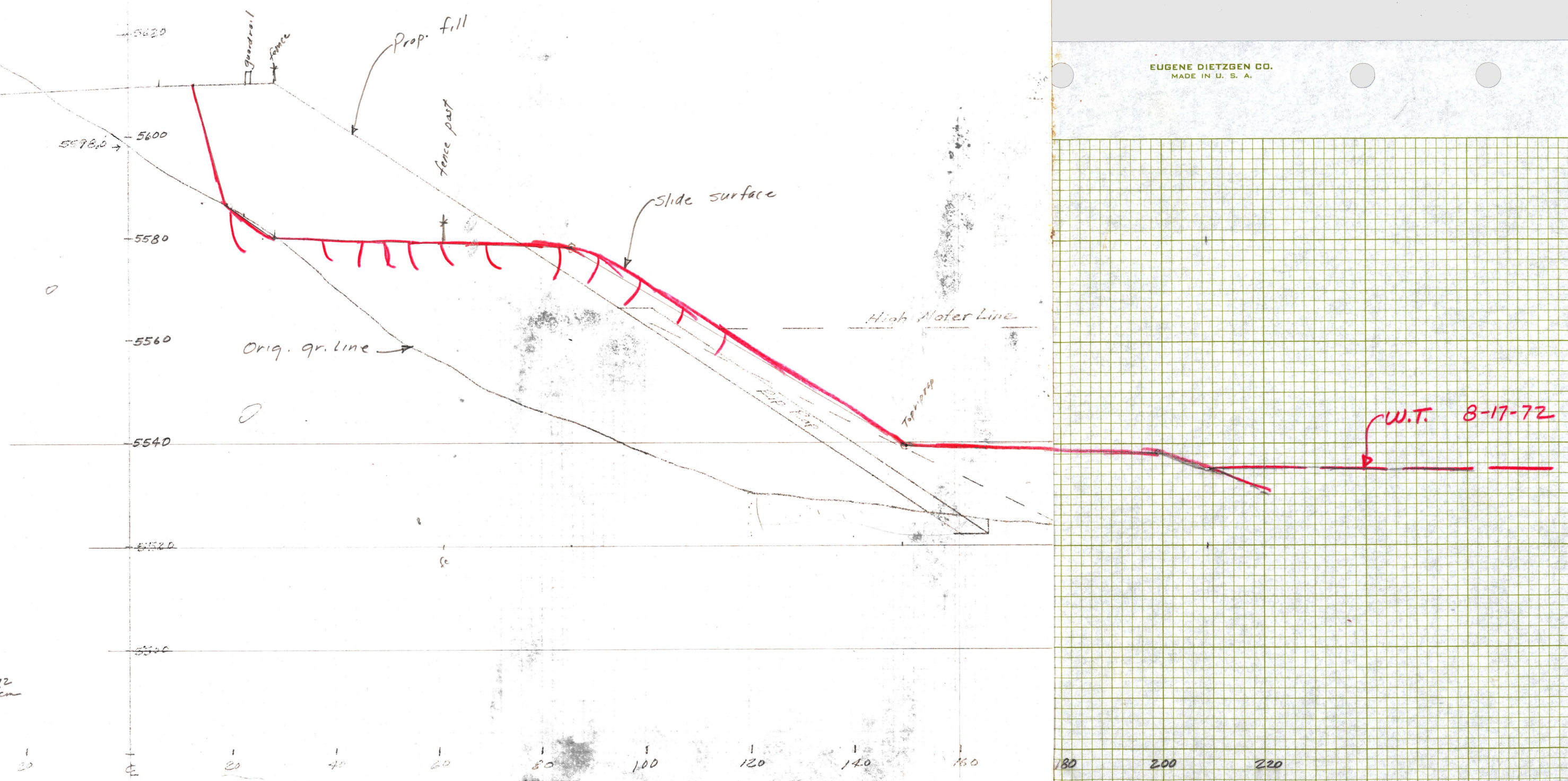


Sta. 1137.5

EUGENE DIETZGEN CO.
MADE IN U. S. A.

8-22-72
Hem



SLOPE STABILITY CALCULATION SWEDISH CIRCLE METHOD

$$F.S. = \frac{\sum N \tan \phi + \sum bcl + \sum [-W \sin \alpha]}{\sum W \sin \alpha} = \frac{15.228 + 1.850 + 0.179}{15.218} = \boxed{1.13} \text{ Factor of Safety}$$

Project No: _____
Project Name: _____
Calculated by _____ Date _____
Checked by _____ Date _____

Use battress #1 calcs w/o battress

SLOPE STABILITY CALCULATION SWEDISH CIRCLE METHOD

Replace slide material
w/ compacted granular borrow
1 1/2 : 1 Slope

Soil Layer	Slice No.	Area Ft. ²	α°	$\sin \alpha$	$\cos \alpha$	δ_T lb/Ft. ³	w_T lb/Lin.Ft.	$T_d \times 10^4$		δ_b lb/Ft. ³	w_b lb/Lin.Ft.	$N \times 10^4$		ϕ°	Ton ϕ	N Ton ϕ	L Ft.	C lb/Ft. ²	bcl $\times 10^4$ lb/Lin.Ft.
								W_T	$W_T \sin \alpha$			W_*	$W_* \cos \alpha$						
	1	228	58.7			120		2.7360	2.338	120	?	2.736	1.421	20		0.517	38	500	1.900
	2	627				120	75240			120	75240			20				0	
	3	916	37.8			130	119080	19.4320	11.910	68	62288	13.7528	8.429	40	4.866	4.866		0	
	4	1242	18			130		16.146	4.989	68		8.4456	8.032	40		6.740		0	
	5	506	5			130		6.578	0.573	68		3.4403	3.428	40		2.876		0	
Total								19.810								14.999			1.900

$$F.S. = \frac{\sum N \tan \phi + \sum bcl + \sum (-W \sin \alpha)}{\sum W \sin \alpha} = \frac{14.999 + 1.900}{19.810}$$

0.85

Factor of Safety

Where: $b = 1 \text{ Ft.}$; $w_T = \text{Total Weight}$; $w_b = \text{Buoyant Weight}$
 $W_* = \text{Sum of } w_T \text{ of layers above water table and}$
 $w_b \text{ of layers below water table.}$

Project No: _____
 Project Name: _____
 Calculated by: _____ Date: _____
 Checked by: _____ Date: _____

2.184
2.830
5.014

#33

SLOPE STABILITY CALCULATION SWEDISH CIRCLE METHOD

Granular fill
w/o batterress
2 1/2:1 slope lower

Soil Layer	Slice No.	Area Ft. ²	α°	$\sin \alpha$	$\cos \alpha$	γ_T lb/Ft. ³	w_T lb/Lin.Ft.	$T_d \times 10^4$		γ_b lb/Ft. ³	w_b lb/Lin.Ft.	$N \times 10^4$		ϕ°	$\tan \phi$	$N \tan \phi$	L Ft.	C lb/Ft. ²	$bCL \times 10^4$ lb/Lin.Ft.
								W_T	$W_T \sin \alpha$			W_*	$W_* \cos \alpha$						
	1	500				120	60 000			120	60 000			20	1.1474		37	500	1.850
	2	496	40.2			130	64 480	12.4480	8.035	68	33 728	9.3728	7.159	40		4.133			
	3	1300	22.4			130	169 000	16.900	6.440	68		8.840	8.173	40		6.858			
	4	855	10			130		11.115	1.930	68		5.814	5.726	40		4.805			
	5	504	-6			130		6.552	-0.685	68		3.427	3.408	40		2.860			
									+ 16.405										
									- 0.685										
Total																18.656			1.850

$$F.S. = \frac{\sum N \tan \phi + \sum bCL + \sum / - W \sin \alpha /}{\sum W \sin \alpha} = \frac{18.656 + 1.850 + 0.685}{16.405} = \boxed{1.29} \quad \text{Factor of Safety}$$

Where: $b = 1 \text{ Ft.}$; $w_T = \text{Total Weight}$; $w_b = \text{Buoyant Weight}$
 $W_* = \text{Sum of } w_T \text{ of layers above water table and}$
 $w_b \text{ of layers below water table.}$

Project No: _____
 Project Name: _____
 Calculated by: _____ Date: _____
 Checked by: _____ Date: _____

#33 Granular fill

w/o buttress

but w/ 3:1 slope

SLOPE STABILITY CALCULATION
SWEDISH CIRCLE METHOD

Soil Layer	Slice No.	Area Ft. ²	α°	$\sin \alpha$	$\cos \alpha$	γ_T lb/Ft. ³	w_T lb/Lin.Ft.	$T_d \times 10^4$		γ_b lb/Ft. ³	w_b lb/Lin.Ft.	$N \times 10^4$		ϕ°	Ton ϕ	N Ton ϕ	L Ft.	C lb/Ft. ²	bcl $\times 10^4$ lb/Lin.Ft.
								W_T	$W_T \sin \alpha$			W_*	$W_* \cos \alpha$						
	1	507				120	60840			120	60840			20			37	500	1.850
	2	496	40.2			130	64480	12.5320	8.089	68	33728	9.4568	7.223	40	4.170				
	3	1400	22.0			130		18.200	6.818	68		9.520	8.827	40	7.407				
	4	1005	7.0			130		13.065	1.592	68		6.834	6.783	40	5.692				
	5	825	-8			130		10.725	-1.493	68		5.610	5.555	40	4.661				
									+16.499										
									-1.493										
Total.								17.992							21.930				1.850

$$F.S. = \frac{\sum N \tan \phi + \sum bcl + \sum [-W \sin \alpha]}{\sum W \sin \alpha} = \frac{21.930 + 1.85 + 1.493}{16.499} = 1.53 \quad \text{Factor of Safety}$$

Where: $b = 1 \text{ Ft.}$; $w_T = \text{Total Weight}$; $w_b = \text{Buoyant Weight}$
 $W_* = \text{Sum of } w_T \text{ of layers above water table and}$
 $w_b \text{ of layers below water table.}$

Project No: _____
 Project Name: _____
 Calculated by: _____ Date: _____
 Checked by: _____ Date: _____

#33

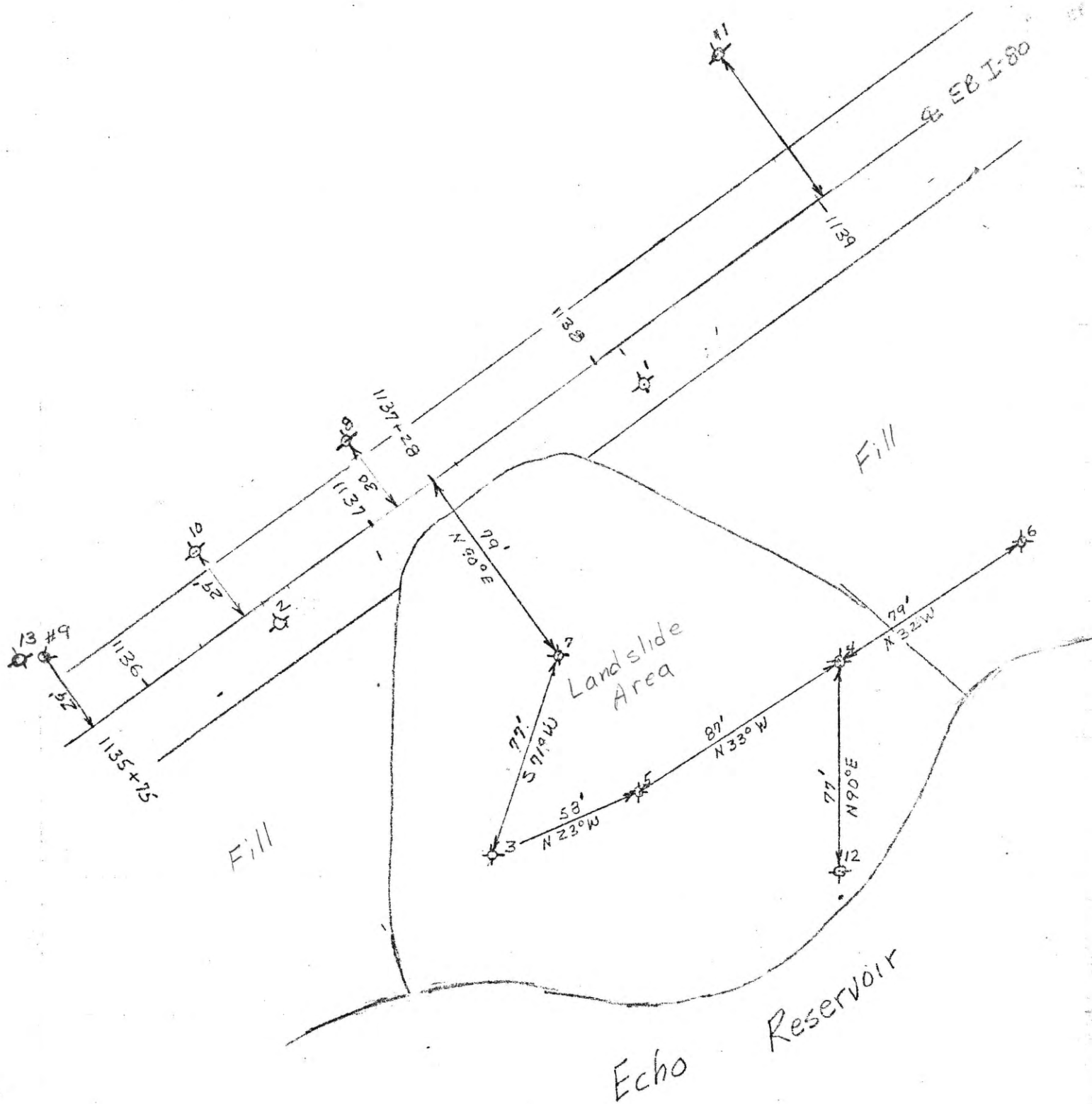
Granular fill w/
30' batterSLOPE STABILITY CALCULATION
SWEDISH CIRCLE METHOD

Soil Layer	Slice No.	Area Ft. ²	α°	$\sin \alpha$	$\cos \alpha$	γ_T lb/Ft. ³	w_T lb/Lin.Ft.	$T_d \times 10^4$		γ_b lb/Ft. ³	w_b lb/Lin.Ft.	$N \times 10^4$		ϕ°	Ton ϕ	N Ton ϕ	L Ft.	C lb/Ft. ²	bcl $\times 10^4$ lb/Lin.Ft.
								W_T	$W_T \sin \alpha$			W_*	$W_* \cos \alpha$						
	1	495	40.2			120	59400			120	59400			20	4430		37	500	1.850
	2	496	40.2			130	64480	12.388	7.996	08	33728	9.3128	7.113	40		4.007			
	3	1180	22.6			130		15.340	5.895	68		8.024	7.408	40		6.216			
	4	885	6.2			130		11.505	1.243	08		6.018	5.983	40		5.020			
	5	698	-6.4			130		-9.074	-1.012	68		4.746	4.716	40		3.957			
Total								+ 15.134								19.300			1.850

$$F.S. = \frac{\sum N \tan \phi + \sum bcl + \sum (-W \sin \alpha)}{\sum W \sin \alpha} = \frac{19.300 + 1.85 + 1.012}{15.134} = 1.46 \quad \text{Factor of Safety}$$

Where: $b = 1 \text{ Ft.}$; $w_T = \text{Total Weight}$; $w_b = \text{Buoyant Weight}$
 $W_* = \text{Sum of } w_T \text{ of layers above water table and}$
 $w_b \text{ of layers below water table.}$

Project No: _____
 Project Name: _____
 Calculated by: _____ Date: _____
 Checked by: _____ Date: _____



LEGEND

✱ Auger or Drill Hole and Number
Scale 1" = 50'

LOCATION PLA

I-80
Echo Reservoir
Landslide #2
Summit Co., UT.
Aug 28, 1972

motion, seconded by Commissioner Plant, and unanimously passed:

That we accept the recommendation of the department and close Fifth South ramp beginning Monday, August 28, and close Sixth South ramp beginning the day after Labor Day, or as soon as practical, and that the contractor be asked to expedite these projects as rapidly as possible in order to get both ramps re-opened; and that we provide whatever engineering assistance is needed to insure this is carried out.

Commissioner Plant pointed out there was no error in the way the proposal was bid in the first place, but other factors involving safety, maintenance, etc. had arisen since that time.

REPORT ON ROAD DAMAGE AT ECHO

Alex Mansour reported investigation was going on at this very moment. From a map he discussed the second slide area. We originally thought we would have to construct a retaining wall of some type. Our Materials Section has conducted borings throughout the area of the slide, about 30 - 40 feet down. We find that we run into shale, and we cannot drive piling into it. Open excavation down to the point of shale is also economically prohibitive. We think at the moment we can go back into the job and that we can bench a series of steps and refill the embankment to some appropriate slope. To repair the damage by this means will require the cooperation of the reservoir management. We propose to meet with them to see if we can leave a mass of earth in the reservoir. We would reconstruct our riprap on the first section of slide, but we must make the toe of the slope stable.

