BUCKHORN-MESA WPP

SPOOK HILL FLOODWAY

DESIGN CALCULATIONS

A300.801

1970

INDEX

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Arizona State Office
Phoenix, Arizona

Design Report

Job: Spook Hill Floodway
Project: Buckhorn-Mesa WPP
Location: Maricopa County, Arizona

Summary: The design is in accordance with the supplemented work plan with the following changes:

(1) The Spook Hill Floodway and the Spook Hill dam will be constructed as separate contracts.

(2) The junction structures are changed to wide weirs.

(3) The sediment basin is moved downstream along the river to protect the habitat of the Yuma Clapper Rail.

Description of Job:

The job consists of an earth floodway to carry the principal spillway discharge from the Spook Hill Floodwater Retarding Structure to the Salt River and to intercept flood flows from the adjacent watershed. The job is located in Maricopa County about 12 miles northeast of Mesa, Arizona.

Layout:

(1) The layout of the floodway is shown on the construction drawings. The floodway centerline is parallel to the centerline of the Bureau of Reclamation's proposed Salt-Gila Aqueduct and has been moved as close to the aqueduct as possible to allow for a greater undisturbed area to the east of the floodway. Other parts of the floodway follow the alinement of the supplemented work plan.

(2) The layout of the sediment basin has been relocated as shown on the construction drawings to permit a minimum of interference with wildlife habitats and existing fences and utilities.

Hydraulic Design:

(1) Hydrologic information was taken from the preliminary design in the form of maximum discharges. These discharges were distributed washes along the floodway according to relative drainage areas. These discharges were then used to determine the type of inlet to be used.

(2) Water surface profiles were run on the "TRAPW" program to determine (a) maximum depth (n = 0.027) and (b) maximum velocity (n = 0.024). Allowable velocity techniques were used for determining channel stability.

(3) Water surface profiles were also run by a momentum program written by Lew Burton and amended by Bert Clemmens to determine the effect of adding large sideflows. It was determined that junction structures were unnecessary and wide weirs could be used in their place.

(4) A three-foot ditch was designed to collect and carry any floodwater along the maintenance road to pipe and weir inlets. Pipe inlets were designed with a two-foot head above the top of the pipe riser (at the ditch invert). Weir inlets were designed such that the energy of the flow at critical depth was less than two feet.

(5) The sediment basin was designed to carry the 100-year discharge. The area of the basin was designed to remove approximately 50 percent of the fines (a greater percentage will be removed for lesser storms). The volume of the basin was designed to store sediment accumulated over a ten-year period. The outlet of the basin was located and designed to allow for a minimum of damage to wildlife habitats.

Foundation and Embankment Design:

(1) Fine-grained materials were designated for use in construction of roadways to control seepage through the embankments. A high permeability could cause a steady seepage condition to exist causing stability problems on the embankment and possible damage to the Salt-Gila Aqueduct.

(2) All dikes were keyed two feet into the ground to get a more stable foundation and to help stop head-cutting.

(3) The sediment basin dike was designed with materials found on the site. Leakage is not a problem and seepage should not cause failure since the head is low and the material is coarse grained.

Structure Design:

(1) Grouted rock riprap is to be used at both weir and pipe inlets to increase allowable velocites of the side flow above the water surface.

(2) Additional loose rock riprap will be used around the grouted rock at the inlets. Loose rock riprap will also be used along the channel and dikes where allowable velocities are less than the actual velocity.

(3) Access will be provided across the project to Red Mountain Ranch by a bridge to be constructed by Maricopa County at the extension of Thomas Road (Sta. 131+30.61). The county's design of the bridge has not yet been completed.

Appendix

The important design calculations and cost estimates are included.

Submitted by Albert J. Clemmens
Civil Engineer

Approved by Paul Mansell
Design Engineer

SCS-MGT-4a (REV. 5-70)
(FORMERLY SCS-344a)

Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-344a Rev. 5-66
Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

/

Buckhorn Mesa WPP

Final Alignment

Spook Hill Floodway

Alignment

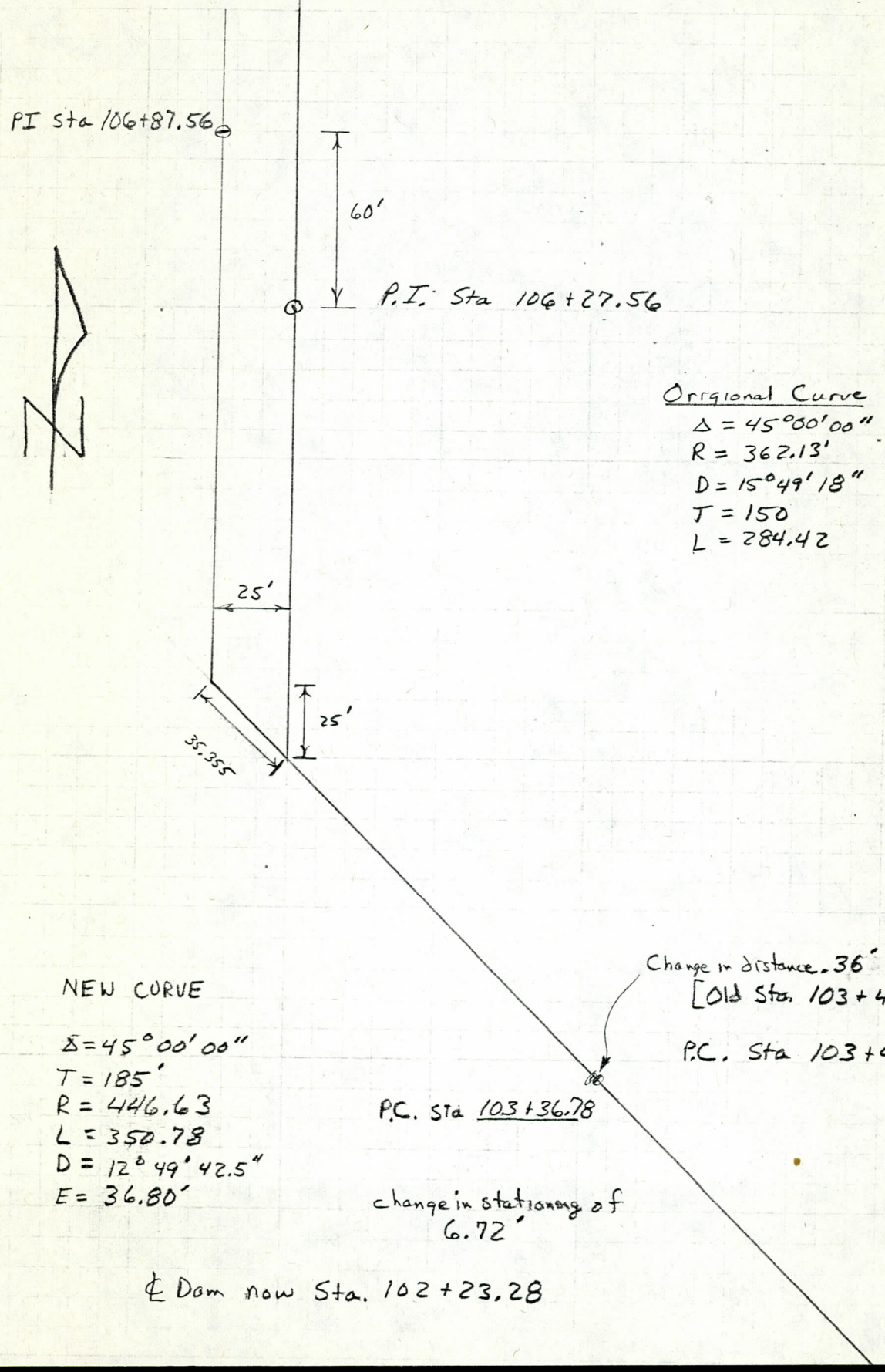
	Station		Bearing	Distance	Δ	R	D	T	L	Grid		Coordinants	
P.I. #7	102 +	23.28								N899,670	.02	E 571,8	74.37
PC	103 +	36 78	N 45° 05' 15.3" W	298.50									
PI #8	105 +	21 78			45°00'00"	446.63	12°49'475"	185.00	350.78	N899,8	30.77	E 571,6	62.97
P.T.	106 +	27 56	N 00° 05' 15.3" W	7928.17									
PC.	180 +	30 73											
PI #9	184 +	30 73			55°59'40"	752.38	7°36'55"	400.00	735.29	N907,80	9.93	E 571,	650.85
PT	187 +	66 02	N 55° 54' 25.7" E	1928.64									
PC	196 +	94. 66											
PI #10	202 +	94 66			49°44'05'	1294.52	4°25'34"	600.00	1123.69	N908.8	90.00.	E 573.2	48.00
PT	208 +	18 35	N 06° 10' 20.7" E										

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 2

STATE	PROJECT		
Az	Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 4-15-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Re-Alignment of Spook Hill Floodway			SHEET 1 OF 3



Orrgional Curve

$\Delta = 45°00'00''$ ✓
$R = 362.13'$
$D = 15°49'18''$
$T = 150$ ✓
$L = 284.42$ ✓

Change in distance .36'
[Old Sta. 103+43.50]

P.C. Sta 103+43.14

NEW CURVE

$\Delta = 45°00'00''$
$T = 185'$
$R = 446.63$
$L = 350.78$
$D = 12°49'42.5''$
$E = 36.80'$

P.C. Sta 103+36.78

change in stationing of 6.72'

℄ Dam now Sta. 102+23.28

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

3

STATE AZ		PROJECT BOCKHORN MESA WPP SPOOK HILL FRS	
BY A.C.	DATE 4-15-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT RE - Alignment of SPOOK HILL FLOODWAY			SHEET 2 OF 3

Origional Curve

$\Delta = 55°59'40''$

$R = 564.28'$

$D = 10°09'13.4''$

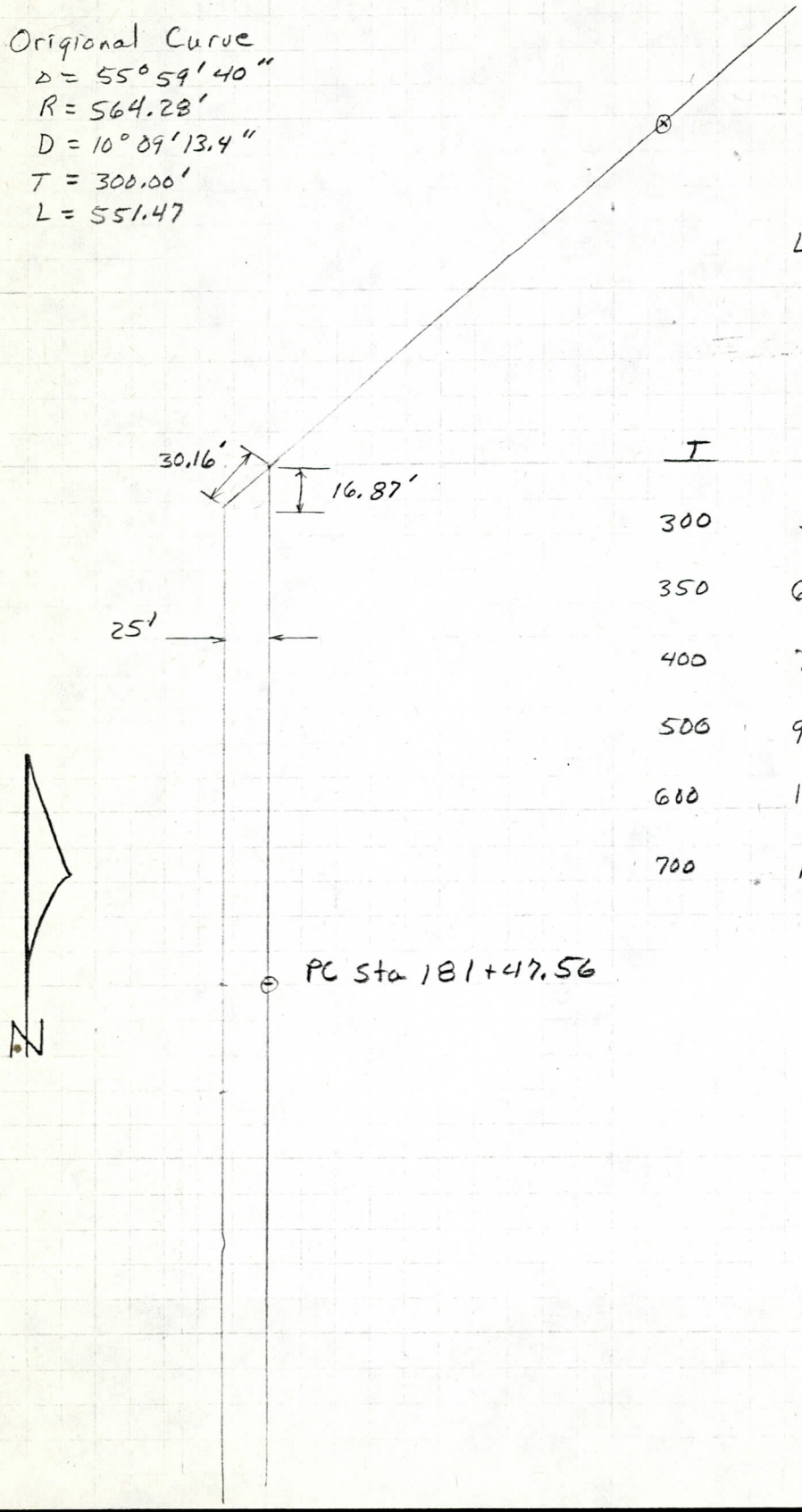
$T = 300.00'$

$L = 551.47$

PT Sta 186+99.03

$R = T/\tan(\Delta/2)$

$L = \frac{\pi \Delta R}{180}$



T	R	L
300	564.28	551.47
350	658.33	643.38
400	752.38	735.29
500	940.47	919.11
600	1128.57	1102.94
700	1316.66	1286.76

STATE		PROJECT		
AZ		BUCKHORN MESA WPP SPOOK HILL FRS		
BY A.C.	DATE 4-15-76	CHECKED BY	DATE	JOB NO.
SUBJECT RE-Alignment of SPOOK HILL FLOODWAY				SHEET 3 OF 3

To keep the stationing the same

PC_{II} sta $= PC_{I}$ sta $+ T_1 - 16.87 - T_2$

PT_{II} sta. $= PC_{II}$ sta $+ L_2$

PT_{II} sta. $= PC_{I}$ sta. $+ L_1 - T_1 - 30.16 + T_2$

$\cancel{PC_{I}\text{ sta.}} + T_1 - 16.87 - T_2 + L_2 = \cancel{PC_{I}\text{ sta.}} + L_1 - T_1 - 30.16 + T_2$

