SADDLEBACK DIVERSION REPAIR DESIGN FILE

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ARIZONA STATE OFFICE
ENGINEERING STAFF
PHOENIX, ARIZONA
February 8, 1989

DESIGN REPORT

Job: Harquahala
Project: Saddleback Diversion Repair
Location: Maricopa County, Arizona
Authority: PL-566
Phase: Final Design

Summary

This design is for the repair of the Saddleback Diversion structure located approximately 70 miles west of Phoenix, Arizona. The structure was damaged by an intense storm during September 2, 1984, which caused severe erosion around the abutments of the side inlets. Although the storm greatly exceeded the design event for the structure, the investigation committee (Engineering Report, February 1987) determined that the collector channel capacities and the side inlet capacities were deficient to handle the design flows.

Also included within this design is an erosion control measure for the Saddleback FRS Drainage Channel north of the Buckeye - Salome Road (See engineering report, May 1984 as amended).

The preliminary design review was completed February 1989. Comments from the local sponsor were received and reviewed with their representatives during a meeting held March 2, 1989.

Description of the Job

The diversion carries floodwater releases from Harquahala FRS and Saddleback FRS plus the 50-year flood event from the diversion drainage area. According to the original design report, the total drainage area to the diversion is 145 square miles of which 8.6 square miles are directly above the diversion.

Design Objective

The purpose of this design is to repair the diversion side inlets and collector system so that it provides adequate capacity for the 50 year design storm and to repair the FRS Drainage Channel Stations 112+00 to 147+00.

Basis for Design

1. Saddleback FRS and Diversion Geology Report, 1978
2. Original Plans, Specifications, an Design Report for Saddleback FRS and Saddleback Diversion
3. May 1984 Engineering Report
4. Hydrology Report, September 2, 1984
5. Engineering Report, February 1987
6. Hydrology Report, December 1988
7. Engineering Design Standards, Far West States
8. NEH, Section 5
9. Preliminary Design review comments, Flood Control District of Maricopa County, March 2, 1989.

General Basic Data

During a site visit on October 31, 1988 by the State Conservation Engineer, State Construction Engineer, State Design Engineer, and designer, the consensus of the group was that 50 year design storm side inlets be provided at the intersection of each significant wash combined with a collector dike between each side inlet to provide for local drainage in the areas where rilling of the slopes has occurred. This design approach will remain within the constraints imposed by the structure and the right-of-way limitations as they exist now. The collector channel upstream of the collector dike is generally much larger hydraulically than necessary because the collector channel is the borrow source for the new collector dike. The collector channel will be sized to provide approximately 30 percent more excavation volume than earthfill volume to allow for shrinkage, waste and clearing and grubbing losses. The contractor will be allowed to extend or widen the collector channel in an approved manner if additional fill material is required. The collector channel invert is designed to minimize head cutting, rilling of the upstream slopes and provide positive drainage to the side inlets.

In December 1988, the Assistant State Conservationist (P) and the State Conservation Engineer decided to include the needed drain channel repair and to prevent further erosion occuring at the upstream end of Saddleback FRS. The same design concept of providing a protective dike with side inlets was used.

Location and Layout

The distance from the existing fence to the top of the diversion channel slope is approximately 50 to 75 feet. This is adequate area to construct the new collector dike, collector channel, and new side inlets.

Hydrology

The hydrology report of September 1984 combined with the original design hydrology was used to size the new side inlets. The design flow for the watershed directly above the diversion is based on the 50 year frequency, 24 hour duration storm runoff.

The December 1988 report "Inflow Estimates Along Saddleback FRS" provided the supplemental hydrology to size the side inlets along the Saddleback FRS drainage channel areas requiring erosion control. The design capacities of the side inlets are based on the 100 year, 24 hour duration storm which is consistent with the original design of the FRS.

Hydraulic Design

The side inlet design capacities were based on the general rectangular weir formula using a discharge coefficient of 3.1. This is considered to be conservative (low) because it neglects the velocity of approach. Sediment transport was not considered. Side inlets will prevent headcutting and the corresponding movement of eroded materials into the diversion channel.

Structural Design

The pre-design investigation revealed that some of the existing side inlets have very poor grout penetration into the rock riprap. The original construction specification for rock riprap allowed 75 percent of the rock to be smaller than 6 inches and 50 percent to be smaller than 4 inches. The SCS in Arizona recently installed similar grouted rock side inlets with good results using 12 inch thick sections instead of the 24 inch thick sections that were originally specified for the diversion. This design uses a larger graded rock because it assures better grout penetration while reducing the design quantities and costs.

Environmental Considerations

This repair will positively impact the visual aspects of this site by eliminating the erosion and headcutting which is currently taking place with each storm. There are no adverse biological impacts anticipated by this design.

Construction Drawings

The drawings for this project were prepared and stored on the CAD system. Pertinent information was taken from the original construction drawings prepared for Saddleback Diversion and FRS. There are no standard drawings incorporated into this design.

Specifications

The NEH Section 20 standard specifications have been used for this project. There are no elements of work requiring specially written specifications.

Cost Estimate

Due to the mild winters and dry climate, the only seasonal impact that can be forseen to affect the cost of the structure is the availability of water for construction in the area. The Harquahala Irrigation District has water available located approximately 2 miles northwest of the project from March through the summer months for irrigation. The irrigation district stated they could supply a demand of at least 100,000 gallons per day. The water could be made available during the winter months for an approximate one-third increase in cost. The overall impact to the the cost estimate would be negligible because most of the costs for the water are incurred in its application, not the cost of the water itself. The water consumption should also be somewhat less in the winter due to cooler temperatures and generally more frequent rainfall.

The contract is scheduled to be set aside for 8-A. Therefore, the designer has attempted to apply the experience gained by SCS in Arizona 8-A contract negotiations to generate realistic 8-A negotiated construction costs. As a comparison, a second cost estimate was generated using bid abstracts from recent projects.

Construction Schedule

The design utilizes construction practices that are relatively simple. There are relatively few bid items and the construction sequence of the items of work are straightforward. The contractor should be made aware of the potential erosion hazard of subgrades prior to placing the grouted rock riprap. Foundation preparation and grouting of the structures should be scheduled accordingly.

Operation and Maintenance

This design reduces but does not eliminate the need for O&M along the upstream edge of the diversion. The collector channel must be checked periodically for sediment bars and deposits to prevent water from breaking over the collector dike and creating rills on the diversion side slopes. However, this design minimizes sediment deposits because of the greater number of side inlets aligned with existing washes, the increased capacity of the collector channel and the new collector dike being generally somewhat higher than the surrounding ground elevations.

The original O&M plan and agreement dated April 1980, is sufficient and need not be revised.

Construction Review

The State Construction Engineer and GR should assure that construction methods for the structural backfill of the existing inlets provide well compacted soils against the grouted rock structures.

The location of the new collector dike should be flexible to place it as close to the top of slope as possible while minimizing the amount of earthfill required to construct the dike and leaving sufficient room for the new collector channel. The designed collector dike centerline offsets from the existing fence are provided in the drawings but may be field adjusted as necessary.

A preconstruction conference must be held to explain the intent of the design to the contractor.

John M. Harrington 3-16-89

Submitted by: John M. Harrington, Civil Engineer Date

Donald E. Paulus 3-16-89

Recommended by: Donald E. Paulus, State Design Engineer Date

Ralph M. Arrington 3-16-89

Approved by: Ralph M. Arrington, State Conservation Engineer Date

SADDLEBACK DIVERSION REPAIR

JMH 9-9-88

PROPOSED DRAWING LAYOUT

SHEET 1

TITLE

INDEX GEN. NOTES

SIGNATURES

SHEET 2

WATERSHED LOCATION MAP

PROJECT LOCATION MAP

SHEET 3

Waste Areas

BASELINE DATA

SHEET 4

Profile 12+00 to 80+00 ✓

SHEET 5

Profile 80+00 to 146+00 ✓

SHEET 6

Profile 146+00 to 212+00 ✓

SHEET 7

Profile 212+00 to 245+00 ✓

SHEET 8

New Side Inlet Detail & Schedule ✓

SHEET 9

DETAILS

- Fill @ Existing Inlets
- Borrow X-SECT ✓
- CATTLE XING
- Typical Dike Cross Section ✓ & Table ✓

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Saddleback Div. Repair

FIELD SURVEYS

Alternate No. 1 - If this alternate is chosen, detailed
- Topo at minimum 100 foot stations from Fence Line to Top of left bank.

≈ 20,000 feet ⟹ 250 X-sections @ 6 per hour

40 hours survey time ⟶ 5 days

- Topo Extensive bank erosion to determine limits and quantities of repair. ⟶ 1 day

- Survey Sediment deposits in channel for excavation limits and quantities. ⟶ 1 day

- Locate exact ℄ stations for new inlets best fit to field. & elevation ⟶ 1 day

8 days Field work

4-½ days travel over 2 week period.

COST P.D. -

(4 ½ days) x 2 week x 2 people x 75 = $1350.00

Alternate No. 2 - No dike constructed, just additional inlets.

- Locate exact Inlet locations & topo each area.
32 new inlets - 8 per day - ⟶ 4 days

- Survey Sediment ⟶ 1 day

Say 1 week x 4½ days x 2 people x 75.00 = $675.00

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SURVEY DATA REQ'D.

2 { - Best ℄ For new inlets
  - Best Elevation for crest.
- Actual ℄ sta of existing inlets

1 { - Determine sta.'s of minor rilling (< 1.0 FT)
  - Determine sta's of 2 or more feet excavation.

4 { - X-SECT FROM ℄ OF INLETS TO dike tieing into existing ground..

1 - Define limits of sediment removal.

8 days + travel = 2 weeks.

JMH 10-19-88

Saddleback repair

SURVEY INFO. REQ'D

- Best ℄ for new inlets
- Best elev. for new inlet crests
- Actual ℄ of existing inlets
- Sta. limits of minor rilling (≤1.5 ft)
- Sta. limits of major rilling (≥1.5 ft)
- X-Sect's at new inlet locations
- Limits of sediment removal

SURVEY TIME ESTIMATED

- 2 weeks survey using 2-man crew and part time guidance from state office design section.

PER DIEM VS. TRAVEL DAILY

P.D. - 4½ days × 2 wks × 2 people × 75.00 = $1350.00

TRAVEL - 10 extra round trips @ 200 mi. @ 20¢/mile = 400.00

+ 2 to 4 extra days crew time 2 men × 10.00/hr × 3 days × 9 hrs = 540.00

940.00

CONCLUSION

About same cost or slightly cheaper to drive daily. Recommend 4-10 hr days weekly if possible.

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Using 3 week time frame for weather delays etc., if started Oct. 31, complete November 18.

Saddleback Diversion
Control Monuments

MONUMENT	STATION	OFFSET FROM C/L DIVERSION	ELEVATION
1	1+17.38	150.0	1183.46
2	4+35.60	150.0	1181.65
3	10+59.70	150.0	1181.93
4	12+89.55	150.0	1179.09
5	16+70.09	150.0	1181.33
6	19+69	150.0	1179.62
7	25+00.32	150.0	1173.80
8	30+00	150.0	1171.69
9	35+00	150.0	1169.22
10	40+00	150.0	1168.11
11	45+00	150.0	1166.93
12	50+00	130.0	1163.83
13	55+00	130.0	1164.21
14	60+37.15	150.0	1164.00
15	65+17.61	150.0	1163.25
16	70+00	150.0	1163.66
17	75+00	150.0	1161.36
18	81+83	150.0	1158.22
19	86+81.08	150.0	1155.38
20	90+00	150.0	1154.12
21	95+00	150.0	1151.91
22	100+69.43	150.0	1152.67
23	105+00	200.0	1151.16
24	110+00	200.0	1149.92
25	115+94.68	200.0	1148.47
26	120+00	200.0	1147.71
27	125+00	200.0	1147.64
28	130+00	200.0	1146.29
29	135+00	250.0	1144.79
30	140+90.92	250.0	1143.05
31	144+82	250.0	1142.14
32	149+10.85	250.0	1139.65
33	155+00	250.0	1138.44
34	159+47.27	250.0	1135.14
35	165+00	250.0	1133.39
36	170+00	250.0	1130.94
37	177+40.81	250.0	1129.33
38	185+00	250.0	1127.84
39	190+00	250.0	1125.68
40	195+00	250.0	1125.56
41	202+74.10	250.0	1124.71
42	210+00	250.0	1123.86
43	215+00	250.0	1121.53
44	220+32.64	250.0	1122.27
45	225+00	250.0	1118.79
46	230+00	250.0	1115.95
47	238+39.09	350.0	1110.84
48	245+00	350.0	1103.79
49	249+30.30	400.0	1096.93

Saddleback FRS

JMH 1-4-89

Subsidence Monuments - Top of Dam

STA	Elev - 5-82	
210+00	~~1200.96~~	1193.90
220+00	~~1201.26~~	1194.19
230+00	~~1201.51~~	1194.43
240+00	1200.90	
250+00	1200.94	
260+00	1200.84	
270+00	1201.48	

Saddleback Diversion
Control Monuments

MONUMENT	STATION	OFFSET FROM C/L DIVERSION	ELEVATION	DIST. FROM FENCE TO MONU.
1	1+17.38	150.0	1183.46	
2	4+35.60	150.0	1181.65	
3	10+59.70	150.0	1181.93	
4	12+89.55	150.0	1179.09	10.0 outside
5	16+70.09	150.0	1181.33	10.0 outside
6	19+69	150.0	1179.62	8.0 outside
7	25+00.32	150.0	1173.80	20 outside
8	30+00	150.0	1171.69	35.[illegible] outside
9	35+00	150.0	1169.22	31.5 outside
10	40+00	150.0	1168.11	27.0 outside
11	45+00	150.0	1166.93	22.0 outside
12	50+00	130.0	1163.83	33 inside
13	55+00	130.0	1164.21	9.5 inside
14	60+37.15	150.0	1164.00	6 outside
15	65+17.61	150.0	1163.25	?
16	70+00	150.0	1163.66	14.5 inside
17	75+00	150.0	1161.36	17.5 inside
18	81+83	150.0	1158.22	
19	86+81.08	150.0	1155.38	
20	90+00	150.0	1154.12	[illegible]
21	95+00	150.0	1151.91	37.5 inside
22	100+69.43	150.0	1152.67	45.5 inside
23	105+00	200.0	1151.16	6.0 outside
24	110+00	200.0	1149.92	5.1
25	115+94.68	200.0	1148.47	[illegible] outside
26	120+00	200.0	1147.71	9.8 inside
27	125+00	200.0	1147.64	8.0 inside
28	130+00	200.0	1146.29	15.0 inside
29	135+00	250.0	1144.79	27.7 outside
30	140+90.92	250.0	1143.05	19.8 outside
31	144+82	250.0	1142.14	21.0 outside
32	149+10.85	250.0	1139.65	19.5 outside
33	155+00	250.0	1138.44	11.5 outside
34	159+47.27	250.0	1135.14	5.0 OUTSIDE of Fence
35	165+00	250.0	1133.39	4.3' OUTSIDE of Fence
36	170+00	250.0	1130.94	[illegible]
37	177+40.81	250.0	1129.33	5.5' outside of Fence
38	185+00	250.0	1127.84	5.5' inside
39	190+00	250.0	1125.68	12.6' inside
40	195+00	250.0	1125.56	20.0' inside
41	202+74.10	250.0	1124.71	29.8', inside
42	210+00	250.0	1123.86	20.2', inside
43	215+00	250.0	1121.53	12.5', inside
44	220+32.64	250.0	1122.27	4.9', inside
45	225+00	250.0	1118.79	20.7' outside of Fence
46	230+00	250.0	1115.95	
47	238+39.09	350.0	1110.84	
48	245+00	350.0	1103.79	
49	249+30.30	400.0	1096.93	

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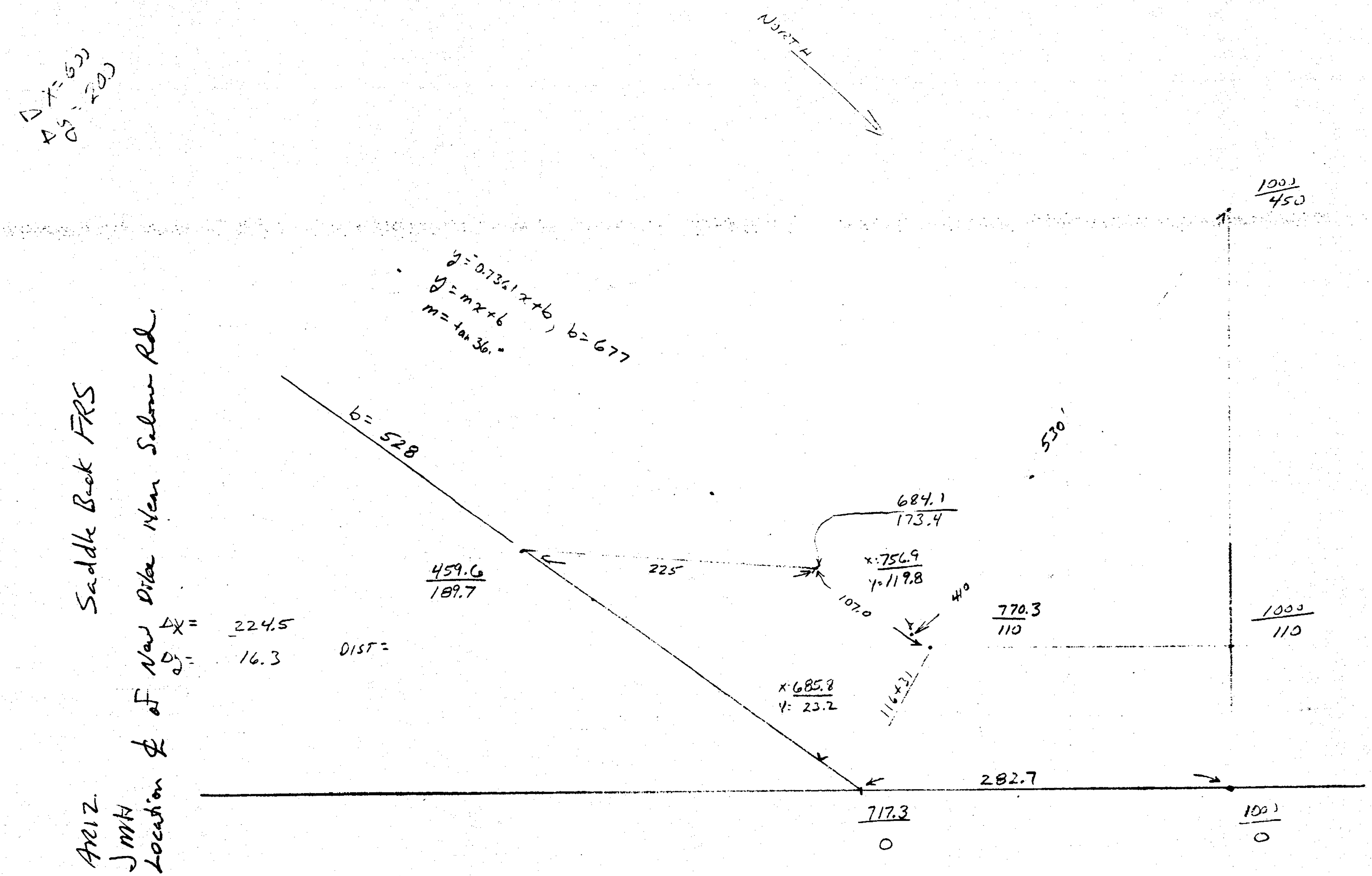
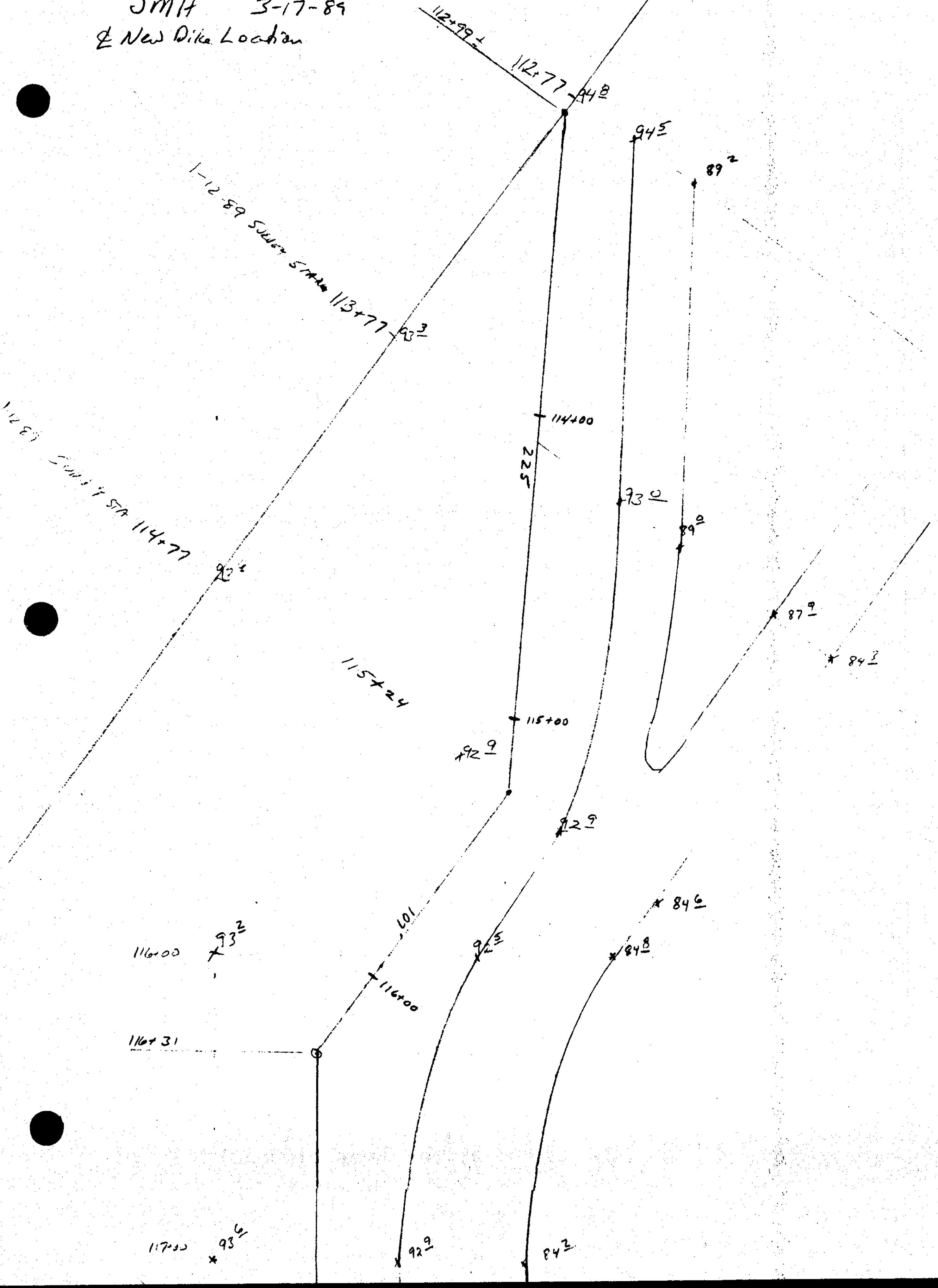
Location ℄ of New Dike Near Saloon Rd.
Saddle Back FRS



AHCL FRS

JMH 3-17-89

℄ New Dike Location



SADDLEBACK DIVERSION REPAIR

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COLLECTOR DITCH X-SECT DIMENSIONS

STATION		LEFT SLOPE H:V	B FEET	D FEET
17+00	26+00	5:1	14	2.5
29+00	35+00	5:1	14	2.5
38+00	40+00	5:1	20	2.5
43+50	48+00	5:1	20	2.5
52+00	59+00	5:1	20	2.5
61+25	114+00	5:1	24	2.5
127+00	150+00	3:1	28	3.5
155+00	177+00	5:1	28	2.5
182+00	184+00	5:1	30	3.0
193+00	209+00	5:1	20	3.5
~~206+00~~	~~209+00~~	~~5:1~~	~~20~~	~~2.5~~
226+00	232+00	2:1	10	2.5
238+00	243+00	5:1	30	3.5

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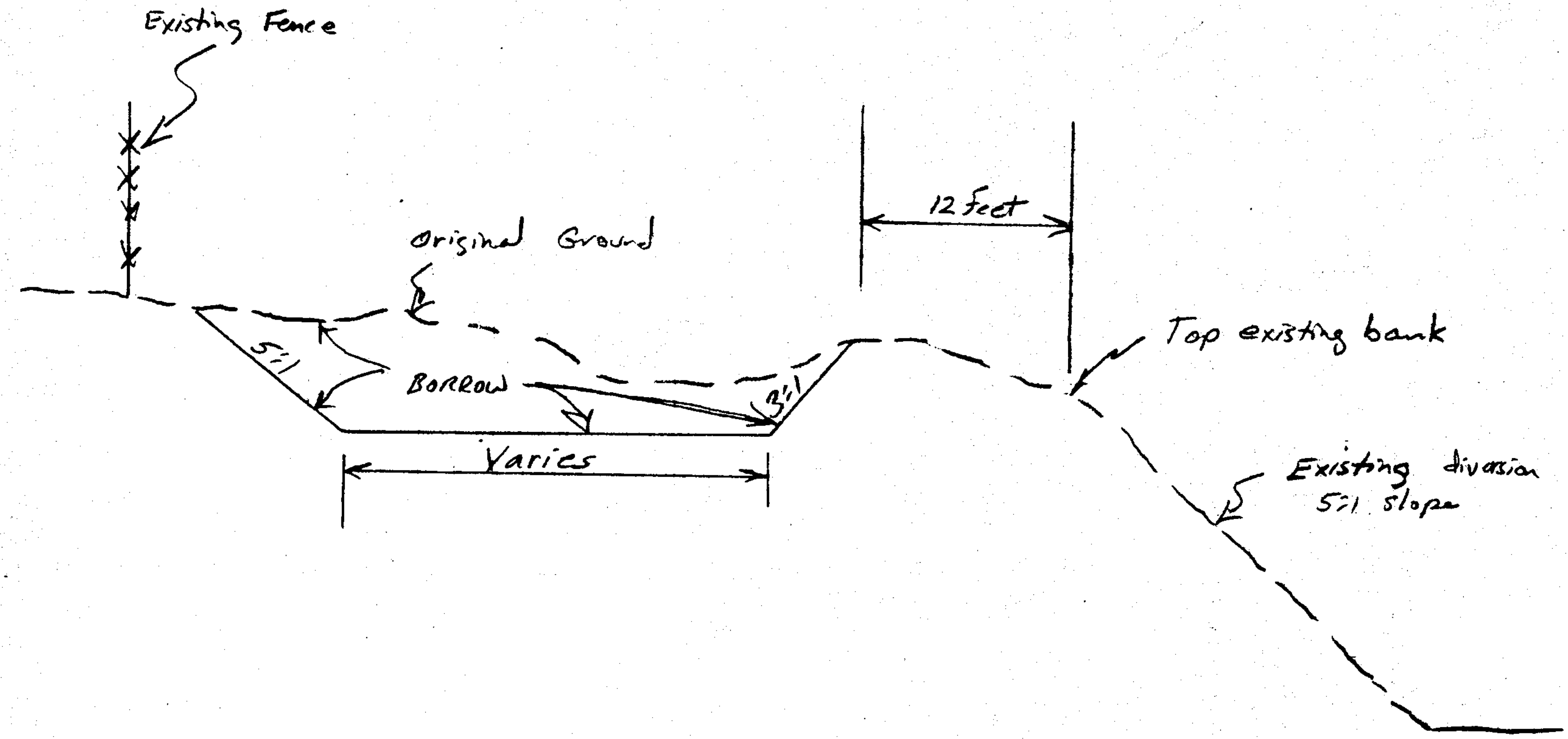
Borrow X-Sect

Saddleback Diversion Repair



TYPICAL BORROW X-SECTION

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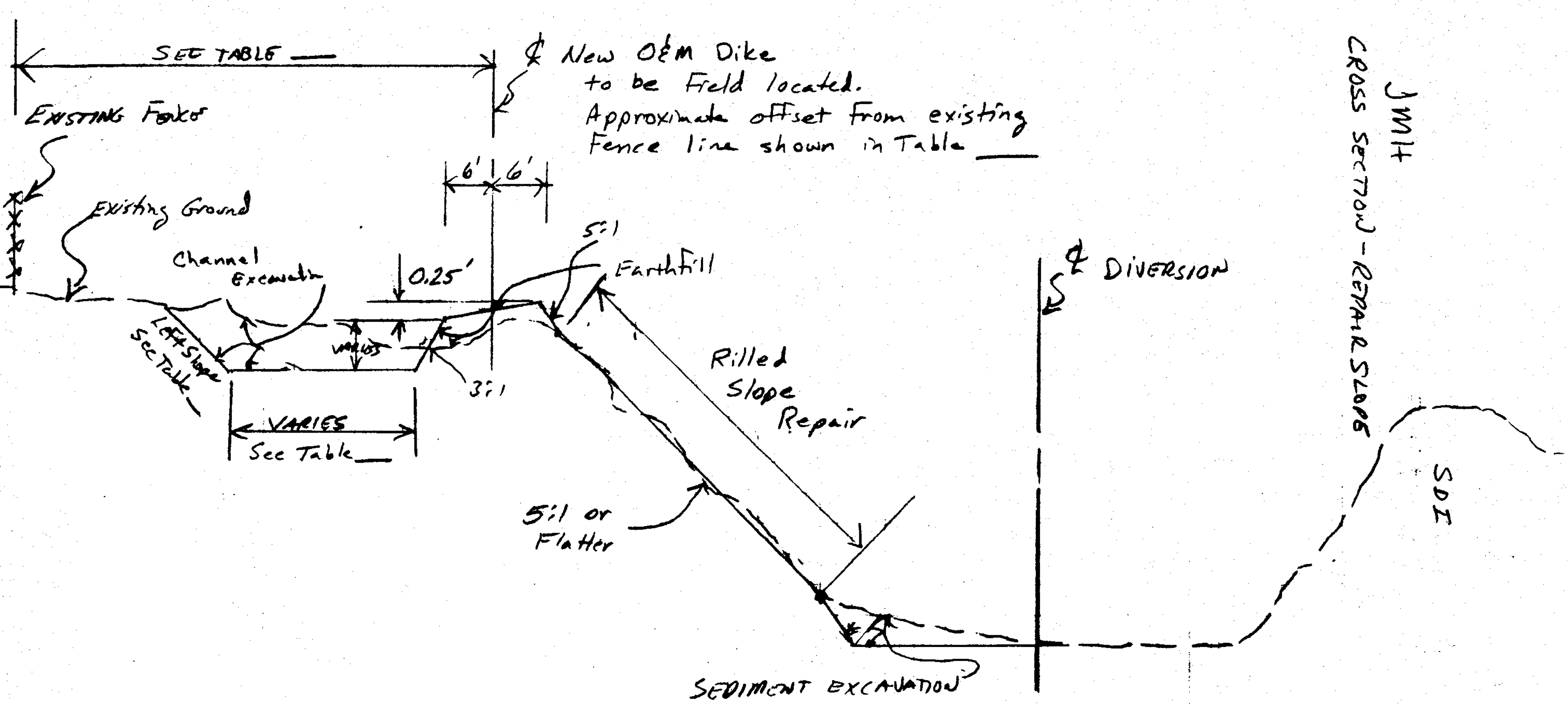
CROSS SECTION - REPAIR SLOPE

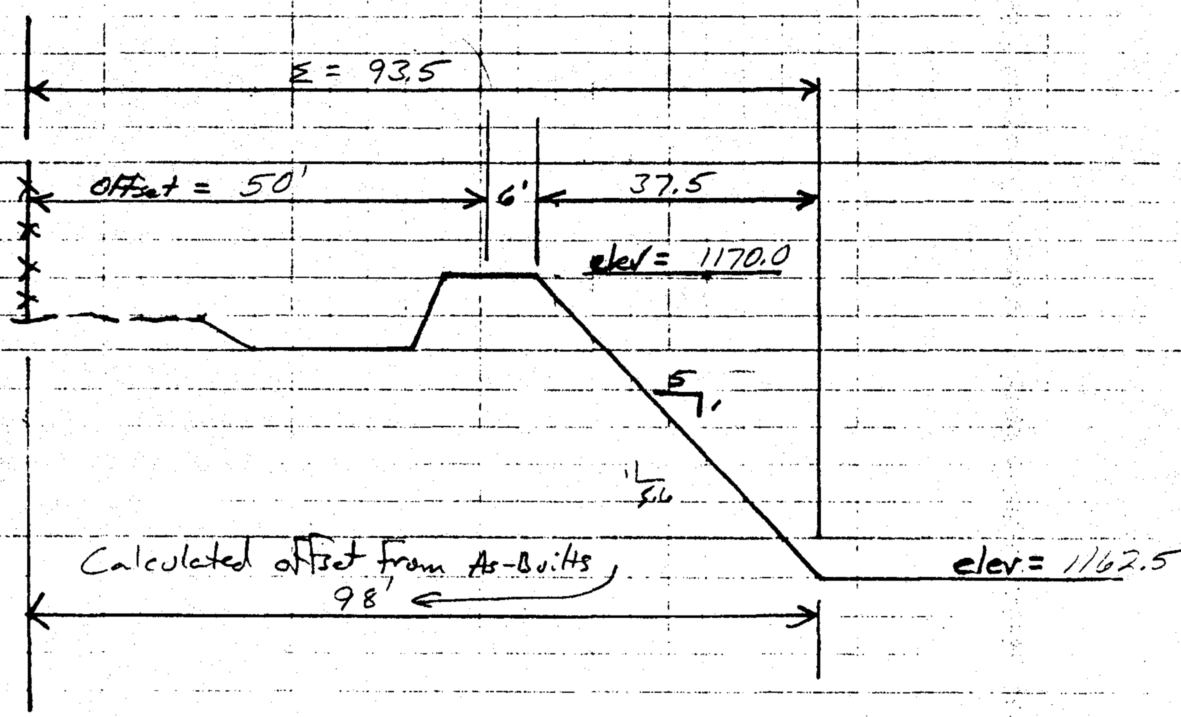


TYPICAL X-SECT WITH O&M DIKE

PROJECT: SADDLEBACK DIVERSION REPAIR

JMH DATE 11-29-88 CHECKED BY DATE

Check Slope fit with new dike offset SHEET ___ OF ___

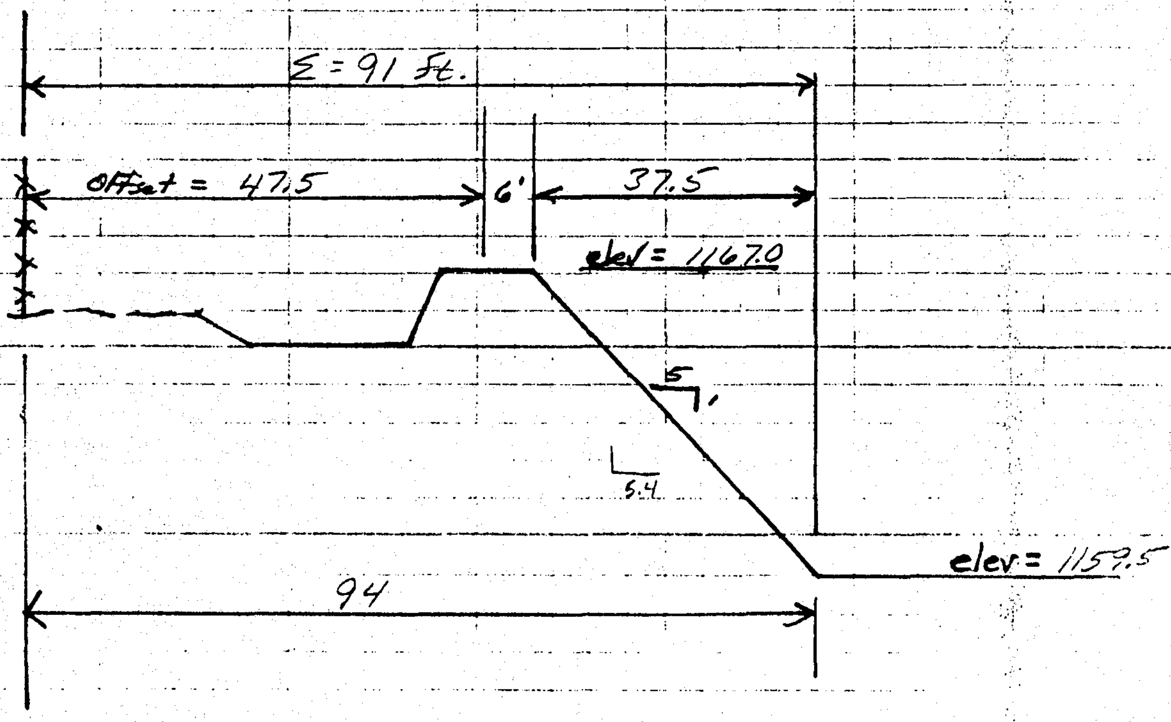


No. 3 Difference = 4.5 ft < 5.0 ok

PROJECT SADDLEBACK DIVERSION REPAIR

JMH 11-29-88

Check Slope fit with new dike offset



No. 5 difference = 3 ft < 5 ft ok

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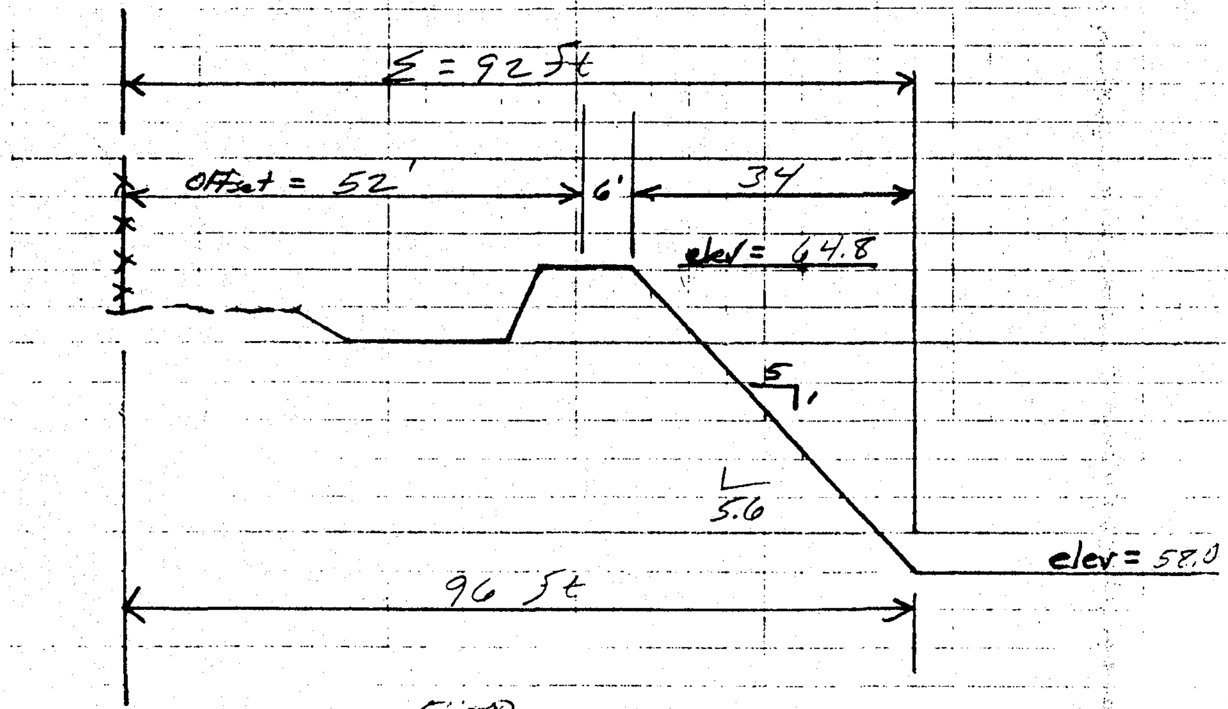
PROJECT Saddleback Diversion Repair
JMH 11-29-88
CHECKED BY DATE JOB NO.

Check Slope fit with new dike offset SHEET



54-50
No. 6 difference = 4 ft > 5 ft ok

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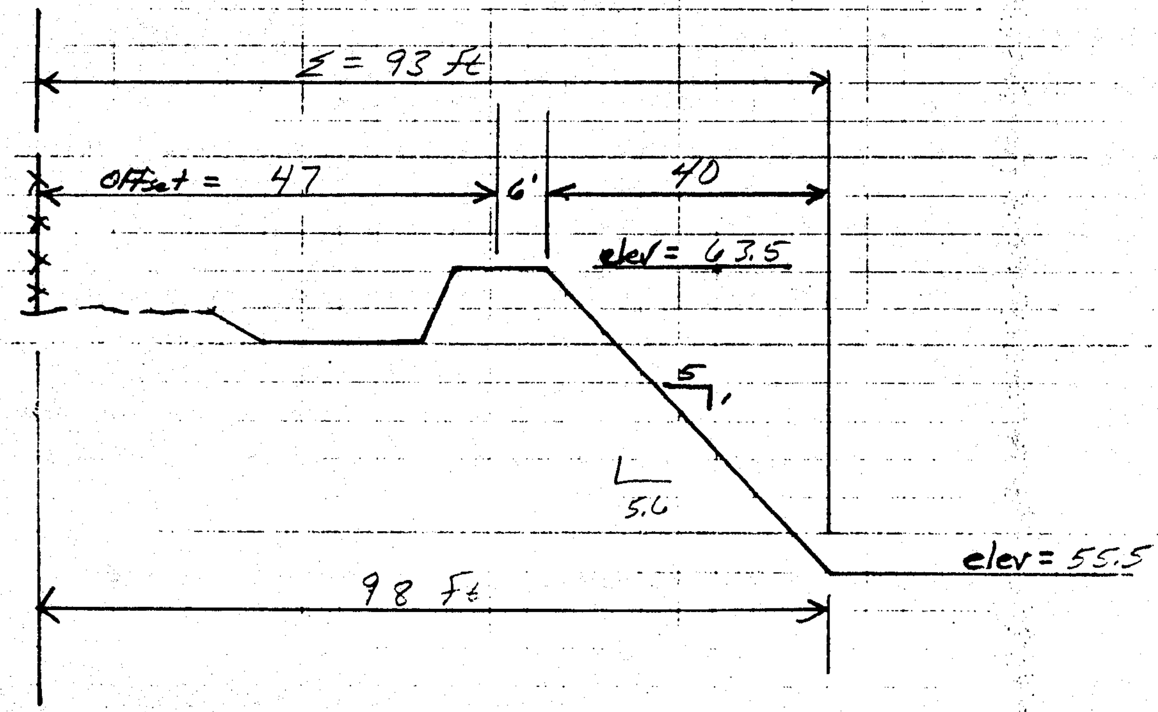
Check Slope fit with new dike offset



No. 7 difference = 5' = 5' ok

PROJECT Saddleback Diversion Repair

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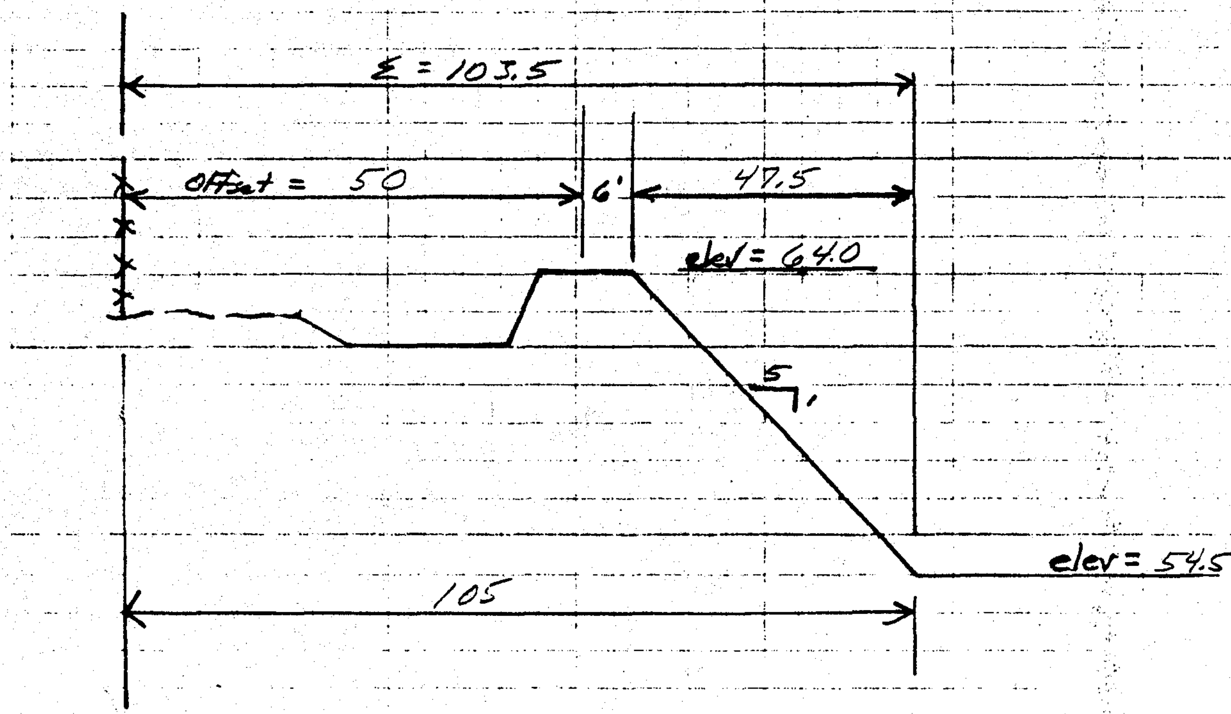
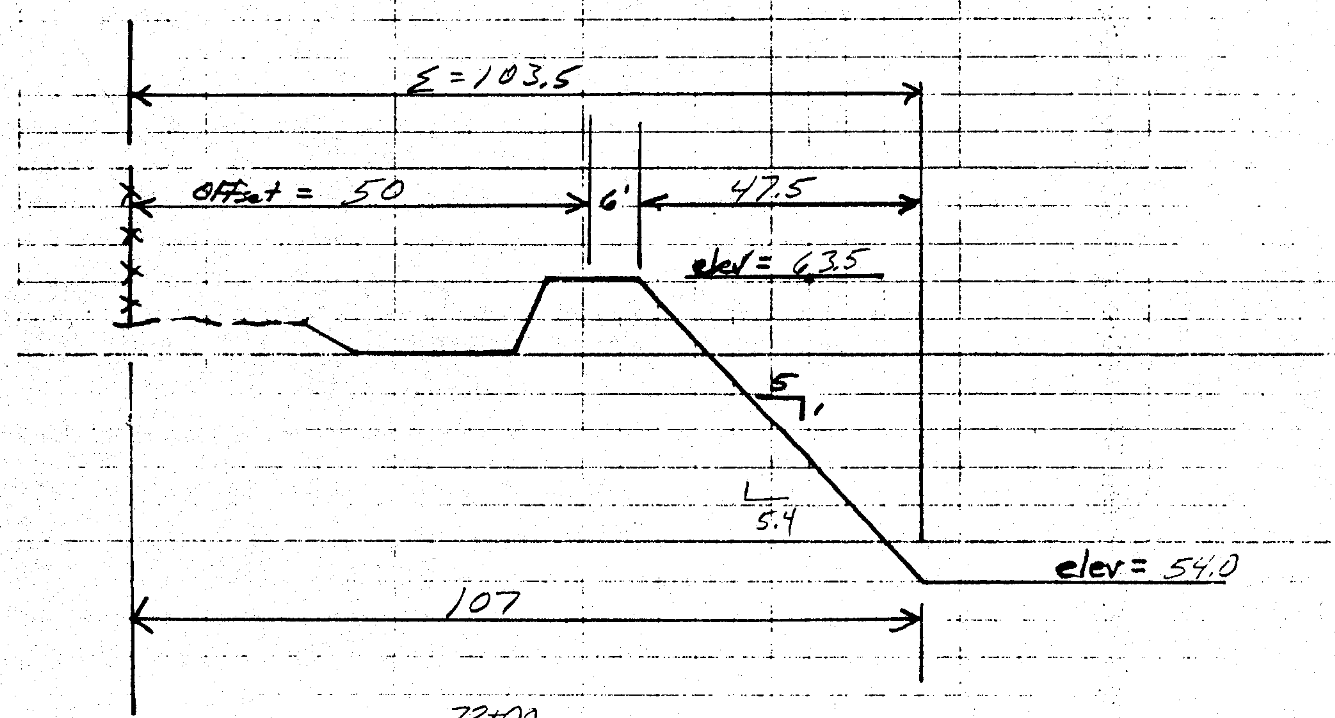
Check Slope fit with new dike offset



No. 8 difference = 1.5' < 5' ok

Check Slope fit with new dike offset



72+00
No. 9 diff. = 3.5 < 5' ok

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PROJECT Saddleback Diversion Repair

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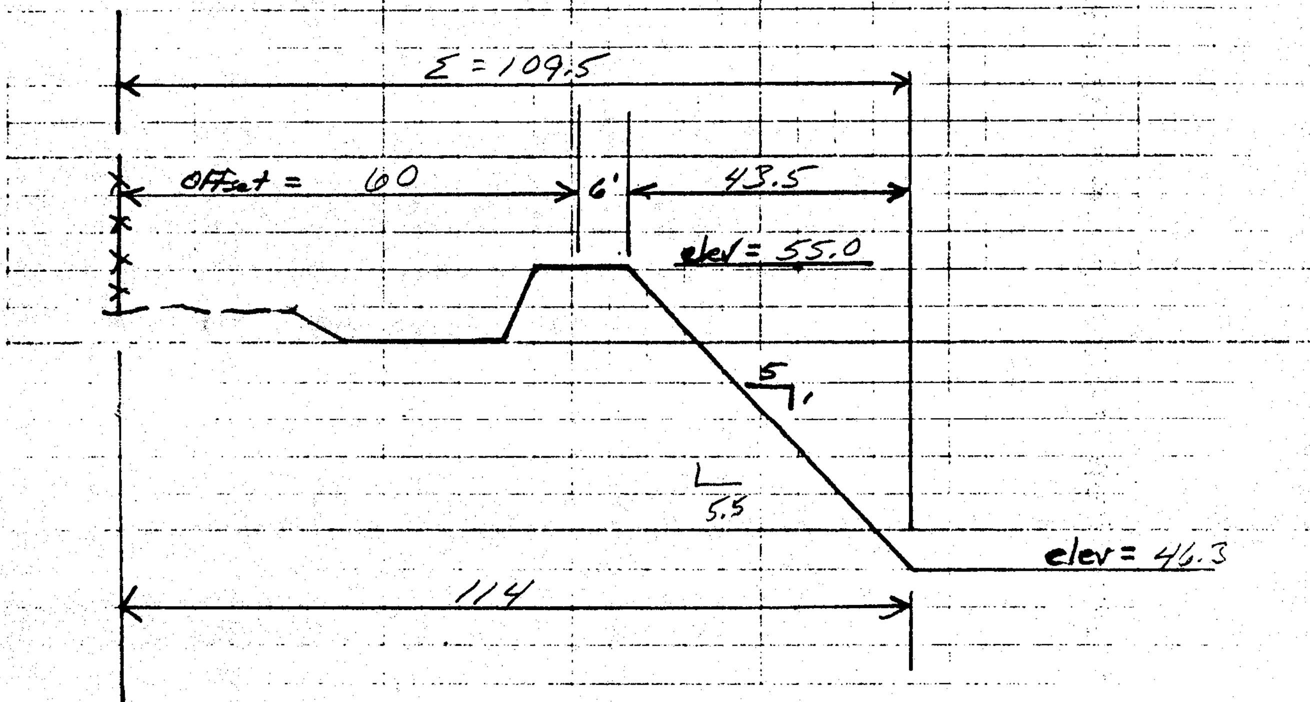
Check Slope fit with new dike offset



88+50

No 10 diff = 4.5 < 5' ok

PROJECT SADDLEBACK DIVERSION REPAIR

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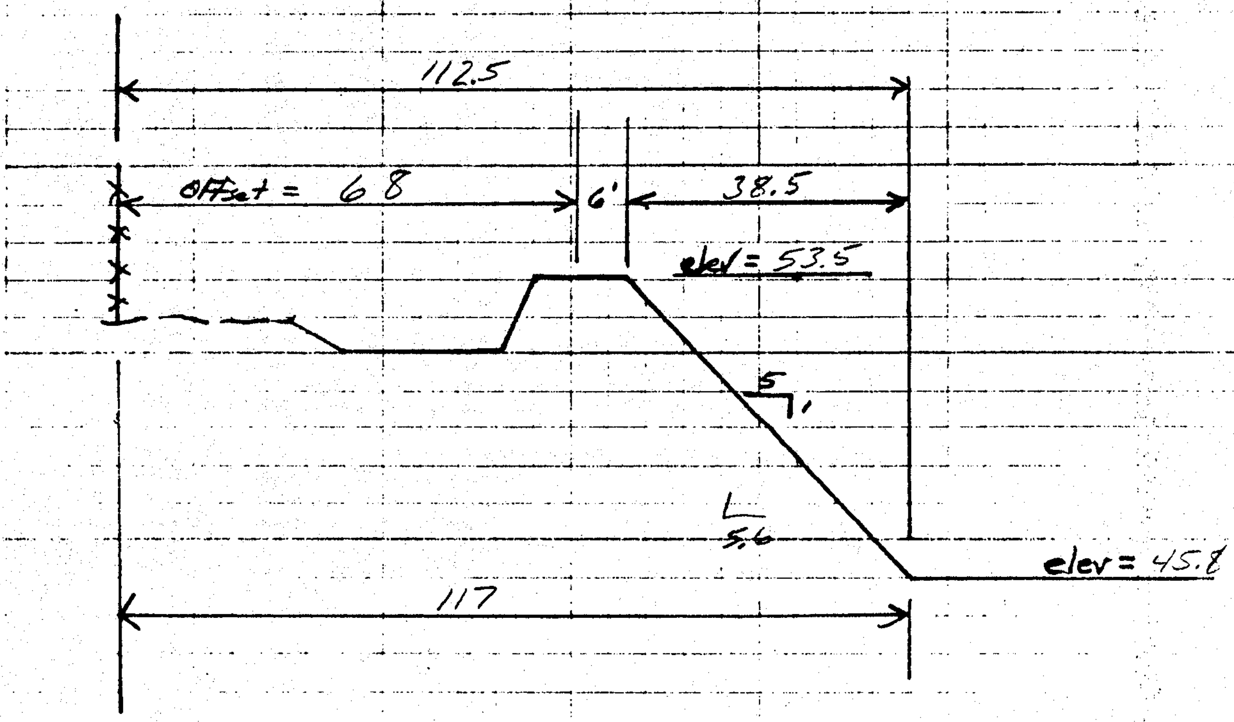
Check Slope fit with new dike offset



92+00

No 11 diff = 4.5 ft > 5 ft ok

SADDLEBACK DIVERSION REPAIR

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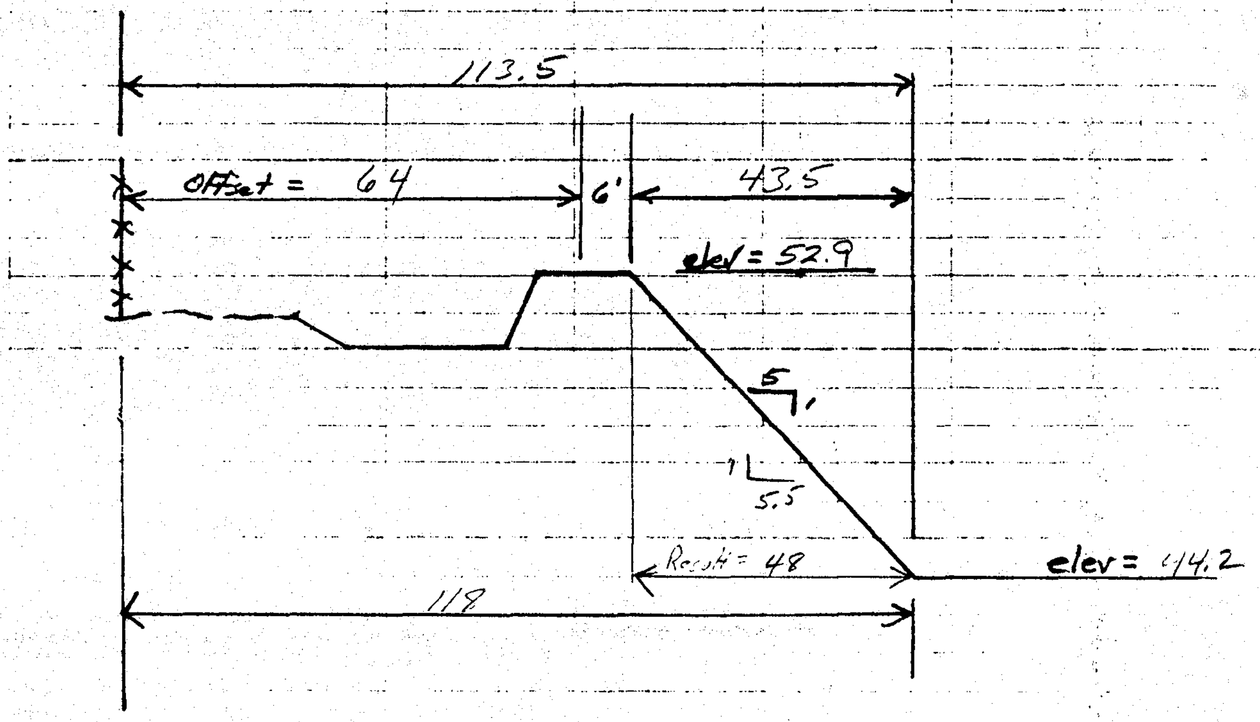
Check Slope fit with new dike offset



99+70

No 12. 4.5 > 5'. OK

PROJECT SADDLEBACK DIVERSION REPAIR

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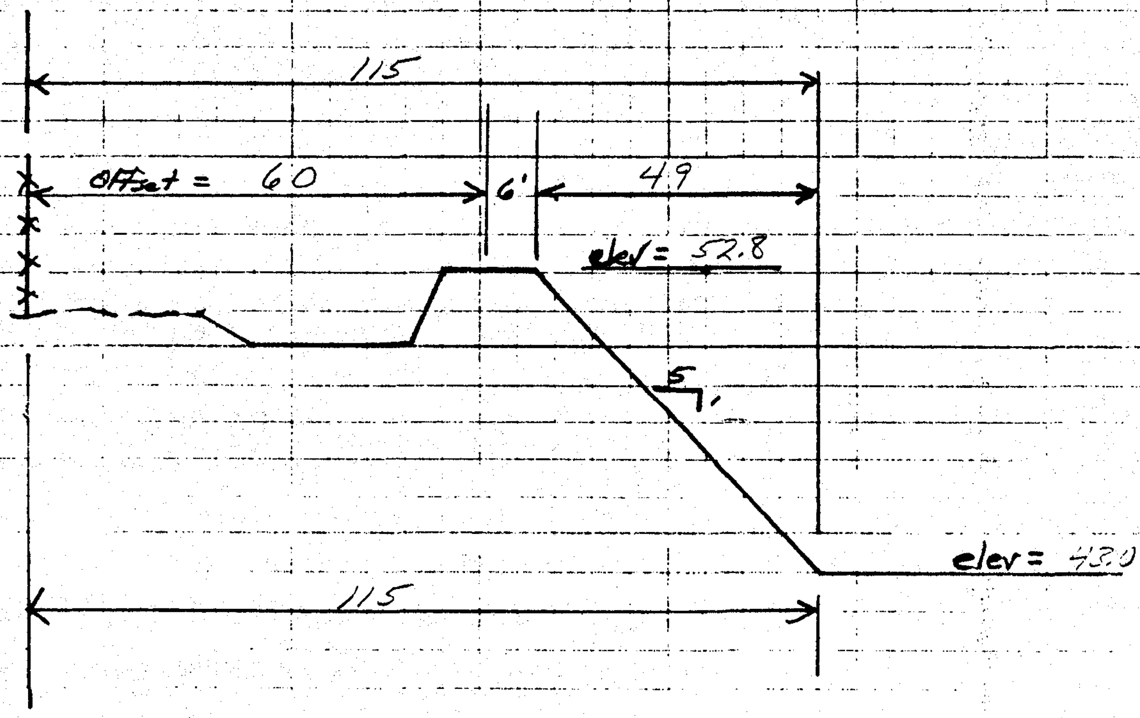
Check Slope fit with new dike offset



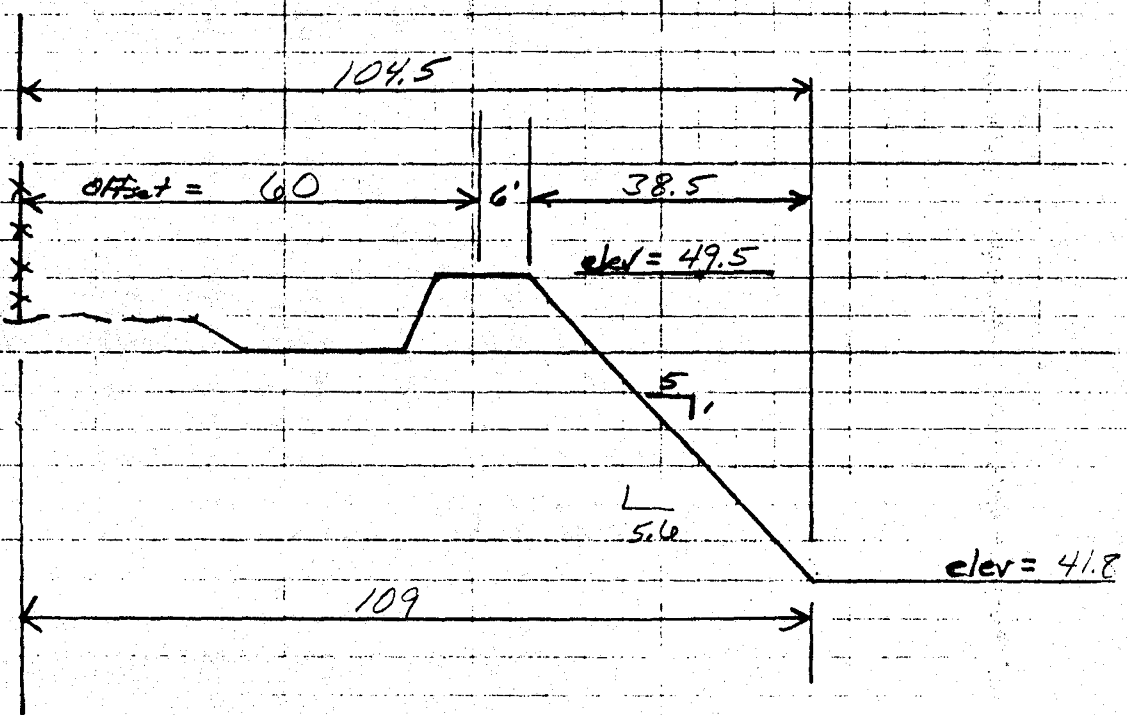
105+00

No 13 diff = 0 ok

PROJECT SADDLEBACK DIVERSION REPAIR

JMH DATE 11-29-88 CHECKED BY DATE JOB NO

Check Slope fit with new dike offset



112+00

No. 14 diff = 4.5 < 5.0 ok

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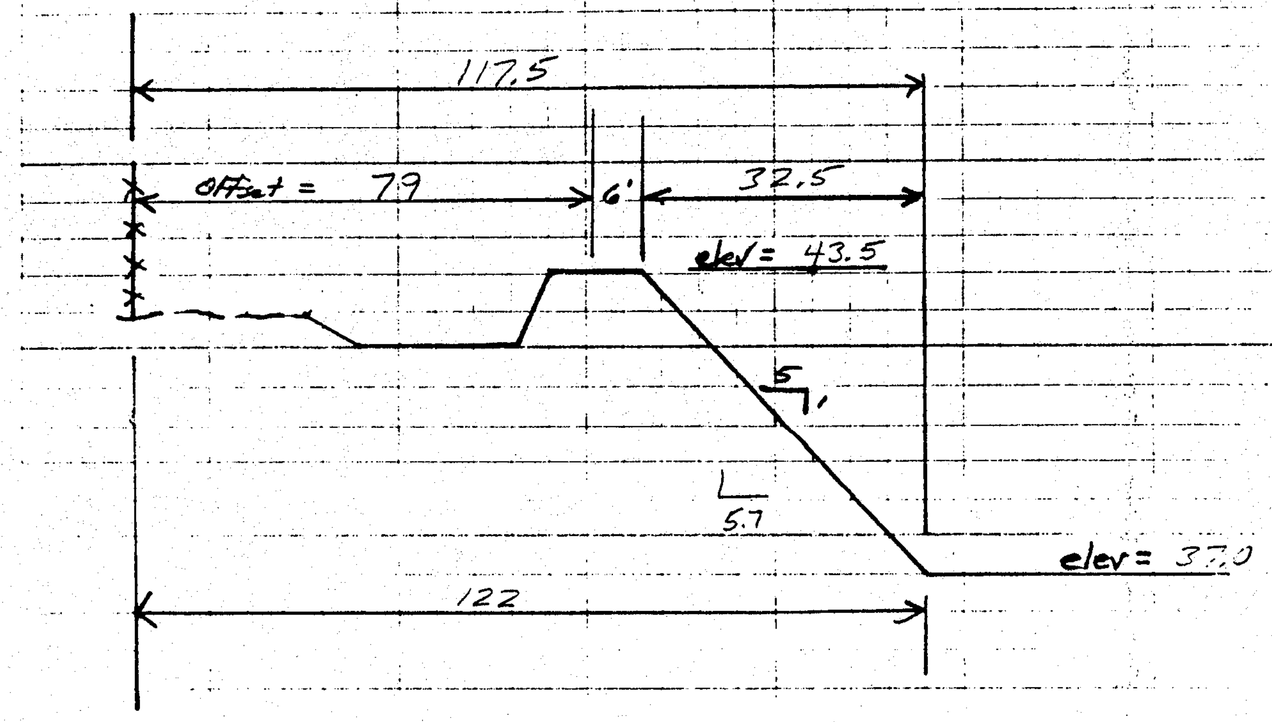
Check Slope fit with new dike offset

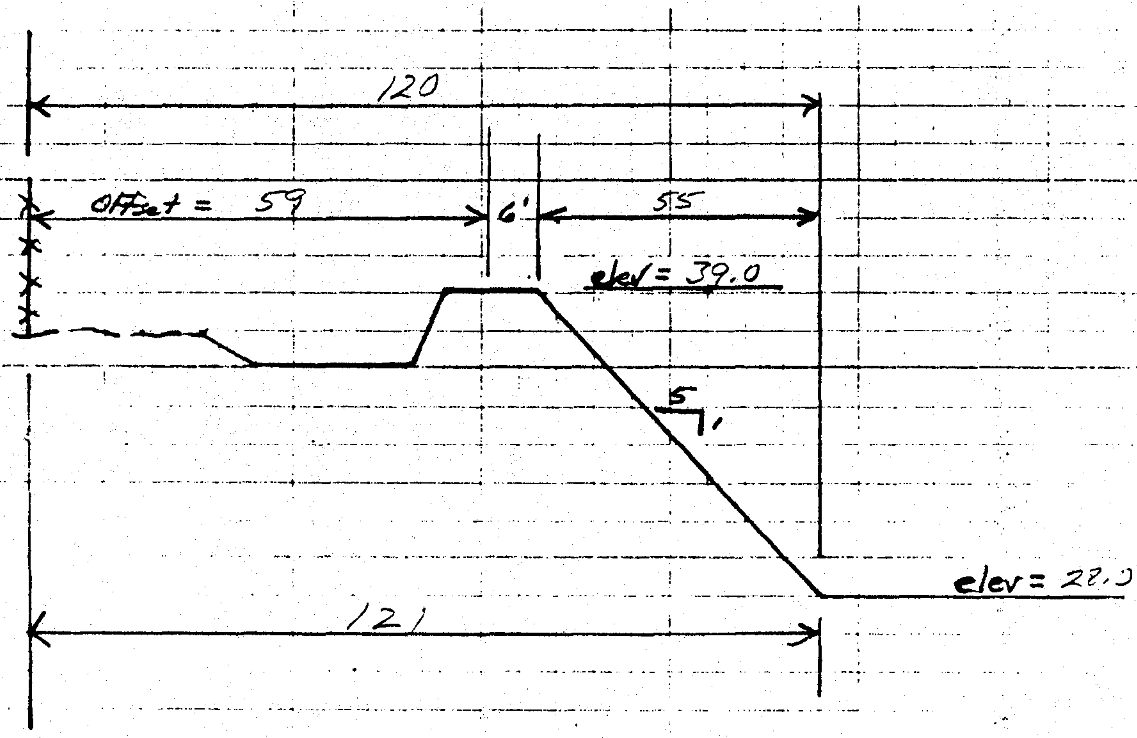


135+75
No 16 diff = 4.5' < 5' ok

PROJECT Saddleback Diversion Repair

JMH DATE 11-29-88 CHECKED BY

Check Slope fit with new dike offset SHEET

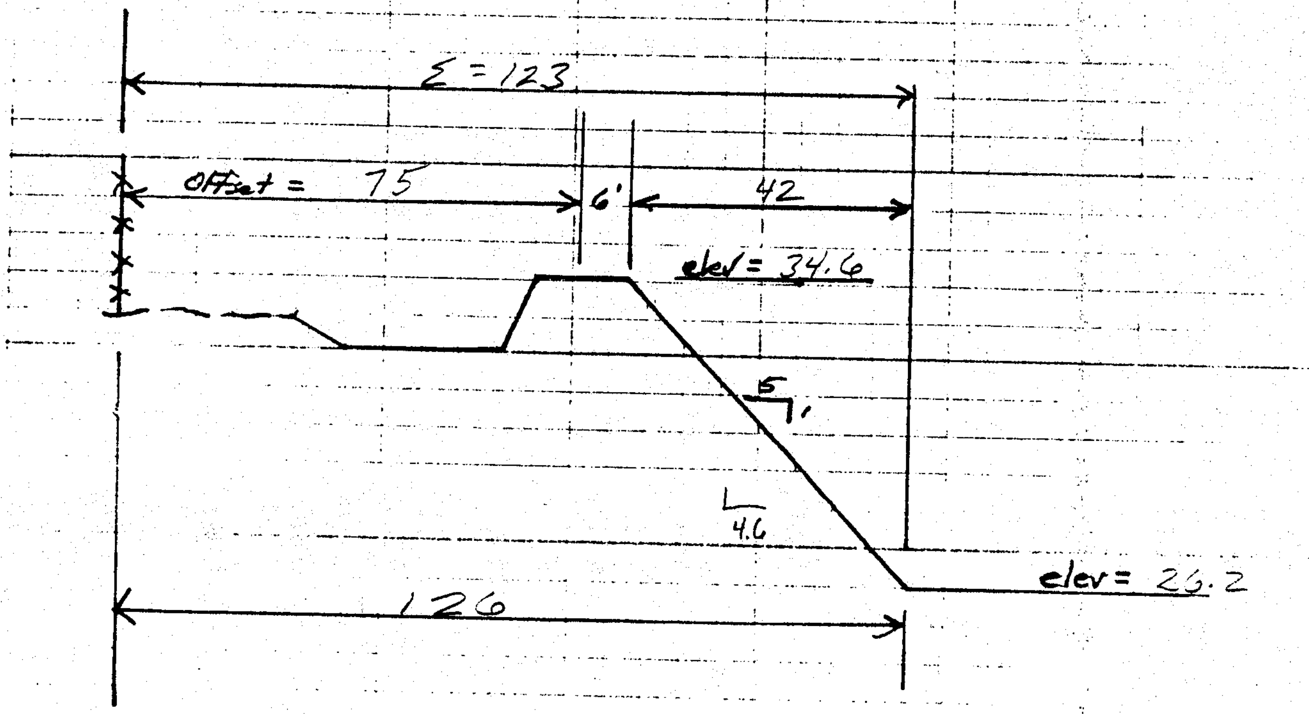


148+00
No 17 diff = 1' < 5' ok

PROJECT: Saddleback Diversion Repair

BY: JMH DATE: 11-29-88 CHECKED BY DATE

Check Slope fit with new dike offset SHEET



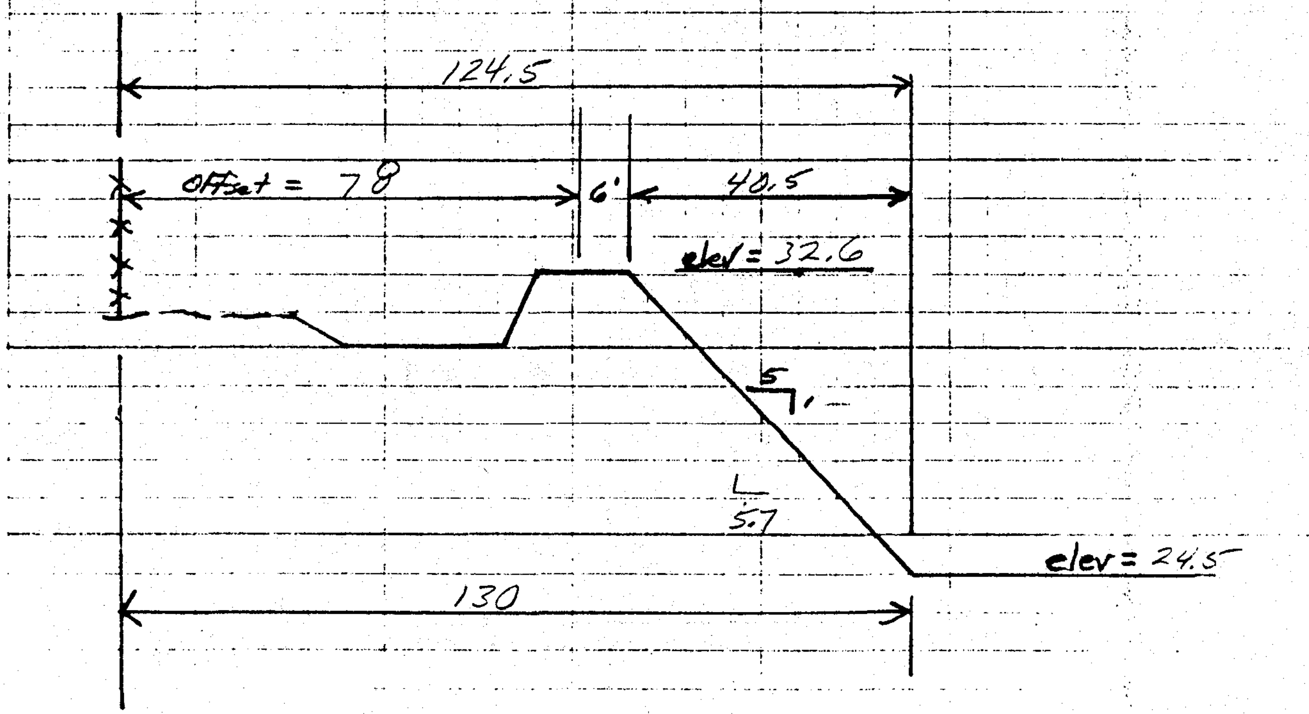
157+00

No 18 3' < 5' ok

PROJECT Saddleback Diversion Repair

BY JMH DATE 11-29-88 CHECKED BY DATE JOB NO

Check Slope fit with new dike offset SHEET



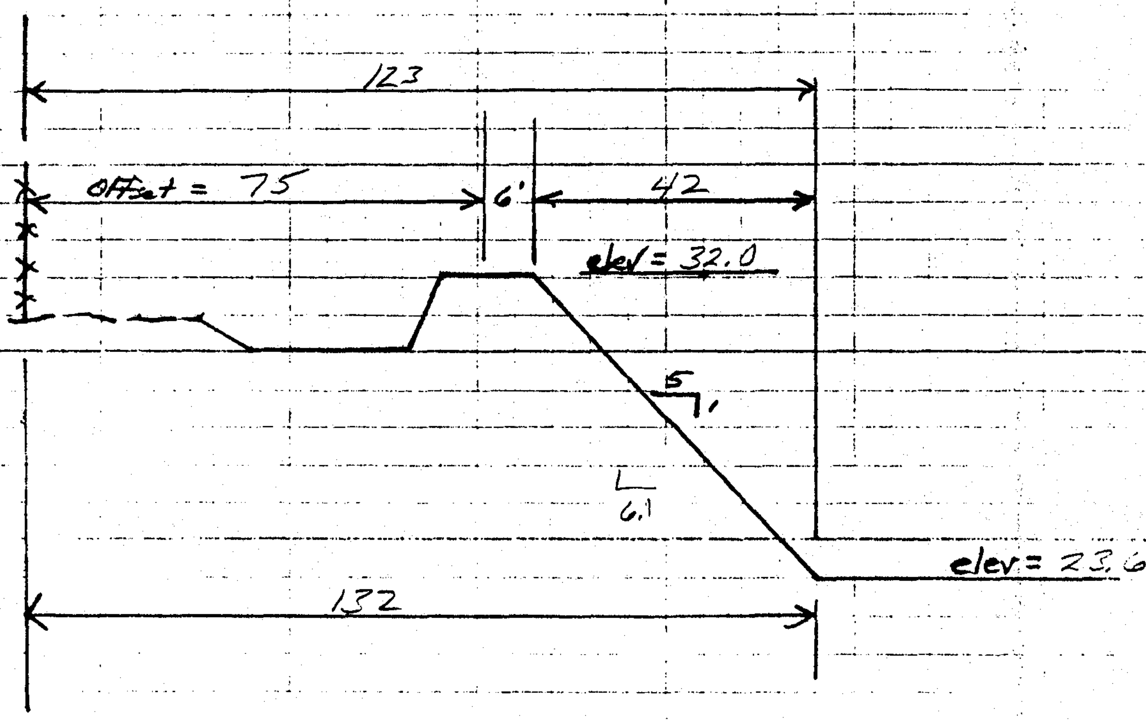
165+00
No. 19 diff = 5.5' ≈ 5 ft ok

SOIL CONSERV...