The original structure we had in mind was economically prohibitive. We were talking upwards of a half-million dollars. We feel the repair along the lines discussed will be well within \$100,000.00. It is contingent upon how well the reservoir people cooperate with us, and whether or not the slide has placed enough material at the toe of the slope to make a stable condition.

We have discussed the problem with FHWA and have been advised if we can document the fact that this is an unusual condition beyond routine maintenance, the possibility of Interstate funds is very encouraging.

*From "Minutes of the meeting of the S.R.C.
August 25, 1972*

Memorandum

UTAH STATE DEPARTMENT OF HIGHWAYS

DATE: September 20, 1972

TO : George W. Bohn, Division Engineer
08-42.3 Federal Highway Administration

FROM : Alex E. Mansour, P.E.
08-RD Chief, Roadway Design Division

SUBJECT: I-80-4(38)160 - Coalville to Echo Junction
Slide at Station 1137+25+
"u"

This memorandum is in response to our telephone conversation of September 15, 1972, in which we were requested to furnish additional supporting data to that submitted with our memorandum of September 5, 1972.

Three copies of the slope stability calculations are attached. The slip plane is shown on the cross sections used in these analyses. Four different conditions were assumed for these analyses as follow:

- (1) Soil and water conditions just before failure
- (2) Rock-gravel buttress replacing existing materials at the toe without drains
- (3) Rock buttress with embankment drained by means of trench drains
- (4) Rock buttress with disturbed slide materials all removed and replaced by free draining granular borrow.

Conditions 3 and 4 were considered theoretically satisfactory methods for making the repair. However, because of anticipated construction difficulties in adopting condition 3, it was decided to remove all the slide material as indicated in condition 4.

Three copies of logs of drill holes shown on Sheet 5 of the plans are also attached. It will be noted from the drill hole logs that the elevation of the collar for drill hole #12 is 5540 instead of 5530 shown on the plans. The profile for the slide between drill hole #5 and drill hole #12 is incorrectly plotted. With the proper plot for drill hole #12, we believe that excavation to 5510 will carry through the loose sandy silty strata and into the dense sand and gravel strata indicated by the log.

The estimated location of the slide plane is based on data obtained from the drill holes. It is anticipated that the benches shown on Sheet 2 of the plans will be excavated into natural ground below the slip plane. The precise location of the benches will have to be determined during excavation of the slide material.

The granular backfill material for underdrains is intended to meet the specification requirements on page 271 of the Standard Specifications for the coarse graded material, except that 100 percent of the material shall pass a 6-inch sieve size. It is not required that the material

"safe today - alive tomorrow"

George W. Bohn, Division Engineer
Federal Highway Administration 08-42.3
September 20, 1972
Page 2

be uniformly graded to 6" maximum. The 6" size was stipulated on the basis that most of the material would pass the 2½" but that a few rocks from 2½" to 6" size would not be objectionable in the granular backfill.

We trust the foregoing information will be adequate for your consideration of our proposed design and will permit participation with Interstate funds on repair of the slide.

Attachments

AEM/OHMillikan:jfh

cc: Blaine J. Kay
D. L. Sargent
W. J. Stephenson
J. Q. Adair - District #2
Byron M. Parker

   
ROUTING SLIP N-2
Indicate by Check Mark
Persons Concerned

() W. J. Stephenson
() Dale E. Peterson
(~~✓~~) ~~David Price~~
() Norman W. Coombs
() Heber Vlam
() Carl Craner
() Ronald Delis
() Keith Bishop
() Wade Betenson
() Max Wiley
() Fred Bennett
() Victor Sorbe
() Earl Barnes
() Sherman Jensen
() George Brox
() Ed Keane
() Marvin Stevens
() Mac Burton
() Tom Eward
() Mark Chipman
() Blanche Christensen
() Nora Barber
(*✓*) *Loren Pauscher*
(*✓*) *Gerry Maughan*

For your info Dave

SLOPE STABILITY CALCULATION SWEDISH CIRCLE METHOD

19°

520

Soil Layer	Slice No.	Area Ft. ²	α°	Sin α	Cos α	δ _T lb/Ft. ³	w _T lb/Lin.Ft.	Td x 10 ⁴		δ _b lb/Ft. ³	w _b lb/Lin.Ft.	Nx 10 ⁴		φ°	Tan φ	N Tan φ	L Ft.	C lb/Ft. ²	bclx10 ⁴ lb/Lin.Ft.
								W _T	W _T Sin α			W*	W*Cos. α						
1	1	22				130	2860											520	
2	2	49	61.5°	.8788	.4771	140	6860	9720	+8542			.4638	19	.3443	0.1597	16	0	.8320	
2	3	125	53°	.7986	.6018	140	17500	17500	+13976			1.0532	19		2.3626	12.5		.6500	
2	4	254				140	35560												
3	5	327	36.5°	.5948	.8038	70	22890	58450	+3.4767			4.6985	19		1.6177	35		1.8200	
3	6	287	20.5°	.3502	.9367	70	20090	20090	+7036			1.8818	19		0.6479	16		.8320	
3	7	400 402	7.5°	.1305	.9914	70	28000	+28000	+3655			2.7760	19		0.9558	23.3		1.2116	
3	8	420 424	-14°	-.2419	.9702	70	29400	-29400	-7112			2.8527	19		0.9822	43.5		2.2620	

$$F.S. = \frac{\sum N \tan \phi + \sum bcl + \sum (-W \sin \alpha)}{\sum W \sin \alpha} = \frac{4.726 + 7.608 / -7.11}{6.798} = \boxed{1.7} \quad \text{Factor of Safety}$$

Where: b = 1 Ft.; w_T = Total Weight; w_b = Buoyant Weight
W* = Sum of w_T of layers above water table and
w_b of layers below water table.

Project No: _____
Project Name: Echo Res
Calculated by: Keene Date 8-23-72
Checked by: _____ Date _____

PAGE 7 OF

NOTES:

[illegible]

$$\begin{array}{r} 6 \\ 2.5 \\ \hline 15.0 \end{array}$$

R-452

GENERAL PURPOSE CARD PUNCHING FORM

PAGE 2 OF

JOB		Coalville #2
BY	DATE 9/12/72	

PUNCHING INSTRUCTIONS

[illegible]

NOTES:

FIELD IDENTIFICATION

	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
	800.	5608.						
	965.	5698.						
	1017.	5584.						
	1055.	5560.						
2	1080.	5546.						
2	1137.	5514.						
	1500.	5514.						
	800.	5608.						
	965.	5608.						
	1017.	5584.						
	1055.	5560.						
2	1140.	5510.						
2	1200.	5495.						
2	1500.	5495.						
2	800.	5400.						
2	900.	5400.						
2	1000.	5400.						
2	1100.	5400.						
2	1200.	5400.						
2	1300.	5400.						
2	1500.	5400.						

R-452

GENERAL PURPOSE CARD PUNCHING FORM

PAGE 3 OF

JOB		Coxsack # 2	
BY		DATE	9/12/72

PUNCHING INSTRUCTIONS

[illegible]

NOTES:

FIELD IDENTIFICATION

[illegible]

R-452

PAGE 1 OF

JOB		Corbello Slide # 2	
BY		DATE 9/12/72	

WRITTEN AS:

PUNCH AS:

NOTES:

FIELD IDENTIFICATION

	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
x	COALHILLE SLIDE NO. 2 8-15-72 2 SUMMIT SIZED 236 2 Pure emulsion							
	09.12.72							
x	SLOPE = 1, STD 1, 2 TO 1, FROM 5566, GRANULAR BOP ROCK EMBARKMENT, 30 FT BUTTRESS AT 5540							
	0							
x	1100 5600 1265 5660 60 160 710000 15 15 10							
	800. 5608.							
	1028. 5608.							
	1090. 5566.							
x	1142. 5540.							
x	1172. 5540.							
x	1224. 5514.							
	1500. 5514.							
x	10 5 4 4 9 2 1							
	800. 5608.							
	965. 5608.							
	1017. 5584.							
	1055. 5560.							
x	1102. 5560.							
x	1142. 5540.							
x	1172. 5540.							

$$\begin{array}{r}
 1142 \\
 1090 \\
 \hline
 52
 \end{array}$$

26

$$\begin{array}{r}
 5540 \\
 5514 \\
 \hline
 26
 \end{array}$$

PAGE 2 OF

PUNCHING INSTRUCTIONS

[illegible]

FIELD IDENTIFICATION

	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
x 1,224.	5514.							
1,500.	5514.							
800.	5608.							
965.	5608.							
10,17.	5584.							
1055.	5560.							
10,80.	5546.							
1,137.	5514.							
x 1,309.	5514.							
x 1,400.	5514.							
1,500.	5514.							
800.	5608.							
965.	5608.							
10,17.	5584.							
1055.	5560.							
1,140.	5510.							
1,200.	5495.							
x 1,300.	5495.							
x 1,400.	5495.							
1,500.	5495.							

R-452

GENERAL PURPOSE CARD PUNCHING FORM

PAGE 3 OF

JOB	
BY	DATE

PUNCHING INSTRUCTIONS

[illegible]

NOTES:

FIELD IDENTIFICATION

1-10										11-20										21-30										31-40										41-50										51-60										61-70										71-80									
1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
800.										5400.																																																																					
x 850.										5400.																																																																					
900.										5400.																																																																					
1,000.										54,000.																																																																					
1,100.										54,000.																																																																					
1,200.										54,000.																																																																					
1,300.										54,000.																																																																					
x 1,400.										54,000.																																																																					
1,500.										54,000.																																																																					
500.										.3640										120.																																																											
0.										.8391										130.																																																											
0.										.8391										130.																																																											
4000.										.8391										150.																																																											
800.																				5608.																																																											
965.																				5608.																																																											
1017.																				5584.																																																											
1055.																				5560.																																																											
1500.																				5560.																																																											

1 = 130
2 = 140
3 = 70

SLOPE STABILITY CALCULATION SWEDISH CIRCLE METHOD

Soil layer	Slice No.	Area Ft. ²	α°	$\sin \alpha$	$\cos \alpha$	δ_T lb/Ft. ³	w_T lb/Lin.Ft.	$T_d \times 10^4$		δ_b lb/Ft. ³	w_b lb/Lin.Ft.	$N \times 10^4$		ϕ°	Tan ϕ	N Tan ϕ	L Ft.	C lb/Ft. ²	bCLx10 ⁴ lb/Lin.Ft.
								W_T	$W_T \sin \alpha$			W_*	$W_* \cos \alpha$						
1	1	45	70	.940	.342	130	5850	5850	.5457	130	3150	.3150	1.077	19	.344	.0371	19.5	520	1.014
2	2	140				140	19600			70	9800								
2	3	164	55.7	.826	.564	140	22960	42560	3.5159	70	11480	2.128	1.199	19		.4129	280	0	1.456
2	4	20				140	2800				2800								
2	5	200				140	28000				2800								
3	6	38	45.5	.713	.7009	70	2660	33460	2.387	70	2660	3.346	2.345	19		.807	12.5	520	.650
2	7	420				140	58800			130	58800								
3	8	580	29.5	.492	.870	70	40600	99400	4.895	70	40600	7.00	6.09			2.977	34	520	1.768
2	9	112				140	15680			70	7840								
3	10	826	9	.1564	.988	70	57820	73500	1.150	70	57820	6.566	6.485			2.233	29	520	1.508
2	11	62.5				140	8750			70	4375								
3	12	750	-8	.1392	.990	70	5250	14000	-1.948	70	52500	5.6875	5.632			1.939	25.5	520	1.326
2	13	90				140	5600			70	2800								
3	14	4705	-23.5	.399	.917	70	32900	38500	-1.535	70	32900	3.57	3.274			1.127	22	520	1.144
3	15	170	-36	.588	.809	70	11900	11900	-.699	70	11900	1.19	.963			.331	22	520	1.144
								-4.18											
Total								8.3154								9.966			9.98

$$F.S. = \frac{\sum N \tan \phi + \sum b c L + \sum (-W \sin \alpha)}{\sum W \sin \alpha} = \frac{9.9 + 10.0 + 4.2}{12.5} = 1.25 \quad \text{Factor of Safety}$$

Where: $b = 1 \text{ Ft.}$; $w_T = \text{Total Weight}$; $w_b = \text{Buoyant Weight}$
 $W_* = \text{Sum of } w_T \text{ of layers above water table and}$
 $w_b \text{ of layers below water table.}$

Project No: _____
 Project Name: Echo Res.
 Calculated by: _____ Date 8-23-72
 Checked by: _____ Date _____

Buttress:

The buttress shall be constructed of three layers; (1) 10 feet of riprap at bottom; (2) 3 feet of riprap on top, and (3) layer of granular backfill in the middle section.

Drainage Trenches:

Shall be filled to a depth of five feet with granular backfill material as per Section 603.03 except that 100 percent of the material shall pass the 6 inch sieve opening instead of the 2 1/2 inch opening.

Granular Borrow:

At top of embankment, the granular borrow shall meet specification Section 204.

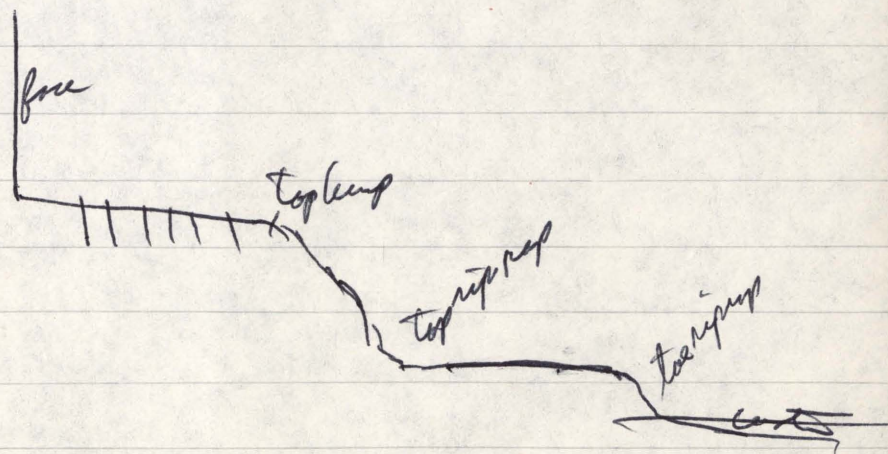
A-1-a or A-1-b

Rip Rap:

Shall meet specification section 611.

8-17-72

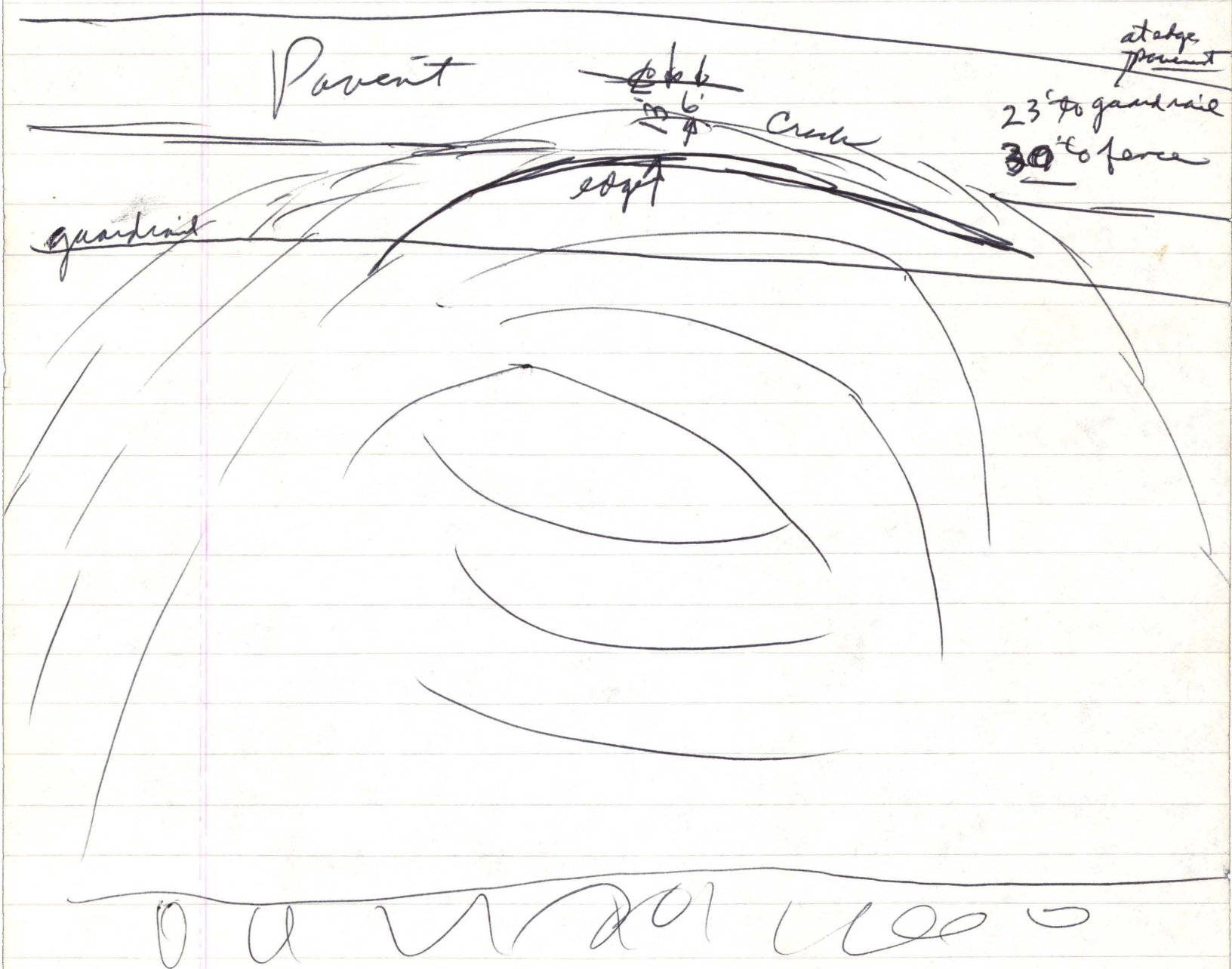
		For sight	Elev	
☒	1137+00			
☒	1138+50	3.8	5610.4	HI = 5614.2
	1137+50	Back		
☒	1139+00	5.4	5608.8	
	1137+25			
☒	1138+75	4.6	5609.6	
	1137+25			
edge asph.	1138+75	4.7	5609.5	HI
T.P.		For	Back	
		12.2	5602.0	1.3 5603.3
T.P.		12.6	5690.7	0.0 5690.7
T.P.		12.6	5678.1	0.0 5678.1
T.P.	Highwater mark?	12.3	5665.8	0.8 5666.6
	above riprap			
T.P.		12.0	5654.6	0.9 5655.5
Bot. riprap		5.5	5650.0	
T.P.		12.5	5643.0	1.5 5644.5
TP Water level		9.2	5635.3	10.0 5645.3
10' E of water		7.3	5638.0	
60' E of water old top riprap		5.0	5639.5	
near horizontal loc of top old fill				
125' E of water to top hump			5678.1	
150' E to new fence line				
183' E to fence				
		2' higher	5680	than top hump at old fence line



17
11
10
27
65
25
33

top hump
new fence line
to face of slide

Slide scars at sides are on same
slope angle as fill slope above!