$2T_1 + L_2 + 13.29 = 2T_2$

$633.29 + L_2 = 2T_2$

A curve radius large enough to keep the same stationing would put us out of the right of way limits

Let $T_2 = 400$, $L = 735.29$

$P.C._{II}$ sta. 180 + 30.69

PT_{II} sta. 187+65.98 was old station 187+68.87

change in downstream stationing is 2.89 feet

(subtract 2.89 from old station to get new)

S-347a 5-51
Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Buckhorn Mesa WPP

Spook Hill FRS. & Floodway

Preliminary Design Alignment

Alignment

	Station		Bearing		dist.		Δ	R	D	T	L		Grid		Coordinates		
	87 +	00±	S 79°	30' 00.3"W	930.09												
P.C.	96 +	30.09															
P.I #1	97 +	30.09					36°01'30"	307.54	18°37'49"	100.00'	193.37		N 884,	797.889	E 583,	958.968	
P.T.	98 +	23.46	N 64° 28' 29.7W		1,293.12												
P.C.	109 +	16.58															
P.I. #2	110 +	16.58					2°29'30"	4,598.27	1°14'46"	100.00	199.97		N 885,	355.102	E 582,	792.061	
P.T	111 +	16.55	N 61° 58' 59.7W		3,028.36												
P.C.	132 +	35.68															
P.I #3	140 +	44.91					16°26'47"	5,599.61	1°01'24"	809.23	1,607.33		N 886,	777.613	E 580,	118.594	
P.T.	148 +	43.01	N 45° 32' 08.6W		8,355.78												
P.C.	216 +	71.29															
P.I #4	223 +	89.56					22°01'54"	3,689.74	1°33'10.1"	718.27	1418.80		N 892,	630.54	E 574,	155.180	
P.T.	230 +	90.09	N 23° 30' 11.8"W		5,979.20	✓											
P.C.	276 +	51.02															
P.I #5	283 +	51.02					23°24'50"	3,378.11	1°41'46"	700.00'	1,380.46		N 898,	113.69	E 571,	770.67	
P.T.	290 +	31.48	N 0° 05' 14.3"W		1,450.10												
P.C.	296 +	31.58															
P.I. #6	297 +	31.58					45°00'00"	362.13	15°49'18"	150.00	284.42		N 899,5	63.79	E 571,	768.46	
P.T	299 +	16.00	N 44° 54' 44.7'E		150.00												
ε																	
P.I #7	102 +	30					90°00'00"						N 899,6	70.02	E 571,	874.37	
P.C.	103 +	43.14	N 45° 05' 15.3'W		263.14												
P.I. #8	104 +	93.14					45°00'00"	362.13	15°49'18"	150.00	284.42		N 899.8	55.80	E 571,	688.01	
P.T	106 +	27.56	N 00° 05' 14.3"W		7970.00												
P.C.	181 +	47.56															
P.I #9	184 +	47.56					55°59'40"	564.28	10°9'13.4"	300.00	551.47		N 907,8	25.80	E 571,	675.84	
P.T.	186 +	99.03	N 55° 54' 25.7"E		1898.48												
P.C	196 +	97.51															
PI #10	202 +	97.51					49°44'05"	1294.52	4°25'34"	600.00	1123.69		N 908,8	90.00	E 573,	248.00	
PT	208 +	21.20	N 06° 10' 20.7"E														

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 6

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 4-19-76	CHECKED BY	DATE	JOB NO.
SUBJECT Floodway Alignment - Math Check				SHEET 1 OF 1

CAP invert elevation 1551.0 and is essentially flat through floodway reach. 22' bottom, 1½:1 side slopes up 17.6', then 2:1 berm up to roadway (19.8' above bottom) 24' wide, 2:1 slope back to ground line. 1½ ft ditch with 2:1 slopes

STATION 133+50 - invert elevation 1565.38, 30' bottom 2:1 side slopes, 14 ft maintenance road @ El 1578.0 ℄ are 145' apart

$$11' + 17.6(1.5) + (19.8-17.6)(2) + (24) + (6) + (1578-1551-19.8)(2) + 14 + (1578-1565.38)(2) + 15 = \underline{140.4'}$$

STATION 144+50 - invert elevation 1566.16, maintenance road at 1578.1

$$11' + 17.6(1.5) + (19.8-17.6)(2) + 24 + 6 + (1578.1-1551-19.8)(2) + 14 + (1578.1-1566.16)(2) + 15 = \underline{139.3'}$$

With the road elevations as shown, the aqueduct and floodway can be constructed with centerlines 145' apart

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO : 1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP- SPOOK HILL FLOODWAY		
BY A.C. / DATE 6-1-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT SEDIMENT BASIN SURVEY			SHEET 1 OF 6

TURNING AN INITIAL ANGLE AT THE SECTION CORNER FROM THE CAP P.I. (15), To a Know section line Bearing, the following survey was run.

913,064.11	N Coord of section corner
571,153.52	E " " "
1.	
1.	
2 37 0.0	Bearing of section line
880.84	distance along section line to beginning of Dike
2.	
3.	
158 40 34.0	TP 5
121.85	
3.	
3.	
188 10 23.0	TP 6
104.65	
4.	
3.	
166 48 40.0	TP 7
169.15	
5.	
3.	
160 34 29.0	TP 8
264.95	
6.	
3.	
128 14 24.0	TP 9 Begin Basin
~~ERROR~~	
131.65	
7.	
3.	
180 0 0.0	TP 10
415.25	
8.	
3.	
134 37 35.0	TP 11
80.12	
9.	
3.	
249 58 50.0	TP 12
139.78	

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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GPO:1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C. / DATE 6-1-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT SEDIMENT BASIN SURVEY			SHEET 2 OF 6

10•		
	3•	TP 13 begin spillway
156 8 37•0		
175•00		
11•		
	3•	TP 14 end spillway
90 0 0•0		
123•66		
12•		
	3•	
148 21 47•0		TP17
136•76		
13•		
	3•	TP 18 end dike
163 21 12•0		
1,159•73		
14•		
	3•	TP 19
211 56 47•0		
459•92		
15•		
	3•	Section Corner 13/18 24/19
23 6 42•0		
.....		(calculated closing angle)
- 0 0•0		
- 0 0•0		
	0•37	Latitude error
	-0•14	departure error
	0•40	Total error
10,849•68		Traverse closure factor (2nd order survey)
.....		

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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☆GPO:1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C. / DATE 6-1-76	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN SURVEY -			SHEET 3 OF 6

Bearings for surveyed lines specified by quandrant

1.	1.	2 37 0.0
2.	4.	18 42 26.0
3.	4.	10 32 3.0
4.	4.	23 43 23.0
5.	4.	43 8 54.0
6.	3.	85 5 30.0
7.	3.	85 5 30.0
8.	3.	39 43 5.0
9.	4.	70 18 5.0
10.	3.	85 50 32.0
11.	2.	4 9 28.0
12.	2.	35 47 41.0
13.	2.	52 26 29.0
14.	2.	20 29 42.0

13/18
24/19

TP5

TP6

TP 7

TP 8

TP 9

TP10

TP 11

TP 12

TP 13

TP 14

TP 17

TP 18

TP 19

Section corner

4	1
3	2

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 10
GPO:1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP- SPOOK HILL FLOODWAY		
BY A.C. / DATE 6-1-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT SEDIMENT BASIN SURVEY			SHEET 4 OF 6

Adjusted traverse with Coord.

16.	
0.37	latitude error
-0.14	departure error
0.	
913,064.11	Coord. of Section Corner N.
571,153.52	" E.
1.	
1.	quadrant
2 37 1.7	adjusted Bearing
880.72	adjusted Distance
1.	
913,943.92	N Coord TP 5
571,193.73	E Cord
2.	
4.	
18 42 30.2	Adjusted Bearing
121.83	
2.	
914,059.31	N TP6
571,154.65	E
3.	
4.	
10 32 5.4	Adjusted Bearing
104.63	
3.	
914,162.19	N TP7
571,135.52	E
4.	
4.	
23 43 28.0	Adjusted Bearing
169.13	
4.	
914,317.02	N TP8
571,067.47	E
5.	
4.	
43 9 0.9	Adjusted Bearing
264.92	
5.	
914,510.30	N TP9
570,886.29	E

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE //
GPO 1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY: A.C.	DATE: 6-1-76	CHECKED BY:	DATE:
JOB NO.: 2005			
SUBJECT: SEDIMENT BASIN SURVEY		SHEET 5 OF 6	

6 •
3 •
85 5 26 • 7
131 • 64
6 •
914,499 • 04
570,755 • 13 TP10
7 •
3 •
85 5 26 • 7
415 • 22
7 •
914,463 • 50
570,341 • 42 TP11
8 •
3 •
39 42 46 • 2
80 • 12
8 •
914,401 • 87
570,290 • 23 TP 12
9 •
4 •
70 18 9 • 3
139 • 77
9 •
914,448 • 98
570,158 • 64 TP13
10 •
3 •
85 50 29 • 2
174 • 98
10 •
914,436 • 29
569,984 • 11 TP14
11 •
2 •
4 9 27 • 0
123 • 67
11 •
914,312 • 94
569,993 • 08 TP17

12 •
2 •
35 47 34 • 4
136 • 77
12 •
914,202 • 00
570,073 • 07 TP 18
13 •
2 •
52 26 22 • 3
1,159 • 82
13 •
913,494 • 97
570,992 • 48 TP 19
14 •
2 •
20 29 37 • 4
459 • 97
14 •
913,064 • 11
571,153 • 52 Section Corner
. . . . . .
-765,440 • 24 Area sq ft
-17 • 57 Ac.
. . . . . .

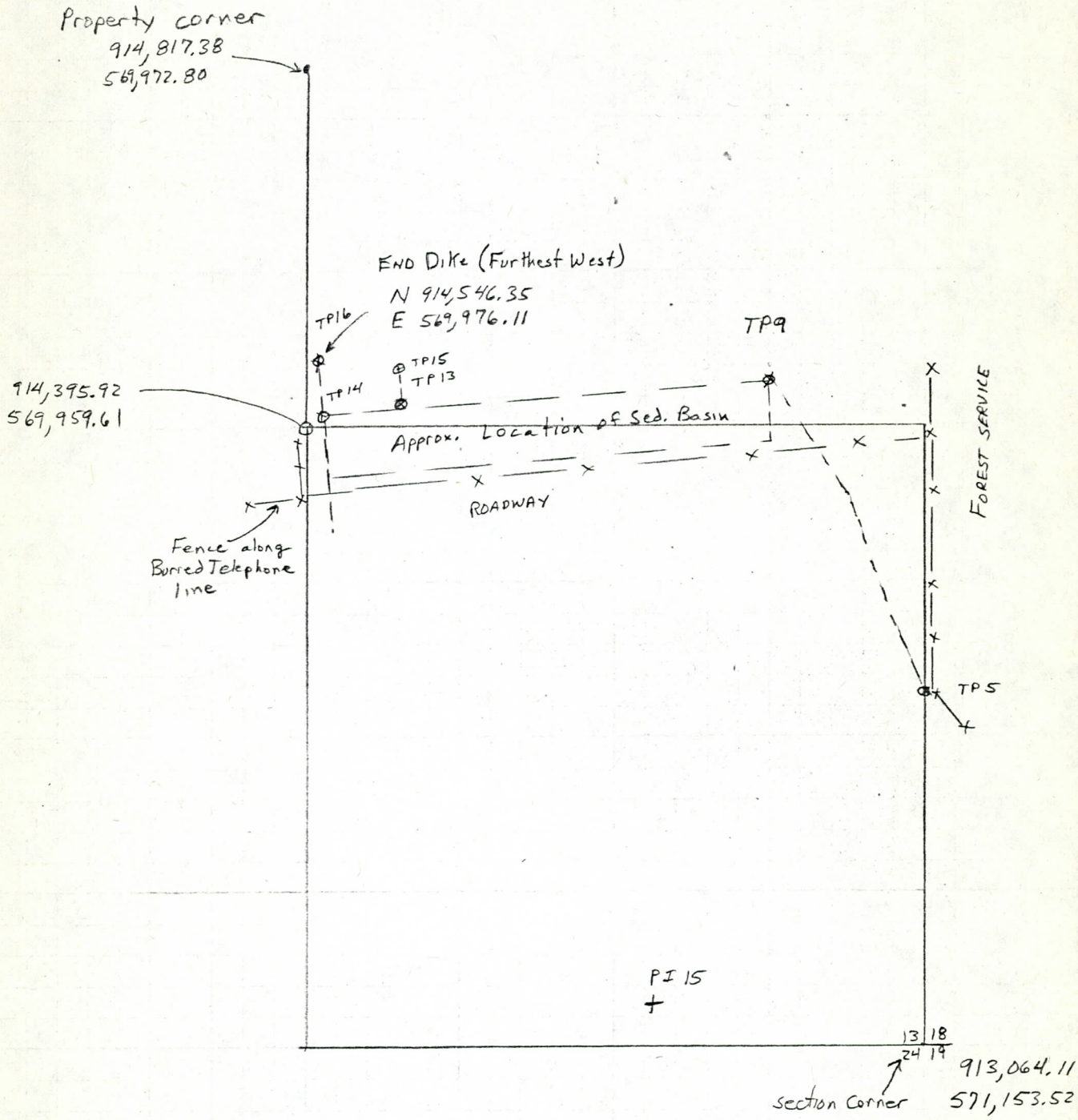
TP 16, END OF DIKE, Same Bearing as line 14-17 110.35' North from TP14
N 914,546.35
E 569,976.11

