text{Standard Counts}}$ = Count Ratio; For Density Air Gap. or Depth Probe $\frac{\text{Direct Contact Reading}}{\text{Air Gap or Standard Count Read.}}$ = Count Ratio

Remarks:
Tested By: Engineer:

NTS

-NUCLEAR TESTING SERVICES-

NUCLEAR MOISTURE-DENSITY DETERMINATION

Project Name: Crandall - Retaining Wall Date: 4/27/82
Project Number: _____ Authority Number: _____
Instrument Used and Number: 2401 #1819 Material Type: Shaft Muck

DENSITY		MOISTURE	
Air Gap ☐ 4" D.P. ☐ 6" D.P. ☐ 8" D.P. ☐			
Before	After	Before	After
1	1	1	1
2	2	2	2
3	3	3	3
Total	Total	Total	Total
Average	Average	Average	Average

	Test No.	Station Ft. Rt. or Lt. of Line	Final	Progress		Air Gap Read. or Standard Counts	Direct Contact Reading	Count Ratio	Lbs. Ft.^{3}	Dry Den.	Proctor	T-180 ~~T-99~~	% Comp.
8"	1				Density	459	303	0.660	140^5	122	125		97^6
					Moisture	410	334	0.815	18^5				
4"	1				Density	459	775	1.688	138^7	120^2			96^2
					Moisture	410	334	0.915	18^5				
					Density								
					Moisture								
8"	2				Density		278	0.649	141^5	125^9			100
					Moisture		295	0.720	15^6				
4"	2				Density		750	1.634	141^0	125^4			100
					Moisture		295	0.720	15^6				
					Density								
					Moisture								
8"	3				Density		320	0.697	137^3	115^8			92^6
					Moisture		375	0.915	21^7				
4"	3				Density		825	1.797	132^7	111^0			89^0
					Moisture		375	0.915	21^7				
					Density								
					Moisture								
8"	4				Density		318	0.693	137^7	124			97%
					Moisture		305	0.744	16^3				
4"	4				Density		714	1.556	145^3	128^7			103^1
					Moisture		305	0.744	16^3				
					Density								
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					Density								
					Moisture								

For Moisture: $\frac{\text{Contact Counts}}{\text{Standard Counts}}$ = Count Ratio; For Density Air Gap. or Depth Probe $\frac{\text{Direct Contact Reading}}{\text{Air Gap or Standard Count Read.}}$ = Count Ratio

Remarks _____
Tested By _____ Engineer _____

N|S

-NUCLEAR TESTING SERVICES-

NUCLEAR MOISTURE-DENSITY DETERMINATION

Project Name C.C. Date 4/22/81
Project Number Authority Number
Instrument Used and Number 2401 # 1819 Material Type ROAD FILL

DENSITY		MOISTURE	
Air Gap ☐ 4"D.P. ☐ 6"D.P. ☐ 8"D.P. ☐			
Before	After	Before	After
1	1	1	1
2	2	2	2
3	3	3	3
Total	Total	Total	Total
Average	Average	Average	Average

	Test No.	Station Ft. Rt. or Lt. of Line	Final	Progress		Air Gap Read. or Standard Counts	Direct Contact Reading	Count Ratio	Lbs. Ft.^{3}	Dry Den.	Proctor	T-180 (T-99)	% Comp.
8"	1	Ret. WALL 1/2			Density	458	339	0.740	134		120 9		
		Ret. SPP & 48"			Moisture	421	213	0.506	9.5				
4"	2	" "			Density	458	909	1.985	124 2		120 9		
					Moisture	421	213	0.506	9.5				
8"	3	Ret Wal East			Density	457	391	0.856	126 0		127 2		
		48" 101			Moisture	407	325	0.799	18 0				
4"	4	"			Density	457	795	1.740	135 2				
					Moisture	407	325	0.799	18 0				
					Density								
					Moisture								
8"	5	Retaining wall			Density	457	309	0.676	139 1				
					Moisture	423	299	0.707	153 0				
4"	6	"			Density	457	779	1.705	137 2				
					Moisture	423	299	0.707	153 0				
	7				Density	457	310	0.678	139 0				
					Moisture	423	307	0.726	157 3				
	8				Density	457	801	1.753	135 0				
					Moisture	423	307	0.726	157 3				
					Density								
					Moisture								
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For Moisture: $\frac{\text{Contact Counts}}{\text{Standard Counts}}$ = Count Ratio; For Density Air Gap. or Depth Probe $\frac{\text{Direct Contact Reading}}{\text{Air Gap or Standard Count Read.}}$ = Count Ratio