SADDLEBACK DIVERSION REPAIR

JMH 11-29-88

Check Slope fit with new dike offset



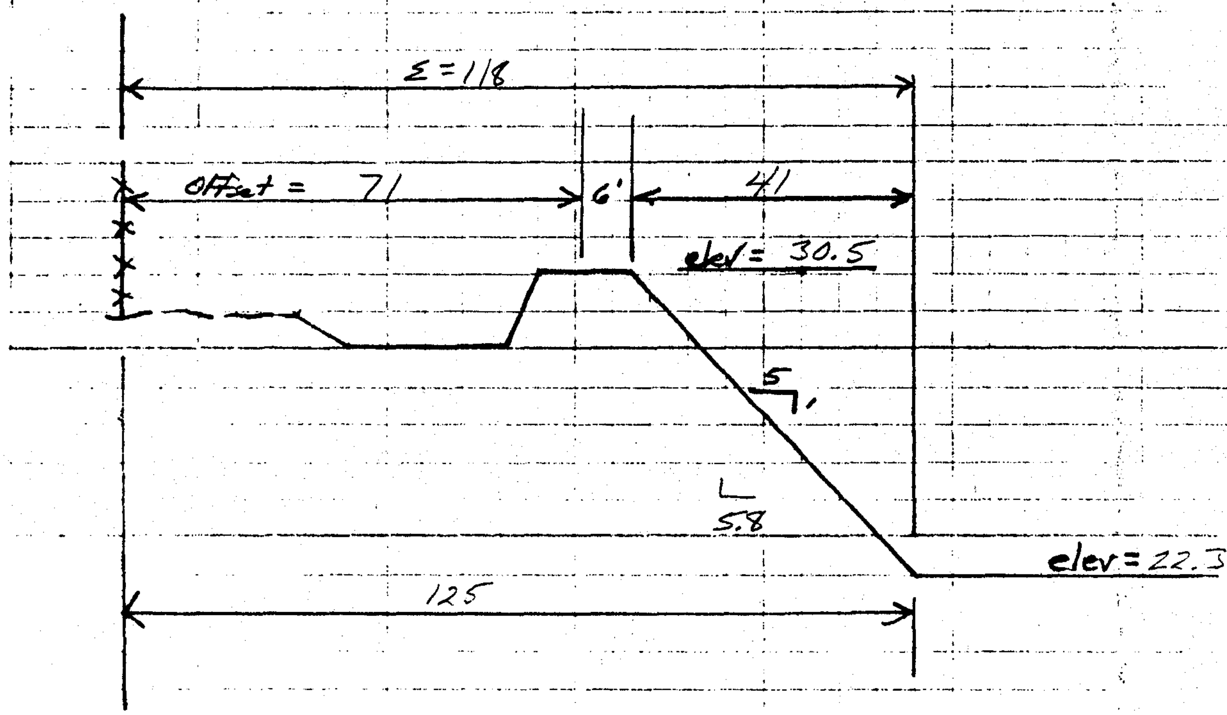
169+00

No 20. diff = 9 ft > 5 ft ?

PROJECT SADDLEBACK DIVERSION REPAIR

JMH 11-29-88

Check Slope fit with new dike offset



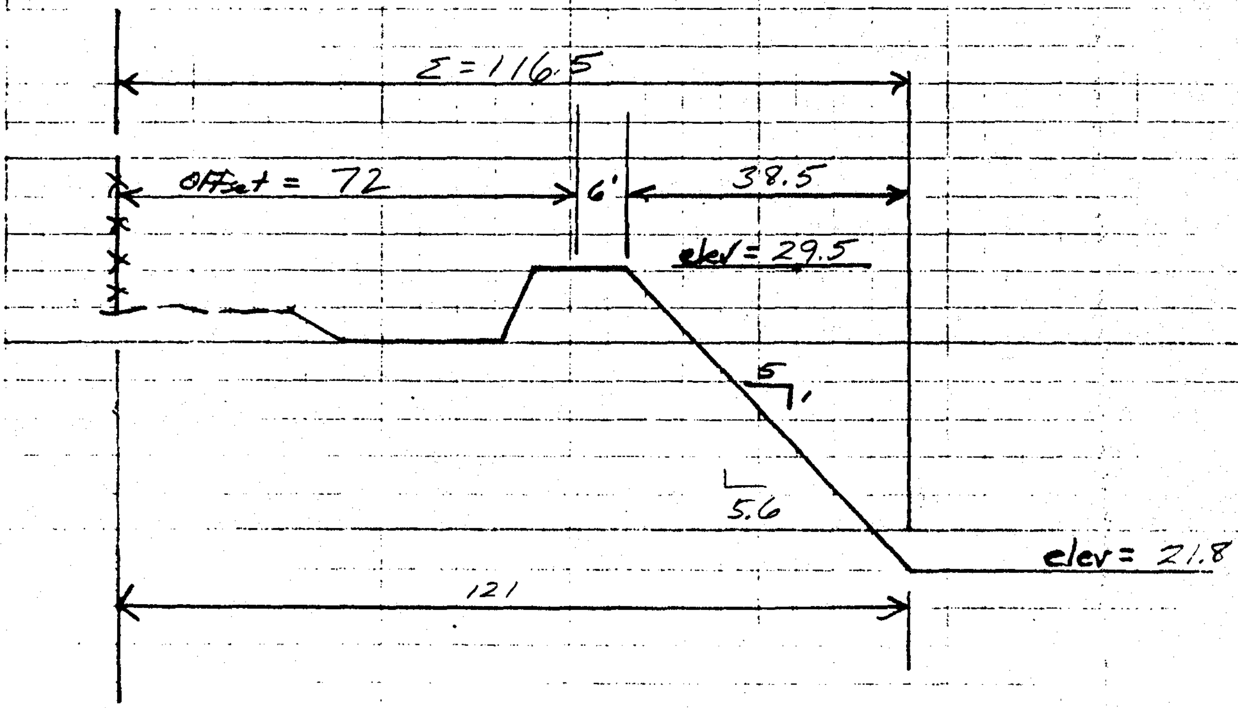
174+50
No. 21 diff = 7' > 5' ?

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT: SADDLEBACK DIVERSION REPAIR

JMH 11-29-88

Check Slope Fit with new dike offset

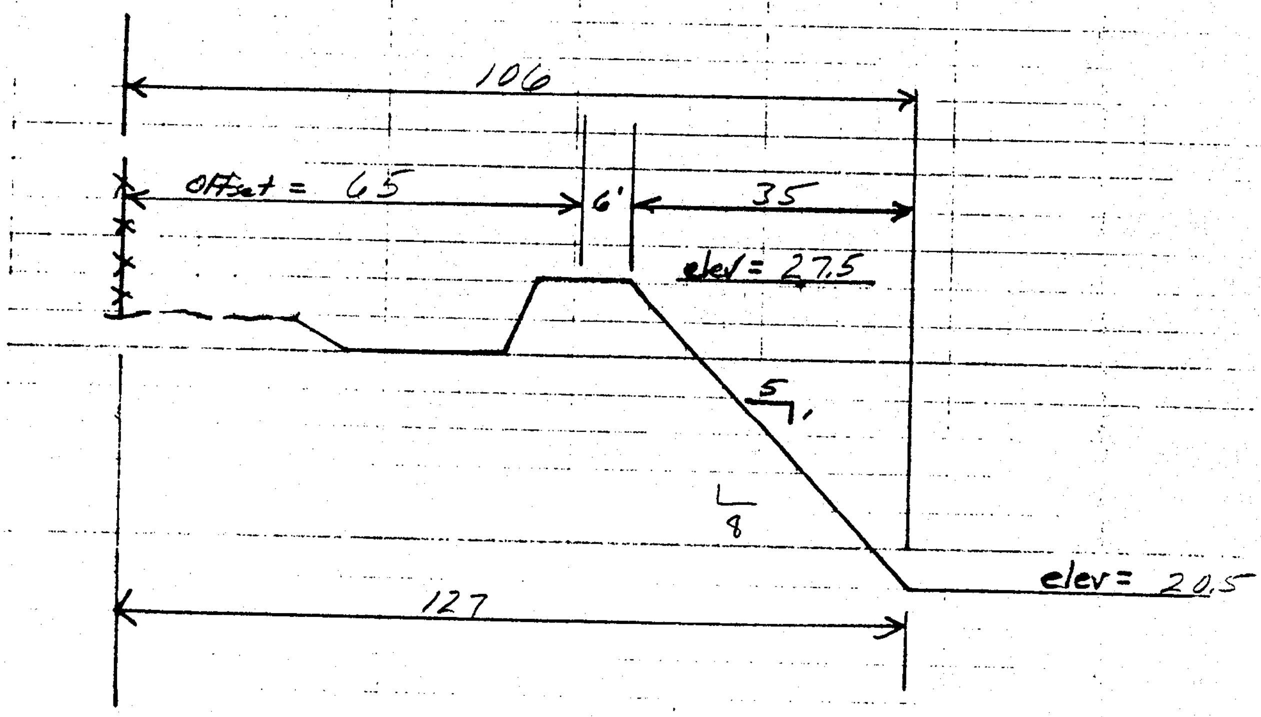


176+00
No. 22 diff = 4.5 > 5' ok

SADDLEBACK DIVERSION REPAIR

JMH 11-29-88

Check Slope Fit with new dike offset

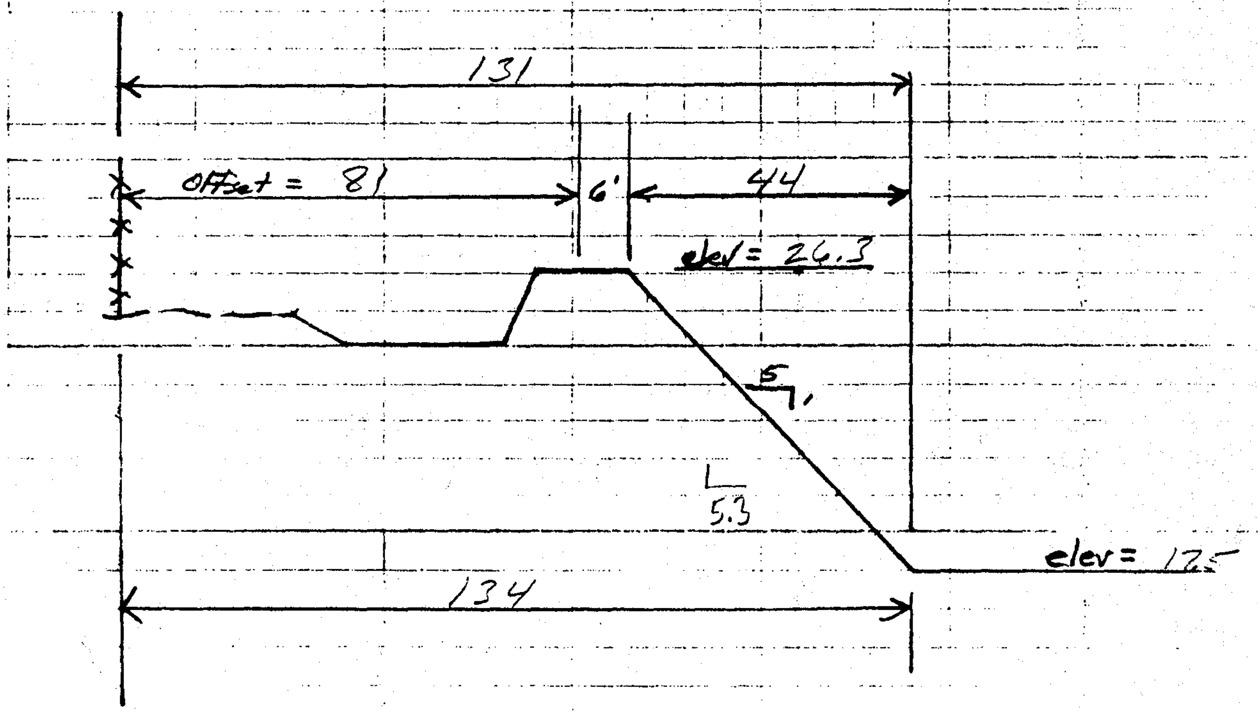


183+00
No. 23 diff = 21' > 5' ?

SADDLEBACK DIVERSION REPAIR

JMH 11-29-88

Check Slope fit with new dike offset



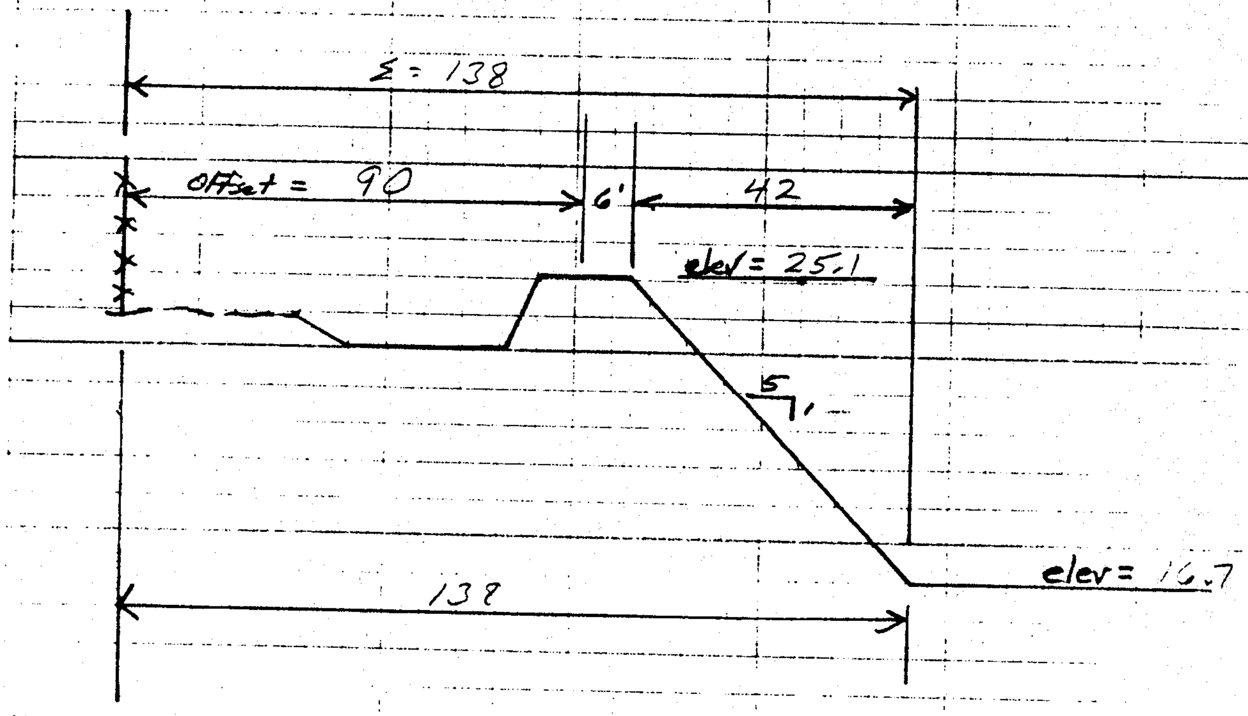
196+50
No. 25 diff = 3 ft < 5 ft OK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT Saddleback Diversion Repair

BY JMH DATE 11-29-88 CHECKED BY DATE JOB NO.

Check Slope fit with new dike offset



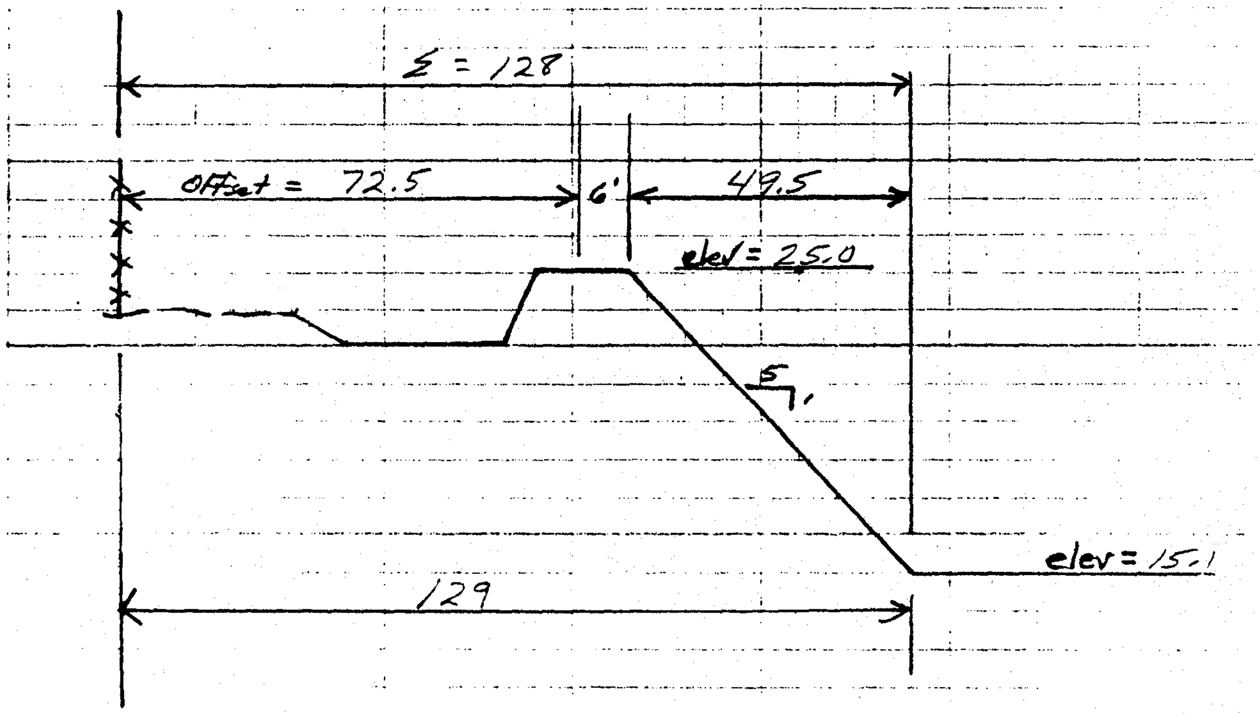
200+00
No 26 diff = -0- ok

U.S. DEPARTMENT ...
SOIL CONSERVATION ...

BY JMH DATE 11-29-88 CHECKED BY DATE JOB NO.

SADDLEBACK DIVERSION REPAIR

Check Slope fit with new dike offset

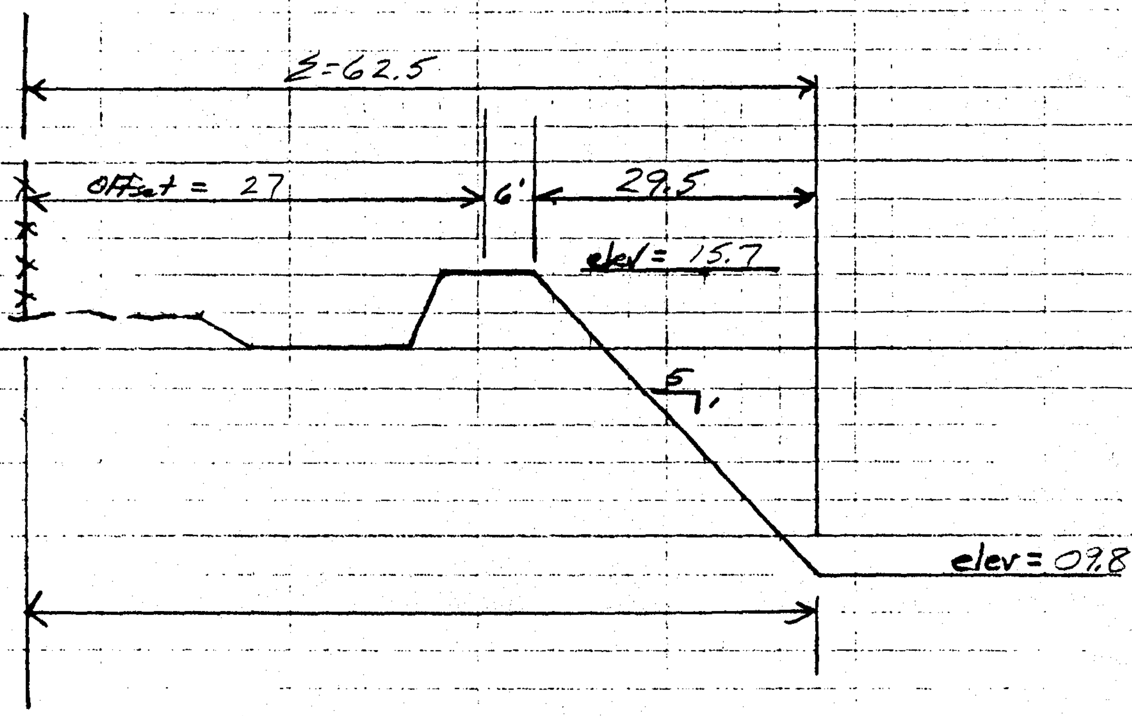


207+50
No 27 diff = 1 ft < 5 ft ok

PROJECT Saddleback Diversion Repair

BY JMH DATE 11-29-88 CHECKED BY DATE JOB NO.

SUBJECT Check Slope fit with new dike offset SHEET



23+50
No. 29

ARIZ
JMH 12-6-88

SADDLEBACK DIVERSION REPAIR

HYDROLOGY

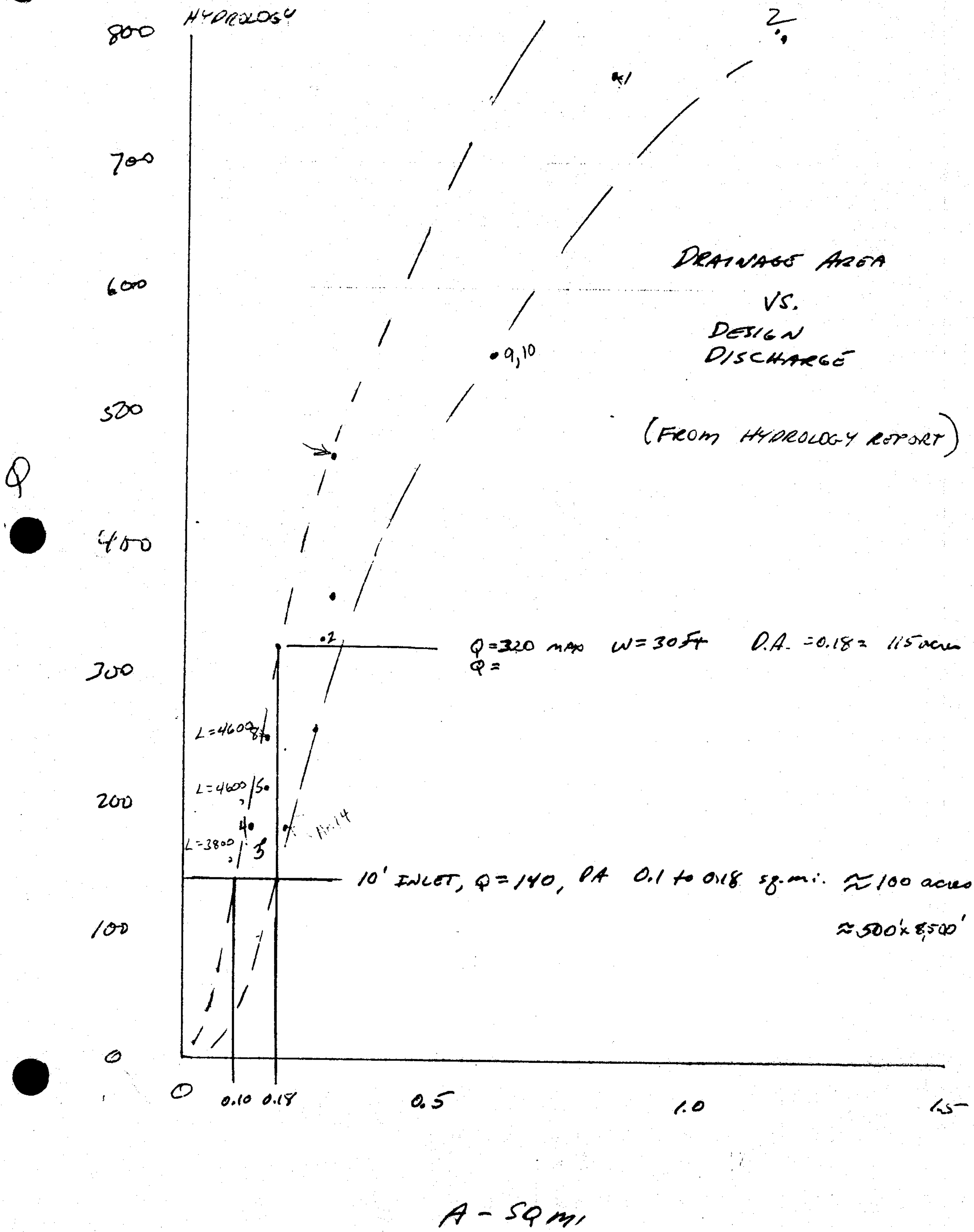
The 2nd hydrology report, done after the storm event that damaged the structure, checked and adjusted the design hydrology. The 2nd hydrology report was used for this repair design. A graph of design discharge versus drainage area was made to size the smaller new inlets which gives reasonable results.

No new hydrology was necessary for this project.

Update 1-17-89 Hydrology for Saddleback FRS local drainage north of Salome Road performed 12-88 has been added to this project.

ARIZ
JMH

SOI


HYDROLOGY
800
700
600
500
400
300
200
100
0
Q
DRAINAGE AREA
VS.
DESIGN
DISCHARGE
(FROM HYDROLOGY REPORT)
9,10
Q=320 MAX W=30 Ft D.A. =0.18 = 115 acres
Q =
L=4600 8
L=4600 5
4
L=3800 3
10' INLET, Q=140, DA 0.1 to 0.18 sq.mi. ≈100 acres
≈500'x 8,500'
0
0.10
0.18
0.5
1.0
1.5
A - SQ MI

ENGINEERING REPORT

SADDLEBACK DIVERSION
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

U.S.D.A. - SOIL CONSERVATION SERVICE
201 E. INDIANOLA SUITE 200
PHOENIX, ARIZONA 85012

FEBRUARY 1987

Date of Installation: 1981 to 1982

Saddleback Diversion is located on an alluvial fan. The diversion takes the principal spillway outflow from Saddleback FRS and the runoff from Saddleback Mountain and outlets these flows into an unnamed tributary to the major drainage of Centennial Wash. Grouted rock side inlets were placed at points of existing washes along the diversion channel to inlet intercepted runoff into the channel. Earthen collector channels extend perpendicular to the side inlets. They collect and divert overland flow to the side inlets.

The diversion, side inlets, and collector channels were designed for the 50-year 24-hour storm. On September 2, 1984, an intense storm produced peak discharges that exceeded design for the middle and lower reaches of the diversion. The diversion performed remarkably well, conveying up to twice design discharge without damage.

The storm changed the location of several washes and caused flow braiding and erosion on the alluvial fan above the diversion. Runoff water by overland flow and washes deposited sediment bars in the earthen collector channels. The channels were overtopped and breached. Fifteen of the 17 grouted rock side inlets were overtopped or flanked by erosion through the abutments or through the collector channels adjacent to the inlets.

The primary cause of the damage to the side inlets and collector channels was because the storm exceeded design for most of the problem areas. Responsibility is assigned to natural occurrences. There were, however, three areas of shortcomings in the design: (1) The side inlets were incorrectly sized and were too small even for the 50-year storm. (2) The side inlets and collector channels were designed and constructed without freeboard. (3) No allowance was made for sediment accumulation in the collector channels.

Incorrect sizing of the side inlets could have been prevented by a detailed review of design computations. The designer(s) followed established policy in not providing freeboard or accounting for sediment since the side inlets and collector channels are considered minor structures. Arizona SCS policy regarding freeboard and sediment for structures of this type should be re-examined.

Remedial Treatment 1/ The investigating engineers recommend the repair of inlet structures and breached collector channels, the construction of collector channels and dikes to cover the entire length of the diversion, the enlargement of the collector channels to accomodate some sediment accumulations, and adding additional side inlets at locations where new major washes now exist.

1/ For additional information contact:

State Conservation Engineer
USDA, Soil Conservation Service
201 E. Indianola, Suite 200
Phoenix, AZ 85012

Include a copy of abstract with request.

REPORT OF INVESTIGATION COMMITTEE

FOR

HARQUAHALA VALLEY

WATERSHED

SEPTEMBER 2, 1984 STORM OF SADDLEBACK DIVERSION

BY

Original Committee

William E. Payne, Jr.

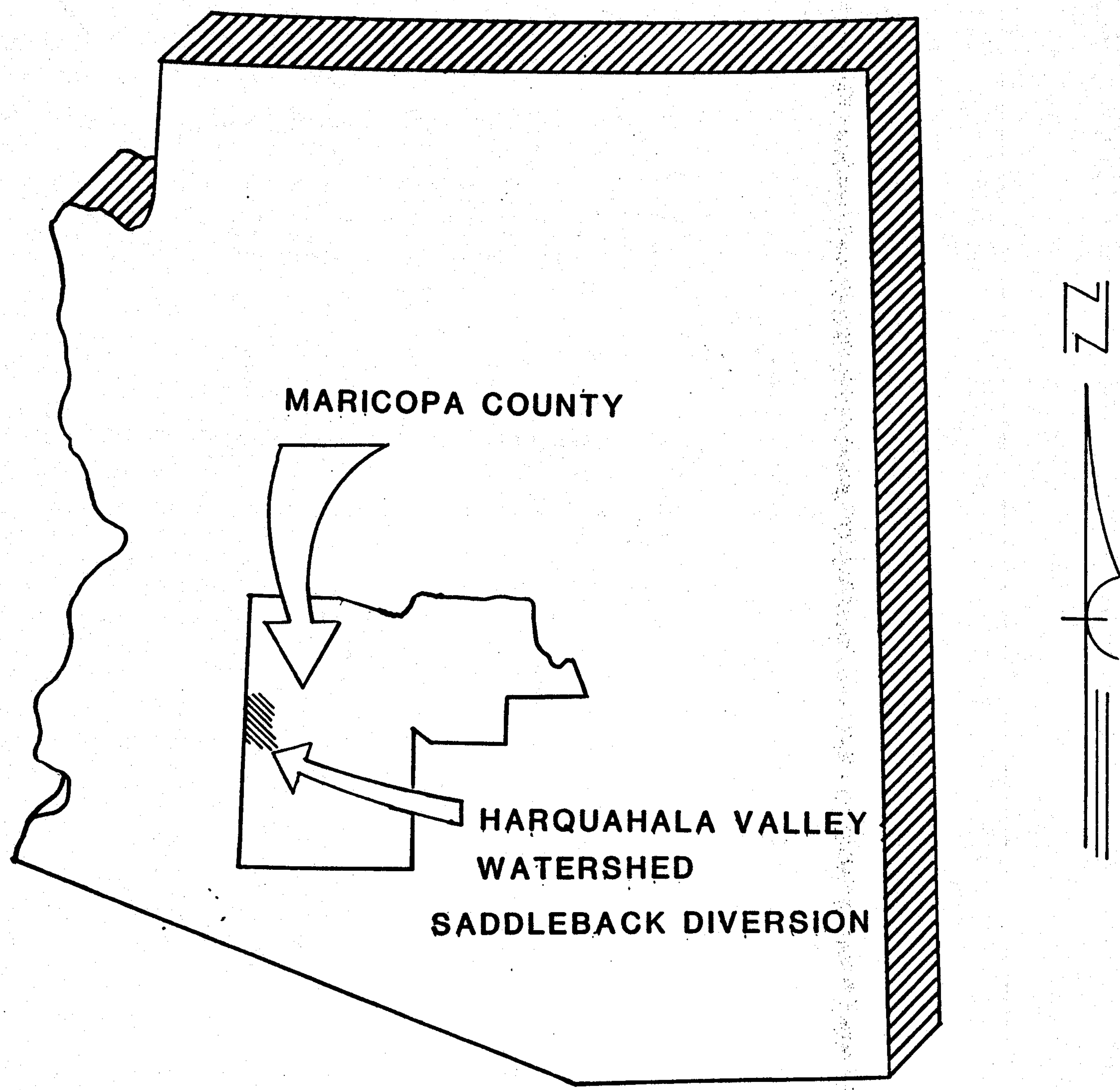
Herman N. McGill

Present Committee

John E. Weaver, Chairman

Harry C. Millsaps, Member

LOCATION MAP



ARIZONA

ENGINEERING REPORT
for
Saddleback Diversion
Maricopa County, Arizona

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U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PHOENIX, ARIZONA

February 1987

ENGINEERING REPORT

STORM OF SEPTEMBER 2, 1987 - SADDLEBACK DIVERSION

Project: Harquahala Valley Watershed Project

Location: Maricopa County, Arizona

Site: Saddleback Diversion

Appropriation: PL-566

General Description of Problem:

An intense storm on September 2, 1984 caused overtopping of grouted rock side inlet structures and breaching of collector channels that collect and divert overland flow to the side inlets. Damage consists of erosion around the abutments of the side inlets; collector channels filled with sediment, overtopped, eroded and breached.

Authority:

Letters dated January 29, 1985 and November 4, 1986 from Verne Bathurst, State Conservationist.

Composition of Committee:

This report was prepared by two separate committees. The original committee, appointed January 29, 1985 was:

William E. Payne, Jr., State Design Engineer, SCS, Phoenix, Arizona

Herman N. McGill, Hydraulic Engineer, SCS, Temple, Texas

On November 4, 1986, the present committee was appointed for the purpose of revising the original report and incorporating comments received from the West Technical Service Center (memo of May 22, 1986 from Donald Wallin). The present committee is:

John E. Weaver, Asst. State Conservation Engineer, SCS, Phoenix, Arizona (Chairman)

Harry C. Millsaps, Hydraulic Engineer, SCS, Phoenix, Arizona (Member)

INVESTIGATIONS

PROJECT DATA

Saddleback Diversion is a Class VII structure that is 4.73 miles long, constructed across an alluvial fan. The drainage area above the diversion is 8.6 square miles. The diversion takes the principal spillway outflow from Saddleback FRS and runoff from the intervening area and outlets into an unnamed tributary to Centennial Wash. The geometery of the diversion is a dike with a 12 foot top width and side slopes of 3 to 1 and 4 to 1. The channel has a variable bottom width with 3 to 1 and 5 to 1 side slopes. Approximately 1,900 feet of the channel at the upper end is rock riprapped. There are four grouted rock drop structures for grade control and velocity reduction within the channel.

There are 18 side inlets at the points where the diversion intercepts washes that drain the west slopes of Saddleback Mountain. Seventeen of these inlets are grouted rock grade control structures referred to as "side inlets". The No. 18 inlet is a earth channel outletting at channel grade. The grouted rock inlets vary in bottom width from 10-60 ft. The grouted rock is 2.0 ft. thick. The weir inlet is 2.0 ft. deep for all of the inlets. A detail drawing and other data on these structures is shown in Appendix B, which is a copy of sheet 20, As-Built Plans.

Collector channels, referred to on the plans, in the design file, and in the construction records as "lateral swales", were constructed to direct overland flow to the side inlets. These channels were 2.0 ft. deep, with 3:1 side slopes, and a bottom width of either 10, 20, or 30 ft. (see Appendix B, As-Built Drawing). The channels vary in length from 197 ft. at Inlet No. 4 to 2,510 ft. at Inlet No. 12.

The diversion, side inlets, and collector channels were designed for a 50-year, 24-hour storm. The design discharge for a specific collector channel was assumed to be 1/3 the design discharge of the side inlet.

Saddleback Diversion was designed by PRC Toups, a consulting engineering firm. Construction inspection was done by the firm of Sergent, Hauskins, and Beckwith.

DAMAGES

The 50-year, 24-hour design capacity for the diversion varies from 1120 cfs at the Saddleback FRS outlet to 6060 cfs at the diversion outlet. On Sunday, September 2, 1984 a storm event passed through the watershed in a northwest to southeast direction with an approximate duration of 4 hours. This storm event produced an estimated outflow of 739 cfs at the Saddleback FRS outlet and 12,355 cfs at the diversion outlet. The diversion functioned perfectly during and after the storm with the water level within one foot of the top of the diversion dike. There was very little or no erosion to the diversion dike or channel. The major erosion was around and between the side inlets into the diversion channel.

The runoff water from overland sheet flow and side washes caused sediment bar development in the collector channels which were overtopped by floodwaters.

Fifteen of the 17 side inlets were overtopped or flanked by erosion through the abutments or through the collector channels adjacent to the inlets. The storm produced discharges of up to twice the design discharges in the lower reaches of the diversion but, the side inlets and collector channel in the upper reaches, where the design discharge was not exceeded, were also damaged (see photographs).

COMMITTEE ACTIVITIES

Herman McGill, Hydraulic Engineer, Temple, Texas began the hydrologic study of the site on November 5, 1984 and sent the completed study to the Arizona State Office in January, 1985. A copy of Mr. McGill's report is attached (see Appendix A). Harry C. Millsaps , Hydraulic Engineer, Phoenix, Arizona, analyzed Mr. McGill's study for each side inlet in January, 1985. A copy of Mr. Millsaps analysis is attached (see Appendix A). William Payne, Design Engineer, Phoenix, Arizona, interviewed the SCS Government Representative for construction and reviewed the design and construction records, and prepared the original Engineering Report, dated December 1985.

The present committee was assigned in November 1986. This committee reviewed the work done by McGill and Payne, reviewed the design and construction records, and conducted additional interviews.

INTERVIEWS

Interviews were conducted with Tom Jayo, SCS Government Representative for construction; John Sullivan, SCS Construction Engineer; Ralph Arrington, State Conservation Engineer; Paul Monville, Government Representative for the design contract and the State Design Engineer at the time of design (telephone conversation); and Ash C. Patel, Designer, PRC Toups.

EVALUATION

DESIGN

Key elements of the design included the hydraulic sizing of the side inlet structures and the collector channels, sediment in the collector channels, and location of the side inlets.

Experience in Similar Design

Arizona SCS has experience with the design and construction of side inlets into a diversion channel on four previous projects. These are discussed below:

1. RWCD Reach 2 - there was some erosion at the side inlets on this project but the erosion resulted from soil piping, which did not occur in the coarse soils at Saddleback Diversion.

2. RWCD Reach 3 - this project has not been tested.

3. Signal butte Floodway - the inlets here have performed well except for ponding of water outside the right-of-way.

4. Spookhill Floodway - this project has experienced erosion damage very similar to that which occurred to the side inlets and collector channels at Saddleback Diversion. These damages were repaired by the project sponsor and an engineering report was not prepared. This committee did not conduct an in-depth comparison of the two projects.

Side Inlets

Details and design discharges for the grouted rock side inlets are shown on the As-Built Drawing sheet 20 in Appendix B.

The Design Report for this project (see pages 3.1-50 and 3.1-52 in Appendix B) shows that the design width of the inlets was determined by applying Mannings Formula to the natural wash upstream from the inlet. This method results in supercritical flow over the weir crest.

These inlets were constructed with no slope through the weir. The committee used the broad crested weir method (see Appendix B) to compute as-built capacities. This method shows that the actual capacity of all 17 weirs is less than 50-year discharge capacity. For example, the capacity of inlet No. 7 is only 47% of that needed for the 50-year discharge (see Table 1). The weirs were designed and constructed without freeboard.

Collector Channels

The collector channels, called "lateral swales" in the drawings and design file, are earthen channels constructed to divert overland flow to the grouted rock side inlets. The channels had a bottom width of either 10, 20, or 30 ft. with a 2.0 ft. depth (see As-Built Drawing, sheet 20, in Appendix B).

The intent of the designers (see excerpt from Design Report, page 3.1-50 in Appendix B) was to size the channel capacity at 1/3 of the capacity of a corresponding side inlet.

The bottom slope of the collector channels is not shown on the drawings. The Committee determined the slope from the slope stake survey field books and computed the As-Built capacity of the collector channel (see Computations in Appendix B). A comparison of design and As-Built capacity is shown in Table 2. In summary, the As-Built capacity either equals or exceeds design capacity (1/3 Q of side inlets) except for inlets No. 1, 7, 9, and 17. The collector channels did not have any allowance for freeboard or sediment accumulations.

Sediment

Sediment bars across the collector channels caused overtopping and breaching of the collector dikes. Extensive attention was given in design to the subject of sedimentation for the main diversion channel but not for the collector channels. No allowances were made in the design for sediment. Hydraulic sizing assumed that the collector channels would carry the run-off without the need to increase capacity for sediment or added freeboard.

CONSTRUCTION

Construction records were reviewed. Construction was in accordance with plans and specifications. Construction operations did not have any bearing on the problems encountered.

CONCLUSIONS

The primary cause of the damage to the side inlets and collector channel was an intense storm that exceeded design discharge for most of the area where problems were encountered. The 50-year design capacity was exceeded at 13 of the 17 inlets (see Table 1). This storm caused flow braiding on the alluvial fan above the structures, erosion, and significant deposition of sediment in the collector channels. The primary responsibility is assigned to natural occurrences beyond the reasonable control of anyone involved with this project.

However, there were some damages to the inlets and collectors channels in the upper reaches of the diversion where the storm peaks were actually less than the design discharges. This occurred at Inlet No's. 2, 3, 5 & 8 (see Table 1). At Inlet No. 4, the storm peak was greater than the design discharge but this was not due to the intensity of the storm, but to an increase in the drainage area assumed to be contributing to this inlet. The design drainage area was 0.14 square miles as compared to 0.29 square miles used for the storm. This apparent discrepency has not been reconciled as of this writing (see Millsap's report in Appendix A).

The as-built capacity of all 17 side inlets is less than the planned 50-year capacity because the weir width was determined by Mannings Formula instead of the weir formula (see Appendix B). The actual capacity versus 50-year discharge varies from 47% at Inlet No. 7 to 95% at Inlet No. 14. At Inlet No's. 2 and 3, the storm discharge exceeded the as-built capacity, but was approximately equal to or less than the 50-year design discharge (see Table 1). These two inlets might not have been damaged had they been designed correctly. Responsibility is with design, although it should be recognized that failure of most of the inlets would still have occurred even if they had been sized correctly, because of breaching of the collector channels adjacent to the side inlets.

The collector channels had adequate hydraulic capacity at the time of construction (see Table 2), but no allowance was made for sediment accumulation. Further, no freeboard was provided for either the collector channels or the side inlets. There does not appear to be any definite Arizona SCS policy regarding freeboard, or for accounting for sediment in the design of secondary type systems such as these side inlets and collector channels above a main diverison. The primary design (and review) attention is on the main diversion structure. Accounting for freeboard and sediment is at the option of the designers. Thus, the designers of Saddleback Diversion followed established procedures.

RECOMMENDATIONS

Undersizing of the side inlets during design should have been detected during the several reviews of the design calculations. More time and attention should be given to a detailed review to avoid a recurrence of this particular short-coming.

SCS policy/criteria that needs to be re-examined includes:

1. Freeboard requirements for side inlets.
2. Freeboard requirements for collector channels.
3. Sediment accumulation in collector channels.
4. Overdesigning collector channels to account for shifting, braided flow on alluivial fans.

Recommended remedial treatments for Saddleback Diversion are:

1. All of the 17 side inlets are undersized. Decide if it is prudent to enlarge the structures to handle the 50-year discharge.

2. Repair collector channels. Construct additional channels and dikes

the entire length of the diversion. Enlarge the channels to accomodate some sediment.

3. Add side inlets in locations where new major washes now exist.

4. Repair existing side inlets.

SUMMARY

1. Saddleback Diversion was completed in 1982. On September 2, 1984, an intense storm produced peak discharges that exceeded design for the middle and lower reaches of the diversion. Peak discharge at the outlet was double design discharge.

2. The diversion performed almost perfectly, providing greater than design protection for downstream properties. Water levels in the diversion came within one foot of overtopping the diversion dike; without damage to the main diversion channel, diversion dike, or four large grouted rock grade control structures.

3. The intense storm changed the location of several side washes and caused flow braiding and erosion on the alluvial fan of the contributing drainage area.

4. Runoff water by overland sheet flow and washes deposited sediment bars in the collector channels. Almost all of the collector channels were overtopped and breached.

5. Fifteen of 17 grouted rock side inlets were overtopped and/or flanked by floodwaters. The structures are still structurally intact except for erosion around the abutments where the collector channels meet the side inlets.

6. Construction was in accordance with plans and specifications and had no bearing on the problems encountered.

7. The primary cause of the damage to the side inlets and collector channels was an intense storm that exceeded design for most of the problem areas. Responsibility is assigned to natural occurrences.

8. The as-built capacity of all 17 side inlets is less than 50-year capacity because the designer(s) did not use established design methods to size the structures. This undersizing might have contributed to damage at Inlet No.'s 2 & 3 where the storm exceeded as-built but not design capacities. Responsibility is with design. This problem could have been prevented by a detailed review of design computations.

9. The collector channels and side inlets were designed and constructed without freeboard. The addition of freeboard would probably not have

prevented failure of the collector channels because of the sediment bars across the channels. The designers followed established procedures. Arizona SCS policy regarding freeboard for these type structures should be re-examined.

10. No allowances, other than sediment removal during normal maintenance, were made for sediment accumulations in the collector channels despite the fact that floodwater had to turn 90° when they met the channels and one channel was 2,510 feet long.

11. The exceptional success of the main diversion should not be obscured or discounted by the problems encountered with the secondary side inlet and collector channel system. The design engineers for this project faced a very close benefit-cost ratio of 1.16:1. The watershed work plan did not have any provisions to handle side inflow other than sloping the upstream side of the main diversion channel on a 5:1 slope. The structural grouted rock side inlets and collector channels were added during design as a better, but costlier, method to handle side inflow. The designers took some risk in the design of the collector channels and side inlets (no freeboard and no allowance for sediment) since the main line of defence, the main diversion channel, was immediately downstream. The collector channels and side inlet were considered to be secondary, or minor, structures in the total project.

<u>TABLE 1</u>

ENGINEERING REPORT
SADDLEBACK DIVERSION
Comparison of Design, AS-Built, and Storm Discharges
for
Side Inlets

Inlet No.	50-Year Q (cfs)	Design Q (cfs)	As-Built Q (cfs)	Percent As-Built/ 50-year	Storm of 12-2-84 (cfs)	Was Inlet Damaged
1	773	780	578	75%	1/	No
2	325	360	245	69%	325	Yes
3	172	180	140	81%	184	Yes
4	182	180	140	77%	353	Yes
5	208	210	158	76%	123	Yes
6	177	180	140	79%	26	Minor
7	956	1020	447	47%	1024	Yes
8	150	205	140	82%	210	Yes
9	535	545	447	84%	860	Yes
10	535	565	360	67%	860	No
11	176	185	158	90%	236	Yes
12	797	880	447	56%	1655	Yes
13	449	470	272	61%	1670	Yes
14	147	180	140	95%	279	Yes
15	212	225	184	87%	448	Yes
16	790	800	491	62%	1774	Yes
17	790	805	447	57%	1637	Yes

1/ Not Determined

TABLE 2

ENGINEERING REPORT

SADDLEBACK DIVERSION

Comparison of Design and As-Built Discharge
for
Collector Channels

Inlet No.	Intended/ Design Q (cfs)	As-Built Q (cfs)	Was Channel Overtopped?
1	250	137	No
2	110	206	Yes
3	60	142	Yes
4	60	128	Yes
5	70	North = 142	
		South = 75	Yes
6	60	231	No
7	320	227	Yes
8	50	North = 139	Yes
		South = 160	Yes
9	180	167	Yes
10	180	North = 152	?
		South = 171	?
11	60	90	Yes
12	270	304	Yes
13	150	205	Yes
14	60	N/A	N/A
15	70	155	Yes
16	260	265	Yes
17	260	216	

1/ Equals 1/3 of design discharge for side inlets.

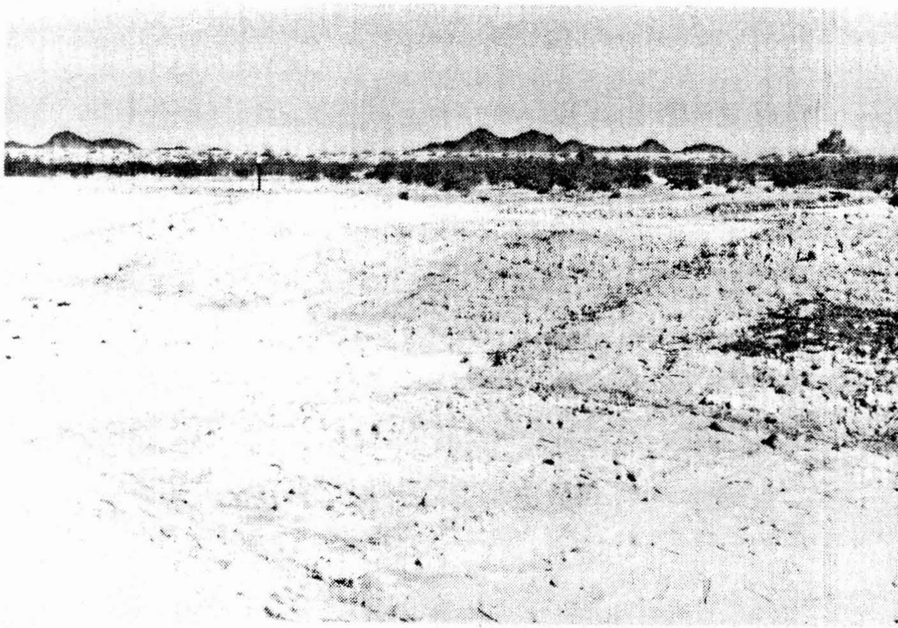


Photo No. 1

STATION 7+00 SIDE INLET #1
NO DAMAGE

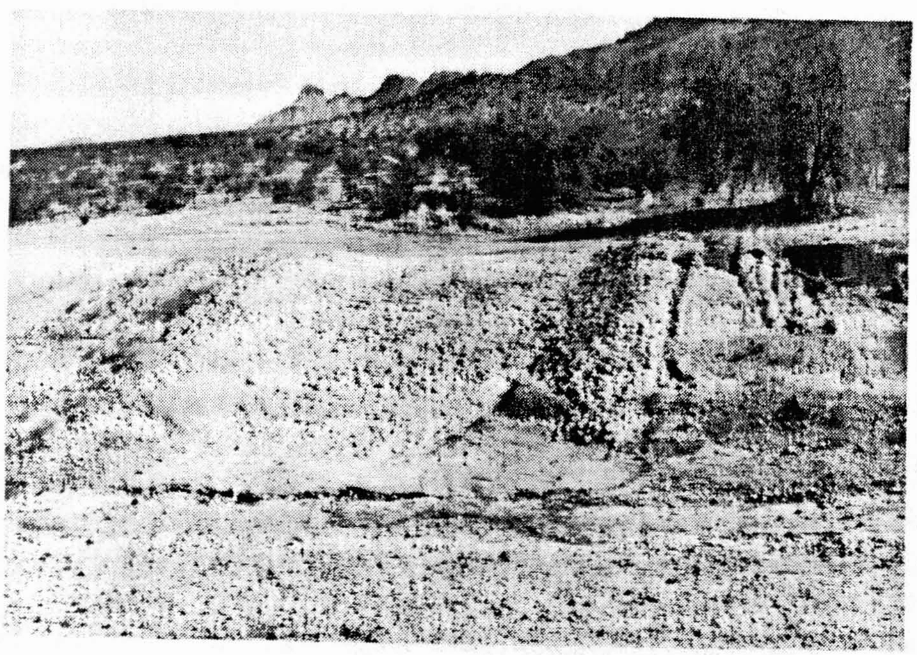


Photo No. 2

STATION 14+00 SIDE INLET #2
SEDIMENT BARS IN COLLECTOR CHANNELS
CAUSED OVERTOPPING OF DIKE

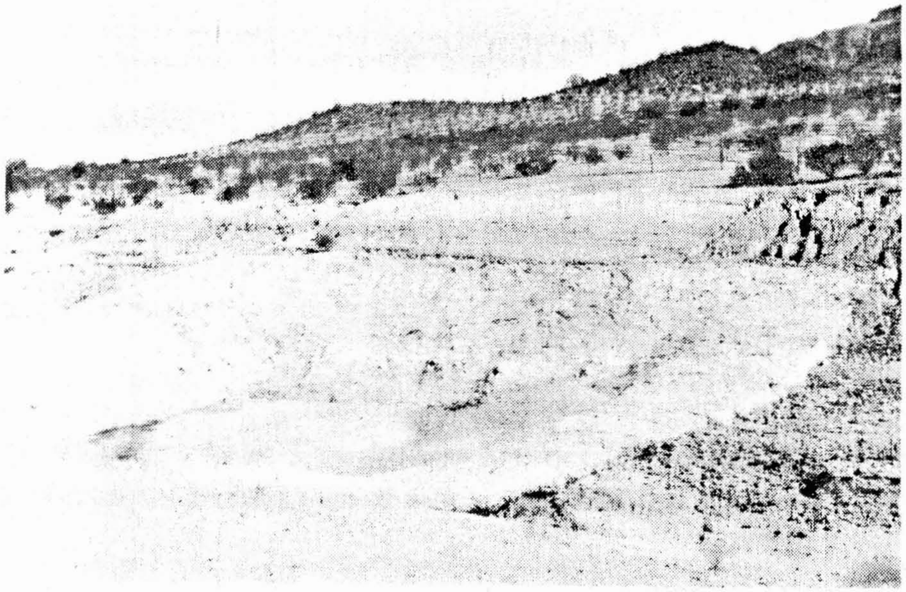


Photo No. 3

STATION 19+69 DROP #1
SOME OVERBANK EROSION

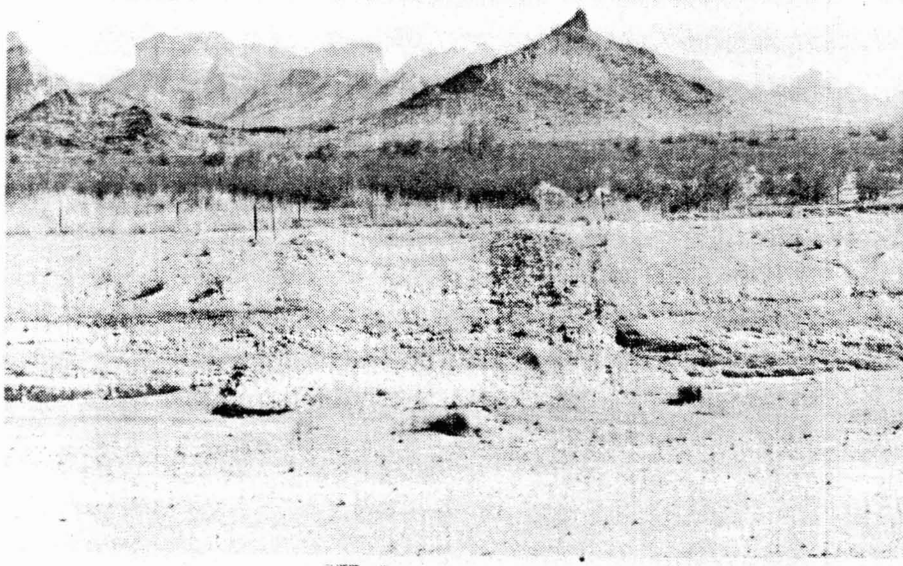


Photo No. 4

STATION 29+00 SIDE INLET #3
SOME RILL EROSION DUE TO OVERTOPPING

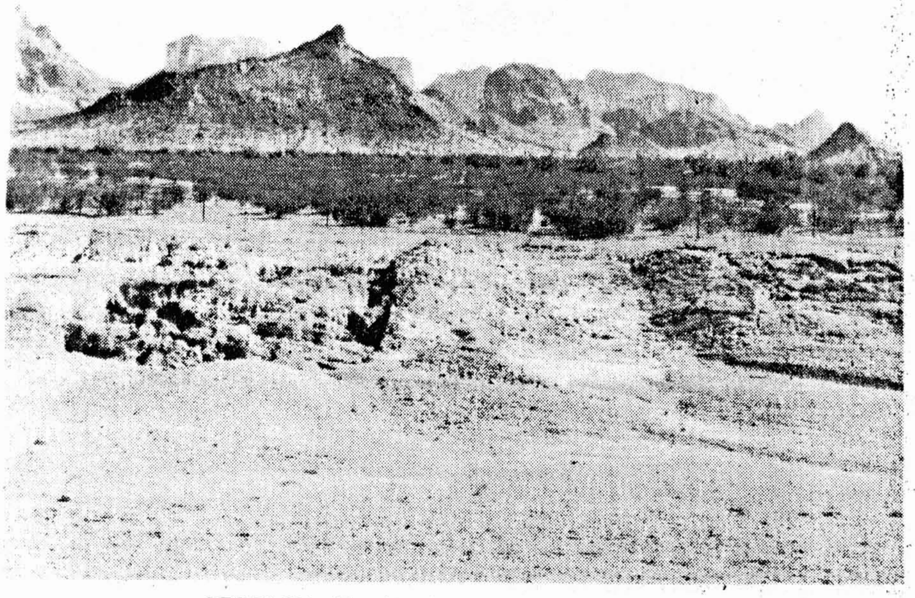


Photo No. 5

STATION 41+61.6 SIDE INLET #4
EROSION FROM OVERTOPPING

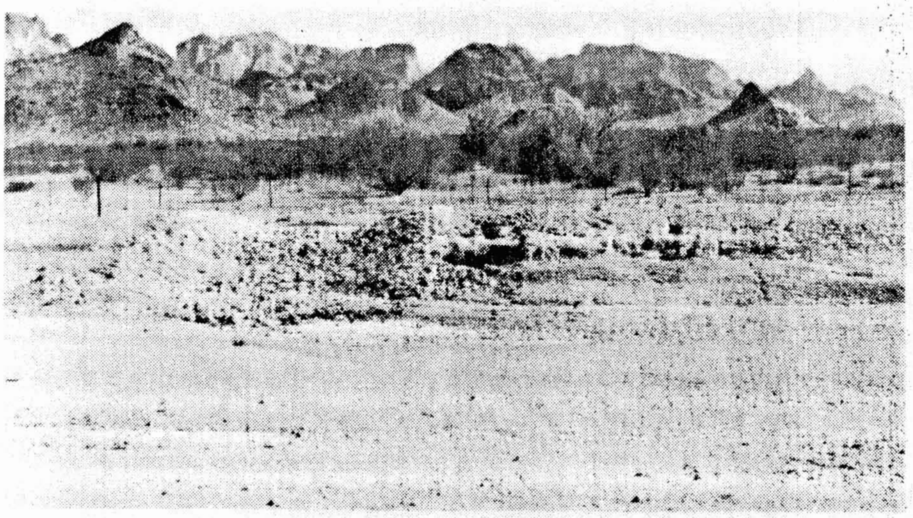


Photo No. 6

STATION 52+00 SIDE INLET #5
OVERTOPPED COLLECTOR DIKE
FOR APPROXIMATE 200 FEET.