Top shale 2.5' higher than E 1138+50
ditch line left of 1137+10 -

free water in clumpy silt above shale

bedding dip 25° West -

apparent dip 16° to slide - N 10° W

UTAH STATE DEPARTMENT OF HIGHWAYS

MATERIALS & TESTS DIVISION

SOILS UNIT

AASHO CLASSIFICATION
OF SOILS

Form R-22

FE 8-31-72

PROJECT NAME Echo Reservoir Slide # 2

PROJECT NO. _____

SOURCE OF
MATERIAL: Sta

SOIL
BORROW
SAMPLE

T.H.# or
BORING

2-12.0'

DEPTH

Screen Size	Weight Retained	Percent Retained		Spec's		Percent Passing 3" Material	① DATE <u>8-24-72</u> LAB. NO. <u>72-7-FS-49</u>	
+ 3" Boulders								
3"	0.0	0.0			3"	100		
2"					2"			
1 1/2"					1 1/2"			
1"					1"			
3/4"					3/4"			
# 4					# 4			
-# 4 Wet ()								
-# 4 Dry								
Total		100.0						
			Percent Passing # 4 Mat'l					
# 10	1.3	.6	99.4'		# 10	99'		
# 40	10.0	4.3	95.1'		# 40	95'		
# 200	46.4	20.1	75.0'		# 200	75'		
-# 200	172.8	75.0			AASHO CLASSIFICATION			
Total	230.5	100.0			A-6 (12)			
MOISTURE DETERMINATION						L.L.	40-	Soluble Salts sent to chem. lab. Date
Hygro. Oven Wash Wash						P.L.	21-	
Beaker #	5-77				5-7	P.I.	19-	
Wet Soil + Beaker	444.2			Wet Soil + Beaker	465.5	% Gr.	1'	
Dry Soil + Beaker	428.3			Beaker	218.2	% C.S.	4'	
H ₂ O	15.9'			Wet Soil	247.3'	% F.S.	20'	
Dry Soil + Beaker	428.3					% S & C	75'	
Beaker	209.5						100	
Dry Weight	218.8'			Dry Weight	230.5'	Remarks.		
Percent H ₂ O	7.3'			Percent H ₂ O				

Tested by

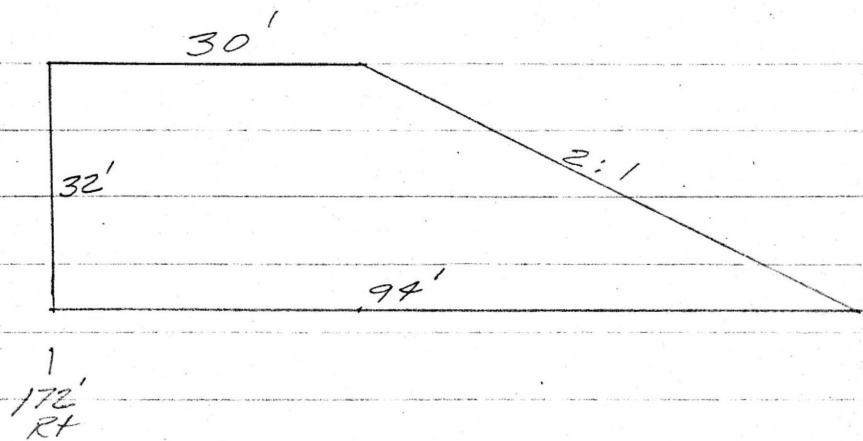
Phil S.

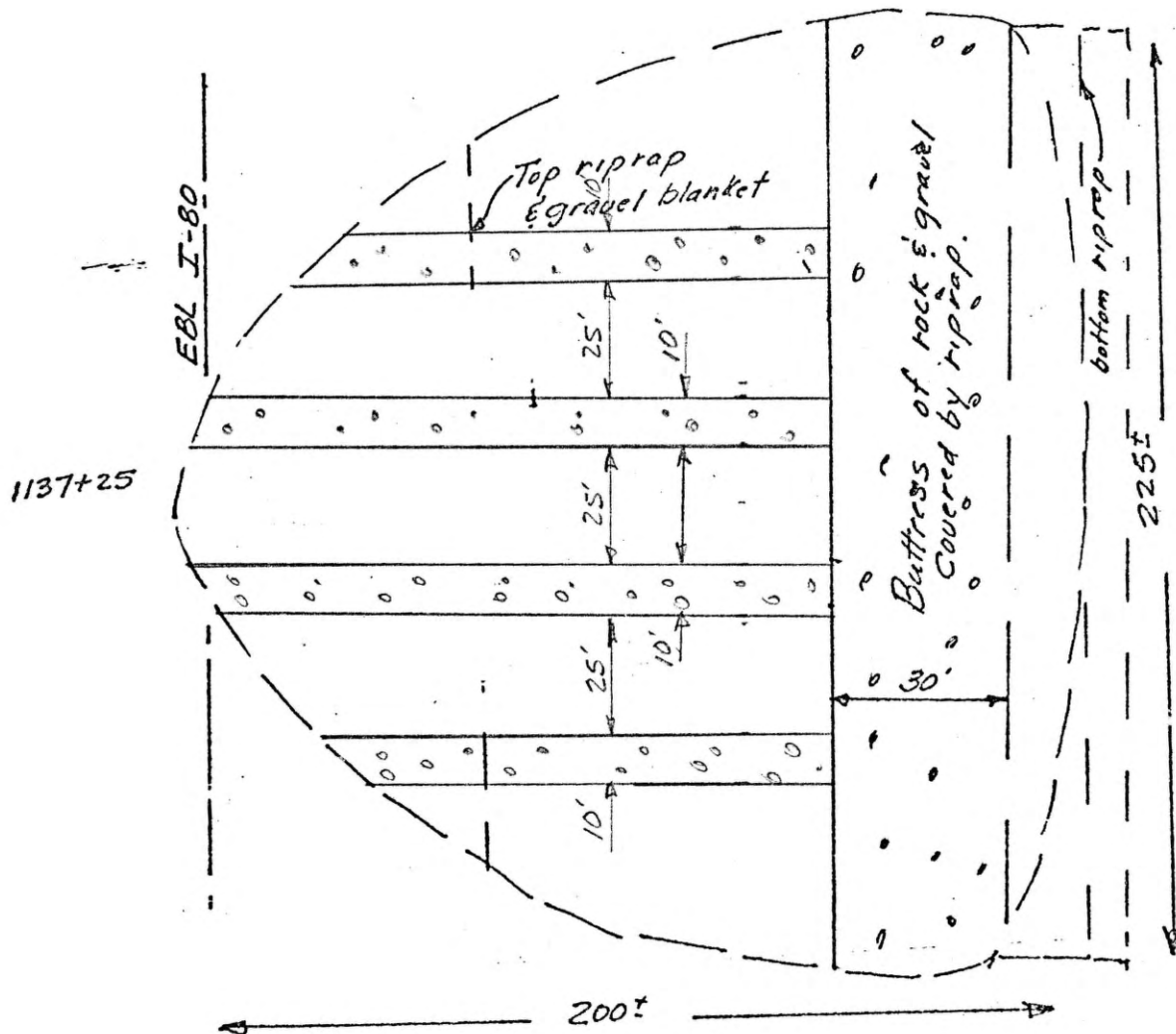
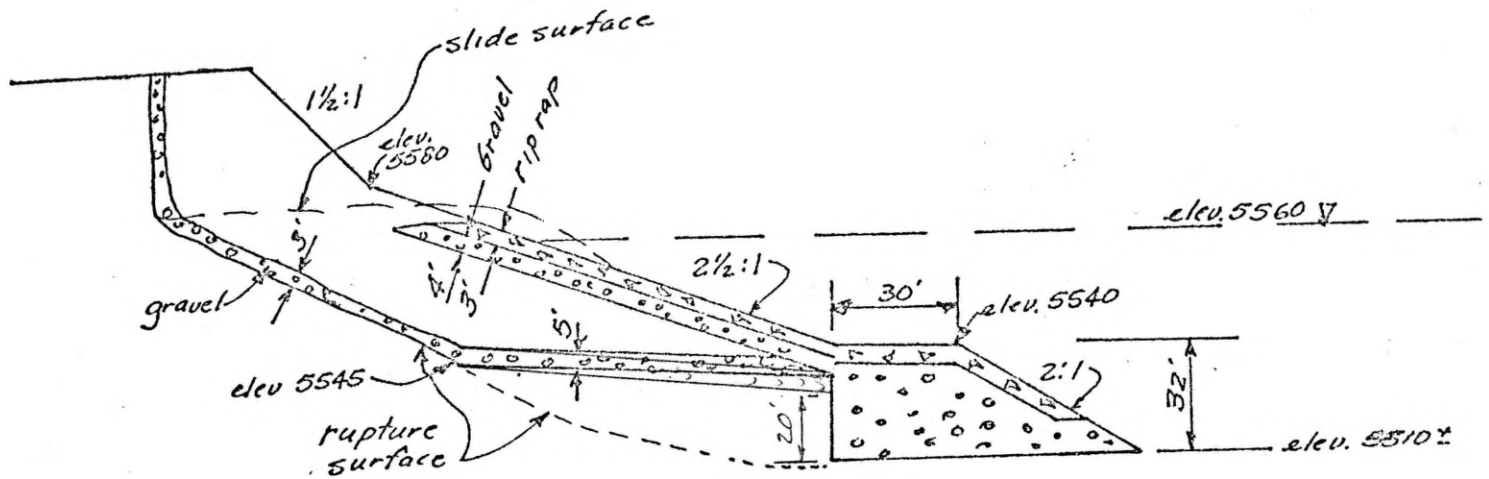
Materials Engineer

Proposal #1

1. Excavate very loose silt at toe of slide to elevation 5510' and replace with compacted rock-gravel buttress as shown in schematic sketch.
2. Excavate two trenches, 10' wide at bottom, from buttress to intersection of slide plane and elevation 5545', thence along slide plane to the slide scarp. Clean and smooth trenches, backfill with compacted free draining gravel 5 feet deep. Build embankment over trenches with available materials to surface slope of $2\frac{1}{2}:1$ from top of buttress to elevation 5580', thence on $1\frac{1}{2}:1$ slope to grade.
3. Slope surface of embankment should include a 4' layer of free draining gravel topped

with a 3 foot layer of riprap
from elevation 5520' to 5564'





Proposed Repair
 Slide of
 8-15-72

Schematic
 (no scale)

Buttress:

see ~~SP~~

Bottom 10 feet - riprap spec.
material.

Upper 20 feet - similar spec
to ^{hand-placed} riprap ^{materials} except 30 % of
the rock shall be not less than
 $\frac{1}{3}$ ft³ in vol.

Trench Drains

5 feet of free-draining (open
graded gravel)
granular backfill (C03.03)
 < 3% - 200

Above free-draining gravel:
pit-run gravel (for
strength and filter action)
granular borrow ?
A-1-a or A-1-b
[A-2-4, A-2-5] ~~and A-2-6~~

4. Original design should have included a granular blanket beneath the fill to allow drainage of ground water seepage ^{from the fill} (see ~~and~~ ^{section} where toe of fill is in high water of lake) should ^{have} been specifically constructed with ^{gently sloping} layers of free-draining material to allow drainage of fill materials

4' Gravel filter under slope
riprap
open graded gravel
base ~~riprap~~ gravel
"granular backfill borrow"

5 Displacement control monuments
at toe of slide

4 Piezometers

I-80-4(9)160
West Limits of Cosville to Echo Jet.

Justification for Change in Design
near Station 1136 to 1139

I Soil and Geologic Information Pertaining
to Original Design

1. Materials Report
2. Soil Survey Profiles
3. Geological Recon. Report
- ~~4. Consultants Report~~

SUMMARY - The original soils
survey and geologic report
indicated bedrock near the
ground surface with the beds
dipping into the hillside on

the left. The soil cover developed over these beds in this area classified A-2-4, A-4(6) and A-6(6). No known seeps or other ground water problems were detected at that time.

A fault which runs westerly near the head of the slide was not noted. This fault has possibly aggravated the unstable slope condition in that the clayey siltstone and shale beds have been

broken and shattered, rendering them more vulnerable to weathering and decomposition. The fault zone has also acted as a conduit for ground water seepage, which further contributes to the weathering process. The result of this decomposition is typically a silt-clay soil.

II Decomposition of Embankment Materials

Materials used for construction of the fills were commonly siltstone, sandstone and shale.

The siltstones and shales have broken down into silt-clay materials which have low frictional resistance to shearing and low permeability impeding the escape of water from the soil pores.

III Unusual and Originally Unanticipated Hydrologic Conditions

We believe the primary direct cause of the slide has been the unusually rapid drawdown of Echo Reservoir. This rapid drawdown of the

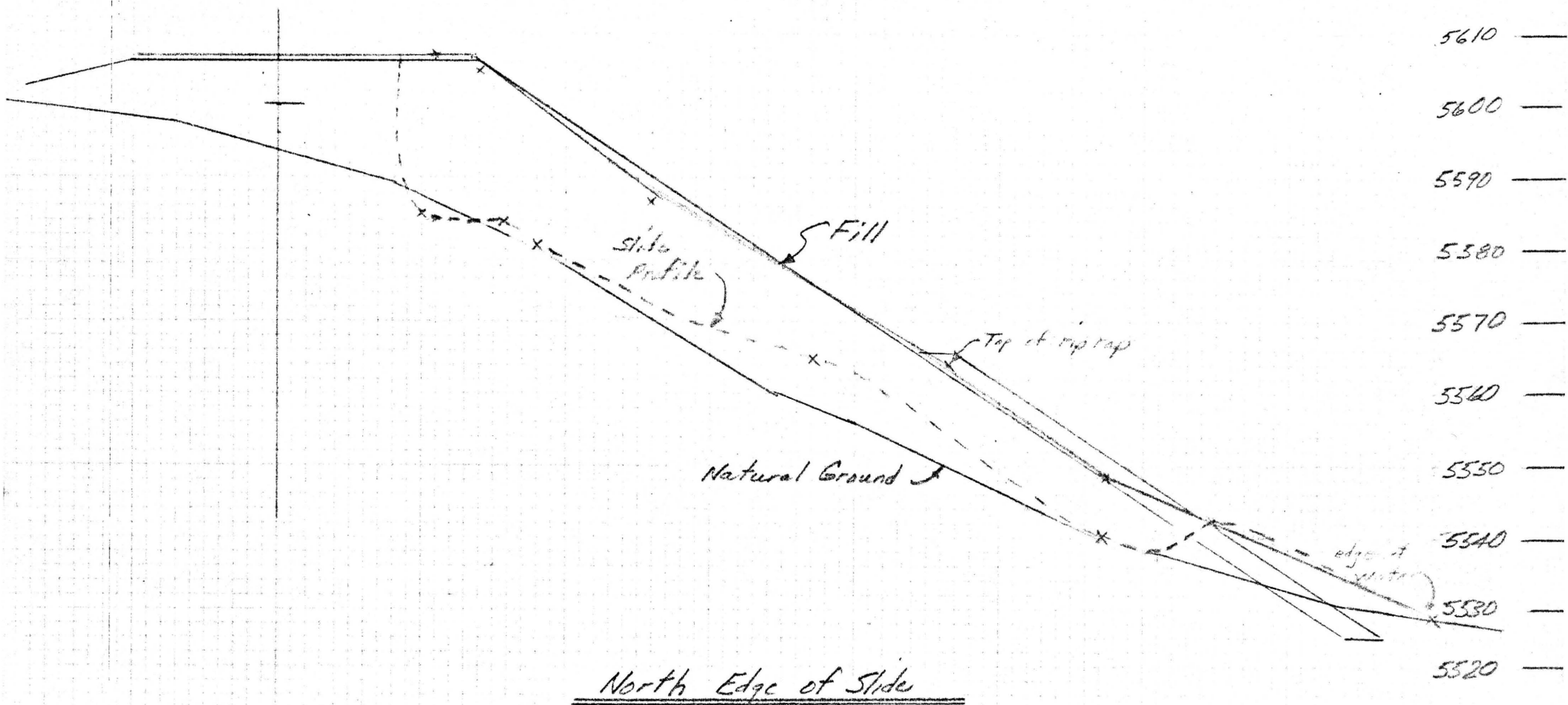
water level caused unstable slope conditions in the embankment below the high water line by:

(a) removal of neutral or buoyancy forces without water drainage, causing a more severe loading condition; (b) a reduction in shear strength because the permeability of the embankment materials is too low to allow sufficiently rapid pore water drainage.