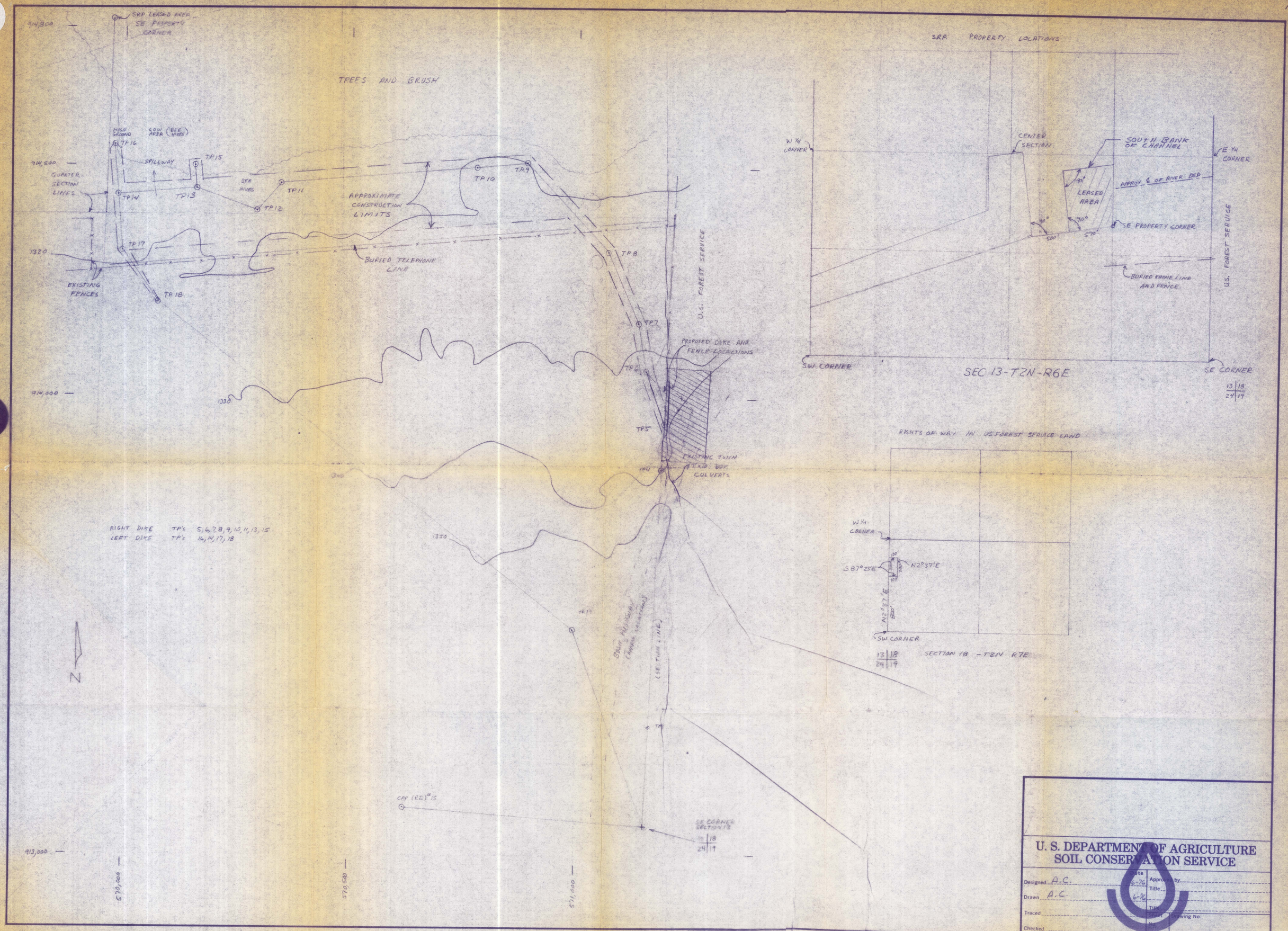
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 12

☆ GPO : 1969—O—357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 6-1-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT SURVEY RESULTS			SHEET 6 OF 6





U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed A.C.	Date 6-76	Approved by	
Drawn A.C.	6-76	Title	
Traced		Title	
Checked		No.	Drawing No.
		Of	

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

* GPO: 1972 —460-109

STATE: Arizona
PROJECT: Buckhorn Mesa W.P.P. - Spook Hill Fldw.
BY: Burton
DATE: 7/17/75
CHECKED BY:
DATE:
JOB NO.: 2005
SUBJECT: Floodway Design Summary
SHEET 1 OF 1

Station	Invert Elevation	Channel Grade	Q	b	z	Comments
102+72	1566.0					Begin Fldw.
		.00020	808.	30.	2.	
159+50	1564.86					Change Grade
		.00609	808.	30.	2.	
183+85	1550.03					
		.00609	1614.	30.	2.	
187+00	1548.11					Change Grade
		.000519	1614	30.	2.	
191+10	1547.90					
		.000519	2136	30.	2.	
192+00	1547.86					Begin Transition
		.000519	2136	30.	Varies 2.0-1.0	
193+00	1547.80					End Transition
		.000519	2136	30.	1.	
207+70	1547.03					End Fldw.

FORM TSC-ADP-5 3-74

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE P. O. Box 6567, Fort Worth, Texas 76115

SUBJECT: MGT-ADP-Computer Assistance - SPOOK HILL

DATE: Sept. 8, 1975

TO:

Paul Monville
Room 6029 Federal Bldg.
Phoenix, Arizona 85025

At your request we have developed computer solution for:

TRAPW

ORDER NO. 10-ADP-AZ-76 ADP NO. 1440 COST $15.00

ATTACHMENTS:

x INPUT DATA SHEETS

x PRINTED OUTPUT

____ PLOTTINGS

____ SUPPORTING DATA

____ PUNCHED CARDS

REMARKS:

If you have any questions please feel free to contact the ADP Unit (Telephone Area Code 817 334-5231

Erlend B Warnick

Erlend B. Warnick
Head, ADP Unit

UNITED STATES DEPARTMENT OF AGRICULTURE

REQUEST FOR SUPPLIES, EQUIPMENT, OR SERVICE

16

132614

TO: CENTRAL SUPPLY SECTION, WASHINGTON, D. C. 20250

DATE: 9/3/75

AGENCY NO.: 10-ADP-AZ-76

AGENCY: SCS

APPROPRIATION SYMBOL AND PROJECT NO.: 12X1072 AZ-S (WF-08) (2005)

ENCUMBERED: $ 15.00

DELIVER VIA–	MESSENGER	PARCEL POST	FREIGHT	EXPRESS	MAIL	AIR EXPRESS	AIR PARCEL POST

IGNEE — GIVE YOUR ZIP CODE NUMBER

Paul Monville
Room 6029 Federal Bldg.
Phoenix, AZ 85025

BILL MATERIALS AND TRANSPORTATION TO:

CODE SYMBOLS:
√—FURNISHED
X—BACK-ORDERED
TOS—TEMPORARILY OUT OF STOCK: RE-ORDER EACH ITEM ON SEPARATE REQUISITION
NS—NOT STOCKED

Please furnish in accordance with instructions hereon the following items which I certify are necessary for use in the public service.

(Signature of authorized representative)

CODE	LINE NO.	ITEM NO.	DESCRIPTION OF ARTICLES	NUMBER OF UNITS	UNIT	DO NOT WRITE IN THESE COLUMNS: UNIT PRICE	STORES		FORMS	
	1		Project formulation:							
	2		Profiles for trapezoidal channels							
	3		Spook Hill Floodway							
	4									
	5		Use enclosed input data							
	6		Retain data at ADP Unit for future use.							
	7		In case of questions, call Paul Monville Phone: 8-602-261-4721							
	8									
	9									
	10									
	11									
	12									

Cartons/boxes used for shipment:

DO NOT WRITE BELOW THIS LINE

FILLED BY:

CHECKED BY:

PACKED OR DELIVERED BY:

SUBTOTALS

REQUISITION TOTAL

SHIPPED VIA–	PARCEL POST	FREIGHT	EXPRESS	MAIL	AIR EXPRESS	AIR PARCEL POST

GOVT. B/L NO. DATE

CONTAINERS CLASS WEIGHT

RECEIPT

I CERTIFY that the materials, equipment, or services itemized above have been received in the quantity specified, except as otherwise noted.

(Date) (Signature)

5. MEMORANDUM COPY

AD-2-65 14

JOB Spook Hill Floodway

BY RJM DATE 9/3

WRITTEN AS:

P AS:

NOTES: PROFILES FOR TRAPEZOIDAL CHANNELS

PT-HD2-1130F Form 1 of 4

FIELD IDENTIFICATION

1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7

Control Word		Card Ident.
JOB TRAP		1

Control Word		Card Ident.
TITLE	Buckhorn Mesa w/PP Acc - Spook Hill Floodway	2

Control Word		Card Ident.
ENDJOB		

JOB Spook Hill Floodway

BY TJM DATE 9/3

WRITTEN AS:

PUNCHED AS:

NOTES: PROFILES FOR TRAPEZOIDAL CHANNELS

PT-HD2-1130F

Sheet 2 of 4

FIELD IDENTIFICATION

1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80

Control Word	Elev Chan Bot	Expansion Coef	Contr. Coeff	Plot Request			Card Ident
CHANBOTTOM	1547.03	0.25	0.15				3

Control Word		Enter discharge values in CFS for each cross section					Card Ident
DISCHARGE	2136.	2136.	886.				4
DISCHARGE	2136.	2136.	886.				5
DISCHARGE	2136.	2136.	886.				6
DISCHARGE	2136.	2136.	886.				7
DISCHARGE	1614.	1614.	640.				8
DISCHARGE	1614.	1614.	640.				9
DISCHARGE	808.	808.	286.				10
DISCHARGE	808.	808.	286.				11
DISCHARGE	808.	808.	286.				12
DISCHARGE							
DISCHARGE							
DISCHARGE							

PAGE ___ OF 18

JOB Spook Hill Floodway

BY RIM DATE 9/3

WRITTEN AS:

PUN AS:

NOTES: PROFILES FOR TRAPEZOIDAL CHANNELS

PT-HD2-1130F

Sheet 3 of 4

FIELD IDENTIFICATION

1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80

Control Word	Station	Bottom Width (ft)	Side-Slope	Gradient of Bottom ft/ft	Manning's 'N'		Card Ident.
X-SECTION	20770.	30.	1.0	.000519			13
X-SECTION	20767.	30.	1.0	.000519			14
X-SECTION	19300.	30.	1.0	.000519			15
X-SECTION	19200.	30.	2.0	.000519			16
X-SECTION	19110.	30.	2.0	.000519			17
X-SECTION	18700.	30.	2.0	.006090			18
X-SECTION	18385.	30.	2.0	.006090			19
X-SECTION	15950.	30.	2.0	.000200			20
X-SECTION	10272.	30.	2.0	.000200			21
X-SECTION							
X-SECTION							
X-SECTION							
X-SECTION							
X-SECTION							
X-SECTION							
X-SECTION							
X-SECTION							

JOB Spook Hill Floodway

BY RJM DATE 9/13

WRITTEN AS:

PUNCH AS.

NOTES: PROFILES FOR TRAPEZOIDAL CHANNELS

PT-HD2-1130F Sheet 4 of 4

FIELD IDENTIFICATION

1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80

Control Word	Profile No	Manning's N	Starting Depth (ft)		Card Ident.
PROFILE	1	0.027	5.08		22
PROFILE	2	0.024	5.08		23
PROFILE	3	0.024	12.90		24
PROFILE					
PROFILE					
PROFILE					
PROFILE					
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PROFILE					
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PROFILE					
PROFILE					
PROFILE					
PROFILE					
PROFILE					

PAGE ___ OF ___

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JOB Spook Hill Floodway

BY RIM DATE 9/3

WRITTEN AS:

P AS:

NOTES:

PROFILES FOR TRAPEZOIDAL CHANNELS

PT-HD2-1130F

Form 1 of 4

FIELD IDENTIFICATION

1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	12345678

Control Word		Card Ident.
JOB TRAP		

Control Word		Card Ident.
TITLE		

Control Word		Card Ident.
ENDJOB		25

N.

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 5

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 19110. STARTING DEPTH = 9.077 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
19109.1	9.077	1556.841	3.692	437.120	30.000	2.000	0.00822	13.92871
19098.5	9.075	1556.843	3.693	437.026	30.000	2.000	0.00822	14.03565
19087.8	9.074	1556.844	3.693	436.932	30.000	2.000	0.00822	14.14258
19077.2	9.073	1556.846	3.694	436.839	30.000	2.000	0.00822	14.24948
19066.5	9.071	1556.848	3.695	436.745	30.000	2.000	0.00822	14.35636
19055.8	9.070	1556.850	3.696	436.651	30.000	2.000	0.00821	14.46322
19045.2	9.068	1556.852	3.697	436.559	30.000	2.000	0.00821	14.57005
19034.5	9.067	1556.853	3.697	436.467	30.000	2.000	0.00821	14.67686
19023.9	9.066	1556.855	3.698	436.375	30.000	2.000	0.00821	14.78365
19013.2	9.064	1556.857	3.699	436.283	30.000	2.000	0.00821	14.89042
19002.5	9.063	1556.859	3.700	436.191	30.000	2.000	0.00821	14.99716
18991.9	9.061	1556.860	3.700	436.099	30.000	2.000	0.00820	15.10388
18981.2	9.060	1556.862	3.701	436.007	30.000	2.000	0.00820	15.21058
18970.6	9.059	1556.864	3.702	435.915	30.000	2.000	0.00820	15.31726
18959.9	9.057	1556.866	3.703	435.823	30.000	2.000	0.00820	15.42391
18949.2	9.056	1556.868	3.704	435.731	30.000	2.000	0.00820	15.53054
18938.6	9.055	1556.869	3.704	435.641	30.000	2.000	0.00820	15.63715
18927.9	9.053	1556.871	3.705	435.550	30.000	2.000	0.00819	15.74374
18917.3	9.052	1556.873	3.706	435.460	30.000	2.000	0.00819	15.85030
18906.6	9.050	1556.875	3.707	435.370	30.000	2.000	0.00819	15.95684
18895.9	9.049	1556.877	3.707	435.279	30.000	2.000	0.00819	16.06336
18885.3	9.048	1556.878	3.708	435.189	30.000	2.000	0.00819	16.16984
18874.6	9.046	1556.880	3.709	435.099	30.000	2.000	0.00819	16.27631
18864.0	9.045	1556.882	3.710	435.009	30.000	2.000	0.00818	16.38274
18853.3	9.044	1556.884	3.711	434.918	30.000	2.000	0.00818	16.48917
18842.6	9.042	1556.886	3.711	434.829	30.000	2.000	0.00818	16.59556
18832.0	9.041	1556.887	3.712	434.740	30.000	2.000	0.00818	16.70193
18821.3	9.040	1556.889	3.713	434.652	30.000	2.000	0.00818	16.80830
18810.7	9.038	1556.891	3.714	434.563	30.000	2.000	0.00818	16.91462
18800.0	9.037	1556.893	3.714	434.475	30.000	2.000	0.00817	17.02094
18789.3	9.036	1556.895	3.715	434.386	30.000	2.000	0.00817	17.12722
18778.7	9.034	1556.897	3.716	434.297	30.000	2.000	0.00817	17.23349
18768.0	9.033	1556.898	3.717	434.209	30.000	2.000	0.00817	17.33974
18757.4	9.032	1556.900	3.717	434.120	30.000	2.000	0.00817	17.44596
18746.7	9.030	1556.902	3.718	434.032	30.000	2.000	0.00817	17.55216
18736.0	9.029	1556.904	3.719	433.945	30.000	2.000	0.00816	17.65834
18725.4	9.028	1556.906	3.720	433.858	30.000	2.000	0.00816	17.76451
18714.7	9.026	1556.908	3.720	433.771	30.000	2.000	0.00816	17.87064
18704.1	9.025	1556.910	3.721	433.684	30.000	2.000	0.00816	17.97676
18700.0	9.024	1556.910	3.721	433.651	30.000	2.000	0.00816	18.01758