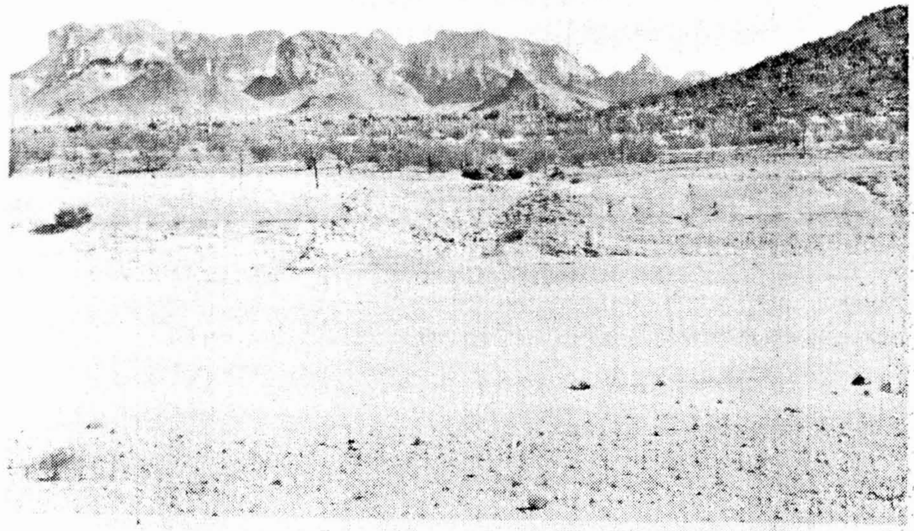


Photo No. 7

STATION 61+25 SIDE INLET #6
NO DAMAGE

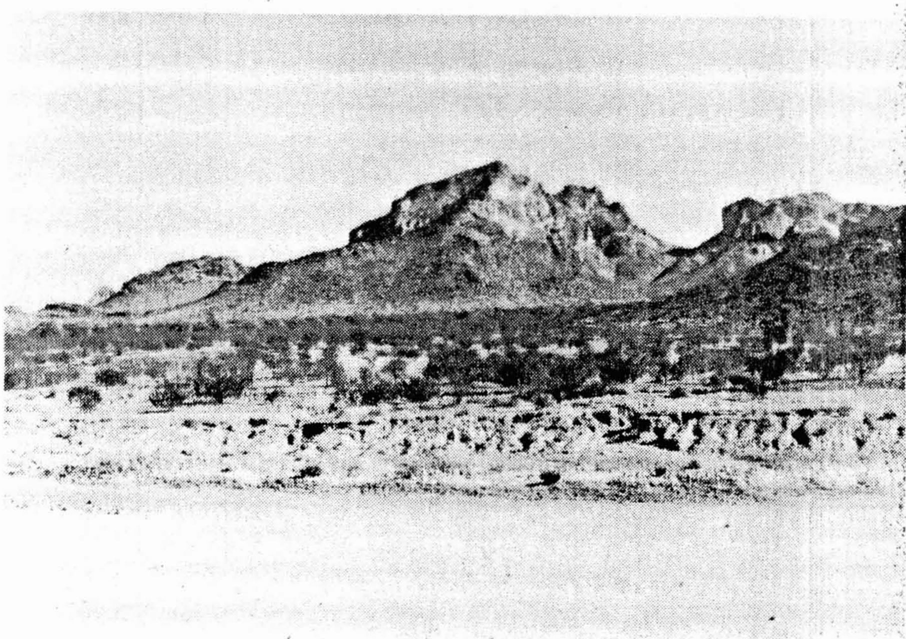


Photo No. 8

APPROXIMATE STATION 63+75
COLLECTOR CHANNEL AND DIKE OVERTOPPED
SEVERE EROSION

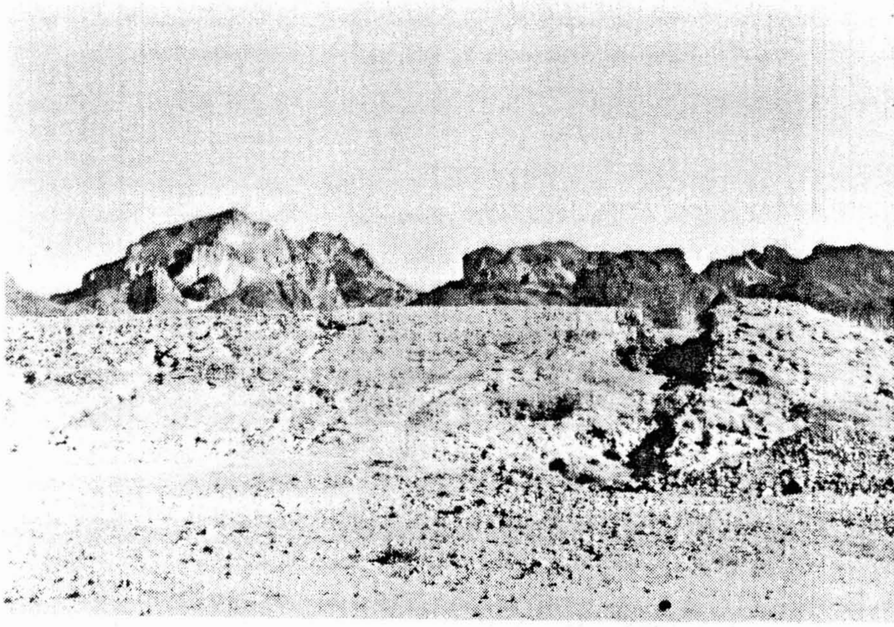


Photo No. 9

STATION 80+12 INLET #7
SEVERE EROSION ON NORTH SIDE FROM
OVERTOPPING

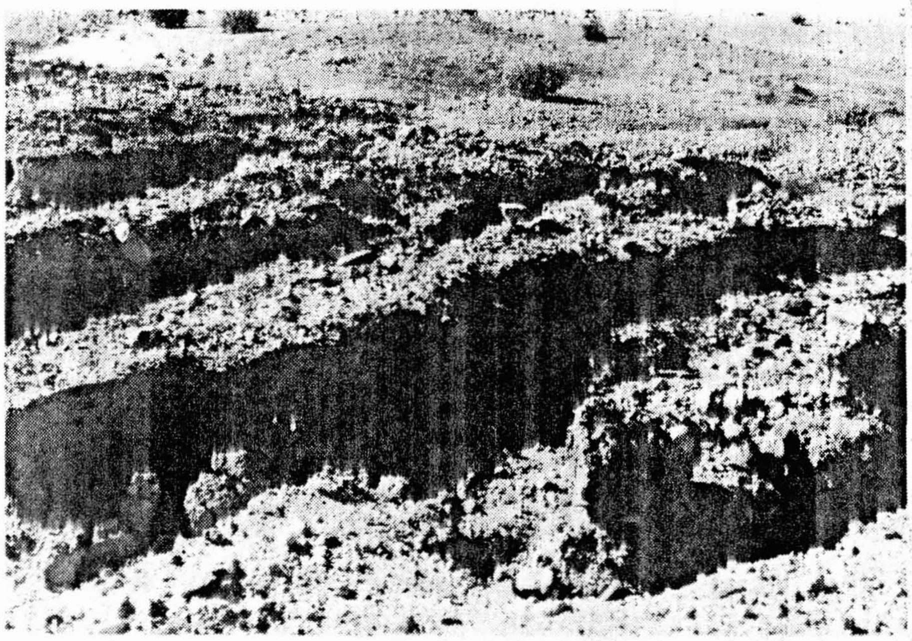


Photo No. 10

STATION 80+12 SIDE INLET #7 LOOKING
WEST. SEVERE EROSION ON SOUTH SIDE
FROM OVERTOPPING

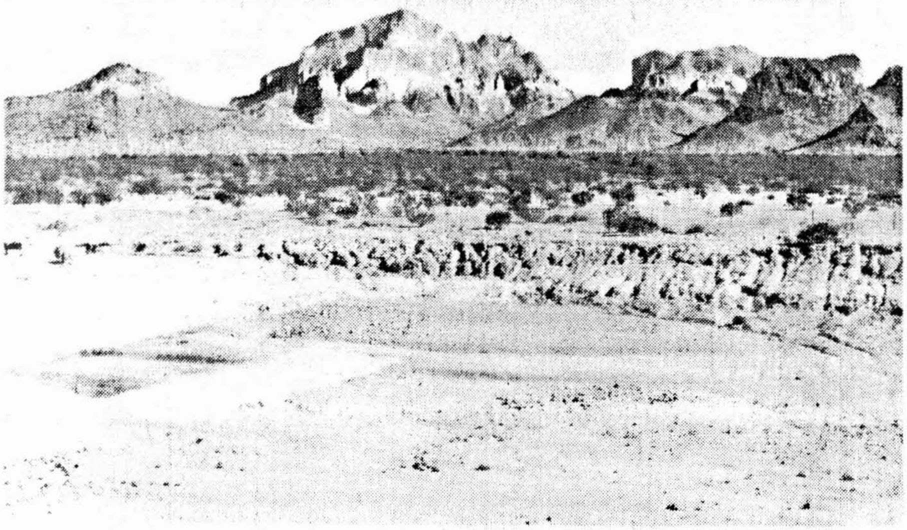


Photo No. 11

STATION 81+83 DROP #2
EROSION FROM OVERTOPPING

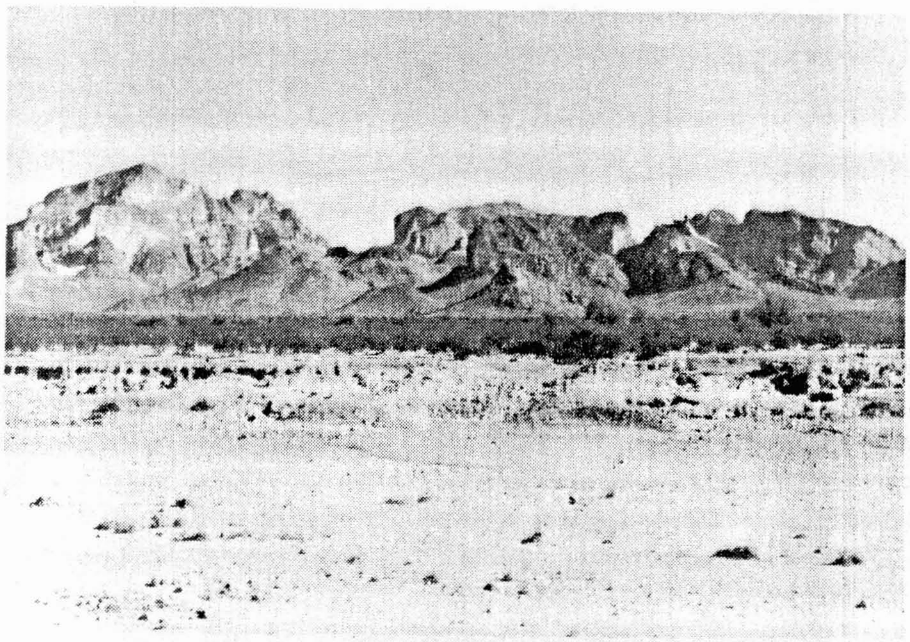


Photo No. 12

STATION 90+08.5 SIDE INLET #8
EROSION FROM OVERTOPPING
ON BOTH SIDES

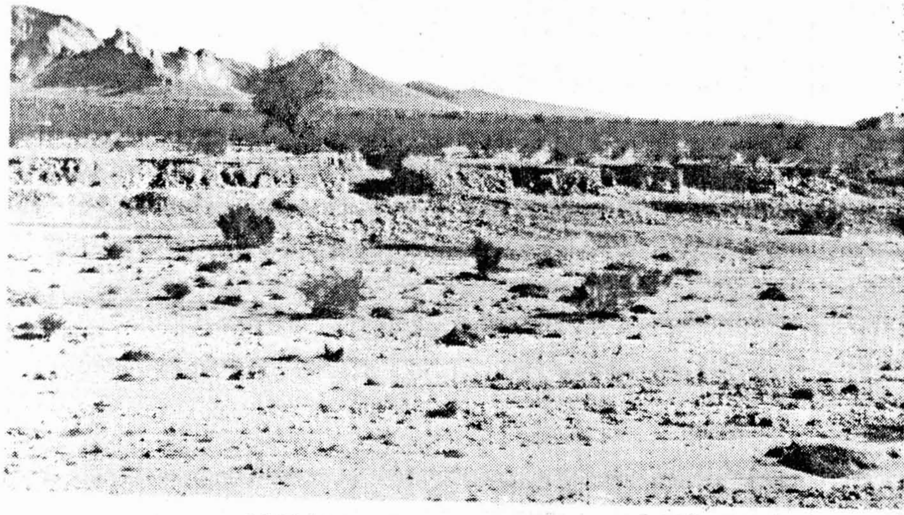


Photo No. 13

APPROXIMATE STATION 99+00
A NEW GULLY 5 FEET DEEP AND 10 FEET
WIDE AND SEVERE EROSION FROM
OVERTOPPING

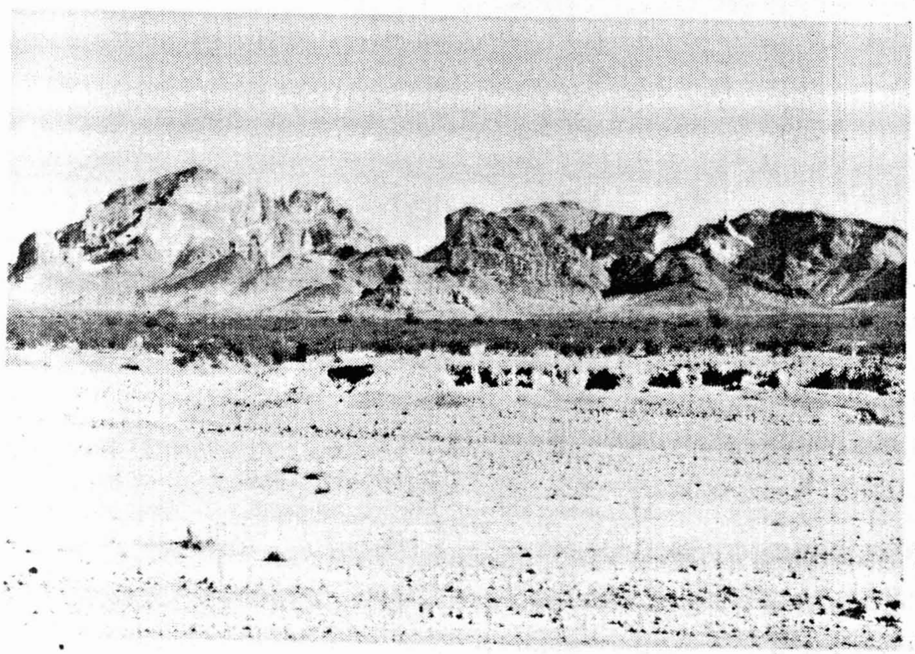


Photo No. 14

STATION 108+14.5 SIDE INLET #9
OVERTOPPING OF COLLECTOR DIKES

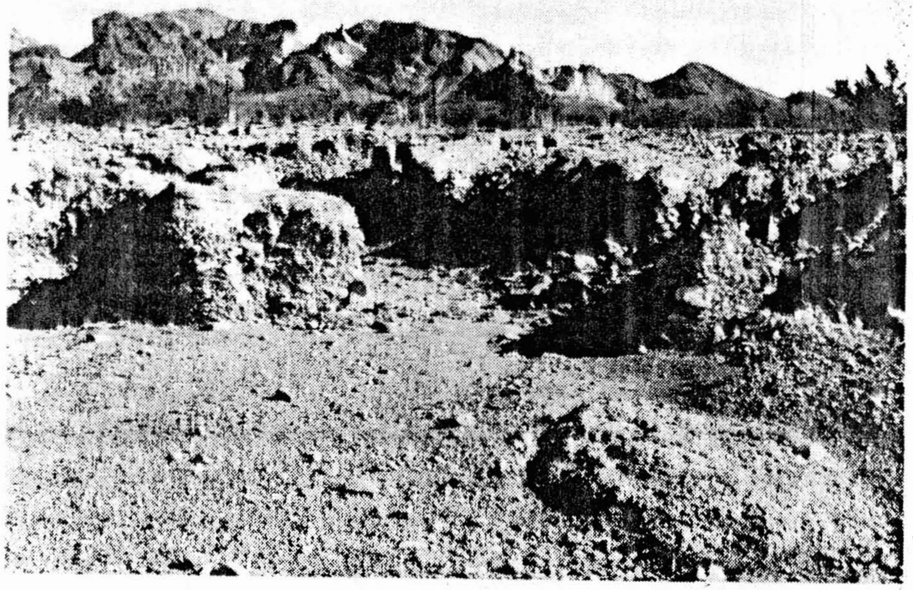


Photo No. 15

STATION 108+14.5 INLET #9
EROSION ON NORTH SIDE

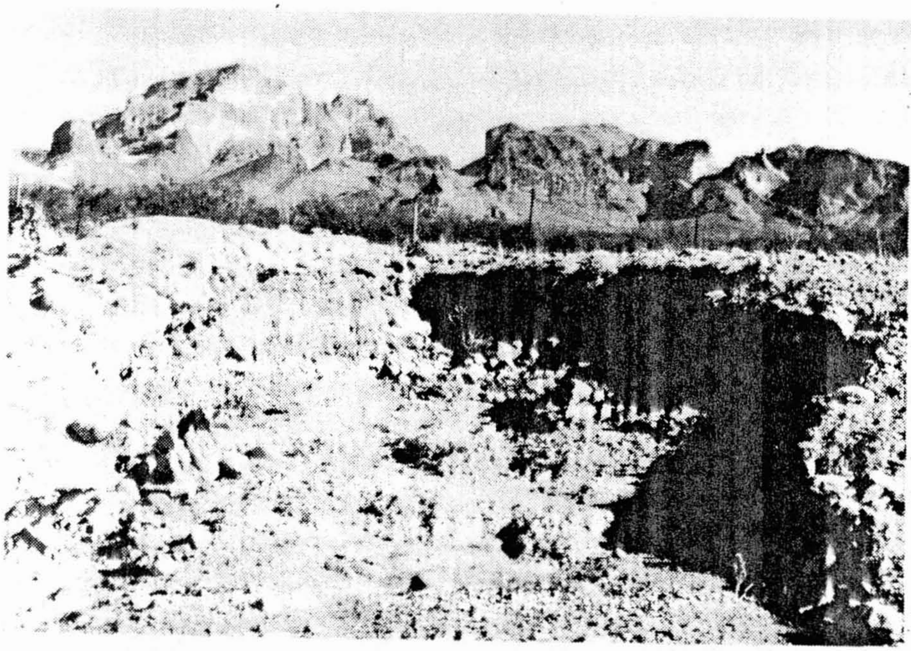


Photo No. 16

STATION 108+14.5 INLET #9
EROSION ON SOUTH SIDE

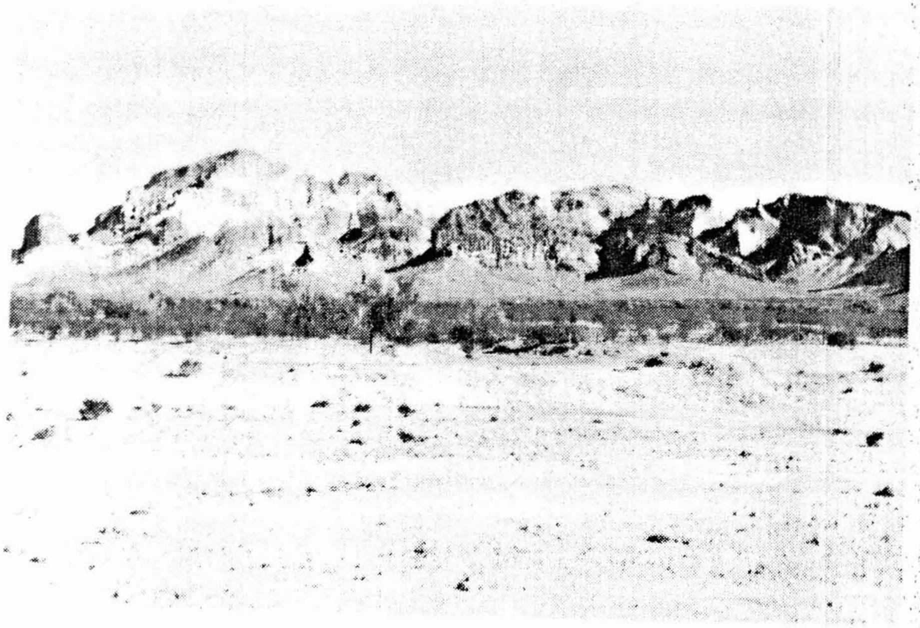


Photo No. 17

STATION 121+26 SIDE INLET #10
NO DAMAGE

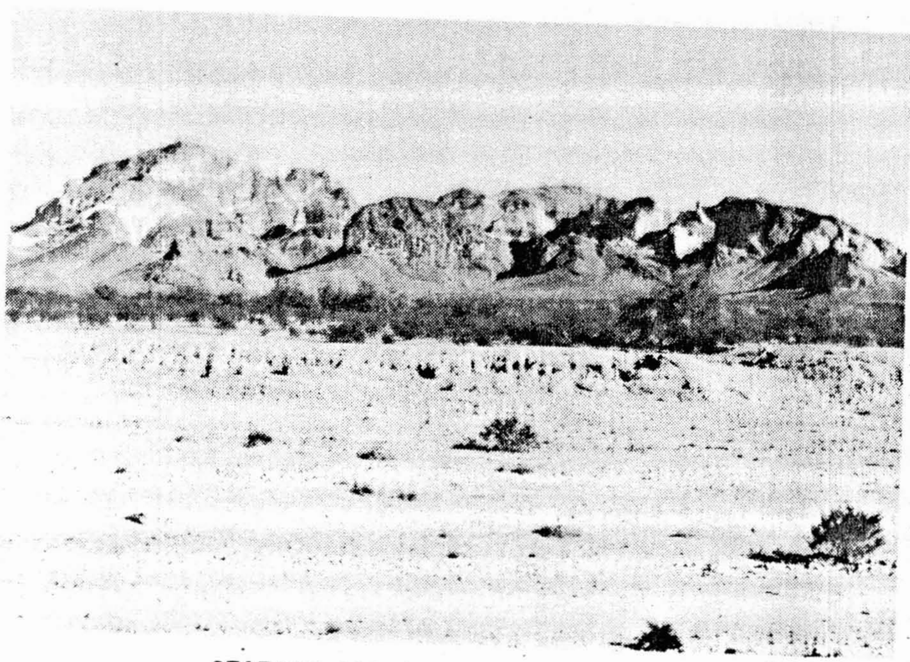


Photo No. 18

STATION 128+32 SIDE INLET #11
EROSION FROM OVERTOPPING

Photo No. 19

APPROXIMATE STATION 133+00
SEVERE EROSION FROM GULLYING

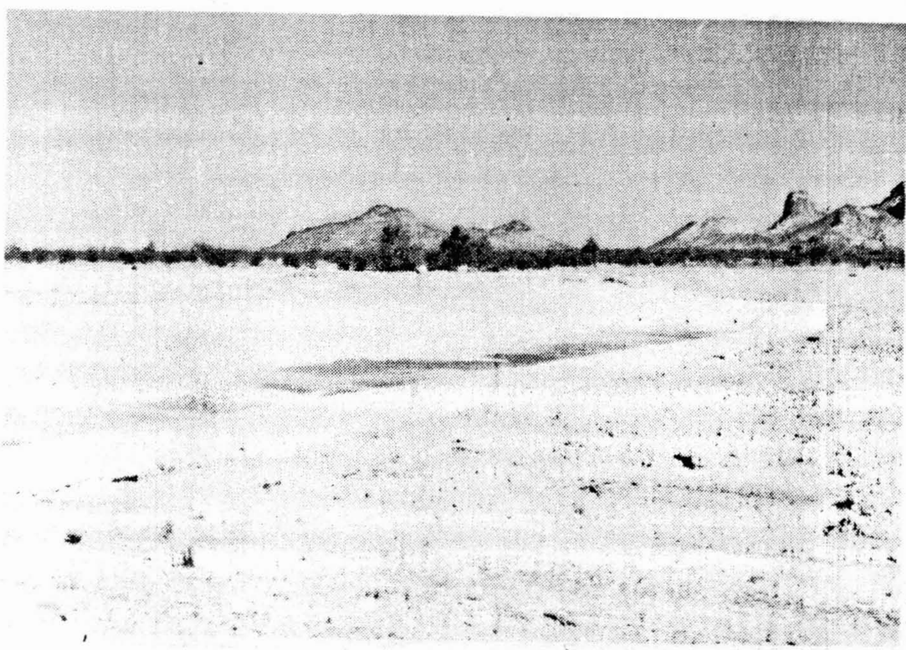


Photo No. 20

STATION 144+82 DROP #3
MINOR RILL EROSION

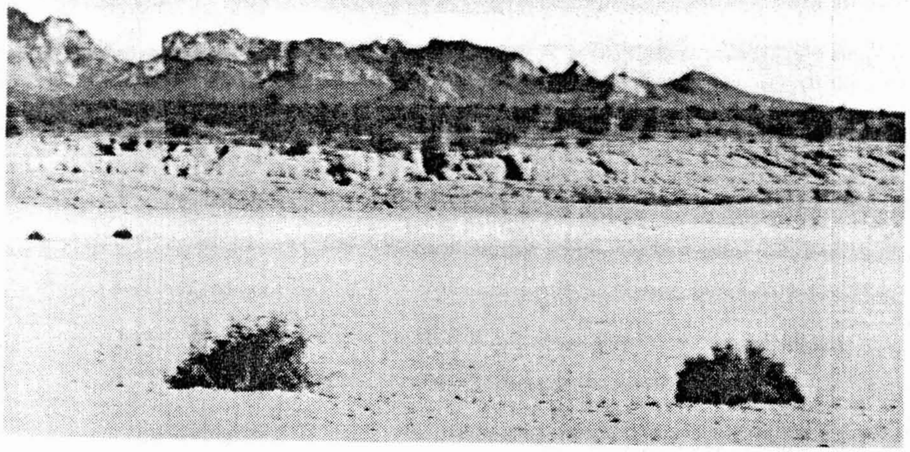


Photo No. 21

STATION 157+96 SIDE INLET #12
EROSION FROM OVERTOPPING
ON BOTH SIDES

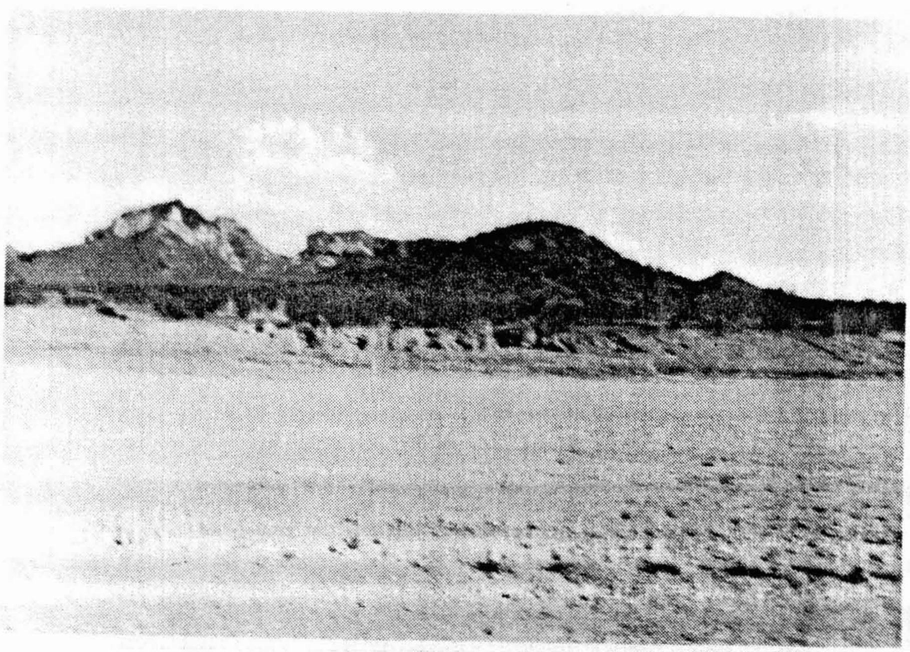


Photo No. 22

STATION 170+05 SIDE INLET #13
EROSION FROM OVERTOPPING
ON BOTH SIDES

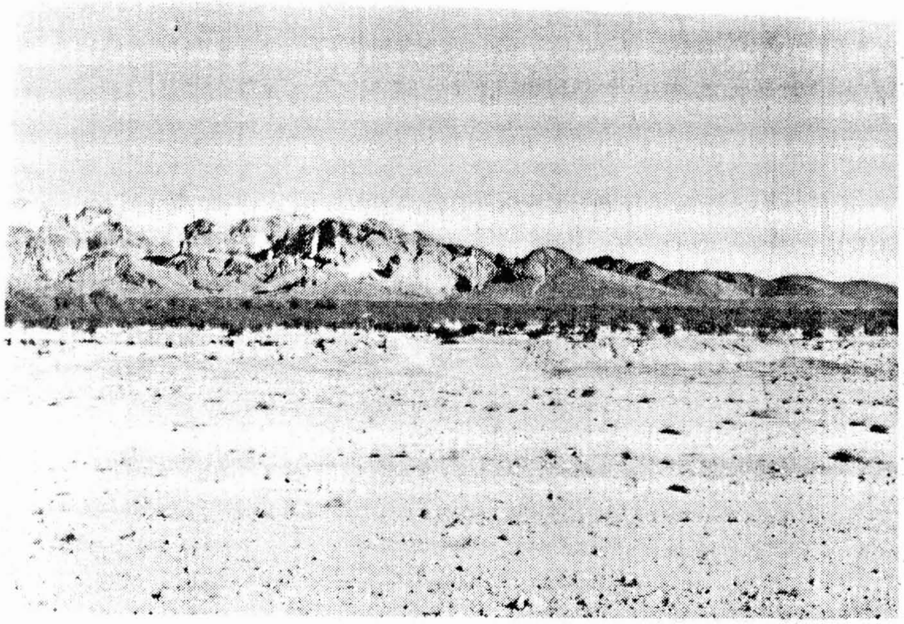


Photo No. 23

STATION 173+98 SIDE INLET #14
EROSION FROM OVERTOPPING
ON BOTH SIDES

Photo No. 24

STATION 183+65 SIDE INLET #15
EROSION FROM OVERTOPPING ON
BOTH SIDES

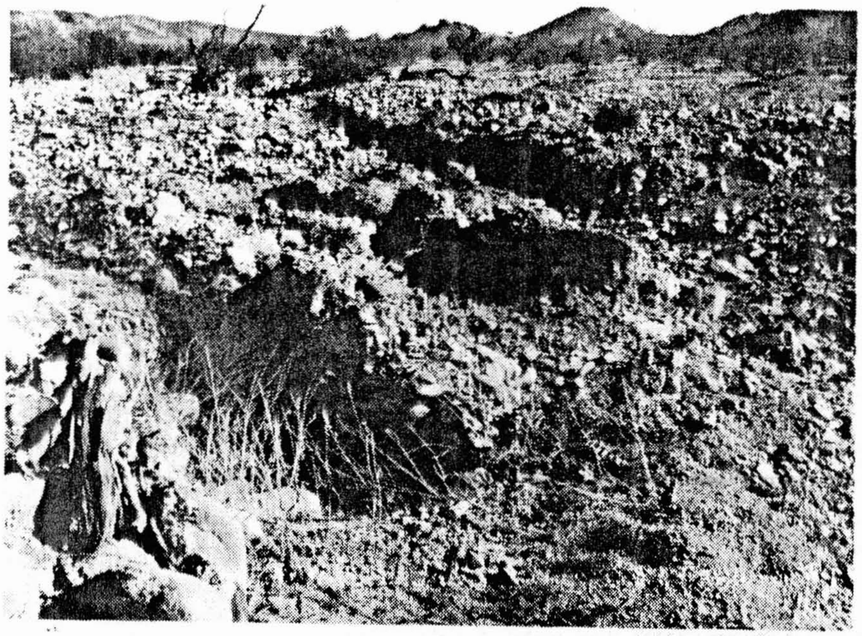


Photo No. 25

APPROXIMATE STATION 200+00
SEVERE EROSION FROM GULLYING

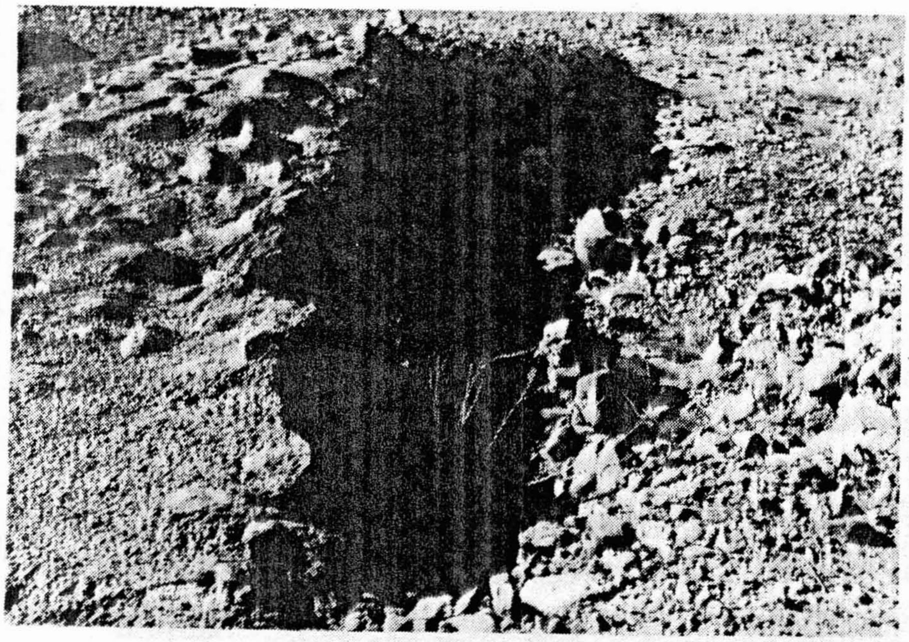


Photo No. 26

STATION 202+00 SIDE INLET #16
EROSION ON SOUTH SIDE FROM
OVERTOPPING

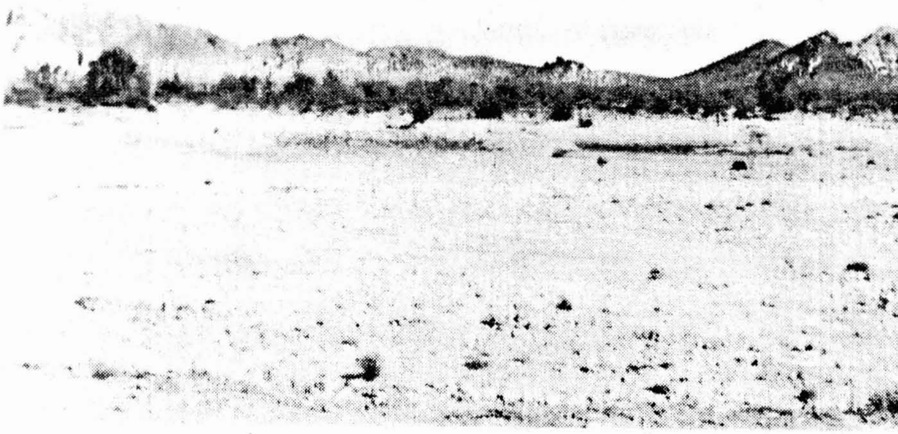


Photo No. 27

STATION 220+80 SIDE INLET #17
EROSION FROM OVERTOPPING ON
BOTH SIDES

APPENDIX A

APPENDIX A
(Hydraulic Report by Herman C. McGill

HARQUAHALA VALLEY WATERSHED
Saddleback Diversion
Study of September 2, 1984 Storm

Surveys

Surveys included carrying a level line along the upstream side of the channel. The elevation of high water marks in the diversion and side inlet channels were recorded. The location of side entrance problems were documented. Survey results are summarized on Table 1.

Rainfall

Figure 1 shows the rainfall amounts reported at locations near the watershed. The red values were obtained by work unit staff, the green during the study. Reported amounts range from 2 to 11 inches. There are no residences in the drainage area of Saddleback diversion, thus no rainfall information was available there. It appears, however, that the most intense part of the storm traveled from NW to SE and traversed the central and lower portion of the diversion watershed. High water marks at FRS 1 showed that the maximum stage was 4.8 feet over the principal spillway crest. The total capacity at this stage is 1732 acre-feet or .32 inches runoff from the watershed. The sediment pool capacity is 424 acre-feet or .08 inches. Because of the short duration of the storm, and small principal spillway capacity of FRS 1, rainfall above the site was not used in the Saddleback Diversion Study.

The storm distribution was taken from the recorder chart (Figure 2). The tabulated values were used because it was not possible to accurately read shorter time increments from the chart. It is probable that more intensive rainfall occurred during shorter time increments.

Runoff

Soil cover complex runoff curve number 90 was used to determine the runoff volume. This approximates the work plan value that was used for determining the 50-year design storm for the diversion. This appears high but runoff volume is not important for this study. The comparison of peak discharges and flow stage elevations determined by high water marks to the design values was the objective of the study.

Storm Evaluation Studies

Water surface profiles were prepared by Toups Corporation engineers using the Corps of Engineers HEC II program. The 10-yr and 50-yr frequency storms and the floodwater retarding structure principal spillway outflow discharge and elevation are recorded in Volume II of their design report. This did not provide enough information to make cross section hydraulic ratings. The planned cross section dimensions were input for the SCS WSP2 program. The planned dimensions were used instead of the "as built" ones because differences were not significant and they were more readily available. The design engineer used .030 "n value" for the central portion of the channel and .035 for the bank sections. Because most of the flow is carried in the central segment and the bank segments flow differences between the use of .030 and .035 are small, one segment sections using .030 were entered in the WSP2 program.

The output from the WSP2 program was used in a TR-20 program to model the watershed. The convex routing method was used in the original study and in this study. The point that incremental drainage areas enter the diversion was altered based on a recent aerial photograph of the watershed and the location where it was noted that excessive inflow occurred. Selected time of concentrations are consistent with those used in the watershed plan. Table 2 is a schematic of the watershed showing incremental drainage areas and Tc values used in this study.

Five storms were routed through the watershed beginning with FRS 2. The Type II, 24-hour, 50-year storm (3.6 inches) was routed to evaluate the model. The resulting discharges and elevations compared favorably with those used in the plan except in the upper reaches of the diversion. It was later discovered that in this study it was assumed that an .84 square mile drainage area flowed into the FRS. The original plan entered this flow near the upstream end of the diversion. Because the discharge from the FRS is the principal contributor to the peak discharge in the upper reaches of the diversion, changes were not made.

Four additional storms using the 1984 storm time distribution were routed through the watershed. Aerial distributions were varied to obtain the best flow - high water mark relationship. Storm No. 5 appears to provide the best relationship, though the high water marks are generally higher than the generated elevations in the central and lower reaches of the watershed. This could be partly due to the reduced channel capacity caused by silt bars. Table 3 is a summary of these results. This shows that rainfall above the floodwater retarding structures probably averaged less than 3 inches and ranged from 5 to 7 inches below the FRS.

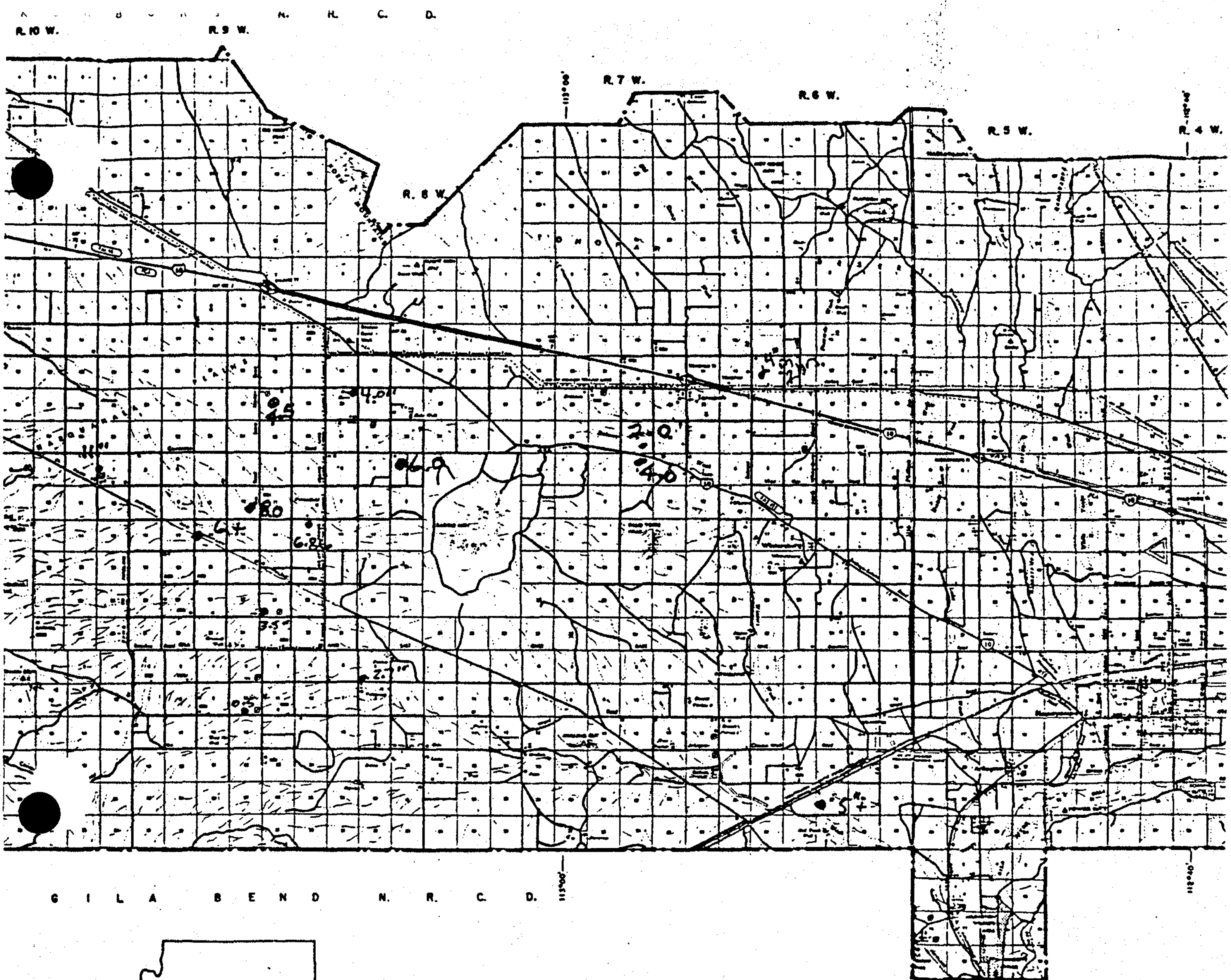
The incremental drainage area peak discharges for each of the five storms and the capacity of each side inlet structure are shown on Table 4. It is noted that Storm 1 discharges compare favorably to the capacity of the side inlet structures. This is expected in as much as the same storm and Tc were used. However, the location of side inlet inflow differs somewhat. A study of the drainage area flow patterns shows that the location of inlet flow is subjective.

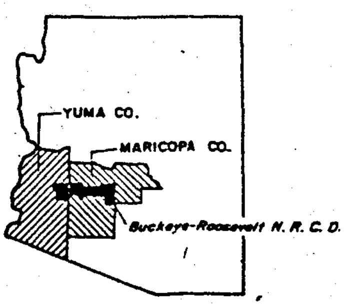
Generally, channels were used to divert flow to the inlet structure location. Flow in these were partially blocked by sediment bars resulting in over-bank flow before the inlet structure capacity was reached. In some locations these breached the bank between the training channel and diversion. This occurred in the upper reaches of the diversion where the design flow of the structure was not exceeded as well as in the central and lower reaches.

Conclusions

The study shows that the September 2, 1984 storm exceeded the 50-year frequency design storm in the central and lower reaches of the diversion. Flows, based on high water marks, were estimated to be about 2 times design flows near the diversion outlet. This did not appear to have caused significant damage to the diversion channel.

The location of inflow to the diversion is subjective, but a recent aerial photograph and onsite studies show that side inlet structures were not always located where needed. Also the limited capacity of the below natural ground channels used to divert flow to the side inlet structures were reduced by sediment bars resulting in over-bank inflow to the diversion. This caused damage to the upstream bank of the diversion and in some locations, left sediment bars in the diversion channel.





HARQUAHALA VALLEY
RAINFALL AMOUNTS
LABOR DAY STORM 1984
4hr. duration.

BUCKEYE-ROOSEVELT
NATURAL RESOURCE CONSERVATION DISTRICT

MARICOPA AND YUMA COUNTIES, ARIZONA

OCTOBER 1976

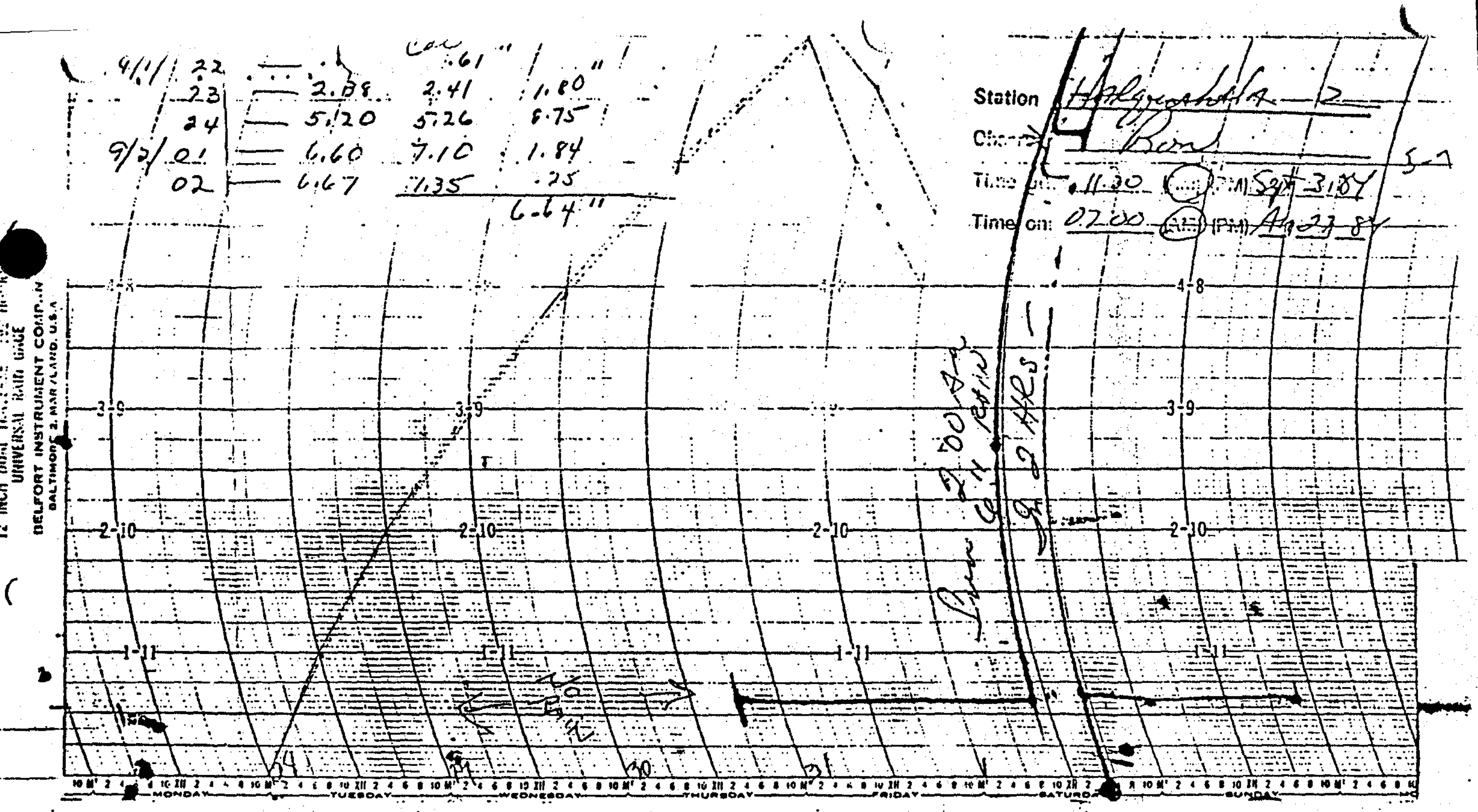
SCALE 1:250,000

TABLE 4
HARQUAHALA VALLEY WATERSHED
Saddleback Diversion

Peak Discharge from Incremental Drainage Areas

STATION	DESIGN		TYPE II STORM DIST.		1984 STORM DISTRIBUTIONS				SIDE INLET	
	Drainage Area Mi²	Discharge cfs	Drainage Area Mi²	Storm 1 cfs	Storm 2 cfs	Storm 3 cfs	Storm 4 cfs	Storm 5 cfs	Station	Capaci cfs
1000	.840	773							700	780
1090			.27	362	250	250	250	325		
1500			.02	44	20	20	20	26	1390	360
2200	.293	355								
3000			.15	271	142	142	142	184	2900	180
4500			.29	471	272	353	353	353	4161	180
5500			.10	193	95	123	123	123	5200	210
6500			.02	44	20	26	26	26	6125	180
6800	.554	739								
7500			.53	512	451	591	732	732		
8500			.53	512	451	591	732	732	8012	1020
8700	1.075	956								
9500			.14	253	132	171	210	210	9408	205
11000			.60	643	524	766	847	847	10814	545
12200	1.304	1220							12126	535
12500			.61	653	533	779	861	861		
13000			.16	206	147	214	236	236	12832	85
16000			1.06	880	856	1390	1655	1655	15796	880
17000			1.07	888	864	1404	1670	1670	17005	470
17500			.16	204	147	235	279	279	17398	180
18000	2.323	1740								
18500			.26	320	235	377	448	448	18365	255
20500			1.17	894	917	1490	1774	1774	20200	800
22500			1.08	825	846	1375	1637	1637	22080	805
23500			.10	181	94	150	178	178		
23800	2.623	1792								
23900			.43	528	389	626	743	743		
24400	.4323	437								

NOTE: Storm 1 is 24-hour 50-year Type II Storm - 3.6 inches
Storm 2 is 1984 storm distribution - 4.00 inches
Storm 3 is 1984 storm FRS to Sta 3000 - 4.0"; Sta 3000 to Sta 9500 - 5.0"; Sta 9500 to Sta 13000 - 5.5"; Sta 13000 to Sta 2390
Storm 4 is 1984 storm FRS to 3000 - 4.0"; Sta 3000 to Sta 6500 - 5.0"; Sta 6500 - Sta 13000 - 6.0"; Sta 13000 to Sta 23900 - 7"
Storm 5 is 1984 storm FRS - 3.0"; FRS to Sta 6500 - 5.0"; Sta 6500 - Sta 13000 - 6.0"; Sta 13000 to Sta 23900 - 7"



Station
Time on: 02:00
12 INCH DUAL TRAVERSE
UNIVERSAL RAIN GAGE
BELFORT INSTRUMENT COMP
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
23 — 2.38 2.41 1.80"
24 — 5.20 5.26 8.75
9/2/01 — 6.60 7.10 1.84
02 — 6.67 7.35 .75
6.64"

Figure 2

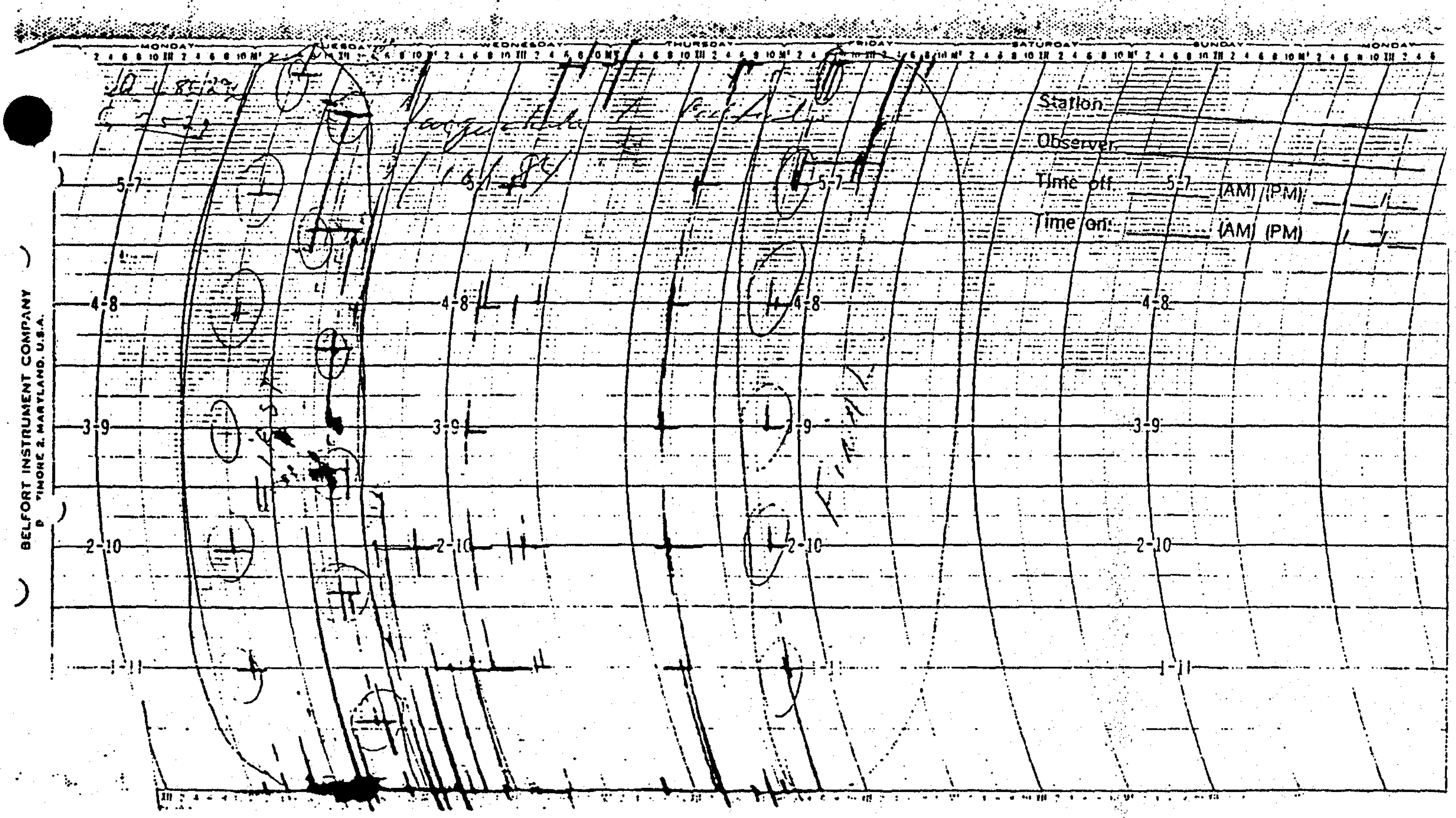

MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
MONDAY
Station
Observer
Time off (AM) (PM)
Time on (AM) (PM)
5-7
4-8
3-9
2-10
1-11
BELFORT INSTRUMENT COMPANY
TIMORE 2, MARYLAND, U.S.A.

TABLE 1
Harquahala Valley Watershed
Saddleback Diversion

Structure Damage Study - September 1984 Storm

Str 2	-	Sta 13+90	Structure did not overtop but overtopped training dike DS of structure.	
		Sta 15+00	HWM side entrance channel	1180.6
		Sta 15+00	HWM diversion	1175.8
Str 3	-	Sta 29+00	Structure Overtopped .4 foot	
		Sta 29+50	HWM side entrance channel	1171.1
		Sta 29+50	HWM diversion	1167.2
		Sta 31+00 to 35+00 overbank inflow to diversion		
Str 4	-	Sta 35+50	Begin side entrance channel	
		Sta 37+00	Flow over side entrance channel bank .4'	
		Sta 37+00	HWM diversion	1164.9
		Sta 38+50	Flow over entrance channel bank	
		Sta 41+00	HWM side entrance channel	1167.4
		Sta 41+00	HWM diversion	1164.3
		Sta 41+54	Side entrance channel bank breached	
		Sta 41+61	Str 4	
		Sta 42+50	HWM diversion	1163.8
		Sta 44+00	Side entrance channel bank overtopping	
		Sta 51+90	HWM side entrance	1164.2
			HWM diversion	1162.1
Str 5	-	Sta 52+00		
		Sta 52+50	Side entrance overtopped	
Str 6	-	Sta 61+25	Not overtopped	
		Sta 61+25	HWM diversion	1160.0
		Sta 63+50-66+00	Side entrance overtopped and breached in places.	
		Sta 68+50	Side entrance overtopped & breached	
		Sta 73+00	Side entrance channel begins overtopped in/out	
		Sta 77+00	HWM side entrance channel	1161.6
			HWM diversion	1157.1
		Sta 79+00	HWM diversion	1156.9

Str 7 -	Sta 80+12	Eroded around both abutments	
	Sta 86+00	Over bank flow to here narrow Terrace begins-breached at 86+80	
	Sta 88+00	HWM diversion	1151.1
	Sta 88+60	Terrace breach	
	Sta 89+00	Begin breach & severe bank erosion	
	Sta 90+00	Begin side inlet to Str 8	
	Sta 91+60	Begin side inlet embankment overtop	
	Sta 93+00	Severe bank erosion	
Str 8 -	Sta 94+08	Eroded around both abutments	
	Sta 101+00	Side entrance overtopped to here	
	Sta 103+00	Begin side entrance channel to Str 9 some flow around end	
	Sta 104+00	HWM diversion	1148.7
	Sta 105+00	Entrance overtopped severe bank erosion	
	Sta 107+00	Entrance overtopped-severe bank erosion	
Str 9	Sta 108+00	N. abutment overtopped	
	Sta 109+00	Sheet flow severe bank erosion	
	Sta 115+00	HWM diversion	1145.8
	Sta 117+00	Begin side inlet channel to Str 10	
	Sta 120+00	Side inlet channel overtopping begins	
		HWM diversion	1145.1
		HWM side inlet channel	1147.6
Str 10 -	Sta 121+00	Str 10	
	Sta 127+00	HWM diversion	1143.7
	Sta 127+00	Side inlet overtopped	
Str 11 -	Sta 128+30	Str overtopped	
	Sta 128+80	HWM side inlet	1146.3
	Sta 134+00	Side inlet channel overtopped	
	Sta 135+90	Side inlet channel breached	
	Sta 138+00	HWM diversion	1140.3
	Sta 139+40	Side inlet channel overtopped and breached-severe erosion	
	Sta 144+30	HWM diversion	1137.4
	Sta 147+00	HWM diversion	1132.5
		Side inlet channel overtopped and breached.	
	Sta 155+75	Side inlet channel overtopped and breached.	
		Side inlet channel blocked with gravel bar.	—
Str 12 -	Sta 158+00	Breached around both abutments	
	Sta 161+00	Begin side inlet channel to Str 13	
	Sta 163+00	HWM diversion	1130.8
		Side inlet channel overtopping begins severe erosion.	

Str 13	-	Sta 170+00		
		Sta 171+20	Side inlet channel breached.	
Str 14	-	Sta 174+00	Washed around both abutments	
		Sta 175+00	HWM side inlet channel	1129.6
			HWM diversion	1127.7
		Sta 177+00	Severe erosion to here	
		Sta 179+00	HWM diversion	1126.9
		Sta 179+00	HWM side inlet channel	1128.7
		Sta 182+00	HWM side inlet channel	1127.3
			HWM diversion	1126.4
		Sta 182+70	Side inlet channel breached to Sta 183+50	
Str 15	-	Sta 184+00	Eroded both abutments	
		Sta 188+00	HWM diversion	1125.0
		Sta 190+00	Stream starting to cut into Div	
		Sta 195+00	Begin overtopping DS	
		Sta 196+00	HWM side inlet channel	1125.4
		Sta 196+30	Breach into diversion	
		Sta 197+50	End breach into diversion	
		Sta 198+00	HWM side inlet	1125.4
			HWM diversion	1123.7
		Sta 199+50	Begin breach into diversion	
		Sta 201+00	End breach into diversion	
			HWM side inlet	1123.3
			HWM diversion	1122.7
Str 16	-	Sta 202+00	The structure not referenced in notes and does not appear on photo. As built plans show it in place. It appears that the inlet may have been shaped and no structure built.	
		Sta 202+75	Cut into diversion 3' deep 30' wide	
		Sta 207+50	Begin breach into diversion	
		Sta 212+00	HWM side inlet	1121.7
			HWM diversion	1120.0
		Sta 219+00	HWM side inlet	1120.1
			HWM diversion	1118.6
Str 17	-	Sta 220+80	Eroded US abutment overtopped US & DS 25'	
		Sta 221+50	HWM side inlet	1120.0
			HWM diversion	1117.6
		Sta 230+00	HWM diversion	1115.5
		Sta 236+00	HWM diversion	1114.2
		Sta 237+00	HWM diversion	1113.7

TABLE 2
Harquahala Valley Watershed
Saddleback Diversion

1984 Storm TR-20 Schematic

	Station	Drainage Area Increment	Drainage Area Total	Tc
FRS 2	0	29.56	29.56	3.26
Sec 1	1090	.27	29.83	.37
Sec 2	1500	.02	29.85	.09
Sec 3	3000	.15	30.00	.23
Sec 4	4500	.29	30.29	.28
Sec 5	5500	.10	30.39	.20
Sec 6	6500	.02	30.41	.08
Sec 7	7500	.53	30.94	.78
Sec 8	8500	.53	31.47	.78
Sec 9	9500	.14	31.61	.23
Sec 10	11000	.60	32.21	.67
Sec 11	12500	.61	32.82	.67
Sec 12	13000	.16	32.98	.41
Sec 13	14000	0	32.98	
Sec 14	15000	0	32.98	
Sec 15	16000	1.06	34.04	1.00
Sec 16	17000	1.07	35.11	1.00
Sec 17	17500	.16	35.27	.45
Sec 18	18500	.26	35.53	.52
Sec 19	19500	0	35.53	
Sec 20	20500	1.17	36.70	1.12
Sec 21	21500	0	36.70	
Sec 22	22500	1.08	37.78	1.12
Sec 23	23500	.10	37.79	.23
Sec 24	23900	.43	38.22	.53

TABLE 3
HARQUAHALA VALLEY WATERSHED
Saddleback Diversion
Summary of TR20 Flood Routings

Station	TR20 Sec #	50-yr Storm HECII Disc. cfs	50-yr Storm HECII Elev. ft.	Storm No. 1 Disc. cfs	Storm No. 1 Elev. ft.	HWM 1984 Storm Elev. ft.	Storm No. 2 Disc. cfs	Storm No. 2 Elev. ft.	Storm No. 2 HWM Diff.	Storm No. 3 Disc. cfs	Storm No. 3 Elev. ft.	Storm No. 3 HWM Diff.	Storm No. 4 Disc. cfs	Storm No. 4 Elev. ft.	Storm No. 4 HWM Diff.	Storm No. 5 Disc. cfs	Storm No. 5 Elev. ft.	Storm No. 5 HWM Diff.
FWS 2		764	1189.4	755	1189.1	1182.9	802	1190.5		802	1190.5		802	1190.5		739	1188.6	
82		950	1179.1															
100					(1177.9)	1177.6		(1178.1)	-.5		(1178.1)	-.5		(1178.1)	-.5		(1177.8)	-.8
1090	1	1090	1177.1	762	1175.9		802	1176.1		802	1176.1		802	1176.1		739	1175.8	
1500	2	1160	1176.3	762	1175.0	1175.8	802	1175.1	.7	802	1175.1	.7	802	1175.1	.7	748	1174.9	.5
2950						1167.2		(1167.3)	-.1		(1167.3)	-.1		(1167.3	-.1			
3000	3	1370	1167.1	896	1167.6		835	1167.4		835	1167.4		835	1167.4		852	(1167.4)	-.1
3500		1370	1165.8															
3700					(1165.5)	1164.9		(1165.1)	-.2		(1165.1)	-.2		1165.1	-.2		1165.2	-.1
4000		1370	1164.7															
4100					(1164.5)	1164.3		(1164.1)	.2		(1164.2)	.1		(1164.2)	.1		(1164.3)	.2
4250					(1164.1)	1163.8		(1113.7)	.1		(1113.8)	0		(1113.8)	0		(1113.9)	.1
4500	4	1500	1163.5	1242	1163.3		1012	1162.9		1073	1163.0		1073	1163.0		1140	1163.1	
5000		1500	1162.3															
5200					(1161.6)	1162.1		(1161.2)	.9		(1161.4)	.7		(1161.4)	.7		(1161.5)	.8
5500	5	1500	1161.1	1311	1160.9		1069	1160.5		1172.6	1160.7		1172.8	1160.7		1244	1160.8	
6000		1500	1160.3															
6125					(1160.0)	1160.0		(1159.7)	.3		(1159.9)	.1		(1159.9)	.1		(1160.0)	.2
6500	6	1900	1159.2	1211	1158.5		1078	1158.2		1182	1158.4		1182	1158.4		1252	1158.5	
7000		1900	1158.1															
7500	7	1900	1157.2	1682	1156.5		1522	1156.4		1768	1156.6		1907	1156.7		1977	1156.8	
7700					(1156.0)	1157.1		(1155.8)	1.3		(1156.1)	1.0		(1156.2)	.9		(1156.3)	1.0
7900					(1154.4)	1156.9		(1154.2)	2.7		(1154.5)	2.4		(1154.7)	2.2		(1154.7)	2.2
8000		2350	1155.8															
8500	8	2350	1150.6	2137	1150.4		1962	1150.2		2350	1150.6		2628	1150.8		2690	1150.8	
8800					(1149.6)	1151.1		(1149.6)	1.5		(1150.0)	1.1		(1150.3)	.8		(1150.3)	.8
9000		2350	1149.6															
9500	9	2590	1148.6	2103	1148.2		2049	1148.2		2465	1148.5		2773	1148.8		2843	1148.8	
10000		2590	1147.7															
10400					(1146.8)	1148.7		(1146.8)	1.9		(1147.3)	1.4		(1147.6)	1.1		(1147.6)	1.1
10500		2860	1146.7															
11000	10	2860	1145.8	2583	1145.9		2591	1145.9		3180	1146.5		3572	1146.8		3640	1146.9	
11500		3250	1144.7		(1144.8)	1145.8		(1144.8)	1.0		(1145.4)	.4		(1145.7)	.1		(1145.7)	.1
12000		3250	1143.6		(1143.7)	1145.1		(1143.7)	1.4		(1144.4)	.7		(1144.7)	.4		(1144.7)	.4
12500	11	3250	1142.7	3044	1142.6		2996	1142.6		3902	1143.3		4376	1143.6		4440	1143.6	
12700					(1142.3)	1143.7		(1142.3)	1.4		(1143.0)	.7		(1143.3)	.4		(1143.3)	.4

Station	[illegible] Sec #	50-yr Storm HECII Disc. cfs	50-yr Storm HECII Elev. ft.	Storm No. 1 Disc. cfs	Storm No. 1 Elev. ft.	HWM 1984 Storm Elev. ft.	Storm No. 2 Disc. cfs	Storm No. 2 Elev. ft.	Storm No. 2 HWM Diff.	Storm No. 3 Disc. cfs	Storm No. 3 Elev. ft.	Storm No. 3 HWM Diff.	Storm No. 4 Disc. cfs	Storm No. 4 Elev. ft.	Storm No. 4 HWM Diff.	Storm No. 5 Disc. cfs	Storm No. 5 Elev. ft.	Storm No. 5 HWM Diff.
13000	12	3500	1141.6	3105	1141.9		3107	(11419)		4070	1142.6		4565	1142.9		4627	1143.0	
13500		3500	1140.6															
13800					(1139.8)	1140.3		(1139.9)	.4		(1140.4)	-.1		(1140.7)	-.4		1140.7	-.4
14000	13	3740	1139.5	3051	1139.3		3101	1139.4		4059	1139.8		4552	1140.1		46.14	1140. 1	
14400		3740	1138.3															
14430					(1138.0)	1137.4		(1138.1)	-.7		(1138.5)	-1.1		(1138.8)	-1.4		(1138.8)	-1.4
14467		3740	1137.8															
14519		3740	1132.4															
14700					(1131.3)	1132.5		(1131.4)	1.1		(1131.9)	.6		(1132.1)	.4		(1132.1)	.4
15000	14	3970	1131.2	2994	1130.6		3094	1130.7		4049	1131.2		4543	1131.4		4605	1131.4	
15500		3970	1130.1															
16000	15	4320	1129.0	3792	1128.8		3916	1128.8		5404	1129.5		6170	1129.8		6228	1129.8	
16300					(1128.2)	1130.8		(1128.2)	2.6		(1129.0)	1.8		(1129.3)	1.5		(1129.3)	1.5
16500		4320	1127.9															
17000	16	4320	1126.9	4571	1126.9		4742	1126.9		6769	1127.8		7803	1128.1		7854	1128.1	
17500	17	4720	1125.8	4587	1125.7	1127.7	4847	1125.8	1.9	6943	1126.7	1.0	8005	1127.1		8060	1127.1	
17900					(1124.8)	1126.9		(1124.9)	2.0		(1125.8)	1.1		(1126.2)	.7		(1126.2)	.7
18000		4720	1124.8															
18200					(1124.1)	1126.4		(1124.3)	2.1		(1125.1)	1.3		(1125.5)	.9		(1125.5)	.9
18500	18	4720	1123.6	4601	1123.4		5019	1123.6		7229	1124.4		8350	1124.8		8404	1124.8	
18800					(1122.8)	1125.0		(1122.9)	2.1		(1123.8)	1.2		(1124.2)	.8		(1124.2)	.8
19000		5110	1122.5															
19500	19	5110	1121.4	4542	1121.2		5013	1121.3		7217	1122.2		8338	1122.5		8393	1122.5	
19800					(1120.7)	1123.7		(1120.8)	2.9		(1121.7)	2.0		(1122.1)	1.6		(1122.1)	1.6
20000		5110	1120.2															
20100					(1120.0)	1122.7		(1120.2)	2.5		(1121.1)	1.6		(1121.5)	1.2		(1121.5)	1.2
20500	20	5110	1119.2	5326	1119.3		5889	1119.5		8668	1120.4		10082	1120.9		10134	1120.9	
21000																		
21200					(1118.0)	1120.0		(1118.1)	1.9									
21500	21	5430	1117.0	5257	1117.2		5881	1117.5		8657	1118.6		10063	1119.1		10115	1119.1	
21900					(1116.3)	1118.6		(1116.5)	2.1		(1117.5)	1.1		(1118.0)	.6		(1118.0)	.6
22000		5430	1116.0															
22500	22	5750	1114.8	5939	1114.9		6678	1115.1		9979	1116.1		11649	1116.5		11700	1116.5	
23000		5750	1113.7		(1113.5)	1115.2		(1113.8)	1.4		(1114.8)	.4		(1115.2)	.2		(1115.2)	.2
23500	23	5750	1112.3	5891	1112.2		6738	1112.5		10070	1113.4		11758	1113.8		11810	1113.8	
23600			(1112.0)		(1111.9)	1114.2		(1112.2)	2.0		(1113.2)	1.0		(1113.6)	.6		(1113.6)	.6
23650		5970	1111.9															
23696		5970	1111.4															
23700					(1111.2)	1113.7		(1111.5)	2.2		(1112.5)	1.2		(1113.0)	.7		1113.0	.7
23711		5970	1110.9															
23900	24			5995	1101.8		7025	1102.2		10530	1103.3		12307	1103.8		12355	1103.9	

NOTE:
1. 50-yr storm discharge and elevation taken from Design Report Volume II, Page 3.1-27 to 33
2. FRS 2 spillway rating Hydrology Documentation supplement No. 1, Page 107
3. Storm No. 1 is 24-hour 50-year Type II storm 3.6 inches
   Storm No. 2 is 1984 Storm distribution -- 4.0 inches
   Storm No. 3 is 1984 storm distribution FRS to Sta 3000-4.0"; Sta 3000 to Sta 9500-5.0"; Sta 9500 to Sta 13000-5.5"; Sta 13000 to Sta 23900-6.0"
   Storm No. 4 is 1984 storm distribution FRS to Sta 3000-4.0"; Sta 3000 to Sta 6500-5.0"; Sta 6500 to Sta 13000-6.0"; Sta 13000 to 23900-7.0"
   Storm No. 5 is 1984 storm distribution FRS-3.0"; FRS to Sta 6500-5.0"; Sta 6500 to Sta 13000-6.0"; Sta 13000 to Sta 23900-7.0"
4. Elevations shown in parenthesis are interpolated values.

TABLE 4
HARQUAHALA VALLEY WATERSHED
Saddleback Diversion

Peak Discharge from Incremental Drainage Areas

STATION	DESIGN		TYPE II STORM DIST.		1984 STORM DISTRIBUTIONS				SIDE INLET	
	Drainage Area Mi^2	Discharge cfs	Drainage Area Mi^2	Storm 1 cfs	Storm 2 cfs	Storm 3 cfs	Storm 4 cfs	Storm 5 cfs	Station	Capacity cfs
1000	.840	773							700	780
1090			.27	362	250	250	250	325		
1500			.02	44	20	20	20	26	1390	360
2200	.293	355								
3000			.15	271	142	142	142	184	2900	180
4500			.29	471	272	353	353	353	4161	180
5500			.10	193	95	123	123	123	5200	210
6500			.02	44	20	26	26	26	6125	180
6800	.554	739								
7500			.53	512	451	591	732	732		
8500			.53	512	451	591	732	732	8012	1020
8700	1.075	956								
9500			.14	253	132	171	210	210	9408	205
11000			.60	643	524	766	847	847	10814	545
12200	1.304	1220							12126	535
12500			.61	653	533	779	861	861		
13000			.16	206	147	214	236	236	12832	85
16000			1.06	880	856	1390	1655	1655	15796	880
17000			1.07	888	864	1404	1670	1670	17005	470
17500			.16	204	147	235	279	279	17398	180
18000	2.323	1740								
18500			.26	320	235	377	448	448	18365	255
20500			1.17	894	917	1490	1774	1774	20200	800
22500			1.08	825	846	1375	1637	1637	22080	805
23500			.10	181	94	150	178	178		
23800	2.623	1792								
23900			.43	528	389	626	743	743		
24400	.4323	437								

NOTE: Storm 1 is 24-hour 50-year Type II Storm - 3.6 inches
Storm 2 is 1984 storm distribution - 4.00 inches
Storm 3 is 1984 storm FRS to Sta 3000 - 4.0"; Sta 3000 to Sta 9500 - 5.0"; Sta 9500 to Sta 13000 - 5.5"; Sta 13000 to Sta 23900 -6.0"
Storm 4 is 1984 storm FRS to 3000 - 4.0"; Sta 3000 to Sta 6500 - 5.0"; Sta 6500 - Sta 13000 - 6.0"; Sta 13000 to Sta 23900 - 7"
Storm 5 is 1984 storm FRS - 3.0"; FRS to Sta 6500 - 5.0"; Sta 6500 - Sta 13000 - 6.0"; Sta 13000 to Sta 23900 - 7"

APPENDIX A
(Comments on McGill Report by
Harry C. Millsaps)

United States Department of Agriculture | Soil Conservation Service

USDA - Soil Conservation Service
201 East Indianola Ave., Suite 200
Phoenix, Arizona 85012

Subject: ENG - Harquahala Valley Watershed, Saddleback Diversion, Storm, of September 2, 1984

Date: January 29, 1985

To: Ralph M. Arrington, SCE
Phoenix, AZ

File Code: 210-13-15

I have reviewed the Special Study Report on the Saddleback Diversion, Harquahala Valley Watershed for the Storm of September 2, 1984 by Herman McGill, Temple, Texas, and have drawn the following conclusions concerning the adequacy of the design of the diversion and its side inlets.

In general, it appears that the diversion channel itself functioned as design with only minor damage, although the design discharges were exceeded by more than two times in its lower reaches. (Design Q = 5995 cfs at Station 239+00 as compared to an estimated Q = 12,355 cfs for the September 2, 1984 storm.) The same, however, cannot be said for the inlet structures and their respective collector channels which were designed to collect and discharge overland flows into the diversion channel. I have evaluated the functioning of each of the inlets and made the following observations.

Inlet No. 1

This inlet is located at Station 7+00 just north of Courthouse Road. The inlet has a drainage area of 0.84 square miles, but was inadvertently left out of Mr. McGill's study. Observation in the field, however, showed that there was little or no damage to this structure and it seemed to have functioned as design. From Mr. McGill's study it can be shown that the historical peak discharges in this area were generally less than the design discharges.

Inlet No. 2

This inlet is located at Station 14+00, and although it did not overtop, there was some damage to the abutements, and the training dike overtopped downstream of the structure. The drainage area estimated by Mr. McGill ($0.27\ Mi^2$) agrees closely with that used in the design ($0.29\ Mi^2$). The September storm peak was estimated at 325 cfs as compared with the design discharge of 360 cfs. Therefore, the downstream training dike should not have overtopped and probably needs to be raised.

Inlet No. 3

Inlet No. 3 is located at Station 29+00 and has a drainage area of 0.15 square miles based on Mr. McGill's study. This compares with D.A. = 0.13 square miles used in design. The design peak was Q = 180 cfs as compared to the estimated storm peak Q = 184 cfs. The difference is only 4 cfs and yet the inlet was overtopped by 0.4 feet. Either the storm peak was larger than estimated or the inlet structure was not properly designed and installed.

Inlet No. 4

This inlet is located at Station 41+62 and has a drainage area of 0.29 square miles as estimated by Mr. McGill. This is more than twice the drainage area of 0.14 square miles used in design. The September storm peak was estimated at 353 cfs as compared to the design Q = 180 cfs. Mr. McGill estimated a design Q = 471 cfs for the 50-year, 24-hour storm. This latter discharge would be somewhat high since Mr. McGill used a CN = 90 as compared to CN = 88 based on average conditions and used in the design. However, the inlet would be considered underdesigned since there is a difference in the contributing drainage area.

Inlet No. 5

Inlet No. 5 has a drainage area of 0.10 square miles as estimated by Mr. McGill and is located at Station 52+00. The drainage area used in design was 0.16 square miles, with a design peak of 210 cfs. The September storm peak was estimated at only 123 cfs and yet the collector channel overtopped downstream of the structure. Also this inlet may be improperly located since the major channel in the drainage area is located about 100 feet downstream of the present structure, and the collector channel was overtopped near this location during the September storm.

Inlet No. 6

The drainage area for this inlet is questionable. The structure is located near a small butte at Station 61+25 and appears to have a very limited drainage area based on a large scale photograph (Scale 1" = 400') used by Mr. McGill. Mr. McGill estimated the contributing area at only 0.02 square miles as compared to 0.13 square miles used in the design. The design peak was 180 cfs as compared to only 26 cfs estimated for the historical storm. The structure itself did not overtop, but there was some overtopping of the collector channel downstream of the structure noted by Mr. McGill. There appears to be some kind of channel in this area as indicated on the large photo, but none is shown on the as-built plans. It is recommended that a collector channel be installed in this area if there is none; or if there is one, that it be enlarged.

Inlet No. 7

This inlet is located at Station 80+12 and has a total drainage area of 1.08 square miles as used in the design. The design discharge was 1020 cfs. Mr. McGill split the drainage into two equal areas (0.55 square miles each) with estimated design peaks of 512 cfs each for the 50-year, 24-hour storm. This would mean that a new inlet structure would need to be located upstream of Inlet No. 7. A logical location would be near Station 72+00 where a rather large channel intersects the diversion and near the point where the side channel was overtopped during the September storm. Some work may need to be done near the small butte located in this drainage area in order to insure that flow would be directed torward the proposed new inlet structure. It is in this drainage area where the historical storm peaks first begin to exceed designed discharges. Mr. McGill estimated the September storm peaks at 732 cfs each for the two separate drainage areas.

Inlet No. 8

This inlet is located at Station 94+08 and was designed for 250 cfs from a 0.16 square mile drainage area. These compare to a drainage area of 0.14 square miles used by Mr. McGill with a historical storm peak of 210 cfs. Little or no damage should have occurred in this area, but this was not the case. Major overtopping and severe erosion did occur both upstream and downstream of the structure. It could have been that the historical storm peak was much larger than estimated, or the collector channels were under designed or did not function as designed due to sediment deposits within the channels. Although Mr. McGill used a 6.0" rainfall in this reach for the September storm, his computed elevations were still below the surveyed highwater marks for the diversion.

Inlet No. 9 and 10

The drainage areas for these two inlets are questionable, since both serve the same major composite drainage area. It is unknown and impossible to determine which inlet would receive the largest amount of storm runoff. It was assumed by both Mr. McGill and the designers that the total D.A. would be split evenly between the two structures or about 0.60 square miles each. The computed historical peaks for each area was about 860 cfs, and compares to design peaks of about 550 cfs each. Although major overtopping occurred in this reach, the design discharges appear to be adequate. Based on the observations made on the upstreams inlets, however, I would suggest that the collector channels be evaluated for capacity.