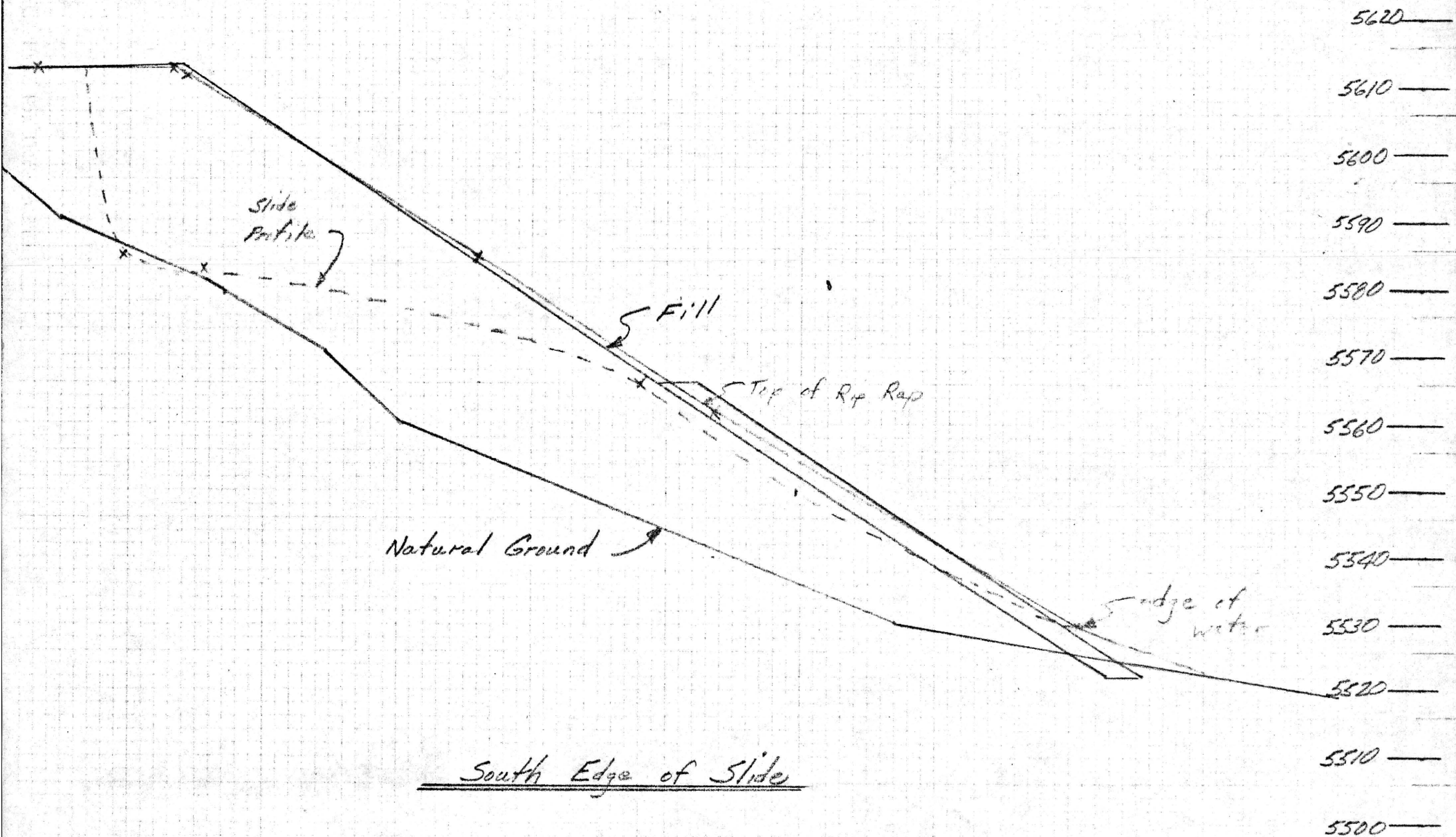
IV Changed Environmental Conditions

Field observations and borehole data indicate that ground water movement may have increased in the affected area (as well as in the area of the first slide) this year over that of the past several years.

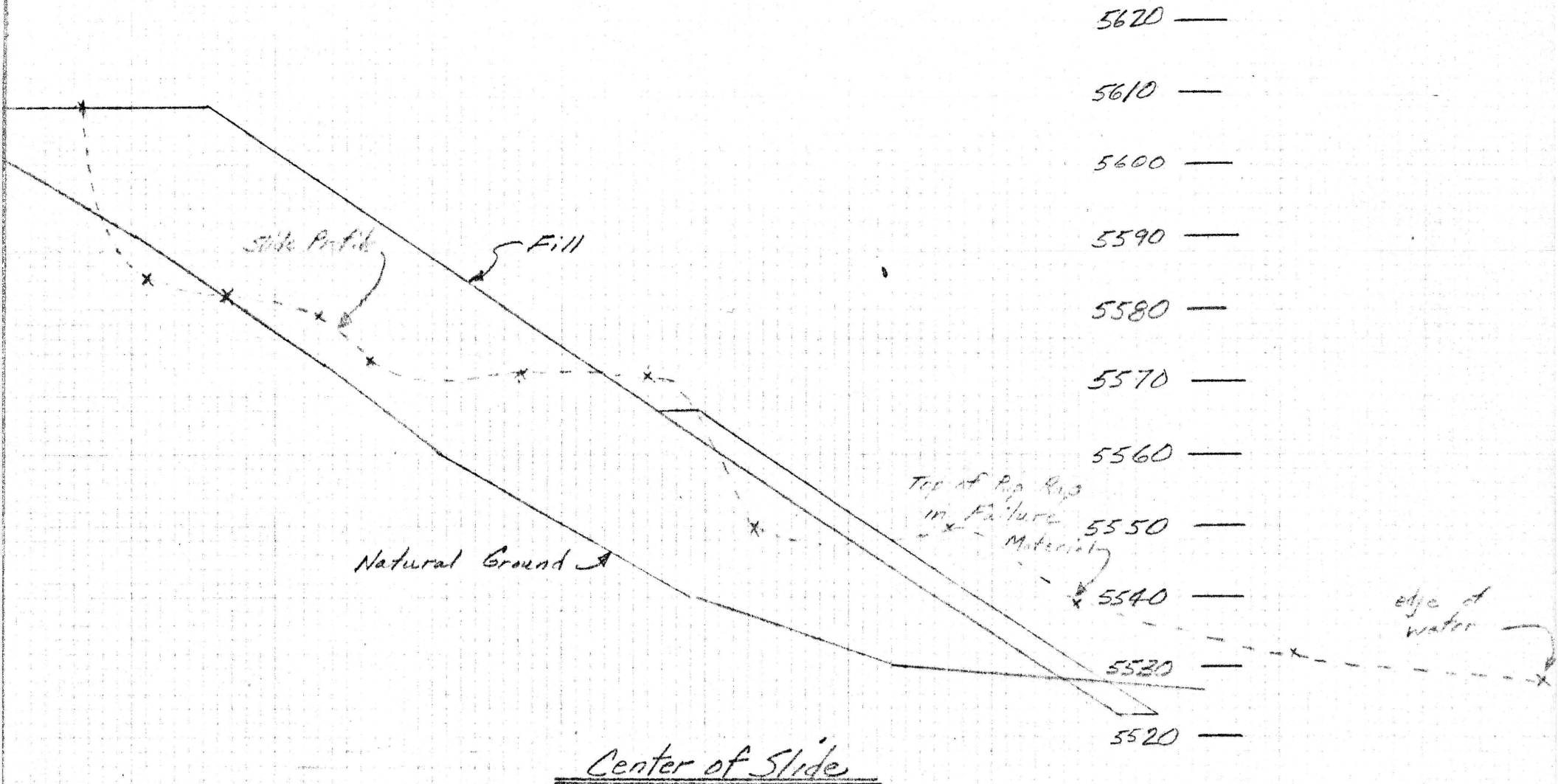
Sta 1138+00



Sta 1136+50



1137+50



U#FSS99106,
ID:432628 5785 GCM

TO CONTINUE TYPE-- NEW OR TYPE-- OLD

USED .12 UNITS
OLD RI80EBL

READY

100 72,2,3,16,1,20,0,20,.5,3,5
160 63,-42,78,-48,-120,.364,500,1
170 28,-48,78,-42,-68,.839,0,1
180 78,-42,193,-94,-68,.839,0,1
190 28,-48,52,-62,150,.839,4000,1
200 52,-62,112,-98,150,.839,4000,1
210 197,-94,400,-94,58,.364,400,1
220 193,-94,203,-98,-68,.839,0,1
230 112,-98,205,-98,68,.839,0,1
240 205,-98,400,-98,68,.839,0,1
250 112,-98,172,-113,150,.839,4000,1
260 172,-113,400,-113,150,.839,4000,1
270 -1
280 8*0

290
300
REPLACE

READY
LIST RI80EBL

RI80EBL 13:33PDT 09/14/72

100 72,2,3,16,1,20,0,20,.5,3,5
110 -100,0,-63,0,150,.839,4000,1
120 -63,0,0,0,-120,.364,500,1
130 0,0,63,-42,-120,.364,500,1
140 -63,0,-11,-24,150,.839,4000,1
150 -11,-24,28,-48,150,.839,4000,1
160 63,-42,78,-48,-120,.364,500,1
170 28,-48,78,-42,-68,.839,0,1
180 78,-42,193,-94,-68,.839,0,1
190 28,-48,52,-62,150,.839,4000,1
200 52,-62,112,-98,150,.839,4000,1
210 197,-94,400,-94,58,.364,400,1
220 193,-94,203,-98,-68,.839,0,1
230 112,-98,205,-98,68,.839,0,1
240 205,-98,400,-98,68,.839,0,1
250 112,-98,172,-113,150,.839,4000,1
260 172,-113,400,-113,150,.839,4000,1
270 -1
280 8*0
290
300

READY
OLD S0ILXS***

READY
RUN

S0ILXS 13:36PDT 09/14/72

VERSION DATED 10/7/71 LIST S0IINF***

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?)

DATA FILE NAME IS ?RI80EBL

I N P U T D A T A

IDENTIFICATION NO. = 72 2 3

NO. OF LINES IN SECTION = 16

SFMIN= 0.500 SFMAX= 3.000 DELHGR= 5.000

N	X1	Y1	X2	Y2	W	F	C	U
1	-100.0	0.	-63.0	0.	150.000	0.839	4000.	1.000
2	-63.0	0.	0.	0.	-120.000	0.364	500.	1.000
3	0.	0.	63.0	-42.0	-120.000	0.364	500.	1.000
4	-63.0	0.	-11.0	-24.0	150.000	0.839	4000.	1.000
5	-11.0	-24.0	28.0	-48.0	150.000	0.839	4000.	1.000
6	63.0	-42.0	78.0	-48.0	-120.000	0.364	500.	1.000
7	28.0	-48.0	78.0	-42.0	-68.000	0.839	0.	1.000
8	78.0	-42.0	193.0	-94.0	-68.000	0.839	0.	1.000
9	28.0	-48.0	52.0	-62.0	150.000	0.839	4000.	1.000
10	52.0	-62.0	112.0	-98.0	150.000	0.839	4000.	1.000
11	197.0	-94.0	400.0	-94.0	58.000	0.364	400.	1.000
12	193.0	-94.0	203.0	-98.0	-68.000	0.839	0.	1.000
13	112.0	-98.0	205.0	-98.0	68.000	0.839	0.	1.000
14	205.0857535.0		400.0	-98.0	68.000	0.839	0.	1.000
15	112.0	-98.0	172.0	-113.0	150.000	0.839	4000.	1.000
16	172.0	-113.0	400.0	-113.0	150.000	0.839	4000.	1.000

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 20.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= 0.
INITIAL RADIUS OF FAILURE ARC (FT) R= 20.0

O U T P U T D A T A

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
19574.0	7615.1	10386.3	20.0	0.	20.0	2.618
26057.2	16216.8	19377.1	20.0	0.	25.0	2.132
32471.1	27422.1	29074.7	20.0	0.	30.0	2.060
38857.9	41210.8	39831.6	20.0	0.	35.0	2.010
30959.3	22298.7	27326.0	25.0	0.	30.0	1.949
37386.5	35355.1	39189.0	25.0	0.	35.0	1.856
35860.4	29337.0	36608.9	30.0	0.	35.0	1.781
42299.6	44268.6	50729.5	30.0	0.	40.0	1.706
40762.6	37332.0	47225.6	35.0	0.	40.0	1.654
45661.0	46283.7	59176.2	40.0	0.	45.0	1.554
47324.1	51400.3	65557.6	40.0	5.0	50.0	1.506
45668.2	43289.8	59679.9	45.0	5.0	50.0	1.491

SQRT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

810 SOILX\$

SQRT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

890 SOILX\$

SQRT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

890 SOILX\$

SQRT(-B) NOT AL

USED 16.17 UNITS

RUN

S0ILX\$ 13:43PDT 09/14/72

VERSION DATED 10/7/71 LIST S0IINF***

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?2

INPUT NEW H,G, AND R
VALUES?144,30,131

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT)	H=	144.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT)	G=	30.0
INITIAL RADIUS OF FAILURE ARC (FT)	R=	131.0

OUTPUT DATA

COHESIVE FRICTIONAL OVERTURNING HORIZ. VERT. RADIUS S.F.