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
1614.	0.000519	30.0	2.0 / 1	0.0270	-410.000	-0.820

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 1

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 20770. STARTING DEPTH = 5.080 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
20769.	5.630	1552.659	10.648 VC	200.596	30.000	1.000	0.00002	0.00002

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
2136.	0.000519	30.0	1.0 / 1	0.0270	-3.000	-0.006

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 2

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 20767. STARTING DEPTH = 5.630 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT) $d+Fbd$ $d+.2(d+\frac{V^2}{2g})$
20764.0	5.680	1552.713	10.538	202.677	30.000	1.000	0.01358	2.17894
20725.9	6.096	1553.148	9.706	220.052	30.000	1.000	0.01478	2.36484
20687.7	6.355	1553.426	9.243	231.072	30.000	1.000	0.01553	2.56259
20649.6	6.555	1553.645	8.913	239.635	30.000	1.000	0.01612	2.76880
20611.5	6.720	1553.829	8.655	246.786	30.000	1.000	0.01660	2.98183
20573.3	6.863	1553.991	8.442	252.994	30.000	1.000	0.01702	3.20070
20535.2	6.988	1554.135	8.262	258.515	30.000	1.000	0.01739	3.42468
20497.0	7.102	1554.268	8.106	263.506	30.000	1.000	0.01773	3.65326
20458.9	7.205	1554.390	7.967	268.076	30.000	1.000	0.01804	3.88602
20420.7	7.300	1554.504	7.844	272.299	30.000	1.000	0.01833	4.12262
20382.6	7.388	1554.611	7.732	276.230	30.000	1.000	0.01859	4.36278
20344.5	7.470	1554.712	7.630	279.912	30.000	1.000	0.01884	4.60628
20306.3	7.547	1554.808	7.537	283.377	30.000	1.000	0.01907	4.85290
20268.2	7.619	1554.900	7.451	286.653	30.000	1.000	0.01929	5.10247
20230.0	7.688	1554.987	7.371	289.761	30.000	1.000	0.01950	5.35483
20191.9	7.753	1555.072	7.297	292.718	30.000	1.000	0.01970	5.60985
20153.7	7.815	1555.152	7.227	295.541	30.000	1.000	0.01989	5.86740
20115.6	7.874	1555.230	7.161	298.240	30.000	1.000	0.02008	6.12737
20077.5	7.930	1555.306	7.100	300.828	30.000	1.000	0.02025	6.38965
20039.3	7.985	1555.379	7.042	303.314	30.000	1.000	0.02042	6.65415
20001.2	8.037	1555.450	6.987	305.705	30.000	1.000	0.02058	6.92079
19963.0	8.087	1555.519	6.934	308.010	30.000	1.000	0.02074	7.18948
19924.9	8.135	1555.586	6.885	310.233	30.000	1.000	0.02089	7.46015
19886.8	8.181	1555.652	6.837	312.382	30.000	1.000	0.02103	7.73274
19848.6	8.226	1555.716	6.792	314.460	30.000	1.000	0.02117	8.00717
19810.5	8.269	1555.778	6.749	316.473	30.000	1.000	0.02131	8.28340
19772.3	8.311	1555.839	6.708	318.424	30.000	1.000	0.02144	8.56135
19734.2	8.352	1555.898	6.668	320.317	30.000	1.000	0.02157	8.84099
19696.0	8.391	1555.957	6.630	322.156	30.000	1.000	0.02169	9.12227
19657.9	8.429	1556.014	6.593	323.943	30.000	1.000	0.02181	9.40513
19619.8	8.466	1556.070	6.558	325.682	30.000	1.000	0.02193	9.68954
19581.6	8.502	1556.125	6.524	327.374	30.000	1.000	0.02204	9.97544
19543.5	8.537	1556.179	6.491	329.022	30.000	1.000	0.02215	10.26281
19505.3	8.571	1556.233	6.460	330.629	30.000	1.000	0.02226	10.55160
19467.2	8.605	1556.285	6.429	332.196	30.000	1.000	0.02237	10.84179
19429.0	8.637	1556.336	6.400	333.725	30.000	1.000	0.02247	11.13332
19390.9	8.668	1556.387	6.371	335.218	30.000	1.000	0.02257	11.42618
19352.8	8.699	1556.437	6.344	336.676	30.000	1.000	0.02267	11.72033
19314.6	8.729	1556.486	6.317	338.101	30.000	1.000	0.02276	12.01575
19300.0	8.741	1556.504	6.307	338.640	30.000	1.000	0.02280	12.12970

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
2136.	0.000519	30.0	1.0 / 1	0.0270	-1467.000	-2.934

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 3

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 19300. STARTING DEPTH = 8.741 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
19299.8	8.742	1556.505	6.303	338.839	30.000	1.002	0.00155	12.13125
19297.2	8.754	1556.518	6.256	341.416	30.000	1.027	0.00156	12.15154
19294.6	8.766	1556.530	6.209	343.991	30.000	1.053	0.00157	12.17198
19292.0	8.778	1556.541	6.163	346.562	30.000	1.079	0.00159	12.19258
19289.4	8.789	1556.553	6.118	349.131	30.000	1.105	0.00160	12.21333
19286.8	8.800	1556.564	6.073	351.697	30.000	1.131	0.00161	12.23423
19284.2	8.811	1556.575	6.029	354.260	30.000	1.157	0.00162	12.25529
19281.6	8.822	1556.586	5.986	356.820	30.000	1.183	0.00163	12.27650
19279.0	8.832	1556.596	5.943	359.378	30.000	1.209	0.00164	12.29786
19276.4	8.842	1556.606	5.901	361.933	30.000	1.235	0.00166	12.31938
19273.8	8.852	1556.616	5.860	364.485	30.000	1.261	0.00167	12.34104
19271.2	8.862	1556.626	5.819	367.035	30.000	1.287	0.00168	12.36286
19268.6	8.871	1556.635	5.779	369.582	30.000	1.313	0.00169	12.38483
19266.0	8.881	1556.645	5.739	372.127	30.000	1.339	0.00170	12.40696
19263.4	8.890	1556.654	5.701	374.669	30.000	1.365	0.00171	12.42923
19260.8	8.899	1556.662	5.662	377.209	30.000	1.391	0.00173	12.45166
19258.2	8.907	1556.671	5.624	379.747	30.000	1.417	0.00174	12.47424
19255.6	8.916	1556.679	5.587	382.282	30.000	1.443	0.00175	12.49697
19253.0	8.924	1556.688	5.550	384.815	30.000	1.469	0.00176	12.51985
19250.4	8.932	1556.696	5.514	387.345	30.000	1.495	0.00177	12.54288
19247.8	8.940	1556.704	5.478	389.873	30.000	1.521	0.00178	12.56606
19245.2	8.948	1556.712	5.443	392.399	30.000	1.547	0.00180	12.58939
19242.6	8.955	1556.719	5.408	394.923	30.000	1.573	0.00181	12.61288
19240.0	8.963	1556.727	5.374	397.444	30.000	1.599	0.00182	12.63652
19237.4	8.970	1556.734	5.340	399.963	30.000	1.625	0.00183	12.66030
19234.8	8.977	1556.741	5.307	402.480	30.000	1.651	0.00184	12.68424
19232.2	8.984	1556.748	5.274	404.996	30.000	1.677	0.00185	12.70832
19229.6	8.991	1556.755	5.241	407.508	30.000	1.703	0.00187	12.73256
19227.0	8.998	1556.761	5.209	410.019	30.000	1.729	0.00188	12.75694
19224.4	9.004	1556.768	5.177	412.528	30.000	1.755	0.00189	12.78148
19221.8	9.011	1556.775	5.146	415.035	30.000	1.781	0.00190	12.80616
19219.2	9.017	1556.781	5.115	417.539	30.000	1.807	0.00191	12.83100
19216.6	9.023	1556.787	5.085	420.042	30.000	1.833	0.00192	12.85598
19214.0	9.029	1556.793	5.055	422.543	30.000	1.859	0.00193	12.88112
19211.4	9.035	1556.799	5.025	425.041	30.000	1.885	0.00195	12.90640
19208.8	9.041	1556.805	4.996	427.538	30.000	1.911	0.00196	12.93183
19206.2	9.047	1556.810	4.967	430.032	30.000	1.937	0.00197	12.95742
19203.6	9.052	1556.816	4.938	432.525	30.000	1.963	0.00198	12.98315
19201.0	9.058	1556.822	4.910	435.016	30.000	1.989	0.00199	13.00902
19200.0	9.060	1556.823	4.899	435.973	30.000	1.999	0.00200	13.01902

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
2136.	0.000519	30.0	1.9 / 1	0.0270	-100.000	-0.200

CONTRACTION OR EXPANSION COEFF = 1.15

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 4

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

Calc drfhd

BEG. STATION = 19200. STARTING DEPTH = 9.060 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
19199.8	9.060	1556.823	4.899	435.982	30.000	2.000	0.00180	13.02082
19197.4	9.060	1556.824	4.898	436.013	30.000	2.000	0.00180	13.04422
19195.1	9.061	1556.824	4.898	436.044	30.000	2.000	0.00180	13.06763
19192.8	9.061	1556.825	4.898	436.075	30.000	2.000	0.00180	13.09104
19190.4	9.062	1556.825	4.897	436.106	30.000	2.000	0.00180	13.11445
19188.1	9.062	1556.826	4.897	436.138	30.000	2.000	0.00180	13.13785
19185.7	9.063	1556.826	4.897	436.169	30.000	2.000	0.00180	13.16126
19183.4	9.063	1556.827	4.896	436.199	30.000	2.000	0.00180	13.18467
19181.1	9.063	1556.827	4.896	436.228	30.000	2.000	0.00180	13.20810
19178.7	9.064	1556.828	4.896	436.258	30.000	2.000	0.00180	13.23154
19176.4	9.064	1556.828	4.895	436.287	30.000	2.000	0.00180	13.25497
19174.0	9.065	1556.829	4.895	436.317	30.000	2.000	0.00180	13.27840
19171.7	9.065	1556.829	4.895	436.347	30.000	2.000	0.00180	13.30183
19169.4	9.066	1556.830	4.894	436.376	30.000	2.000	0.00180	13.32526
19167.0	9.066	1556.830	4.894	436.406	30.000	2.000	0.00180	13.34869
19164.7	9.067	1556.830	4.894	436.435	30.000	2.000	0.00180	13.37213
19162.3	9.067	1556.831	4.893	436.465	30.000	2.000	0.00180	13.39556
19160.0	9.067	1556.831	4.893	436.494	30.000	2.000	0.00180	13.41899
19157.7	9.068	1556.832	4.893	436.524	30.000	2.000	0.00180	13.44242
19155.3	9.068	1556.832	4.892	436.554	30.000	2.000	0.00180	13.46585
19153.0	9.069	1556.833	4.892	436.583	30.000	2.000	0.00180	13.48929
19150.6	9.069	1556.833	4.892	436.613	30.000	2.000	0.00180	13.51272
19148.3	9.070	1556.833	4.891	436.642	30.000	2.000	0.00180	13.53615
19146.0	9.070	1556.834	4.891	436.672	30.000	2.000	0.00180	13.55960
19143.6	9.071	1556.834	4.891	436.702	30.000	2.000	0.00180	13.58305
19141.3	9.071	1556.835	4.890	436.731	30.000	2.000	0.00180	13.60651
19138.9	9.071	1556.835	4.890	436.761	30.000	2.000	0.00180	13.62997
19136.6	9.072	1556.836	4.890	436.790	30.000	2.000	0.00180	13.65342
19134.3	9.072	1556.836	4.889	436.820	30.000	2.000	0.00180	13.67688
19131.9	9.073	1556.837	4.889	436.849	30.000	2.000	0.00180	13.70034
19129.6	9.073	1556.837	4.889	436.879	30.000	2.000	0.00180	13.72379
19127.2	9.074	1556.837	4.888	436.909	30.000	2.000	0.00180	13.74725
19124.9	9.074	1556.838	4.888	436.938	30.000	2.000	0.00180	13.77071
19122.6	9.075	1556.838	4.888	436.968	30.000	2.000	0.00180	13.79416
19120.2	9.075	1556.839	4.887	436.997	30.000	2.000	0.00180	13.81762
19117.9	9.076	1556.839	4.887	437.027	30.000	2.000	0.00180	13.84107
19115.5	9.076	1556.840	4.887	437.057	30.000	2.000	0.00180	13.86453
19113.2	9.076	1556.840	4.886	437.086	30.000	2.000	0.00180	13.88799
19110.9	9.077	1556.841	4.886	437.116	30.000	2.000	0.00180	13.91145
19110.0	9.077	1556.841	4.886	437.127	30.000	2.000	0.00180	13.92048

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
2136.	0.000519	30.0	2.0 / 1	0.0270	-90.000	-0.180