Inlet No. 11

The design of this inlet should have been pretty straight forward since it has a fairly well defined drainage area. Mr. McGill estimated D.A. = 0.16 square miles as compared to 0.24 square miles used in design. The structure is located at Station 128+32, and was overtopped during the September storm. This would be expected, since the storm peak (236 cfs) exceeded that used in design (185 cfs). I would judge that this structure is adequate from a hydrologic standpoint, although it hydraulics may need to be evaluated.

Inlet No. 12 and 13

The drainagae area for these two structures, like those for Inlets No. 9 and 10, are questionable, since there is a separation of flow near the point where the mountain canyon discharges onto the alluvial fan. Although both Mr. McGill and Toups assumed that the canyon flow would be divided equally between the two inlets, there is a major difference in the total drainage area used in the respective studies. Mr. McGill estimated a total drainage area of 2.13 square miles as compared to 1.66 square miles used by Toups. Both Mr. McGill and Toups used 1.06 square miles for Inlet No. 12, but on Inlet No. 13, Mr. McGill used 1.07 square miles as compared to 0.60 square miles used by Toups. Assuming that Mr. McGill's drainage areas are correct, Inlet No 12 would be adequately designed, but Inlet 13 would be underdesigned. During the September 1984 storm, however, the estimated peak for even Inlet No. 12 was nearly doubled that of the design discharge. (Design Q = 880 cfs as compared to the estimated September storm peak of 1655 cfs.) For Inlet No. 13, the Design peak was 470 cfs as compared to the computed peak for the September storm of 1670 cfs or more than three times the design flow. Again it is suggested that the collector channels be evaluated for capacities.

Inlet No. 14

This inlet is located at Station 173+98 and has a fairly well defined drainage area, although some of the canyon flow from Inlets 12 and 13 drainage areas could be diverted into this inlet. Mr. McGill estimated the contributing area at 0.16 square miles as compared to 0.20 square miles used in the design. The design flow was estimated at 180 cfs and appears to be reasonable, although the September storm produced a discharge estimated at 279 cfs, which washed out both abutements and overtopped the diversion embankment.

Inlet No. 15

This inlet, located at Station 183+65, has a drainage area of 0.26 square miles based on Mr. McGill's study as compared to 0.31 square miles used in the design. This structure is again subject to excess flow from the canyon assumed to be contributing to Inlets No.'s 12 and 13. The design discharge was estimated at 255 cfs and appears to be adequate, although the capacity of the collector channel needs to be checked. The peak for the September storm was estimated at 448 cfs.

Inlet No. 16

This inlet is located at Station 202+00, with a drainage area of 1.17 square miles and a design discharge of 800 cfs. Although this structure was not referenced in Mr. McGill's field notes he did observe that severe erosion had occured both upstream and downstream of the structure with a 3' deep , 30'-wide channel being eroded in the embankment of the diversion near Station 202+75. The design discharge appears to be adequate although the historical peak was estimated at 1774 cfs.

Inlet No. 17

Inlet No. 17 is located at Station 220+00 and has a drainage area of 1.08 square miles as determined by Mr. McGill. This compares with a D. A. = 1.16 square miles used in design. The design peak was estimated at 805 cfs and appears to be adequate, although the September storm produced a peak of 1637 cfs. From the large photo, it can be noted that the drainage areas for both Inlets No. 16 and 17 are subjective, since they serve a common drainage area. The division where about half of the total drainage area contributes to each inlet is as good as any, and was used by both Mr. McGill and PRC Toups Corporation.

Inlet No. 18

This inlet is located at 241+75 but was not constructed and does not show on the as-built plans except as a "lateral swale". Some erosion, however, did occur at this location during the September storm, and it is recommended that an inlet structure be installed. The total drainage area was estimated at 0.43 square miles by both Mr. McGill and Toups.

Summary of Conclusions

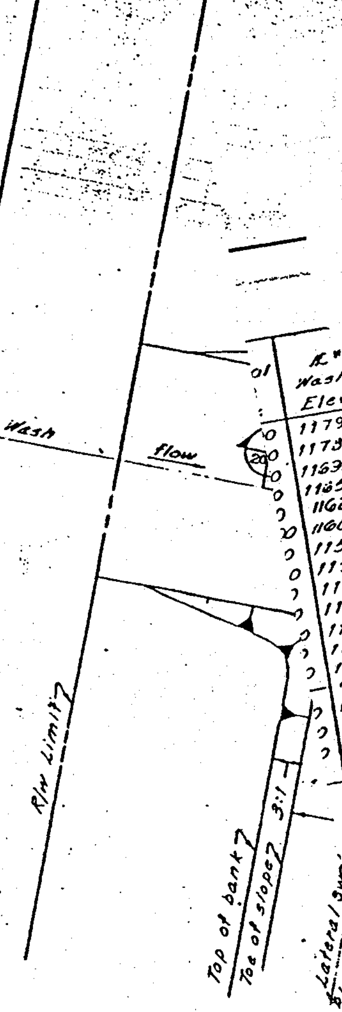
Based on Mr. McGill's study, Inlet Structures No's. 4 and 13 are definitely underdesigned due to differences in drainage areas. There are also some questions as to adequacy of the collector channels on most structures with reference to their designed capacities. There is also a need for a structure at Station 241+75 or Inlet No 18, although this structure does not show on the as-built plans. It is proposed that a new structure be located near Station 72+00 in the reach between Inlets No.'s, 6 and 7.

Submitted by:

Harry C. Millsaps
Hydraulic Engineer

APPENDIX B

APPENDIX B
INLET WEIR DETAILS

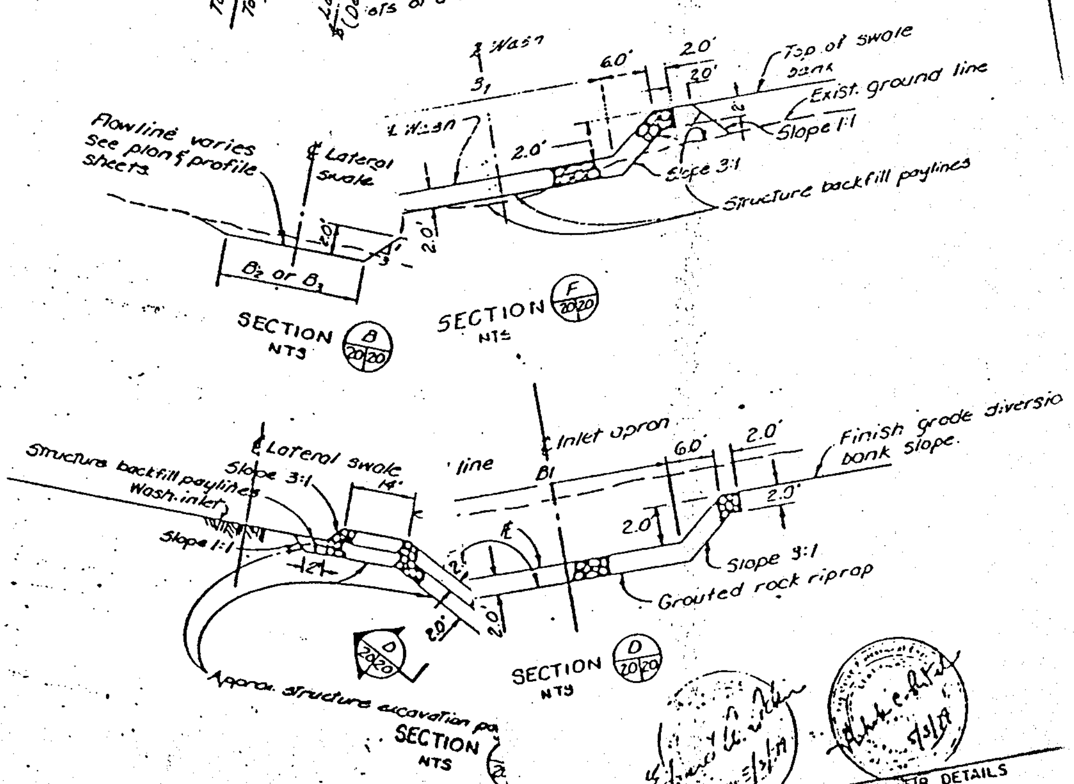


Schedule Of Inlet Structures Dimensions (Ft)

℄ Wash Elev.	B_1	B_2	B_3	C_1	C_2	C_3	L_1	L_2	W	Q cfs
1179.00	60	—	10	12.5	—	72	31	20	76	780
1173.00	22	—	10	15	—	83	38	20	39	360
1163.50	10	10	10	[illegible]	—	36	57.5	20	26	180
1165.00	10	10	10	23.5	37	87	25	20	26	180
1162.00	12	—	10	38.5	37	[illegible]	18	20	28	210
1160.00	10	—	10	[illegible]	[illegible]	[illegible]	18	20	26	180
1158.00	45	—	20	[illegible]	[illegible]	[illegible]	[illegible]	20	61	1020
1150.00	10	10	10	77.5	13.5	[illegible]	[illegible]	20	26	205
1147.60	45	—	10	30	[illegible]	[illegible]	[illegible]	20	61	545
1144.00	35	10	10	39	[illegible]	[illegible]	[illegible]	20	51	565
1144.00	[illegible]	—	10	[illegible]	[illegible]	[illegible]	[illegible]	20	29	135
1132.00	45	—	30	[illegible]	[illegible]	[illegible]	[illegible]	20	61	530
1123.00	25	—	23	[illegible]	[illegible]	54	3.5	20	41	470
1127.00	10	—	—	10	23	45.5	3.5	20	26	180
1124.00	15	—	—	20	138	11	32.5	20	31	255
1120.00	50	—	—	20	15.5	220	—	20	66	800
1117.00	45	—	—	10	—	—	—	—	61	805
1106.0	—	—	—	—	—	—	—	—	—	25

located in grouted riprapped section of diversion. require compacted fill to provide two feet depth ection. Compacted fill to be in accordance with

ets of a lateral swale only. No inlet structure is provided.



INLET WEIR DETAILS

SADDLEBACK DIVERSI
HARQUAHALA VALLEY W.P.
MARICOPA COUNTY, ARIZONA
DEPARTMENT OF AGRIC
CONSERVATION SER

TOUPS CORPORATION

CONSULTING ENGINEERS AND PLANNERS

APPENDIX B
(Excerpt from Design Report)

BY JB DATE 9/26/78 CLIENT U.S. Soil Conservation Service SHEET NO. ____ OF ____

CHECKED ________ DATE ________ JOB Saddleback FRS & Div. Chl. JOB NO. 3043-000

Weir Inlets - 50-YR Design Discharge Estimation

TR-20 AREA	(Schematic)	AREA SQ MI.	CFS Q	SUB AREA	AREA SQ MI.	cfs Q (Design Wier)	Approx. Q/2	Approx Q/3
7C	(025)	0.84	773	1	0.84	773	400	250
7A	(028)	0.293	355	2	0.293	355	200	110
7B	(031)	0.554	739	3	0.129	172	100	60
				4	0.136	182	100	60
				5	0.133	177	100	60
				6	0.156	208	100	70
7C	(034)	1.075	956	7	1.075	956	500	32[illegible]
8A	(037)	1.304	1220	8	0.160	150	100	50
				9	0.572	535	250	18[illegible]
				10	0.572	535	250	18[illegible]
8B	(040)	2.323	1740	11	0.235	176	100	60
				12	1.064	797	400	[illegible]
				13	0.228	171	100	60
				14	0.600	449	200	15[illegible]
				15	0.196	147	100	50
9A	(043)	2.623	1792	16	0.310	212	100	70
				17	1.156	790	400	26[illegible]
				18	1.157	790	400	26[illegible]
9B	(046)	0.432	437	19	0.432	437	200	15[illegible]

* Swale Design Q

PT (1)[a] AREA 7C 0.84 SM Q_{50} = 773 CFS

CHANNEL THRU BANK

APPENDIX B
(Excerpt from Design Report)

B = 60' Z = 2 n = 0.03 D = 2' S = 0.0067

V = 6.1 Q = 782 CFS

PT (2) AREA 7A 0.29 SM Q_{50} = 355 CFS

B = 22' Z = 2 n = 0.03 D = 2' S = 0.01

V = 7.0 Q = 364

PT (3) AREA 0.129 SM Q_{50} = 172

B = 10' Z = 2 n = 0.03 D = 2' S = 0.01

V = 6.4 Q = 180

PT (4) AREA 0.136 SM Q_{50} = 182

B = 10' Z = 2 n = 0.03 D = 2' S = 0.01

V = 6.4 Q = 180

PT (6) AREA 0.133 SM Q_{50} = 177

B = 10' Z = 2 n = 0.03 D = 2' S = 0.01

V = 6.4 Q = 180

PT (5) AREA 0.156 SM Q_{50} = 208

B = 12' Z = 2 n = 0.03 D = 2' S = 0.01

V = 6.6 Q = 210

PT (7) AREA 1.075 SM Q_{50} = 956

B = 45' Z = 2 n = 0.03 D = 2' S = 0.02

V = 10.4 Q = 1022

PT (8) AREA 0.16 SM Q_{50} = 150

B = 10 Z = 2 n = 0.03 D = 2' S = 0.0133

V = 7.4 Q = 207

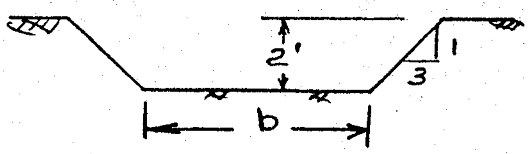
[a] See sht. 3.1-55 for approx. weir inlet location

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona	PROJECT Saddleback Diversion		
BY J. Weaver / DATE 1-11-86	CHECKED BY	DATE	JOB NO.
SUBJECT Engineering Report			SHEET 1 OF 5

Compute As-Built Capacity of Side Inlets



Weir flow

EQUIVALENT RECTANGULAR SECTION

$W = b + Z(d)$
$W = b + 3 \cdot 2$
$W = b + 6$

RECTANGULAR BROAD-CRESTED WEIR

$Q = 3.1\, W H^{3/2}$

$W = b + 6$
$H = 2$
$H^{3/2} = 2.828$

Inlet #	b	As-Built Q	50-Year Q	% As-Built/50-Year
1	60	578	773	75 %
2	22	245	325	69
3	10	140	172	81
4	10	140	182	77
5	12	158	208	76
6	10	140	177	79
7	45	447	956	47
8	10	140	150	82
9	45	447	535	84
10	35	360	535	67
11	12	158	176	90
12	45	447	797	56
13	25	272	449	61
14	10	140	147	95
15	15	184	212	87
16	50	491	790	62
17	45	447	790	57

TOUPS CORPORATION

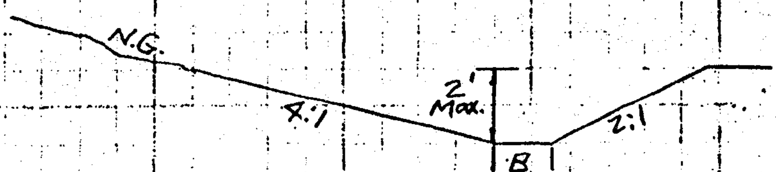
CONSULTING ENGINEERS AND PLANNERS

BY JB DATE 9/27/78 CLIENT US. Soil Conservation Service SHEET NO. ____ OF ____

CHECKED ______ DATE ______ JOB Saddleback FRS & Div. Chl JOB NO. 3043-000

Lateral Swale Design Table for subareas (1-19) contributary

50 yr frequency storm runoffs.



TYPICAL SECTION
(LOOKING DOWNSTREAM)

Z:1 = 3 (Average)
B = Varies
n = 0.03
d = 2' (Max.)
S = 0.003%

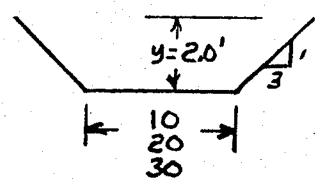
	B	d	Q	V	Dist. out from top of 2:1 slope	
	0.0001	1	4.95	1.65	+6'	
	10	1	30	2.33	+16	
	20	1	57	2.48	+26	
	30	1	84	2.54	+36	
	40	1	111	2.58	+46	
	0.0001	2	31	2.62	+12'	
	10	2	109	3.42	+22'	
	20	2	192	3.70	+32'	
	30	2	277	3.85	+42'	
	40	2	362	3.94	+52'	
	50	2	448	4.00	+62'	
DITCH TO PT①	10	2	141	4.4		S = 0.005 Z = 3 (Av.)

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	SADDLEBACK DIVERSION		
BY J. Weaver	DATE 1-8-86	CHECKED BY / DATE	JOB NO.
SUBJECT ENGINEERING REPORT			SHEET 2 OF 5

As-Built Capacity of Lateral Swales



$n = 0.03$

$$Q = \frac{1.49 A R^{2/3} \sqrt{S}}{n}$$

general formulas

b=10'

$A = (b+zy)(y) = [10+3(2)]2 = 32$

$p = b+2y\sqrt{1+3^2} = 10+4(3.16) = 22.64$

$R = A/p = 32/22.64 = 1.41$

$R^{2/3} = 1.26$

$$Q = \frac{(1.49)(32)(1.26)\sqrt{S}}{.03} = 2002\sqrt{S}$$

b=20'

$A = (b+zy)(y) = (20+6)(2) = 52$

$P = 20+4\sqrt{10} = 32.65$

$R = A/p = 1.59$

$R^{2/3} = 1.36$

$$Q = \frac{(1.49)(52)(1.36)\sqrt{S}}{0.03} = 3512\sqrt{S}$$

b=30'

$A = (30+6)(2) = 72$

$P = 30+4\sqrt{10} = 42.65$

$R = A/P = 1.69$

$R^{2/3} = 1.418$

$$Q = \frac{(1.49)(72)(1.418)\sqrt{S}}{0.03} = 5070.8\sqrt{S}$$

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	SADDLEBACK DIVERSION		
BY J. WEAVER — DATE 1-8-86	CHECKED BY	DATE	JOB NO.
SUBJECT ENGINEERING REPORT			SHEET 3 OF 5

COMPUTE AS-BUILT SLOPES OF LATERAL SWALES

Channel slopes are not shown on drawings. Obtain slopes from slope stake field books.

	Weir Inlet	Stations	L	Δ Elev	Slope
Field Book #4	1	4+00 to 7+00	300'	1.4'	0.0047
	2	10+60 to 13+90	330'	3.5	0.0106
	3	26+00 to 29+00	300'	1.5'	0.005
	4 N	35+50 to 41+63	613'	2.5'	0.004
	S	41+63 to 43+60	197'	0.8'	0.004
Field Book #3	5 N	50+00 to 52+00	200'	1.0	0.005
	S	52+00 to 59+00	700'	1.0	0.0014
	6	59+00 to 61+25	225'	3.0'	0.0133
	7	73+00 to 80+13	713	3.0'	0.0042
	8 N	88+50 to 94+08	630	3.0'	0.0048
	S	94+09 to 97+20	311	2.0'	0.0064
	9	104+00 to 108+17	417	2.9	0.007
Field Book #2	10 N	117+80 to 121+25	345'	2.0	0.0058
	S	121+25 to 124+00	275'	2.0	0.0073
	11	125+10 to 128+00	300'	0.6	0.002
	12	133+90 to 158+50	2,510'	9.0	0.0036
	13	161+20 to 170+00	880'	3.0'	0.0034
Field Book #1	14				
	15	177+00 to 183+65	665'	4.0'	0.006
	16	195+00 to 202+00	700'	4.0	0.0057
	17	210+50 to 221+00	1,050'	4.0'	0.0038
	18	237+13 to 241+75	462'	0 (FLAT)	0.0000

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona	PROJECT: Saddleback Diversion			
BY: J. Weaver	DATE: 1-8-86	CHECKED BY:	DATE:	JOB NO.:
SUBJECT: Engineering Report				SHEET 4 OF 5

As-Built Capacity of Lateral Swales

inlet	Swales bottom width	Swales slope		Q cfs
1	10	.0047	$2002\sqrt{S}$	= 137
2	10	.0106	"	= 206
3	10	.005	"	= 142
4 N	10	.004	"	= 128
S	10	.004	"	= 128
5 N	10	.005	"	= 142
S	10	.0014	"	= 75
6	10	.0133	"	= 231
7	20	.0042	$3512\sqrt{S}$	= 227
8 N	10	.0048	$2002\sqrt{S}$	= 139
S	10	.0064	"	= 160
9	10	.007	"	= 167
10 N	10	.0058	"	= 152
S	10	.0073	"	= 171
11	10	.002	"	= 90
12	30	.0036	$5070.8\sqrt{S}$	= 304
13	20	.0034	$3512\sqrt{S}$	= 205
14	—			
15	10	.006	$2002\sqrt{S}$	= 155
16	20	.0057	$3512\sqrt{S}$	= 265
17	20	.0038	$3512\sqrt{S}$	= 216
18	10	Flat	$2002\sqrt{S}$	= ? S=0.00%

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona	PROJECT: Saddleback Diversion		
BY: J. Weaver	DATE: 1-9-86	CHECKED BY:	DATE:	JOB NO.:
SUBJECT: Engineering Report			SHEET 5 OF 5

COMPARE DESIGN & AS-BUILT Q FOR LATERAL SWALES

inlet	design inlet Q	design swale Q/3 [1]	As-built Q [2]
1	773	250	137
2	355	110	206
3	172	60	142
4	182	60	128
5	208	70	N = 142 S = 75
6	177	60	231
7	956	320	227
8	150	50	N = 139 S = 160
9	535	180	167
10	535	180	N = 152 S = 171
11	176	60	90
12	797	270	304
13	449	150	205
14	147	60	—
15	212	70	155
16	790	260	265
17	790	260	216
18	790	260	? S = 0.00%

1/ Swale Q = Inlet Q/3. See Design File, p. 3.1-50

2/ Max. Capacity at 2.0' depth. No freeboard.

APPENDIX C

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING • HYDROLOGY

B. DWAINE SERGENT, P.E.
LAWRENCE A. HANSEN, PH.D., P.E.
RALPH E. WEEKS, P.G.
DARREL L. BUFFINGTON, P.E.
DONALD VAN BUSKIRK, P.G.
JOHN B. HAUSKINS, P.E.
DALE V. BEDENKOP, P.E.
DONALD L. CURRAN, P.E.
J. DAVID DEATHERAGE, P.E.
MICHAEL R. RUCKER, P.E.
GEORGE H. BECKWITH, P.E.
ROBERT W. CROSSLEY, P.E.
DONALD G. METZGER, P.G.
JONATHAN A. CRYSTAL, P.E.
PAUL V. SMITH, P.G.
ROBERT D. BOOTH, P.E.
NORMAN H. WETZ, P.E.
ROBERT L. FREW
ALLON C. OWEN, JR., P.E.

February 12, 1986

Mr. David O. Lambson
Contracting Officer
United States Department of Agriculture
Soil Conservation Service
201 East Indianola
Suite 200
Phoenix, Arizona 85012

Re: Investigation Report
Saddleback Division
Harquahala WPP

Dear Mr. Lambson,

I apologize for not replying sooner to your request of January 9, 1986. Robert R. Koons, P.E., is no longer employed by Sergent, Hauskins & Beckwith Geotechnical Engineers, Inc. (SHB) and I felt he could best perform this review. By the time I got the information to him, and he discussed the project with your staff, this much time had passed.

I have attached Mr. Koons' letter, which is self-explanatory. If you have questions or if we can be of service, please call.

Respectfully submitted,

Sergent, Hauskins & Beckwith Engineers

By ____________________
B. Dwaine Sergent, P.E.
President

Copies: Addressee (1)

REPLY TO: 3940 W. CLARENDON, PHOENIX, ARIZONA 85019

PHOENIX (602) 272-6848 · ALBUQUERQUE (505) 884-0950 · SANTA FE (505) 471-7836 · SALT LAKE CITY (801) 266-0720 · EL PASO (915) 778-3369

Robert R. Koons, P.E., Inc.
Construction Engineering Services

February 3, 1986

B. Dwaine Sergent
Sergent, Hauskins & Beckwith
3940 W Clarendon Ave
Phoenix, AZ 85019

Ref: Investigation Report Saddleback Div., Harguahala WPP

Dear Mr. Sergent:

Responding to a request from SCS, I have reviewed their Engineering Report prepared to investigate possible deficiencies in the structures following a storm in September, 1984. My comments are related to construction and inspection services provided by Sergent, Hauskins & Beckwith.

The report was reviewed without the benefit of a set of plans or construction photographs. As the construction was completed nearly four years ago, I can rely only on the memory of the work as I recall seeing it.

The investigators apparently made a thorough analysis of the hydrology and hydraulics for the particular storm event in question. The inherent vagaries of these studies became obvious as the investigators did not exactly agree with the designers in calculating of drainage areas for the various structures. Rainfall distribution pattern is unknown and inflow at the various structures was estimated by methods unknown to me. Mr. Millsaps concluded that two of the Inlet Structures were underdesigned and he questions the adequacy of the collection channels on most of the structures.

4645 S. Lakeshore Dr., Suite 7 • Tempe, AZ 85282 • (602) 820-3104

The report reveals no deficiency or fault in construction or materials. Inasmuch as I did not inspect the damange following the storm, I cannot comment on the quailty or performance of the structures or channels. But again considering the variables inherent in hydrolgy studies as well as in construction of the lateral collection channels, it may be nearly impossible to predit exactly the performance of these structures. Even with the knowledge gained from this study the exact performance for an event with a somewhat different rainfall distribution pattern would be difficult, in my opinion.

In conclusion, and with only the limited information available to me, I can find no relationship between the construction and inspection services provided and the damage resulting from the September 1984 storm. My only recommendation would be to provide a greater saftey factor in design for those project features in which the variables in design and construction have the greatest impact on performance.

Very truly yours,

Robert R. Koons

Robert R. Koons, P.E.
President

PRC Engineering
4131 North 24th Street
Phoenix, AZ 85016
602-954-9191

prc
Planning Research Corporation

11 March 1986

Ralph M. Arrington
State Conservation Engineer
USDA, Soil Conservation Service
201 East Indianola, Suite 200
Phoenix, Arizona 85012

Dear Mr. Arrington:

First, I would like to apologize for the delay in responding to the letter of January 9, 1986 from Mr. David O. Lambson of your office. Basic research of the Saddleback Diversion Harquahala W.P.P. was required by our office since the engineers who originally worked on the project are no longer employed at PRC Engineering.

It is apparent that the September 2, 1984 storm which the Diversion Structure experienced was significantly greater than the 50-year 24-hour design storm. According to the post-storm analysis performed by the SCS, the main diversion channel operated with little or no problems during this event. However, some erosion damage did occur in several of the seventeen side inlets to the main channel.

It is our opinion that all of the side inlets were properly sized and located at the time of design. Eleven of the seventeen side inlets were relocated during construction varying from 2 to 82 feet according to the SCS post-storm analysis. As of yet, our office has not found documentation for relocating these side inlets. However, it is possible that the side inlets were adjusted in the field during construction for some reason; possibly to better fit natural drainage channel locations which existed at the time of construction.

During a storm of this intensity and magnitude it is common for alluvial fan type flows to migrate across the fan and establish new drainage channels and concentration points. Without the benefit of mapping pre- and post-flood drainage patterns this cannot be verified but, based on our present knowledge of alluvial fan hydrology it is probable that some drainage patterns did change during this storm.

Evidence of sediment deposition in the side inlets, as cited in the SCS post-storm analysis may have been responsible for reduced capacity and contributed to the over-topping of several side inlets. Sediment deposition may have occurred in the side inlets prior to the September 2, 1984 storm in sufficient quantity to reduce the capacity of the inlets. Also, because the September 2, 1984 storm was so intense it may have transported larger than design quantities of sediment into the side inlets.

One or a combination of both of these factors could have reduced the capacity of the side inlets and caused flows to over-top them.

After careful review of the post-storm document prepared by the SCS and our engineering files on the Saddleback Diversion Harqualala W.P.P., it is PRC Engineering's position that the structure performed at or beyond its design capabilities. We trust that you are satisified with the structure and look forward to working with the SCS in the future.

If you have any additional questions regarding this matter please do not hestitate to call me at 954-9191.

Sincerely,

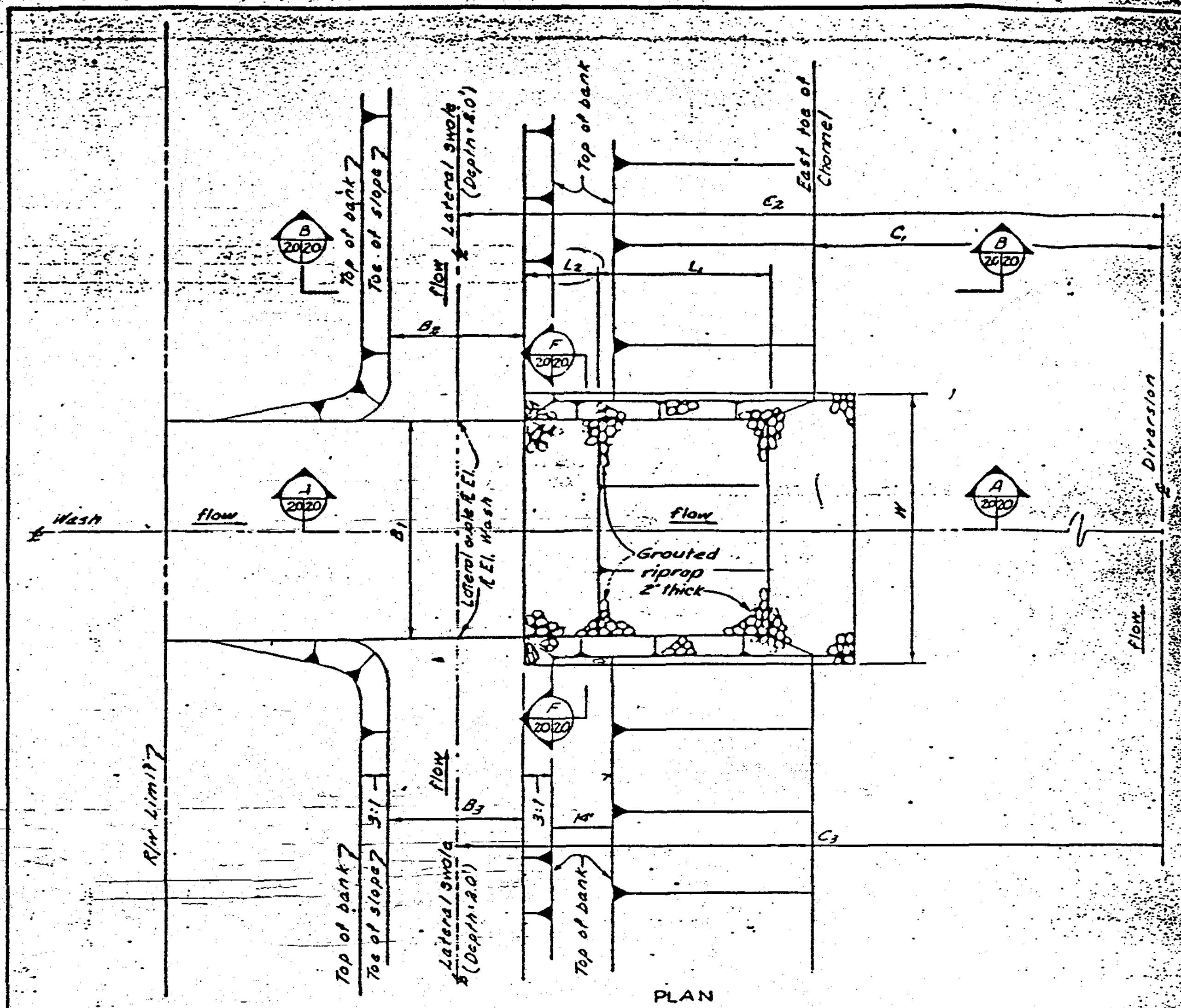
PRC ENGINEERING, INC.

John Gerometta, P.E.
Associate Vice President

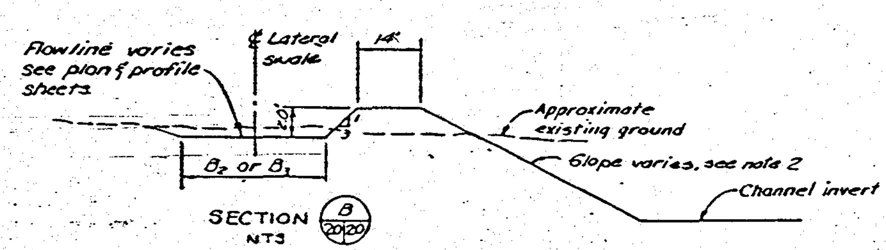
JG:smk

APPENDIX D

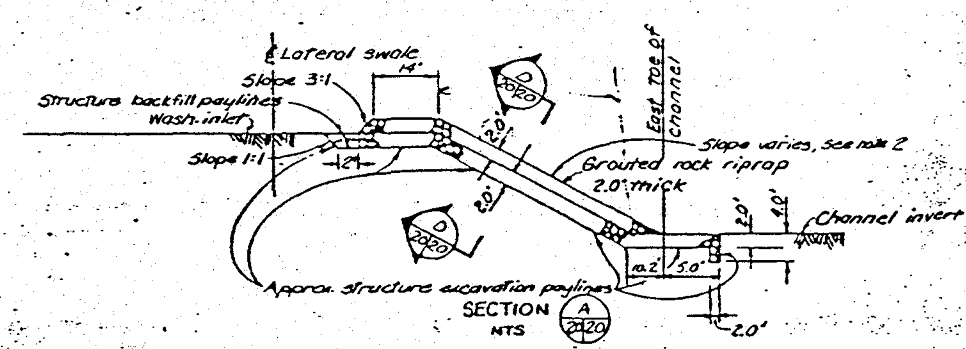
APPENDIX B
INLET WEIR DETAILS



PLAN
NTS



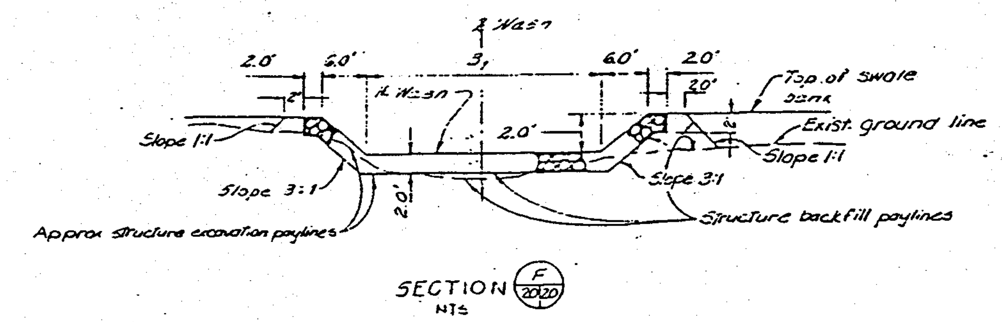
SECTION B 20/20
NTS



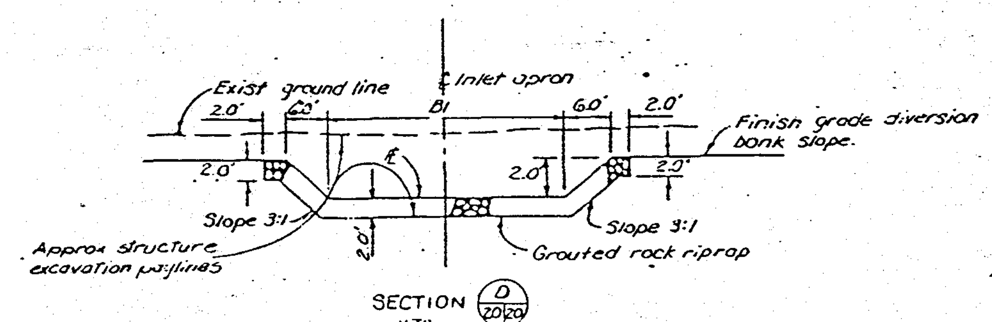
SECTION A 20/20
NTS

C_1	C_2	C_3	L_1	℄ STATION	Location Point	Approx Station Along ℄	℄ Lateral Swale Elev.	℄** Wash Elev.	B_1	B_2	B_3	C_1	C_2	C_3	L_1	L_2	W	Q cfs
									Schedule Of Inlet Structures Dimensions (Ft)									
12.5	—	71.2	25.7	7+00	1*	7+00	1179.00	1179.00	60	—	10	12.5	—	72	31	20	76	780
15.0	—	82.4	32.0	13+90	2	14+00	1173.00	1173.00	22	—	10	15	—	83	38	20	39	360
18.5	—	86.0	32.5	29+00	3	29+00	1163.50	1163.50	10	—	10	[illegible]	—	36	37.5	20	26	180
29.53	87.13	87.13	22.5	41+60.6	4	41+50	1165.00	1165.00	10	10	10	29.5	87	87	25	20	26	180
38.63	91.63	91.63	18.0	52+00	5	53+50	1162.00	1162.00	12	10	10	38.5	87	[illegible]	18	20	28	210
46.72	—	98.97	17.3	61+26	6	61+25	1160.00	1160.00	10	—	10	[illegible]	—	87	18	20	26	180
63.35	—	129.5	26.0	80+12	7	80+00	1158.00	1158.50	45	—	20	[illegible]	—	[illegible]	[illegible]	20	61	1020
71.57	129.7	129.7	23.0	94+08.5	8	94+00	1150.00	1150.00	10	10	10	71.5	129.5	[illegible]	[illegible]	20	26	205
79.85	—	140.0	25.0	108+14.5	9	108+50	1147.50	1147.50	45	—	10	[illegible]	—	147.5	[illegible]	20	61	545
89.65	144.9	144.9	20.2	121+26	10	121+50	1144.00	1144.00	35	10	10	[illegible]	[illegible]	[illegible]	26	20	51	565
94.95	—	157.2	27.3	128+32	11	[illegible]	1144.00	1144.00	[illegible]	—	10	[illegible]	—	[illegible]	[illegible]	20	29	135
115.0	—	190.0	30.0	157+96	12	[illegible]	1132.00	1132.50	45	—	30	[illegible]	—	[illegible]	[illegible]	20	61	330
121.4	—	189.7	28.3	170+05	13	[illegible]	1129.50	1129.30	25	—	20	[illegible]	—	[illegible]	[illegible]	20	41	470
123.5	—	—	22.6	173+98	14	174+00	—	1127.00	10	—	—	[illegible]	—	[illegible]	[illegible]	20	26	180
128.6	—	181.8	18.3	183+65	15	183+50	1124.00	1124.00	15	—	10	[illegible]	—	[illegible]	13.5	20	31	255
138.3	—	196.7	18.6	202+00	16	202+00	1120.00	1120.00	50	—	20	138	—	196.5	13.5	20	66	800
145.5	—	209.6	23.8	220+80	17	221+00	1117.00	1117.00	45	—	20	145.5	—	211	32.5	20	61	805
					18***	224+00	1106.0	1106.0	—	—	10	—	—	220	—	—	—	25

* Structure No 1 is located in grouted riprapped section of diversion.
** ℄ Elevation may require compacted fill to provide two feet depth inlet weir cross section. Compacted fill to be in accordance with specifications.
*** Structure No 18 consists of a lateral swale only. No inlet structure is provided.

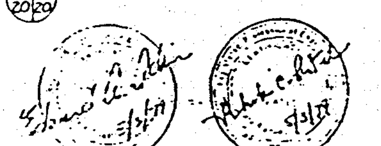


SECTION F 20/20
NTS



SECTION D 20/20
NTS

NOTE:
1. Lateral swale stationing, as shown on sheets 5 to 11, are approximate. Actual length of lateral swale to be determined in the field at the time of construction by the engineer.
2. Slope is 4:1 for location Pt. No. 1 and 5:1 for all others.



AS BUILT
DATE MAY 1982

INLET WEIR DETAILS
SADDLEBACK DIVERSION
HARQUAHALA VALLEY W.P.P.
MARICOPA COUNTY, ARIZONA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed C.E.S.	Date 9-78	Approved by	
Drawn J.B. L.J.C.	9-78	Title	
Traced		Title	
Checked A.C.	2-79	Sheet 20 of [illegible]	Drawing No. 7-E-24040

ACK ENGINEERS, INC.
2255 N. 44th St. Suite 220 • Phoenix, Az. 85008 • Phone (602) 244-2566

Edward A. Adair, P.E.
R. Gerald Green, P.E.
Samuel E. Kao, PhD, P.E.

April 17, 1987

Mr. Ralph M. Arrington
State Conservation Engineer
UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
201 East Indianola Avenue
Suite 200
Phoenix, Arizona 85012

Dear Mr. Arrington:

On March 25, 1987, I received a request to comment upon the damage investigations carried out by your office on the Saddleback Diversion in the Harquahala Valley Watershed. I have reviewed your engineering report dated February 1987 and concur with the comments submitted by PRC Engineering in their letter dated 11 March 1986.

In addition, I offer the following observations:

1. The inappropriateness of using the Mannings formula for the side inlet design was concluded by your office in favor of a weir formula. My examination of drawing no. 7-E-24040 reveals the intention of positive slope from lateral swales through side inlets and down the side slope of the diversion. Therefore, I am still of the opinion that the use of channel flow criteria is appropriate.

2. The effectiveness of flood protection structures is greatly dependent upon proper maintenance. This is especially true for those elements having no freeboard and no deposition capacity. In addition, if the upslope side of the diversion is located normal to an alluvial fan, side inlets and accompanying training channels and dikes may be left high and dry as a result of a localized previous storm event. Nothing was indicated in the report about the history of maintenance and more particularly the length of time since the last maintenance was carried out. References in the report were made to reductions in side inlet capacity due to sediment bars.

If I can be of further assistance, please do not hesitate to contact me.

Sincerely,

Edward A. Adair

Edward A. Adair, P.E.

EAA:pmm

PRC Engineering
4131 North 24th Street
Phoenix, AZ 85016
602-954-9191

prc
Planning Research Corporation

April 27, 1987

3043-000-00

Mr. Ralph M. Arrington
State Conservation Engineer
USDA, Soil Conservation Service
201 East Indianola, Ste 200
Phoenix, Arizona 85012

Dear Mr. Arrington:

PRC Engineering has finished reviewing the Engineering Report for the Saddleback Division Hanquahala Valley Watershed in Maricopa County, Arizona, dated February 1987. We appreciate the opportunity to review this document and make comment.

As we stated in our earlier letter dated March 11, 1986, none of the engineers or designers who participated on this project are currently employed by PRC Engineering. Lacking the first hand knowledge has put us at a disadvantage regarding the specifics of the design process and how design decisions were arrived. However, we feel the current Engineering Report addresses some of the elements brought to attention in our March 11, 1986 correspondence.

At this time we have no further comments concerning the revised Engineering Report. If you require any additional information, please do not hesitate to call me at 954-9191.

Sincerely,

PRC ENGINEERING, INC.

John W. Gerometta, P.E., L.S.
Associate Vice President
Director of Public Works

JG/js/87

INFLOW ESTIMATES
ALONG
SADDLEBACK FRS

North of Buckeye-Salome Road

HARQUAHALA VALLEY WS

RP McArthur
12/88

SADDLEBACK FRS INFLOW ESTIMATES
HARQUAHALA VALLEY WS

RPMcArthur, 12/88

PURPOSE: This study was made at the request of Ralph Arrington, St. Cons. ~~Engineer,~~ to estimate annual peak inflow rates for selected frequencies for the Saddle back FRS north of the Buckeye-Salome Road Crossing. Uncontrolled inflow has been causing some gully erosion at various points of inflow into the low flow channel of the Saddleback FRS.

PROCEDURE: A field examination was made of the area of concern (Dec. 21, 1988, D. Paulus & R. McArthur) to assess existing flow paths and limitations. Of particular concern was the effect of inflow through culverts along I-10 from upland areas.

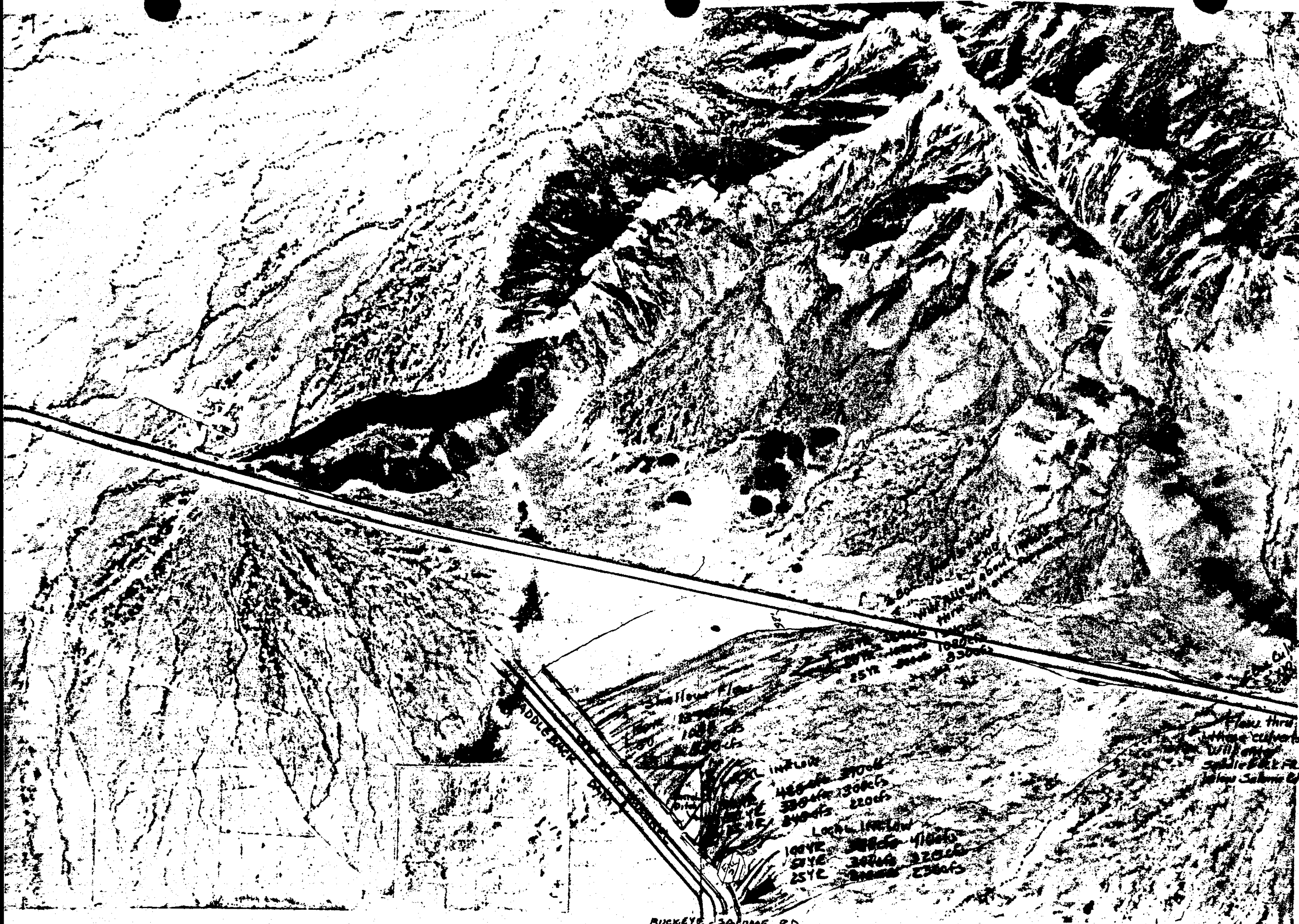
Subareas were defined by the existing short dike and abandoned concrete irrigation ditch and the fill area that resulted from spoil disposal during the construction of the Saddleback FRS.

TR 55 was used to make the peak flow estimates. Storm distribution Type II was used; 24-Hr precipitation values previously derived in the hydrology of Centennial Levee Reach 1; hydrologic soil groups were determined from the Maricopa County, Arizona, Central Part published soil survey report; runoff curve numbers were taken from Table 2-2d, TR 55; times of concentration were estimated using land slopes from

USGS 7.5 minute quad sheets and approx. hydraulic parameters.

RESULTS: Assuming that a collector system is used to bring the shallow, widespread flows together and discharge them in at a discrete location the flow estimates are shown for three locations

Location	Peak Flow Estimates (cfs) 100 Yr	50 Yr	25 Yr
Between Buckeye-Salome Road & Spoil area	410	320	230
Between Spoil area and abandoned irrigation pipeline(?)	390	300	220
Between adandoned irrigation pipeline and north end of Saddleback FRS; flow coming from above I-10	1340	1080	830



Shallow Flow
Local Inflow
100YR
50YR
25YR
410cfs
220cfs
2380cfs
Flow thru
culverts
BUCKEYE - SALOME RD

TR-55 GRAPHICAL DISCHARGE METHOD

VERSION 1.11

.oject : Harquahala Valley WS
County :
State:
User: RPM
Checked: ____
Date: 12-28-88
Date: --------
[Su]btitle: Saddleback FRS Inflow Estimates

Data: Drainage Area : 327 Acres
Runoff Curve Number : 77
Time of Concentration: 0.70 Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1	2	3	4	5	6
Frequency (yrs)	100	50	25	10	5	2
24-Hr Rainfall (in)	4.13	3.60	3.07	2.43	1.92	1.25
Ia/P Ratio	0.14	0.17	0.19	0.25	0.31	0.48
Runoff (in)	1.91	1.51	1.12	0.70	0.41	0.12
Unit Peak Discharge (cfs/acre/in)	0.662	0.649	0.631	0.599	0.553	0.333
Pond and Swamp Factor 0.0% Ponds Used	1.00	1.00	1.00	1.00	1.00	1.00
Peak Discharge (cfs)	414	319	231	137	73	13

oject : Harquahala Valley WS User: RPM Date: 12-28-88
County : State: Checked: ____ Date: ________
›title: Saddleback FRS Inflow Estimates

Data: Drainage Area : 335 Acres
Runoff Curve Number : 77
Time of Concentration: 0.80 Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1	2	3	4	5	6
Frequency (yrs)	100	50	25	10	5	2
24-Hr Rainfall (in)	4.13	3.60	3.07	2.43	1.92	1.25
Ia/P Ratio	0.14	0.17	0.19	0.25	0.31	0.48
Runoff (in)	1.91	1.51	1.12	0.70	0.41	0.12
Unit Peak Discharge (cfs/acre/in)	0.613	0.600	0.584	0.554	0.511	0.310
Pond and Swamp Factor 0.0% Ponds Used	1.00	1.00	1.00	1.00	1.00	1.00
Peak Discharge (cfs)	393	303	219	129	69	12

TR-55 GRAPHICAL DISCHARGE METHOD

VERSION 1.11

Project : Harquahala Valley WS
County :
State:
Subtitle: Saddleback FRS Inflow Estimates

User: RPM
Checked: ____

Date: 12-28-88
Date: ________

Data: Drainage Area : 763 Acres
Runoff Curve Number : 84
Time of Concentration: 0.67 Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1	2	3	4	5	6
Frequency (yrs)	100	50	25	10	5	2
24-Hr Rainfall (in)	4.13	3.60	3.07	2.43	1.92	1.25
Ia/P Ratio	0.09	0.11	0.12	0.16	0.20	0.30
Used	0.10	0.11	0.12	0.16	0.20	0.30
Runoff (in)	2.49	2.02	1.57	1.06	0.69	0.27
Unit Peak Discharge (cfs/acre/in)	0.706	0.703	0.691	0.671	0.645	0.575
Pond and Swamp Factor 0.0% Ponds Used	1.00	1.00	1.00	1.00	1.00	1.00
Peak Discharge (cfs)	1340	1084	830	543	338	119

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
ARIZONA		SADDLE BACK FRS		
BY R. McArthur	DATE 12/22/88	CHECKED BY	DATE	JOB NO.
SUBJECT ESTIMATED INFLOW ALONG SADDLE BACK FRS				SHEET ___ OF ___

NORTH OF BUCKEYE-SALOME ROAD
USING TR55 COMPUTER PROGRAM TO MAKE COMPUTATIONS TYPE II STORM

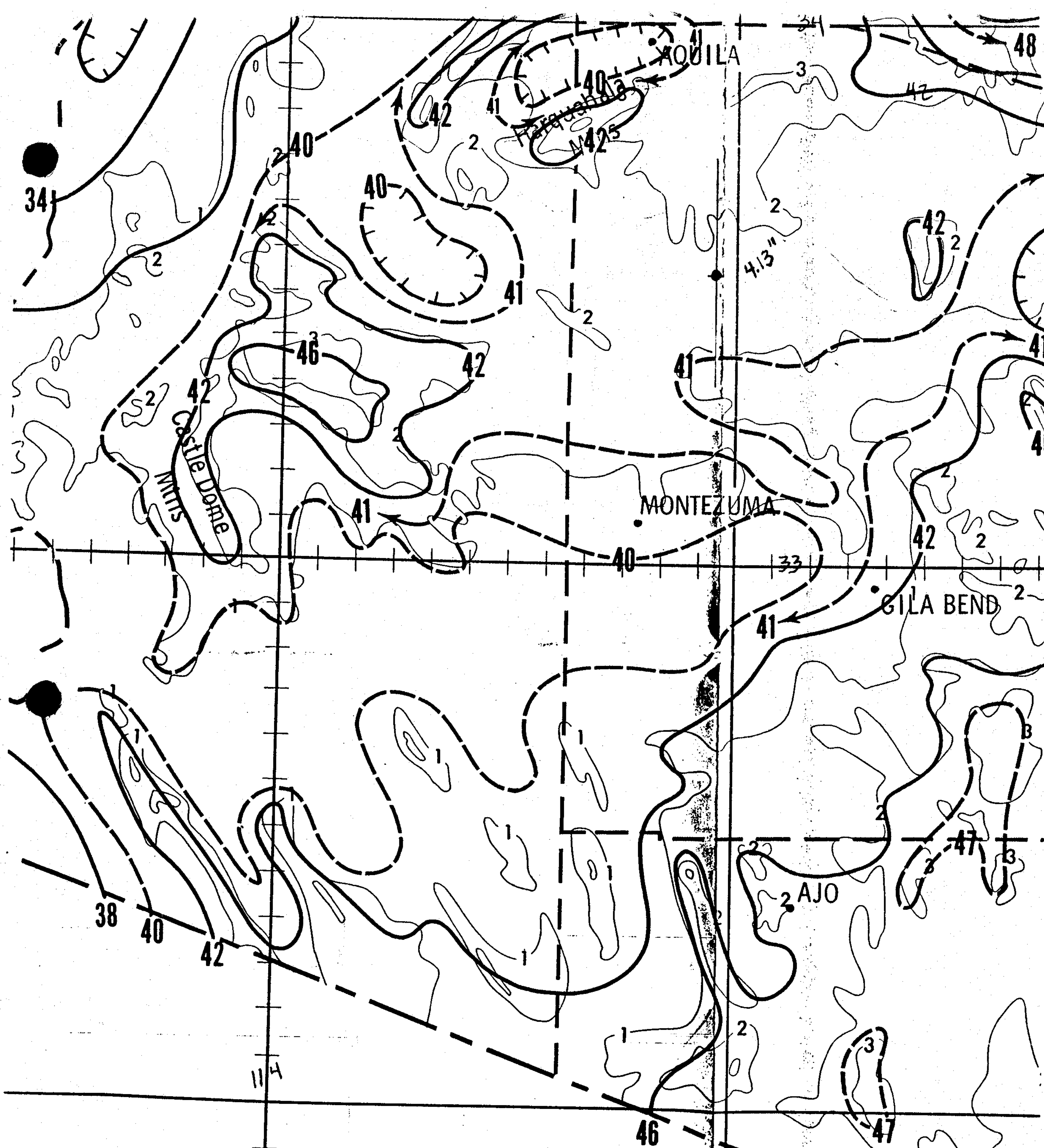
BELOW I-10 RCN = 75

Frequency	Precipitation	PEAK FLOW cfs Tc = 0.7 Hr, 0.52 mi 335 acres (A)+(B)	Tc = 0.8, 0.51 mi 327 (B)+(C)	Tc = 0.7, 0.30 mi 192 (A)
100	4.13	424	383	243
50	3.60	327	295	187
25	3.07	237	214	136
10	2.43	140	126	80
5	1.92	75	68	43
2	1.25	13	12	7

ABOVE I-10

Frequency	Precipitation	PEAK FLOW Tc = 0.67 Hrs. DA: 763 RCN = 83
100	4.13	1293
50	3.60	1034
25	3.07	786
10	2.43	508
5	1.92	311
2	1.25	102

REVISED



-YEAR 24-HOUR PRECIPITATION

ISOPLUVIALS OF 100-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH

COMPUTATION SHEET

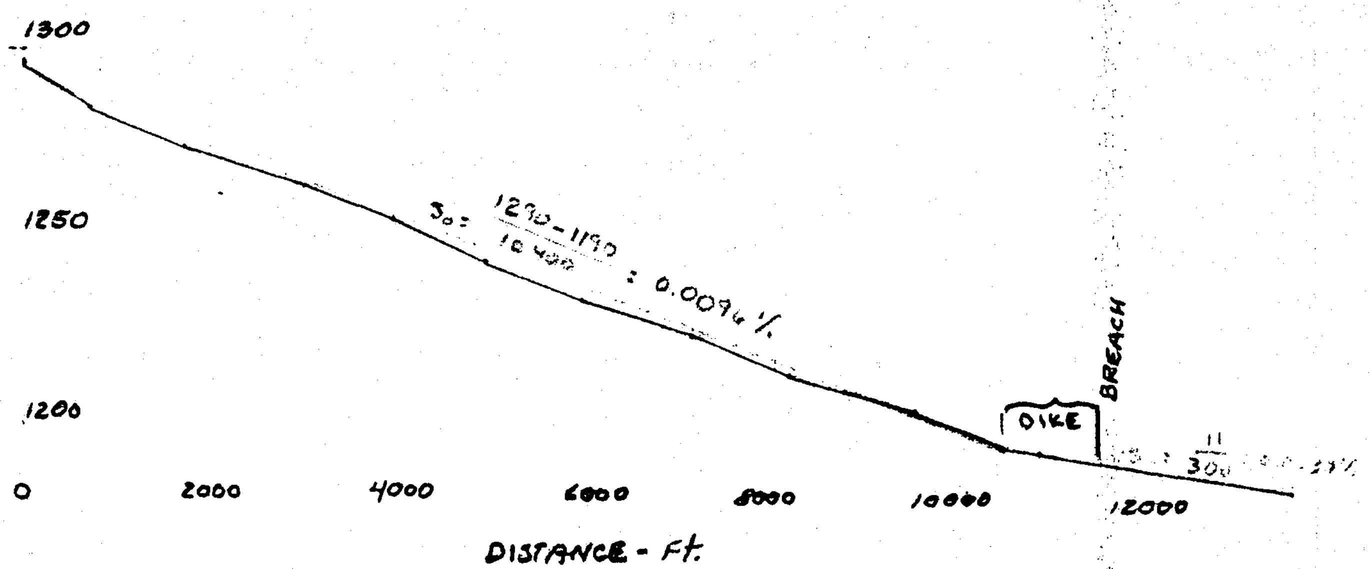
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE	PROJECT			
ARIZONA	HARQUAHALA VALLEY WS			
BY: RMcArthur	DATE: Dec. 22, 198?	CHECKED BY	DATE	JOB NO.
SUBJECT: SADDLEBACK FRS - Inflow Estimates				SHEET ___ OF ___

Time of Concentration Estimates for Local Inflow Below I-10 to Saddleback FRS



Assume $r \approx 1.2$

$n \approx 0.04$

$V = \frac{1.486}{n} r^{2/3} S^{1/2}$

$= \frac{1.486}{0.04} (1.2)^{2/3} (0.0096)^{1/2} = 4.1$ fps

$T_{T_1} = \frac{10400}{(4.1)(3600)} = 0.70$ hrs.

$r \approx 1.8$

$n = 0.045$

$V = 2.96$ fps

$T_{T_2} = \frac{1000}{2.96(3600)} = 0.09$ hrs.

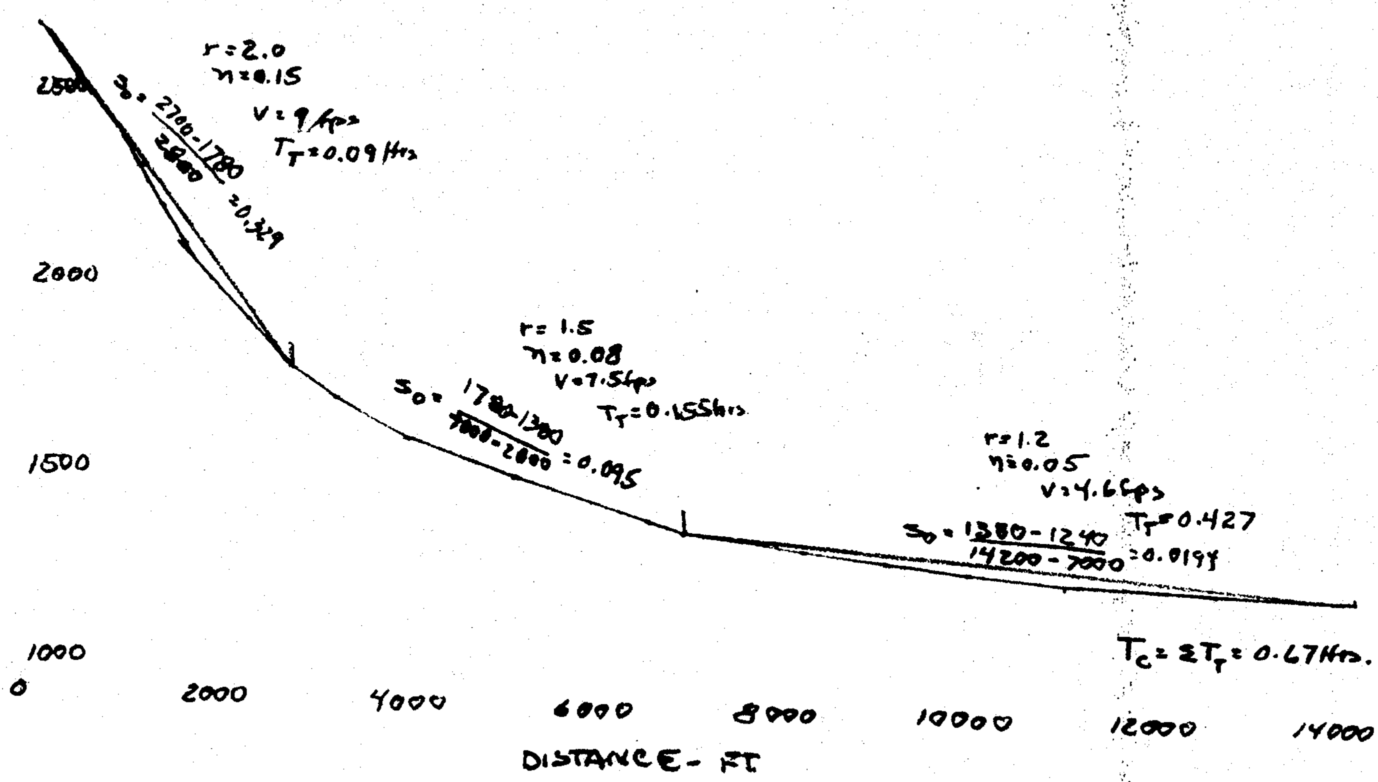
$T_c = \Sigma T_T = 0.79$ hrs or 47 mins.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

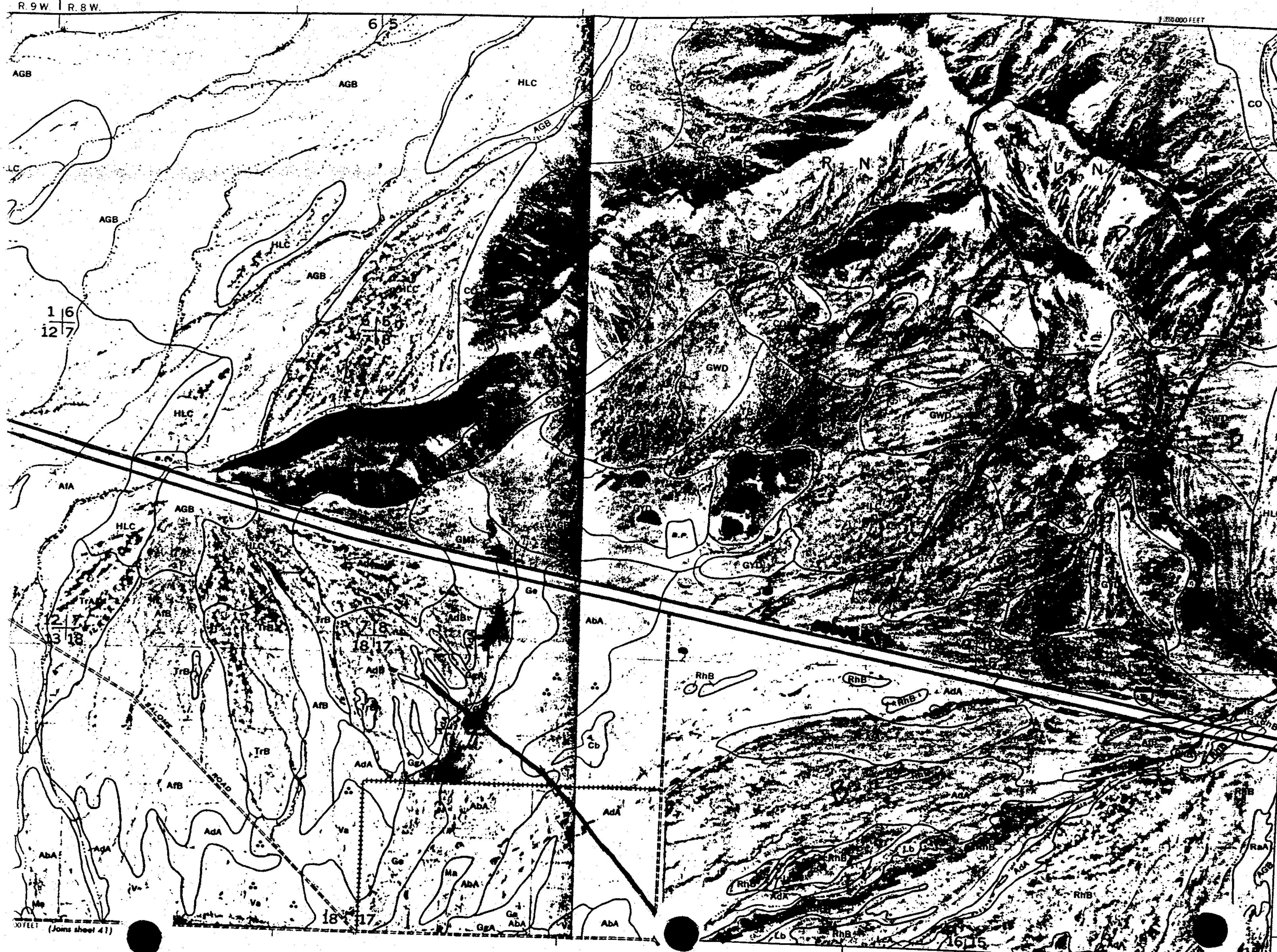
STATE	PROJECT			
ARIZONA	HARQUAHALA VALLEY WS			
BY: R. McArthur	DATE: 12/28/88	CHECKED BY	DATE	JOB NO.
SUBJECT: SADDLEBACK FRS - Inflow Estimates				SHEET ____ OF ____

Time of Concentration Estimate to Culverts Under I-10 for Drainage Area Above I-10



TIME OF CONCENTRATION ESTIMATE FOR SUBDRAINAGE AREA ABOVE I 10 CONTRIBUTING INFLOW TO NORTHERN PORTION OF SADDLEBACK FRS

MARICOPA COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 28



Desert

60% D

5% C

35% B

Above I

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

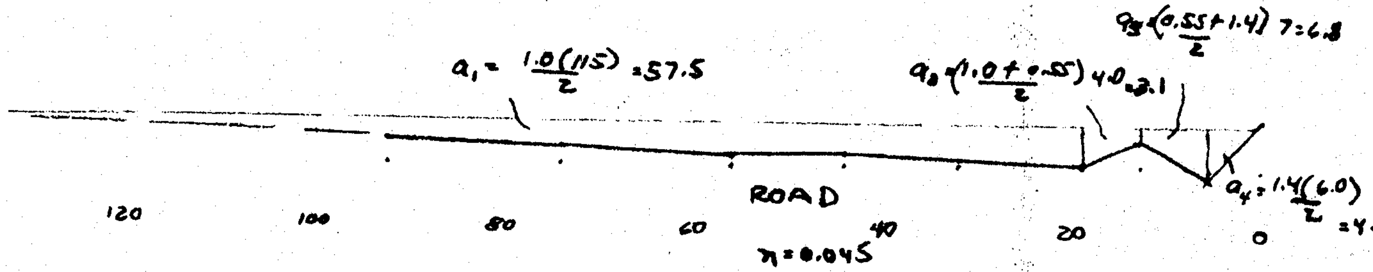
U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	HARQUAHALA VALLEY WS		
BY: R. McArthur	DATE: 12/21/88	CHECKED BY	DATE	JOB NO.
SUBJECT: ESTIMATING FLOW CAPACITIES OF STRUCTURAL		SHEET ___ OF ___	

CROSS SECTIONS AFFECTING FLOW INTO SADDLEBACK FRS

CROSS SECTIONS ROUGHLY DETERMINED IN THE FIELD 12/21/88 BY McARTHUR & PAVLUS



(A)

$n = 0.045$

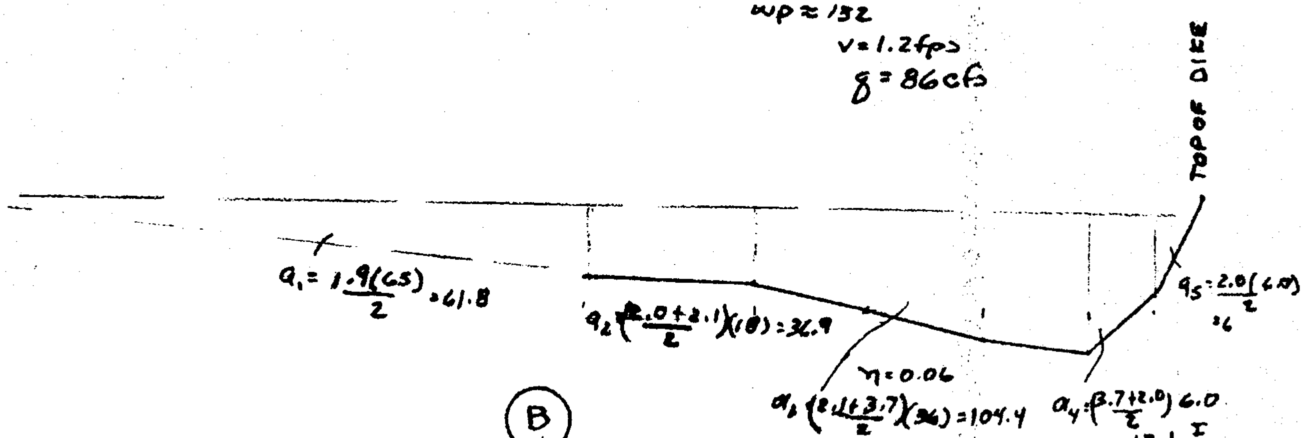
$S = \frac{0.3}{100} = 0.003$

$a_T = 71.6^{\square}$ $r = 0.54$

$wp \approx 132$

$v = 1.2$ fps

$Q = 86$ cfs



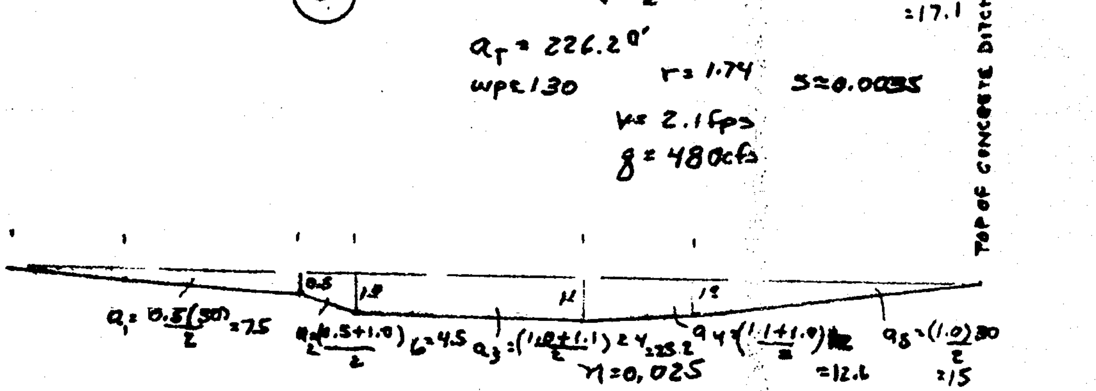
(B)

$a_T = 226.2^{\square'}$

$wp \approx 130$ $r = 1.74$ $S \approx 0.0035$

$v = 2.1$ fps

$Q = 480$ cfs



(C)

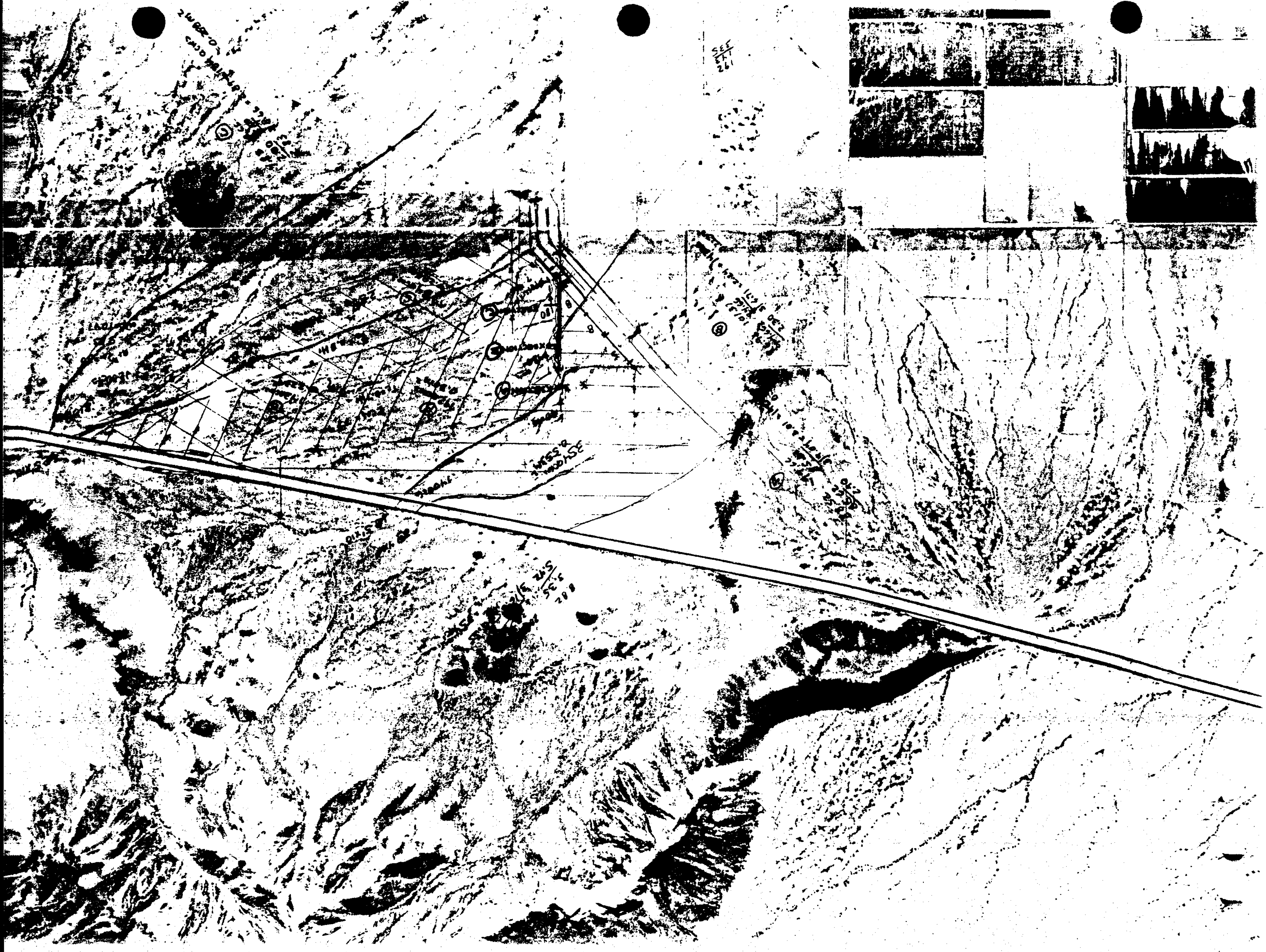
$S = \frac{0.4}{100} = 0.004$

$a_T = 64.8^{\square'}$ $r = 0.63$

$wp \approx 103$

$v = 2.8$

$Q = 179$, say 180 cfs



ARIZONA HARQUAHALA VALLEY WS

R. McArthur 12/22/88

ESTIMATES OF MAXIMUM FLOW THRU CULVERTS ALONG I-10 THAT MAY IMPACT STUDY AREA

GIVEN: Box culverts under I-10 that may impact study area; West of REST AREA
2 @ 4'x10' and 1 @ 5'x10'

FIND: With a max HW = 3+5 = 8' and assuming inlet control estimate maximum flow through culverts without road overflow.