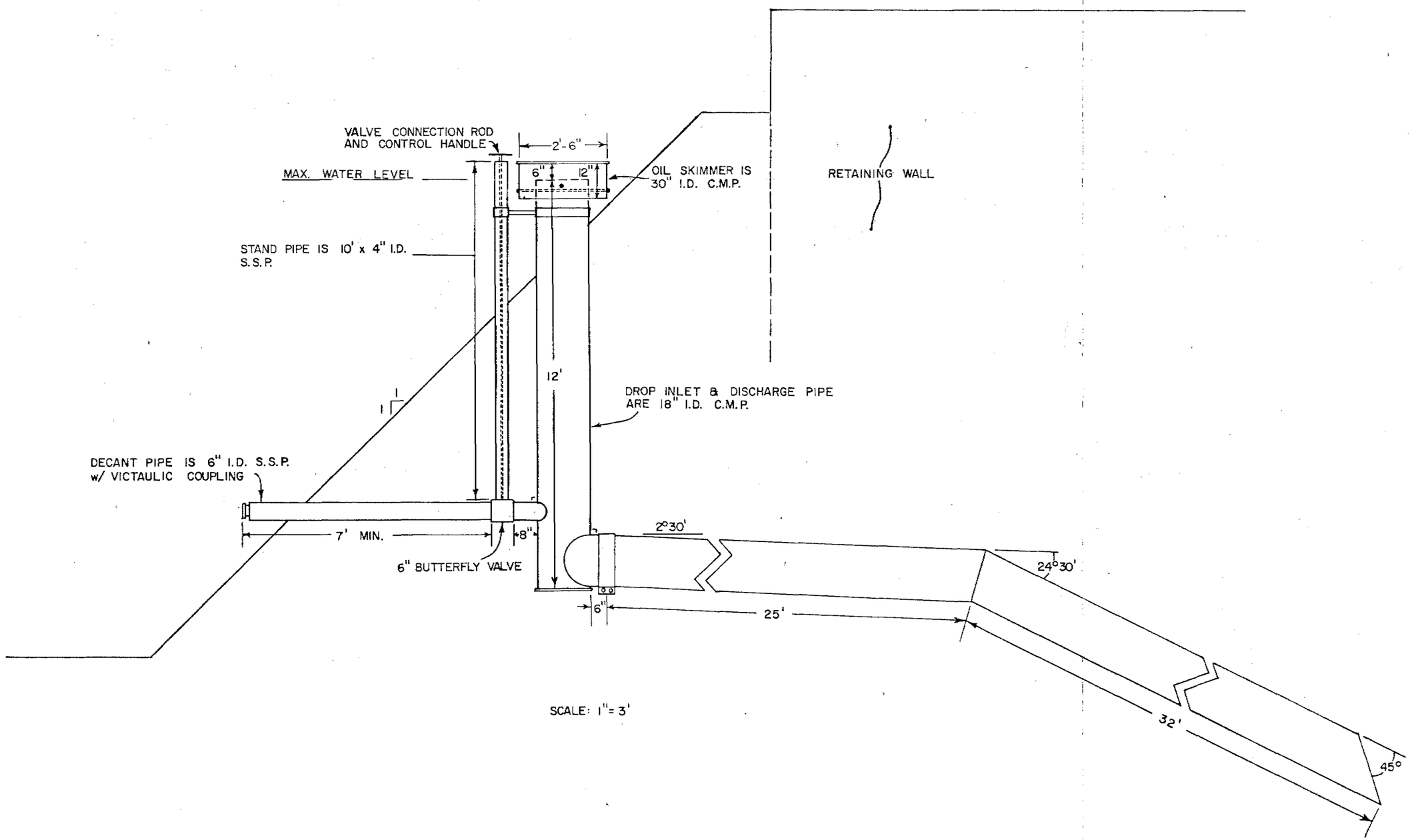
Remarks
Tested By Engineer

NTS

PRICE RIVER COAL COMPANY
ENGINEERING DEPARTMENT
HELPER, UTAH

CRANDALL CANYON POND RELOCATION OVERFLOW AND DECANT DETAIL

DRAWING NUMBER
B



DRAWN JAU 7-27-82 CHECKED.
TRACED. APPROVED FOR SAFETY.
APPROVED.

REVISIONS

REFERENCE DRAWINGS