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 6

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 18700. STARTING DEPTH = 9.024 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
18699.3	9.021	1556.910	3.724	433.397	30.000	2.000	0.00626	18.02384
18691.1	8.971	1556.908	3.752	430.109	30.000	2.000	0.00622	18.10499
18682.9	8.921	1556.906	3.781	426.830	30.000	2.000	0.00617	18.18553
18674.8	8.871	1556.904	3.810	423.561	30.000	2.000	0.00612	18.26545
18666.6	8.821	1556.901	3.840	420.304	30.000	2.000	0.00608	18.34475
18658.4	8.772	1556.899	3.869	417.057	30.000	2.000	0.00603	18.42345
18650.2	8.722	1556.897	3.900	413.819	30.000	2.000	0.00598	18.50154
18642.0	8.672	1556.895	3.930	410.593	30.000	2.000	0.00594	18.57901
18633.8	8.622	1556.893	3.961	407.377	30.000	2.000	0.00589	18.65588
18625.6	8.572	1556.890	3.993	404.171	30.000	2.000	0.00584	18.73215
18617.4	8.523	1556.888	4.025	400.975	30.000	2.000	0.00580	18.80781
18609.2	8.473	1556.886	4.057	397.791	30.000	2.000	0.00575	18.88288
18601.0	8.423	1556.884	4.090	394.616	30.000	2.000	0.00570	18.95735
18592.9	8.373	1556.882	4.123	391.453	30.000	2.000	0.00566	19.03122
18584.7	8.324	1556.880	4.156	388.299	30.000	2.000	0.00561	19.10449
18576.5	8.274	1556.877	4.190	385.156	30.000	2.000	0.00557	19.17718
18568.3	8.224	1556.875	4.224	382.025	30.000	2.000	0.00552	19.24927
18560.1	8.174	1556.873	4.259	378.903	30.000	2.000	0.00548	19.32078
18551.9	8.125	1556.871	4.294	375.792	30.000	2.000	0.00543	19.39171
18543.7	8.075	1556.869	4.330	372.692	30.000	2.000	0.00539	19.46205
18535.5	8.025	1556.867	4.366	369.603	30.000	2.000	0.00534	19.53181
18527.3	7.976	1556.865	4.403	366.524	30.000	2.000	0.00530	19.60098
18519.1	7.926	1556.863	4.440	363.456	30.000	2.000	0.00525	19.66959
18511.0	7.876	1556.861	4.478	360.400	30.000	2.000	0.00521	19.73760
18502.8	7.827	1556.859	4.516	357.354	30.000	2.000	0.00517	19.80506
18494.6	7.777	1556.857	4.555	354.319	30.000	2.000	0.00512	19.87193
18486.4	7.728	1556.855	4.594	351.295	30.000	2.000	0.00508	19.93824
18478.2	7.678	1556.853	4.634	348.281	30.000	2.000	0.00503	20.00398
18470.0	7.629	1556.851	4.674	345.279	30.000	2.000	0.00499	20.06916
18461.8	7.579	1556.849	4.715	342.288	30.000	2.000	0.00495	20.13378
18453.6	7.530	1556.847	4.756	339.308	30.000	2.000	0.00490	20.19783
18445.4	7.480	1556.845	4.798	336.339	30.000	2.000	0.00486	20.26132
18437.2	7.431	1556.844	4.841	333.382	30.000	2.000	0.00482	20.32426
18429.1	7.381	1556.842	4.884	330.435	30.000	2.000	0.00478	20.38663
18420.9	7.332	1556.840	4.928	327.500	30.000	2.000	0.00473	20.44846
18412.7	7.283	1556.838	4.972	324.577	30.000	2.000	0.00469	20.50973
18404.5	7.233	1556.837	5.017	321.664	30.000	2.000	0.00465	20.57046
18396.3	7.184	1556.835	5.063	318.764	30.000	2.000	0.00461	20.63064
18388.1	7.135	1556.833	5.109	315.875	30.000	2.000	0.00457	20.69028
18385.0	7.116	1556.833	5.127	314.767	30.000	2.000	0.00455	20.71307

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
1614.	0.006090	30.0	2.0 / 1	0.0270	-315.000	-0.630

CONTRACTICN OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 7

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 18385. STARTING DEPTH = 7.116 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
18380.1	7.086	1556.833	2.581	313.039	30.000	2.000	0.03509	20.74816
18316.8	6.702	1556.833	2.777	290.918	30.000	2.000	0.03261	21.18696
18253.5	6.318	1556.833	2.999	269.421	30.000	2.000	0.03021	21.59405
18190.2	5.936	1556.834	3.250	248.563	30.000	2.000	0.02787	21.97037
18126.8	5.554	1556.837	3.538	228.361	30.000	2.000	0.02561	22.31685
18063.5	5.175	1556.842	3.868	208.844	30.000	2.000	0.02343	22.63446
18000.2	4.799	1556.850	4.251	190.059	30.000	2.000	0.02132	22.92424
17936.9	4.428	1556.863	4.695	172.085	30.000	2.000	0.01931	23.18727
17873.6	4.066	1556.885	5.210	155.058	30.000	2.000	0.01740	23.42486
17810.3	3.719	1556.921	5.802	139.240	30.000	2.000	0.01563	23.63853
17747.0	3.400	1556.987	6.455	125.156	30.000	2.000	0.01404	23.83038
17683.7	3.139	1557.110	7.094	113.885	30.000	2.000	0.01277	24.00363
17620.4	2.978	1557.333	7.544	107.094	30.000	2.000	0.01199	24.16357
17557.1	2.923	1557.662	7.711	104.782	30.000	2.000	0.01171	24.31713
17493.7	2.912	1558.035	7.743	104.340	30.000	2.000	0.01166	24.46898
17430.4	2.910	1558.417	7.748	104.273	30.000	2.000	0.01165	24.62054
17367.1	2.910	1558.801	7.749	104.263	30.000	2.000	0.01165	24.77204
17303.8	2.910	1559.185	7.749	104.262	30.000	2.000	0.01165	24.92354
17240.5	2.910	1559.569	7.749	104.262	30.000	2.000	0.01165	25.07505
17177.2	2.910	1559.953	7.749	104.262	30.000	2.000	0.01165	25.22655
17113.9	2.910	1560.337	7.749	104.262	30.000	2.000	0.01165	25.37805
17050.6	2.910	1560.721	7.749	104.262	30.000	2.000	0.01165	25.52955
16987.3	2.910	1561.105	7.749	104.262	30.000	2.000	0.01165	25.68105
16924.0	2.910	1561.489	7.749	104.262	30.000	2.000	0.01165	25.83255
16860.6	2.910	1561.873	7.749	104.262	30.000	2.000	0.01165	25.98405
16797.3	2.910	1562.257	7.749	104.262	30.000	2.000	0.01165	26.13555
16734.0	2.910	1562.641	7.749	104.262	30.000	2.000	0.01165	26.28705
16670.7	2.910	1563.025	7.749	104.262	30.000	2.000	0.01165	26.43855
16607.4	2.910	1563.409	7.749	104.262	30.000	2.000	0.01165	26.59005
16544.1	2.910	1563.793	7.749	104.262	30.000	2.000	0.01165	26.74155
16480.8	2.910	1564.177	7.749	104.262	30.000	2.000	0.01165	26.89305
16417.5	2.910	1564.562	7.749	104.262	30.000	2.000	0.01165	27.04455
16354.2	2.910	1564.946	7.749	104.262	30.000	2.000	0.01165	27.19606
16290.9	2.910	1565.330	7.749	104.262	30.000	2.000	0.01165	27.34756
16227.5	2.910	1565.714	7.749	104.262	30.000	2.000	0.01165	27.49906
16164.2	2.910	1566.098	7.749	104.262	30.000	2.000	0.01165	27.65056
16100.9	2.910	1566.482	7.749	104.262	30.000	2.000	0.01165	27.80206
16037.6	2.910	1566.866	7.749	104.262	30.000	2.000	0.01165	27.95356
15974.3	2.910	1567.250	7.749	104.262	30.000	2.000	0.01165	28.10506
15950.0	2.910	1567.397	7.749	104.262	30.000	2.000	0.01165	28.16333

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
808.	0.006090	30.0	2.0 / 1	0.0270	-2435.000	-4.870

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 1 REACH= 8

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 15950. STARTING DEPTH = 2.910 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
15938.6	3.173	1567.663	7.005	115.344	30.000	2.000	0.02862	28.19195
15791.0	3.895	1568.413	5.488	147.225	30.000	2.000	0.03818	28.64767
15643.3	4.233	1568.779	4.962	162.832	30.000	2.000	0.04231	29.17480
15495.7	4.472	1569.047	4.639	174.157	30.000	2.000	0.04530	29.74663
15348.1	4.660	1569.264	4.409	183.243	30.000	2.000	0.04768	30.35271
15200.5	4.816	1569.449	4.232	190.903	30.000	2.000	0.04969	30.98702
15052.8	4.951	1569.612	4.089	197.561	30.000	2.000	0.05144	31.64550
14905.2	5.069	1569.758	3.971	203.467	30.000	2.000	0.05298	32.32521
14757.6	5.174	1569.892	3.870	208.783	30.000	2.000	0.05437	33.02388
14609.9	5.269	1570.016	3.782	213.622	30.000	2.000	0.05564	33.73974
14462.3	5.356	1570.131	3.705	218.066	30.000	2.000	0.05680	34.47130
14314.7	5.435	1570.239	3.636	222.176	30.000	2.000	0.05788	35.21736
14167.1	5.509	1570.342	3.575	226.000	30.000	2.000	0.05888	35.97685
14019.4	5.578	1570.438	3.519	229.574	30.000	2.000	0.05981	36.74885
13871.8	5.642	1570.531	3.468	232.929	30.000	2.000	0.06069	37.53260
13724.2	5.702	1570.620	3.422	236.090	30.000	2.000	0.06151	38.32737
13576.5	5.758	1570.705	3.379	239.078	30.000	2.000	0.06229	39.13257
13428.9	5.811	1570.787	3.340	241.909	30.000	2.000	0.06303	39.94761
13281.3	5.862	1570.865	3.303	244.598	30.000	2.000	0.06373	40.77200
13133.7	5.910	1570.942	3.269	247.159	30.000	2.000	0.06440	41.60528
12986.0	5.955	1571.016	3.237	249.601	30.000	2.000	0.06504	42.44704
12838.4	5.998	1571.088	3.207	251.935	30.000	2.000	0.06565	43.29689
12690.8	6.040	1571.158	3.178	254.168	30.000	2.000	0.06623	44.15448
12543.2	6.079	1571.226	3.152	256.309	30.000	2.000	0.06679	45.01947
12395.5	6.117	1571.292	3.127	258.364	30.000	2.000	0.06733	45.89158
12247.9	6.153	1571.357	3.103	260.339	30.000	2.000	0.06785	46.77053
12100.3	6.188	1571.420	3.081	262.239	30.000	2.000	0.06834	47.65602
11952.6	6.221	1571.482	3.059	264.068	30.000	2.000	0.06882	48.54784
11805.0	6.253	1571.543	3.039	265.832	30.000	2.000	0.06928	49.44575
11657.4	6.284	1571.602	3.020	267.534	30.000	2.000	0.06972	50.34952
11509.8	6.314	1571.660	3.001	269.177	30.000	2.000	0.07015	51.25896
11362.1	6.343	1571.718	2.984	270.765	30.000	2.000	0.07057	52.17388
11214.5	6.370	1571.774	2.967	272.301	30.000	2.000	0.07097	53.09409
11066.9	6.397	1571.829	2.951	273.787	30.000	2.000	0.07136	54.01942
10919.2	6.423	1571.884	2.935	275.227	30.000	2.000	0.07173	54.94970
10771.6	6.448	1571.937	2.920	276.622	30.000	2.000	0.07210	55.88479
10624.0	6.472	1571.990	2.906	277.974	30.000	2.000	0.07245	56.82454
10476.4	6.496	1572.042	2.893	279.286	30.000	2.000	0.07279	57.76881
10328.7	6.518	1572.093	2.879	280.559	30.000	2.000	0.07312	58.71745
10272.0	6.527	1572.113	2.875	281.039	30.000	2.000	0.07325	59,08345

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
808.	0.000200	30.0	2.0 / 1	0.0270	-5678.000	-11.356

CONTRACTION OR EXPANSION COEFF = 1.00

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C. / DATE 4-26-76	CHECKED BY	DATE	JOB NO.
SUBJECT FLOODWAY WATER SURFACE PROFILES			SHEET 1 OF 14

Junction Structure Design

From TRAP W program at STA 190+02.5 (≈190+00),

$d_3 = 9.063$ $Q = 1614$ (changed from 2136 at 191+10)

the following table represents data used for backwater curves upstream through the three junction structures. $\theta = 0°$

Summary Table

Station	$Q_{1 or 3}$	Q_2	S	n	d (solution)
190+00	2136	—			9.063
			.000519	.035	
189+00	1768	368			9.355
			.000519	.027	
187+00	1768	—			9.395
			.00609	.027	
185+00	1768	—			8.175
			.00609	.035	
181+00	1246	522			6.50
			.00609	.027	
159+50	1246	—			3.73
			.00020	.027	
152+00	808	—			5.92
			.00020	.027	
110+50	808				6.707
			.00020	.035	
109+50	117	691			6.93

The program used is based on the momentum equation from TR 25 (Figure 5-1)

$$\frac{Q_3^2}{gA_3} + \left(\frac{b_3}{2} + \frac{z d_3}{3}\right) d_3^2 = \frac{Q_1^2}{gA_1} + \frac{Q_2^2 \cos\theta}{gA_2} + \left(\frac{b_1}{2} + \frac{z d_1}{3}\right) d_1^2 + A_a h - \frac{P_a l n^2 V_a^2}{2.21 R_a^{4/3}}$$

$\cos\alpha \approx 1.0$ $b_3 = b_1 = 30'$, $z = 2.0$ $\theta = 90°$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE ARIZONA		PROJECT BUCKHORN MESA WPP SPOOK HILL FLOODWAY	
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP			SHEET 2 OF 14

Begin Sta 190+00 -
Junction 190+00 to 189+00

0.03500	n
0.00051	S
2,136.00000	Q_3
30.00000	b_3
9.06300	d_3
2.00000	z_3
436.16593	A_3
70.53096	P_3
1,768.00000	Q_1
30.00000	b_1
2.00000	z_1
368.00000	Q_2
100.00000	b_2
2.00000	z_2
90.00000	θ
100.00000	ℓ
0.05190	h
9.35500	d_1 (Trial)
455.68205	A_1
71.83683	P_1
1,110.53205	A_2
445.92399	A_a
71.18390	P_a
6.26439	R_a
1,952.00000	Q_a
4.37742	V_a
2,053.61018	M_3 A
2,053.97301	M_1 A

Begin Drawdown Curve
Sta 189+00 to 187+00

0.03500	← error
0.00051	
1,768.00000	
30.00000	
9.35500	
2.00000	
455.68205	
71.83683	
1,768.00000	
30.00000	
2.00000	
0.00000	
0.00000	
0.00000	
0.00000	
200.00000	
0.10380	
9.39500	
458.38204	
72.01571	
0.00000	
457.03205	
71.92627	
6.35417	
1,768.00000	
3.86843	
2,071.84654	A
2,071.88359	A

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE ARIZONA		PROJECT BUCKHORN MESA WPP SPOOK HILL FLOODWAY	
BY A.C.	DATE 4-26-76	CHECKED BY	DATE
			JOB NO. 2005
SUBJECT WSP			SHEET 3 OF 14

Backwater (slope change)
Sta 187+00 to 185+00

0.02700
0.00609

1,768.00000
30.00000
9.39500
2.00000
458.38204
72.01571

1,768.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
200.00000
1.21800

8.17500
378.91124
66.55971
0.00000

418.64664
69.28771
6.04214
1,768.00000
4.22313

2,088.87142 - A

2,088.34880 A

Junction
Sta 185+00 to 181+00

0.03500
0.00609

1,768.00000
30.00000
8.17500
2.00000
378.91124
66.55971

1,246.00000
30.00000
2.00000

522.00000
400.00000
2.00000

90.00000
400.00000
2.43600

6.50000
279.50000
59.06883
2,684.50000

329.20562
62.81429
5.24093
1,507.00000
4.57768

1,623.20023 A

1,623.47091 A

STATE	PROJECT			
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY			
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	4-26-76			2005
SUBJECT				SHEET 4 OF 14

Backwater Curve
Sta 181+00 to 180+00

0.02700	
0.00609	
1,246.00000	
30.00000	
6.50000	
2.00000	
279.50000	
59.06888	
1,246.00000	
30.00000	
2.00000	
0.00000	
0.00000	
0.00000	
0.00000	
100.00000	
0.60900	
5.90000	
246.62000	
56.38560	
0.00000	
263.06000	
57.72724	
4.55694	
1,246.00000	
4.73656	
.....	
989.55158	A
989.24883	A
.....	