DIVISION BY ZERO

LINE CALLING-ROUTINE

460 S0ILX\$

WARNING: VALUE OUT OF RANGE ENCOUNTERED DURING EXECUTION LINE 480

WARNING: VALUE OUT OF RANGE ENCOUNTERED DURING EXECUTION LINE 500

WARNING: VALUE OUT OF RANGE ENCOUNTERED DURING EXECUTION LINE 520

WARNING: VALUE OUT OF RANGE

USED 2.82 UNITS

OLD RI80EBL

READY

100 72,2,3,16,1,90,-10,60,.5,3,5

REPLACE

READY

OLD S0ILX\$***

READY

RUN

S0ILX\$ 13:48PDT 09/14/72

VERSION DATED 10/7/71 LIST S0IINF***

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?1

DATA FILE NAME IS ?RI80EBL

INPUT DATA

INPUT DATA

IDENTIFICATION NO. = 72 2 3

NO. OF LINES IN SECTION = 16

SFMIN= 0.500 SFMAX= 3.000 DELHGR= 5.000

N	X1	Y1	X2	Y2	W	F	C	U
1	-100.0	0.	-63.0	0.	150.000	0.839	4000.	1.000
2	-63.0	0.	0.	0.	-120.000	0.364	500.	1.000
3	0.	0.	63.0	-42.0	-120.000	0.364	500.	1.000
4	-63.0	0.	-11.0	-24.0	150.000	0.839	4000.	1.000
5	-11.0	-24.0	28.0	-48.0	150.000	0.839	4000.	1.000
6	63.0	-42.0	78.0	-48.0	-120.000	0.364	500.	1.000
7	28.0	-48.0	78.0	-42.0	-68.000	0.839	0.	1.000
8	78.0	-42.0	193.0	-94.0	-68.000	0.839	0.	1.000
9	28.0	-48.0	52.0	-62.0	150.000	0.839	4000.	1.000
10	52.0	-62.0	112.0	-98.0	150.000	0.839	4000.	1.000
11	197.0	-94.0	400.0	-94.0	53.000	0.364	400.	1.000
12	193.0	-94.0	203.0	-98.0	-63.000	0.839	0.	1.000
13	112.0	-98.0	205.0	-98.0	68.000	0.839	0.	1.000
14	205.0857535.0		400.0	-98.0	68.000	0.839	0.	1.000
15	112.0	-98.0	172.0	-113.0	150.000	0.839	4000.	1.000
16	172.0	-113.0	400.0	-113.0	150.000	0.839	4000.	1.000

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 90.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= -10.0
INITIAL RADIUS OF FAILURE ARC (FT) R= 60.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
14142.2	93522.3	46286.2	90.0	-10.0	60.0	2.326
14016.0	110125.9	53864.6	95.0	-10.0	65.0	2.305

SQRT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

810 SOILX\$
SQRT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

890 SOILX\$
SQRT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

890 SOILX\$
SQRT(-B) NOT ALLOWED EVALUATE FOR +B

USED 11.95 UNITS
OLD R180EBL

READY
230 112,-98,203,-98,68,.839,0,1
240 203,-98,400,-98,68,.839,0,1
REPLACE

READY
OLD SOILX\$***

READY
RUN

S0ILX\$ 13:56PDT 09/14/72

VERSION DATED 10/7/71 LIST S0IINF***

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?1

DATA FILE NAME IS ?K180EBL

INPUT DATA

IDENTIFICATION NO. = 72 2 3

NO. OF LINES IN SECTION = 16

SFMIN= 0.500 SFMAX= 3.000 DELHGR= 5.000

N	X1	Y1	X2	Y2	W	F	C	U
1	-100.0	0.	-63.0	0.	150.000	0.839	4000.	1.000
2	-63.0	0.	0.	0.	-120.000	0.364	500.	1.000
3	0.	0.	63.0	-42.0	-120.000	0.364	500.	1.000
4	-63.0	0.	-11.0	-24.0	150.000	0.839	4000.	1.000
5	-11.0	-24.0	28.0	-48.0	150.000	0.839	4000.	1.000
6	63.0	-42.0	78.0	-48.0	-120.000	0.364	500.	1.000
7	28.0	-48.0	78.0	-42.0	-68.000	0.839	0.	1.000
8	78.0	-42.0	193.0	-94.0	-68.000	0.839	0.	1.000
9	28.0	-48.0	52.0	-62.0	150.000	0.839	4000.	1.000
10	52.0	-62.0	112.0	-98.0	150.000	0.839	4000.	1.000
11	197.0	-94.0	400.0	-94.0	58.000	0.364	400.	1.000
12	193.0	-94.0	203.0	-98.0	-68.000	0.839	0.	1.000
13	112.0	-98.0	203.0	-98.0	68.000	0.839	0.	1.000
14	203.0	-98.0	400.0	-98.0	68.000	0.839	0.	1.000
15	112.0	-98.0	172.0	-113.0	150.000	0.839	4000.	1.000
16	172.0	-113.0	400.0	-113.0	150.000	0.839	4000.	1.000

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 90.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= -10.0
INITIAL RADIUS OF FAILURE ARC (FT) R= 60.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
14142.2	93522.3	46286.2	90.0	-10.0	60.0	2.326
14016.0	110125.9	53864.6	95.0	-10.0	65.0	2.305
13898.0	85088.0	43359.7	95.0	-5.0	65.0	2.283
16101.8	118500.2	61649.7	95.0	-5.0	70.0	2.183
16018.5	91632.2	49733.9	95.0	0.	70.0	2.165
18214.5	127050.9	69839.1	95.0	0.	75.0	2.080
18420.1	107627.5	60620.3	90.0	0.	70.0	2.079
20709.1	120343.6	71345.5	85.0	0.	70.0	1.977

RETURN PROBLEM TO ENGINEER

RETURN PROBLEM TO ENGINEER
 THE SAFETY FACTOR IS ABOVE MAX OR BELOW MIN OR THE RADIUS
 BECOMES LESS THAN THE INITIAL RADIUS.
 INPUT NEW H,G, AND R
 VALUES?70,0,40

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 70.0
 INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= 0.
 INITIAL RADIUS OF FAILURE ARC (FT) R= 40.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
9701.6	549.1	989.2	70.0	0.	40.0	10.362
20533.9	8615.2	11626.5	70.0	0.	45.0	2.507
20993.6	32262.3	26032.3	70.0	0.	50.0	2.046
22297.6	60499.1	43250.1	70.0	0.	55.0	1.914
23818.9	94175.2	62575.0	70.0	0.	60.0	1.886
23279.5	113603.3	72754.8	75.0	0.	65.0	1.881
23882.7	85057.0	59747.7	75.0	5.0	65.0	1.823
26211.3	102092.4	71102.6	70.0	5.0	65.0	1.804
27167.2	77286.7	61139.7	65.0	5.0	60.0	1.708
28862.4	56299.2	51023.3	60.0	5.0	55.0	1.669
31347.9	66809.5	61975.4	55.0	5.0	55.0	1.584
44104.5	35331.4	51474.9	50.0	5.0	50.0	1.543
45668.2	43289.8	59679.9	45.0	5.0	50.0	1.491
47227.4	47966.9	65215.3	45.0	10.0	55.0	1.460
48778.7	52520.1	69898.5	45.0	15.0	60.0	1.449
44406.3	46085.2	63069.5	50.0	15.0	60.0	1.435
45063.2	50695.7	67508.3	50.0	20.0	65.0	1.418
45739.9	55106.2	71358.1	50.0	25.0	70.0	1.413
46411.1	59371.4	74887.1	50.0	30.0	75.0	1.413

MINIMUM SAFETY FACTOR

46411.1	59371.4	74887.1	50.0	30.0	75.0	1.413
---------	---------	---------	------	------	------	-------

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?2

INPUT NEW H,G, AND R
 VALUES?144,30,131

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 144.0
 INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= 30.0
 INITIAL RADIUS OF FAILURE ARC (FT) R= 131.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
302018.1	238039.3	122152.7	144.0	30.0	131.0	4.421

RETURN PROBLEM TO ENGINEER
 THE SAFETY FACTOR IS ABOVE MAX OR BELOW MIN OR THE RADIUS
 BECOMES LESS THAN THE INITIAL RADIUS.
 INPUT NEW H,G, AND R
 VALUES?120,-50,30

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT)	H=	120.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT)	G=	-50.0
INITIAL RADIUS OF FAILURE ARC (FT)	R=	30.0

OUTPUT DATA

	COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
0.	40571.0	14258.1	120.0	-50.0	30.0	2.845	
0.	35046.6	13137.0	125.0	-50.0	30.0	2.668	
0.	29679.0	11763.6	130.0	-50.0	30.0	2.523	
0.	24507.4	10207.2	135.0	-50.0	30.0	2.401	
0.	19571.5	8528.3	140.0	-50.0	30.0	2.295	
0.	14918.7	6780.5	145.0	-50.0	30.0	2.200	
0.	10611.6	5018.5	150.0	-50.0	30.0	2.114	
0.	6738.0	3309.1	155.0	-50.0	30.0	2.036	
0.	3430.1	1746.1	160.0	-50.0	30.0	1.964	
0.	924.6	487.0	165.0	-50.0	30.0	1.899	

SORT(-B) NOT ALLOWED EVALUATE FOR +B

LINE CALLING-ROUTINE

890 SOILXS
Z

USED 47.64 UNITS
BYE

0079.32 CRU 0000.81 TCH 0014.71 KC

OFF AT 14:09PDT 09/14/72

5785
?R<[W[SW<WWW4SVI
U#=FSS99106, MON
ID:432628 0236 GM

INVALID PROJECT ID:
PROJECT ID MUST BE ENTERED AS FOLLOWS:

432628 XXXX III

WHERE:

XXXX = FOUR DIGIT AUTHORITY NUMBER.
III = TWO OR THREE OF USERS INITIALS.

IF YOU ARE STILL HAVING PROBLEMS CALL GARY JENKINS 328-5744

U#=FSS99106,
ID:432628 5942 GM

TO CONTINUE TYPE-- NEW OR TYPE-- OLD

USED .14 UNITS
NEW RI80EBL

READY

100 72,2,5,18,1,90,-30,100,.5,3,10
110 -100,0,-63,0,150,.839,4000,1
120 -63,0,0,0,-120,.364,500,1
130 0,0,63,-42,-120,.364,500,1
140 -63,0,-11,-24,150,.839,4000,1
150 -11,-24,28,-48,150,.839,4000,1
160 63,-42,75,-48,-120,.364,500,1
170 28,-48,75,-48,-68,.839,0,1
180 75,-48,115,-68,-68,.839,0,1
190 115,-68,145,-68,-68,.839,0,1
200 28,-48,52,-62,150,.839,4000,1
210 52,-62,112,-98,150,.839,4000,1
220 145,-68,197,-94,-68,.839,0,1
230 197,-94,400,-94,58,.364,400,1
240 197,-94,205,-98,-68,.839,0,1
250 112,-98,205,-98,68,.839,0,1
260 205,-98,400,-98,68,.839,0,1
270 112,-98,172,-113,150,.839,4000,1
280 172,-113,400,-113,150,.839,4000,1
290 -1
300 8*0
SAVW
FORMAT NOT CORRECT
READY
SAVE

READY
OLD SOILX\$***

READY
RUN

SOILX\$ 14:04PDT 09/13/72

VERSION DATED 10/7/71 LIST SOIINF***

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?)

DATA FILE NAME IS ?RI80EBL

INPUT DATA

IDENTIFICATION NO. = 72 2 5

NO. OF LINES IN SECTION = 18

SFMIN= 0.500 SFMAX= 3.000 DELHGR= 10.000

N	X1	Y1	X2	Y2	W	F	C	U
1	-100.0	0.	-63.0	0.	150.000	0.839	4000.	1.000
2	-63.0	0.	0.	0.	-120.000	0.364	500.	1.000
3	0.	0.	63.0	-42.0	-120.000	0.364	500.	1.000
4	-63.0	0.	-11.0	-24.0	150.000	0.839	4000.	1.000
5	-11.0	-24.0	28.0	-48.0	150.000	0.839	4000.	1.000
6	63.0	-42.0	75.0	-48.0	-120.000	0.364	500.	1.000
7	28.0	-48.0	75.0	-48.0	-68.000	0.839	0.	1.000
8	75.0	-48.0	115.0	-68.0	-68.000	0.839	0.	1.000
9	115.0	-68.0	145.0	-68.0	-68.000	0.839	0.	1.000
10	28.0	-48.0	52.0	-62.0	150.000	0.839	4000.	1.000
11	52.0	-62.0	112.0	-98.0	150.000	0.839	4000.	1.000
12	145.0	-68.0	197.0	-94.0	-68.000	0.839	0.	1.000
13	197.0	-94.0	400.0	-94.0	58.000	0.364	400.	1.000
14	197.0	-94.0	205.0	-98.0	-68.000	0.839	0.	1.000
15	112.0	-98.0	205.0	-98.0	68.000	0.839	0.	1.000
16	205.0	-98.0	400.0	-98.0	68.000	0.839	0.	1.000
17	112.0	-98.0	172.0	-113.0	150.000	0.839	4000.	1.000
18	172.0	-113.0	400.0	-113.0	150.000	0.839	4000.	1.000

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 90.0
 INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= -30.0
 INITIAL RADIUS OF FAILURE ARC (FT) R= 100.0

OUTPUT DATA

COHESIVE FRICTIONAL OVERTURNING HORIZ. VERT. RADIUS S.F.

875218.8 308424.6 93575.1 90.0 -30.0 100.0 12.649

RETURN PROBLEM TO ENGINEER

THE SAFETY FACTOR IS ABOVE MAX OR BELOW MIN OR THE RADIUS
 BECOMES LESS THAN THE INITIAL RADIUS.

INPUT NEW H,G, AND R
 VALUES?40,0,50

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 40.0
 INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= 0.
 INITIAL RADIUS OF FAILURE ARC (FT) R= 50.0

OUTPUT DATA

COHESIVE FRICTIONAL OVERTURNING HORIZ. VERT. RADIUS S.F.

158894.0 131646.4 72444.5 40.0 0. 50.0 4.011

RETURN PROBLEM TO ENGINEER

THE SAFETY FACTOR IS ABOVE MAX OR BELOW MIN OR THE RADIUS
 BECOMES LESS THAN THE INITIAL RADIUS.

INPUT NEW H,G, AND R
 VALUES?90,-30,40

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 90.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= -30.0
INITIAL RADIUS OF FAILURE ARC (FT) R= 40.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
7616.6	42698.2	24589.9	90.0	-30.0	40.0	2.046
7710.0	63581.8	36911.6	80.0	-30.0	40.0	1.931

RETURN PROBLEM TO ENGINEER
THE SAFETY FACTOR IS ABOVE MAX OR BELOW MIN OR THE RADIUS
BECOMES LESS THAN THE INITIAL RADIUS.

INPUT NEW H,G, AND R
VALUES?60,-30,30

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 60.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= -30.0
INITIAL RADIUS OF FAILURE ARC (FT) R= 30.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
5047.7	61306.5	31348.3	60.0	-30.0	30.0	2.117
8038.7	39667.8	24531.3	70.0	-30.0	30.0	1.945
7710.0	63581.8	36911.6	80.0	-30.0	40.0	1.931
11942.1	31583.7	23255.6	80.0	-20.0	40.0	1.872
14846.3	81194.2	52810.6	80.0	-20.0	50.0	1.819
16143.8	41778.1	33480.7	80.0	-10.0	50.0	1.730
15228.4	69625.6	49181.6	90.0	-10.0	60.0	1.725
19231.0	84961.3	63965.5	90.0	0.	70.0	1.629
20479.2	52941.4	45241.3	80.0	0.	60.0	1.623
24330.7	82611.3	67276.5	70.0	0.	60.0	1.590

RETURN PROBLEM TO ENGINEER
THE SAFETY FACTOR IS ABOVE MAX OR BELOW MIN OR THE RADIUS
BECOMES LESS THAN THE INITIAL RADIUS.

INPUT NEW H,G, AND R
VALUES?70,0,40

INITIAL X COORD. OF CENTER OF FAILURE ARC (FT) H= 70.0
INITIAL Y COORD. OF CENTER OF FAILURE ARC (FT) G= 0.
INITIAL RADIUS OF FAILURE ARC (FT) R= 40.0

OUTPUT DATA

COHESIVE	FRICTIONAL	OVERTURNING	HORIZ.	VERT.	RADIUS	S.F.
9701.6	549.1	989.2	70.0	0.	40.0	10.362
24631.1	23775.7	27756.2	70.0	0.	50.0	1.744
24330.7	82611.3	67276.5	70.0	0.	60.0	1.590
28879.2	98409.4	84295.1	70.0	10.0	70.0	1.510
33980.0	55412.7	59947.0	60.0	10.0	60.0	1.491
36427.0	65900.5	72900.8	60.0	20.0	70.0	1.404
38474.6	76163.7	82630.7	60.0	30.0	80.0	1.387
40440.6	56388.5	71644.3	70.0	40.0	90.0	1.352
42329.0	65057.9	79698.4	70.0	50.0	100.0	1.347

MINIMUM SAFETY FACTOR

42329.0	65057.9	79698.4	70.0	50.0	100.0	1.347
---------	---------	---------	------	------	-------	-------