HEC Circular No. 10, BPR

Chart 2 6'x4' $q = 265/6 = 44.2$ cfs/ft x 10 = 440 cfs

2 @ 440 cfs = 880 cfs

Chart 3 6'x5' $q = 310$ cfs$/6 = 51.7$ cfs/ft x 10 = 516 cfs

TOTAL FLOW THRU CULVERTS = 880 + 520 = 1400 cfs

with a land slope of 0.01%, $n = 0.04$, $q = 1400$ cfs

$a r^{2/3} = 380$

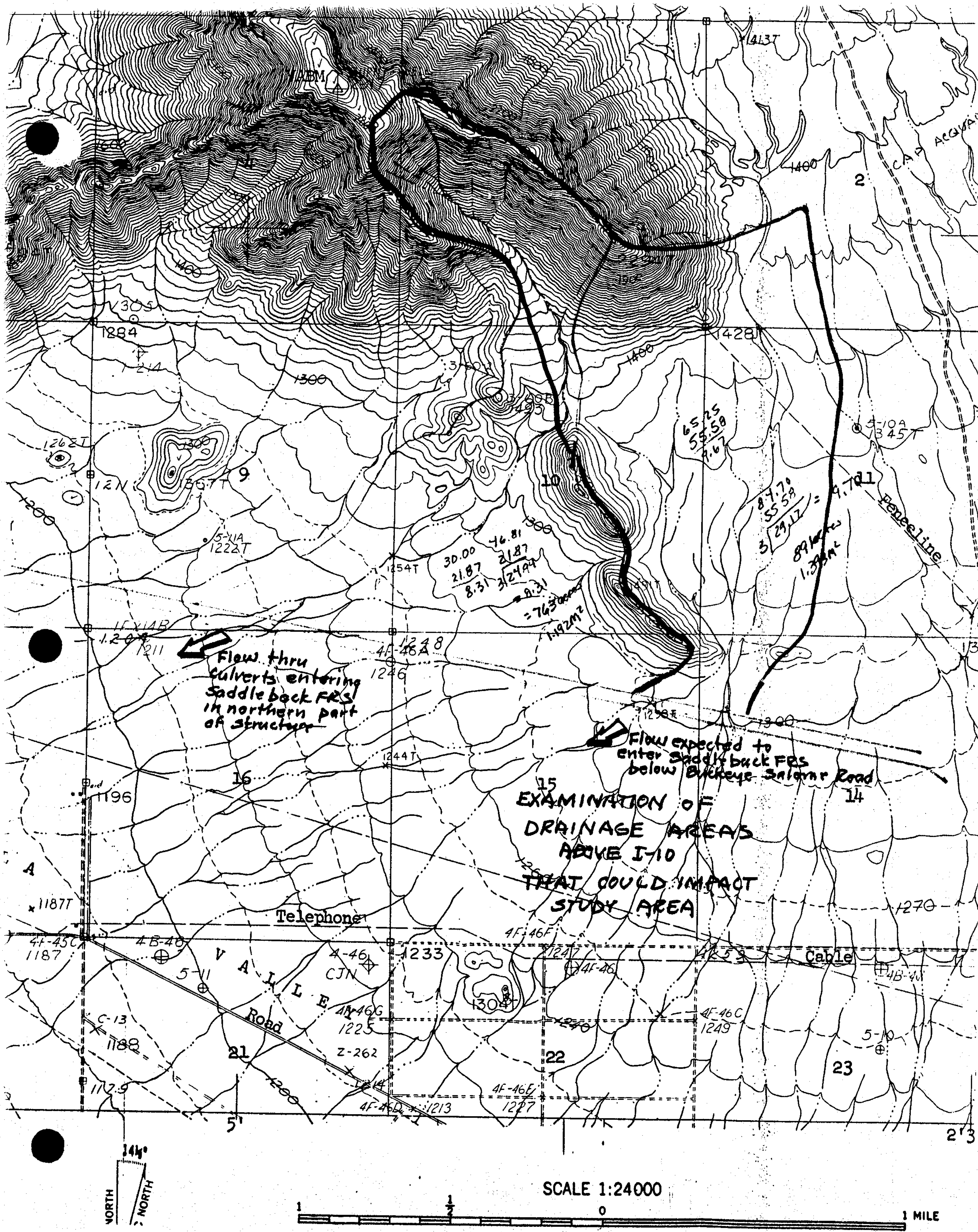
w/ $r \approx 1.0$ $a = 380$ wp = 380 Flood plain width
$r \approx 0.5$ $a = 600$ wp = 1200 " "

$r = \frac{a}{wp}$

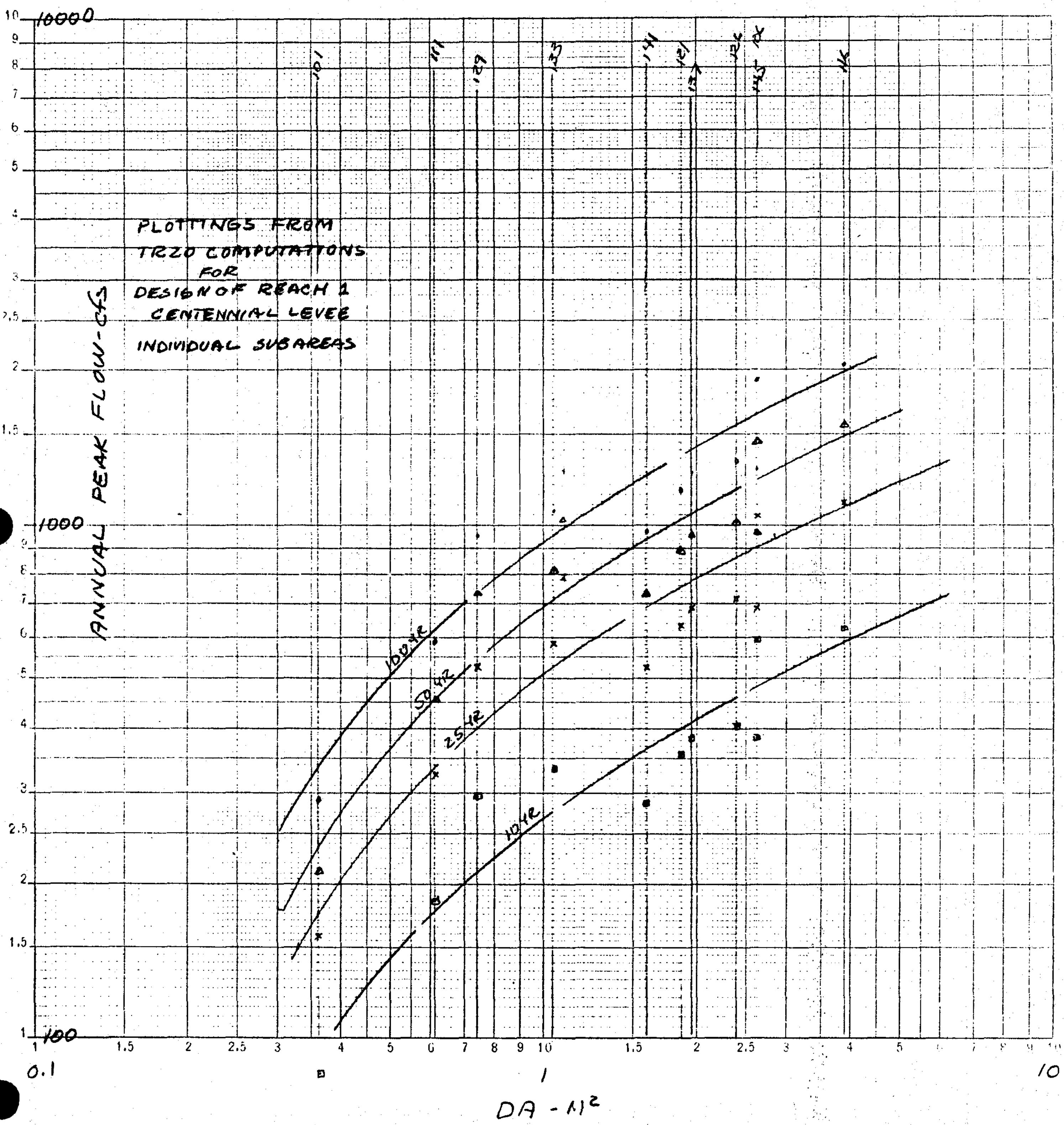
GIVEN: Box Culverts under I-10 to East of REST AREA that may impact study area
6 @ 5'x10' HW (max) = 3+5 = 8' w/o overtopping Rd

FIND: Maximum flow; approx flow width

HEC Circular 3 6'x5' = 310 cfs/6 = 51.7 x 10 = 516 cfs
Total flow 6 x 516 = 3096 cfs or 3100 cfs
with land slope = 0.01%, $n = 0.04$ $q = 3100$ $a r^{2/3} = 820$
w/ $r = 1.0$ $a = 820$ width 820
$r = 0.5$ $a =$ [illegible] width = 2600'



Flow thru culverts entering Saddleback FRS in northern part of structure
Flow expected to enter Saddleback FRS below Buckeye Salome Road
EXAMINATION OF DRAINAGE AREAS ABOVE I-10 THAT COULD IMPACT STUDY AREA
Telephone
Cable
Road
V A L L E Y
Fenceline
1.192 mi²
SCALE 1:24000
1 MILE
NORTH



PLOTTINGS FROM
TR20 COMPUTATIONS
FOR
DESIGN OF REACH 1
CENTENNIAL LEVEE
INDIVIDUAL SUBAREAS
ANNUAL PEAK FLOW-cfs
DA - MI²
10000
1000
100
0.1
1
10
100YR
50YR
25YR
10YR
101
111
129
133
141
121
137

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS.......... 1 (500 YR)	2 (100 YR)	3 (50 YR)	4 (25 YR)	5 (10 YR)	6 (5 YR)	7 (2 YR)
XSECTION 101	.36							
ALTERNATE 1		485.91	290.64	222.26	158.09	86.19	42.36	5.44
XSECTION 103	.36							
ALTERNATE 1		197.91	121.57	94.28	68.34	39.50	20.47	3.53
XSECTION 105	2.58							
ALTERNATE 1		1865.73	1148.48	887.69	640.64	369.79	188.62	29.94
XSECTION 106	2.63							
ALTERNATE 1		3189.79	1913.04	1465.88	1046.20	591.22	290.83	37.22
XSECTION 108	2.63							
ALTERNATE 1		1343.38	824.54	639.32	463.43	270.40	140.79	24.86
XSECTION 111	.61							
ALTERNATE 1		980.08	592.21	455.66	327.00	186.48	91.99	10.12
XSECTION 113	.61							
ALTERNATE 1		426.26	262.03	203.23	147.22	85.44	43.78	6.82
XSECTION 116	3.91							
ALTERNATE 1		3431.50	2048.32	1564.95	1112.33	624.73	306.69	44.88
XSECTION 118	3.91							
ALTERNATE 1		2422.07	1475.72	1139.48	821.20	473.70	242.27	40.18
XSECTION 121	1.86							
ALTERNATE 1		1953.65	1166.56	891.27	633.26	354.58	171.31	23.54
XSECTION 123	1.84							
ALTERNATE 1		1628.75	1022.77	787.09	564.44	321.45	160.31	23.14
XSECTION 125	.02							
ALTERNATE 1		24.76	.00	.00	.00	.00	.00	.00
XSECTION 126	2.37							
ALTERNATE 1		2220.42	1325.00	1012.28	719.53	404.12	198.66	28.35
XSECTION 127	2.39							
ALTERNATE 1		2220.42	1325.00	1012.28	719.53	404.12	198.66	28.35

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS.......... 1 (500YR)	2 (100YR)	3 (50YR)	4 (25YR)	5 (10YR)	6 (5YR)	7 (2YR)
XSECTION 128	2.39							
ALTERNATE 1		1821.78	1085.68	828.49	588.02	329.96	162.99	24.80
XSECTION 129	.74							
ALTERNATE 1		1595.10	959.46	735.89	525.46	296.00	140.86	15.84
XSECTION 131	4.97							
ALTERNATE 1		3603.64	2194.53	1681.90	1200.21	679.24	335.79	52.01
XSECTION 132	4.97							
ALTERNATE 1		2788.10	1678.83	1282.51	912.20	515.78	258.96	44.04
XSECTION 133	1.09							
ALTERNATE 1		1751.29	1058.22	814.22	584.31	333.21	164.37	18.09
XSECTION 134	5.00							
ALTERNATE 1		2682.48	1638.69	1269.44	919.18	535.43	278.18	49.02
XSECTION 135	9.97							
ALTERNATE 1		5382.60	3266.23	2509.74	1798.31	1025.70	523.06	90.22
XSECTION 136	9.97							
ALTERNATE 1		4353.71	2620.20	2008.10	1435.84	821.59	422.13	77.41
XSECTION 137	1.95							
ALTERNATE 1		2100.41	1255.92	960.32	683.08	383.23	184.37	24.69
XSECTION 138	2.56							
ALTERNATE 1		2202.91	1313.14	1002.04	710.69	432.22	214.90	31.21
XSECTION 139	12.53							
ALTERNATE 1		4966.65	3001.58	2306.23	1654.96	947.66	492.26	93.09
XSECTION 140	12.53							
ALTERNATE 1		4848.26	2926.66	2247.91	1612.30	924.28	480.58	91.48
XSECTION 141	1.56							
ALTERNATE 1		1619.43	966.00	737.52	523.43	287.76	141.03	19.62
XSECTION 142	4.21							
ALTERNATE 1		1833.88	1130.18	878.96	692.78	404.94	230.23	41.26

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS........... 1 (500 YR)	2 (100 YR)	3 (50 YR)	4 (25 YR)	5 (10 YR)	6 (5 YR)	7 (2 YR)
XSECTION 143	16.74							
ALTERNATE 1		6287.40	3809.15	2932.47	2078.42	1199.00	618.19	118.94
XSECTION 144	16.74							
ALTERNATE 1		6042.08	3651.55	2808.68	1999.73	1154.53	597.23	115.53
XSECTION 145	2.63							
ALTERNATE 1		2152.92	1281.79	971.78	689.54	386.68	190.86	28.42
XSECTION 146	2.99							
ALTERNATE 1		2195.93	1336.44	1021.04	726.01	408.87	208.89	31.61
XSECTION 147	19.73							
ALTERNATE 1		6627.80	4006.48	3086.86	2210.81	1283.87	669.48	132.36

ARIZONA SADDLEBACK DIVERSION SIDE INLET REPAIR
JMH 10-4-88
DEPTH OF SECTION FOR GROUTED ROCK 1

These inlets are being fashioned after those designed for EMF R-5 in 1986. The Reach 5 inlets have flowed two or three times since installation with no ill-side affects as of yet. They were designed as 12-inch thick sections placed on 3:1 side slopes into the channel. The net drop was approx. 9 feet. The designer based the design thickness on the Engineering Design Stds., Far West States, using Figure 1.7 for a class "C" channel, 12-inch thick concrete having an allowable velocity of 17.4 fps. He then used a water surface profile program to determine the flow velocities down the side inlets. The width of each inlet was increased as necessary with Q constant, H varying to reduce velocities to acceptable limits.

NEH SECTION 5 contains graphs of Mannings equation for slopes up to

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50%. (DWG ES-34 sheet 4)

Calculate max. velocity. Determine max. q based on 2 foot depth of weir. Least resistance is very wide weir where side slopes are negligible in hydraulic radius. This makes for worst condition, ie, max. velocity.

$$q = 3.1 (H)^{3/2} = 3.1(2)^{3/2} \doteq 9 \text{ cfs/ft}$$

Given: $S = 0.20$ (5:1)
$n =$ ~~0.03~~ 0.025 Alt { concrete = 0.018, RUBBLE = 0.033 }

$$9 = \frac{1.486}{.025} A R^{2/3} (.20)^{1/2}$$

$$AR^{2/3} = 0.339$$

By trial & error

y	A	R	$AR^{2/3}$
.5	.5	.5	0.315
.4	.4	.4	0.427
.52	.52	.52	0.336

∴ $y_n = 0.52$ ft

$$V = \frac{q}{A} = \frac{9}{.52} \approx 17.3 \text{ fps.}$$ OK

≤ 17.6

SOI

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As long as the weir flow depth is less than or equal to 2 feet, and (the side inlets are sized in width based on 9 cfs per foot) the velocities on the side inlets are within the acceptable limits of 17.6 Ft/sec on 12-inches of concrete as allowed by the EDS, Far West States.

The EMF Reach 5 side inlet design is acceptable for this site with minor adjustments. The original design of the side inlets for the Division consisted of a 24-inch deep section. During the site visit, it was observed the penetration of the grout into the 24-inch section was not complete. FOR CONTINUATION OF THIS DISCUSSION, SEE NEXT SHEET.

SADDLEBACK DIVERSION

JMH 10-4

GROUT ROCK RIPRAP GRADATION

The original design of the side inlets for the Diversion consisted of 24-inch thick grouted rock sections. During the site visit, it was observed that penetration of the grout into the 24-inch section was not complete. A review of the rock grading specification revealed that as much as 75% could be smaller than 6-inches and 50% could be smaller than 4-inches.

Experience has shown that penetration into rock this small is highly doubtful.

The EMF-Reach 5 specification allowed only 50% to pass the 6-inch size and allowed a <u>maximum</u> of 5% to be smaller than 3 inches. Confidence of the inspection staff in the 12-inch thick section ~~of this grade~~ was very high for this gradation.

ARIZ. Saddleback Diversion Repair

JMH 2-21-89

New Inlets - Location & Size

Sizing and locating the new side inlets involves looking at the whole system and applying judgement combined with a site inspection to evaluate the magnitude of the damage at each location.

There were 17 original inlets installed with the project. The February 1987 Engineering Report, page 8 discusses the close benefit-cost ratio as it impacted the design of these side inlets.

Careful review shows that there are varied reasons the side inlets failed as a whole. In an attempt to hold costs down, the number of inlets first installed was limited. This led to lengthy side channels that silted in and failed.

Another reason for failure are the large number of washes that intersected the diversion. The collector (or side) channels could not withstand the momentum of the water carried in the natural washes.

Some of the inlets were not aligned directly with the primary washes of each sub area. Again, the momentum of the water carried straight into the diversion.

A few of the very large washes split from one into two branches moving downstream. Due to the dynamics of the braiding action, it was impossible to determine which branch would carry what portion of any given storm.

Finally, the storm that occurred greatly exceeded the design storm by approximately 2 times the design flow.

This repair design expands the collector systems and provides additional inlets to those existing. Judgement must be excercised by viewing the whole system for locating and sizing the new inlets. There are areas where new very large inlets have been provided near large existing inlets which combined, provide excess capacity. However, directing the large quantity of water to the mis-aligned inlet would be more costly than simply installing a new inlet.

An indeterminate amount of water could be expected to flow thru the existing inlets via the collector system.

There are areas where an inlet should be provided for relatively low discharges, but a minimum size of 5 feet wide was used. This tends to skew the numbers by showing "over" design capacity although the 5 foot width will not cost significantly more to build than a one foot width and is more practical from a construction viewpoint.

The following sheets show excess capacity provided by the new plus the old inlets. The new inlet capacities were based on providing a minimum of 1/2 foot freeboard, and a maximum head of 2.5 feet.

Only Drainage Area 7A does not show any excess capacity. If freeboard was used, it would then have approximately 20 cfs excess capacity.

The rest of the drainage areas have from 10% to 50% capacity in excess of the peak discharges from the incremental drainage areas per the original design.

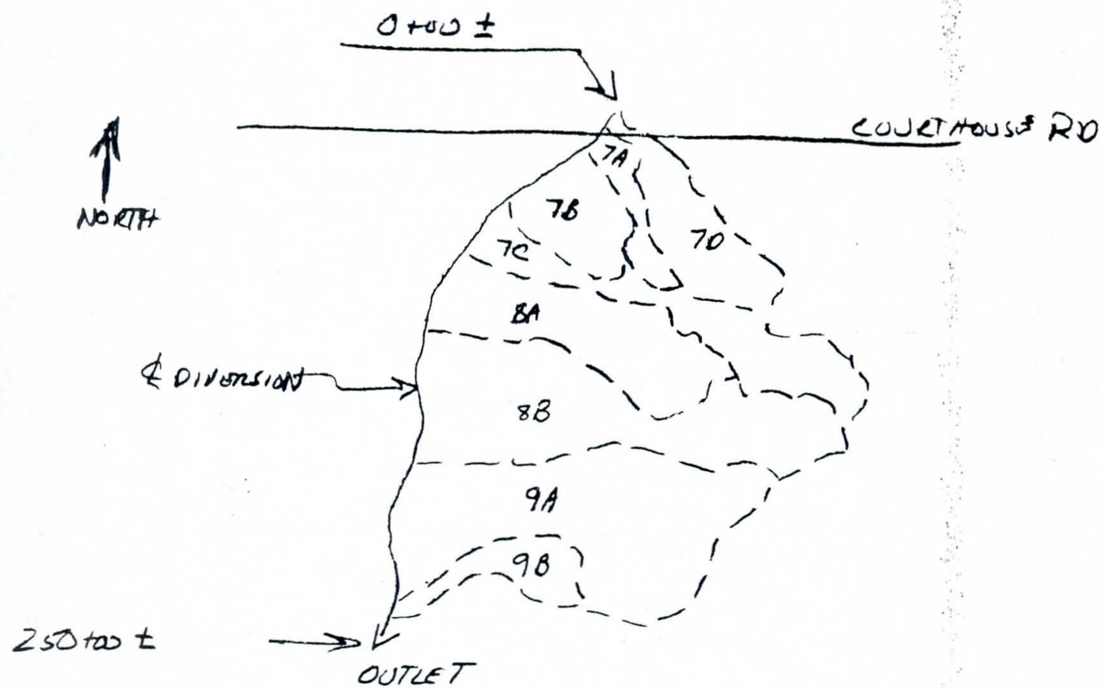
$$Q = 3.1\ W H^{3/2}$$

$$W = \text{width} + 2(\text{sideslope})$$

ARIZONA DIVERSION - SADDLEBACK

JMH 2-16-89

SUMMARY OF SIDE INLET LOCATIONS - FINAL



ORIG. INLETS	ORIG. DES. Q_{50}	D.A.	NEW INLETS IN D.A.
1	773	7D	NONE REQ'D
2	355	7A	#1
3	172	7B	#2 thru #5
4	182		
5	208		
6	177		
7	956	7C	#6 thru #9
8	150	8A	#10 thru #15
9	535		
10	535		
11	176	8B	#16 thru #21
12	797		
13	449		
14	147		
15	212	9A	#22 thru #27
16	790		
17	790		
18	437	9B	#28

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CHECK NEW SIDE INLET CAPACITIES VS. HYDROLOGY

INLET No.	W (Neglect Sides)	B	(WITH SIDES) Q DESIGN (MIN ½' Freeboard)	$3.1(2.5)^{3/2} = 12.25$ CLH^{3/2} (Neglect Sides)	ULTIMATE 2 = 10.45 2.5 = 14.1 $CL(H + \frac{V_a}{2g})^{3/2}$ $V_a = 4$, + (2F + L sides
1	10	2	H=1.5 74	88	125
2	5	2.5	H=2 79	61	99
3	5	2.5	2 79	61	99
4	5	2.0	1.5 45	44	73
5	10	2.5	2 123	122	169
6	10	2.5	2 123	122	169
7	10	2.5	2 123	122	169
8	10	2.5	2 123	122	169
9	50	2.5	2 473	612	733
10	5	2.5	2 79	61	99
11	5	2.5	2 79	61	99
12	45	2.5	2 430	551	662
13	5	2.5	2 79	61	99
14	10	2.5	2 123	122	169
15	5	2.5	2 79	61	99
16	5	2.5	2 79	61	99
17	10	2.5	2 123	122	169
18	45	2.5	2 430	551	662
19	15	2.5	2 167	183	240
20	45	3.0	2 430	724	853
21	5	2.5	2 79	61	99
22	10	2.5	2 123	122	169
23	5	2	1.5 45	44	73
24	50	3.5	2 473	1,015	1170
25	5	2.5	2 79	61	99
26	5	2.5	2 79	61	99
27	5	2.5	2 79	61	99
28	35	3.5	2.5 477	710	832

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DA and Corresponding Inlets

5

① D.A.	② PEAK Q FROM INCR. D.A. (ENG. REPORT-87)	③ EXISITING INLET CAP. As-Built	④ NEW INLET CAP (1/2 Ft. min Freeboard)	⑤ TOTAL INLET CAP ③+④		% OVER DESIGN
7A	355	#2 = 245	#1 = 74	324	⟨31⟩	⟨-8%⟩
7B	739	#3 = 140 #4 = 140 #5 = 158 #6 = 140	#2 = 79 #3 = 79 #4 = 45 #5 = 123	904	165	22%
7C	956	#7 = 447	#6 = 123 #7 = 123 #8 = 123 #9 = 473	1289	333	35%
8A	1220	#8 = 140 #9 = 447 #10 = 360	#10 = 79 #11 = 79 #12 = 430 #13 = 79 #14 = 123 #15 = 79	1816	596	49%
8B	1740	#11 158 #12 447 #13 272 #14 140	#16 79 #17 123 #18 430 #19 167 #20 430 #21 79	2325	585	33%
9A	1792	#15 184 #16 491 #17 447	#22 123 #23 45 #24 473 #25 79 #26 79 #27 79	2000	208	12%
9B	437	NONE	#28	477	40	9%

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JMH 2-21-89
FINAL INLET LOCATIONS

NEW SIDE INLET #1 STA 14+50

D.A. 7A

This inlet is aligned immediately downstream of existing inlet #2 at an area of severe erosion and a well defined wash in the D.A. The engineering report states #2 was undersized 80 cfs. New inlet No. 1 adds 125 cfs ultimate capacity.

NEW #2 & #3 STA 20+50, 31+15

New #2 was added because of the long distance between nearest 2 inlets (1600 feet) and erosion taking place at Drop Structure #1. The D.A. is approximately 14 acres so a minimum inlet size of 5 feet is sufficient.

Existing inlet #3 was undersized 32 cfs. New inlet #3 is located in an area of erosion approximately 200 feet downstream of existing #3. A new 5 foot inlet will again be sufficient.

D.A. 7.B

NEW #4 & #5 STA 41+30, 45+50

Existing #4 obtained severe damage. New Inlet #4 will be located adjacent to old #4 to increase its overall capacity.

New inlet #5 is aligned with a wash about 400 feet downstm of existing #4. Its D.A. is approximately 75 acres. From the graph on sheet 2 of the hydrology section, the most extreme Q for this D.A. is 160 cfs. A new 10 foot inlet has 169 cfs capacity.

NEW #6 STA 54+00

7C

Existing #5 was undersized 50 cfs. The D.A. to New #6 is approx. 65 acres. A 10 foot inlet aligned at the breach will be adequate.

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FINAL INLET LOCATIONS

7

7C

NEW #7 STA 64+00

Existing #6 was undersized 37 cfs. The D.A. for this inlet is very difficult to define. Existing #6 was not damaged (10 foot inlet) but severe erosion is located 300 feet downstream at 64+00. Another 10 foot inlet will be added here.

NEW #8 & #9 STA 69+00 & 72+00

The 1987 Engineering report recommends a new inlet with 500 plus cfs capacity at 72+00 because of a major wash that splits approx. 1 mile upstm.

New inlet #8 is in the same questionable D.A. as new #7 and is aligned with major breach, 10 feet wide.
New inlet #9 is a 50 foot wide inlet aligned with a wash and breach, capacity is 522 cfs with 1/2 foot freeboard.

8A

NEW #10 & #11 STA 88+50, 92+00

Existing #8 was severely damaged. New inlets #10, and #11 are aligned with 2 washes upstream of Existing #8. D.A. for #10 is approximately 30 acres, a minimum 5 foot inlet is adequate.

New #11 adds 100 cfs capacity to a wash about 200 feet upstm of existing #8.

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FINAL INLET LOCATIONS 8

NEW 12 & 13 STA 99+70 and 105+00

8A Existing inlet #9 was undersized 88 cfs. This is based on inlet #10 taking 1/2 the Flow of D.A. #9 was severely damaged, #10 recieved no damage. The engineering report states it would be impossible to determine the split between 9 and 10. New inlet #12 is aligned with a wash that is more defined than the location for existing #9. Severe gulleying 5 feet deep took place at 99+70. Existing #9 was a 45 foot inlet, so New #12 is also 45 feet.

New #13 is located at a breach upstream of existing #9, less than 10 acre D.A. so a minimum 5 foot inlet was used.

NEW #14 STA 112+00

At a breach between #9 & #10, less than 10 acres, 5 foot inlet.

NEW #15 STA 127+20

Existing #11 was undersized 18 cfs. A minimum 5 foot inlet aligned with breach 100 feet upstream will be sufficient.

NEW #16, #17, #18 STA 135+75, 148+00, 157+00

8B The distance between existing #11 and #12 is approximately 3,000 feet. Inlet #12 was damaged and erosion occured at approx. 500 foot intervals inbetween, at existing washes. Drop Structure No. 3 requires an extra measure of protection because of the relatively low east abutment. The diversion design WSP is slightly above the left bank in some places. Any side inlet installed below the WSP has the

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FINAL INLET LOCATIONS

potential to allow a significant amount of water out of the diversion channel into the collector system which would circumvent the drop structure and overload downstream inlets or breach the collector dike.

New inlet #16 was added and is unique from the other inlets in that its crest is higher than the collector channel invert. This prevents water from backing out of the diversion and releases water into the diversion as the collector system flow increases.

The majority of the water is carried by the collector system by drop structure No. 3 to new inlets 17 and 18. An extra foot of freeboard was added to the collector dike through this reach to protect drop structure No. 3.

8B

Existing Inlet #12 was not aligned with the primary wash. The best solution appears to be to add an identical inlet 100 feet upstream of #12. #12 and #13 come from a common wash almost 2 miles upstream. Both were damaged. New Inlets #18 and #20 will be built adjacent to #12 and #13 and more than double the original design capacity.

NEW INLET 19 STA 164+80

#19 is a 15 foot inlet (Q = 240 cfs). Combined with the collector system and the two new large inlets about 500 feet each direction, this Q = 240 plots in the middle of the graph of D.A. vs Q on page 2 of hydrology for 125 acres.

AZ SDI
JMH 2-21-89
FINAL INLET LOCATIONS 10

8B

NEW INLET #20 STA 169+00

Discussed somewhat with New Inlet #18. Existing #13 is 200 feet downstream of the major wash where new #20 will be located. Due to the unpredictable split between #18 and #20, another 45 foot inlet was used. Inlet #20 has an extra 1/2 foot freeboard due to the inlet being approximately 1/2 foot below the collector channel invert.

NEW INLET #21 STA 174+50

Existing inlet #14 was undersized slightly. New #21 aligned with a breach as a minimum 5 foot inlet will suffice.

9A

NEW INLET #22 STA 183+00

Existing inlet #15 was undersized 30 cfs. #15 is a 15 foot wide inlet. Alignment with the actual wash is 50 feet upstream. A ten foot inlet aligned with wash with a collector dike to allow existing inlet to function as over flow will be provided.

NEW INLET #23 STA 190+00

Aligned with a breach and a small D.A., a 5 foot inlet will handle.

NEW INLET #24 STA 200+00

Existing #16 missed the main wash by 200 feet. Inspection at site shows that an identical inlet is obviously needed at the wash. 50 wide.

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FINAL INLET LOCATIONS

11

9A

NEW #25 STA 207+50

Aligned with a breach in a relatively flat area of braided washes, small D.A. Minimum 5 foot inlet used.

NEW #26 STA 218+00

Aligned with a breach, similar to New #25.

NEW #27 STA 231+50

From 226+00 to 231+00, series of minor rills and erosion. Collector system and a minimum 5 foot inlet will cure.

9B

NEW #28 STA 241+50

No inlet was installed downstream of drop structure No. 4. Designer evidently planned for Diversion Swale to Daylight in this area which did not happen. 1987 Engineering report recommends an inlet be provided. The D.A. is 0.43 sq. mi. Original design showed Q of 437 cfs. The inlet provided has a capacity of 430 cfs with 1 foot of freeboard.

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JMH 12-6-88

Saddleback DIV. REPAIR

VERY GENERAL CHECK INLET CAPACITY
COMPARISON BEFORE/AFTER REPAIR

The original design provided 16 inlets having a combined total width of 461 Feet. The original hydrology estimated 4,940 total cfs from the diversion watershed. Plugging into the Formula

$$Q = 3.1\, w\, h^{3/2}$$

$$h = \left[\frac{Q}{3.1(w)}\right]^{2/3} \qquad w = w + 3(d)$$

$$h = \left[\frac{4940}{3.1(461+16(\omega))}\right]^{2/3} = 2.01 \text{ Feet.}$$

With the additional inlets provided by this design, total $w = 896$ feet for 45 inlets

$$h = 1.23 \text{ Feet.}$$

Above is assuming all inlets flowing at exactly the same depth of course. But this shows that before, the inlets were theoretically slightly undersized with no freeboard or reserve capacity, whereas now they have approximately 3/4 Foot freeboard capacity.

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JMH 1-17-89

FRS- Earthfill Borrow Source

Stockpile north of Salome Rd, east (outside) of Fence line.

Talked with Ralph Arrington and John Sullivan. They believe it to be an earth material spoil area. Should not be contaminated with debris such as clearing and grubbing material.

Talked with Tom Sayo on phone, who was Govt. Rep. on this A&E contract. He recollects it as an excess rock pile.

Approximate volume of pile from As-Builts:

300' × 500' × 4' Deep ÷ 27 = 22,000 CY.

→ Visited site about February 1, spoil field <u>is</u> suitable material for earthfill.

A2

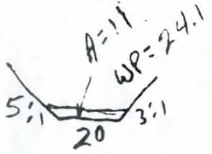
JMH 12-2-88

Saddleback Diversion Repair

Collector ditch velocity

A review of the geological data and conditions at the site reveal that much of the collector ditches are located in a moderately to strongly indurated caliche stratum. The function of the collector ditches are to collect local drainage and direct them to the side inlets. These flows are considered to be very minor and a small amount of erosion can be tolerated. The O&M plan ~~att~~ requires inspection of the collector system for unraveling of the toe of slopes and possible maintenance re-grading.

The collector ditches are generally on grades less than 0.005. Using an $n = 0.03$ ($n = 0.025$), width of 20 feet and flow depth of 6-inches, $Q = 23$ cfs, $V \approx 2$ fps.



if n = ...
$Q = 27$
$V \leq 2.5$

From EDS, Far West states, this velocity corresponds to a d_{75} of about 3mm to 5mm. From Toups design report for the original project, 9 soil samples between station 34+00 to 197+00, obtained following d_{75}: 8.4 mm, 6.5mm, 14mm, 4.75mm, 110 mm, 6.4 mm, 3.2 mm, 16 mm, 76.2 mm.

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JMH 12-2-88

Collector ditch velocity 2

Using a d_{75} of 6.5 mm, straight channel, Flowing less than 1.0 feet deep

$$\text{Permissible Velocity} = A_e B_e C_e$$
$$= 3.0(0.8)(1.0)$$
$$= 2.4 \text{ Fps} \quad \underline{OK}$$

Because of caliche and armoring that will take place, the permissible velocity should be somewhat higher than 2.4 Fps.

CONSTRUCTION SPECIFICATION

Harquahala Valley Watershed
Saddleback Diversion Side Inlet Repair

SPECIFICATION NO.	PAGES
2	1 to 2
3	1 to 3
5	1 to 3
7	1 to 4
8	1 to 2
10	1 to 3
11	1 to 3
21	1 to 6
23	1 to 9
62	1 to 6
94	1 to 6
522	1
523	1
531	1
532	1
533	1
534	1
591	1 to 2

CONSTRUCTION SPECIFICATION

2. CLEARING AND GRUBBING

1. SCOPE

The work shall consist of the clearing and grubbing of designated areas by removal and disposal of trees, snags, logs, stumps, shrubs and rubbish.

2. MARKING

The limits of the areas to be cleared and grubbed will be marked by means of stakes, flags, tree markings or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

3. REMOVAL

All trees not marked for preservation and all snags, logs, brush, stumps, shrubs and rubbish shall be removed from within the limits of the marked areas. Unless otherwise specified, all stumps, roots and root clusters having a diameter of one inch or larger shall be grubbed out to a depth of at least two feet below subgrade elevation for concrete structures and one foot below the ground surface at embankment sites and other designated areas.

4. DISPOSAL

All materials removed from the cleared and grubbed areas shall be burned or buried at locations shown on the drawings or as specified in Section 6 of this specification.

5. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the length of the cleared and grubbed area will be measured to the nearest full station (100 feet) along the line designated on the drawings or in the specifications. Payment for clearing and grubbing will be made for the total length within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

6. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 1, Clearing and Grubbing

(1) This item shall consist of clearing and grubbing within the limits of the diversion and FRS as shown on the drawings and staked in the field.

(2) In Section 4, Disposal, waste materials shall be disposed in the waste areas shown on the drawings.

(3) Upon completion of disposal, the waste areas shall be graded in a manner which will result in finished surfaces similar to those that exist prior to construction.

(4) Measurement for payment will be based on the centerlines of the existing diversion channel and the drainage channel. Measurement and payment will include compensation for Subsidiary Item, Stucture Removal.

CONSTRUCTION SPECIFICATION

3. STRUCTURE REMOVAL

1. SCOPE

The work shall consist of the removal, salvage and disposal of structures (including fences) from the designated areas.

2. MARKING

Method 1 Each structure unit to be removed will be marked by means of stakes, flags, painted markers or other suitable methods.

Method 2 The limits of the areas from which structures must be removed will be marked by means of stakes, flags or other suitable methods. Structures to be preserved in place or salvaged will be designated by special markings.

3. REMOVAL

Method 1 All structures designated in the contract for removal shall be removed to the specified extent and depth.

Method 2 Within the areas so marked all visible structures and attachments and all buried structures located and identified by survey stakes shall be removed to the specified extent and depth.

4. SALVAGE

Structures that are designated to be salvaged shall be carefully removed and neatly placed in the specified storage areas. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly match marked with paint prior to disassembly. All pins, nuts, bolts, washers, plates and other loose parts shall be marked or tagged to indicate their proper locations in the structure and shall be fastened to the appropriate structural member or packed in suitable containers. Materials from fences designated to be salvaged shall be placed outside the work area on the property from which they were removed. Wire shall be rolled into uniform rolls of convenient size. Posts and rails shall be neatly piled.

5. DISPOSAL OF REFUSE MATERIALS

Refuse materials resulting from structure removal shall be burned or buried at location shown on the drawings or as specified in Section 7 of this specification.

6. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Structure Removal

(1) This item shall consist of:

(a) the removal of the concrete lined irrigation ditchs and abandoned gas line within the construction limits along the FRS drain channel.

(b) the removal and replacement of the barbed wire fences at the cattle crossings in the construction areas at the diversion and to access the borrow source and waste area for the FRS.

(2) Fence materials damaged or otherwise unsuitable for reconstruction of the fences shall be replaced by the Contractor and shall conform to the requirements of Material Specification 591.

(3) Refuse materials shall be buried a minimum of 24-inches in the designated refuse area shown on the drawings.

(4) No separate payment will be made for structure removal. Compensation for structural removal will be included in payment for Bid Item 1, Clearing and Grubbing.

CONSTRUCTION SPECIFICATION

5. POLLUTION CONTROL

1. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air during construction operations in accordance with these specifications.

2. MATERIALS

All materials furnished shall meet the requirements of the Material Specifications listed in Section 8 of this specification.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The work and measures shall include but not be limited to the following, as shown on the drawings or as specified in Section 8 of this specification.

Staging of Earthwork Activities - The excavation and moving of soil materials shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.

Seeding - Seedings to protect disturbed areas shall be as specified on the drawings or in Section 8 of this specification.

Mulching - Mulching shall be used to provide temporary protection to soil surfaces from erosion.

Diversions - Diversions shall be used to divert water away from work areas and/or to collect runoff from work areas for treatment and safe disposition.

Stream Crossings - Culverts or bridges shall be used where equipment must cross streams.

Sediment Basins - Sediment basins shall be used to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.

Straw Bale Filters - Straw bale filters shall be used to trap sediment from areas of limited runoff. Bales are temporary and shall be removed when permanent measures are installed.

Waterways - Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of chemical pollutants (such as drained lubricating or transmission oils, greases, soaps, asphalt, etc.) produced as a by-product of the project's work. At the completion of the construction work, sumps shall be voided without causing pollution as specified in Section 8 of this specification.

Sanitary facilities such as pit toilets, chemical toilets, or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. At the completion of construction work, facilities shall be disposed of without causing pollution as specified in Section 8 of this specification.

5. AIR POLLUTION

Local and state regulations concerning the burning of brush or slash or disposal of other materials shall be adhered to.

Fire prevention measures shall be taken to prevent the start or the spreading of fires which result from project work. Fire breaks or guards shall be constructed at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated fully suppress dust.

6. MAINTENANCE, REMOVAL ,AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as nearly to original conditions as practicable.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Pollution Control

(1) This item shall consist of all work and materials required to control or reduce pollution within the work areas.

(2) The Contractor is required to adhere to all applicable local, state and federal laws and regulations pertaining to the control of pollution as may result from construction of this project.

(3) The Contractor is responsible for maintaining air, water, and vegetative quality within the work area. Methods include:

(a) Establishing turn areas, haul roads, work site access roads, temporary building sites, and equipment yards in approved locations, and staging earthwork activities to prevent contamination of air and water, to minimize erosion.

(b) Operating mechanized equipment at the job site in a manner that will avoid destruction or removal of trees and shrubs unless necessary for construction of the measure.

(4) In Section 4, Chemical Pollution, no chemical pollutants such as drained lubricating or transmission oils, greases, soaps, asphalt, etc., shall be disposed of at the site.

(5) No separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Item 5, Channel Excavation, Common.

CONSTRUCTION SPECIFICATION

7. ENGINEERING CONSTRUCTION SURVEYS

1. SCOPE

The work consists of performing all surveys required for (1) layout of the work, (2) construction control, and (3) quantity surveys for progress payment estimates from baselines and bench marks established by the Government. It includes furnishing all the necessary equipment, labor, and materials. Not included is work required for making the original and final surveys for computing quantities.

2. EQUIPMENT AND MATERIALS

Equipment used for all construction surveys shall be of a quality and condition that provides the specified accuracy. The equipment shall be maintained in good working order and good adjustment. Records of calibration tests and adjustments shall be maintained and be available for inspection by the Government

Materials include all the necessary field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and other accessories required for layout and construction control of all of the work.

3. QUALITY OF WORK

Surveys shall be certified by a Land Surveyor or Engineer licensed by the State. The work shall be perfromed to the accuracy and detail appropriate for the location and type of job. Daily quantities of earthwork may be estimated from load count or equivalent measurement (within 25 percent ±); measurement for progress payments should be accurate within 10 percent ±/

Notes, sketches, and other data shall be complete, recorded neatly, and organized in a manner that will allow reproduction of copies for job documentation.

Differential leveling shall be third order with such precision that the error of closure (in feet) shall not exceed plus or minus 0.1 times the square root of the distance (in miles). The elevations of bench marks and temporary bench marks shall be determined and recorded to the nearest 0.01 foot.

Transit traverses shall be third order with such precision that; (1) the linear error of closure shall not exceed one foot in 3,000 feet, and (2) the angular error of closure shall not exceed 1.0 minute times the square root of the number of angles turned.

Surveys will be reviewed periodically and randomly checked by the Government to assure that the specified quality is being maintained.

4. PRIMARY CONTROL

The base lines and bench marks for primary control, which are necessary to establish the lines and grades needed for construction, will be established by the Government. They will be shown on the drawings and located on the ground before construction.

The base lines and benchmarks shall be used as the origin of all surveys needed to establish lines and grades for construction.

5. CONSTRUCTION SURVEY AND MEASUREMENT RECORDS

All survey data will be recorded in fully identified, bound field notebooks, Pages shall ne numbered consecutively. The required books shall be turned over to and become the property of the Government, prior to acceptance of the work or any part of this work. All entries shall be legible, reproducible, and follow the format in Soil Conservation Service TR-62, "Engineering Layout, Notes, Staking and Calculations." The bound field note books shall be available at all times during the progress of the work for examination and use by the Government. Copies of field book notes shall be made available to the Contracting Officer upon request. Electronically generated survey data and computations shall be bound, paginated, and referenced in the bound field notebook containing the survey control in a manner that will make all of the information intelligible and permanent. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, the weather (if field work), the individual or individuals who performed and checked the work and sketches and other information pertinent to the work.

6. STAKING

The location and marking of all stakes shall be as shown in Soil Conservation Service TR-62 as supplemented below.

a. Clearing and grubbing - The boundary of the clearing and grubbing areas shall be staked or flagged at 200-foot intervals or less if needed to clearly mark the limits of work.

b. Excavation - Cut stakes shall be placed on the centerline at the intersection of the planned side slopes and natural ground line. All slope stakes shall be marked with the required cut, horizontal distance, and slope ratio. Offset reference stakes and hubs shall be placed at full stations, on at least one side of the proposed excavation.

c. Earth Fill - Fill stakes shall be placed on the centerline and at the toes of the planned slopes and shall be marked with the fill, horizontal distance, constucted slope ratio, and stationing. Offset reference stakes and hubs shall be provided as a minimum on both sides of the fill at full stations.

Earthwork slope stakes shall be placed as a minimum at full stations, break in the original ground surface, and at other intermediate stations as necessary to insure accurate location of construction. Slope stakes and cross sections shall be at right angles to the centerline. Distances shall be measured horizontally; rod readings shall be taken vertically and recorded to the nearest 0.1 foot.

7. MEASUREMENT AND PAYMENT

Payment will be made as the work proceeds, after receipt of invoices from the contractor showing (contractor or subcontractor) surveying costs and cost of supplies. If the total of incremental payments is less than the contract lump sum for surveys, the balance will be included in the final contract payment. Total payment will be the contract lump sum price for surveys, regardless of actual cost to the contractor.

Payment will not be made under this item for the purchase cost of materials and equipment having a residual value.

Payment of the contract lump sum price for surveys will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the item to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 2, Survey

(1) This item shall consist of furnishing personnel, equipment, materials and performing surveys required for :

(a) Construction Layout
(b) Computation of quantities for progress and final payments.
(c) "As-Built" Construction Drawings

(2) Section 1, Scope, the last sentence does not apply.

(3) The Contractor shall provide the Contracting Officer a statement of qualifications, including specific experience of the survey personnel assigned to the job.

(4) The Contractor shall provide the Contracting Officer with a monthly schedule of surveys to be performed.

(5) Monuments damaged by the Contractor which are outside of the channel excavation limits will be replaced by the government at the Contractor's expense. The actual cost to the government for replacing the monuments will be deducted from the payment due the Contractor.

CONSTRUCTION SPECIFICATION

8. MOBILIZATION

1. SCOPE

The work shall consist of the mobilization of the Contractor's forces and equipment necessary for performing the work required under the contract. Mobilization will not be considered as work in fulfilling the contract requirement for commencement of work.

Mobilization shall include the cost for transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities as the site not covered in specific bid items, and other pereparatory work at the site. The cost of the entire amount of premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable shall be paid upon request when evidence of full payment to the surety has been provided to the Contracting Officer.

Work done under this specification shall not include mobilization for any specific item of work for which payment for mobilization is provided elsewhere in the contract.

The specification covers mobilization for work required by the contract at the time of award. If additional mobilization costs are incurred during performance of the contract as a result of changed or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

2. PAYMENT

Payment will be made as the work proceeds, after presentation of invoices by the Contractor showing his own mobilization costs and evidence of the charges of suppliers, subcontractos, and others for mobilization work performed by them. If the total of such payments is less than the contract lump sum for mobilization, the unpaid balance will be included in the price final contract payment. Total payment will be the lump sum contract price for mobilization, regardless of actual cost to the Contractor.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

Payment of the lump sum contract price for mobilization will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of the work.

3. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 3, Mobilization

(1) This item shall consist of the mobilization of the Contractor's equipment and forces for the construction of the project as shown on the drawings and contained in the specifications.

CONSTRUCTION SPECIFICATION

10. WATER FOR CONSTRUCTION

1. SCOPE

The work shall consist of furnishing, transporting, and using water for construction purposes in accord with the applicable specifications.

2. FACILITIES AND EQUIPMENT

The Contractor shall build and maintain such access and haul roads as are needed, and shall furnish, operate, and maintain all pumps, piping, tanks, and other facilities needed to load, transport, and use the water as specified.

These facilities shall be equipped with meters, tanks, or other devices by which the volume of water supplied can be measured.

3. DUST ABATEMENT AND HAUL ROAD MAINTENANCE

Water for dust abatement and haul road maintenance shall be applied to haul roads and other dust-producing areas as needed to prevent excessive dust and to maintain the roads in good condition for efficient operation while they are in use.

4. EARTHFILL, DRAINFILL, ROCKFILL

Water for earthfill, drainfill, or rockfill shall be used in the fill materials as specified in the applicable construction specifications.

5. CONCRETE, MORTAR, GROUT

Water used in mixing or curing concrete, pneumatically applied mortar, or other portland cement mortar or grout shall meet the requirements of the applicable construction specifications and shall be used in conformance with those specifications. Payment for water used in these items is covered by the applicable concrete, mortar or grout specification.

6. MEASUREMENT AND PAYMENT

For water items for which specific unit prices are established in the contract, the volume of water furnished and used in accordance with the specifications will be measured to the nearest 1000 gallons.

Except as otherwise specified, the measurement for payment will include all water needed at the construction site, except as noted in Section 5, to perform the work required under the contract in accordance with the specifications but will not include water wasted or used in excess of the amount needed. It will not include water used in concrete which is mixed elsewhere and transported to the site.

Payment for water will be made at the contract unit price. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to furnishing, transporting, and using the water.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 4, Water

(1) This item shall consist of furnishing and applying all water necessary for performance of the work described in this contract.

(2) Water may be purchased from the Harquahala Irrigation District, telephone number 602/372-4791.

(3) Measurement and payment will be based on metered quantity of water and/or load counts of water pulls and trucks with rating capacity certifications. Accuracy of meters shall be checked and certified to plus or minus 2 percent of actual flow within normal flow range. All certifications shall be submitted to the Contracting Officer at least seven (7) days prior to their use.

CONSTRUCTION SPECIFICATION

11. REMOVAL OF WATER

1. SCOPE

The work shall consist of the removal of surface water and ground water as needed to perform the required construction in accordance with the specifications. It shall include (1) building and maintaining all necessary temporary impounding works, channels, and diversions, (2) furnishing, installing and operating all necessary pumps, piping and other facilities and equipment, and (3) removing all such temporary works and equipment after they have served their purposes.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, flumes, sumps, and other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site and away from the construction work while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainage way in which its headworks are located.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for diverting surface water before beginning the construction work for which the diversion is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches and other parts of the construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps, casings, wellpoints, and other equipment needed to perform the dewatering as specified. Dewatering methods that cause a loss of fines from foundation areas will not be permitted.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer in writing, his plan for dewatering before beginning the construction work for which the dewatering is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

4. DEWATERING BORROW AREAS

Unless otherwise specified in Section 8, the Contractor shall maintain the borrow areas in drainable condition or otherwise provide for timely and effective removal of surface and ground waters that accumulate within the borrow areas from any source. Borrow material shall be processed as necessary to achieve proper and uniform moisture content for placement.

If pumping to dewater borrow areas is included as an item of work in the bid schedule, each pump used for this purpose shall be equipped with a water meter in the discharge line. Accuracy of the meters shall be such that the measured quantity of water is within 3 percent, plus or minus, of the true quantity. Means shall be provided by the Contractor to check the accuracy of the water meters when requested by the Contracting Officer.

5. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized.

6. REMOVAL OF TEMPORARY WORKS

After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required to present a sightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

Except as otherwise specified, pipes and casings shall be removed from temporary wells and the wells shall be filled to ground level with gravel or other material approved by the Contracting Officer.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

8. <u>ITEMS OF WORK AND CONSTRUCTION DETAILS</u>

Items of work to be performed in conformance with this specification and the construction details are:

a. <u>Subsidiary Item, Removal of Water</u>

(1) This item shall consist of the temporary diversion of surface water and dewatering of the construction site during the construction period.

(2) No separate payment will be made for removal of water. Compensation for Removal of Water will be included in Bid Item 5, Channel Excavation, Common; Bid Item 6, Structure Excavation, Common; and Bid Item 7, Sediment Removal, Common.

CONSTRUCTION SPECIFICATION

21. EXCAVATION

1. SCOPE

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. CLASSIFICATION

Excavation will be classified as common excavation or rock excavation in accordance with the following definitions or will be designated as unclassified.

Common excavation shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded on to hauling equipment by means of excavators having a rated capacity of one cubic yard and equipped with attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation.

Excavation will be classified according to the above definitions by the Engineer, based on his judgment of the character of the materials and the site conditions.

The presence of isolated boulders or rock fragments larger than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

For the purpose of this classification, the following definitions shall apply:

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of 200-300 net horsepower (at the flywheel).

Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of 12-20 yards.

Pusher tractor shall be defined as a track type tractor having a power rating of 200-300 net horsepower (at the flywheel) equipped with appropriate attachments.

3. UNCLASSIFIED EXCAVATION

Items designated as "Unclassified Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed. When excavation is unclassified, none of the definitions or classifications stated in Section 2 of this specification shall apply.

4. BLASTING

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations.

Blasting shall be done in such a way as to prevent damage to the work or unnecessary fracturing of the foundation and shall conform to any special requirements in Section 12 of this specification.

5. USE OF EXCAVATED MATERIALS

To the extent they are needed, all suitable materials from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitablity of materials for specific purposes will be determined by the Engineer. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

6. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the location shown on the drawings.

7. BRACING AND SHORING

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workers, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

8. STRUCTURE AND TRENCH EXCAVATION

Structure or trench excavation shall be completed to the specified elevations and to sufficient length and width to include allowance for forms, bracing and supports, as necessary, before any concrete or earthfill is placed or any piles are driven within the limits of the excavation.

9. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fills, additional materials shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as directed by the Engineer.

Borrow pits shall be excavated and finally dressed in a manner to eliminate steep or unstable side slopes or other hazardous or unsightly conditions.

10. OVEREXCAVATION

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the Engineer. Concrete that will be exposed to the atmosphere when construction is completed shall contain not less than 6 sacks of cement per cubic yard of concrete. Concrete that will be permanently covered shall contain not less than 4.5 sacks of cement per cubic yard. The concrete shall be placed and cured as specified by the Contracting Officer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved compacated earthfill, except that, if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding or drainfill.

11. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Regardless of quantities excavated, the measurement for payment will be made to the specified pay limits, except that excavation outside the specified lines and grades directed by the Engineer to remove unsuitable material will be included. Excavation required because unsuitable conditions result from the Contractor's improper construction operations, as determined by the Contracting Officer will not be included for measurement and payment.

The pay limits shall be defined as follows:

a. The upper limit shall be the original ground surface as it existed prior to the start of construction operations except that where excavation is performed within areas designated for previous excavation or fill the upper limit shall be the modified ground surface resulting from the specified previous excavation or fill.

b. The lower and lateral limits shall be the neat lines and grades as shown on the drawings.

Payment for each type and class of excavation will be made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all equipment, and all other items necessary and incidental to the performance of the work, except that extra payment for backfilling overexcavation will be made in accordance with the following provisions:

Payment for backfilling overexcavation, as specified in Section 10 of this specification, will be made only if the excavation outside specified lines and grades is directed by the Engineer to remove unsuitable material and if the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 12 of this specification.

12. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 5, Channel Excavation, Common

(1) This item shall consist of all excavation required to construct the collector channels as shown on the drawings and staked in the field.

(2) Measurement and payment will include compensation for Subsidiary Items, Removal of Water, and Pollution Control.

b. Bid Item 6, Structure Excavation, Common

(1) This item shall consist of all excavation required to construct side inlet structures, as shown on the drawings and staked in the field.

(2) Measurement and payment will include compensation for Subsidiary Item, Removal of Water.

c. Bid Item 7, Sediment Removal, Common

(1) This item shall consist of all excavation required to remove the sediment deposits in the diversion channel within the limits shown on the drawings.

(2) Section 5, Use of Excavated Material, does not apply. The sediment is considered unsuitable for earthfill material and shall be disposed of in the waste areas shown on the drawings.

(3) Measurement and payment will include compensation for Subsidiary Item, Removal of Water.

d. Subsidiary Item, Borrow Excavation, Common

(1) This item shall consist of all excavation required to complete Bid Item 8, Earthfill; Bid Item 9, Structure Backfill; and Bid Item 10, Slope Repair, after all suitable materials from Bid Item 5, Channel Excavation and Bid Item 6, Structure Excavation have been depleted.

(2) Borrow material may be obtained by extending the collector channels as shown on the drawings and approved by the Contracting Officer.

(3) Finished borrow areas shall drain to the side inlets.

(4) Borrow material taken from existing spoil fields shall be removed in uniform layers not exceeding one foot in depth unless otherwise approved by the Contracting Officer. Upon completion, the spoil fields shall be graded in a manner which will result in finished surfaces similar to those that existed prior to construction.

(5) No separate payment will be made for this item. Compensation for this item will be included in Bid Item 8, Earthfill; Bid Item 9, Structure Backfill; and Bid Item 10, Slope Repair.

CONSTRUCTION SPECIFICATION

23. EARTHFILL

1. SCOPE

The work shall consist of the construction of earth embankments and other earthfills required by the drawings and specifications.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Engineer.

Fill materials shall contain no sod, brush, roots or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill.

The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

3. FOUNDATION PREPARATION

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earthfill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of two inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to effect a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose materials by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be not steeper than 1 horizontal to 1 vertical unless otherwise specified. Test pits or other cavities shall be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill shall not be placed upon a frozen surface, nor shall now, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exeed the maximum thickness specified. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of fill compacted by manually directed power tampers.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill in dams, levees and other structures designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

b. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

c. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of approximately 2 percent shall be maintained to insure effective drainage, and except as otherwise specified, for drainfill or sectional zones.

d. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are specifically authorized in the contract.

e. Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification, and shall be scarified, moistened and recompacted when the new fill is placed against it as needed to insure a good bond with the new fill and to obtain the specified moisture content and density at the contact of the in place and new fills.

5. CONTROL OF MOISTURE CONTENT

During placement and compaction of fill, the moisture content of the Materials being placed shall be maintained within the specified range.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet when deposited on the fill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

6. COMPACTION

Earthfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the protion of the fill material finer than the maximum particle size used in the compaction test method specified.

Class B comapction. Each layer of fill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction. Each layer of fill shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified, or by an approved equivalent method. Each pass shall consist of at least one passage of the roller wheel or drum over the entire surface of the layer.

Fill adjacent to strutures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping, or manually directed power tampers or plate vibrators. Unless otherwise specified, heavy equipment including backhoe mounted power tampers, or vibrating compactors and manually directed vibrating rollers, shall not be operated within 2 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

The passage of heavy equipment will not be allowed: (1) over cast-in-place conduits prior to 14 days after placement of the concrete; (2) over cradled or bedded precast conduits prior to 7 days after placement of the concrete cradle or bedding; or (3) over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 2 feet, whichever is greater.

Compacting of fill adjacent to structures shall not be started until the concrete has attained the strength specified in Section 10 for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of fill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and spillway risers, cast-in-place (with inside forms in place)	7 days
Conduits and spillway risers, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlet bents (backfilled both sides simultaneously)	3 days

7. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE FILL

Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

8. TESTING

During the course of the work, the Engineer will perform such tests as are required to identify materials, to determine compaction characteristics, to determine moisture content, and to determine density of fill in place. These tests performed by the Engineer will be used to verify that the fills conform to the requirements of the specifications. Such tests are not intended to provide the Contractor with the information required by him for the proper execution of the work and their performance shall not relieve the Contractor of the necessity to perform tests for that purpose.

Densities of fill requiring Class A compaction will be determined by the Engineer in accordance with ASTM Method D 1556, D 2167, D 2922 or D 2937 except that the volume and moist weight of included rock particles larger than those used in the compaction test method specified for the type of fill will be determined and deducted from the volume and moist weight of the total sample prior to computation of density or if using the nuclear gauge, added to the specified density to bring it to the measure of equivalent compostion for comparision. The density so computed will be used to determine the percent compaction of the fill matrix. Unless otherwise specified, moisture content will be determined by one of the following methods: ASTM Method D-2216, D-3017.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill within the specified zone boundaries and pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified, no deduction in volume will be made for embedded conduits and appurtenances.

The pay limits shall be as defined below, with the further provision that earthfill required to fill voids resulting from over excavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only where such overexcavation is directed by the Engineer to remove unsuitable material and where the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

The pay limits shall be the measured surface of the foundation when approved for placement of the fill and the specified neat lines of the fill surface.

Payment for each type and compaction class of earthfill will be made at the contract unit price for that type and compaction class of fill. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work, except furnishing, transporting, and applying water to the foundation and fill materials. Water applied to the foundation and fill materials will be measured and payment will be made as specified in Construction Specification 10.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 10 of this specification.

10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 8, Earthfill

(1) This item shall consist of placing and compacting earthfill to construct the following:

(a) The side inlet structures where earthfill is required to bring the eroded washes up to the grades shown on the drawings.

(b) The dike along the upstream bank of the diversion channel between Station 14+00 and Station 244+00 as shown on the drawings.

(c) The dike along the upstream bank of the FRS drainage channel between Station 112+99 and Station 147+00.

(2) Earthfill materials shall be obtained from the required excavations or the approved borrow locations as shown on the drawings.

(3) In Section 6, Compaction, Class C shall apply. Each layer of fill shall be compacted with a minimum of three (3) passes by fully loaded earth moving equipment having a minimum empty weight of 70,000 pounds or approved equipment designed specifically for compaction of earthfill materials.

(4) The maximum size of rock fragements incorporated in the earthfill shall be six (6) inches.

(5) The maximum thickness of a layer before compaction shall be twelve (12) inches.

(6) The moisture content of the fill material shall be maintained within the limits required to: (a) prevent bulking or dilatance of the material under the action of the hauling or compacting equipment; (b) prevent the adherence of the fill material to the treads and tracks of the equipment; and (c) insure the crushing and blending of the soil clods and aggregations into a homogeneous mass.

(7) Measurement and payment will include compensation for Subsidiary Item, Borrow Excavation.

b. <u>Bid Item 9, Structure Backfill</u>

(1) This item shall consist of placing and compacting backfill within five (5) feet laterally of the existing side inlet structures to repair the erosion and undermined grouted rock rip-rap around the structures.

(2) Backfill material shall consist of materials obtained from the required excavations or the approved borrow locations.

(3) In Section 6, Compaction Class C shall apply. Each layer of backfill shall be compacted with a minimum of two (2) passes using manually directed power tampers or plate vibrators having a minimum rated capacity of 3400 pounds per blow. The contractor shall submit a backfill plan for approval by the engineer for the backfill to be placed beneath the undermined grouted rock rip-rap structures that will prevent dislodgement of rocks that are a part of the structures.

(4) The maximum size of rock fragements incorporated in the fill shall be three (3) inches.

(5) The maximum thickness of a layer before compaction shall be six (6) inches.

(6) The moisture content of the fill material shall be maintained within the limits required to: (a) prevent bulking or dilatance of the material under the action of the hauling or compacting equipment; (b) prevent the adherence of the fill material to the treads and tracks of the equipment; and (c) insure the crushing and blending of the soil clods and aggregations into a homogeneous mass.

(7) Section 9, Measurement and Payment shall not apply. Payment for structure backfill will be made at the contract lump sum price and will include compensation for Subsidiary Item, Borrow Excavation. Such payment will constitute full compensation for all items necessary and incidental to the work for placing all backfill at the existing side inlets within the limits as shown on the drawings.

c. <u>Bid Item 10, Slope Repair</u>

(1) This item shall consist of scarifying and compacting the east bank of the diversion channel and the FRS drainage channel to repair the rills and gulleys to the lines as shown on the drawings.

(2) Earthfill shall be provided in the areas of excessive erosion to provide a reasonably uniform slope.

(3) In Section 6, Compaction, Class C shall apply. Each layer of fill shall be compacted with a minimum of three (3) passes by fully loaded earth moving equipment having a minimum empty weight of 70,000 pounds or approved equipment designed specifically for compaction.

(4) The maximum size of rock fragments incorporated in the earthfill added to the slopes shall be six (6) inches.

(5) In Section 5, Placement, compaction in horizontal layers is not required.

(6) The maximum thickness of a layer before compaction shall be twelve (12) inches.

(7) The moisture content of the fill material shall be maintained within the limits required to: (a) prevent bulking or dilatance of the material under the action of the hauling or compacting equipment; (b) prevent the adherence of the fill material to the treads and tracks of the equipment; and (c) insure the crushing and blending of the soil clods and aggregations into a homogeneous mass.

(8) Section 9, Measurement and Payment, does not apply. Measurement and payment will be for the length of the slopes repaired measured to the nearest full station along the centerline of the diversion channel and drainage channel respectively and will include compensation for Subsidiary Item, Borrow Excavation. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work, except furnishing, transporting, and applying water to the foundation and fill materials. Water applied to the foundation and fill materials will be measured and payment will be made as specified in Construction Specification 10.

CONSTRUCTION SPECIFICATION

62. GROUTED ROCK RIPRAP

1. SCOPE

The work shall consist of furnishing, transporting, and placing rock and concrete grout in the construction of grouted rock riprap sections.

2. MATERIALS

Rock for grouted rock riprap shall conform to the requirements of Material Specification 523, or if so specified shall be obtained from designated sources. It shall be free from dirt, clay, sand, rock fines, and other materials not meeting the required gradation limits.

At least 30 days prior to delivery of rock from other than designated sources, the Contractor shall designate, in writing, the source from which he intends to obtain the rock and information satisfactory to the Contracting Office that the material meets the requirements of the contract. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in Section 13 of this specification.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in Section 13 of this specification. The rock shall conform to the specified grading limits when installed in the riprap.

Filter or bedding materials when required, shall unless otherwise specified, conform to the requirements of the Material Specification 521.

Portland cement shall conform to the requirements of Mateiral Specification 531 for the specified type.

Pozzolan. Unless otherwise specified in Secion 13 of this specification, pozzolans conforming to Specification ASTM C-618 Class F in amounts not to exceed 20 percent, based on absolute volume, may be substituted for an equivalent amount of portland cement in the grout mixture.

Aggregates shall conform to the requirements of Material Specification 522, except that the grading for coarse aggregate shall be as specified in the construction details.

Water shall be clean and free from injurious amounts of oils, acid, alkali, organic matter or other deleterious substances.

Air-entraining admixtures shall conform to the requirements of Material Specification 532.

Curing compound shall conform to the requirements of Material Specification 534.

Other admixtures, when required, shall be as specified in the construction details.

3. SUBGRADE PREPARATION

Riprap or filter shall not be placed until the subgrade surfaces have been inspected and approved by the Engineer.

4. FILTER LAYERS OR BEDDING

When filter layers or bedding beneath the riprap is specified, the material shall be spread uniformly on the prepared subgrade surfaces to the depth shown on the drawings. Compaction of the material will not be required but the surfaces of such layers shall be finished reasonably free of mounds, dips, or windrows.

5. PLACING ROCK

The rock shall be placed on the surfaces and to the depths specified in such a manner as to avoid displacement of the underlying materials. The rock may be equipment or hand placed as necessary to produce a surface in which the tops of the individual rocks do not vary more than the specified deviation from the neat lines shown on the drawings. Double decking of thin, flat rocks to bring the surface up to the required grade will not be permitted.

6. DESIGN OF THE GROUT MIX

The mix proportions for the grout mix shall be as specified in the construction details. During the course of the work the Engineer will require adjustment of the mix proportions whenever necessary. After the mix has been designated, it shall not be changed without the approval of the Engineer.