Sta 180+00 to 179+00

0.02700	
0.00609	
1,246.00000	
30.00000	
5.90000	
2.00000	
246.62000	
56.38560	
1,246.00000	
30.00000	
2.00000	
0.00000	
0.00000	
0.00000	
0.00000	
100.00000	
0.60900	
5.31000	
215.69220	
53.74704	
0.00000	
231.15610	
55.06632	
4.19777	
1,246.00000	
5.39029	
.....	
854.81482	A
854.62434	A
.....	

STATE ARIZONA		PROJECT BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 5 OF 14

Sta 179+00 to 178+00

0.02700
0.00609

1,246.00000
30.00000
5.31000
2.00000
215.69220
53.74704

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.00000
0.60900

4.74000
187.13520
51.19792
0.00000

201.41370
52.47248
3.83846
1,246.00000
6.18627

. . . . . .

746.56885 A

746.33153 A

. . . . . .

Sta 178+00 to 177+00

0.02700
0.00609

1,246.00000
30.00000
4.74000
2.00000
187.13520
51.19792

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.00000
0.60900

4.22000
162.21679
48.87241
0.00000

174.67600
50.03516
3.49106
1,246.00000
7.13320

. . . . . .

665.97886 A

665.83660 A

. . . . . .

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 6 OF 14

Sta 177+00 to 176+00

0.02700
0.00609

1,246.00000
30.00000
4.22000
2.00000
162.21679
48.87241

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.00000
0.60900

3.83000
144.23780
47.12828
0.00000

153.22730
48.00034
3.19221
1,246.00000
8.13171

614.82100 A

614.38232 A

Sta 176+00 to Sta 175+00

0.02700
0.00609

1,246.00000
30.00000
3.83000
2.00000
144.23780
47.12828

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.80000
0.60900

3.73000
139.72579
46.68106
0.00000

141.98180
46.90467
3.02702
1,246.00000
8.77577

592.17672 A

592.87776 A

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPB SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 7 OF 14

Sta 175+00 to 174+00
Normal depth is reached @175+00

0.02700
0.00609

1,246.00000
30.00000
3.73000
2.00000
139.72579
46.68106

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.00000
0.60900

3.73000
139.72579
46.68106
0.00000

139.72579
46.68106
2.99320
1,246.00000
8.91746

. . . . . .
588.78658 A

588.91013 A
. . . . . .

Backwater Curve (Slopechange)
Sta 159+50 to 158+50

0.02700
0.00020

1,246.00000
30.00000
3.73000
2.00000
139.72579
46.68106

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.00000
0.02000
4.61000
180.80419
50.61654
0.00000

160.26499
48.64880
3.29432
1,246.00000
7.77462

. . . . . .
588.78658 A

589.10971 A
. . . . . .

STATE	PROJECT			
ARIZONA	BUCKHORN-MESA WPP - SPOOK HILL FLOODWAY			
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 8 OF 14

Sta 158+50 + 157+50	Sta 157+50 to 156+50
0.02700	0.02700
0.00020	0.00020
1,246.00000	1,246.00000
30.00000	30.00000
4.61000	4.97000
2.00000	2.00000
180.80419	198.50179
50.61654	52.22651
1,246.00000	1,246.00000
30.00000	30.00000
2.00000	2.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
100.00000	100.00000
0.02000	0.02000
4.97000	5.22000
198.50179	211.09679
52.22651	53.34454
0.00000	0.00000
189.65299	204.79929
51.42153	52.78553
3.68820	3.87983
1,246.00000	1,246.00000
6.56989	6.08400
.....	.....
651.09645 A	695.55135 A
651.95541 A	695.31349 A
.....	.....

STATE Arizona		PROJECT Buckhorn Mesa WPP Spook Hill Floodway		
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 9 OF 14

Sta 156+50 to 155+50	Sta 155+50 to 154+00
0.02700	0.02700
0.00020	0.00020
1,246.00000	1,246.00000
30.00000	30.00000
5.22000	5.42000
2.00000	2.00000
211.09679	221.35280
53.34454	54.23897
1,246.00000	1,246.00000
30.00000	30.00000
2.00000	2.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
100.00000	150.00000
0.02000	0.03000
5.42000	5.66000
221.35280	233.87120
54.23897	55.31228
0.00000	0.00000
216.22480	227.61200
53.79176	54.77563
4.01966	4.15535
1,246.00000	1,246.00000
5.76252	5.47422
.....	.....
732.23581 A	764.88236 A
732.14735 A	764.13766 A
.....	.....

STATE	PROJECT			
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY			
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 10 OF 14

Sta 154+00 to Sta 152+00

0.02700
0.00020

1,246.00000
30.00000
5.66000
2.00000
233.87120
55.31228

1,246.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
200.00000
0.04000
5.92000
247.69280
56.47504
0.00000

240.78200
55.89366
4.30785
1,246.00000
5.17480

807.83097 A

807.85149 A

Backwater Curve (change in discharge)
Sta 152+00 to Sta 151+00

0.02700
0.00020

808.00000
30.00000
5.92000
2.00000
247.69280
56.47504

808.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
100.00000
0.02000
5.95000
249.30500
56.60920
0.00000

248.49890
56.54212
4.39493
808.00000
3.25152

745.97083 A

745.82690 A

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 11 OF 14

Sta 151+00 to 146+00	Sta 146+00 to 141+00
0.02700	0.02700
0.00020	0.00020
808.00000	808.00000
30.00000	30.00000
5.95000	6.09000
2.00000	2.00000
249.30500	256.87620
56.60920	57.23530
808.00000	808.00000
30.00000	30.00000
2.00000	2.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
500.00000	500.00000
0.10000	0.10000
6.09000	6.21000
256.87620	263.42819
57.23530	57.77196
0.00000	0.00000
253.09060	260.15220
56.92225	57.50363
4.44625	4.52409
808.00000	808.00000
3.19253	3.10587
.....	.....
752.89578 A	785.92752 A
753.04211 A	785.87518 A
.....	.....

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT			SHEET 12 OF 14

Sta 141+00 to 135+00	Sta 135+00 to 125+00
0.02700	0.02700
0.00020	0.00020
808.00000	808.00000
30.00000	30.00000
6.21000	6.33500
2.00000	2.00000
263.42819	270.31444
57.77196	58.33098
808.00000	808.00000
30.00000	30.00000
2.00000	2.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
600.00000	1,000.00000
0.12000	0.20000
6.33500	6.50700
270.31444	279.89209
58.33098	59.10018
0.00000	0.00000
266.87132	275.10327
58.05147	58.71558
4.59714	4.68535
808.00000	808.00000
3.02767	2.93707
.....	.....
815.17961 A	846.57470 A
815.25443 A	846.48852 A
.....	.....

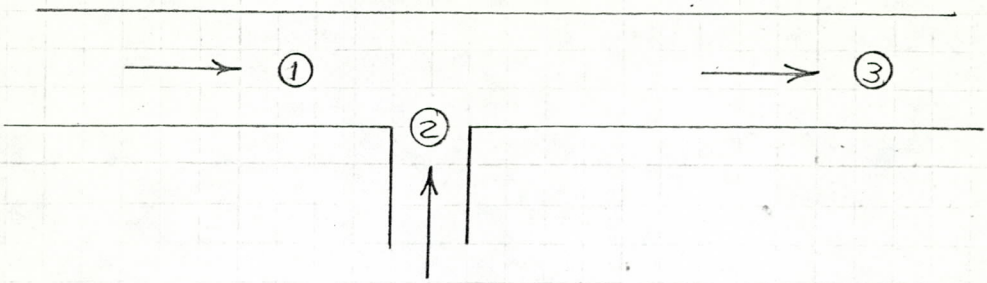
STATE	PROJECT			
Az	Buckhorn Mesa WPP Spook Hill Floodway			
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2805
SUBJECT WSP				SHEET 13 OF 14

Sta 125+00 to 110+00
↑ 50' off - error insignificant

Junction
Sta 110+50 to 109+50

0.02700	0.03500
0.00020	0.00020
808.00000	808.00000
30.00000	30.00000
6.50700	6.70700
2.00000	2.00000
279.89209	291.17769
59.10018	59.99461
808.00000	117.00000
30.00000	30.00000
2.00000	2.00000
0.00000	691.00000
0.00000	100.00000
0.00000	2.00000
0.00000	90.00000
1,500.00000	100.00000
0.30000	0.02000
6.70700	6.93000
291.17769	303.94980
59.99461	60.99190
0.00000	789.04980
285.53489	297.56374
59.54740	60.49325
4.79508	4.91895
808.00000	462.50000
2.82977	1.55428
.....	.....
891.32093 A	945.61410 A
891.35314 A	944.83686 A
.....	.....

STATE ARIZONA		PROJECT BOCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-26-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT WSP				SHEET 14 OF 14



Conclusions: There is absolutely no reason to direct the side flow in the direction of flow in the floodway. The momentum added is insignificant. (Sideslopes ~~will~~ be ~~changed through the junction to allow sideflow to enter the channel~~).

Also, the momentum equation can easily be adapted to backwater and drawdown analysis. It has the added feature of being able to add and subtract discharges, and include reaches through junctions.

STATE Ariz	PROJECT Buckhorn Mesa WPP Spook Hill FRS		
BY RJM	DATE 8-5-75	CHECKED BY	DATE	JOB NO.

SUBJECT Side Inlets

SHEET 1 OF 10

Determine: Side inlet discharges

Procedure:

Distribute routed discharges between channels located on topographic map

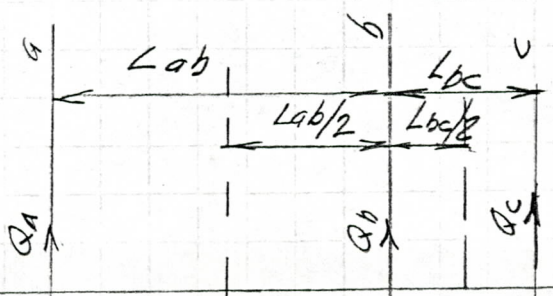
Given:
100yr Discharges - Side Inlets

Station	Discharge cfs	Length L
110+50	691	—
111+00		
	130	2470
135+70		
	951	3160
167+30		
	817	3770*
205+00		

*will require further breakdown

Solution

Q = total disch. for drainage area
L = total ℄ length of drainage area



$$Q_b = Q\left(\frac{L_{ab} + L_{bc}}{2L}\right)$$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE: Ariz
PROJECT: Buckhorn Mesa WPP Spook Hill FRS
BY: PJM
DATE: 8-5-75
CHECKED BY:
DATE:
JOB NO.:
SUBJECT: Inlet Locations
SHEET 2 OF 10

	Inlet No	Station ℄ Floodway	Q cfs	Inlet Type	Dh or L	slope S	Length ℓ	Outlet Elev
	1	108+90	691	Channel				
	2	112+40	27	Pipe	24	.1977	48	
	3	119+70	26	Pipe	24	.206	50	
	4	122+10	26	Pipe	24	.202	48	
	5	129+60	31	Pipe	24	.1881	46	
	6	133+80	21	Pipe	24	.1840	46	
	7	137+70	96	Weir				
	8	140+20	54	Weir	30	.248	58	
	9	141+30	54	Weir	30	.304	76	
	10	143+80	66	Weir				
	11	145+70	63	Weir	30	.278	66	
	12	148+00	99	Weir				
	13	152+30	84	Weir				
	14	153+60	51	Weir	30	.271	64	
	15	155+70	56	Weir				
	16	157+30	50	pipe	30	.270	64	
	17	159+00	39	pipe	30	.267	64	
	18	159+90	30	Pipe	24	.268	64	
	19	161+00	44	Pipe	30	.272	64	
	20	162+80	47	Pipe	30	.278	66	
	21	164+10	116	Weir				
	~~22~~	~~167+80~~	4	None				
	~~23~~	~~169+10~~	5	None				
	~~24~~	~~170+90~~	9	None				
	~~25~~	~~174+90~~	9	None				
	~~26~~	~~176+60~~	6	None				
22	27	178+70	(41) 8	Pipe	30	.1856	46	
23	28	183+85	368	Channel				
24	29	191+10	368	Channel				
25	30	193+10	(41) 7	Pipe	30	.241	56	
	~~31~~	~~195+80~~	11	None				
	~~32~~	~~200+10~~	13	None				
	~~33~~	~~203+90~~	10	None				

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
PJM	8-5-75			

SUBJECT
Side Inlets
Monroe 1880

SHEET 3 OF 10

$Q_b = Q\left(\frac{L_{ab}+L_{bc}}{2L}\right)$ — Program

0000	056	Q
1	060	(
2	110	↓
3	000	0
4	056	L
5	060	
6	110	↓
7	001	1
8	056	Sta a
9	060	
0010	110	↓
1	002	2
2	056	Sta b
3	060	
4	110	↓
5	003	3
6	066	
7	001	1
8	056	Sta c
9	060	
0020	065	
1	110	↓
2	004	4
3	022	−
4	111	↑
5	003	3
6	021	+
7	026	(
8	111	↑
9	003	3
0030	022	−
1	111	↑
2	002	2
3	027	)
4	023	X
5	111	↑
6	000	0
7	024	÷
8	002	2
9	024	÷