ENTER OPTION CODE (1=NEW CASE, 2=NEW H,G,R, 3=STOP?3

PROGRAM STOP AT 2060

USED 45.71 UNITS

>0<

46.07

44.45

42.73

40.93

39.03

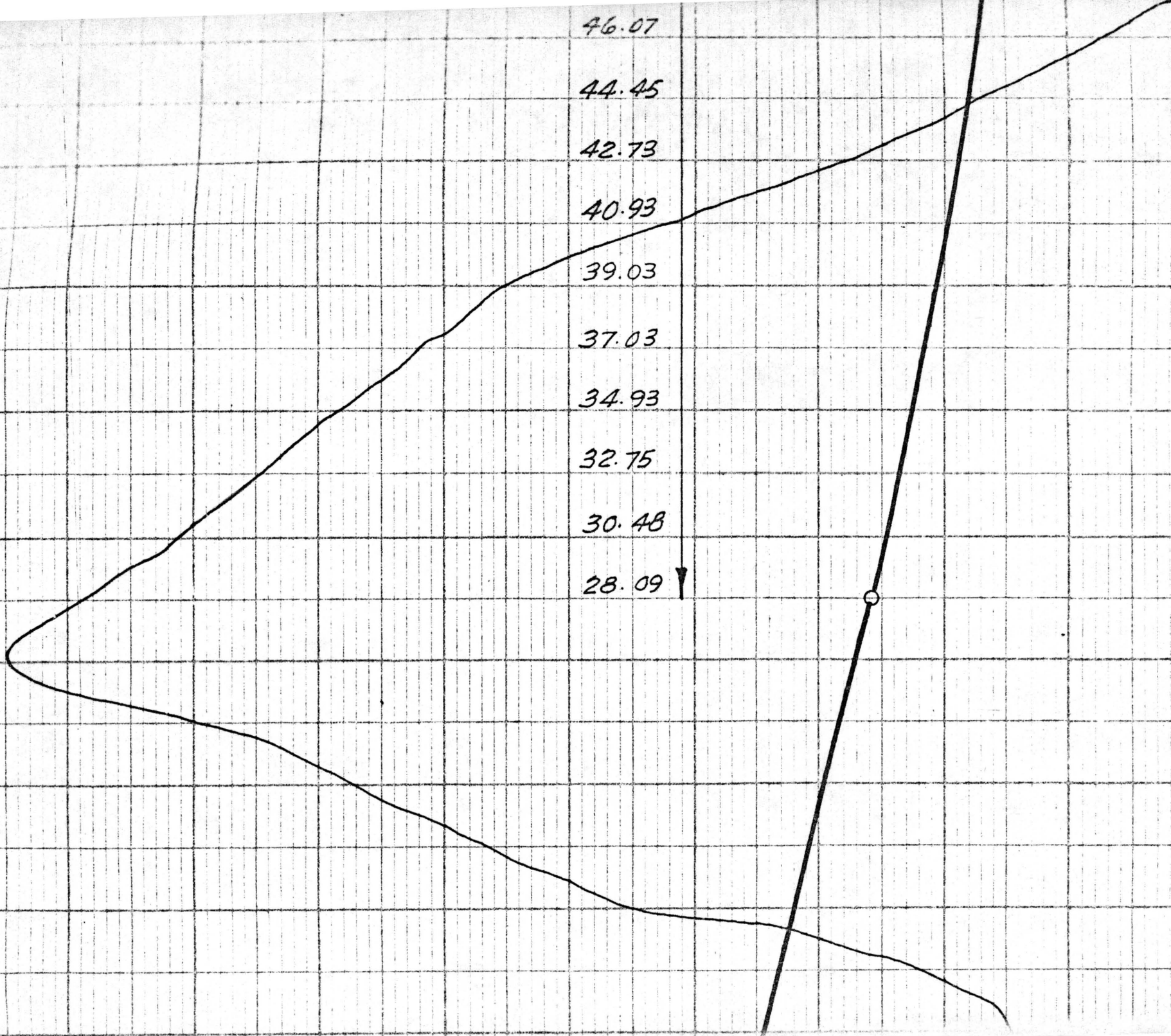
37.03

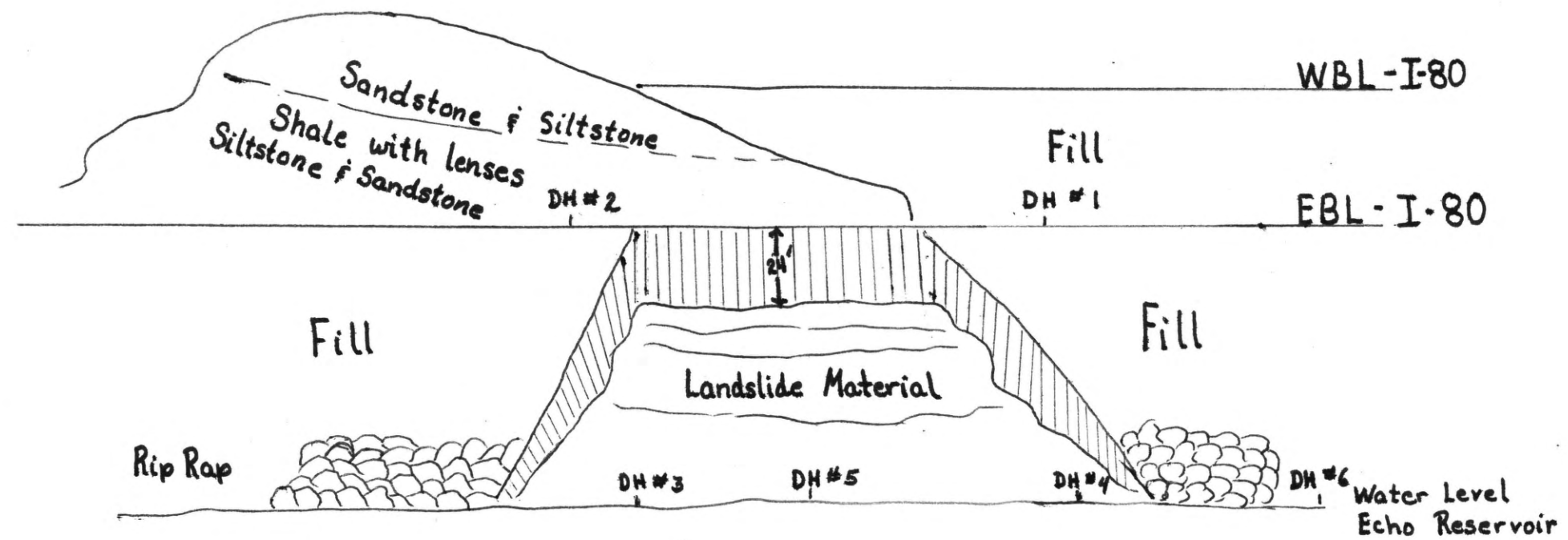
34.93

32.75

30.48

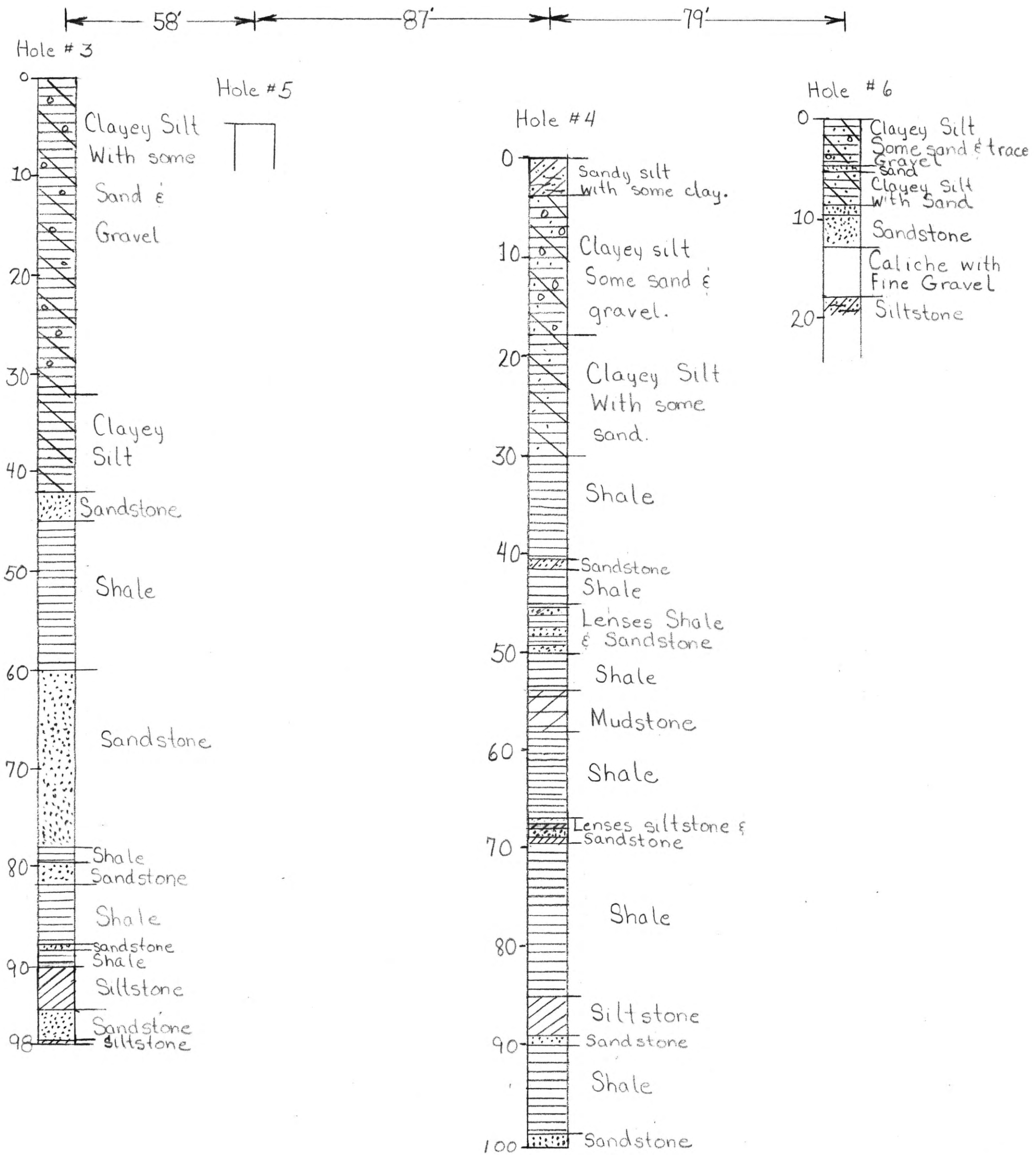
28.09





Generalized Profile of Slide #2 Area

Generalized Cross Section at Toe of Landslide

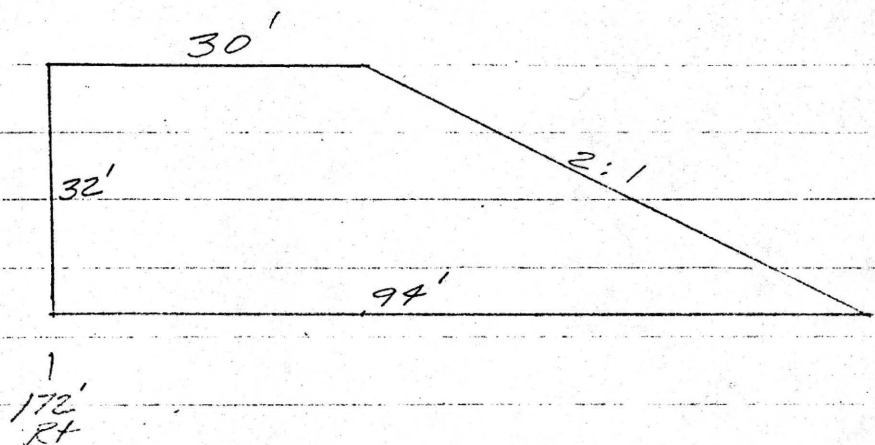


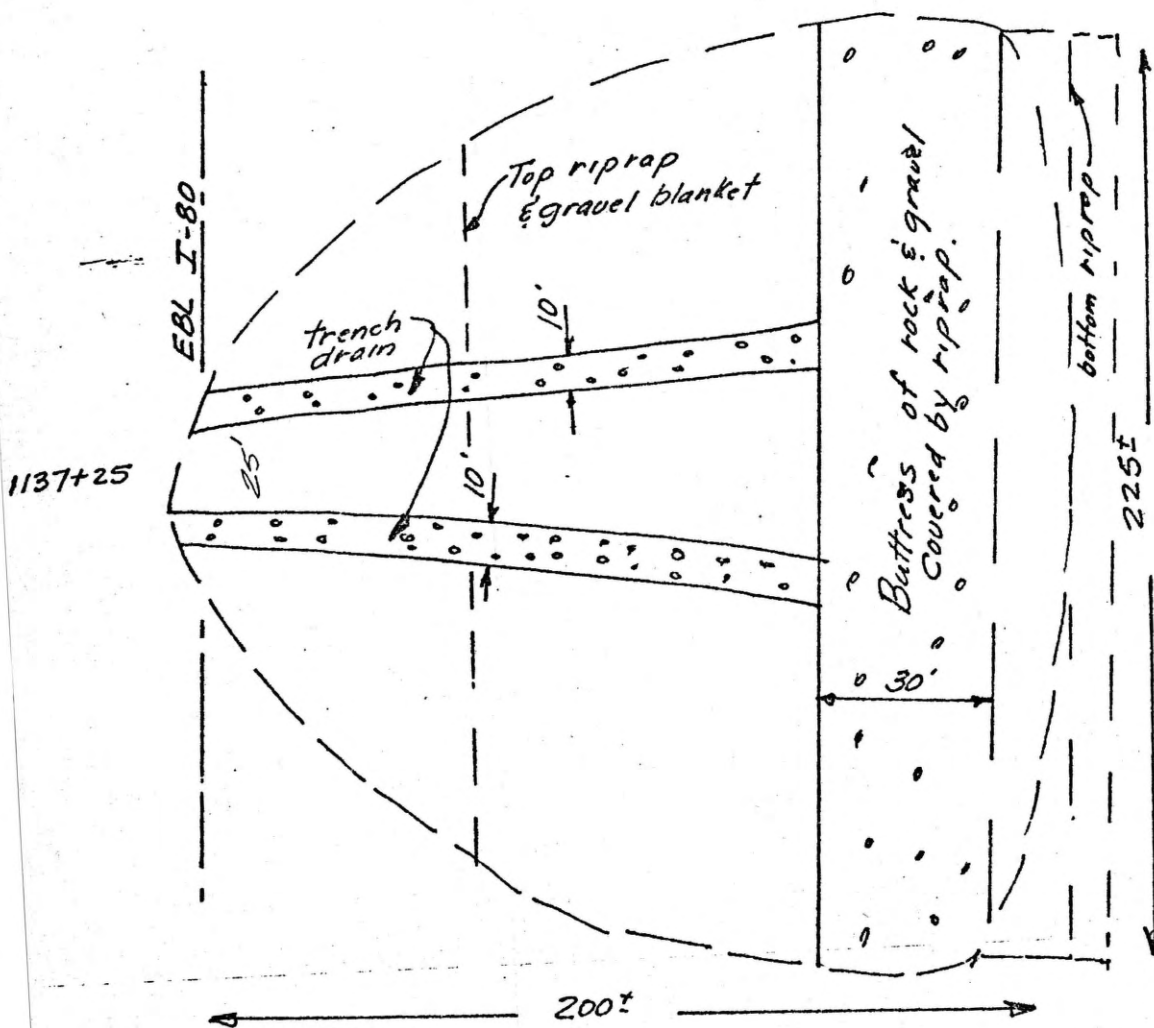
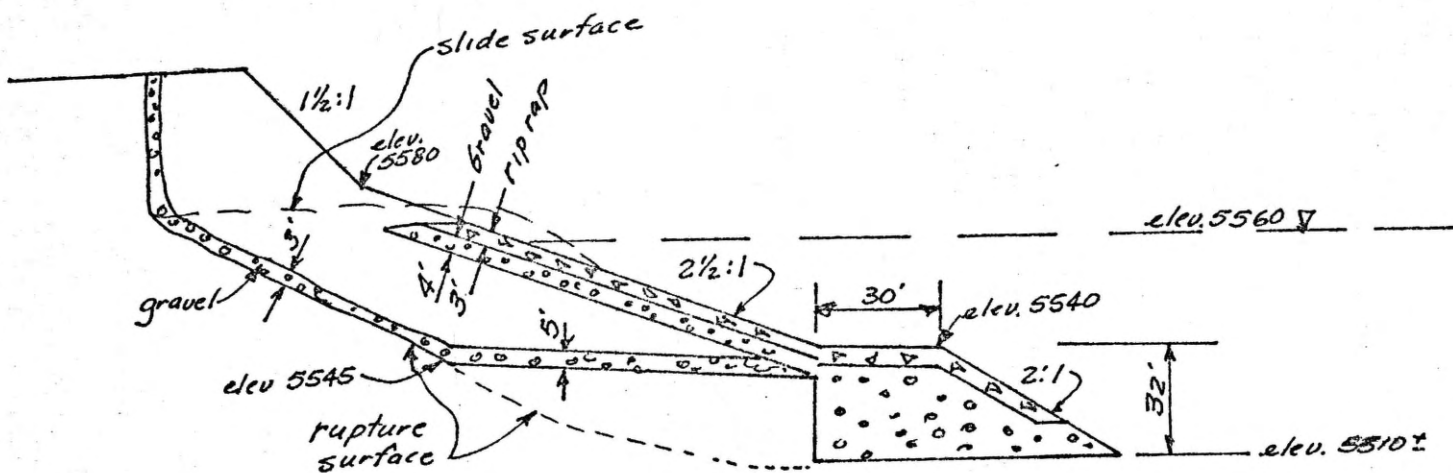
8-28-72

Proposal #1

1. Excavate very loose silt at toe of slide to elevation 5510' and replace with compacted rock-gravel buttress as shown in schematic sketch.
2. Excavate two trenches, 10' wide at bottom, from buttress to intersection of slide plane and elevation 5545', thence along slide plane to the slide scarp. Clean and smooth trenches, backfill with compacted free draining gravel 3' deep. Build embankment over trenches with available materials to surface slope of $2\frac{1}{2}:1$ from top of buttress to elevation 5530', thence on $1\frac{1}{2}:1$ slope to grade.
3. Slope surface of embankment should include a 3' layer of free draining gravel topped

with a 3 foot layer of riprap
from elevation 5520' to 5564'.