7. HANDLING AND MEASUREMENT OF MATERIAL

Materials shall be stockpiled and batched by methods that will prevent segregation or contamination of aggregates and insure accurate proportioning of the ingredients of the mix.

Except as otherwise provided in Section 11, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 pounds each. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight plus the weight of surface moisture it contains.

Water shall be measured, by volume or by weight, to an accuracy within one percent of the total quantity of water required for the batch.

Admixtures shall be measured within a limit of accuracy of ± 3 percent.

8. MIXERS AND MIXING

The mixer, when loaded to capacity, shall be capable of combining the ingredients of the grout mix into a thoroughly mixed and uniform mass and of discharging it with a satisfactory degree of uniformity.

Mixer shall be operated within the limits of the manufacturer's guaranteed capacity and speed of rotation.

The time of mixing after all cement and aggregates are in the mixer drum shall be not less than one minute for mixers having a capacity of one cubic yard or less. For mixers of larger capacities, the minimum time shall be increased fifteen seconds for each cubic yard or fraction thereof of additional capacity. The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate, and all mixing water shall be introduced into the drum before one-fourth of the mixing time has elapsed.

When ready-mixed grout mix is furnished, the Contrator shall furnish to the Engineer a delivery ticket showing the time of loading and the quantities of materials used for each load of grout mix.

No mixing water in excess of the amount called for by the job mix shall be added to the grout mix during mixing or hauling or after arrival at the delivery point.

9. CONVEYING AND PLACING

The grout mix shall be delivered to the site and placed within 1-1/2 hours after the introductin of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. The Engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the final placement as rapidly as practicable by methods that will prevent segregation of the aggregates or loss of mortar.

Grout mix shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation.

The grout mix shall not be placed until the rock riprap has been inspected and approved by the Engineer.

Rock to be grouted shall be kept wet for at least 2 hours immediately prior to grouting.

The rock riprap shall be flushed with water to remove the fines from the rock prior to placing the grout. The rock shall be kept moist just ahead of the actual placing, but the grout shall not be placed in standing or flowing water. Grout placed on inverts or other nearly level areas may be placed in one course. On slopes, the grout shall be placed in two (2) courses in successive lateral strips approximately ten (10) feet in width starting at the toe of the slope and progressing to the top. The grout shall be delivered to the place of final deposit by approved means and discharged directly on the surface of the rock, using a splash plate of metal or wood to prevent displacement of the rock directly under the discharge. The flow of grout shall be directed with brooms, spades or baffles to prevent it from flowing excessively along the same path and to assure that all intermittent spaces are filled. Sufficient barring shall be done to loosen tight pockets of rock and otherwise aid the penetration of grout so that all voids shall be filled and the grout fully penetrates the rock blanket. All brooming on slopes shall be uphill and after the grout has stiffened, the entire surface shall be rebroomed to eliminate runs and to fill voids caused by sloughing.

After completion of any strip or panel, no workman or other load shall be permitted on the grouted surface for a period of twenty-four (24) hours. The grouted surface shall be protected from injurious action by the sun, rain, flowing water and mechanical injury.

10. CURING AND PROTECTION

The surface of treatment materials shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

The grouted rock may be coated with an approved curing compound in lieu of continued application of moisture. The compound shall be sprayed on the moist concrete surfaces as soon as free water has disappeared, but shall not be applied to any surface until finishing of that surface is completed. The compound shall be applied at a uniform rate of not less than one gallon per 150 square feet of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed concrete. If the membrane is damaged during the curing period, the damaged area shall be resprayed at the rate of application specified above.

Grout mix shall not be placed when the daily minimum temperature is less than 40°F unless facilities are provided to insure that the temperature of the materials is maintained at not less than 50°F nor more than 90°F during placement and the curing period. Grout mix shall not be placed on frozen surfaces. When freezing conditions prevail, rock to be grouted must be covered and heated to a range of 50°F to 90°F for at least 24 hours prior to placing treatment materials.

11. INSPECTING AND TESTING FRESH GROUT

The Engineer will inspect and test grout during the course of the work. Sampling of fresh grout will be done by the methods prescribed in ASTM Designation C 172. The volume of each batch will be determined by the methods prescribed in ASTM Designation C 138.

The Engineer shall have free entry to all parts of the Contractor's plant and equipment which concern mixing and placing the grout while work on the contract is being performed. Proper facilities shall be provided for the Engineer to inspect materials and processes used in mixing and placing the grout as well as for securing samples of the grout mix. All tests and inspections shall be so conducted as not to interfere unnecessarily with the mixing and placing of the grout.

When ready-mixed grout is furnished, the Contractor shall furnish to the Engineer a statement-of-delivery ticket for each batch delivered to the job site. The ticket shall show the total weights in pounds of cement, water, and fine and coarse aggregates, amount of air-entraining agent, time of loading, and the revolution counter reading at the time of batching.

12. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of grouted rock riprap, including filter layers or bedding, will be determined from the specified thickness shown on the drawings and the area on which acceptable placement has been made. Payment for grouted rock riprap will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the grouted rock riprap and filter layers or bedding.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in he payment for the itme of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 13 of this specification.

13. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 11, Grouted Rock Riprap

(1) This item shall consist of furnishing and placing all grouted rock riprap as shown on the drawings.

(2) The rock shall be graded as follows:

Partical Size (inch)	Percent Passing (by dry wt.)
12	100
9	40-85
6	10-50
3	0-5

(3) In Section 6, Design of the Grout Mix, the Contractor shall be responsible for proportioning the mix. The grout shall consist of portland cement, fine and coarse aggregate, water, and an air entraining agent. The minimum cement content shall be 5 1/2 bags per cubic yard of grout. The maximum nominal size of coarse aggregate shall be 3/8 inch. The slump shall be within the range of 6 to 10 inches. The air content (by volume) of the grout mixture at the time of placement shall be five (5) to seven (7) percent. At least five (5) days prior to placement of grout, the contractor shall furnish the Engineer with a statement of the mix proportions for approval.

(4) Cement shall be type II or IIA.

CONSTRUCTION SPECIFICATION

94. CONTRACTOR INSPECTION

1. Scope

The work shall consist of providing all equipment, materials, labor and services necessary to ensure that the specified quality is maintained on all work performed. The Contractor shall be responsible for the day-to-day quality control.

2. Equipment and Materials

Equipment for materials testing shall be of the quality and condition required to meet the test specifications cited in the contract references. Equipment shall be in good condition and properly adjusted. Calibration of equipment shall be done at the frequency specified in Section 8. Records of equipment calibration tests shall be available to the government at all times. Nuclear devices shall be operated and maintained by qualified operators and as prescribed by applicable state and federal regulations.

Materials include but shall not be limited to: sand for density tests, bound field books and forms for record-keeping, concrete specimen molds, and all other equipment and materials prescribed by the test procedures referenced in the contract.

The quality of materials used in quality control testing and the equipment employed shall: meet the appropriate standards specified and the standards of the industry, be appropriate for its intended use, and provide the accuracy specified by the contract requirements unless otherwise specified in Section 8 of this specification.

3. Inspection Personnel

Inspections and materials testing shall be accomplished by qualified personnel: a licensed engineering firm, testing laboratory, certified inspection technicians, or licensed and experienced personnel from the contractor's organization. The contractor's written inspection plan shall identify the names and qualifications, training, and experience of all quality control personnel who will actually be performing the inspection and quality control work.

4. Inspection System

The Contractor shall develop and conduct an inspection system adequate to maintain quality control of all work performed and materials and equipment used. The inspection system established shall be based upon a plan and implemented by the necessary mobilization of personnel, equipment and materials. Inspection shall include the initial work needed to verify adequacy of completed work and provide controls for any corrective work. The inspection system and records to substantiate daily conduct of the system shall be kept by the Contractor and are subject to review by the Contracting Officer, at any time.

The Contrctor's inspection system shall cover all aspects of quality control and shall specifically address any testing and inspection requirements detailed in Section 8 of this specification. The planned inspection system shall also identify the Contractor's primary quality control manager and provide an organizational listing of the individual quality control personnel and their specific duties, experience and qualifications.

If the government's quality assurance inspections indicate that the contractor's inspection system is not adequate or is not producing the desired results, corrective actions shall be taken by the Contractor in both the inspection system, its plan and the work. The Contracting Officer may direct that changes be made in the inspection system including, but not limited to, the removal of unsatisfactory quality control personnel.

5. Pre-Construction Conference

After the contract is awarded and before construction operations are started the Contractor shall meet with the Contracting Officer and discuss the contractor's inspection plan. The meeting shall develop a mutual understanding regarding inspection details including the form of documentation to be used for recording the quality control operations, inspections, management procedures and the interrelationship of Contractor and government inspection efforts. The finalized plan will be approved by the Contracting Officer and it shall become a part of the contract.

6. Records

The inspection records shall be kept daily and shall document both acceptable and deficient features of the work. They shall include complete records of required material tests, submittal and approval of shop drawings, manufacturer's recommendation and certifications, and a complete record of materials delivery, quality examination, certification and storage. Tests performed by the Contractor (including sub contractors) shall be a part of the record. All records shall be on forms acceptable to the Contracting Officer and shall be legible, properly dated and identified as to the responsible tester, the material or item tested, and its location of placement in the structure. In addition, these records shall include factual evidence that required activities or tests have been performed, including but not limited to the following:

1. Type and number of control activities and tests involved and the location (elevation, station and offset) of the work tested.

2. Result of control activities or tests.

3. Method of testing used (e.g. citation of reference specification).

4. Nature of defects, cause for rejection, etc.

5. Proposed remedial action.

6. Corrective actions taken and quality control testing.

7. <u>Measurement and Payment</u>

For items of work for which lump sum prices are established in the contract, payment for contractor inspection will be made at the contract lump sum price. Such payment shall constitute full compensation for all labor, materials, equipment, transportation and all other items necessary and incidental to completion of the work. Progress estimates for payment of this bid item will be based on the percent completion of all contract items (dollar value) used in preparing the regular progress payments.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 12, Quality Control

(1) This item shall consist of furnishing the personnel, equipment and material required to provide adequate internal quality control and document that the specified quality is being achieved for:

(a) Channel Excavation, Common; Structure Excavation, Common; Borrow Excavation Common

The Quality Control Manager shall evaluate the suitability of the excavated materials for use as earthfill and structure backfill, including but not limited to, compaction qualities, rock size, moisture content, and organic materials content

(b) Earthfill and Structure Backfill

The Quality Control Manager shall be readily available at all times during fill placement operations to control the construction techniques which affect the fill characteristics and to document the quality of the compacted fill material.

(c) Grouted Rock Riprap

The Quality Control Manager shall control the construction techniques that will assure the placement of properly graded rock riprap uniformly throughout the grouted rock sections. The Quality Control Manager shall provide direction to the Contractor's construction forces in the placement, finishing and curing of the grout to assure full penetration of the grout within the rock sections and that the completed surfaces are properly finished and cured. The Quality Control Manager shall verify that the grout delivered to the project meets all aspects of the mix design and is placed within the proper limits of time, temperatures, air content, and slump range.

(d) Slope Repair

The Quality Control Manager shall provide direction to the repair of the rilled slopes on the upstream bank to assure the slopes have sufficient moisture and are scarified a sufficient depth to provide compacted material in the rills that is well bonded to the underlying materials.

(2) The Contractor shall designate an experienced Quality Control Manager who shall be on site during all major construction activities. The Quality Control Manager's primary responsibility shall be to establish and correct construction methods and techniques and to document that the minimum specified quality of construction is achieved. The Quality Control Manager shall be in authority over all of the Contractor's construction personnel, including foremen, to assure that construction operations will achieve the specified quality. The Quality Control Manager shall advise and obtain concurrance and approval from the Engineer at critical points in the construction process such as for subgrade approval. Such concurrance and/or corrective work required by the Engineer shall be transferred to the foremen through the Quality Control Manager to maintain proper communication channels and consistent quality control efforts.

(3) The names and qualifications of proposed quality control personnel shall be submitted to the Contracting Officer for review and approval prior to the preconstruction conference. Any changes in quality control personnel will require submittal of their qualifications and the approval of the Contracting Officer.

(4) The Contractor's quality control plan shall address the following information:

(a) State the scope of the quality control.

1. Establish construction operations that achieve the minimum specified quality.

2. Provide daily quality control supervision and documentation of construction operations.

3. Perform necessary tests to verify the quality of the construction activities.

4. Review and approval of shop drawings and material submittals.

5. Identify and document aspects that do not meet the job requirements. Document corrective actions and reworked materials.

(b) Identify the Quality Control Manager and responsibilities/authorities. Identify other quality control/testing personnel and attach qualification statements for each.

(c) List each major construction activity (earthfill, grout, etc.) and discuss the Contractor's schedule and production rates for each.

1. Explain the initial start up work and construction techniques for each item. State the level of guidance provided by the Quality Control Manager in the field.

2. Discuss the level of quality control on a day-to-day basis.

3. Explain the procedures that will be followed when deficiencies are discovered.

4. Estimate the number and type of quality control tests that will be taken daily.

5. Show a graph of each construction item and production rates along with the quality control staff requirements to provide the necessary field supervision and testing as explained in the quality control plan.

(d) Discuss records, forms, timing, and distribution list of documentation. Copies of all test results and inspection reports shall be submitted to the Contracting Officer within 24 hours of when the test or inspection report is completed and certified. Provide an organization chart relating the Quality Control Manager, the site superintendent, and the foremen.

(e) Attach list of quality control/testing equipment required by the Contractor's quality control plan.

MATERIAL SPECIFICATION

522. AGGREGATE FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of portland cement concrete.

2. QUALITY

Aggregate shall conform to the requirements of ASTM Specification C-33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when: (1) the specified alternate conditions of acceptance can be proved prior to the use of the aggregates on the job and within a period of time such that no work under the contract will be delayed by the requirements of such proof; or, (2) the specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

3. REACTIVITY WITH ALKALIES

The potential reactivity of aggregates with the alkalies in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C 289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C 33, Appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used, except under one of the following conditions:

a. Applicable test results of mortar bar tests, made according to ASTM Method C 227, are available which indicate an expansion of less than 0.10 percent at six months in mortar bars made with cement containing not less than 0.8 percent alkalies expressed as sodium oxide; or

b. Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with "low alkali" cement, containing less than 0.60 percent alkalies expressed as sodium oxide.

MATERIAL SPECIFICATION

523. ROCK FOR RIPRAP

1. SCOPE

This specification covers the quality of rock to be used in the construction of rock riprap.

2. QUALITY

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Except as provided below, the rock shall have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 ± 300 grams of rock fragments, reasonably uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

MATERIAL SPECIFICATION

531. PORTLAND CEMENT

1. SCOPE

This specification covers the quality of portland cements.

2. QUALITY

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specified types of cement, except that, when Type I portland cement is specified, Type IS portland blast-furnace slag cement or Type IP portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited in the specifications.

If air-entraining cement is to be used, the Contractor shall furnish the manufacturer's written statement giving the source, amount and brand name of the air-entraining addition.

3. STORAGE AT THE CONSTRUCTION SITE

Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agencies. Cement that is partially hydrated or otherwise damaged will be rejected.

MATERIAL SPECIFICATION

532. AIR-ENTRAINING ADMIXTURES (FOR CONCRETE)

1. SCOPE

This specification covers the quality of air-entraining admixtures for concrete.

2. QUALITY

Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260, except that the relative durability factor in the freezing and thawing test shall be not less than 95.

MATERIAL SPECIFICATION

533. WATER-REDUCING AND SET-RETARDING ADMIXTURES FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of water-reducing and set-retarding admixtures for portland cement concrete.

2. QUALITY

Water-reducing and set-retarding admixtures shall conform to the requirements of ASTM Specification C 494, except that resistance to freezing and thawing shall be determined in all cases, and the minimum relative durability factor shall be 95.

3. TYPES

Admixtures shall be Type A, Water-Reducing or Type D, Water-Reducing and Retarding, as defined in ASTM Specification C 494.

4. PERFORMANCE IN THE JOB MIX

When added in the manner and amount recommended by the manufacturer to the concrete used on the job, with no change in the cement content or proportions of the aggregates, admixtures shall have the following effects:

Type A or Type D: The water content at the required slump shall be at least 5 percent less with the admixture than without. The air content shall remain within the range specified, but shall not exceed 8 percent in any case.

Type D: The time of initial setting, determined as prescribed in ASTM C 494, shall be from 1 to 3 hours longer with the admixture than without.

MATERIAL SPECIFICATION

534. CURING COMPOUND (FOR CONCRETE)

1. SCOPE

This specification covers the quality of liquid membrane-forming compounds suitable for spraying on concrete surfaces to retard the loss of water during the curing process.

2. QUALITY

The curing compound shall meet the requirements of ASTM Specification C 309.

Unless otherwise specified the compound shall be Type 2.

3. DELIVERY AND STORAGE

All curing compound shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner to prevent damage to the containers and to protect water-emulsion types from freezing.

MATERIAL SPECIFICATION

591. FARM FIELD FENCING MATERIALS

1. SCOPE

This specification covers the quality of materials used in the construction of farm field fences.

2. WIRE GAUGE

When the size of steel wire is designated by gauge number, the diameter shall be as defined for U.S. Steel Wire Gauge.

3. FENCING

Barbed wire, woven wire and wire netting fencing shall conform to the requirements of Federal Specification RR-F-221 for the specified types and styles of fencing. Barbed wire and woven wire shall have zinc coating of at least 0.50 ounce per square foot of wire surface unless otherwise specified.

4. STAYS, FASTENERS, AND TENSION WIRE

Stays and fasteners shall conform to the requirements of Federal Specification RR-F-221 unless otherwise specified. Tension wires shall have a tensile strength not less than 58,000 pounds per square inch. Stays, fasteners and tension wire shall have Class 3 zinc coating as specified in ASTM Specification A 641.

5. WOOD FENCE POSTS AND BRACES

Wood posts shall be of black locust, red cedar, osage orange (Bois d'Arc), redwood, pressure treated pine or other wood of equal life or strength. At least half the diameter or diagonal dimension of red cedar or redwood posts shall be in heartwood. Pressure treatment shall conform to Material Specification 585. The posts shall be sound, new, free from decay, with all limbs trimmed substantially flush with the body. They shall be substantially straight throughout their length.

Wood braces shall be of material equal to or better than construction grade Douglas fir. They shall be pressure treated in conformance with Material Specification 585.

6. STEEL FENCE POSTS AND BRACES

Steel fence posts and braces shall conform to the requirements of Federal Specification RR-F-221. Posts with punched tabs for fastening the wires shall not be used.

7. CONCRETE FENCE POSTS

Concrete fence posts shall be manufactured to the specified requirements of size, shape, and strength.

8. PANEL GATES

Panel gates shall be the specified types, sizes, and quality and shall include the necessary fittings. The fittings shall consist of not less than two hinges and two latches or galvanized chains for fastening. Latches shall be of such design that a padlock may be used for locking. All fittings shall be equivalent to the gate manufacturer's standard.

9. WIRE GATES

Wire gates shall be the type shown on the drawings, constructed in accordance with these specifications at the locations and to the dimensions shown on the drawings. The materials shall conform to the kinds, grades, and sizes specified for new fence, and shall include the necessary fittings and stays.

10. STAPLES

Staples used to fasten fence wire to wood posts shall be 9-gage galvanized wire with a minimum length of 1-1/2 inches for soft woods and a minimum length of one inch for close-grain hardwoods.

11. GALVANIZING

All iron and steel fencing materials, except as otherwise specified, shall be zinc coated by the hot dip process, except that clips, bolts, and other small hardware may be protected by electrodeposited zinc or cadmium coating.

* U.S. GOVERNMENT PRINTING OFFICE:1986-623-325/508

AZ Saddleback Diversion Repair

JMH 12-1-88

Clearing & Grubbing Quantities 1

Pay per nearest Station

Sta 17	to Sta 26	=	9
29	35	=	6
38	41	=	3
43	48	=	5
52	59	=	7
61	114	=	53
127	150	=	23
155	177	=	22
182	184	=	2
190	209	=	19
226	232	=	6
237	243	=	6
			161 FULL STATIONS

UP DATE 1-27-89

AT THE FRS
113+00 to 147+00 = 34 STATIONS

195

AZ

Saddleback Diversion Repair

JMH 12-1-88

Water Quantities

1 2

Water will be req'd for the following items:

- Earth Fill
- Structure Back Fill
- Slope Repair
- Grouted Rock Riprap
- Dust control - minimal req'd due to remote site and small operation.

EARTHFILL AND STRUCTURE BACKFILL - 21,000 CY.

From weekly density summary's during original construction, the average optimum moisture on the diversion was approximately 13% @ dry densities around 117 #/ft

$$117 \times 27 = 3159 \ \#/CY$$

$$\times 0.13$$

410 #/CY moisture.

Assuming completely dry

$$21{,}000 \ CY \times 410 \frac{\#}{CY} \times \frac{1}{8.33 \frac{lb}{GAL}} = 1{,}034{,}000 \text{ Gallons}$$

$$= 1{,}034 \text{ M.Gal}$$

AZ
JMH

Water Quantities Cont'd

assume 10% extra material wet
assume 20% water wasted
assume 3% Subgrade prep

33% extra

1,034
× 1.33

1,375 MGal ← UPDATE 1-27-89 5600 CY for FRS 5600/21,000 = 27%
×1.27 = 1746

SLOPE REPAIR, 69,000 S.Y.

From cost analysis, determined 10,000 gal water pull @ 8 loads per day = 40 loads per week handled approximately 20,000 SY including waste.

$\frac{69,000}{20,000} \times 400 \frac{MGal}{Week}$ = ~~1,200~~ 1380 MGal ←

GROUTED ROCK RIPRAP 2,600 CY, 29 structures.

Overwetting would be ½ load per structure

SAY 150 MGal is more than req'd ← ok

SUB TOTAL

~~1775~~ 1750 + ~~1,200~~ 1380 + 150 = ~~2,725~~ 3,280 MGal

IF 1 load per day used to wet work area
Assume now 4 months = 80 × 10 = 800 MGal

TOTAL ~~3,500~~ MGal ←
4,000 MGal

AZ

JMH 12-1-88

QUANTITIES - CHA. EXC. & EARTHFILL

SUMMARY FROM COMPUTER PRINT OUT

	Job #	STATIONS	CUT	FILL
	13	17+00 to 26+00	1218	541
changed 3-3-89	14	29 → 35	801	343
3-3-89	15	38 → ~~36~~ 41+30	~~178~~ 295	~~178~~ 227
3-3-89	16	43 → 48	~~600~~ 568	~~392~~ 424
	12	52 → 59	899	572
	11	62 → 78	2258	1868
	26	78 → 94	2282	2173
	17	94 → 114	3439	2623
	18	127 → 150	6734	3344
3-3-89	27	155 → 157	~~196~~ 160	~~224~~ 413
	19	157 → 177	~~3160~~ 3297	~~2421~~ 2393
	20	182 → 184	645	201
3-3-89	~~42~~	~~190 → 193~~	~~900~~	—
3-3-89	21	190 ~~193~~ → 209	~~2132~~ 3468	~~3429~~ 3675
	22	226 → 232	440	512
3-3-89	23	237+50 ~~238~~ → 243	~~1484~~ 1543	~~993~~ 1276
		TOTALS	~~27,329~~ 28,047 CY	~~19,993~~ 20,585 CY
3-3-89	50 -	FRS 113+00 to 147+00	— N/A	6291
				~~25,646~~ 26,876

+MISC. @ FRS 600 ≈ 27,500

$\frac{20,585}{28,047} = 73\%$

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

frs

in

Maricopa COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 050

Checker ______________
Date ______________

****

frs

TOP Wi	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
	3:1	3:1	150.0	147+00		0.0		19.4	
					100		0.0		116.7
12	3:1	3:1	150.0	146+00		0.0		43.6	
					100		0.0		276.4
12	3:1	3:1	148.0	145+00		0.0		42.7	
					200		0.0		611.4
12	3:1	3:1	144.0	143+00		0.0		47.8	
					200		0.0		1012.1
12	3:1	3:1	141.0	141+00		0.0		60.4	
					200		0.0		1466.9
12	3:1	3:1	137.0	139+00		0.0		62.4	
					200		0.0		1882.9
12	3:1	3:1	134.0	137+00		0.0		49.9	
					200		0.0		2246.7
12	3:1	3:1	130.0	135+00		0.0		48.3	
					200		0.0		2590.2
12	3:1	3:1	127.0	133+00		0.0		44.5	
					200		0.0		2893.0
12	3:1	3:1	123.0	131+00		0.0		37.3	
					200		0.0		3182.4
12	3:1	3:1	119.0	129+00		0.0		40.9	
					100		0.0		3345.6
12	3:1	3:1	118.0	128+00		0.0		47.2	
					100		0.0		3522.0
	3:1	3:1	116.0	127+00		0.0		48.1	
					100		0.0		3701.9
	3:1	3:1	114.0	126+00		0.0		49.1	
					100		0.0		3877.1
12	3:1	3:1	112.0	125+00		0.0		45.5	
					100		0.0		4043.0
12	3:1	3:1	110.0	124+00		0.0		44.1	
					100		0.0		4204.9

12	3:1	3:1	110.0	122+00		0.0		41.8	
					100		0.0		4539.3

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	3:1	3:1	110.0	Off-CL		0.0		53.7	
					100		0.0		4778.8
12	3:1	3:1	110.0	120+00		0.0		75.7	
					100		0.0		5016.6
12	3:1	3:1	110.0	119+00		0.0		52.8	
					100		0.0		5334.1
12	3:1	3:1	110.0	118+00		0.0		118.6	
					100		0.0		5634.2
12	3:1	3:1	110.0	117+00		0.0		43.4	
					100		0.0		5813.2
12	3:1	3:1	120.0	116+00		0.0		53.2	
					76		0.0		5960.6
12	3:1	3:1	120.0	115+24		0.0		51.5	
					124		0.0		6183.2
12	3:1	3:1	55.0	114+00		0.0		45.5	
					101		0.0		6290.7
12	3:1	3:1	10.0	112+99		0.0		12.0	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Collector & Dike
17+00 to 26+00

Designer : jmh
Date : 01/05/88
Job Number 013

Input RJL
14' DITCH

Checker [signature]
Date 1/88

****

collector

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	42.0	26+00		0.0		28.5	
					100		42.8		103.6
12	5:1	5:1	41.0	25+00		23.1		27.4	
					100		136.9		201.8
	5:1	5:1	40.0	24+00		27.7		25.6	
					100		272.3		277.7
12	5:1	5:1	39.0	23+00		45.4		15.4	
					100		448.7		326.8
12	5:1	5:1	39.0	22+00		49.9		11.1	
					100		620.4		368.1
12	5:1	5:1	38.0	21+00		42.8		11.1	
					100		797.6		397.5
12	5:1	5:1	40.0	20+00		52.8		4.8	
					100		953.6		438.1
12	5:1	5:1	50.0	19+00		31.4		17.1	
					100		1077.6		493.8
12	5:1	5:1	50.0	18+00		35.5		13.0	
					100		1218.2		540.7
12	5:1	5:1	50.0	17+00		40.4		12.4	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 11/05/88
Job Number 014

Checker ________________
Date ________________

14' DITCH

****

collector

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	40.0	35+00		1.4		45.2	
					100		43.4		136.2
12	5:1	5:1	42.5	34+00		22.0		28.3	
					100		145.0		225.0
[illegible]	5:1	5:1	45.0	33+00		32.9		19.6	
					100		299.3		276.2
12	5:1	5:1	50.0	32+00		50.5		8.0	
					100		479.4		303.7
12	5:1	5:1	50.0	31+00		46.8		6.8	
					100		634.4		328.8
12	5:1	5:1	40.0	30+00		37.0		6.8	
					100		801.2		343.2
12	5:1	5:1	40.0	29+00		53.1		1.0	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 015

Checker ______________
Date ______________

****

38+00 to 41+00

TOP Wi	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
[illegible]	5:1	5:1	53.0	41+30		14.0		9.4	
					130		116.5		49.0
12	5:1	5:1	50.0	40+00		34.4		11.0	
					100		226.4		115.0
12	5:1	5:1	47.0	39+00		24.9		24.7	
					100		294.7		227.0
12	5:1	5:1	44.0	38+00		12.0		35.8	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 016

Checker ______________
Date ______________

****

43+50 to 48+00

Top Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
	5:1	5:1	45.0	48+00		2.0		55.6	
					100		42.3		164.3
12	5:1	5:1	50.0	47+00		20.9		33.2	
					100		163.7		256.8
12	5:1	5:1	50.0	46+00		44.7		16.8	
					100		328.0		315.0
12	5:1	5:1	45.0	45+00		44.1		14.6	
					100		490.9		386.2
12	5:1	5:1	43.0	44+00		43.9		23.8	
					50		568.2		424.5
12	5:1	5:1	44.0	43+50		39.6		17.6	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 012

20' DITCH

Checker ______________
Date ______________

****

12

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	46.0	59+00		29.7		21.9	
					100		124.2		82.6
12	5:1	5:1	47.0	58+00		37.4		22.7	
					100		271.6		148.4
[illegible]	5:1	5:1	49.0	57+00		42.2		12.8	
					100		414.6		205.6
12	5:1	5:1	50.0	56+00		35.0		18.1	
					100		543.0		287.0
12	5:1	5:1	51.0	55+00		34.3		25.8	
					100		677.4		379.1
12	5:1	5:1	52.0	54+00		38.3		23.9	
					100		809.1		467.1
12	5:1	5:1	53.0	53+00		32.9		23.6	
					100		899.4		572.2
12	5:1	5:1	46.0	52+00		15.9		33.1	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 011

24' DITCH

Checker ______________
Date ______________

****

collector

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	60.0	78+00		37.2		31.7	
					100		113.5		101.7
[illegible]	5:1	5:1	62.0	77+00		24.1		23.2	
					100		194.2		183.5
[illegible]	5:1	5:1	62.0	76+00		19.5		21.0	
					100		255.8		263.3
12	5:1	5:1	62.0	75+00		13.8		22.1	
					100		330.7		375.3
12	5:1	5:1	52.0	74+00		26.6		38.4	
					100		423.8		481.5
12	5:1	5:1	57.0	73+00		23.6		18.9	
					100		528.2		671.6
12	5:1	5:1	50.0	72+00		32.8		83.8	
					100		671.8		884.1
12	5:1	5:1	50.0	71+00		44.8		31.0	
					100		832.8		988.7
12	5:1	5:1	50.0	70+00		42.2		25.5	
					100		1020.8		1071.9
12	5:1	5:1	50.0	69+00		59.3		19.4	
					100		1249.1		1149.7
12	5:1	5:1	50.0	68+00		64.0		22.6	
					200		1591.1		1392.2
12	5:1	5:1	46.0	66+00		28.4		42.9	
					100		1720.2		1537.8
12	5:1	5:1	46.0	65+00		41.3		35.8	
					100		1906.7		1642.0
12	5:1	5:1	47.0	64+00		59.4		20.5	
					100		2052.1		1769.0
[illegible]	5:1	5:1	45.0	63+00		19.1		48.1	
					100		2258.1		1868.4
	5:1	5:1	51.0	62+00		92.1		5.6	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

Maricopa COUNTY, Arizona

Designer :
Date : 01/01/80
Job Number 026

24' DITCH

Checker ______________
Date ______________

****

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	58.0	94+00		43.9		60.6	
					100		190.4		139.3
[illegible]	5:1	5:1	66.0	93+00		58.9		14.7	
					100		428.7		174.7
[illegible]	5:1	5:1	68.0	92+00		69.7		4.5	
					100		649.4		194.7
12	5:1	5:1	67.0	91+00		49.5		6.4	
					100		831.4		232.3
12	5:1	5:1	66.0	90+00		48.8		13.9	
					100		957.1		320.9
12	5:1	5:1	60.0	89+00		19.0		34.0	
					100		1052.7		444.1
12	5:1	5:1	60.0	88+00		32.6		32.6	
					100		1191.4		542.4
12	5:1	5:1	55.0	87+00		42.3		20.5	
					100		1364.2		612.1
12	5:1	5:1	55.0	86+00		51.1		17.2	
					100		1530.7		682.3
12	5:1	5:1	50.0	85+00		38.8		20.7	
					100		1695.5		759.0
12	5:1	5:1	50.0	84+00		50.1		20.7	
					100		1894.0		939.5
12	5:1	5:1	49.0	83+00		57.1		76.8	
					100		2041.8		1129.0
12	5:1	5:1	50.0	82+00		22.7		25.5	
					100		2083.9		1544.4
12	5:1	5:1	45.0	81+00		0.0		198.8	
					100		2105.7		2002.0
[illegible]	5:1	5:1	60.0	80+00		11.8		48.3	
					100		2172.4		2102.9
[illegible]	5:1	5:1	69.0	79+00		24.2		6.2	
					100		2281.6		2172.7
12	5:1	5:1	61.0	78+00		34.7		31.5	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 017

24 ' DITCH

Checker ______________
Date ______________

****

17

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
					200		296.1		203.9
12	5:1	5:1	54.0	114+00		45.2		23.6	
					200		673.0		368.6
	5:1	5:1	60.0	112+00		56.6		20.9	
					100		896.9		436.9
12	5:1	5:1	60.0	111+00		64.4		16.0	
					100		1072.0		532.3
12	5:1	5:1	52.0	110+00		30.2		35.6	
					100		1224.7		706.5
12	5:1	5:1	55.0	109+00		52.2		58.5	
					100		1321.4		948.2
12	5:1	5:1	58.0	108+00		0.0		72.0	
					100		1465.3		1147.4
12	5:1	5:1	60.0	107+00		77.7		35.5	
					100		1670.2		1302.9
12	5:1	5:1	60.0	106+00		32.9		48.4	
					100		1734.1		1480.4
12	5:1	5:1	60.0	105+00		1.6		47.4	
					100		1761.7		1597.2
12	5:1	5:1	65.0	104+00		13.4		15.7	
					100		1839.2		1674.0
12	5:1	5:1	60.0	103+00		28.5		25.7	
					100		2011.3		1742.9
12	5:1	5:1	60.0	102+00		64.5		11.5	
					100		2259.3		1824.3
12	5:1	5:1	60.0	101+00		69.4		32.5	
					100		2508.7		1917.0
12	5:1	5:1	63.0	100+00		65.3		17.6	
					100		2762.8		1972.0
	5:1	5:1	65.0	99+00		71.9		12.1	
					100		2952.7		2058.4
12	5:1	5:1	60.0	98+00		30.6		34.5	
					100		3010.3		2194.7
12	5:1	5:1	58.0	97+00		0.4		39.1	
					100		3107.0		2342.9
12	5:1	5:1	56.0	96+00		51.8		40.9	

TOP h	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
					100		3280.0		2465.0
12	5:1	5:1	62.0	95+00		41.6		25.1	
					100		3438.6		2623.3
12	5:1	5:1	58.0	94+00		44.1		60.4	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

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saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 018

28' DITCH

Checker ______________
Date ______________

****

18

Make steeper to fit inside fence line

Top Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	3:1	5:1	57.0	150+00		34.1		67.4	
					100		146.8		275.4
[illegible]	3:1	5:1	54.0	149+00		45.2		81.3	
					100		331.1		595.1
[illegible]	3:1	5:1	59.0	148+00		54.4		91.3	
					100		493.2		782.2
12	3:1	5:1	64.0	147+00		33.2		9.7	
					100		619.6		854.6
12	3:1	5:1	55.0	146+00		35.0		29.4	
					100		743.6		948.8
12	3:1	5:1	69.0	145+00		32.0		21.5	
					100		860.0		1079.7
12	3:1	5:1	80.0	144+00		30.9		49.2	
					100		1088.9		1259.4
12	3:1	5:1	88.0	143+00		92.7		47.8	
					100		1395.6		1447.5
12	3:1	5:1	87.0	142+00		72.9		53.7	
					100		1730.3		1644.9
12	3:1	5:1	84.0	141+00		107.9		52.9	
					100		2112.6		1844.2
12	3:1	5:1	85.0	140+00		98.5		54.8	
					100		2471.8		2003.6
12	3:1	5:1	88.0	139+00		95.4		31.3	
					100		2835.9		2159.3
12	3:1	5:1	82.0	138+00		101.2		52.8	
					100		3203.8		2320.2
12	3:1	5:1	85.0	137+00		97.5		34.1	
					100		3587.2		2504.3
[illegible]	3:1	5:1	79.0	136+00		109.5		65.2	
					100		3966.4		2742.2
[illegible]	3:1	5:1	79.0	135+00		95.3		63.2	
					100		4252.7		2933.5
12	3:1	5:1	82.0	134+00		59.2		40.0	
					100		4593.4		3012.8
12	3:1	5:1	75.0	133+00		124.8		2.8	
					100		5063.7		3020.9

TOP h	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	3:1	5:1	71.0	Off-CL		129.1		1.5	
					100.		5526.7		3034.6
12	3:1	5:1	67.0	131+00		120.9		5.9	
					100		5943.8		3091.6
12	3:1	5:1	67.0	130+00		104.3		24.9	
					100		6277.4		3158.0
12	3:1	5:1	62.0	129+00		75.9		10.9	
					100		6483.6		3245.3
12	3:1	5:1	63.0	128+00		35.5		36.2	
					100		6733.7		3344.3
12	3:1	5:1	63.0	127+00		99.6		17.2	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

Maricopa COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 027

Checker ______________
Date ______________

****

155+00 to 157+00

TOP Wi	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
	5:1	5:1	78.0	157+00		39.8		10.0	
					100		116.7		171.8
12	5:1	5:1	72.0	156+00		23.3		82.8	
					100		159.8		413.4
12	5:1	5:1	70.0	155+00		0.0		47.7	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

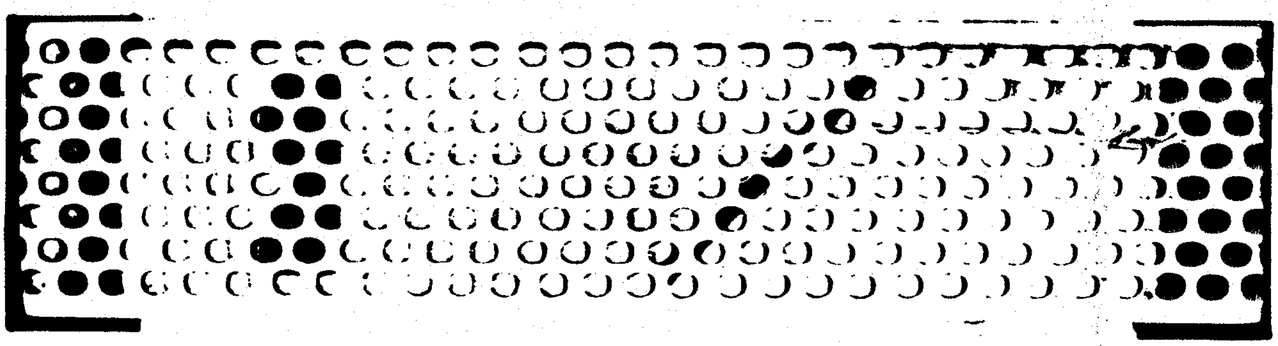
Designer : jmh
Date : 01/01/80
Job Number 019

Checker _______________
Date _______________

****

157+00 to 177+00

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
[illegible]	5:1	5:1	68.0	177+00		18.9		15.8	
					100		97.5		120.0
12	5:1	5:1	72.0	176+00		33.8		49.0	
					100		325.9		217.2
12	5:1	5:1	73.0	175+00		89.6		3.5	
					100		660.1		227.9
12	5:1	5:1	69.0	174+00		90.9		2.2	
					100		953.7		267.6
12	5:1	5:1	65.0	173+00		67.7		19.2	
					100		1163.9		354.1
12	5:1	5:1	65.0	172+00		45.8		27.5	
					100		1261.6		572.0
12	5:1	5:1	65.0	171+00		6.9		90.2	
					100		1343.9		761.6
12	5:1	5:1	77.0	170+00		37.5		12.2	
					100		1475.0		903.4
12	5:1	5:1	75.0	169+00		33.3		64.3	
					100		1572.0		1086.1
12	5:1	5:1	70.0	168+00		19.1		34.3	
					100		1646.9		1296.8
12	5:1	5:1	70.0	167+00		21.4		79.5	
					100		1753.0 ✓		1506.8 ✓
12	5:1	5:1	72.0	166+00		35.9		33.9	
					100		1920.0		1678.6
[illegible]	5:1	5:1	78.0	165+00		54.2		58.9	
					100		2100.1		1827.2
1[illegible]	5:1	5:1	75.0	164+00		43.0		21.4	
					100		2256.3		1893.6
12	5:1	5:1	75.0	163+00		41.3		14.4	
					100		2368.8		1960.1
12	5:1	5:1	75.0	162+00		19.5		21.5	
					100		2483.9		[illegible]



[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	
					100		2689.2		[illegible]
12	5:1	5:1	72.0	160+00		68.2		16.7	
					100		2973.7		[illegible]

159

) to 177+00 (continued) 01/01/80 page [illegible]

TOP [illegible]	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yd
12	5:1	5:1	74.0	Off-CL		85.4		4.7	
					100		3175.1		[illegible]
12	5:1	5:1	67.0	158+00		23.3		56.2	
					100		3297.0		2393.[illegible]
12	5:1	5:1	75.0	157+00		42.5		14.7	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Serv[illegible]

CROSS-SECTION DATA

prepared for

saddle

OH-IRM 5/10/86

US Department of!Agriculture
Soil Conservation!Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, ARIZONA

Designer!: jmh
Date : 01/01/80
Job Number!020

30' DITCH

Checker!______________
Date ______________

****

20

TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	75.0	184+00		105.5		12.1	
					100		335.2		105.7
12	5:1	5:1	65.0	183+00		75.6		45.0	
					100		646.9		200.6
12	5:1	5:1	82.0	182+00		92.7		6.2	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 021

Checker ______________
Date ______________

****

190+00 to 209+00

TOP W[illegible]	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
	5:1	5:1	70.0	209+00		51.0		44.5	
					100		178.4		211.9
12	5:1	5:1	70.0	208+00		45.4		69.9	
					100		332.1		467.0
12	5:1	5:1	75.0	207+00		37.6		67.8	
					100		530.1		650.1
12	5:1	5:1	80.0	206+00		69.4		31.0	
					100		816.8		748.3
12	5:1	5:1	85.0	205+00		85.4		22.0	
					100		975.0		790.3
12	5:1	5:1	80.0	204+00		0.0		0.7	
					100		1036.2		907.8
12	5:1	5:1	80.0	203+00		33.0		62.8	
					100		1100.0		1301.3
12	5:1	5:1	93.0	202+00		1.4		149.7	
					100		1102.6		1944.4
12	5:1	5:1	90.0	201+00		0.0		197.6	
					100		1124.9		2435.4
12	5:1	5:1	90.0	200+00		12.0		67.5	
					100		1238.8		2633.2
12	5:1	5:1	90.0	199+00		49.5		39.3	
					100		1463.6		2773.1
12	5:1	5:1	85.0	198+00		71.8		36.2	
					100		1724.5		2932.0
	5:1	5:1	80.0	197+00		69.1		49.6	
					100		1907.0		3102.3
	5:1	5:1	81.0	196+00		29.5		42.3	
					100		2031.3		3245.3
12	5:1	5:1	80.0	195+00		37.6		34.9	
					100		2246.0		3353.5
12	5:1	5:1	80.0	194+00		78.4		23.5	
					100		2554.3		3428.6

					100		2873.5		3500.4
12	5:1	5:1	80.0	192+00		84.3		21.8	
					100		3197.1		3575.1

19) to 209+00 (continued) 01/01/80

						** EXCAVATION **		** FILL **	
TOP Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	Area (SqFt)	Volume (Cu.Yds)	Area (SqFt)	Volume (Cu.Yds)
12	5:1	5:1	80.0	Off-CL		90.4		18.6	
					100		3467.7		3675.1
12	5:1	5:1	78.0	190+00		55.7		35.4	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

Maricopa COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 022

Checker ______________
Date ______________

****

226+00 to 232+00

TOP Wi	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
	2:1	5:1	27.0	232+00		22.4		19.2	
					100		87.1		66.5
10	2:1	5:1	27.0	231+00		24.6		16.7	
					125		177.2		175.1
10	2:1	5:1	23.0	229+75		14.3		30.2	
					75		212.5		266.5
10	2:1	5:1	23.0	229+00		11.1		35.6	
					100		268.0		376.2
10	2:1	5:1	26.0	228+00		18.8		23.6	
					100		351.2		448.1
10	2:1	5:1	28.0	227+00		26.1		15.2	
					100		440.2		512.7
10	2:1	5:1	27.0	226+00		21.9		19.7	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

Maricopa COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 023

Checker _______________
Date _______________

****

237+15 to 243+00

TOP Wi...	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
	5:1	5:1	35.0	243+00		54.0		55.7	
					100		281.8		181.6
12	5:1	5:1	40.0	242+00		98.2		42.3	
					100		603.0		410.6
12	5:1	5:1	61.0	241+00		75.3		81.3	
					100		927.3		651.6
12	5:1	5:1	78.0	240+00		99.8		48.9	
					100		1263.1		897.6
12	5:1	5:1	105.0	239+00		81.5		83.9	
					100		1500.1		1185.9
12	5:1	5:1	144.0	238+00		46.5		71.8	
					50		1543.1		1276.0
12	5:1	5:1	170.0	237+50		0.0		25.5	

Structure Back Fill is required for the following structures by inspection of photo's in the 1987 engineering report.

#2, very minor rill, 12" WIDE, 4" deep, one side negligible.

#3 negligible.

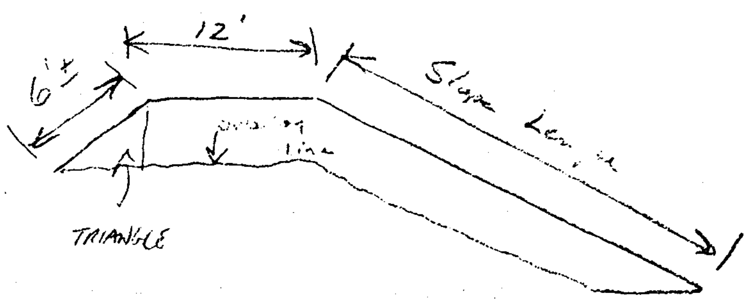
	ESTIMATE DEPTH	
→ #4 - Severe, both sides	3L, 2R	
→ #5 - Severe, one side only	2R	
→ #7 - Severe, both sides	3L, 3R	
→ #8 - Severe, both sides	2L, 2R	DIFF. TO TELL
→ #9 - Severe, both sides	3L, 3R	
→ #11 - Severe, one side only	2L	
→ #12 - Severe, both sides	3L, 3R	
→ #13 - Severe, both sides	3L, 3R	
→ #14 - Severe, both	2L, 2R	
→ #15 - Severe, both	2L, 2R	
→ #16 - Severe, one side	2R	
→ #17 - Severe, both ?	?	

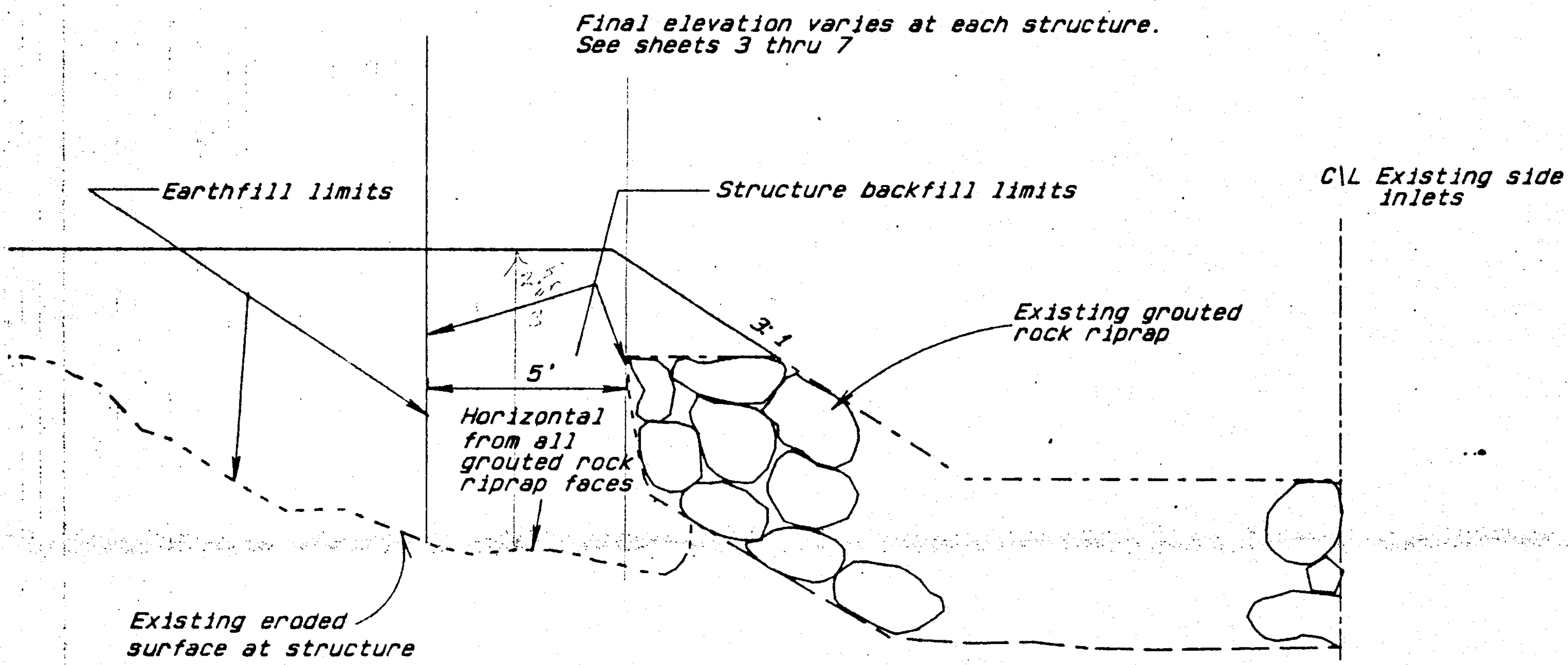
25/10 → 2.5'

Set up computer spread sheet, use cross section shown on next page, input elevation top & bottom compute slope length for each side. Quantity will be based on 2½ and 3 feet deep rills, 5 Ft wide for comparison.

$A_{2.5} = 12.5$ S.F.

$A_3 = 15$ S.F.





TYPICAL SECTION--STRUCTURE BACKFILL AT EXISTING STDF TNI F

Structure backfill quantities
?/3/89

① Inlet No.	② Height	③ Slope L	④ Sides 2 or 1?	⑤ Total L	⑥ Volume
4	6.5	33.15	2	102.3	47
5	5.6	28.56	1	46.56	22
7	7.6	38.76	2	113.52	53
8	6.6	33.66	2	103.32	48
9	7.1	36.21	2	108.42	50
11	7.3	37.23	1	55.23	26
12	8.1	41.31	2	118.62	55
13	7.7	39.27	2	114.54	53
14	6.6	33.66	2	103.32	48
15	5.7	29.07	2	94.14	44
16	5.7	29.07	1	47.07	22
17	6.8	34.68	2	105.36	49
			Total		515

③ = 5.1 × ②

⑤ = (③ + 18) × ④

⑥ = $\frac{④ \times (12.5 \text{ S.F.})}{27}$

AZ
ADM 2-23-89 JMH 2-27-89

SADDLEBACK DIVERSION REPAIR

STRUCTURE EXCAVATION SUMMATION 1 9

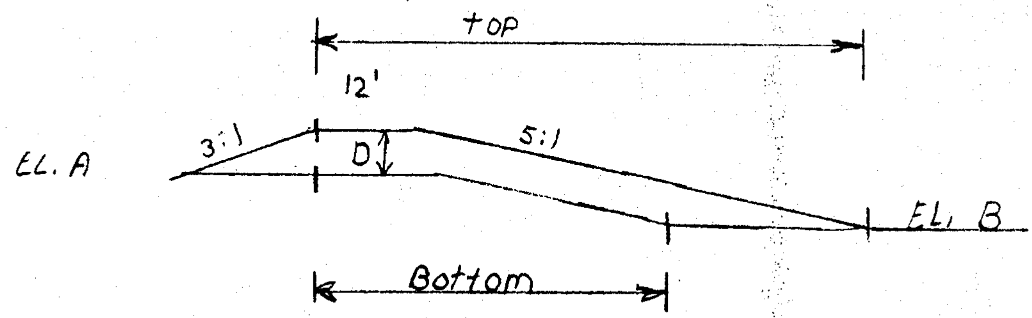
INLET	C.Y.	
1	110	
2	~~120.0~~	141
3	88.2	
4	63.3	
5	122.72	
6	~~113.92~~	118
7	124.9	
8	141.37	
9	~~471.0~~	481
10	~~98.15~~	99
11	90.51	
12	~~417.1~~	415
13	~~102.78~~	107
14	125.15	
15	~~89.66~~	92
16	81.4	
17	150.15	
18	~~403.44~~	408
19	~~169.37~~	174
20	~~456.0~~	498
21	~~89.66~~	92
22	113.92	
23	63.3	
24	~~537.82~~	581
25	~~102.78~~	107
26	94.38	
27	77.51	
28	511.28	
29	733.0	
30	678.0	
31	268.0	
		6949

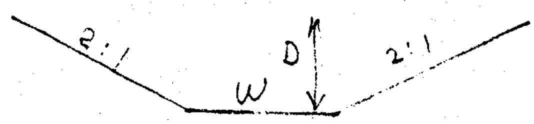
Total = ~~6819.0 yds³~~
6949 CY.

AZ SADDLEBACK DIVERSION REPAIR

ADM 2-23-89 JmH 2-27-89

STRUCTURE EXCAVATION





METHOD: Fig. Area in trapezoid

$$\left[\frac{W + 2(D) + (2(D) + W)}{2}\right] D = A$$

Fig. Avg. Length of Top Line and Bottom Line.

top = width of dike + (EL. top Dike - EL. B) (Slope)

Bottom = width of dike + (EL. A - EL. B) (Slope)

ADD Vol. of Grouted Riprap

ADD 3:1 TRIA = $\frac{\text{trapezoid Area}}{2}$ (D)(Slope) 3:1

AZ
ADM 2-23-89

SADDLEBACK DIVERSION REPAIR
JMR 2-27-89

3 9

STRUCTURE EXCAVATION

INLET #1 $\left[\frac{10' + 2(2) + 2(2) + 10}{2}\right](2) = 28\,ft^2$

Length of topline $12' + (5.1)(8.5) = 55.35'$ AVG. = 50.25'
" " Bottom $12' + (5.1)(6.5) = 45.15'$

$\frac{28}{2} ft^2 (6) = 84\,ft^3$

$(28\,ft^2)(50.25') = 1407\,ft$
84.0
$55.2\,yds^3$
+ GROUT = $54.8\,yds^3$
TOTAL $110.0\,yds^3$

INLET 2 [illegible] (2) = $25\,ft^2$

[illegible] (~~13.3~~ 14.0) = 82.38 AVG. = ~~76~~ 77
[illegible] 12 + (5.1)(~~11.3~~ 11.5) = 69.63

$\frac{25}{2} ft^2 (7.5) = 93.75\,ft^3$

$(25\,ft^2)(77)$ = [illegible] ft^3
$93.75\,ft^3$
74.8 ~~73.89~~ yds^3
+ GROUT = 66 ~~56.1~~
[141] ~~13[illegible]~~ yds^3

INLET 3 SAME AS #2 $25\,ft^2$

TOPLINE $12 + (5.1)(7.4) = 49.74$
BOTTOM $12 + (5.1)(4.9) = 36.99$ AVG. = 43.36'

$(25\,ft^2)(43.36') = 1084.12\,ft$
$93.75\,ft^3$
$43.62\,yds^3$
+ Grout
$88.2\,yds^3$

AZ SADDLEBACK DIVERSION REPAIR
ADM 2-23-89 Jmm 2-27-89
STRUCTURE Excavation 4 9

INLET-4 $\frac{5+2(2)+2(2)+5}{2}(2) = 18\ ft^2$

topline $12+(5.1)(6.4) = 44.64$ $(18ft^2)(39.54') = 711.72\ ft$

Bottom $12+(5.1)(4.4) = 34.44$ AVG = 39.54' 54 ft^3

28.36 yds^3

$\frac{18}{2} ft^2 (6) = 54\ ft^3$ +Grout 34.9

63.3 yds^3

Inlet-5

$\frac{10+2(2.5)+2(2.5)+10}{2}(2.5) = 37.5\ ft^2$

TL $12+(5.1)(7.3) = 49.23$ $(37.5ft^2)(42.85') = 1606.87$

AVG. = 42.85'

BL $12+(5.1)(4.8) = 36.48$ 140.62

64.72 yds^3

$\frac{37.5}{2} ft^2 (7.5) = 140.62\ ft^3$ +Grout 58.

122.72 yds^3

INLET-6 SAME AS #5 $37.5\ ft^2$ $(37.5ft^2)(~~38.77~~\ 40.3') = 1453.87$

140.62

TL $12+(5.1)(~~6.5~~\ 6.8) = 45.15$ AVG. ~~38.77~~ 40.3 61.2 ~~59.05~~ yd

BL $12+(5.1)(~~4.0~~\ 4.3) = 32.4$ + GROUT 57.2 ~~54.87~~ yds^3

$\frac{37.5}{2}(7.5) = 140.62\ ft^3$ [118] ~~113.92~~ yds^3

INLET-7 SAME AS #5 $37.5\ ft^2$ $(37.5ft^2)(43.87') = 1645.125$

140.62 ft

TL $12+(5.1)(7.5) = 50.25$ AVG. 43.87' 66.14 yd

BL $12+(5.1)(5) = 37.5$ +Grout 58.76 yds^3

$\frac{37.5}{2}(7.5) = 140.62\ ft^3$ 124.9 yds^3

AZ
AOM 2-23-89 JMH 2-27-89

SADDLEBACK DIVERSION REPAIR

5 9

STRUCTURE EXCAVATION

INLET # 8 SAME AS # 5 $37.5 ft^2$ $(37.5 ft^2)(51.52) = 1932.19 ft^3$
140.62 ft^3

TL $12' + (9)(5.1) = 57.9'$ AVG. 51.52'
BL $12' + (6.5)(5.1) = 45.15'$

76.77 yds^3
+ GROUT 64.6 yds^3
141.37 yds^3

$\frac{37.5 ft^2}{2}(2.5')(3) = 140.62 ft^3$

INLET # 9 $\left[\frac{50 + 2(2.5) + 2(2.5) + 50}{2}\right] 2.5 = 137.5 ft^2$

$(137.5 ft^2)(~~52~~ 54.)$ [53] = ~~7427.1~~ [7288]
515.62 f

TL ~~14~~ [12] + ~~(9.1)~~ [9.3] (5.1) = ~~60.4~~ [58.4]
BL ~~14~~ [12] + ~~(6.6)~~ [6.8] (5.1) = ~~47.66~~ [45.7]
AVG. = ~~54.~~ ~~52~~ 53

89 ~~294.25~~ yds^3
+ GROUT 192 ~~187.82~~ yds^3
[81.] ~~482.1~~ yds^3

3:1 △ $\frac{137.5 ft^2}{2}(2.5)(3) = 515.62 ft^3$

INLET # 10 SAME AS # 2 $25 ft^2$ $(25 ft^2)(~~48.97'~~ [49.5]) = 1224.25 ft^3$
93.75 ft^3

TL 12 + ~~(8.5)~~ [8.6] (5.1) = 55.35'
BL 12 + ~~(6)~~ [6.1] (5.1) = 42.6
AVG. = ~~48.97'~~ 49.5

49.5 ~~48.81~~ yds^3
+ GROUT 49.6 ~~49.34~~ yds^3
[99] ~~98.15~~ yds^3

3:1 △ = 93.75 ft^3

check out grout more than 51?

INLET # 11 SAME AS # 2 $25 ft^2$ $(25 ft^2)(~~44.89'~~ [43.89]) = 1122.25 ft^3$
93.75 ft^3

TL 12 + ~~(7.7)~~ [7.5] (5.1) = 51.27
BL 12 + ~~(5.2)~~ [5.0] (5.1) = 38.52
AVG = ~~44.89''~~ 43.89

44.1 ~~45.00~~ yds^3
+ GROUT 46.2 ~~45.51~~ yds^3
[91] ~~90.51~~ yds^3

3:1 △ = 93.75 ft^3

AZ
A.L.M. 2-23-89 JMB 2-27-89

SADDLEBACK DIVERSION REPAIR

STRUCTURE EXCAVATION

6 9

#12 $\left[\frac{45+2(2.5)+2(2.5)+45}{2}\right](2.5) = 125\,ft^2 \times$ ~~50~~ 49.5 $= 6250.0\,ft^3$

468.75 ft^3

TL 12+(~~8.7~~ 8.6)(5.1) = 56.37

BL 12+(~~6.2~~ 6.1)(5.1) = 43.62 AVG = ~~50'~~ 49.5

246.5 ~~248.84~~ yds^3

\+ GROUT 168 ~~168.27~~ yds^3

[415] ~~417.+~~ yds^3

3:1 TRIA. $\frac{125\,ft^2}{2}(2.5)(3) = 468.75\,ft^3$

#13 SAME AS #2 25 ft^2 $(25\,ft^2)$(~~53~~ 54.5) = 1325.0 ft^3

93.75 ft^3

TL 12+(~~9.3~~ 9.6)(5.1) = 59.43'

AVG. = ~~53.0'~~ 54.5

BL 12+(~~6.8~~ 7.1)(5.1) = 46.68'

53.9 ~~52.55~~ yds^3

GROUT 52.6 ~~50.23~~ yds^3

[107] ~~102.78~~ yds^3

3:1 Δ = 93.75 ft^3

#14 SAME AS #5 37.5 ft^2 $(37.5\,ft^2)(44.89') = 1633.375\,ft^3$

TL 12+(7.7)(5.1) = 51.27'

BL 12+(5.2)(5.1) = 38.52' AVG. = 44.89'

3:1 Δ 140.62 ft^3

67.55 yds^3

GROUT 57.6 yds^3

125.15 yds^3

#15 SAME AS #2 25 ft^2

TL 12+(~~7.2~~ 7.7)(5.1) = 48.72'

BL 12+(~~4.7~~ 5.2)(5.1) = 35.97

AVG = ~~42.39~~ 44.9

$(25\,ft^2)$(~~42.39'~~ 44.9) = 1058.5 ft^3

3:1 Δ 93.75 ft^3

45 ~~42.68~~ yds^3

\+ GROUT ~~46.98~~ yds^3

[92] ~~89.66~~ yds^3

AZ
A.D.M. 2-23-89

SADDLEBACK DIVERSION
[signature] 2-27-89

STRUCTURE EXCAVATION

7 9

#16 (25 ft²)(38.78') = 969.0 ft³

TL 12 + (6.5)(5.1) = 45.15 AVG = 38.78'

BL 12 + (4.0)(5.1) = 32.4

3:1 Δ 93.75 ft³

~~182.99~~ yds³ 39.4

+Grout 41.98 yds³

~~224.97~~ yds³ 81.4

#17 (37.5 ft²)(55.61') =

TL 12 + (9.8)(5.1) = 61.98'

BL 12 + (7.3)(5.1) = 49.23' AVG. = 55.61

2085.19 ft³

3:1 Δ 140.62 ft³

82.44 yds³

+ GROUT 67.71 yds³

150.15 yds³

#18 (125 ft²)(~~47.96~~ 48.5') =

TL 12 + (~~8.3~~ 8.4)(5.1) = 54.33' AVG. ~~47.96~~ 48.5

BL 12 + (~~5.3~~ 5.9)(5.1) = 41.58'

5994.38 ft³

3:1 Δ 468.75 ft³

241.7 ~~239.38~~ yds³

166.5 Grout ~~164.06~~ yds³

[408] ~~403.44~~ yds³

#19 $\left[\frac{15 + 2(2.5) + 2(2.5) + 15}{2}\right] 2.5 = 50\,ft^2$ (~~46.94~~ 47.9') = 2346.75 ft³

TL 12 + (~~8.1~~ 8.3)(5.1) = 53.31'

BL 12 + (~~5.6~~ 5.8)(5.1) = 40.56' AVG. = ~~46.94~~ 47.9'

187.5 ft³

95.7 ~~93.86~~ yds³

77.3 GROUT ~~75.51~~ yds³

[174] ~~169.37~~ yds³

3:1 Δ $\frac{50\,ft^2}{2}(2.5)(3) = 187.5\,ft^2$

#20 $\left[\frac{45 + 2(3) + 2(3) + 45}{2}\right](3) = 153\,ft^2$ (~~52.29~~ ~~47.2~~ 50.8') = ~~8000.37~~ 7217 ft³

TL 12 + (~~8.4~~ 9.1)(5.1) = ~~59.94~~ 54.8

BL 12 + (~~5.4~~ 6.1)(5.1) = ~~44.64~~ 39.5 AVG. ~~52.29~~ ~~47.2~~ 50.8'

688.5 ft³

313 ~~293.~~ ~~298.53~~ yds³

185 GROUT ~~163.~~ yds³

[498] ~~461.53~~ yds³

456

3:1 Δ $\frac{153}{2}\,ft^2(3)(3) = 688.5\,ft^3$

AZ SADDLEBACK DIVERSION
ADM 2-23-89 Jmt 2-27-89
STRUCTURE EXCAVATION 8 9

#21 SAME AS #15 89.66 yds³

#22 SAME AS #6 113.92 yds³

#23 SAME AS #4 ~~56~~ 63.36 yds³

#24 $\left[\frac{50+2(3.5)+2(3.5)+50}{2}\right](3.5) = 199.5\ ft^2$ (~~42.35~~ 45.9') = 8447.83 ft
1047.38 ft
TL 12+ (~~7.7~~ 8.4)(5.1) = 51.27 AVG: ~~42.35~~ 45.9 — 378 ~~351.67~~ yds
BL 12+ (~~4.2~~ 4.9)(5.1) = 33.42 — GROUT 203 ~~186.15~~ yds³
581 ~~537.82~~ yds

3:1 Δ $\frac{199.5\ ft^2}{2}(3.5)(3) = 1047.38\ ft^3$

#25 SAME AS #13 102.78 yds³

#26 25 ft² — $(25\ ft^2)(47.45') = 1186.13\ ft^3$
TL 12+ (8.2)(5.1) = 53.82' — 3:1 Δ 93.75 ft³
BL 12+ (5.7)(5.1) = 41.07' AVG. = 47.45' — 47.4 yds³
GROUT 46.98 yds³
94.38 yds³

#27 25 ft² — $25\ ft^2(36.23') = 905.63\ ft^3$
TL 12+ (6)(5.1) = 42.6' — 93.75 ft³
BL 12+ (3.5)(5.1) = 29.85' AVG 36.23' — 37.01 yds³
GROUT 40.5 yds³
77.51 yds³

#28 $\left[\frac{35+2(3.5)+2(3.5)+35}{2}\right](3.5) = 147.0\ ft^2$
TL 12+ (10.5)(5.1) = 65.55 — $(147.0\ ft^2)(56.63') = 8323.88\ ft^3$
BL 12+ (7)(5.1) = 47.7 AVG. = 56.63' — 771.75 ft³
336.88 yds³
3:1 Δ $\frac{147.0\ ft^2}{2}(3.5)(3) = 771.75\ ft^3$ — GROUT 174.40 yds³
511.28 yds³

AZ
H.D.M. 2-23-89 JMB 2-27-89

SADDLEBACK DIVERSION REPAIR

STRUCTURE EXCAVATION

9 9

FRS.

#29 $\left[\frac{40 + 2(3.5) + 2(3.5) + 40}{2}\right](3.5) = 164.5\ ft^2$ (~~65.8~~ 76.3) = ~~10824.10~~ 12558. ft^3

TL 12 + (12.3)(6.1) = ~~74.73~~ 87 AVG. = ~~65.8~~ 76.3

BL 12 + (8.8)(6.1) = ~~56.88~~ 65.7

3:1 Δ $\frac{164.5\ ft^2}{2}(3.5)(3) = 863.62\ ft^3$

863.62 ft^3

~~432.88~~ 497 yds^3

+ GROUT 236.0 yds^3

~~668.88~~ 733 yds^3

#30 164.5 ft^2

TL 12 + (11.2)(6.1) = ~~69.12~~ 80.3 AVG. ~~60.2~~' 69.6

BL 12 + (7.7)(6.1) = ~~51.27~~ 59

$(164.5\ ft^2)$(~~60.2~~' 69.6) = ~~9902.08~~ 11455 ft^3

3:1 Δ 863.62 ft^3

~~398.73~~ 456 yds^3

+ GROUT 228.0 yds^3

~~626.73~~ 678 yds^3

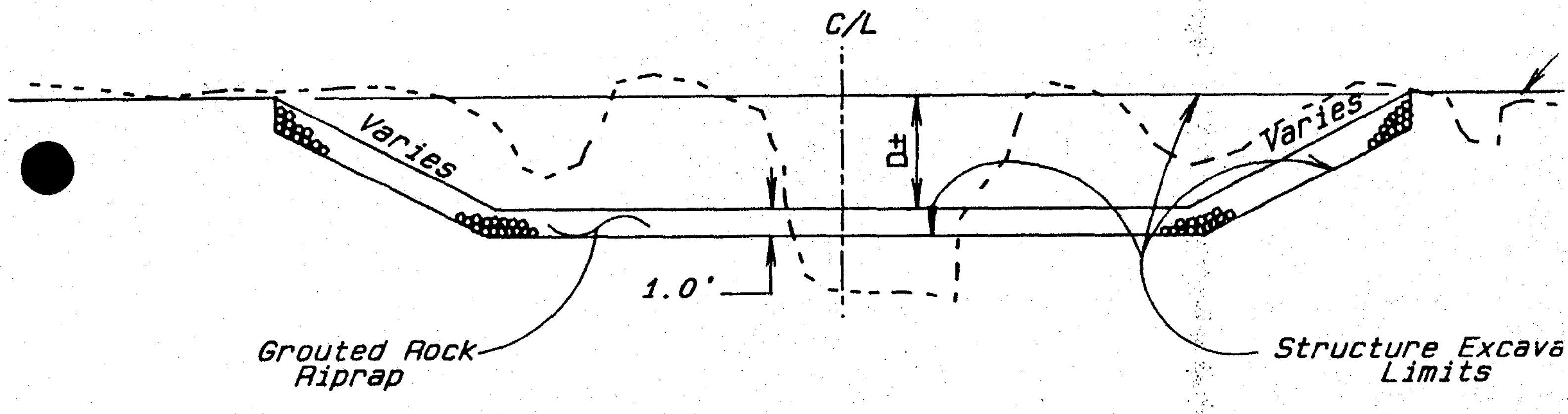
12 ... Riprap

SECTION B 9 9

NEW INLET	STATION	W FEET	D FEET	A ELEV.	B ELEV.	E FEET
1	14+50	10.0	2.0	1178.0	6.5 1171.5	-
2	20+50	5.0	2.5	1176.2	11.5 1164.7	-
3	31+15	5.0	2.5	1167.5	4.9 1162.6	-
4	41+30	5.0	2.0	1165.0	4.4 1160.6	-
5	45+50	10.0	2.5	1164.5	4.8 1159.7	-
6	54+00	10.0	2,5	1162.3	4.3 1158.0	-
7	64+00	10.0	2.5	1161.0	5 1156.0	-
8	69+00	10.0	2.5	1161.5	6.5 1155.0	-
9	72+00	50.0	2.5	1161.2	6.8 1154.4	-
10	88+50	5.0	2.5	1152.6	6.1 1146.5	-
11	92+00	5.0	2.5	1150.8	5.0 1145.8	-
12	99+70	45.0	2.5	1150.4	6.1 1144.3	-
13	105+00	5.0	2.5	1150.3	7.1 1143.2	-
14	112+00	10.0	2.5	1147.0	5.2 1141.8	-
15	127+20	5.0	2.5	1144.0	5.2 1138.8	1.0
16	135+75	5.0	2.5	1141.0	4 1137.0	1.0
17	148+00	10.0	2.5	1135.5	7.3 1128.2	1.0
18	157+00	45.0	2.5	1132.1	5.9 1126.2	-
19	164+80	15.0	2.5	1130.2	5.6 1124.4	-
20	169+00	45.0	3.0	1129.7	6.1 1123.6	-
21	174+50	5.0	2.5	1127.0	4.7 1122.3	-
22	183+00	10.0	2.5	1124.5	4 1120.5	0.5
23	190+00	5.0	2.0	1123.5	4.5 1119.0	-
24	200+00	50.0	3.5	1121.7	4.9 1116.8	0.5
25	207+50	5.0	2.5	1121.5	6.4 1115.1	1.0
26	218+00	5.0	2.5	1118.5	5.7 1112.8	-
27	231+50	5.0	2.5	1113.0	3.5 1109.5	-
28	241+60	35.0	3.5	1104.5	7 1097.5	-

B

be fr... ...er.