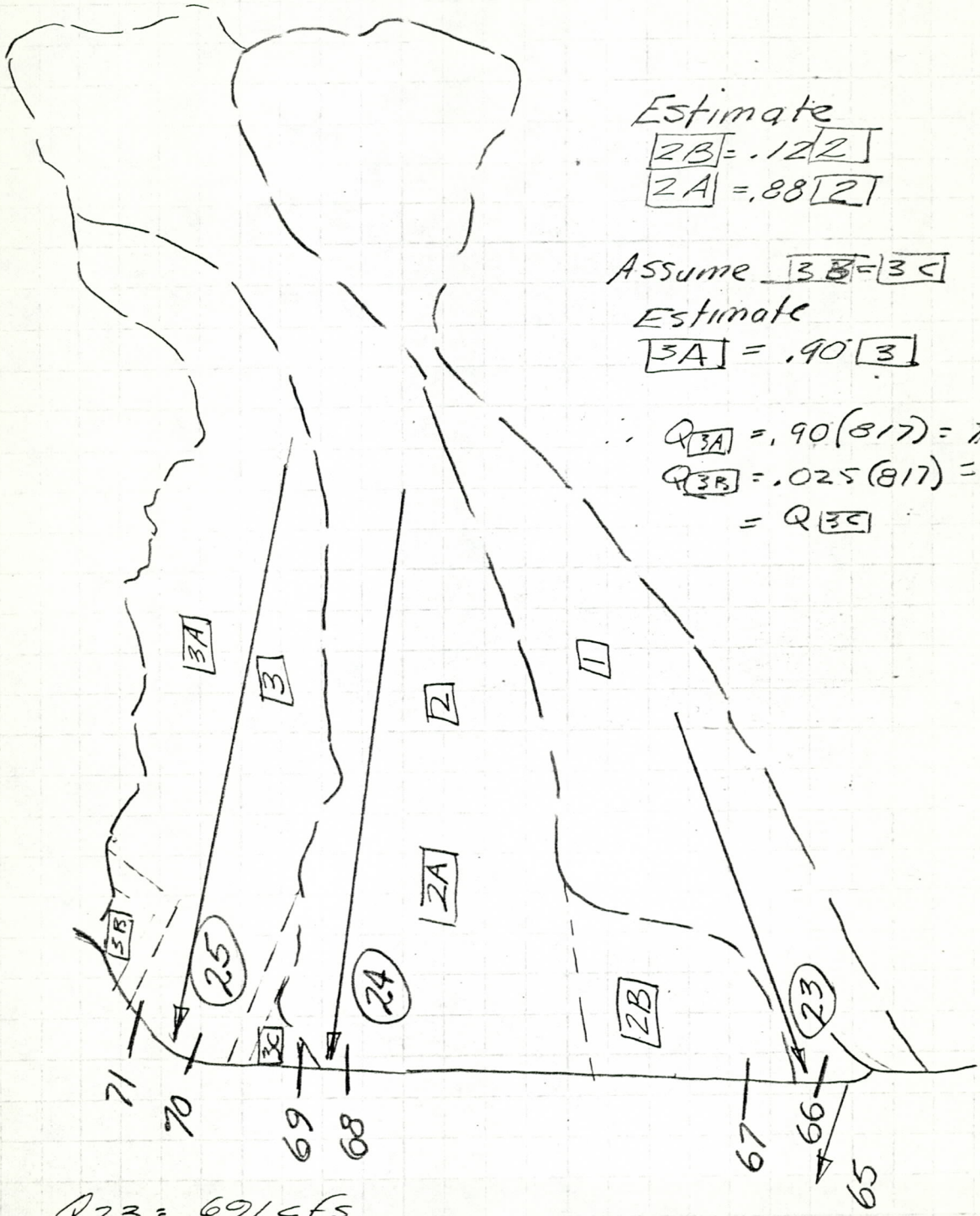
0040	111	↑
1	001	1
2	020	=
3	061	A Qb
4	110	↓
5	005	5
6	111	↑
7	003	3
8	060	Sta b
9	110	↓
0050	002	2
1	111	↑
2	004	4
3	110	↓
4	003	3
5	065	
6	127	Br
7	067	
8	001	1

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	8-6-75			
SUBJECT				SHEET 4 OF 10



Estimate
$\boxed{2B} = .12 \boxed{2}$
$\boxed{2A} = .88 \boxed{2}$

Assume $\boxed{3B} = \boxed{3C}$
Estimate
$\boxed{3A} = .90 \boxed{3}$

$\therefore Q_{\boxed{3A}} = .90(817) = 735 cfs$
$Q_{\boxed{3B}} = .025(817) = 41 cfs$
$= Q_{\boxed{3C}}$

$Q_{23} = 691 cfs$
$Q_{24} = 1081 cfs$
$Q_{25} = 817 cfs$

$Q_{\boxed{2B}} = .12(1081) = 130 cfs$
$Q_{\boxed{2A}} = .88(1081) = 951 cfs$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY: RJM	DATE: 8-6-75	CHECKED BY: (J) Rodda	DATE: 1-22-76
JOB NO.			

SUBJECT: Side Inlets

SHEET 5 OF 10

Adjusted Discharges

station	Discharge cfs	Length L Ft
110+50	691	—
111+00		
	130	2470
135+70		
	951	3160
167+30		
	41	1270
180+00		
	735	1250
192+50		
	41	1250
205+06		

Sta 111+00 to Sta 135+70

$$Q_{112+40} = \frac{(130)\left[\frac{11970-11240}{2} + (11240-11100)\right]}{2470}$$

$$= \underline{27 \text{ cfs}} \checkmark$$

130.00
2,470.00
11,240.00
11,970.00
12,210.00

25.53 cfs A Q
11,970.00 Sta

12,960.00

26.05 A
12,210.00

13,380.00

30.79 A
12,960.00

$$Q_{133+80} = \frac{(130)\left[\frac{13380-12960}{2} + (13570-13380)\right]}{2470}$$

$$= 21 \text{ cfs} \checkmark$$

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP Spook Hill FRS			
BY RJM	DATE 8-6-75	CHECKED BY D. Dodd	DATE 1-22-76	JOB NO. 2005
SUBJECT Side Inlets				SHEET 6 OF 10

Sta 135+70 to Sta 167+30

$$Q_{137+70} = \frac{(951)\left[(13770-13570)+\frac{(14020-13770)}{2}\right]}{3160}$$

$$= 96 \text{ cfs}$$

951.00
3,160.00
13,380.00
13,770.00
14,020.00

96.30 cfs A Q
13,770.00 sta

14,130.00

54.17 A
14,020.00

14,380.00

54.17 A
14,130.00

14,570.00

66.21 A
14,380.00

14,800.00

63.20 A
14,570.00

15,230.00

99.31 A
14,800.00

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 50

GPO : 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	8-6-75			

SUBJECT Side Inlets

SHEET 7 OF 10

15,360.00	
84.27	A
15,230.00	
15,570.00	
51.16	A
15,360.00	
15,730.00	
55.68	A
15,570.00	
15,900.00	
49.66	A
15,730.00	
15,990.00	
39.12	A
15,900.00	
16,100.00	
30.09	A
15,990.00	
16,280.00	
43.64	A
16,100.00	
16,410.00	
46.65	A
16,280.00	

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 51

GPO : 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa w/PP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
RSM	8-6-75	[illegible]	1-22-76	2005

SUBJECT Side Inlets

SHEET 8 OF 10

$$Q_{164+10} = (951)\left[\frac{(16410-16280)}{2} + (16730-16410)\right]$$

✓ 3160

$$= \underline{116 \text{ cfs}}$$

Sta 167+30 to Sta 180+00

$$Q_{167+80} = (41)\left[(16780-16730) + \frac{(16910-16780)}{2}\right]$$

✓ 1270

$$= \underline{4 \text{ cfs}}$$

41.00
1,270.00
16,410.00
16,780.00
16,910.00

~~8.07~~ A
~~16,780.00~~ void

17,090.00

5.00 cfs A Q
16,910.00 Sta

17,490.00

9.36 A
17,090.00

17,660.00

9.20 A
17,490.00

STATE		PROJECT		
Ariz		Buckhorn Mesquite Spook Hill FRS		
BY PJM	DATE 8-6-75	CHECKED BY	DATE 1-22-76	JOB NO. 2005

SUBJECT Side Inlets

SHEET 9 OF 10

17,870.00

6.13 A

17,660.00

$$Q_{178+70} = \frac{(41)\left[\frac{(17870-17660)}{2} + (18000-17870)\right]}{1270}$$

$= \underline{8 \text{ cfs}}$

Sta 180+00 to Sta 192+50

Divide flows evenly between Sta 183+85 and 191+10

$Q = 735/2 = \underline{368 \text{ cfs}}$

Sta 192+50 to Sta 205+00

$$Q_{193+10} = \frac{(41)\left[(19310-19250) + \frac{(19580-19310)}{2}\right]}{1250}$$

$= \underline{7 \text{ cfs}}$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 53

GPO 1958 O—470868

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP Spook Hills RS			
BY RJM	DATE 8-6-75	CHECKED BY [illegible]	DATE 1-22-96	JOB NO. 2005

SUBJECT Side Inlets

SHEET 10 OF 10

41.00
1,250.00
19,210.00
19,310.00
19,580.00

~~6.07~~ Void A
~~19,310.00~~

20,010.00

11.48 cfs A Q
19,580.00 Sta

20,390.00

13.28 A
20,010.00

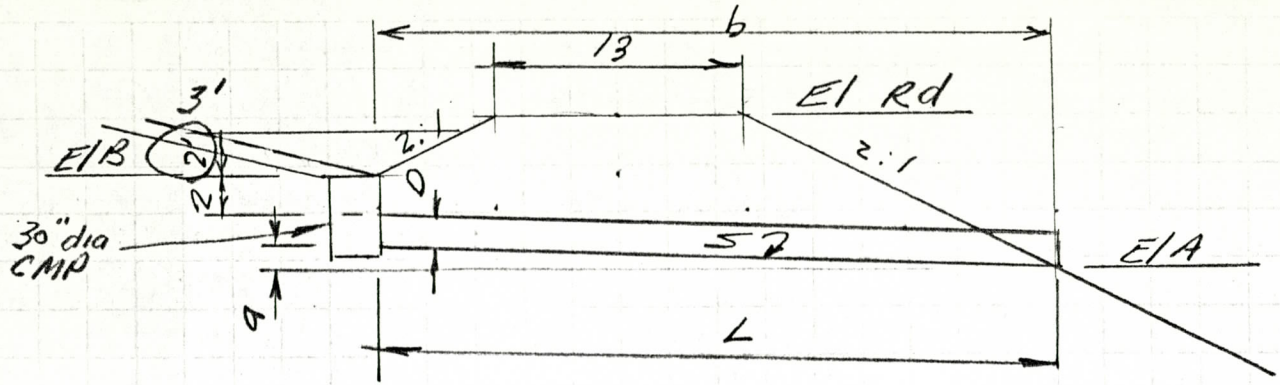
$$Q_{203+90} = \frac{(41)\left[\frac{(20390-20010)}{2} + (20500-20390)\right]}{1250}$$

$= \underline{10 \text{ cfs}}$ ✓

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz
BY RJM
DATE 4/12/76
SUBJECT Pipe Inlets
PROJECT Buckthorn Wash SMP Rock Hill Fes
CHECKED BY
DATE
JOB NO.
SHEET 1 OF 9



Inlet No	Sta	El Rd	El B	El A	Qreqd cfs	Qw cfs	D in	Qo cfs	L ft	S 1/1	Qp cfs
2	112+40	1580.08	1577.08	1572.17	27.0	68.8	24	37.8	36	.0258	34.2
3	119+70	1580.55	1577.55	1571.91	26.0		24	37.8	36	.0456	36.4
4	122+10	1580.21	1577.21	1571.77	26.0		24	37.8	36	.0400	35.8
5	129+60	1579.01	1576.01	1571.42	31.0		24	37.8	34	.01882	33.9
6	133+80	1578.14	1575.14	1571.~~20~~ 14	21.0		24	37.8	34	.000	31.8
8	140+20	1584.24	1581.24	1570.84	54.0		30	60.5	46	.1283	75.2
9	141+30	1585.20	1582.20	1570.75	54.0		30	60.5	48	.1448	78.0
10	143+80	1587.39	1584.39	1570.58	66.0		30	60.5	NG USE WEIR →		
11	145+70	1587.85	1584.85	1570.40	63.0		30	60.5	NG USE WEIR →		
14	153+60	1586.82	1583.82	1569.60	51.0		30	60.5	54	.1800	84.1
15	155+70	1586.54	1583.54	1569.29	56.0		30	60.5	54	.1806	84.2
16	157+30	1586.34	1583.34	1568.95	50.0		30	60.5	54	.1832	84.6
17	159+00	1585.98	1582.98	1568.23	39.0		30	60.5	56	.1830	84.8
18	159+90	1586.00	1583.00	1567.53	30.0		24	37.8	58	.1978	50.9
19	161+00	1585.86	1582.86	1566.86	44.0		30	60.5	58	.1983	87.4
20	162+80	1585.62	1582.62	1565.77	47.0		30	60.5	54	.229	91.4

GPO 1958 O—470668

STATE Ariz	PROJECT Buckhorn Mesa WPP Spook Hill FRS			
BY PJM	DATE 9/8/76	CHECKED BY	DATE	JOB NO.

SUBJECT Pipe Inlet

SHEET 2 OF 9

Weir Flow

$Q_w = 3.1 L H^{3/2}$

where L = circumference for 30" dia pipe

$= \frac{\pi D}{12} = 7.85'$

$H = 2'$

$Q = 3.1(7.85)(2)^{3/2} = 68.8$ cfs

Orifice Flow

$Q_o = .67 a \sqrt{2gh}$

where $h = 4 + D/24$

D	a	h	Q
24	3.14	5.00	37.8
30	4.91	5.25	60.5

Pipe Flow

$Q_p = a \sqrt{\frac{2gh}{1 + K_e + K_p L}}$ where $K_e = 0.5$

$L = \sqrt{a^2 + b^2}$

D inlet

$a = E/B - 2 - D - E/A$

$b = 19 + 2(E/Rd - E/A)$

$h = E/B + 2 - E/A - \frac{2}{3}D$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 56

GPO 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	4/8/76			

SUBJECT Pipe Inlet

SHEET 3 OF 9

Inlet No2 D = 24" n = 0.024

a = 1577.08 - 2 - 2 - 1572.15 = 0.930
b = 19 + 2 (1580.08 - 1572.15) = 34.9

$L = \sqrt{(34.9)^2 + (0.930)^2}$
= 34.9 USE 36

S = 0.930 / 36 = 0.0258

$Q_p = 3.14 \sqrt{\dfrac{64.4(1577.08 + 2 - 1572.17 - 1.333)}{1.5 + (.0423)(36)}}$

= 34.2 cfs > Q_r = 27.0 cfs OK

Inlet No3 D = 24" n = 0.024

A = 3.14 sq ft Kp = 0.0423

a = 1577.55 - 2 - 2 - 1571.91 = 1.64
b = 19 + 2 (1580.55 - 1571.91) = 36.28

$L = \sqrt{(1.64)^2 + (36.28)^2}$ = 36.3'
USE 36'

S = 1.64 / 36 = 0.0456 '/'

h = 1577.55 + 2 - 1571.91 - 1.33 = 6.31

$Q_p = 3.14 \sqrt{\dfrac{64.4(6.31)}{1.5 + (.0423)(36)}}$

= 36.4 cfs > Q_r = 26.0 cfs OK

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill FRS		
BY PJM	DATE 4/8/76	CHECKED BY	DATE	JOB NO.