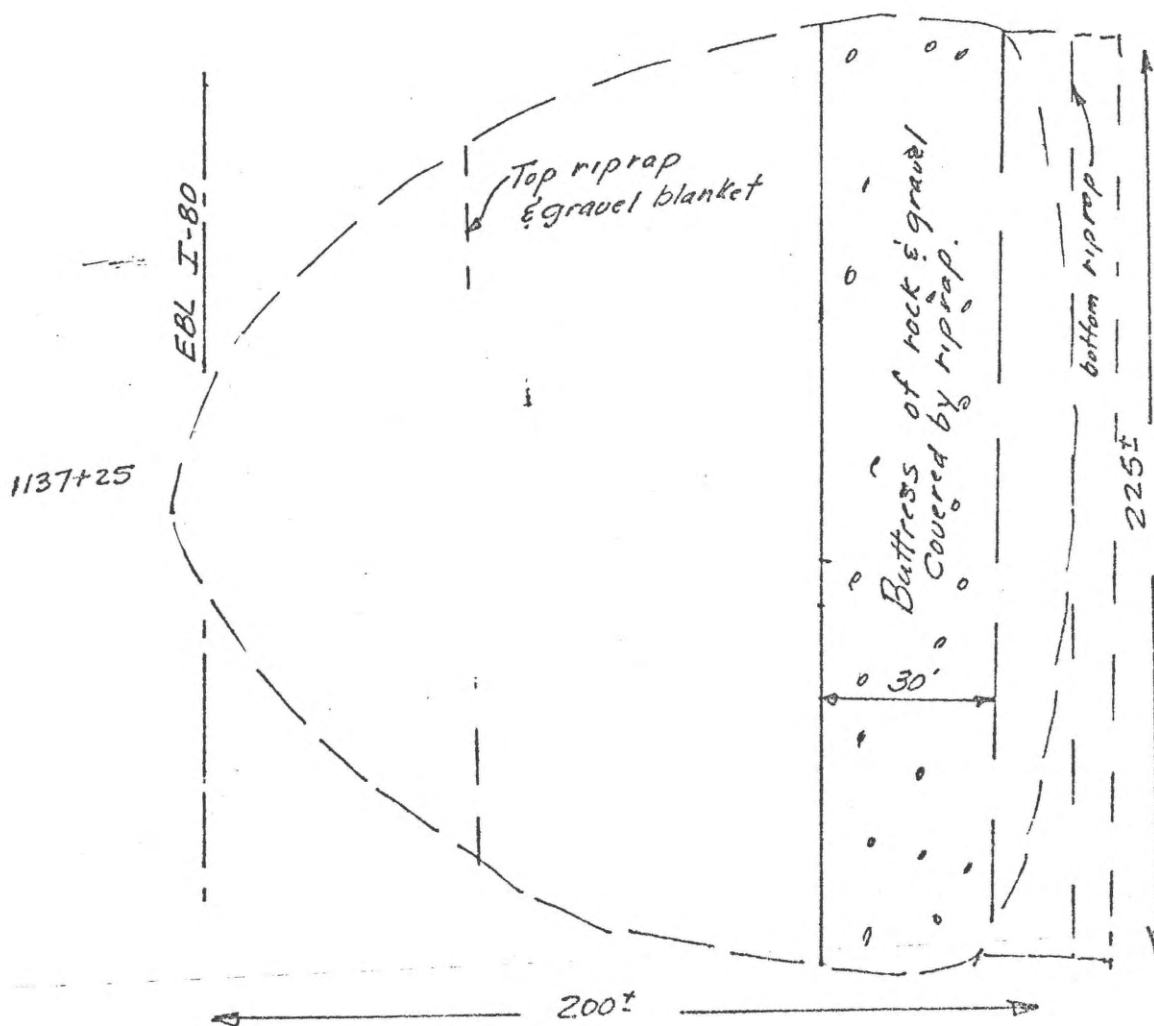
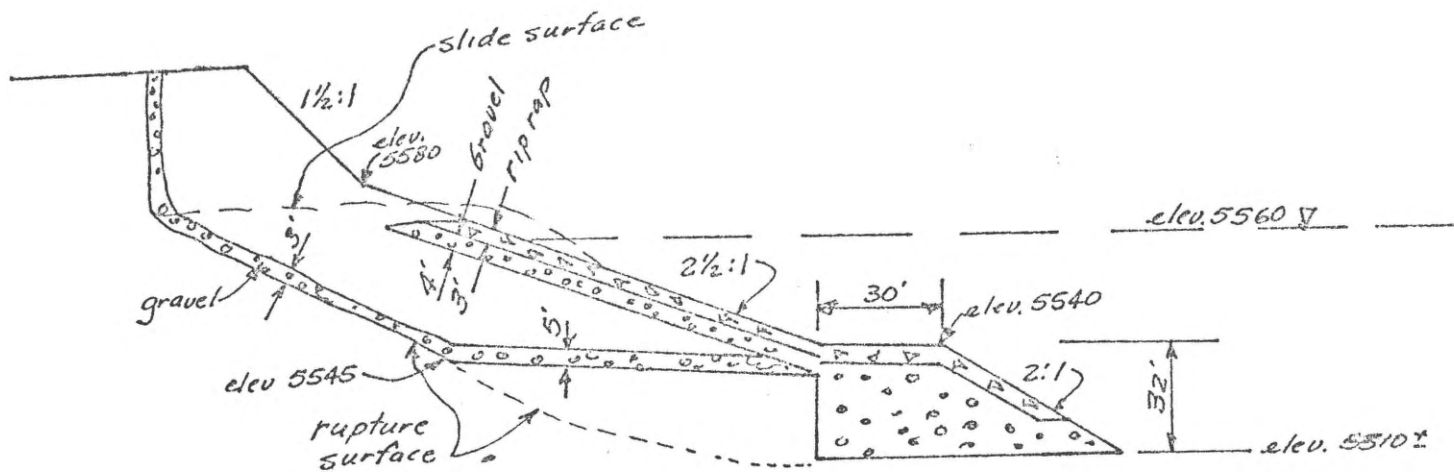


Proposed Repair
 Slide of
 8-15-72

Schematic
 (no scale)

Proposal #2 for Slide Stabilization

1. Shift alignment 20 feet left.
2. Construct bin wall as close to slump scarp as possible.
3. Use $1\frac{1}{2}:1$ slope from new shoulder to bin wall.
4. Use .2 trench drains as shown for #1 to help stabilize slide for future rapid drawdown conditions.
5. Use free draining gravel at base and back of bin wall to drain ground seepage.



Proposed Repair
Slide of
8-15-72

Schematic
(no scale)

Memorandum.

Project Engineer

UTAH STATE DEPARTMENT OF HIGHWAYS

DATE: July 22, 1966

TO : Dr. ~~L. E. Egent~~, Engineer of Plans, Surveys and ContractsFROM : *W. J. Liddle*
W. J. Liddle, Engineer of Materials & Research

SUBJECT: I-80-4(9)160, Riprap for East Bound Lane of project.

A plans in hand inspection was made on Monday July 8, 1966 with representation as follows: the U.S.B.P.R., Design Division, Construction Division, Materials Division and the District 1 Materials Section.

One of the major items discussed was the riprapping of the East Bound Lane embankments where they projected into Echo Reservoir. Considerable time was spent investigating possible sources and discussing the economical factors involved.

Out of the discussions the following decisions were reached:

To construct embankments from subgrade elevation to Freeboard elevation on a 1.5:1 slope and from Freeboard elevation to ground elevation on a 2:1 slope. Also, from Freeboard elevation to the depth shown on the plans, place a 3 foot thick layer of riprap from the hardest project conglomerates on the 2:1 embankment slope. It was also considered advisable to construct all embankments below Freeboard elevation with gravel or fractured rock. To the fullest extent practical the embankments shall be constructed with the harder and least fractured material placed on the outer or reservoir side.

One of the main points discussed was the need for the most careful and selective control possible for obtaining riprap from project materials. This is imperative due to the high degree of variation in the hardness and susceptibility to erosion by freezing and thawing of the available materials. Proper control is essential in order to obtain the economy which can result only from the use of the most satisfactory of the project materials. It was conceded that it would probably be best to have the material selected by a geologist as they would be better qualified to determine the quality of the matrix in the conglomerate.

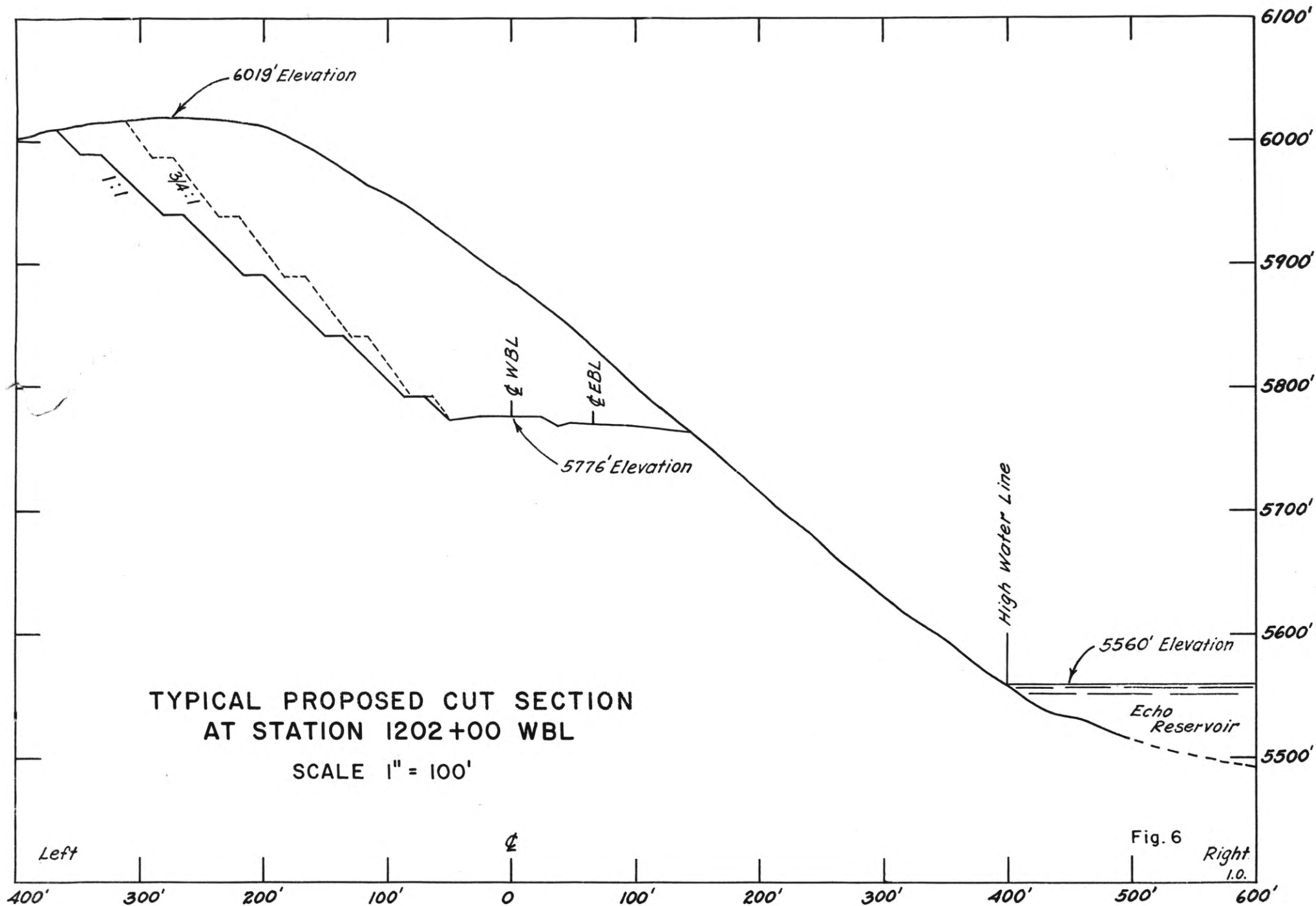
It is estimated that 62000± cubic yards of riprap will be required. Because of this large quantity it was recommended that materials from solid rock excavations used as riprap should be deducted from the roadway excavation quantities.

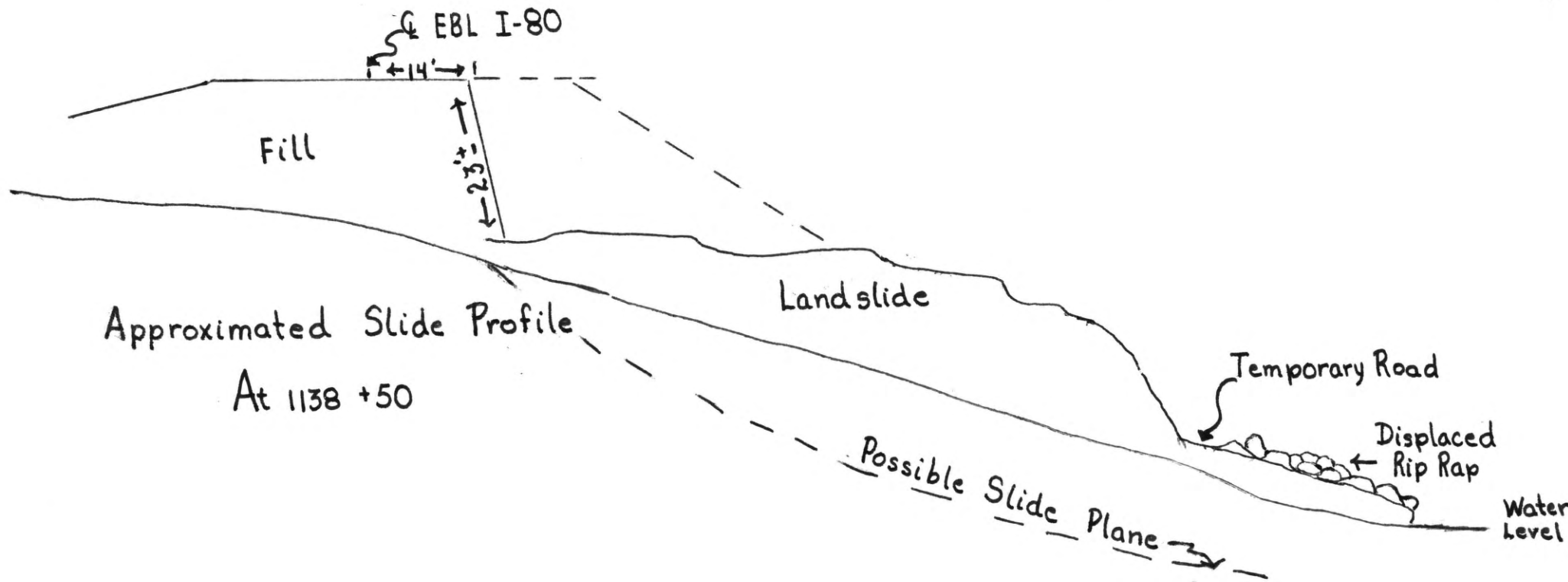
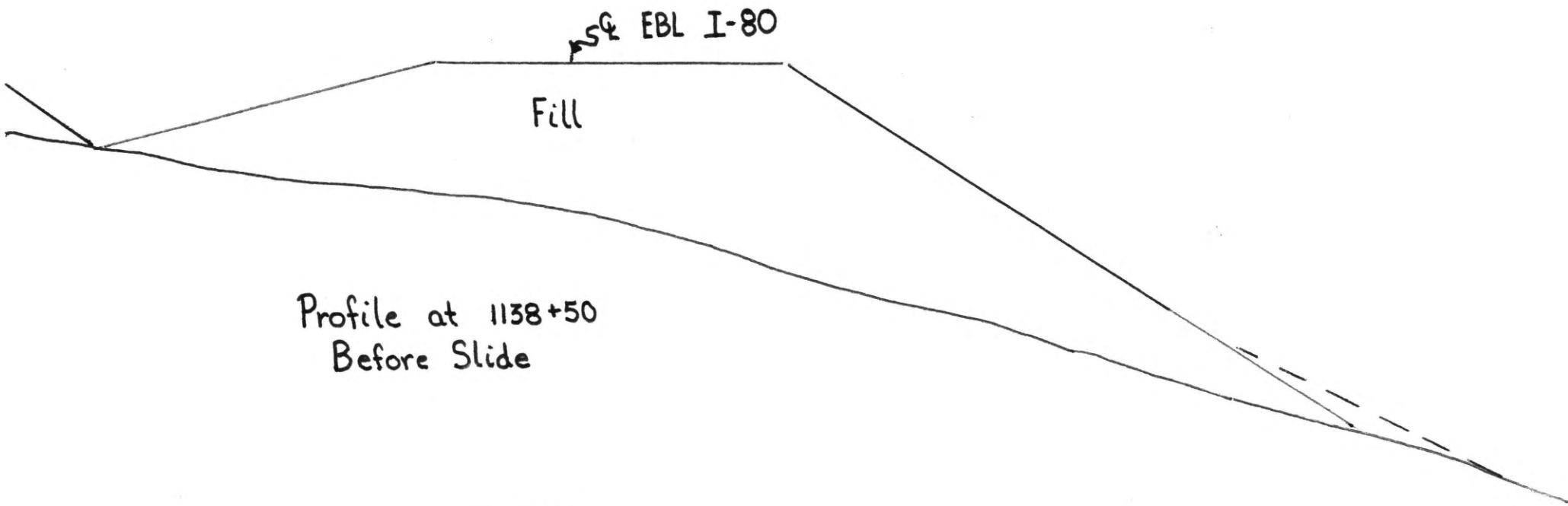
Mr. Earl Harris, the manager for the Weber River Water Users Association has informed us of full co-operation in facilitating the construction within the reservoir limits. It has been determined that the most practical time for this construction would be between July 1 and April 1. Both of these dates could vary considerably according to snow pack, spring run-off,

rainfall, storage needs and user demand. Water level control is directly related to these factors. The most feasible time for such control during the irrigation season is after July 1.