SECTION B 1010 1010

88

NEW INLET	STATION	W FEET	D FEET	A ELEV.	B ELEV.	F FEET
29	115+60	40.0	3.5	1192.0	1183.2	61
30	124+50	40.0	3.5	1192.0	1184.3	64

77

NEW SIDE INL
SADDLEBACK
HARQUAHA
MARICOPA COUN

AZ
JMH 2-27-89 aum 3-1-89
ST. EXC - INLET 31

SADDLE FRS

SECT #	AREA	AVG A	DIST	VOL
1-1	70			
		86.5	7.5	650
1-A	103			
		107	14	1500
2-2	111			
		134	12	1600
4-4	157			
		78.5	30	2360
6-6	0			

6105 6110

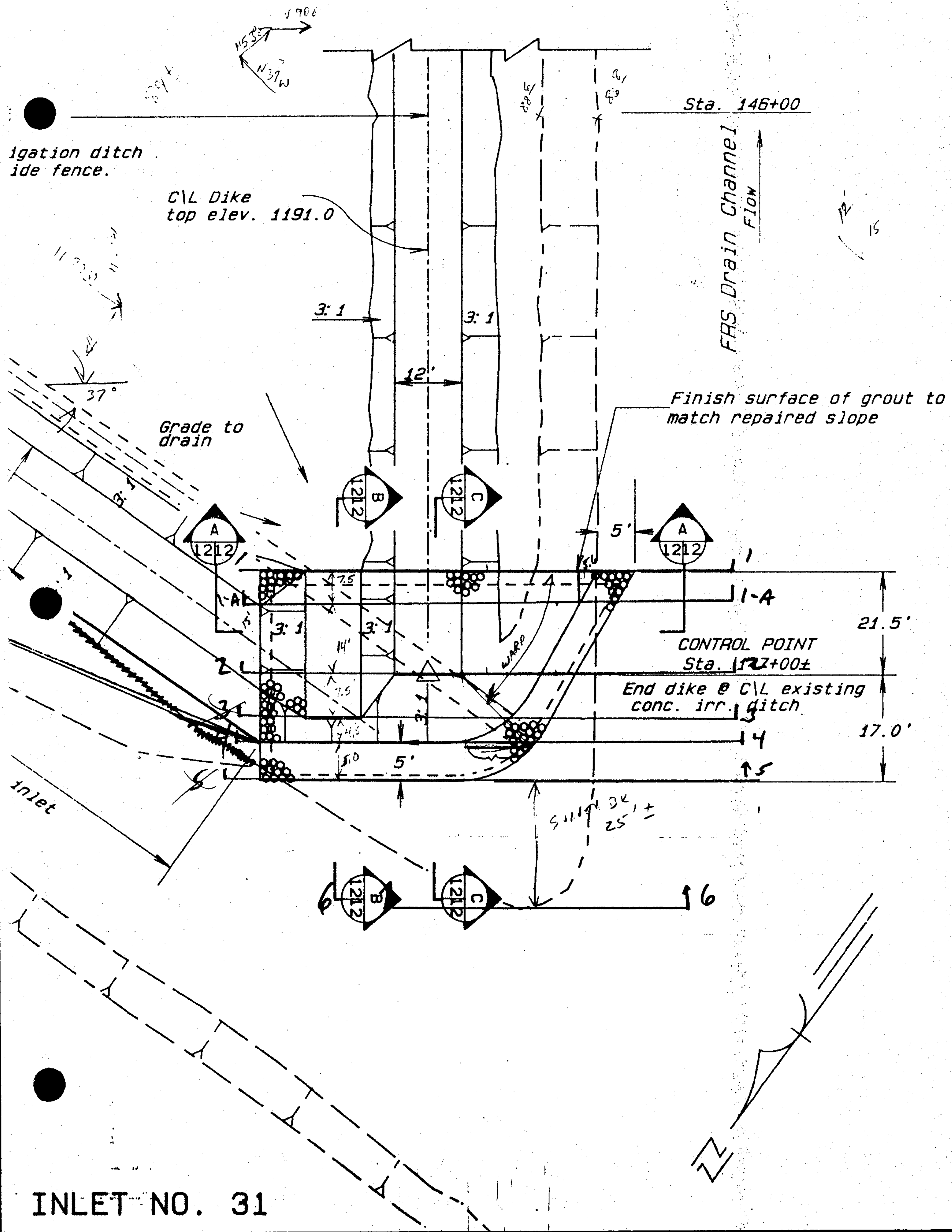
÷27 = 226 CY ok

+ CUTOFFS

2' x 3' x Length ÷ 27 =

$\frac{6}{27} \times (61 + 38 + 50 + 40\pm)$ = 42

268 CY



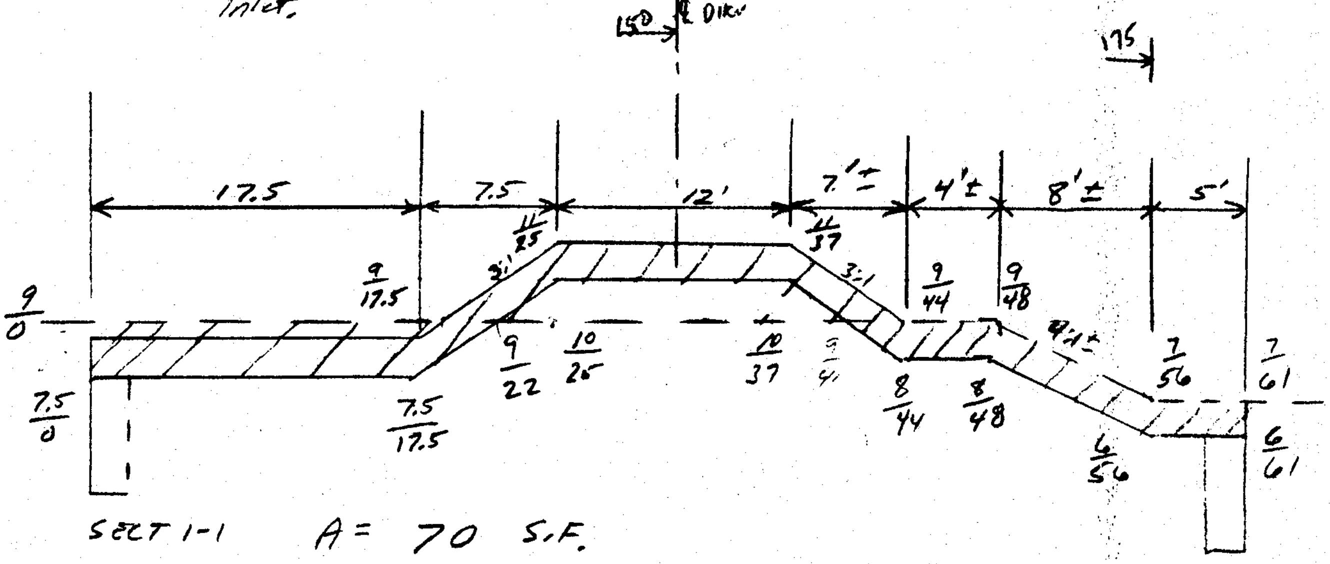
Sta. 146+00
igation ditch
ide fence.
C\L Dike
top elev. 1191.0
FRS Drain Channel
Flow
3:1
3:1
12'
37°
Grade to
drain
Finish surface of grout to
match repaired slope
A 1212
B 1212
C 1212
5'
21.5'
CONTROL POINT
Sta. 1?7+00±
End dike @ C\L existing
conc. irr. ditch
17.0'
5'
14'
inlet

INLET NO. 31

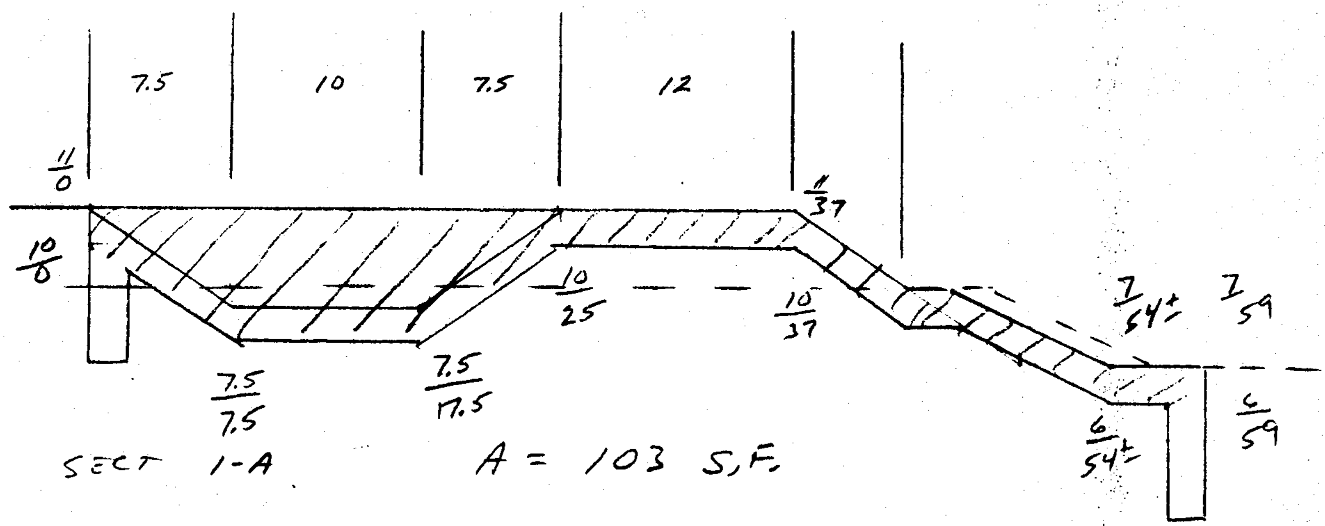
Tb.

JMH 2-27-89 aom 3-1-89
INLET 31, ST. EXC.

Do all earthwork, dikes etc, then cut out for inlet.

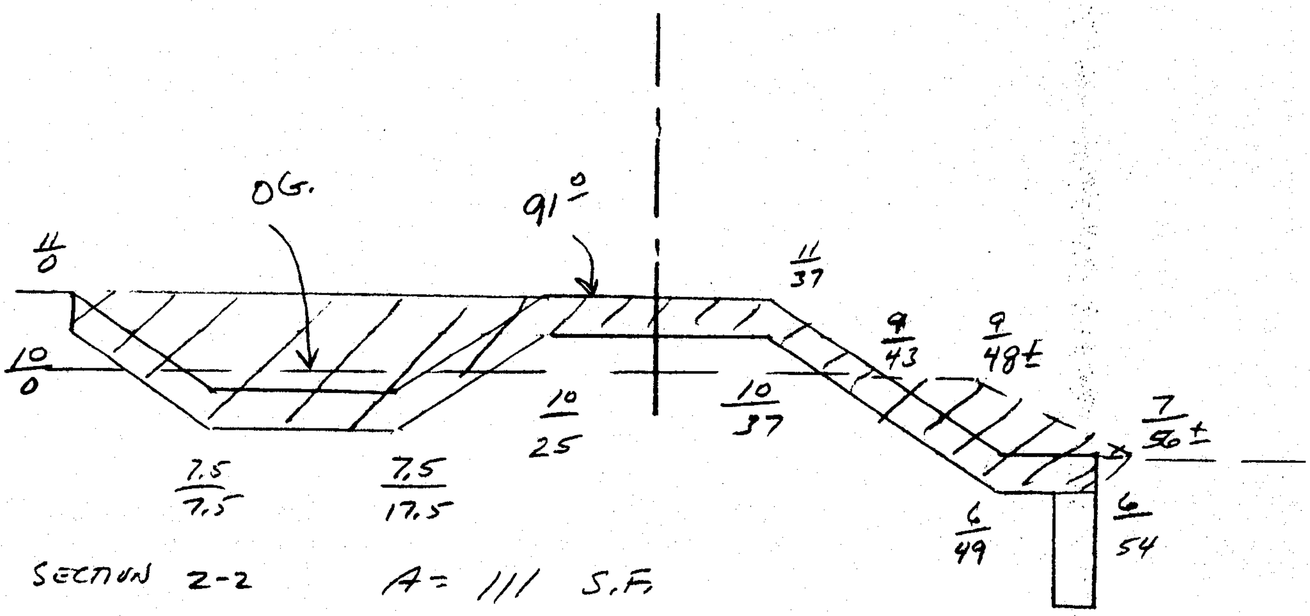


SECT 1-1 A = 70 S.F.
71.63

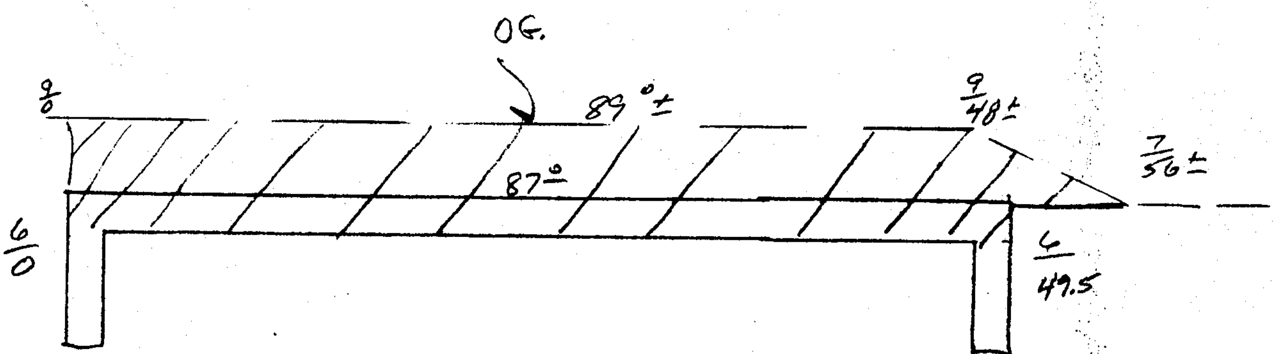


SECT 1-A A = 103 S.F.

awm 3-1-89



SECTION 2-2 A = 111 S.F.



SECT 4-4 A = 157 S.F.

SECT 6-6 - A=0

AZ Saddleback Diversion Inlet Repair

JMH 12-1-88

SEDIMENT REMOVAL SUMMARY

STATION LIMIT	VOL. CUT
68+00 → 73+00	1275
80 → 82	196
88 → 90	257
99 → 101	411
106 → 112	1066
140 → 142	64
148 → 150	102
157 → 159	207
164 → 168	510
174 → 176	156
182 → 184	123
199 → 206	1978

TOTAL 6,345 CY

US Department of Agriculture
Soil Conservation Service

PLANNED

Sediment

QUANTITY CALCULATIONS

68+00 to 73+00

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 011

Checker ________________
Date ________________

****

11

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	115.0	73+00		40.1		0.0	
					100		254.6		0.0
1	5:1	500:1	109.0	72+00		97.3		0.0	
					100		591.2		11.1
	5:1	500:1	108.0	71+00		84.4		6.0	
					100		875.8		22.1
1	5:1	500:1	111.0	70+00		69.3		0.0	
					100		1135.2		22.1
1	5:1	500:1	108.0	69+00		70.7		0.0	
					100		1274.5		22.1
1	5:1	500:1	110.0	68+00		4.5		0.0	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

80+00 → 82+00

in

Maricopa COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 025

Checker ______________
Date ______________

****

sediment

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	102.0	82+00		0.3		0.0	
					100		97.3		0.0
1	5:1	500:1	111.0	81+00		52.3		0.0	
					100		196.0		0.0
	5:1	500:1	111.0	80+00		1.0		0.0	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle 88+00 to 90+00

in

Maricopa COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 025

Checker ______________
Date ______________

****

sediment

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	114.0	90+00		5.7		0.0	
					100		120.0		0.0
1	5:1	500:1	116.0	89+00		59.1		0.0	
					100		256.9		0.0
	5:1	500:1	116.0	88+00		14.8		0.0	

US Department of Agricultur
Soil Conservation Servic

PLANNED

QUANTITY CALCULATIONS

Sediment 99+00 → 101+

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 017

Checker ______________
Date ______________

****

17

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	EXCAVATION Area (SqFt)	EXCAVATION Volume (Cu.Yds)	FILL Area (SqFt)	FILL Volume (Cu.Yds)
1	5:1	500:1	120.0	101+00		49.0		0.0	
					100		243.9		0.0
1	5:1	500:1	120.0	100+00		82.7		0.0	
					100		411.3		0.0
	5:1	500:1	120.0	99+00		7.6		0.0	

OH-IRM 5/10/86

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

Sediment 106+00 → 112+00

prepared for

saddle

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 017

Checker ______________
Date ______________

****

17

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	115.0	112+00		32.4		0.0	
					100		126.3		0.0
1	5:1	500:1	115.0	111+00		35.8		0.0	
					100		309.4		0.0
1	5:1	500:1	115.0	110+00		63.2		0.0	
					100		564.4		0.0
1	5:1	500:1	115.0	109+00		74.5		0.0	
					100		716.7		0.0
1	5:1	500:1	115.0	108+00		7.7		0.0	
					100		851.2		29.6
1	5:1	500:1	118.0	107+00		65.0		16.0	
					100		1065.6		59.2
1	5:1	500:1	118.0	106+00		50.8		0.0	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

sediment 140+00 to 142+00

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 018

Checker _______________
Date _______________

****

18

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	127.0	142+00		3.1		0.0	
					100		32.3		0.0
1	5:1	500:1	127.0	141+00		14.3		0.0	
					100		63.7		0.0
	5:1	500:1	127.0	140+00		2.6		0.0	

Soil Conservation ...

PLANNED

QUANTITY CALCULATIONS

prepared for

sediment 148+00 to 150+00

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 018

Checker ______________
Date ______________

****

18

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	123.0	150+00		15.5		3.3	
					100		60.1		17.8
1	5:1	500:1	121.0	149+00		17.0		6.3	
					100		102.2		42.9
	5:1	500:1	119.0	148+00		5.7		7.2	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

157+00 → 159+00

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 019

Checker ______________
Date ______________

****

sediment

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	127.0	159+00		4.6		0.0	
					100		97.1		0.0
1	5:1	500:1	127.0	158+00		47.8		0.0	
					100		206.8		0.0
	5:1	500:1	128.0	157+00		11.4		0.0	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

164+00 → 168+00

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 019

Checker ______________
Date ______________

****

sediment

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
1	5:1	500:1	131.0	168+00		1.3		0.0	
					100		65.5		0.0
1	5:1	500:1	132.0	167+00		34.1		0.0	
					100		170.2		0.0
	5:1	500:1	131.0	166+00		22.5		0.0	
					100		310.5		0.0
1	5:1	500:1	131.0	165+00		53.3		0.0	
					100		509.6		0.0
1	5:1	500:1	131.0	164+00		54.1		0.0	

US Department of Agriculture
Soil Conservation Service

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

174+00 → 176+00

in

MARICOPA COUNTY, Arizona

Designer : jmh
Date : 01/01/80
Job Number 019

Checker ________________
Date ________________

****

sediment

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
1	5:1	500:1	122.0	176+00		6.4		0.0	
					100		83.9		0.0
1	5:1	500:1	125.0	175+00		39.0		0.0	
					100		156.1		0.0
	5:1	500:1	125.0	174+00		0.0		0.0	

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

182→184

Designer : jmh
Date : 01/01/80
Job Number 020

Checker ________________
Date ________________

****

sediment

BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	** EXCAVATION ** Volume (Cu.Yds)	** FILL ** Area (SqFt)	** FILL ** Volume (Cu.Yds)
1	5:1	500:1	130.0	184+00		0.3		0.0	
					100		61.5		4.5
1	5:1	500:1	128.0	183+00		33.0		2.4	
					100		123.0		9.0
	5:1	500:1	128.0	182+00		0.3		0.0	

PLANNED

QUANTITY CALCULATIONS

prepared for

saddle

in

MARICOPA COUNTY, Arizona

199+00 ⇒ 206+00

Designer : jmh
Date : 01/01/80
Job Number 021

Checker ______________
Date ______________

****

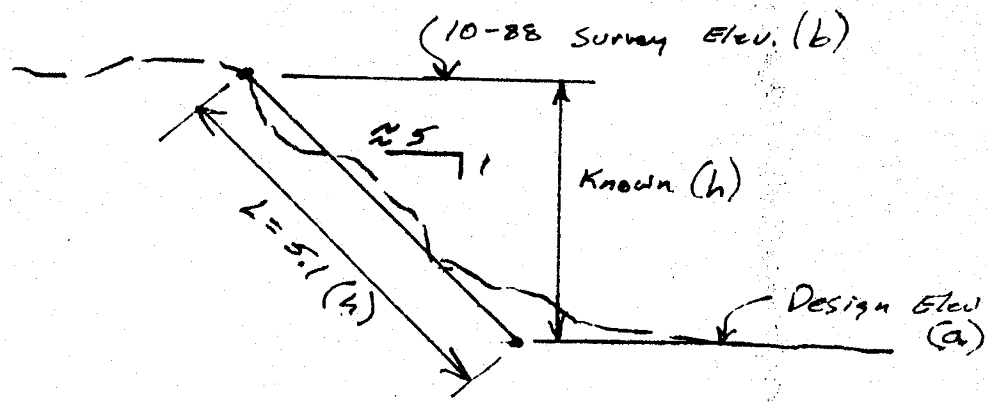
sediment

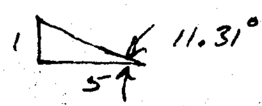
BOT Width	Left SS	Right SS	Off-CL (ft)	CL Sta	Dist (ft)	** EXCAVATION ** Area (SqFt)	Volume (Cu.Yds)	** FILL ** Area (SqFt)	Volume (Cu.Yds)
1	5:1	500:1	134.0	206+00		10.5		0.4	
					100		111.2		0.8
1	5:1	500:1	138.0	205+00		49.6		0.0	
					100		209.9		0.8
	5:1	500:1	140.0	204+00		3.7		0.0	
					100		319.4		0.8
1	5:1	500:1	142.0	203+00		55.4		0.0	
					100		542.2		0.8
1	5:1	500:1	131.0	202+00		64.9		0.0	
					100		737.4		0.8
1	5:1	500:1	141.0	201+00		40.5		0.0	
					100		1392.4		0.8
1	5:1	500:1	139.0	200+00		313.2		0.0	
					100		1978.2		0.8
1	5:1	500:1	140.0	199+00		3.2		0.0	

Saddleback Repair

JMH 11/30/88

SLOPE REPAIR QUANTITIES





$\sin 11.31° = \frac{h}{\text{Slope Length}}$

$SL. = 5.1\,h$

Set up computer spread sheet

Sta	a	b	S.L. Feet	L Feet	AREA SY.
INPUT	INPUT	INPUT	(1)	(2)	(3)

$(1) = (a-b)\,5.1$

$(2) = Sta_n - Sta_{n-1}$

$(3) =$ ~~(1) × (2) ÷ 9~~ AVG SLOPE Length × DIST / 9

60,918 DIV.
8,162 EES
69,080
+ 547
69,627

√201 61,2?0

DIVERSION SLOPE REPAIR

5:1 Slopes

STATION	TOP SLOPE	TOE SLOPE	SLOPE LENGTH	DISTANCE	AREA SY
1700	80.6	71	48.96		
1800	79.8	70.9	45.39	100	524
1900	78.8	70.7	41.31	100	482
2000	78.8	74.2	23.46	100	360
2100	77.6	64.6	66.3	100	499
2200	76	64.4	59.16	100	697
2300	74.5	64.2	52.53	100	620
2400	73.9	64	50.49	100	572
2500	72.9	63.8	46.41	100	538
2600	72.8	63.6	46.92	100	519
2700	63.4	63.4	3.624e-14	100	261
2800	63.2	63.2	7.248e-14	100	0
2900	63	63	7.248e-14	100	0
3000	70.7	62.8	40.29	100	224
3100	69.4	62.6	34.68	100	417
3200	69.4	62.4	35.7	100	391
3300	68.4	62.2	31.62	100	374
3400	68.6	62	33.66	100	363
3500	68.7	61.8	35.19	100	383
3600	61.6	61.6	1.812e-13	100	196
3700	61.4	61.4	1.812e-13	100	0
3800	61.2	61.2	2.174e-13	100	0
3900	67.8	61	34.68	100	193
4000	67.8	60.8	35.7	100	391
4100	67.2	60.6	33.66	100	385
4200	67.4	60.4	35.7	100	385
4300	60.2	60.2	2.899e-13	100	198
4400	65.9	60	30.09	100	167
4500	65.8	59.8	30.6	100	337
4600	65.8	59.6	31.62	100	346
4700	65.6	59.4	31.62	100	351
4800	65.6	59.2	32.64	100	357
4900	59	59	3.624e-13	100	181
5000	58.8	58.8	3.624e-13	100	0
5100	58.6	58.6	3.986e-13	100	0
5200	58.4	58.4	3.986e-13	100	0
5300	63.8	58.2	28.56	100	159
5400	64	58	30.6	100	329
5500	64	57.8	31.62	100	346
5600	64.3	57.6	34.17	100	366
5700	64.4	57.4	35.7	100	388
5800	64.5	57.2	37.23	100	405
5900	64.6	57	38.76	100	422
6000	56.8	56.8	5.073e-13	100	215
6100	56.6	56.6	5.436e-13	100	0
6200	56.4	56.4	5.436e-13	100	0
6300	62	56.2	29.58	100	164
6400	61.9	56	30.09	100	332
6500	62.3	55.8	33.15	100	351
6600	62.4	55.6	34.68	100	377
6700	62.6	55.4	36.72	100	397

1/27/89

6800	62.6	55.2	37.74	100	414
6900	62.5	55	38.25	100	422
7000	62.9	54.8	41.31	100	442
7100	62.5	54.6	40.29	100	453
7200	61	54.4	33.66	100	411
7300	62.8	54.2	43.86	100	431
7400	61.9	54	40.29	100	468
7500	61.7	53.8	40.29	100	448
7600	61.4	53.6	39.78	100	445
7700	61.1	53.4	39.27	100	439
7800	60.8	53.2	38.76	100	434
7900	53	537.972e-13		100	215
8000	52.8	52.87.972e-13		100	0
8100	58.6	52.6	30.6	100	170
8200	60.3	52.4	40.29	100	394
8300	57.3	47.6	49.47	100	499
8400	56.4	47.4	45.9	100	530
8500	56.7	47.2	48.45	100	524
8600	56.6	47	48.96	100	541
8700	56.1	46.8	47.43	100	536
8800	54	46.6	37.74	100	473
8900	53.2	46.4	34.68	100	402
9000	53.5	46.2	37.23	100	400
9100	53.4	46	37.74	100	417
9200	52.8	45.8	35.7	100	408
9300	52.3	45.6	34.17	100	388
9400	51.1	45.4	29.07	100	351
9500	51.9	45.2	34.17	100	351
9600	52.1	45	36.21	100	391
9700	52.3	44.8	38.25	100	414
9800	52.7	44.6	41.31	100	442
9900	52.3	44.4	40.29	100	453
10000	52.3	44.2	41.31	100	453
10100	52.4	44	42.84	100	468
10200	52.9	43.8	46.41	100	496
10300	51.5	43.6	40.29	100	482
10400	52.7	43.4	47.43	100	487
10500	51.6	43.2	42.84	100	502
10600	50.8	43	39.78	100	459
10700	50.2	42.8	37.74	100	431
10800	50	42.6	37.74	100	419
10900	50	42.4	38.76	100	425
11000	49	42.2	34.68	100	408
11100	49	42	35.7	100	391
11200	48.3	41.8	33.15	100	383
11300	48.5	41.6	35.19	100	380
11400	48.8	41.4	37.74	100	405
11500	41.2	41.24.711e-13		100	210
11600	41	414.711e-13		100	0
11700	40.8	40.84.711e-13		100	0
11800	40.6	40.65.073e-13		100	0
11900	40.4	40.45.073e-13		100	0
12000	40.2	40.25.436e-13		100	0
12100	40	405.436e-13		100	0

12200	39.8	39.8	5.436e-13	100	0
12300	39.6	39.6	5.798e-13	100	0
12400	39.4	39.4	5.798e-13	100	0
12500	39.2	39.2	6.16e-13	100	0
12600	39	39	6.16e-13	100	0
12700	38.8	38.8	6.16e-13	100	0
12800	45.8	38.6	36.72	100	204
12900	45.8	38.4	37.74	100	414
13000	44.7	38.2	33.15	100	394
13100	45	38	35.7	100	383
13200	44.1	37.8	32.13	100	377
13300	43.8	37.6	31.62	100	354
13400	43	37.4	28.56	100	334
13500	41.7	37.2	22.95	100	286
13600	42.5	37	28.05	100	283
13700	43.1	36.8	32.13	100	334
13800	41.8	36.6	26.52	100	326
13900	42.2	36.4	29.58	100	312
14000	40.9	36.2	23.97	100	298
14100	39.6	36	18.36	100	235
14200	40.6	35.8	24.48	100	238
14300	39.7	35.6	20.91	100	252
14400	39.4	35.4	20.4	100	230
14500	39.8	35.2	23.46	100	244
14600	39.5	28.63	55.437	100	438
14700	39.4	28.41	56.049	100	619
14800	36.5	28.19	42.381	100	547
14900	36.5	27.97	43.503	100	477
15000	38	27.75	52.275	100	532
15100	27.53	27.53	-1.81e-14	100	290
15200	27.31	27.31	-3.62e-14	100	0
15300	27.09	27.09	-3.62e-14	100	0
15400	26.87	26.87	-3.62e-14	100	0
15500	26.65	26.65	-5.44e-14	100	0
15600	34	26.43	38.607	100	214
15700	34.7	26.21	43.299	100	455
15800	35	25.99	45.951	100	496
15900	35	25.77	47.073	100	517
16000	33.6	25.55	41.055	100	490
16100	33.9	25.33	43.707	100	471
16200	33.6	25.11	43.299	100	483
16300	33.5	24.89	43.911	100	484
16400	32.3	24.67	38.913	100	460
16500	32.1	24.45	39.015	100	433
16600	31.9	24.23	39.117	100	434
16700	32.1	24.01	41.259	100	447
16800	32.2	23.79	42.891	100	467
16900	31.5	23.57	40.443	100	463
17000	31.5	23.35	41.565	100	456
17100	29.8	23.13	34.017	100	420
17200	30.1	22.91	36.669	100	393
17300	29.4	22.69	34.221	100	394
17400	29.4	22.47	35.343	100	386
17500	28.9	22.25	33.915	100	385

17600	27.2	22.03	26.367	100	335
17700	29.9	21.81	41.259	100	376
17800	21.59	21.59	-1.81e-13	100	229
17900	21.37	21.37	-1.81e-13	100	0
18000	21.15	21.15	-1.99e-13	100	0
18100	20.93	20.93	-1.99e-13	100	0
18200	20.71	20.71	-1.99e-13	100	0
18300	27	20.49	33.201	100	184
18400	27	20.27	34.323	100	375
18500	20.05	20.05	-2.17e-13	100	191
18600	19.83	19.83	-2.36e-13	100	0
18700	19.61	19.61	-2.36e-13	100	0
18800	19.39	19.39	-2.36e-13	100	0
18900	19.17	19.17	-2.36e-13	100	0
19000	18.95	18.95	-2.54e-13	100	0
19100	18.73	18.73	-2.54e-13	100	0
19200	18.51	18.51	-2.54e-13	100	0
19300	18.29	18.29	-2.72e-13	100	0
19400	25.8	18.07	39.423	100	219
19500	25.9	17.85	41.055	100	447
19600	25.3	17.63	39.117	100	445
19700	25	17.41	38.709	100	432
19800	25.2	17.19	40.851	100	442
19900	25	16.97	40.953	100	454
20000	25	16.75	42.075	100	461
20100	25	16.53	43.197	100	474
20200	25	16.31	44.319	100	486
20300	25	16.09	45.441	100	499
20400	24.3	15.87	42.993	100	491
20500	23	15.65	37.485	100	447
20600	22.6	15.43	36.567	100	411
20700	23.3	15.21	41.259	100	432
20800	22	14.99	35.751	100	428
20900	22.7	14.77	40.443	100	423
21000	14.55	14.55	-2.99e-13	100	225
21100	14.33	14.33	-2.99e-13	100	0
21200	14.11	14.11	-2.99e-13	100	0
21300	13.89	13.89	-2.9e-13	-21300	0
					60918.367

227 to 243

600' × [illegible] / 9 =

FRS DRAINAGE CHANNEL
SLOPE REPAIR

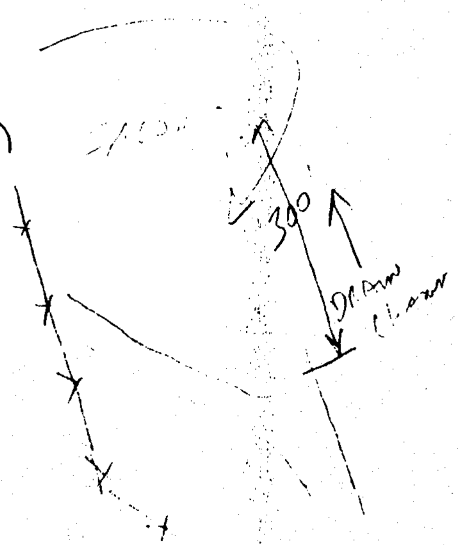
4:1 slopes

STATION	TOP SLOPE	TOE SLOPE	SLOPE LENGTH	DISTANCE	AREA SY
11300	94.5	89.2	21.836		
11400	93	89	16.48	100	212.9
11500	92.9	84.6	34.196	100	281.5
11600	92.6	84.4	33.784	100	377.7
11700	92.9	84.2	35.844	100	386.8
11800	89.1	84.7	18.128	100	299.8
11900	92.7	84.5	33.784	100	288.4
12000	90.1	84.9	21.424	100	306.7
12100	92.6	84.7	32.548	100	299.8
12200	93.4	84.3	37.492	100	389.1
12300	92.8	84.9	32.548	100	389.1
12400	91.9	85	28.428	100	338.8
12500	93.7	85.3	34.608	100	350.2
12600	92.7	85.9	28.016	100	347.9
12700	92.4	85.8	27.192	100	306.7
12800	92.2	85.9	25.956	100	295.3
12900	92	85.4	27.192	100	295.3
13000	92	85.8	25.544	100	293.0
13100	91.8	85.5	25.956	100	286.1
13300	91	85.6	22.248	200	535.6
13500	90.4	85.9	18.54	200	453.2
13700	89.8	86.1	15.244	200	375.4
13900	88.9	86.1	11.536	200	297.6
14100	88.4	86.2	9.064	200	228.9
14300	88.4	86.5	7.828	200	187.7
14500	88.6	86.8	7.416	200	169.4
14600	88.6	86.8	7.416	100	82.4
14700	89	87	8.24	100	87.0
					8162.2

Add for lower slope parallel Drain Channel

300 × (4' AVG HT. × 4:1 slope L.) / 9

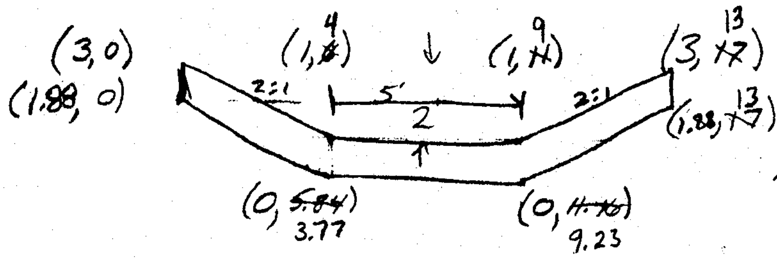
= 547 S.Y.



A2 Saddleback Diversion Inlet Repair

JMH 10-14 AGM 3-1-89

Grouted Rock Riprap Quantities. 1



A = 13.91 sq ft.

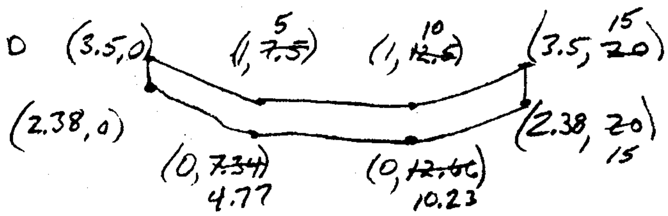
Length = 14' + slope length + 6'

Cutoffs = 3' x [W + 2(2D) + (3D - 3)] x 2' x 2 ends ÷ 27 =

= $\frac{12[W + 7D - 3]}{27}$

→ 5W, 2D. Volume = $\frac{13.91}{27}(L) + \frac{17}{4.5}$ = 0.50 L + 3.8

5W, 2.5 D



A = 16.15 sq ft.

→ 5W, 2.5D Vol = $\frac{16.15}{27}$ L + 4.44 = 0.58 L + 4.5

→ 10W, 2D V = $\frac{18.91}{27}$ (L) + $\frac{22}{4.5}$ = 0.68 L + 4.9

→ 10W, 2.5D V = $\frac{21.15}{27}$ (L) + 5.6 = 0.76 L + 5.6

→ 15W, 2.5D V = $\frac{26.15}{27}$ (L) + 6

→ 45W, 2.5 V = $\frac{56.15}{27}$ (L) + 12.7 =

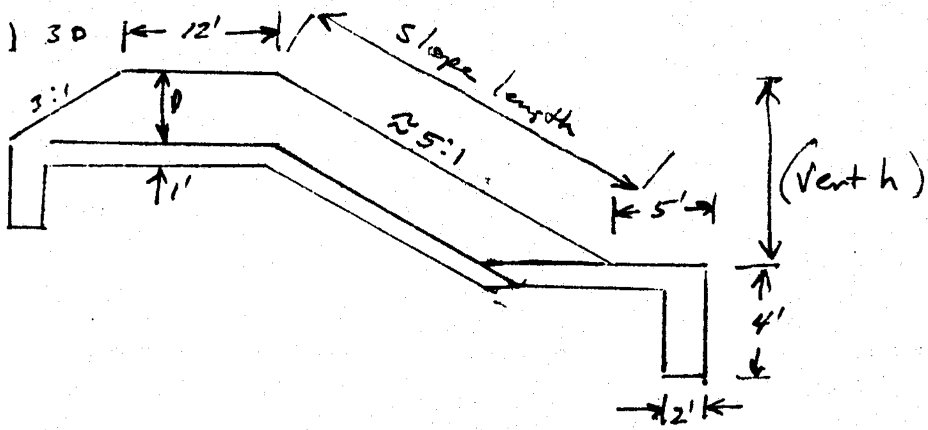
→ 45W, 3.0D V = $\frac{58.41}{27}$ (L) + 13.3

→ 50W, 2.5D V = $\frac{61.15}{27}$ (L) + 14.5

A2 Saddleback Diversion

JMH 12-1-88 aom 3-1-89

Grouted Rock Riprap Quantities



VOL = (X-SECT)(LENGTH) + CUTOFFS

Length = (3D) + 12' + Slope Length + 5'

= 3D + 17' + 5.1(Vert h)

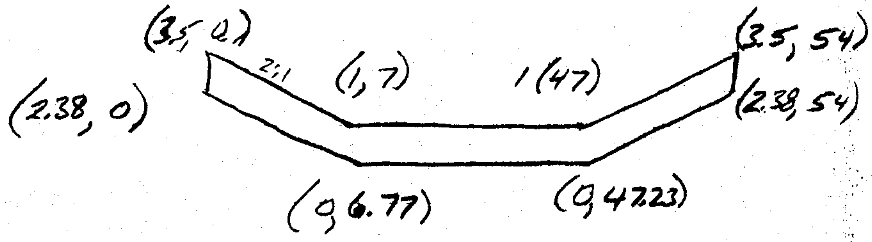
$$Vol = (x\text{-sect})(17 + 3D + 5.1(h)) + \frac{12[W + 7D - 3]}{27}$$

INLET No	W FT	D Ft.	V Ft	XSECT S.F.	VOL C.Y
1	10	2	8.5	~~22.3~~	
2	5	2.5	11.3	~~20.4~~	

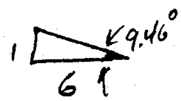
A2 FRS

JMH 1-17-89 [initials] 3-1-89

GROUTED ROCK QUANTITIES FRS



A = 55.65 S.F.



#29:

Length = 3(3.5) + 12 + (95.5 − 83.2) 6.08 + 5 = 102.3

$\frac{102.3 \times 55.65}{27}$ = 210.8 CY ⟶ 210.8

CUTOFF = 2(40+14+8.5) × 2' × 3' ÷ 27 = 27.8 ⟶ 27.8

#30 Length = 3(3.5) + 12 + (95.5 − 84.3) 6.08 + 5 = 95.6

$\frac{95.6 \times 55.65}{27}$ = 197 CY ⟶ 197

+ 27.8 ⟶ 27.8

#31 L × W × D

$\left(\frac{70+48}{2}\right)$ × 36 × 1' ÷ 27 = 79 CY (OK) ⟶ 79

+ CUT OFF = $\frac{(70+36+48+38) \times 2 \times 3}{27}$ = 43 CY (OK) ⟶ 43

585 CY

ARIZ SADDLEBACK FRS DRAIN CH. INLET REPAIR
JMH 3-1-89 CWM 3-1-89
INLET #31, GROUT QUANTITIES

X-SECTIONS TAKEN FROM ST. EXC. CALCS.

SECT	AREA	Σ A	DIST	PRODUCT
1	(17.5+ 7.9+12+7.4+4+ 8.3+5)=62.1			
1-A	(7.9+10+7.9+12+7.4+1+8.3+5)=59.5	121.6	7.5	912
2	(7.9+10+7.9+12+12.7+5)=55.5	115	14	1610
4	49	104.5	12	1254
5	37	86	5	430
				4,206
			÷54 =	77.8

+ Cutoffs. (Same As St. Exc.) 43

GROUTED ROCK

INLET NO	WIDTH FT	DEPTH FT	HEIGHT FT	X-SECT SF	VOLUME CY	
1	10	2	8.5	18.91	55.80	
2	5	2.5	14	16.15	66.03	
3	5	2.5	7.4	16.15	45.90	
4	5	2	6.4	13.91	35.78	
5	10	2.5	7.3	21.15	59.24	
6	10	2.5	6.8	21.15	57.25	
7	10	2.5	7.5	21.15	60.04	
8	10	2.5	9	21.15	66.04	
9	50	2.5	9.3	61.15	191.57	
10	5	2.5	8.6	16.15	49.56	
11	5	2.5	7.5	16.15	46.20	
12	45	2.5	8.6	56.15	168.61	
13	5	2.5	9.6	16.15	52.61	
14	10	2.5	7.7	21.15	60.84	
15	5	2.5	7.7	16.15	46.81	
16	5	2.5	6.5	16.15	43.15	
17	10	2.5	9.8	21.15	69.23	
18	45	2.5	8.4	56.15	166.49	
19	15	2.5	8.3	26.15	77.84	
20	45	2.5 ~~2~~	9.1	58.41	184.65	179.9
21	5	2.5	7.2	16.15	45.29	
22	10	2.5	6.5	21.15	56.05	
23	5	2.5 ~~2~~	6.5	13.91	36.04	38.4
24	50	3.5	8.4	65.65	202.81	
25	5	2.5	8.9	16.15	50.47	
26	5	2.5	8.2	16.15	48.34	
27	5	2.5	6	16.15	41.62	
28	35	3.5	10.5	50.65	177.15	

} corrected 3-17-89

TOTAL ~~2261.4~~ 2258.9

+ FRS 585.4

+ 1/3 Slope Protection Inlet #30 17.2

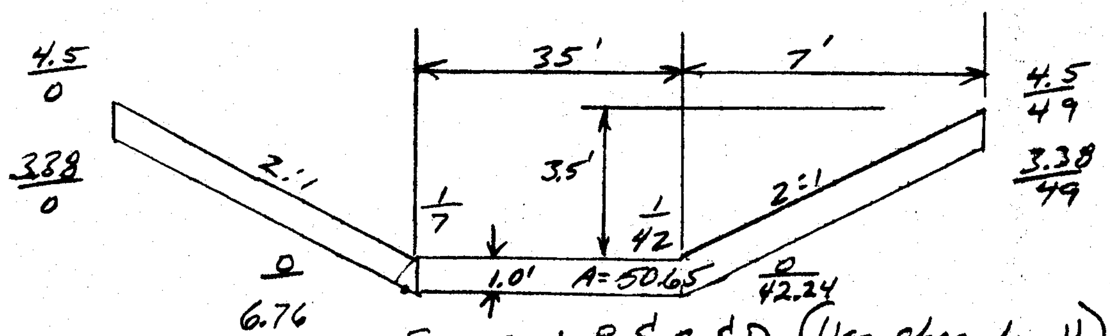
~~2,864~~

2861.5

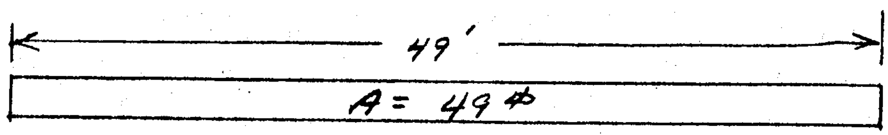
AZ
JMH 3-1-89

SADDLEBACK DIVERSION REPAIR

COMPARISON CHECK - GROUT QUANTITY, INLET # 28



SECTION B & C & D (Use slope length)



Section A (excludes cutoff)
& Section E

SECTION	AREA	ΣA	DIST	PRODUCT
A	49			
		99.65	10.5	1046
B	50.65			
		101.3	12	1216
C	50.65			
		101.3	35.4	3587
D	50.65			
		99.65	18.1	1,804
E	49			
		98	5	490
F	49			
				8,143

÷54 = 150.8 CY

CUTOFFS:

ONSTM - 3'×2'×49' ÷ 27 = 10.9

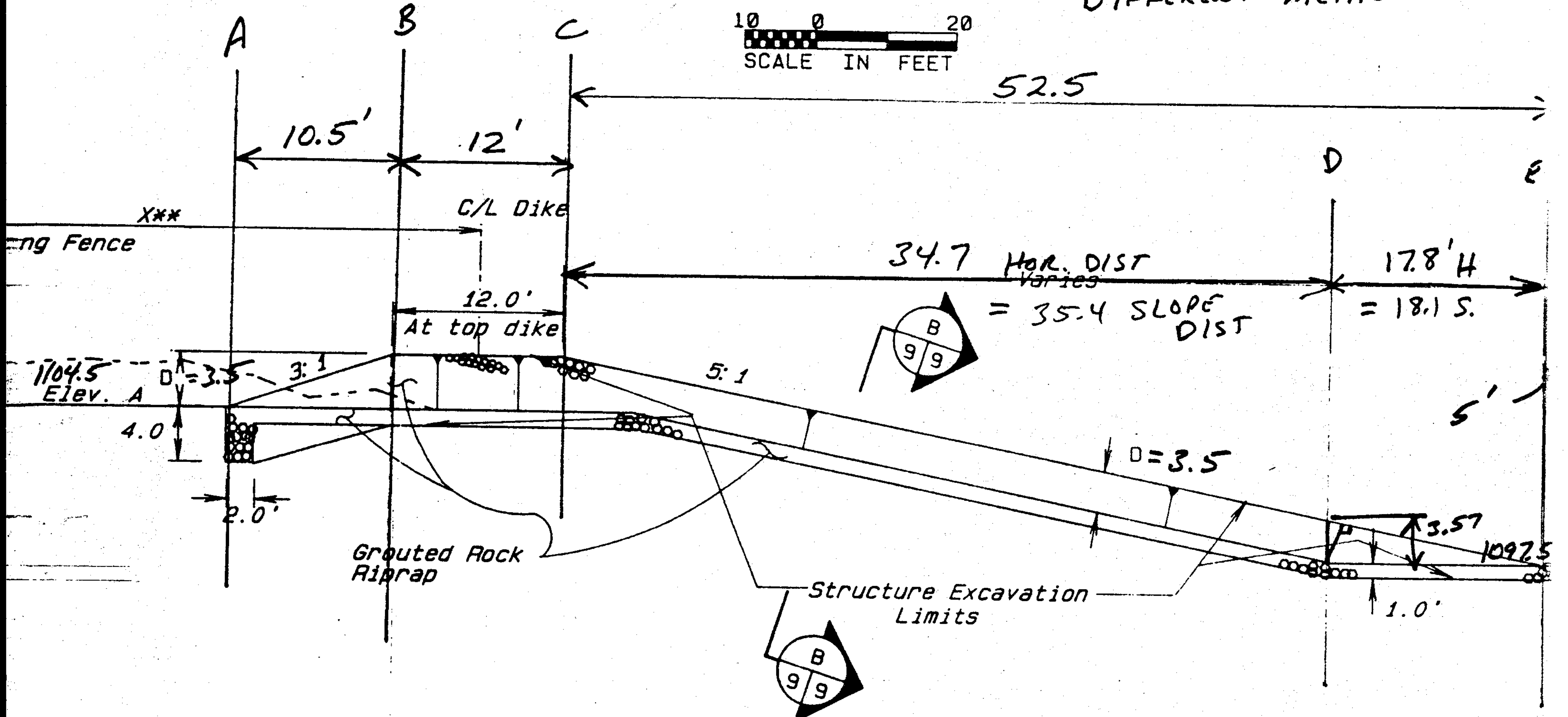
UPSTM - 3'×2'×(49+8.5+8.5) ÷ 27 = 14.7

+ 10.9
+ 14.7

176.4 CY

COMPARED TO 177.1 OK

INLET #28
QUANTITY CHECK COMPARISON
DIFFERENT METHOD

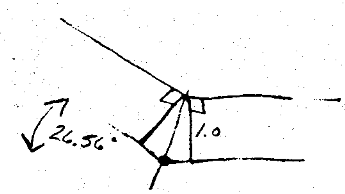


PROFILE ON C\L INLET

5 0 10
SCALE IN FEET

*Downstream ...
terminated ...
caliche as ...

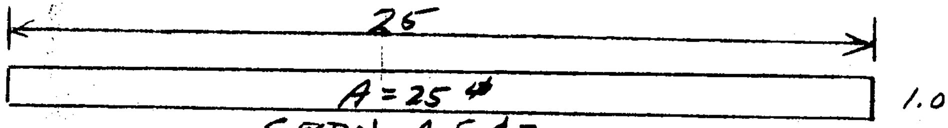
**Dimensions ...
each applic...
sheets 3-6.



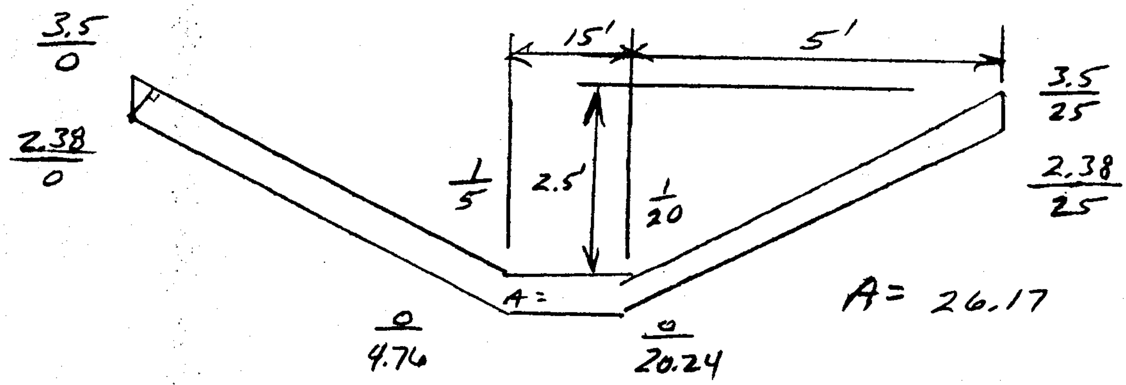
AZ SDIR

JMH 3-1-89

COMPARISON CHECK - INLET #19



SECTION A, E, & F



SECTION B, C, & D

SECTION	A	ΣA	DIST	PRODUCT
A	25			
		51.17	7.5	384
B	26.17			
		52.34	12	628
C	26.17			
		52.34	28.25	1479
D	26.17			
		51.17	13	665
E	25			
		50	5	250
F	25			
				3,406

÷54 = 63.1 CY

CUTOFFS:

DN STM = 3' x 2' x 25' ÷ 27 = 5.6 + 5.6

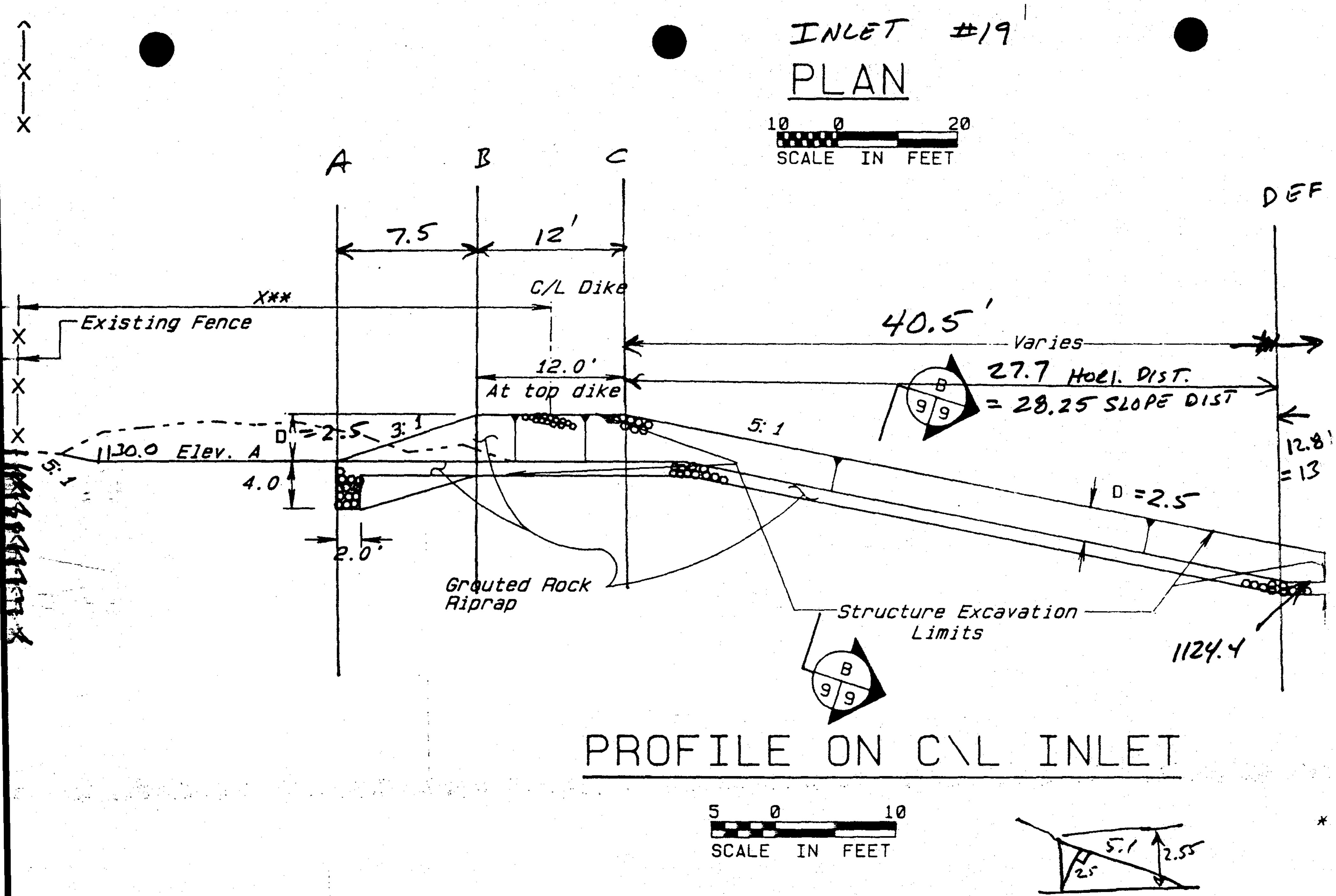
UP STM = 3' x 2' x (25 + 5.5 + 5.5) ÷ 27 = 8.0 + 8.0

76.7 CY

COMPARED TO 76.8 ORIGINALLY CALC'D

OK

INLET #19



PROFILE ON C\L INLET

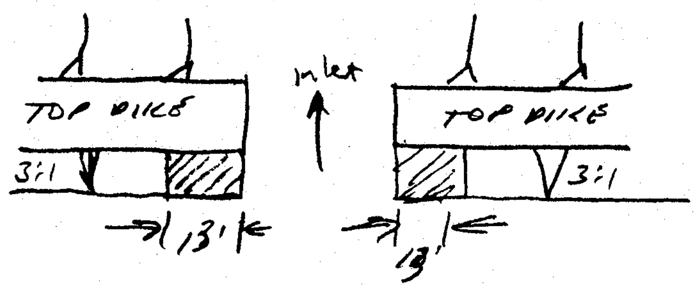
5 0 10
SCALE IN FEET

ARIZ SDI. Repair

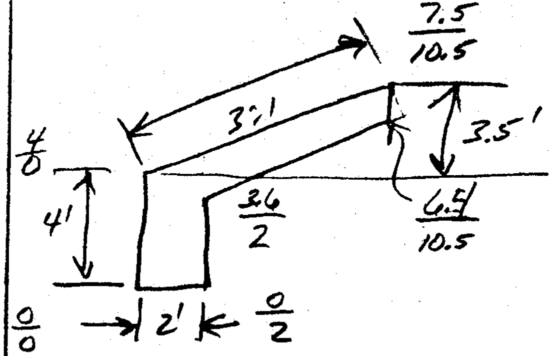
JMH 3-7-89

GROUTED ROCK RIPRAP QUANTITIES

FCD requested additional bank protection at side inlet #30. 13 Feet was added to each side of inlet.



dike height = 3.5



A = 17.9 S.F.

$$Vol = \frac{17.9^{\#} \times 26'}{27} = 17.2 \text{ CY}$$

BID SCHEDULE
SADDLEBACK DIVERSION REPAIR

Item No	Work or Material	Spec No	Quantity	Unit	Unit Price	Amount
1.	Clearing & Grubbing	2	195	Sta.	$ 70.00	$ 13,650.00
2.	Survey	7	1	L.S.	$ 36,500.00	$ 36,500.00
3.	Mobilization	8	1	L.S.	$ 19,000.00	$ 19,000.00
4.	Water	10	4,000	M.G.	$ 6.60	$ 26,400.00
5.	Channel Excavation, Common	21	28,000	C.Y.	$ 1.86	$ 52,080.00
6.	Structure Excavation Common	21	6,950	C.Y.	$ 7.00	$ 48,650.00
7.	Sediment Removal, Common	21	6,500	C.Y.	$ 1.14	$ 7,410.00
8.	Earthfill	23	27,500	C.Y.	$ 2.50	$ 68,750.00
9.	Structure Backfill	23	1	L.S.	$ 15,000.00	$ 15,000.00
10.	Slope Repair	23	195	Sta.	$ 400.00	$ 78,000.00
11.	Grouted Rock Riprap	62	2,864	C.Y.	$ 70.00	$200,484.00
12.	Quality Control	94	1	L.S.	$ 25,000.00	$ 25,000.00

TOTAL $590,920.00

Approved: Ralph M Arrington
State Conservation Engineer

Date: 4-4-89

COST ESTIMATE

BID SCHEDULE

SADDLEBACK DIVERSION REPAIR

Item No	Work or Material	Spec No	Quantity	Unit	Unit Price	Amount
1.	Clearing & Grubbing	2	195	Sta.	$70.00	$13,650.00
2.	Survey	7	1	L.S.	$36,500.00	$36,500.00
3.	Mobilization	8	1	L.S.	$19,000.00	$19,000.00
4.	Water	10	4,000	M.G.	$6.60	$26,400.00
5.	Channel Excavation, Common	21	28,000	C.Y.	$1.86	$52,080.00
6.	Structure Excavation Common	21	6,950	C.Y.	$7.00	$48,650.00
7.	Sediment Removal, Common	21	6,500	C.Y.	$1.14	$7,410.00
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10.	Slope Repair	23	195	Sta.	$400.00	$78,000.00
11.	Grouted Rock Riprap	62	2,864	C.Y.	$70.00	$200,480.00
12.	Quality Control	94	1	L.S.	$25,000.00	$25,000.00

TOTAL $590,920.00

JMH 3-17-89

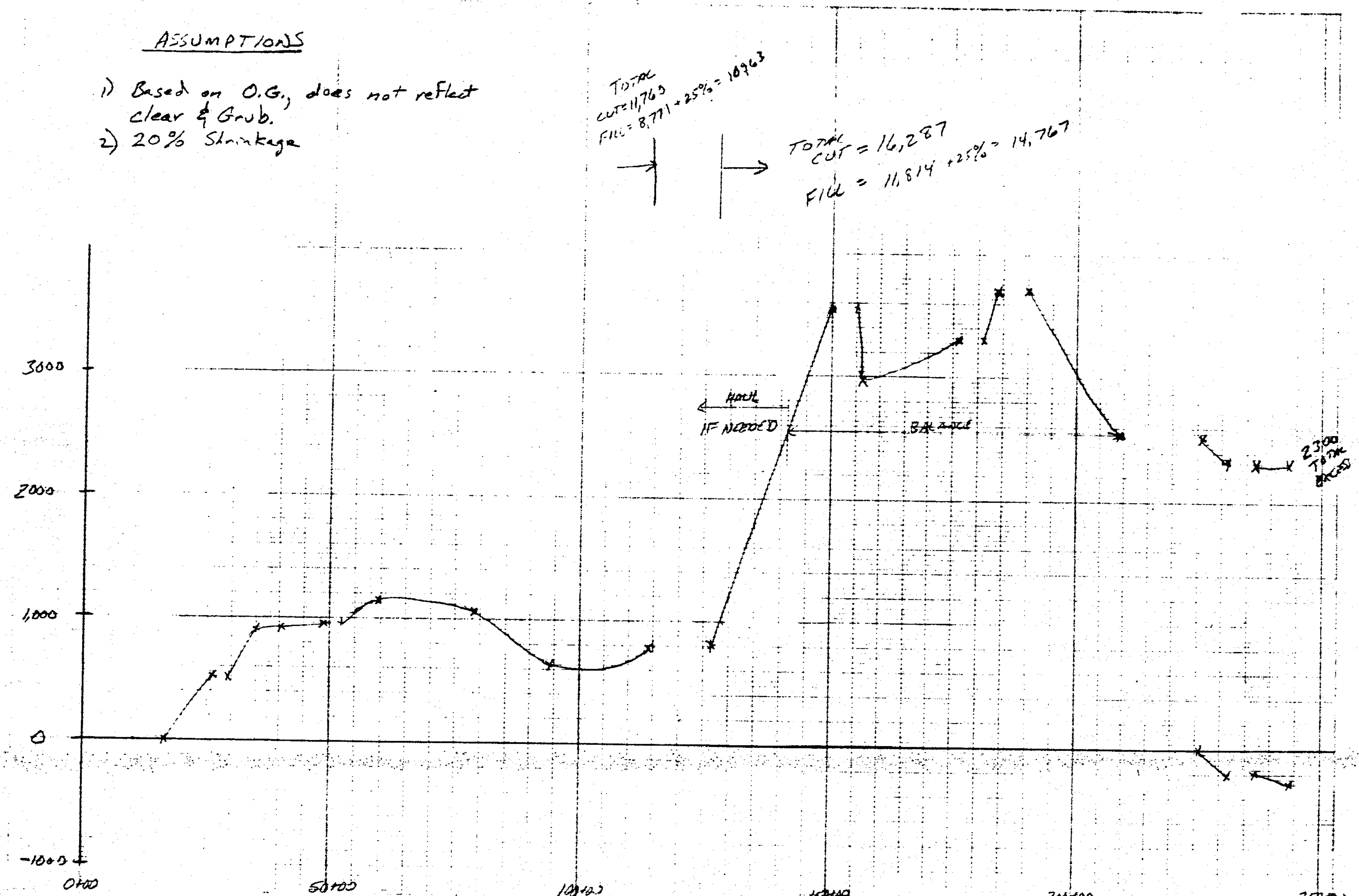
MASS HAUL

(IGNORES CLEAR & GRUB)

STATION	(+) CUT	(−) FILL	BALANCE (W/SHRINK) 20%	CUMUL
17+00 to 26+00	1218	541	540	540
29 to 35	801	343	372	912
38 to 41+30	295	227	11	923
43 to 48	568	424	38	961
52 to 59	899	572	184	1145
62 to 78	2258	1868	− 77	1068
78 to 94	2282	2173	−434	634
94 to 114	3439	2623	160	794
127 to 150	6734	3344	2554	3348
155 to 157	160	413	−356	2991
157 to 177	3297	2393	305	3296
182 to 184	645	201	394	3690
190 to 209	3468	3675	−1,126	2564
226 to 232	440	512	−200	2364
237 to 243	1543	1276	−52	2312

ASSUMPTIONS

1) Based on O.G., does not reflect clear & Grub.
2) 20% Shrinkage



Saddleback Diversion Repair
Mass Haul Diagram

SOIL CONSERVATION SERVICE

SOIL CONSERVATION DISTRICT

JMH

DATE 3-17-89

1510

CLEARING & GRUBBING
160 Stations

Saddleback Diversion Repair

12-2-88

project: 8-A negotiated

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT COSTS			LABOR			MATERIAL				
			HOURS	RATE	COST	HOURS	RATE	COST	QUANTITY	UNIT COST	COST		
AT-146	Clear & Windrow 0.15' surface	20 × 1	20	66.80	1336.00	20	17.00	340.00	—				
AT-623B	Haul windrows to waste	20 × 2	40	90.30	3612.00	40	17.00	680.00	—				
AT-623 WATER	OPERATE FULL TIME For this item	20 × 1	20	70.50	1410.00	20	17.00	340.00	—				
Foreman P/U		20 × 1	20	6.20	124.00	20	20.00	400.00	—				
			SUBTOTALS		6,482			1760.00					
						+50% BURDEN		880.00					
								2640.00				9,122	
										+15% OH&P		1368	
												10490.00	
									UNIT COST = 10490 / 160				$65.56 per Station
											+5% OH&P		= 68.84
										(USE 20% Markup)			

FOR THE ADDED WORK AT THE FRS, CLEARING WILL BE SIMILAR. SAME UNIT PRICE OK.

Bid Item 2

SURVEYS
Lump Sum

Saddleback Dil. Repair

12-2-88
project: 8-A negoti

DESCRIPTION	TOTAL AMOUNT	PROFESSIONAL SERVICES HOURS	RATE	COST		
SITE ORIENTATION & CLEARING LIMITS	1 DAY	8	75.00	600.00		
ORIG. GRD SURVEYS - 3mi. @ 1/2 per day	6 DAYS	48	75.00	3600.00		
SLOPE STK - 3mi @ 1/2 per day	6 DAYS	48	75.00	3600.00		
STRUCT. STK. @ 3 per day, 30 STRUCT	10 DAYS	80	75.00	6,000.00		
MONTHLY PAY EST. SURVEYS 5 @ 1 day	5 DAYS	40	75.00	3,000.00		
As-Builts 3mi @ 1/2 per day	6 DAYS	48	75.00	3600.00		
MISCEL SURVEYS / WEEK	5 DAYS	40	75.00	3,000.00		
OFFICE ENGR. - 2 weeks		80	40.00	3200.00		
		SUBTOTAL		26,600.00		
		+15% OH&P		3,990.00		
		TOTAL		30,590.00	Lump Sum	
ADD FOR FRS REPAIR						
SITE	1					
~~ORIG~~	1					
SLOPE	1					
STRUCT	1					
As-Built	1					
MISC	2					
SUB	6 days	8	75.00	3,600.00		
		+15%		540.00		
		NEW TOTAL		$34,730.00	LUMP SUM	+5% Additional OH&P = $36,500

Bid Item 3

Mobilization

1 Lump Sum

Saddleback Diversion

(location)

12-2-88

project: 8-A negotiat

	DESCRIPTION	TOTAL AMOUNT		UNIT COST					
TRANSPORT	10 MACHINES BY LOW-BOY		10	300	3,000.00				
SET UP OFFICE TRAILER		ELEC. UTIL.		L.S.	500.00				
		Ph. UTIL.		L.S.	200.00				
		TRAILER-move			1000.00				
		Yard Fence			800.00				
BOND COSTS - @ 1.3%	on $600,000.00				7800.00				
			SUBTOTAL		13,300.00				13,300.00
			+15% OH&P		2,000.00			20% OH&P	2,660.00
			TOTAL		$15,300	LUMP SUM			$15,960.00
	Add Foreman - 2 wks	- 80	hrs @ 30.00	(Includes	Burden) =	2,400.00	+20% OH&P		$2,880.00
									18,840.00

Bid Item 4

WATER

3,500 MGal

Saddle Back Diversion Repair

1-30-89

project: 8-A Negotiated

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT COSTS			LABOR			MATERIALS				
			HOURS	RATE	COST	HOURS	RATE	COST	QUANTITY	UNIT COST	COST		
Hurricane Pump	[illegible] 5 mos. - Cost F[illegible]	5×176	880	11.40	10,032.00								
Water									4000	2.00	8,000.00		
3/4 Ton P/u	F/man 1 hr/day		110	6.20	682.00	110	20.00	2,200.00					
					10,714			2,200					
							Budget+50%	1,100					
								3,300					
											SUBTOTAL		22,044
											OH&P	+15%	25,316
											OH&P	+20%	26,417
											UNIT COST		
											26,417 / 4000	=	$6.60

Equipment costs included with Earthfill, St. Backfill, Slope Repair & Grouted Rock Riprap.

Add Foreman, 1 hr. per day check on water - 5 hrs × 5 mos × 4.4 wk/mo × 36.00 × 1.2 (OH&P)

Bid Item 5

Channel Excavation

28,000 CY

[illegible] Diversion Repair

12-5-88

project: 8-A Negotiate

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT COST	LABOR HOURS	LABOR RATE	LABOR COST	MATERIAL				
CAT 623-B	Elevating Scrapers	2 machines	176	90.30	15,893	176	17.00	2,992.00					
CAT 14-G	Blade	1	88	66.80	5,878	88	17.00	1496.00					
D-8L	Dozer - Ripper	1	88	105.30	9266	88	17.00	1496.00					
3/4 ton P/U	F/man + 1 day load, 1 day after		60	6.20	372	60	20.00	1200.00					
	Grade Checker ½ time exc ½ time fill					44	17.00	748.00					
			SUBTOTALS		31,409.00			7,932.00					
						+50%	BURDEN	3966.00					
								$11,898.00			SUBTOTAL	43,307	
										+20%	OHED	8661	
												51,968	
										UNIT	COST	51,968 / 28,000	= $1.86

BID ITEM 6

STRUCTURE EXCAVATION

6,800 CY H/S D

SADDLEBACK SIPHON REPAIR (location)

12-5-88

project: 8-A Negotiated

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT COST	LABOR HOURS	LABOR RATE	LABOR COST
D-8L	Rough cut	3900 CY	80	105.30	8424.00	80.00	17.00	1360.00
CAT 225	FINISH CUT	2900 CY	240	53.70	12,880.00	240	17.00	4,080.00
	F/MAN		80	6.20	596	80	20.00	1,600.00
GRADE CHECKER						280	17.00	4,760.00
			SUBTOTAL		21,900.00			11,800.00
						+ BURDEN		5,900.00
								17,700.00

SUBTOTAL 39,600.00

+20% OH&P 7,920

TOTAL 47,520.00

UNIT COST 47,520 / 6,800 = $6.99/24

USE 7.00

BID ITEM 7

SEDIMENT REMOVAL

6,500 CY

SADDLEBACK DIVERSION REPAIR

(location)

12-5-88

project: 8-A Negotia

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT			LABOR							
			HOURS	RATE	COST	HOURS	RATE	COST					
623-B	Elevating Scrapers	13 HRS → 16x2	32	90.30	2890.00	32	17.00	544.00					
CAT 14-G	BLADE		16	66.80	1069.00	16	17.00	272.00					
F/man	~~½ TIME~~ Full Time		16	6.20	99	16	20.00	320.00					
GR. CHCKR						16	17.00	272.00					
				SUBTOTAL	4058.10			1408					
						+BURDEN		704					
								2,112.00				6,170	
										+20% OH&P		1234	
											TOTAL	7,404.00	
											UNIT COST	7404 / 6500	$1.14 C

Conservation Service

BID ITEM 7

Earthfill

20,000 CY (27,500 W/P)

Schlebach Diversion Repair

12-5-88

project: 8-A Negotiated

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT COST	LABOR HOURS	LABOR RATE	LABOR COST					
CAT-815	Compactor		80	60.70	4856.00	80	17.00	1360.00					
WATERPULL	10,000 GALLON		80	70.50	5640.00	80	17.00	1360.00					
WATER TRUCK	4,000 GALLON		80	28.80	2304.00	80	17.00	1360.00					
TRACTOR/DISC	DISCING FILL		80	50.00	4000.00	80	17.00	1360.00					
F/man	Supervision		40	6.20	248	40	20.00	800.00					
GRADE CHCKR	½ TIME EXC / ½ TIME FILL					40	17.00	680.00					
			SUBTOTALS		17,048.00			6,920.00					
		NOTE: CH. EXC. WAS SHOWN 88 HOURS TIME. THIS CALC. SHOWS 80 HOURS. INCREASE 10% to Match Ch. Exc.			1705.00			692.00					
			SUBTOTALS		18,753.00			7612					
						+50% BURDEN		3806					
								11,418.00		SUBTOTAL		30,171.00	
										+20%	OH&P	6,034	
												36,205.00	
										UNIT	COST	36,205 / 20,000	= $1.81

NOTE PRICE INCREASED SHEET 15 OF

[illegible]

... Conservation Service

BID ITEM 9

Structure Backfill

500 CY

Saddle... Diversion Repair (location)

12-5-88

project: 8-A Negotiated

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT COST	LABOR HOURS	LABOR RATE	LABOR COST
CASE 580 E			100	17.00	1700.00	100	17.00	1700.00
WATER TRUCK	4000 GAL		50	28.80	1440.00	50	17.00	850.00
BOMAG TAMPERS	14" PLATE 5400 #/blow	2 TAMPERS	200	1.10	220.00	—	—	—
LABOR P/U	- 3 Laborers		100	6.20	620.00	300	12.00	3600.00
F/MAN	1/4 TIME		25	6.20	155.00	25	20.00	500.00
			SUBTOTAL		4135.00			6650.00
						+ BURDEN		3325.00
								9975.00

SUBTOTAL	14,110.00
+20% OH & P	2822.00
TOTAL	16,932
UNIT COST	16932 / 500 = $33.86 C

QUITE HIGH

Alternate approach on computation sheets

1 day per structure

get 30.00 per CY

USE

STILL HIGH COMPARED

TO COMPETITIVE BI[D]

BID ITEM 10

SLOPE REPAIR

61,000 Sq. Yds.

Siddibaio Diversion Repair
(location)

12-5-88

project: 8-A ~~NEGOTIATED~~

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT COST	LABOR HOURS	LABOR RATE	LABOR COST					
Waterpull	10,000 Gal		120	70.50	8460.00	120	17.00	2040.00					
Water Truck	4,000 Gal		120	28.80	3456.00	120	17.00	2040.00					
CAT 14-G			120	66.80	8016.00	120	17.00	2040.00					
D-8			40	105.30	4212.00	40	17.00	680.00					
815	COMPACTOR		120	60.70	7284.00	120	17.00	2040.00					
TRACTOR/DISC			120	50.00	6000.00	120	17.00	2040.00					
F[illegible]	½ TIME		60	6.20	372.00	60	20.00	1200.00					
				SUBTOTALS	37,800.00			12,080.00					
						+50%	BURDEN	6,040.00					
								18,120.00		SUB TOTAL		55,920.00	
										+20%	OH&P	11,184.00	
										TOTAL		67,104	
										UNIT	COST	67,104 / 61,000	= $1.10 S

Saddleback Diversion Repair

JMH 1-4-88

Supplier price - ~~Cement~~ Grout & Riprap.

Terry Crocker with Blue Circle returned my call today and quoted the following prices:

5½ Sack mix Grout @ 55^{88} per CY

12-inch minus rock @ 6^{55} per ton

Prices are delivered to Tonopah. He said he used 2 hours of truck time. If we add 1 more hour to rock truck time, he said he used 45^{00} per hour, get about 2^{00} per ton more. $6^{55} + 2^{00} = 8^{55}$

BID ITEM 11
Grouted Rock Riprap
2,530 CY ← OK TOO Apply unit price to revised total of 2835

Saddleback Diversion Repair

12-5-88
project: 8-A Negotiated

	DESCRIPTION	TOTAL AMOUNT	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT COST	LABOR HOURS	LABOR RATE	LABOR COST	MATERIALS QUANTITY	MATERIALS UNIT COST	MATERIALS COST	FROM BLUE CIRCLE	QUOTE
ROCK RIPRAP -	12" - 2530 CY @ 1.7 ton/CY	4300 TONS							4,300	15.00	$64,500.00	10.00	43,000
GROUT MIX	40% VOIDS & WASTE 2530 x 0.40	1012 CY							1,012	50.00	50,600.00	60.00	60,720
CAT 225	HOE TO PLACE ROCK 200 CY/DAY - 15 DAYS		120	53.70	6444.00	120	17.00	2040.00					
CAT 950E	½ - 225 TIME + 3 DAYS CLEANUP	10 DAYS	80	45.10	3608.00	80	17.00	1360.00					
WATER TRCK	4000 GAL - 3 hrs per day	45 HRS	45	28.80	1296.00	45	17.00	765.00					
LABORERS	GROUT CREW - 3 w/P/U	2 Per day Smoothers	120	6.20	744.00	360	12.00	4320.00					
CURE COMPOUND	$\frac{2530 \text{ yd}^3 \times 9 \frac{SF}{SY}}{\frac{1}{2}\text{ Y} \quad 100 \text{ SF/GAL}}$ = 683 GAL	700 Gallons	—	—	—	—	—	—	700	15.00 Gal	10,500.00		
CONCRETE VIBRATORS		2	120	1.10	132.00	—	—	—					
F/man w/PU + 2 days			136	6.20	843.00	136	20.00	2720.00					
			SUBTOTALS		13,068			11,205.00			125,600		
							+50% BURDEN	5,602.00					
								16,328.00					
									SUBTOTAL			154,995.	143,616
									+20%	OH & P		30,999	28,723
									TOTAL			185,994	172,339
													68.[illegible]
									UNIT	COST		185,994 / 2530 =	73.52

BLUE CIRC 3U

USE $70.00

BID ITEM 12

Quality Control

Lump Sum

[illegible]lleback Diversion Repair

12-5-88

project: 8-A Negotiated

	DESCRIPTION	TOTAL AMOUNT	PROFFESIONAL SERVICES HOURS	RATE	COST
Q.C. MNGR.	EST. 4 mos. + 25%	5×176	880	40.00	$35,200
	FOR THIS PROJECT, EQUIP ETC. INCIDENTAL. (SLUMP CONES, . . .)				

This figures appears quite high based on previous projects. EM Floodway Reach 2, 8-A contract negotiated in 1988. $400,000 + contract, Q.C. went for 12,500.00. Approx. 3%.

25,000 for this contract equals 5%. Use for estimate

$25,000

Saddleback Diversion Repair

JMH 12-1-88

Blue book EQuipment Rates

FULL RATES (8A) (MONTHLY)

CAT 623B $10,255 + 32.00 operating

$\frac{10,255}{176} + 32.00 =$ $90.30 per Hr

CAT 815B $\frac{7,285}{176} + 19.30 =$ $60.70 per Hr

CAT D-8L $\frac{10,805}{176} + 28.50 =$ $89.90 per Hr
1-Ripper ~~2285~~ +2.40 ... 1-Ripper + 15.40
105.30

CAT 14G $\frac{7,690}{176} + 18.65 =$ $62.40 per Hr
3-Ripper 595 +1.50 ... 3-Ripper + 4.40
66.80

CAT 225B $\frac{6,600}{176} + 16.20 =$ $53.70 per Hr

CAT 623E $\frac{6,240}{176} + 15.20$
TANK $\frac{1940}{176} + 8.80 =$ $70.50 per Hr

4,000 Gallon Truck $\frac{2,900}{176} + 12.25 =$ $28.80 per Hr

PICK UP - 3/4 TON, 4x4 $\frac{535}{176} + 3.15 =$ $6.20 per Hr

TRACTOR w/ DISC = $50.00

CAT 950E LOADER $\frac{5035}{176} + 16.45 =$ $45.10

CASE - 580E - $\frac{1975}{176} + 5.70 =$ $17.00

COMPUTATION SHEET

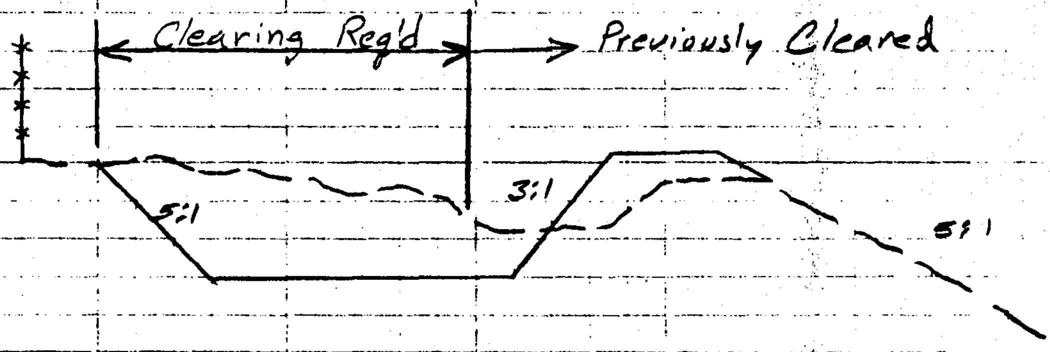
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT Saddleback Diversion Repair

BY JMH DATE 12-2-88 CHECKED BY DATE JOB NO.

Clearing & Grubbing Cost Estimate SHEET 1 OF

For this project, C&G is confined primarily to a narrow strip along the fence line where there was no previous construction. This project provides excavation of a new collector ditch along approximately 160 stations of the diversion. This is the only location that any significant clearing is anticipated.



Assume an average collector ditch bottom width of 24 feet, 2 feet depth of cut. Average cleared width =

$5(2) + 24 + 3(2) = 40$ feet.

Use a 14-G Blade to windrow 0.15 feet of stripping to be picked up by 2-623 scrapers

Volume to be wasted:

$\frac{16000 \times 40' \times 0.15'}{27} = 3,556$ SAY 3,500 CY

Clearing & Grubbing

Assume 50% Fluff due to breaking up soil and brush. 623's will then be req'd to haul an equivelant of 5,500 CY to waste. If design provides 3 spoil sites approximately equal spaced, the average one way haul will be approximately 3/4 mile, say 4,000 Feet. 623B volume equals 22 CY heaped. Because scrapers cross through diversion channel, assume an average of 4% resistance. 623B loaded, 4000 feet, 4% R, travel time equals 2.4 minutes. Return empty, travel time equals 1.8 minutes.

CYCLE TIME

= load + haul + maneuver + return

= 0.9 + 2.4 + 0.7 + 1.8

= 5.8 minutes

Due to narrow work area against Fence, add approximately 20% more time for working condition.

SAY 7.0 minute cycle time.

Use 50 min hour, contractor achieves about 7 loads per hour per scraper. Using two scrapers, this generates 7 x 2 scrapers x 22 CY

Clearing & Grubbing

OR 308 CY per hour of production.

TOTAL TO MOVE = $\frac{5500}{308}$ = 17.8 SAY 20 hours

Assign 10,000 gallon water pull to this operation.

COST:

EQUIP

Scrapers	2 × 20 hrs × 90.30	=	3,612.00
Blade:	1 × 20 × 66.80	=	1,336.00
Waterpull:	1 × 20 × 70.50	=	1,410.00
F/man Truck	1 × 20 × 6.20	=	124.00
			6,482.00 → 6482

LABOR

OPER:	80 hrs @ 17.00	=	1360.00
F/man	20 hrs @ 20.00	=	400.00
			1760.00
	+ 50% Burden	=	880.00
			2640 → 2640

9,122.00

+15% OH&P 1368.00

TOTAL $10,490.00

UNIT PRICE $\frac{\$10,490}{160 \text{ STA}}$ = $ 65.56 per Sta.

Use 70.00

U.S. DEPARTMENT ...
SOIL CONSERVATION SERVICE

STATE | PROJECT
BY JMH | DATE 12-2-88 | CHECKED BY | DATE | JOB NO.

SUBJECT: SURVEYS - COST ESTIMATE | SHEET 4 OF

Typical costs for 3-man crew $75.00 per hour. Due to site location, estimate 3 hour drive time per day, 5 hours production time. Assume office engineering time @ $40.00 per hour.

SURVEYS REQUIRED:	SURVEY	ENGR
ORIENTATION & CLRING LIMITS	1 DAY	8 hr
O.G. SURVEYS 3 mi. @ ½ mi/day	6 DAYS	8 hr
SLOPE STAKING 3 mi @ ½ per day	6 DAYS	8 hr
STRUCTURE STAKING 30 @ 2 per day & GRADE CHECKS	~~15~~ 15 DAYS	8 hr
MONTHLY PAY ESTIMATES - 5 mos @ 1 ENGI. 4 hrs ea	5 DAYS	20 hrs
As-Builts - 3 mi @ ½ per day	6 DAYS	8 hrs
MISC. 1 week	5 DAYS	8 hrs
	44 DAYS	68 hrs. SAY 80

SURVEYING $75 × 8 hrs = $600.00 per day

SURVEY	44 DAYS × 600.00 =	$26,400.00
ENGR.	80 HOURS @ 40 =	3,200.00
		$29,600.00

+15% OH & P $34,040.00 ←

PROJECT

JMH DATE 12-2-88 CHECKED BY DATE JOB NO.

Mobilization - Cost Estimate SHEET 5 OF

EQUIP 2 - SCRAPERS
1 - BLADE
1 - DOZER
1 - WATERPULL
1 - EXCAVATOR
1 - LOADER
1 - TRACTOR/DISC

8 machines on Low-Boy

Typically 500.00 per machine → 4,000.00

OFFICE SET UP

Power, Phone, Transport TRLR, LABOR, Fence → 5,000.00

BOND

1.3% of ≈ $500,000 = 6,500.00

$15,500.00

+15% OH&P 17,825

$18,000 ←

A2 SDI

JMH 12-2-88

COST ESTIMATE - WATER 6

Most of the application costs (equipment time, labor, etc) are included with the unit price for other items of work, ie, waterpull is shown with clearing & grubbing equip., waterpull and truck with earthfill spread and so on. The unit price for this bid item will only include cost for water, hurricane pump and similar related costs.

From contact with Harquahala Irrigation District, they can supply our construction needs at a discharge approximately 2 miles northwest of site at $1.00 per 1,000 gal. For this cost estimate, will double that quote in case of off season etc.

A tire mounted - 6" centrifugal self priming pump, gas powered is 1,000 per month + 5.75 operating cost. Assuming full time use (very high for estimating)

$$\frac{1000}{176} + 5.75 = \$11.40 \text{ per hour.}$$

SAY 5 months. 11.40 × 5 × 176 = 10,032

(high because pump does not operate full time)

PROJECT

BY JMH DATE 12-2-88 CHECKED BY DATE JOB NO

COST EST. - WATER SHEET 7 OF

$$\frac{\$10,032}{3,500\ \text{mGal}} = 2.87 \text{ per M-Gal}$$

Cost for water = 2.00 material
+ 2.87 pump
4.87

+15% OH&P = 5.60 per 1,000 Gallon.

STATE | PROJECT

BY JMH | DATE 12-2-88 | CHECKED BY | DATE | JOB NO.

SUBJECT COST EST. - CHANNEL EXCAVATION | SHEET 8

28,000 BCY

Assume following equip. spread:

2 - CAT 623B scrapers
1 - CAT 14-G Blade
1 - CAT D-8L Dozer
1 - Grde Checker
1 - F/man - ½ TIME

Scraper capacity 22 CY heaped. Use 75% of 22 CY for excavation fluff.

22 x 0.75 = 16.5 SAY 16 CY per cycle

Virtually all excavation will be utilized in immediate vicinity as earth fill. CYCLE TIME

= Load + haul + maneuver + return
= 0.9 + 1 + 0.7 + 1
= 3.6

Very short haul (use 1.0 minute min.) combined with confined width, say 5 minute cycle times. Using 50 minute hour, get 10 loads per hour per scraper.

Hourly production

$\frac{16 CY}{CYCLE} \times 10 \frac{CYC}{HR} \times 2 \text{ machines} = 320 \frac{BCY}{HR}$

COMPUTATION SHEET

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT
BY | DATE 12-2-88 | CHECKED BY | DATE | JOB NO.

COST EST. CH. EXC. SHEET 9 OF

COST

EQUIP

SCRAPERS	2 × 90.30	=	180.60
Blade	1 × 66.80	=	66.80
Dozer	1 × 105.30	=	105.30
F/man Truck	0.5 × 6.20	=	3.10
			$ 355.80 → 355.80

LABOR

OPERATOR	4 @ 17.00	=	68.00
GRADE CHKR	1 @ 17.00	=	17.00
F/MAN	½ @ 20.00	=	10.00
			95.00

+ 50% Burden 142.50 → 142.50

498.30

+15% OH&P $573.00

UNIT PRICE

$ 573 / 320 = $1.79 per CY

Using $1.80, is 20% in contractors Favor when applied to 28,100 BCY because already compensated contractor for 6,000 BCY of clearing removal.

~~4,800~~ 6,800 BCY

Assume 2 operations. Contractor can easily approx. ~~40~~ 60 % of material (3900 BCY) with D-8 by pushing into channel bottom.
At 1 hour per structure, 29 structures
SAY 40 hours total including moving from structure to structure.

2nd operation, excavation of balance of material to subgrade + cutoff trench excavation, 2,900 CY. CAT 225 w/ 1 CY BUCKET, low end of production table (page 116 Handbook) approximately 100 CY per hour. Use 25 % efficiency factor for diversion slopes and complicated excavation

$$\frac{2{,}900\ CY}{25\ CY/HR} = 116 \text{ hours.}$$

Double this figure for moving machine from structure to structure combined with potentially hard excavating conditions (ROCKY CALICHE)

116 x 2 = 232 SAY 6 weeks.

AZ SAI

JMH 12-2-88

COST EST. ST. EXC. 11

EQUIP

DOZER - 80 @ 105.30 = 8424

EXCAVATOR - 240 @ 53.70 = 12,888

21,312.00 21,312

LABOR

OPER. 320 hrs @ 17.00 = 5,440.00

GR CHECKER 320 hrs @ 17.00 = 5,440.00

10,880.00

+ 50% Burden 16,320.00 → 16,320

37,632

+ 15 % OH & P = $ 43,276.00

UNIT PRICE

43,276 / ~~4,800~~ 6,800 = $6.36 per CY

USE $ 6.50 per CY

A2

SDI

JMH 12-2-88

COST EST. SEDIMENT REMOVAL

6,500 BCY

Using same spread as channel exc. (which is somewhat fat for this operation) and cycle times similar to clearing & Grubbing cycles for haul to waste. Material is very loose so anticipate almost no fluff. Use 20 % for cost est. -

6500 × 1.2 = 7,800 CY to move

22 CY per load.

From Clr & Grub, 308 CY per hour.

Cost from CH. EXC = $573.00 per hour

UNIT PRICE

Too high

$\frac{573}{308}$ = 1.86 SAY $2.00 per CY

Redone on other sheet @ 1.14

A2

SDI

JMH 12-2-88

COST EST. - EarthFill

13

20,000 CY

Costs for excavation, transport, and dump have all been included for Channel EXC. Costs associated directly to earthfill will be compacting, water application, discing, grade checker, laborers, and grade checker.

Channel EXC. is hauling 320 BCY per hour. Assume compacted material is about 80% of excavated material due to compaction,

320 x 0.80 = 256 CY per hour of compacted Fill.

Can 1-10,000 gal. water pull and 1-4000 gallon truck @ 1 cycle per hour each meet demand?

256 CY @ 40 gall/CY + 20% WASTE = 12,300 gal/Hr OK

A2 SDI

JMH 12-2

COST EST. EARTHFILL 14

COST

EQUIP (HOURLY)

CAT-815 -	1 @	60.70	=	60.70
WATER PULL -	1 @	70.50	=	70.50
WATER TRUCK	1 @	28.80	=	28.80
TRACTOR/DISC	1 @	50.00	=	50.00
F/MAN TRUCK & LABOR TRUCK	1½ @	6.20	=	9.30
				219.30 → 219.30

LABOR (HOURLY)

OPER.	4 @	17.00	=	68.00
LABOR	1 @	12.00	=	12.00
F/MAN	½ @	20.00	=	10.00
G/CHKR	½ @	17.00	=	8.50
				98.50

+ 50% BURDEN = 147.75 → 147.75

367.05

+ 15% OH&P = 422.10
20% 440.46

UNIT COST 422.10 (440.46) / 256 = $1.65 (1.72) per CY

CONTRACTOR MAY HAVE TO BORROW (SUBSIDIARY)

AZ SDI

JMH 12-2-88

COST EST. - EARTHFILL

IF 20% too little excavation,

20% (20,000 FILL CY) = 4,000 CY.

EXC. PRICE is $1.86

4000 × 1.86 = $7,440 +7,000 FRS@1.86 = 13,020

Distribute over 26,000 CY

$\frac{20,460}{26,000}$ = 0.79 per CY.

TOTAL UNIT COST

1.72
+ 0.79
2.51

SAY **2.50 per CY Fill**

A2 SOI

JMH 12-2-88

COST. EST. – ST. BACKFILL 16

The existing structures that have experienced erosion around the abutments need to be repaired by compacting fill around them. Assume contractor uses two laborers with tampers, 1 more laborer w/ shovel, Case 580 Loader/Hoe, and the 4,000 gallon water truck ½ time, F/man ¼ time.

The hourly cost for this operation is

EQUIP

CASE 580E	1 @	17.00	=	17.00
WATER TRUCK	½ @	28.80	=	14.40
TAMPERS – (BOMAG - 14" PLATE 5400 lb/...)	2 @	1.10	=	2.20
F/man TRUCK – & LABOR TRUCK	1¼ @	6.20	=	7.75
				41.35 → 41.35

LABOR

OPER	1 @	17.00	=	17.00
LABOR	3 @	12.00	=	36.00
F/man	¼ @	20.00	=	5.00
				58.00
+50% Burden				87 → 87

128.35

+15% OH & P = $147.60 per hour

A2 SDI

JMH 12-2-88

COST EST. ST. BACKFILL 17

Typical production rates would be

1 - lift 6" × 5' × 50' ÷ 27 ≈ 5 CY per hour

(10 min.) ... days

UNIT COST

$$\frac{147.60}{5} = 29.52 \quad \text{SAY } \$30^{00} \text{ per CY}$$

Alternative approach = 12 structures.

1 structure per day.

12 days
× 8 hours
×128.35 per hour

12,321

+20% ×1.2

14,786

$$\frac{14,786}{500 \text{ CY}} = 29^{57}$$

use 30 per hour

A2 SDI

JMH 12-2-88

COST EST - SLOPE REPAIR 18

The basic procedure to repair the rilled and sloughed slopes will be to wet slope, rip to rill depth with 14G, continue to wet slopes, disc slopes, and compact with CAT 815 or similar. Since the slopes are 5:1 or flatter, operation of the equipment on the slopes is feasible. Severely eroded areas, say rill depths greater than 2 to 3 feet may require the D-8 to do shaping in these areas.

For the minor (<1-foot) rilled areas, and using an average slope height of 8 feet, we get a slope length of approximately 40 feet. Using a working distance of 500 feet, and ripping 12-inches, volume =

40'×1'×500 ÷27 ≅ 750 CY.

From the CAT handbook, an 815 at its slowest speed making 4 passes can compact 220 CY per hour at 100% efficiency. Cut in half for slope conditions!

$$\frac{750}{410} = 1.85 \text{ say } 2 \text{ HRS.}$$

Check water requirement:

$$750 \text{ CY} \times 40 \frac{\text{Gal}}{\text{CY}} + 20\% \text{ waste} = 36,000 \text{ Gallons}$$

Say 4-loads of 10,000 Gallon water pull are required @ 1-load per hour, accomplish 2-sections per day or 1,000 Feet. Surface area equals

$$1000 \times 40' \div 9 \frac{\text{SF}}{\text{SY}} = 4,450 \text{ SY per day.}$$

There are 61,000 SY estimated to be repaired. Work days equals (70,000)

$$\frac{61,000}{4450} = 13.7 \quad \text{SAY 3 weeks to repair slopes.}$$ 15.7 day

For Severely eroded areas, located at structures existing, structures 2, 4, 5, 7-9, 11-17; 13 structures. At 2 to 3 structures per day, the dozer would work about 5-days,

A2

SDI

JMH 12-2-88

COST EST - SLOPE REPAIR

which equals 1/3 of the time the rest of the spread is required. This appears reasonable. Total COST:

EQUIP

WATERPULL	120	@	70.50	=	8,460
WATER TRUCK	120	@	28.80	=	3,456
BLADE	120	@	66.80	=	8,016
DOZER	40	@	105.30	=	4,212
COMPACTOR	120	@	60.70	=	7,284
TRACTOR/DISC	120	@	50.00	=	6,000
F/MAN TRK	60	@	6.20	=	372
					37,800 → 37,800

LABOR

OPER	640	@	17.00	=	10,880
LABORER	120	@	12.00	=	1,440
F/MAN	60	@	20.00	=	1200
					13,520
+ 50% Burden					20,280 → 20280
					58,080.00

+15% OH&P = 66,792

UNIT COST $\frac{66,792}{61,000}$ = $1.10 per SY

AZ SDI

JMH 12-2-88

COST EST - GROUTED ROCK [illegible] 21

3-7-89 → 2825

2,530 CY

Materials

ROCK 2,530 CY ROCK @ 1.7 ton/CY = 4,300 tons

Assume 5% waste ×1.05

4,500 tons to purchase & deliv.

GROUT 2,530 CY @ 40% voids + WASTE

2530 × 0.40 = 1,012 CY of Grout.

COST OF DELIVERED MAT'LS.

Grout typically goes for 40 to 45 dollars per CY in Metro-Area. Closest apparent plant is in Buckeye,

[illegible] 55 55 [illegible]

Rock

4,500 ton @ $15.00 = $67,500

12[illegible] + 15% = [illegible]

Terry Crocker @ Blue Circle 253-2505 ext 376

Donny Wilcox w/ [illegible] River Sand and Rock [illegible] worked on 15-20 per ton plus [illegible] delivered.

AZ SOI

JMH 12-2-88

COST EST- GPO 5780 RIPRAP 22

Placement

Loader & Excavator (Back Hoe)

Vibrators- Gasoline 1 7/8-inch

$\frac{110^{00}}{176}$ + 45¢ = 5,08

A2 Saddleback Diversion Repair

JMH 10-21

WATER AVAILABILITY

CONTACTED Mr. DICK YANTCY AT HARQUAHALA IRRIG. DISTRICT, 372-4791. They do not have much water in the area of our project in the winter time. They do have during cotton irrigation time from end of March through the summer months. Cost should be around 75 cents per 1,000 gallons. They would have no problem with 100,000 gallons or so per day, a total of say 5 million gallons. He estimated that water would be within 2 miles north or west of our project at Courthouse Road.

Possible to get water at other times of the year. much more expensive because they do not normally have it down there in winter. I did not get a price from him for other times.

AZ
JMH 11-30-88
WATER

Saddleback Diversion Repair

Contacted Mr. Yantey at Harquahala Irrigation District, 372-4791. Asked him about water cost if we need it during their offseason. He said it would probably be around $1.00 per 1,000 gallons.

SCS-B&F-88
Rev. 1-70
File Code B&F-11

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Location

	DESCRIPTION		Quantity	Equip't Hourly Rate	Equip't Cost	Operation & Main Hourly Rate	O&M Cost	Labor Hourly Rate	Sub Contracted	Labor Cost		Item Sub-Total		Item Total
4200	Trucks		7,300 CCY. 32 hrs.	5 x 45.00 $225.00	$7,200.00							$7,200.00		
4300	Placing		14,000 CCY 56 hrs	94.00	5,264.00	$64.00	$3,584.00	$135.50		$7,588.00		16,436.00		
4400	Gradall		64 hrs.	105.00	6,720.00							6,720.00		
	grade checker (2 days beyond gradall)		16 hrs					18.90		303.00		303.00		
4,500	Mech-Service & Truck		80 hrs	10.00	800.00	5.00	400.00	20.00		1,600.00		2,800.00		
5000	EARTHFILL-O&M RD.	1300	from trailer & 10,600 from Borrow 11,900											$46,364.00
5100	Placing													
	1 Blade; Trucks Tractor 40 Mechanic - Foreman		24 hrs	114.00	2,736.00	84.00	2,016.00	97.80		2,347.00		7,099.00		
	Full Spread		40 hrs	339.00	13,560.00	259.00	10,360.00	271.00		10,840.00		34,760.00		
5200	S/G Prep		2 Walk behind; Blade & W.T L.S											
	Blade		12 hrs.	25.00	300.00	15.00	180.00	20.64		248.00		728.00		
	Water Truck		12 hrs.	20.00	240.00	10.00	120.00	17.05		205.00	205	565.00		
	2 Walk Behinds		12 hrs.	20.00	240.00	10.00	120.00	33.46		402.00		762.00		
5300	Clear & Grub		7 Ac @ 350.00									2450.00		
6000	WATER		3200 M's										3.54	11,315.00
6100	Permit		L.S.									25.00		
6200	Purchase Water		3,200 M's	Confirmed / Phone Forwed 1.50								4,800.00		
6300	Tower - Pump											5,940.00		
6400	Tower Install & Maint											550.00		

SCS-B&F-88
Rev. 1-70
File Code B&F-11

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

From EMF [illegible] 1/3
[illegible] Contract Negotiations

Location

	Description		Quantity	Equip. Hourly Rate	Equip Cost	Operation & Maintenance Hourly Rate	Oth. Material Ed. Cost	Labor Hourly Rate	Sub-Contracted	Raw Labor Cost		Item Sub-Total	Unit Price	Item Total
1000	Mobilization		L.S.											8,236.00
1100	Move-In & Out Equip		10 Ea.			$180.00	$1800.00					$1800.00		
1200	Set Up Trailer & Yard		L.S.	–	$100.00	–	100.00	–		$150.00		350.00		
1300	Set Up Yard Utilities		L.S.				800.00	$13.27		150.00		950.00		
1400	Bond		1.3%									5,136		
2000	STRUCTURE REMOVAL (Includes Excavation Common)	1000 Rock & 8120 BCY	L.S.											$15,504.00
2100	Excavation & Load		32 hrs.	$144.00	4,608.00	79.00	2,528.00	114.00		3,648.00		10,784		
2200	Trucks End dump Haul-off		3150 LCY 16 hrs.	5 x 45.00	3,600.00							3,600		
2300	Quotionable if a Grabbell is needed													
2400	Should be in earthfill O&M													
2500	Mechanic - Service & Truck		32 hrs	10.00	320.00	5.00	160.00	20.00		640.00		1,120		
3000	STRUCTURE EXC.		95 C.Y.											3503.00
3100	Backhoe & Crew		32 hrs.	29.00	928.00	19.00	608.00	56.50		1,808.00		3,344.00		
3200	966C Loader & Op		2 hrs.	35.00	70.00	25.00	50.00	19.70		39.40		159.40		
3300	Truck – Doubtful													
4000	EARTHFILL - COMMON		12,100										3.88	46,951.00
4100	Borrow Pit Prep.							Note: No Grade checker						
	Water Trucks, Tract. & Disc, Blade		16 hrs	100.00	1600.00	60.00	960.00	94.21		1,508.00		4,068.00		
	Full Spread		32 hrs	135.00	4320.00	85.00	2,720.00	74.51		2384.00		9,424.00		

8600

3/3 |

SCS-B&F-88
Rev. 1-70
File Code B&F-11

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Location

	DESCRIPTION		Quantity	Equipt Hourly Rate	Equipt. Cost	Operating & Maint. Hourly Rate	Operating & Maint. Cost	Labor Hourly Rate	Sub-Contracted	Labor Cost		Item Sub-Total		Item Total
7000	PAM		414 C.Y.						$58,788.00				$142.00	$58,788.00
8000	Soil Cement		2,110 C.Y.										30.52	64,400.00
8100	Cement Spreading mixing & supervision								20,000			$20,000		
8200	Placing & Compact				$5,246.00		$3,354.00			6,400.00		$15,000		
8300	Cement		2100 bbls	@ 14.00								29,400		
9000	Surveys	L.S.							25,000.00			$25,000.00		25,000.00
10,000	Contractor Insp.	L.S.							12,713.00			$12,713		12,713.00
					57,852		[illegible]		116,501	[illegible]				292,774
											[illegible]		1.2 x	
										+	11,315			
											2,450			
											[illegible]			
											287,6[illegible]			
											5,1[illegible]6			
											292,774			

LOW PRICES BID 1981

BID SCHEDULE NO. 1

SADDLEBACK FLOODWATER RETARDING STRUCTURE

No.	Work or Material	Spec. No.	Quantity	Unit	Unit Price (Low)	(High)	Amount
1.	Clearing and Grubbing	2	146	acres			
2.	Seeding	6	118.8	acres			
3.	Mobilization	8	1 job	Lump sum			
4.	Foundation Excavation, common	21	351,912	Cu.Yd.	1.00	1.00	
5.	Channel Excavation, common	21	456,450	Cu.Yd.	0.80	1.30	
6.	Structure Excavation, common	21	1,657	Cu.Yd.			
7.	Structural Backfill	23	2,683	Cu. Yd.			
8.	Earth Fill	23	687,770	Cu. Yd.	0.28	0.20	
9.	Drain Fill	24	37,527	Cu. Yd.			
[illegible]	Concrete Class 4000 X	31	324.5	Cu. Yd.			
[illegible]	Cement	31	95	Tons			
12.	Steel Reinforcement	34	48,567	Lbs.			
13.	6-inch dia. drain pipe	44	1,690	Lin.Ft.			
14.	Loose Rock Riprap	61	110	Cu. Yd.	13.00	22.00	
15.	Slide Gate, 12" X 12"	71	2	EA			
16.	Metalwork	81	1	Lump Sum			
17.	Identification Sign	81	1	Lump Sum			
18.	6' Chain Link Fence	91	62	Lin. Ft.			
19.	4-strand barbed wire fence	92	65,250	Lin. Ft.			
20.	Grouted Rock Riprap	200	183	Cu. Yd.	28.00	50.00	
21.	Grouting Rock Surface	201	90	Cu. Yd.			
[illegible]	Surface Preparation & Cleaning	201	533	Sq. Yd.			

Total...... $

BID SCHEDULE NO. 2

SADDLEBACK DIVERSION

Prices bid Saddleback

	Work or Material	Spec. No.	Quantity	Unit	LOW Unit Price	HIGH	Amount
1.	Clearing & Grubbing	2	210	Acre			
2.	Seeding	6	300	Acre			
3.	Mobilization	8	1 Job	Lump Sum			
4.	Channel Excavation, common	21	914,790	Cu. Yd.	0.74	1.00	
5.	Channel Excavation, Unclassified	21	107,157	Cu. Yd.	0.79	1.50	
[illegible]	Structure Excavation, Common	21	11,350	Cu. Yd.			
7.	Foundation Excavation, Common	21	12,500	Cu. Yd.			
8.	Structure Backfill	23	7,100	Cu. Yd.			
9.	Earth Fill	23	141,800	Cu. Yd.	0.97	0.20	
1[illegible]	Drain Fill	24	1,810	Cu. Yd.			
[illegible]	Concrete Class 4000 X	31	80	Cu. Yd.			
12.	Cement	31	23	Tons			
13.	Steel Reinforcement	34	5,387	Lbs.			
[illegible].	12" dia. Reinforced Concrete Pipe	42	280	Lin. Ft.			
15.	21" dia. Reinforced Concrete Pipe	42	70	Lin. Ft.			
16.	6" dia. Drain Pipe	44	1,246	Lin. Ft.			
17.	Loose Rock Riprap	61	198	Cu. Yd.	13.00	[illegible]	
18.	Metal Work	81	1	Lump Sum			
19.	Identification Sign	81	1	Lump Sum			
20.	4-strand barbed wire fence	92	56,500	Lin. Ft.			
21.	Grouted Rock Riprap	200	13,503	Cu. Yd.	20.00	[illegible]	
				Total.......	$		

1981 Prices Bid
Saddleback

BID SCHEDULE NO. 3

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
SADDLEBACK FRS & DIVERSION

Item No.	Work or Material	Spec. No.	Quantity	Unit	Unit Price	Amount
1.	Structure Excavation, Common	21	2,425	Cu. Yd.	$	$
2.	Structure Backfill	23	1,205	Cu. Yd.		
3.	Earth Fill	23	7,640	Cu. Yd.	1.18 0.20	
4.	Concrete	31	236.6	Cu. Yd.		
5.	Steel Reinforcement	34	34,250	Lbs.		
6.	65" X 40" Corrugated Metal Pipe Arch (Including End Sections)	51	345	Lin. Ft.		
7.	Loose Rock Riprap	61	1,350	Cu. Yd.	13.00 30.00	
8.	Grouted Rock Riprap	200	141	Cu. Yd.	28.00 50.00	
9.	Pavement Replacement – Courthouse Road	400	756	Sq. Yd.		
10.	Untreated Base – Buckeye Salome Road & 479th Ave.	400	6,145	Sq. Yd.		

Total....$

Performance Time

Time allotments from Con EST.

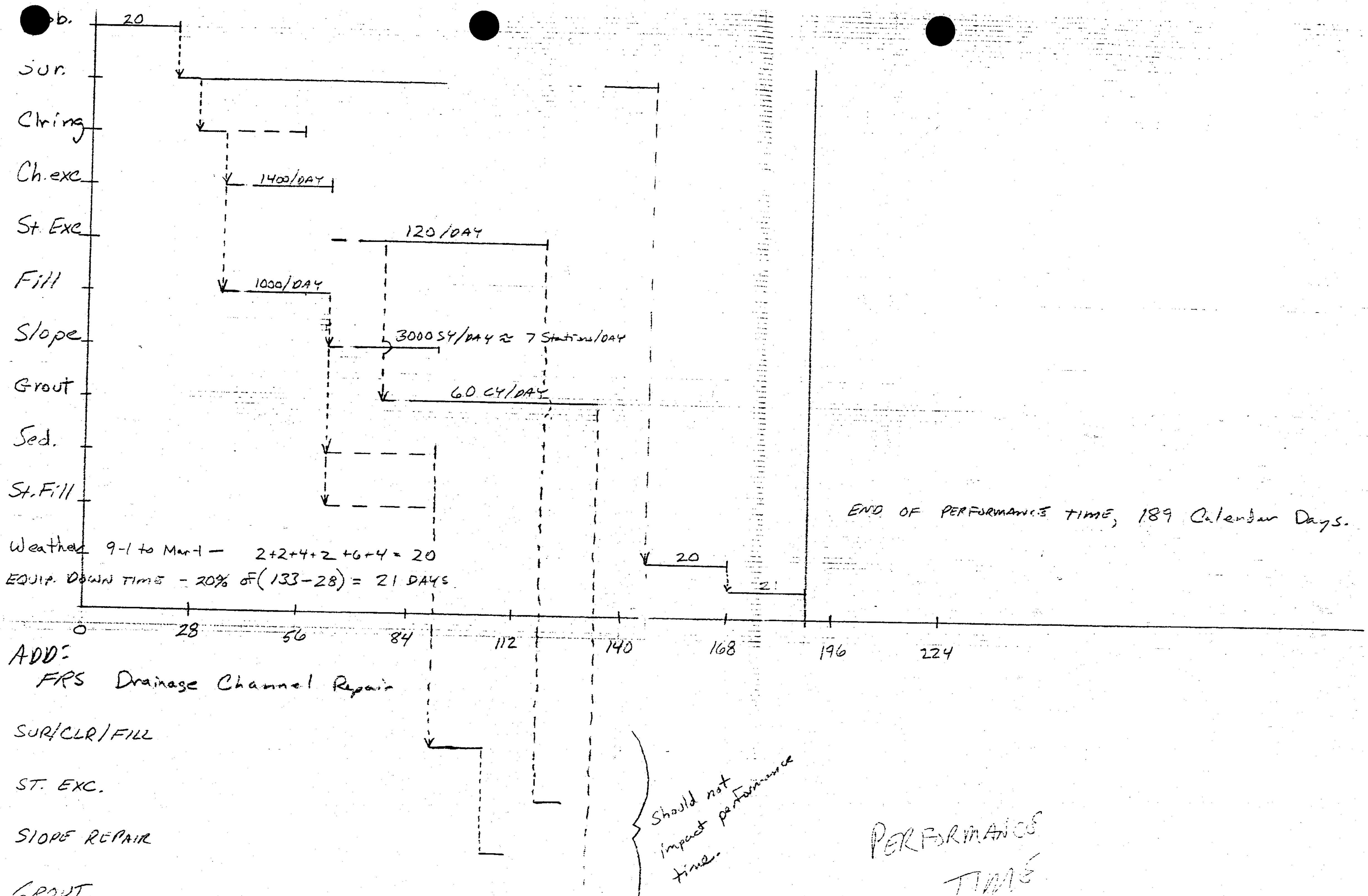
Saddleback Diversion Repair
(location)

12-5-88

project:

	DESCRIPTION	TOTAL AMOUNT	HOURS ASSIGNED PER BID ITEM NO. 1	3	4	5	6	7	8	9	10	11	DIVERSION TOTAL	FRS TOTAL	TOTAL
F/MAN			20/8	80	110	60	80/8	16	44/24	25	60/12	136/24	631	76	707
CAT 623	Scrapers - 2 machines		40/16			176		32	0/48				124 each	24 each	296
CAT 14-G	Blade		20/8			88		16			120/24		244	32	276
WATER PULL	623 W/ 10,000 Gallon		20/8						88/24		120/24		228	56	284
GRADE CHECKER						44	240/24		44/24				328	48	376
D-8L	W/RIPPER					88	40/8				40		168	8	176
CAT 225	EXCAVATOR						240/24			—		120/24	360	48	408
CAT 815	COMPACTOR								88/24		120/24		208	48	256
WATER TRUCK	4,000 Gallon								88/24	50	120/24	45/8	303	56	359
TRACTOR/DISC									88/24		120/24		208	48	256
CASE - 580										100			100		100
CAT 950 E	LOADER											80/24	80	24	104

4 mos @ 176 = 704 hours


Mob.
20
Sur.
Clring
Ch. exc
1400/DAY
St. Exe
120/DAY
Fill
1000/DAY
Slope
3000 SY/DAY ≈ 7 Stations/DAY
Grout
60 CY/DAY
Sed.
St. Fill
Weather 9-1 to Mar-1 — 2+2+4+2+6+4 = 20
EQUIP. DOWN TIME - 20% of (133-28) = 21 DAYS
20
21
END OF PERFORMANCE TIME, 189 Calendar Days.
0
28
56
84
112
140
168
196
224
ADD:
FRS Drainage Channel Repair
SUR/CLR/FILL
ST. EXC.
SlOPE REPAIR
GROUT
Should not impact performance time.
PERFORMANCE TIME

Monthly Average 1979 to 1983
No. rain days ≥ 0.20 inches

STATION	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
CHANDLER HEIGHTS	3.0	1.4	2.4	0.2	0.6	0	0.8	2.0	1.0	0.8	1.0	1.4
MESA EXPERIMENT FARM	3.2	2.2	3.0	0	0.6	0	1.2	2.0	0.8	0.8	1.4	0.8
PHOENIX A.P.	2.6	1.8	2.8	0.2	0.4	0	1.0	1.2	0.6	0.6	1.4	1.2
TONOPAH (BUCKEYE)	2.6	1.6	2.8	0.2	0.8	0	0.6	1.8	0.4	0.2	2.0	1.2
ALL AREA AV.	3	2	3	0	1	0	1	2	1	1	2	1
Dry out	3	2	3	0	1	0	1	2	1	1	2	1
Total Wet Days	6	4	6	0	2	0	2	4	2	2	4	2

Exhibit 56

United States Department of Agriculture

Soil Conservation Service

201 E. Indianola Ave.
Suite 200
Phoenix, Arizona 85012

Subject: ENG - Saddleback Diversion Repair **Date:** April 5, 1989

To: Carol Harris
Administrative Services Officer **File Code:** 210-13

Enclosed are the following documents for the preparation of the Saddleback Diversion 8A Contract:

1) Two sets of plans - The plans have been approved and signed by the State Conservation Engineer but still need the sponsor and NRCD approval signatures. These are in the process of being obtained. WNTC co-approval is not required for this project. We will furnish you with 15 full size sets and 25 half size sets of plans when the cover sheet is returned with signatures.

2) One set of specifications along with a listing of each specification by name and number, and the number of pages.

3) One copy of the bid schedule

4) An approved cost estimate

5) An inspection plan with the State Conservation Engineers co-determiner signature. This plan also requires signatures from the Contracting Officer and Project Engineer. The inspection plan shows the performance time for the construction of this project to be 200 calendar days.

The design review meeting with our project office staff and yourself has been set for April 26, 1989, at 8:00 a.m., in the SCS conference room.

Donald E. Paulus
Donald E. Paulus
State Design Engineer

5 Enclosures

cc: Bart Ambrose, Asst State Conservation (P), Phoenix, AZ
David O. Lambson, Asst State Conservationist (A), Phoenix, AZ
Ralph Arrington, State Conservation Engineer, Phoenix, AZ
John Harrington, Civil Engineer, Phoenix, AZ

United States Department of Agriculture

Soil Conservation Service

201 E. Indianola Ave.
Suite 200
Phoenix, AZ 85012

Subject: ENG - Saddleback Diversion Repair

Date: March 27, 1989

To: Noller Herbert, Project Engineer

File Code: 210-13

The State Office has scheduled a design review meeting for the project office and the administrative section on April 26 at 8:00 a.m. We are sending three sets of preliminary drawings and specifications with the design report for the project office to review in preparation for the meeting.

Ralph M. Arrington
State Conservation Engineer

w/ attachments

RMA

United States
Department of
Agriculture

Soil
Conservation
Service

201 E. Indianola Ave.
Suite 200
Phoenix, Arizona 85012

March 17, 1989

Dan Sagramoso, P.E.
Chief Engineer and General Manager
Flood Control District of Maricopa County
3335 West Durango Street
Phoenix, Arizona 85009

RE: Saddleback Diversion and FRS, Final Design Review.

Dear Dan:

We are transmitting four sets of the Final design report, specifications and construction drawings for your review.

We would appreciate your comments returned to us by April 3, 1989.

Sincerely,

Charles R. Adams
State Conservationist

Enclosures

cc: Scott Clement (w/enclosures)
wmc

Sub: Saddleback Diversion Inlet Repair 3-8-89

To: Don Pavlos
Ralph Arrington
John Sullivan

Please review these documents for our Final Design Review scheduled Wednesday 15th at 7:30:

- Plans
- Items of Work
- Bid Schedule
- Design Report
- FCD comments from Prelim. Review
- Govt. Insp. Plan
- Const. Sched.

Thanks,
John H.

FLOOD CONTROL DISTRICT
of
Maricopa County

3335 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 262-1501

D. E. Sagramoso, P.E., Chief Engineer and General Manager

MAR 02 1989

Mr. Charles R. Adams, State Conservationist
Soil Conservation Service
201 E. Indianola Ave. Suite 200
Phoenix, AZ 85012

RE: Saddleback Diversion Repair

Dear Mr. Adams:

In response to your letter of Febuary 16, 1989, we have reviewed the Saddleback Diversion Repair plans, and specifications and have the following comments:

1. The structure is constructed across an alluvial fan and the washes on fans are subject to sudden avulsions. The proposed repair does not ensure that lateral mitigation of the channel (tributary) would not occur. For example, the existing wash enters the proposed inlet #30 (Sta. 124+50) at an angle of about 45 degrees, the entrance area may easily be flanked by floodwater due to the braiding characteristics of the wash. No measure was proposed to prevent this possible damage.

2. Cut off walls should be provided along the inlets on the diversion channel side slope (Detail A and B, sheets 9 & 10). Is there a possibility that seepage forces exist against the inlet slabs?

3. We have concerns that the grout for the 4' cut off wall will not penetrate to the full depth. Special consideration may be needed to ensure that full penetration is achieved.

4. We are unable to check the size of the inlets without the individual design discharge of the proposed new inlets. We are concerned that the excessive velocity at the toe of the inlet might cause severe erosion.

If you have any questions please contact me or Scott Clement.

Sincerely,

D. E. Sagramoso, P.E.

cc: John Harrington, SCS

subj: Saddleback Diversion Repair FCD Preliminary Design Review

date: 3/2/89

to: Design File

Discussed the FCD's comments (3/2/89 letter from FCD) in the SCS conference room with Scott Clement, Long-Cheng Huang, and Don Paulus today. Following are the explanations and understandings reached:

1. Braiding problem.

SCS agrees that the braiding action of the watershed is a potential problem for the structures. Braiding action can not be prevented. Absolute control of the side inflows could be obtained by providing a primary diversion above the diversion channel to detain (pond) the storm water and release the water at specific locations and at a controlled rate. Such a solution would require additional right-of-way, flowage easements for ponded water, and higher construction costs due to the greater quantities of earthfill required.

The original design provided ~~16~~ 17 side inlets at the diversion. This repair design adds 28 new side inlets to the 16 existing side inlets. This was done in an attempt to address the braiding that occurred. New inlets were aligned at severely eroded areas with the benefit of a large aerial photo which clearly shows the natural washes as they intersect the diversion. Numerous smaller inlets were designed for local collector channel relief. FCD concurred with this explanation. SCS agreed to protect the entrance to side inlet No. 30 at FRS Sta. 124+50 with grouted rock riprap due to the entrance angle of the wash to the inlet.

2. Cutoff walls and uplift pressure.

Experience with the existing side inlets at the site and numerous other side inlets on other local projects has shown that cut off walls on the channel slopes for the side inlets are not required. This apparently is due to the relatively low velocities of the main channel.

Uplift calculations have been performed for similar side inlets. With the upstream cut off walls and short duration of the storms, uplift is not considered to be a factor. The existing inlets at the site have held up well without drains also.

3. Grout penetration.

SCS agrees with FCD's comment. The specifications require full penetration of the grout. This has been accomplished by requiring contractors to place the cutoff walls in two separate lifts.

4. Erosion at toe.

The cutoff walls designed at the toe will provide for the integrity of the structure while allowing for scour that will occur at the bottom of the inlets. The cutoffs may be terminated in moderately hard caliche at the project engineer's discretion. The existing inlets at the site do not have stilling basins. Some scour has occurred at a few of the inlets. Adding stilling basins to the new inlets is not considered necessary at this site.

United States Department of Agriculture

Soil Conservation Service

201 E. Indianola Ave.
Suite 200
Phoenix, AZ 85012

February 16, 1989

Dan Sagramoso, P.E.
Chief Engineer and General Manager
Flood Control District of Maricopa County
3335 West Durango Street
Phoenix, Arizona 85009

Re: Saddleback Diversion and FRS, Preliminary Design Review

Dear Dan:

We are transmitting six sets of the preliminary design report, specifications and construction drawings for your review and comment. One set of documents are for your transmittal to each of Buckeye-Roosevelt NRCD and Wickenburg NRCD.

As was discussed during our last coordination meeting, we would appreciate your review and comments returned to us by March 3, 1989.

Sincerely,

Charles R. Adams
State Conservationist

ACTING FOR

cc: Scott Clement (w/enclosures)

201 E. Indianola Ave.
Suite 200
Phoenix, AZ 85012

Subject: ENG - Saddleback Diversion Repair - Approval Authority

Date: September 7, 1984

To: W.R. Evans, Head, Engineering Staff
WNTC, Portland, OR

File Code: 210-13

The state design unit in Arizona is preparing a design to repair the side inlets of the Saddleback Diversion structure which was severely damaged during a major storm in September of 1984. Although Saddleback Diversion is a Class VII structure, the side inlets fall under Arizona's approval authority of less than a ten foot drop, a maximum unit discharge of 40 cfs per foot, and a maximum capacity of 4,000 cfs.

The damage to the diversion is limited to side inlet erosion. The diversion itself functioned well although the storm event significantly exceeded the design storm.

The side inlets are similar in design and function to the East Maricopa Floodway, Reach 2 side inlets for which Arizona recently designed a repair. Therefore, we conclude that design reviews by the WNTC are not necessary. The final design will be sent to you for your information and records.

Ralph M. Arrington
State Conservation Engineer

10/20/88

addleback Diversion

Is it possible to have FCD determine the following?

- Is there a problem with cattle along the diversion? In other words, will contractor have to maintain fences during construction? No, will ck ~~Clark~~ Carter Gable for cattle...

- Does FCD know of a water source possibly used by their maintenance crews?
Harq. Irrigation District

- Original design, waste could be placed in spoil area west of dike with twelve inches soil cover. Any objections?
No.

Reply at Coord mtg 9AM

DB

File - Design Folder

Subject: Saddleback Diversion Repair

Date: September 1, 1988

To: Don Paulus
State Design Engineer

File code:

The engineering report (February 1987) concerning the failure of the side inlets on Saddleback Diversion attributes the failure to:

1) Storm intensity exceeded the design storm
2) Inadequate capacity of collector channels
3) Improper theory applied to design inlet capacity

The report states that the diversion carried over twice the designed flow capacity yet functioned quite well. The report does not correlate the water surface profile which exceeded the design storm to the side inlet crest elevations. Therefore, this was done in August of 1988. Of the 17 inlets, 11 were found to be essentially submerged, along with their corresponding collector channels, by the diversion flows. In addition, approximately 12,000 feet of the upstream bank of the diversion was completely submerged.

Assuming proper installation, the inlets could have failed for one of three reasons:

1) The design flow for each inlet exceeded the capacity of the inlet
2) The inlet became submerged and no longer functioned as an inlet. This would allow water to flow into the diversion channel at any location where the upstream bank was under water.
3) Water flowing down the diversion eroded the soils immediately upstream and/or downstream of the inlets similar to the erosion on Reach 1 of the EMF at the interface between riprap lined and earth lined sections of the channel.

up to 6fps velocities

There were four inlets that received very minor or no damage, Inlets 1, 3, 6 and 10. Of these inlets, three are not in any of the three categories listed above. (Inlet No. 10 storm flow did not likely exceed the design capacity according to the hydrologist's analysis. There were two inlets, 9 and 10, used to accommodate one drainage area. The split between the two inlets was arbitrarily set at 50% in the hydrology. Inlet No. 9 was severly damaged while inlet No. 10 received no damage. A logical conclusion is that inlet No. 9 carried the majority of the storm water causing its failure while No. 10 carried less than its capacity.)

Inlet No. 2 is the only inlet that failed although it did not fall into any of the three potential failure modes mentioned above. Its failure was shown to be due to blockage of its collector channel.

The engineering report questioned the inlet design capacity by comparing Manning's channel flow to a weir formula. There were five or six inlets where the modeled storm did not exceed the design storm. Of these, four inlets were not significantly damaged. Of the two that were damaged, one crest was submerged by the diversion flow and one had a sediment bar occur in its collector channel. Using a weir formula would be quite conservative to size the width of the inlet crests because the inlet crests in this design are not above the approach channel inverts. The resulting higher velocity of approach increases the capacity of the inlets above the weir equation. The weir formula also assumes that the nappe springs clear of the downstream edge of the weir, which is not the case for the side inlets.

The time of concentration was briefly reviewed for each side inlet. No correlation between damage and the TOC was readily apparent.

In conclusion, of the 13 inlets that failed, even with increased inlet capacity based on a weir formula, 11 inlets would still have been undersized for the storm that occured. Of the two remaining inlets that failed, one was submerged and the other failed due to sedimentation. Therefore, redesigning the side inlets for increased capacity would not alter the erosion damage that occurred on the upstream bank of the diversion during the storm event.

SADDLEBACK DIVERSION REPAIR

JMH 12-6-88

O&M REVIEW.

The original O&M plan dated April, 1980 need not be revised.

It is recommended that upon completion of the repairs, the FCD of Maricopa County in conjunction with SCS representative inspect the Diversion for maintenance that needs to performed by the FCD. During the site investigation and survey it was noted that some of the floodgates at the cattle crossings need to be repaired and the right abutment of drop structure #4 ~~are~~ requires erosion repair.

United States Department of Agriculture

Soil Conservation Service

201 .. Indianola Avenue
Suite 200
Phoenix, Arizona 85012

Harrington

Subject: ENG - Amendment No. 2 to the Government Inspection Plan for Saddleback Diversion Repair

Date: March 1, 1990

To: Carol Harris
Contracting Officer
Phoenix State Office

File Code: 210-12-5

As requested, I have prepared Amendment No. 2 to the Government Inspection Plan for the Saddleback Diversion Repair project which designates the personnel who will be assigned to this project.

If you agree with the selections, please sign the amendment and make the proper distributions.

Ralph M Arrington

RALPH M. ARRINGTON
State Conservation Engineer

Enclosure

AMENDMENT NO. 2 TO SECTION 6 OF THE GOVERNMENT INSPECTION PLAN FOR SADDLEBACK DIVERSION REPAIR.

6. The following personnel have the required contract administration and technical skills. They are scheduled to perform the inspection duties for this project estimated to begin on or about January 1, 1990, through July 1. 1990.

Noller Herbert, Project Engineer/Government Representative, GS-11

Experience:

Worked for SCS 3 years in the Student Cooperative Program in the Area I office, state design office, on several EWP construction contracts, and Assistant Project Engineer for one and one-half years during construction of Signal Butte FRS, Pass Mountain Diversion, Apache Junction FRS and Floodway ($3.3 million), and Bulldog and Signal Butte Floodway joint sealant repair, and EMF R-6 Floodway construction ($2.0 million).

Training:

Engineering NPEG	Ft. Worth, 3-87
Engineering NPEG Construction	Ft. Worth, 5-88
EIT Certificate	Phoenix, AZ 5087
Soil Compaction Techniques	Phoenix, AZ 2-88
Contract Administration	Columbus, OH 2-89
Management Level II	Phoenix, AZ 2-89

Larry Molitor, Chief Inspector, GS-9

Experience:

Total time with SCS - 12 years, total construction - 8 years. Inspected excavation and placement of drainfill on Vineyard FRS. Worked as Concrete Inspector for 3 years during the construction of Signal Butte Floodway (9000 CY of concrete), RWCD Reach 3 (1100 CY concrete), Signal Butte FRS (787 CY of concrete) and Apache/Bulldog (18,100 CY concrete). Chief Inspector for the joint sealant repair on EMF R-5. Served as Alternate Chief Inspector on EMF R-6.

Training:

Mgmt. Level II	Phoenix, AZ	1978
Soil Mechanics Level I	Phoenix, AZ	01/82
Construction Inspection	Ft. Worth, TX	05/83
Concrete	Ft. Worth, TX	05/83
Troxler Nuclear Density Gage	Tempe, AZ	04/87
Hydraulics for Technicians	Phoenix, AZ	02/87
ACI Grade I Certification	Phoenix, AZ	04/87

Gary Mason, Inspector/Materials Testing Technician, GS-7

Experience:

Employed by SCS in Arizona for 9 years in construction inspection. Served as an Assistant Laboratory Testing Technician for 2 years during construction of EMF Reach 1 and 2.

Assigned as the Materials Testing Technician for the construction of Vanar Division Repair, EMF Reach 3, 5, and 6, Signal Butte/Pass Mountain, and Apache/Bulldog from 1984 to present.

Training:

Soils Testing	Lincoln, NE	1985
Concrete	Ft. Worth, EX	1985
Construction Inspection	Ft. Worth, TX	1983
Troxler Nuclear Gage	Las Vegas, NV	1984
ACI Grade I Certification	Phoenix, AZ	1987
Hydraulics for Technicians	Phoenix, AZ	1987
Management Level II	Phoenix, AZ	1989

David Clough, Survey Party Chief, GS-7

Experience:

Has worked for the SCS since 1979 in the following positions:

Materials Testing Lab Technician - 1 year.
Instrument Man - 4 years.
Survey Party Chief - 5 years.

He has worked on the survey crew monitoring contractor surveys for EMF Floodway, Reach 2, 3, 5, and 6, Signal Butte Floodway, Vanar Diversion Repair, Signal Butte FRS and Pass Mountain Diversion, Apache Junction FRS and Bulldog Floodway.

Training:

Survey Records Investigation (BLM)	Phoenix, AZ	1984
Troxler Nuclear Gage	Phoenix, AZ	1980
Management Level II	Phoenix, AZ	1980

Blake Covey, Inspector/Materials Testing Technician, GS-5

Experience:

Has a B.S. in Geology and has been employed by SCS in Arizona for 2 years performing material testing and inspection duties for the Apache Junction FRS, Bulldog Floodway, and EMF R-2 side inlet repair.

Survey Rodman, GS-5

No one assigned. Duties will be performed by available inspector on the job sites.

STATEMENT OF AVAILABILITY

The above mentioned staff and equipment will be available for this project and will be assigned according to the inspection and testing needs.

By: Ralph M Cumming [signature]
(Supervisor)

Title: State Conservation Engineer

Date: 3-1-90

By: [signature]
(Supervisor)

Title: Project Engineer

Date: 3/1/90

APPROVAL OF CO-DETERMINERS

Ralph M Cumming [signature] — 3-1-90
State Conservation Engineer — Date

Carol L. Harris [signature] — 3-16-90
Contracting Officer — Date

GOVERNMENT INSPECTION PLAN
for
SADDLEBACK DIVERSION REPAIR

The work to be accomplished under this contract consists of constructing additional side inlets, a protective berm, and the repair of the easterly slopes of the diversion drainage channel and the FRS drain channel. The project is located approximately 70 miles west of Phoenix, Arizona in the Harquahala Valley watershed.

Major items of work included in the project are:

1.	Channel excavation	28,000 CY
2.	Sediment removal	6,500 CY
3.	Structure excavation	6,800 CY
4.	Earthfill	27,500 CY
5.	Structure backfill	500 CY
6.	Slope repair	70,000 SY
7.	Grouted rock riprap	2,835 CY

1. ITEMS OF WORK TO BE INSPECTED

It is anticipated that periodic or continuous inspection per NEM, Part 512 will be provided for the following work to be performed under the construction contract.

Periodic Inspection	Continuous Inspection
Clearing and grubbing	Earthfill
Structure removal	Structure backfill
Surveys	Slope repair
Mobilization	Grouted rock riprap
Pollution control	
Removal of water	
Water	
Waste disposal	
Sediment removal	
Channel excavation	
Structure excavation	

A. Excavation: Channel, Structure, and Sediment

No specific material testing is required. An inspector will be required to evaluate the soils encountered for their suitability as fill material and ensure removal and disposal of all unsuitable material.

B. Earthfill, Structure Backfill, and Slope Repair

An inspector will be required to monitor subgrade preparation, the fill material, moisture application and distribution, and compactive effort by the contractor. Extra care must be exercised by the contractor while placing structure backfill around the existing inlets to assure adequate compaction is achieved against the grouted rock structures. No specific tests are required.

C. Grouted Rock Riprap

The contractor will be required to submit test data for the gradation of the riprap to be used at the site. An inspector will be required to monitor the rock riprap delivered to the site for significant changes in the gradation or material.

The inspector will observe the placement of the grout for preparation, penetration, finishing and curing. A materials testing technician will be required to test the grout for slump, temperature, and mixing time according to the appropriate ASTM's. The test frequency will be determined by the project engineer in a testing plan.

D. Surveys

The SCS survey party chief will observe the contractor's survey crew during the initial survey work. Random survey checks of the staking will be performed periodically as requested by the project engineer. The design surveys performed during November of 1988 may be used as quality assurance cross sections. The project engineer should verify that field conditions at the time of construction match those conditions shown by the 1988 survey.

2. TIMING OF INSPECTIONS

It is anticipated that the notice to proceed will be issued in September, 1989. The performance time has been calculated to be 200 calendar days. The performance time is based on the work being performed by an average small business contractor using the following major items of equipment or equivalent:

1-Cat. 14-G Grader	2-Cat. 623 Scrapers
1-4,000 gal. Truck	1-10,000 gal. Waterpull
1-D8-L Dozer	1-Cat. 225 Excavator
1-Cat. 815 Compactor	1-Cat. 950 Loader
1-Tractor w/ Disc	1-Case 580 Loader

A construction schedule with an accelerated pace of work with multiple operations should be evaluated for the possibility of the need for another inspector.

A. Saddleback Diversion Site

	Calendar Days	Anticipated Dates
Mobilization	20	09/15 to 10/05
Clearing & Grubbing	7	10/12 to 10/19
Channel Excavation	28	10/20 to 11/17
Structure Excavation	56	10/17 to 01/11
Sediment Removal	14	11/17 to 12/01
Earthfill	28	10/20 to 11/17
Slope Repair	28	11/17 to 12/15
Structure Backfill	14	10/20 to 11/03
Grouted Rock Riprap	56	12/01 to 01/25

B. Saddleback FRS Site

Clearing & Grubbing	7	12/15 to 12/22
Earthfill	14	12/15 to 12/29
Structure Excavation	7	01/11 to 01/18
Slope Repair	7	12/29 to 01/05
Grouted Rock Riprap	14	01/18 to 02/01

3. SKILLS AND EXPERIENCE REQUIRED FOR INSPECTION

A. Project Engineer-Government Representative, GS-11

Skills and Abilities:

a. Ability to manage and schedule project staff effectively.
b. Knowledge of the concept and critical elements of the design.
c. Ability to exercise judgement interpreting engineering plans and specifications and apply to inspections required for the works of improvement.
d. Knowledge of OSHA safety requirements and the SCS supplement.
e. Ability to exercise sound engineering judgement applying the design in the field.
f. Ability to communicate effectively with the contractor and convey the construction requirements of the contract.

Training and Experience:

a. Two or more years of construction inspection and contract administration.
b. Completed the Contract Administration course.
c. Completed the Unified Soil Classification (SM-1) course or equivalent training or experience.
d. Completed Management Level II course.

B. Chief Inspector, GS-7/8/9

Skills and Abilities:

a. Ability to communicate effectively with the contractor's foremen and quality control people.
b. Knowledge of basic staking and construction layout.
c. Ability to apply principles of earthwork inspection.
d. Ability to perform quantity computations.
e. Ability to maintain a job diary.
f. Ability to supervise technicians assigned to the project.
g. Knowledge of OSHA safety requirements and the SCS supplement.

Training and Experience:

a. A minimum of two years as lead inspector for a major item of work.
b. A minimum of four years of construction inspection and testing experience.
c. A minimum of one year experience as an earthfill inspector.
d. Completed the Construction Inspection course.

C. Materials Testing Technician, GS-5/6/7

Skills and Abilities:

a. Knowledge of earthwork testing such as compaction, moisture determination, sieve analysis, unified soil classification system in accordance with the ASTM's.
b. Knowledge of the OSHA safety requirements and the SCS supplement.
c. Knowledge of the principles of placing and compacting earthfill.
d. Ability to perform field tests of plastic concrete.

Training and Experience:

a. A minimum of two years experience as a materials testing technician at a construction site.

D. Survey Party Chief, GS-6/7

Skills and Abilities:

a. Ability to determine survey controls required for the construction of all elements of the project.
b. Ability to communicate with the contractor's survey crew and evaluate their abilities and layout of work.
c. Ability to coordinate SCS surveys with the contractor's surveyors to verify compliance in a timely manner.
d. Ability to check field notes for accuracy and completeness.

Training and Experience:

a. A minimum of two years experience as an instrument man.
b. A minimum of two years experience as party chief providing survey quality assurance for SCS projects.

4. STAFF HOURS REQUIRED DURING CONSTRUCTION

Project Engineer	1,040 hours
Chief Inspector	1,040 hours
Material Testing Tech.	867 hours
Survey Party Chief	520 hours
Survey Rod Man	520 hours

The inspection staff will likely be detailed in the area due to the location of the project. It may be economically desirable to allow travel on overtime as an option to the cost of per diem. Overtime to inspect the work (not including travel) should not be required if the contract provides for a 40 hour week maximum except for federal holidays not recognized by the contractor. Consideration could be given to the contractor and inspection staff to work four 10-hour days weekly. This option would minimize per diem costs and provide more efficient use of daily time for the convenience of the workers. A combination of overtime to travel to the job site early Monday mornings and to return to the inspection staff's home office at the end of the work week may also be more economical than an extra day of per diem.

5. TESTING EQUIPMENT AND FACILITIES

The Mesa Construction Office will provide the equipment for all testing required. The Mesa office can also provide a mobile office trailer which could be placed at or near the construction site. The Mesa Construction Office maintains and calibrates pertinent testing equipment in accordance with ASTM standards.

6. CONSTRUCTION INSPECTION STAFF

The following people have the required contract administration and technical skills. They are scheduled to perform the inspection duties for this project at the end of FY 89 and early FY 90. A statement of qualifications for each is included in the Appendix.

Noller Herbert, Project Engineer, GR, GS-11
Albert Rutledge, Chief Inspector, GS-9
Blake Covey, Materials Testing Technician, GS-5
David Clough, Survey Party Chief, GS-7

Additional personnel such as a survey rod man may occasionally be required to assist the inspection staff.

7. STATEMENT OF AVAILABILITY

The Mesa Construction Office will provide the above mentioned staff, equipment, vehicles, and facilities. Adjustments in assignments can be made as required to match the contractor's scheduling.

Project Engineer Date

APPROVAL OF CO-DETERMINERS

State Conservation Engineer Date

Contracting Officer Date

APPENDIX

INDIVIDUAL STATEMENTS

of

QUALIFICATIONS

STATEMENT OF QUALIFICATIONS
for
CONSTRUCTION INSPECTION

Position: PROJECT ENGINEER

Noller Herbert, Civil Engineer, GS-11
Date of employment with SCS, May 1983

SCS Experience:

Worked three years through the student cooperative program in the Area I office, state design office, and several EWP construction contracts. Served as Assistant Project Engineer for one and one-half years in the Mesa Construction Office during construction of Signal Butte FRS/Pass Mountain Diversion and Apache Junction FRS/Bulldog Floodway projects. Project Engineer at the Mesa Construction Office from September 1988 to present. Projects since that time include EMF Reach-4 and Signal Butte Floodway joint sealant repair and EMF Reach-6 Floodway construction.

Training:

Engineering NPEG	SNTC, 5-88
EIT Certificate	Phoenix, AZ 5-87
Soil Compaction Techniques	Phoenix, AZ 2-88
Contract Administration	Columbus, OH 2-89
Management Level II	Phoenix, AZ 2-89

STATEMENT OF QUALIFICATIONS
for
CONSTRUCTION INSPECTION

Position: CHIEF INSPECTOR

Albert Rutledge, Civil Engineering Technician, GS-9
Date of employment with SCS, February 1967

SCS Experience:

Twenty years experience in construction inspection in Arizona. Served as Chief Inspector from 1981 to present for the following projects:

RWCD Reach 1	$2.9 million
RWCD Reach 2	$5.2 million
Vanar Diversion Repair	$2.1 million
RWCD Reach 3	$2.9 million
Signal Butte/Pass Mtn.	$3.7 million
Apache/Bulldog	$7.7 million
EMF Reach 6	$1.9 million

Training:

Soil Mechanics	WNTC, 1969
Soil Mechanics II	Salt Lake City, UT 1978
Construction Inspection	SNTC, 1968 and 1988
Concrete	SNTC, 1980
Claim Avoidance, Hill Int'l	Phoenix, AZ 1985
Troxler Nuclear Gauge	Phoenix, AZ 1981
ACI Concrete, Grade I	Phoenix, AZ 1987
Soil Compaction Techniques	Phoenix, AZ 1988
Contract Administration	Columbus, OH 1989

STATEMENT OF QUALIFICATIONS
for
CONSTRUCTION INSPECTION

Position: Materials Testing Technician

Blake Covey, Civil Engineering Technician, GS-5
Date of employment with SCS, November 1987

Experience and Background:

Bachelor of Science in Geology from Arizona State University. SCS duties since employment have been performing material tests for the Apache Junction FRS, Bulldog Floodway and EMF Reach-2 side inlet repair.

STATEMENT OF QUALIFICATIONS
for
CONSTRUCTION INSPECTION

Position: Survey Party Chief

David Clough, Survey Technician, GS-7
Date of employment with SCS, July 1979

SCS Experience:

Served in the construction office as instrument man for four years and as Survey Party Chief from 1984 to present. Responsible for installing the primary control lines, monitoring contractor surveys, and performing quality control surveys of the following projects:

RWCD Reach 2
RWCD Reach 3
RWCD Reach 4
EMF Reach 5
EMF Reach 6
Signal Butte Floodway
Vanar Diversion Repair
Signal Butte FRS and Pass Mountain Diversion
Apache Junction FRS and Bulldog Floodway

Training:

Survey Records Investigation (BLM)	Phoenix, AZ 1984
Troxler Nuclear Gauge	Phoenix, AZ 1980
Management Level II	Phoenix, AZ 1980