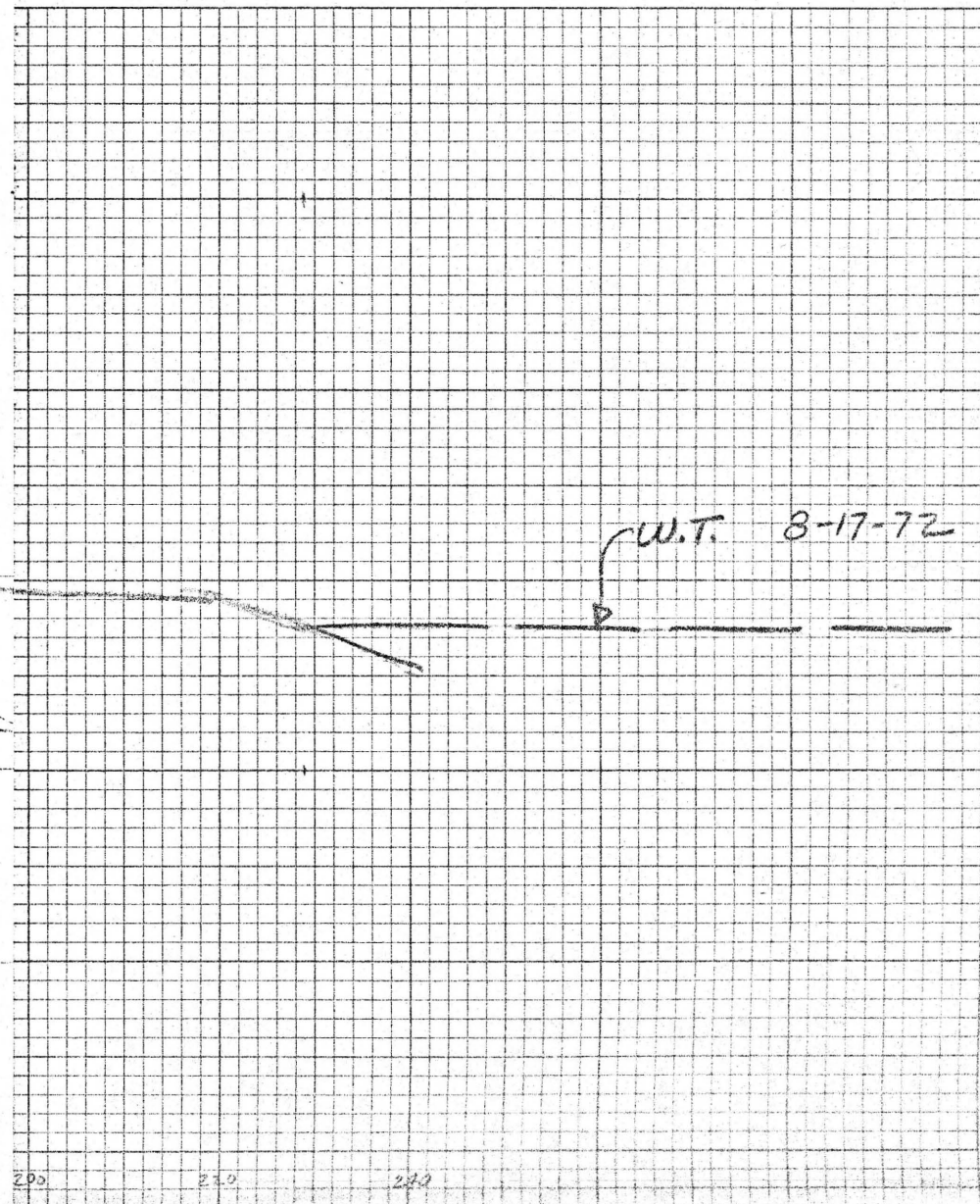
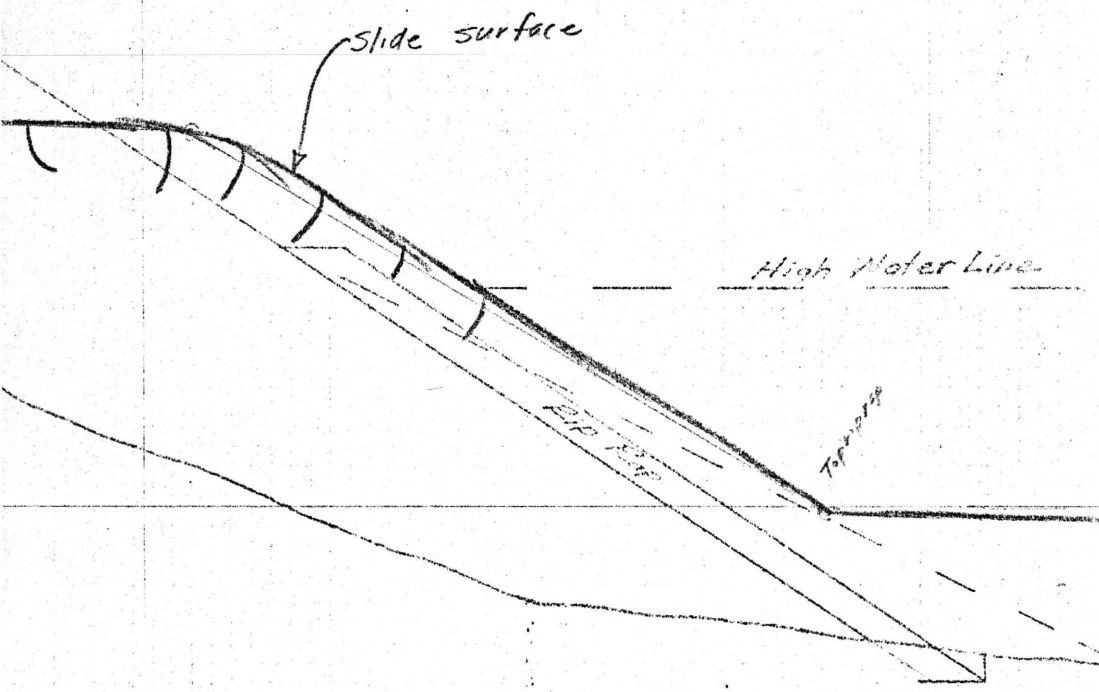
cc: Henry C. Helland

B. J. Kay
R. W. Griffin
D. L. Sargent
J. B. Skewes
C. L. Skoubye
W. E. Mickelson
O. E. Schrader
Project Engineer
Central File
File

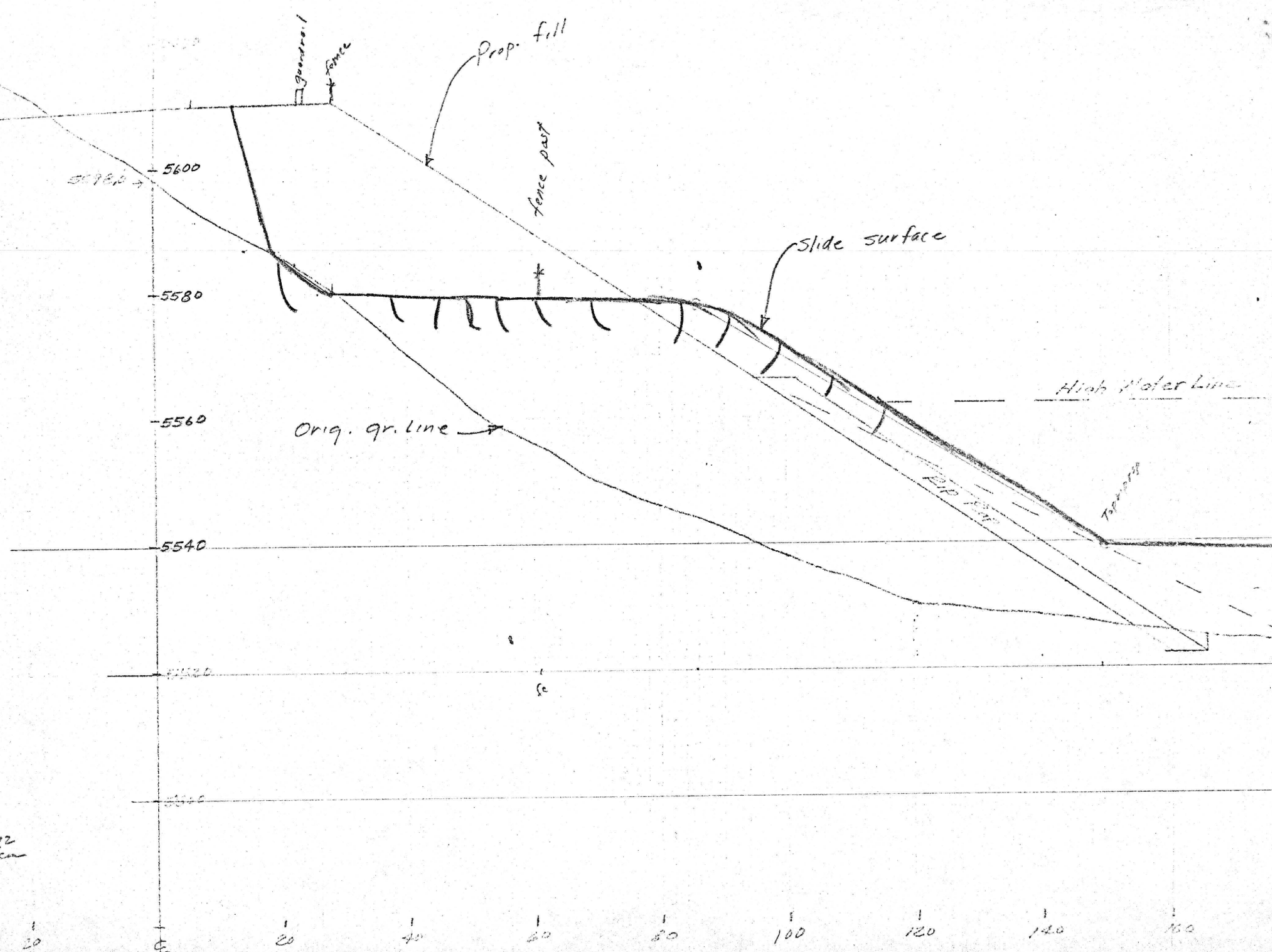




EUGENE DIETZGEN CO.
MADE IN U. S. A.



Q. 1. 111



8-22-72
Gen

Marvin Mair
Caretaker

Martin Garner info from
him.
Asst. Caretaker

336-5605
Coville

Echo Reservoir

about 7 AM

August.

1 -

5545.65

2 -

5545.00

27 - 30.50

3 -

5544.35

28 29.85

4

43.70

5

43.05

6

42.40

7

41.80

8

41.15

9

40.50

10

39.80

11

39.00

12

38.30

13

37.30

14

36.85

15

36.40

16

36.15

17

~~5535.70~~

18

35.20

19

34.65

20

34.15

Earl Harris

323 Eccles Bldg.

Manager

21

33.70

22

33.30

23

32.75

24

32.15

25

31.60

26

31.15

5560.00

Spilling crest

Echo Reservoir Water Levels

July 2	55.90	26	47.90
3	57.40	27	47.60
4	56.95	28	47.30
5	56.50	29	46.95
6	56.05	30	46.45
7	55.50	31	46.05
8			
9	54.30		
10	53.80		
11	53.40		
12	52.95		
13	52.45		
14	51.90		
15	51.40		
16	50.95		
17	50.65		
18	50.30		
19	50.00		
20	49.65		
21	49.30		
22	49.00		
23	58.75		
24	58.50		
25	58.25		

Other Areas of failure in EBL

1179+00 EBL 12

2 1211+00 WBL 1213+60 EBL

1 1241+00 WBL other project

1138+75 Center

SG09

1137+25

1137 SG10.4

1138+50 SG08.9

Weber River Water Users Association

323 Eccles Building

Ogden, Utah 84401

Echo Res.

8-22-72

5533.30

23

32.75

24

32.15

$$\begin{array}{r} 13 \\ 5 \\ \hline 18 \end{array}$$

Weber River Water Users Association

323 Eccles Building

Ogden, Utah 84401

Echo Res.

Jan 1, 1970	5534.10
2/1/70	5541.90
3/1/70	5550.00
4/1/70 —	5550.55
5/1/70 -	53.35
6/1/70 -	5560.10
7/1/70	5558.70
8/1/70	44.60
9/1	29.40
10/1	26.80
10/6	26.50
11/1	32.80
12/1	40.60

Weber River Water Users Association

323 Eccles Building

Ogden, Utah 84401

1/1/71	5547.45
2/1	51.80
3/1 —	51.40
4/1 —	50.05
5/1 —	50.10
6/1 —	57.65
7/1	60.35
8/1	49.00
9/1	32.05
10/1	30.20
11/1	31.20
12/1	39.10

Weber River Water Users Association

323 Eccles Building

Ogden, Utah 84401

1/1/72	5545.60
2/2	48.55
3/1	46.60
4/1	52.60
5/1	54.15
6/1	58.20
7/1	58.40
8/1	45.65
9/1	27.7
9/20	23.0

7- 28

10

32

3- 42

$\frac{17}{25}$

12-45

Echo Res. elevations
water

9-1.

5527.7

9-5

5525.5

9-10

5525.3

9-15

5524.5

9-18

5523.6

9-20

5523.0

9-21

5523.0

L-3067

Marvin Mair
Caretaker

Martin Garner info from
him.
Asst. Caretaker

336-5605
Coville

Echo Reservoir

about 7 AM

August. 1 - 5545.65 Ed.

2 - 5545.00

3 - 5544.35

4 43.70

5 43.05

6 42.40

7 41.80

8 41.15

9 40.50

10 39.80

11 39.00

12 38.30

13 37.30

14 36.85

15 36.40

16 36.15

17 ~~5535.70~~

18 35.20

19 34.65

20 34.15

Earl Harris 323 Eccles Bldg. Manager

21 33.70

22 33.30

Hole # 4 - Starting Elev.
8 AM, Aug 19, 8.5' above water
Level at 10 AM
Hole # 5 is 8.5 higher
than hole # 4

Hole # 2 13.0' Higher
than Hole # 4

Hole # 6 is 4.2 higher
than hole # 4

Sorry for the mistake
Keith Powell

Spilling crest 5560.00

Spilling crest

10/10/72

Earl,

The three areas of apparent settlement are centred about:

1. 1179+00 EBL - just north of vest area (Fitz drilled)
2. 1211+00 WBL or 1213+60 EBL - Keith drilled - Sersun
3. 1241+00 WBL - Karl drilled 2 holes -
on other project to north -
do not have EBL stationing or plans.

Reservoir elevations:

1-1-70	-	5534.10	1-1-71	-	5547.45	1-1-72	5545.66
2-1-70	-	41.90	2-1-71	-	51.80	2-1-72	48.55
3-1-70	-	50.00	3-1-71	-	51.40	3-1-72	46.60
4-1-70	-	50.55	4-1-71	-	50.05	4-1-72	52.60
5-1-70	-	53.35	5-1-71	-	50.10	5-1-72	54.15
6-1-70	-	60.10	6-1-71	-	57.65	6-1-72	58.20
7-1-70	-	58.70	7-1-71	-	60.35	7-1-72	58.40
8-1-70	-	44.60	8-1-71	-	49.00	8-1-72	45.65
9-1-70	-	29.40	9-1-71	-	32.05	9-1-72	27.7
10-1-70	-	26.80	10-1-71	-	30.20	9-20-72	23.00
10-6-70	-	26.50	11-1-71	-	31.20		
11-1-70	-	32.80	12-1-71	-	39.10		
12-1-70	-	40.60					

J. C. Maughan