SUBJECT Pipe Inlet

SHEET 4 OF 9

Inlet No4 D=24 A = 3.14 sf Kp = 0.0423

a = 1577.21 - 2 - 2 - 1571.77 = 1.44
b = 19 + 2(1580.21 - 1577.77 = 35.9

$L = \sqrt{(1.44)^2 + (35.9)^2} = 35.9'$
USE 36'

S = 1.44/36 = 0.0400

h = 1577.21 + 2 - 1571.77 - 1.33 = 6.11

$Q_p = 3.14 \sqrt{\frac{64.4(6.11)}{1.5 + (.0423)(36)}} =$
= 35.8 cfs > Q_r = 26 cfs OK

Inlet No5 D=24" A = 3.14 sf Kp = 0.0423

a = 1576.01 - 2 - 2 - 1571.42 = 0.640
b = 19 + 2(1579.01 - 1571.42) = 34.2

$L = \sqrt{(.640)^2 + (34.2)^2} = 34.2'$
USE 34

S = 0.640/34 = 0.01882 '/'

h = 1576.01 + 2 - 1571.42 - 1.33 = 5.31'

$Q_p = 3.14 \sqrt{\frac{64.4(5.31)}{1.5 + (.0423)(34)}}$
= 33.9 cfs > Q_r = 31 cfs OK

STATE Ariz		PROJECT Buckhorn Mesa WPP Spook Hill FRS		
BY PJM	DATE 4/8/76	CHECKED BY	DATE	JOB NO.
SUBJECT Pipe Inlet				SHEET 5 OF 9

Inlet No 6 $D = 24''$ $A = 3.14 sf$ $K_p = 0.0423$

$a = 1578.14 - 2 - 2 - 1571.\cancel{20}\,14 = 0$

$b = 19 + 2(1578.14 - 1571.\cancel{20}\,14) = 33.0$

$L = b = 33.0$ USE $34.0'$

$h = 4 + 2 - 1.33 = 4.67$

$$Q_p = 3.14 \sqrt{\frac{64.4(4.67)}{1.5 + (0.0423)(34)}}$$

$= 31.8$ cfs $> Q_r = 21.0$ cfs OK

$s = 0.00$

Inlet No 8 $D = 30''$ $A = 4.91 sf$ $K_p = 0.0314$

$a = 1581.24 - 2 - 2.5 - 1570.84 = 5.90$

$b = 19 + (1584.24 - 1570.84)2 = 45.8$

$L = \sqrt{(5.90)^2 + (45.8)^2} = 46.2'$

USE $46'$

$s = 5.9/46 = 0.1283'/'$

$h = 1581.24 + 2 - 1570.84 - \frac{2}{3}(2.5) = 10.73'$

$$Q_p = 4.91 \sqrt{\frac{64.4(10.73)}{1.5 + (0.0314)(46)}} =$$

$= 75.2$ cfs $> Q_r = 54.0$ cfs OK

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY RJM / DATE 4/8/76	CHECKED BY	DATE	JOB NO.
SUBJECT Pipe Inlet			SHEET 6 OF 9

Inlet No 9 D=30" A=4.915f - Kp=0.0314

$a = 1582.20 - 2 - 2.5 - 1570.75 = 6.95$
$b = 19 + 2(1585.20 - 1570.75) = 47.9$

$L = \sqrt{(6.95)^2 + (47.9)^2} = 48.4$
USE 48'

$S = 6.95/48 = 0.1448$

$h = 1582.20 + 2 - 1570.75 - 1.667 = 11.78'$

$Q_p = 4.91\sqrt{\dfrac{64.4(11.78)}{1.5 + (0.0314)(48)}}$
$= 78\text{cfs} > Q_r = 54\text{cfs}$ OK

Inlet No 14 D=30" A=4.915f Kp=0.0314

$a = 1583.82 - 2 - 2.5 - 1569.60 = 9.72'$
$b = 19 + 2(1586.82 - 1569.60) = 53.4'$

$L = \sqrt{(9.72)^2 + (53.4)^2} = 54.3'$
USE 54'

$S = 9.72/54 = 0.1800$

$h = 1583.82 + 2 - 1569.60 - 1.667 = 14.55$

$Q_p = 4.91\sqrt{\dfrac{64.4(14.55)}{1.5 + (0.0314)(54)}}$
$= 84.1\text{cfs} > Q_r = 51.0\text{cfs}$ OK

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY PJM	DATE 4/8/76	CHECKED BY	DATE	JOB NO.

SUBJECT Pipe Inlet

SHEET 7 OF 9

Inlet No 15 $D = 30''$ $A = 4.91 sf$ $K_p = 0.0314$

$a = 1583.54 - 4.5 - 1569.29 = 9.75$
$b = 19 + 2(1586.54 - 1569.29 = 53.5$

$L = \sqrt{(9.75)^2 + (53.5)^2} = 54.4'$
USE 54'

$s = 9.75/54 = 0.1806$

$h = 1583.54 + 2 - 1569.29 - 1.667 = 14.58'$

$Q_p = 4.91 \sqrt{\dfrac{64.4(14.58)}{1.5 + (.0314)(54)}} =$
$= 84.2$ cfs $> Q_r = 56$ cfs OK

Inlet No 16 $D = 30''$ $A = 4.91 sf$ $K_p = 0.0314$

$a = 1583.34 - 4.5 - 1568.95 = 9.89'$
$b = 19 + 2(1586.34 - 1568.95) = 53.8'$

$L = \sqrt{(9.89)^2 + (53.8)^2} = 54.7'$
USE 54.0'

$s = 9.89/54 = 0.1832$

$h = 1583.34 + 2 - 1568.95 - 1.667 = 14.72$

$Q_p = 4.91 \sqrt{\dfrac{64.4(14.72)}{1.5 + (0.0314)(54)}}$
$= 84.6$ cfs $> Q_r = 50.0$ cfs OK

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP Spook Hill FRS			
BY RJM	DATE 4/18/76	CHECKED BY	DATE	JOB NO.
SUBJECT Pipe Inlet				SHEET 8 OF 9

Inlet No 17 $D=30''$ $A=4.91\,sf$ $K_p=0.0314$

$a = 1582.98 - 4.5 - 1568.23 = 10.25$
$b = 19 + 2(1585.98 - 1568.23) = 54.5$

$L = \sqrt{(10.25)^2 + (54.5)^2} = 55.45'$
USE 56'

$S = 10.25/56 = 0.1830$

$h = 1582.98 + 2 - 1568.23 - 1.667 = 15.08$

$$Q_p = 4.91\sqrt{\frac{64.4(15.08)}{1.5 + (0.0314)(56)}}$$
$= 84.8\,cfs > Q_r = 39\,cfs$ OK

Inlet No 18 $D=24'$ $A=3.14\,sf$ $K_p=0.0423$

$a = 1583.00 - 4.0 - 1567.53 = 11.47$
$b = 19 + 2(1586.00 - 1567.53) = 55.9$

$L = \sqrt{(11.47)^2 + (55.9)} = 57.1'$
USE 58'

$S = 11.47/58 = 0.1978'/'$

$h = 1583.00 + 2 - 1567.53 - 1.333 = 16.14$

$$Q_p = 3.14\sqrt{\frac{64.4(16.14)}{1.5 + (.0423)(58)}}$$
$= 50.9\,cfs > Q_r = 30\,cfs$ OK

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill FRS		
BY PJM	DATE 4/8/76	CHECKED BY	DATE	JOB NO.

SUBJECT Pipe Inlet

Inlet No 19 D=30" A=4.91 sq ft Kp=0.0314

a: 1582.86 − 4.5 − 1566.86 = 11.50
b = 19 + 2(1585.86 − 1566.86) = 57.0

$L = \sqrt{(11.50)^2 + (57.0)^2} = 58.1'$
USE 58'

S = 11.50/58 = 0.1983 '/'

h = 1582.86 + 2 − 1566.86 − 1.667 = 16.33'

$Q_p = 4.91\sqrt{\dfrac{64.4(16.33)}{1.5 + (.0314)(58)}}$
= 87.4 cfs > Qr = 44 cfs OK

Inlet No 20 D=30" A=4.91 sf Kp=0.0314

a = 1582.62 − 4.5 − 1565.77 = 12.35'
b = 19 + 2(1585.62 − 1565.77) = 52.3'

$L = \sqrt{(12.35)^2 + (52.3)^2} = 54.1$
USE 54'

S = 12.35/54 = 0.229 '/'

h = 1582.62 + 2 − 1565.77 − 1.667 = 17.18

$Q_p = 4.91\sqrt{\dfrac{64.4(17.18)}{1.5 + (.0314)(54)}}$
= 91.4 cfs > Qr = 47.0 cfs OK

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE ARIZONA		PROJECT BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 7-14-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Pipe Inlet changes				SHEET 1 OF 1

Changes were need on the pipe inlets due to a change in road grades and elevations. On flat grades, a slope of .001 was made for drainage. Submergence on pipe was not considered until the water level reached 2/3 up the pipe diameter

Elevation B is 3' below the roadway elevation

Elevation A is $3' + 2' + D/12 + LS$ below the roadway elevation
L = pipe length S = slope

Inlets 2, 3, 4, 24" pipe 36' long

$$Q_p = a\sqrt{\frac{2gh}{1+K_e+K_pL}}$$ (see previous work)

$$Q_p = 3.14\sqrt{\frac{64.4\ h}{1.57(.0423)(36)}}$$ $Q_p = 27$ cfs $h = 3.47$

h = 1.47 to pass 27 cfs
water surfaces are more than 1.47 feet below B so o.k.

Inlet 5 - water surface elevation 1572.17

h = 3.65', Q_p = 31 cfs required, Q_p actual = 28.08

need 30" pipe to pass 31 cfs

Schedule of Pipe Inlets

Inlet No.	Station	D(IN)	Elev A	Elev B	L (ft)	S
2	112+40	24	1571.65	1575.69	36	0.001
3	119+70	24	1570.86	1574.90	36	0.001
4	122+10	24	1571.60	1574.64	36	0.001
5	129+60	30	1569.79	1573.82	34	0.001
6	133+80	24	1571.59	1575.62	34	0.001
8	140+20	30	1570.84	1581.72	48	0.1225
9	141+30	30	1570.75	1582.19	50	0.1388
14	153+60	30	1569.60	1583.80	56	0.1732
15	155+70	30	1569.29	1583.53	56	0.1739
16	157+30	30	1568.95	1583.32	56	0.1763
17	159+00	30	1568.23	1583.10	56	0.1852
18	159+90	24	1567.53	1582.98	58	0.1974
19	161+00	30	1566.86	1582.84	58	0.1979
20	162+80	30	1565.77	1582.61	60	0.2057

COMPUTATION SHEET
SCS-522 REV 5-58

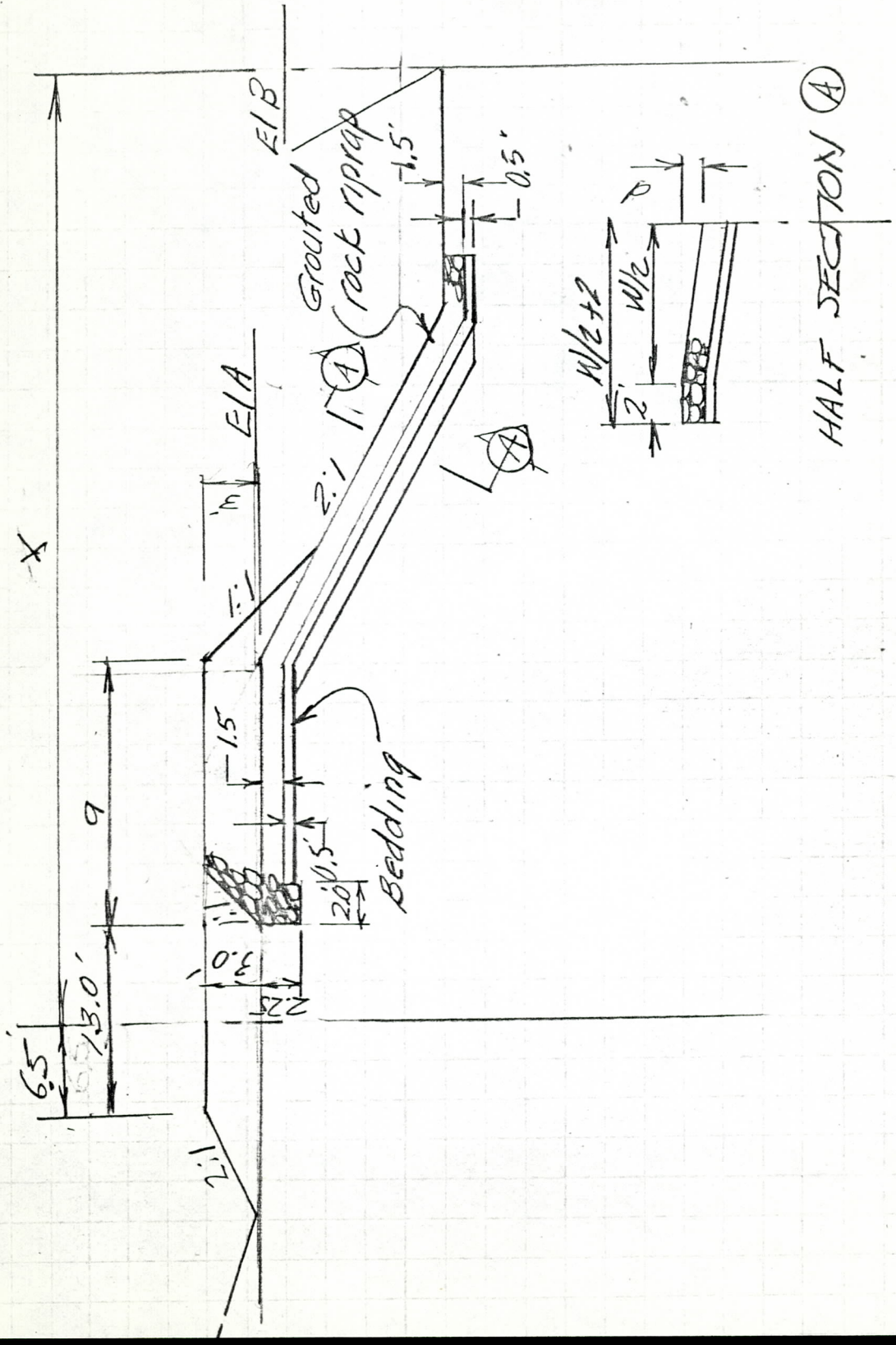
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Dook Hill Fldwy		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	1/26/76			

SUBJECT
Weir Inlet

SHEET 1 OF 6



COMPUTATION SHEET

SCS-522 REV 5-58

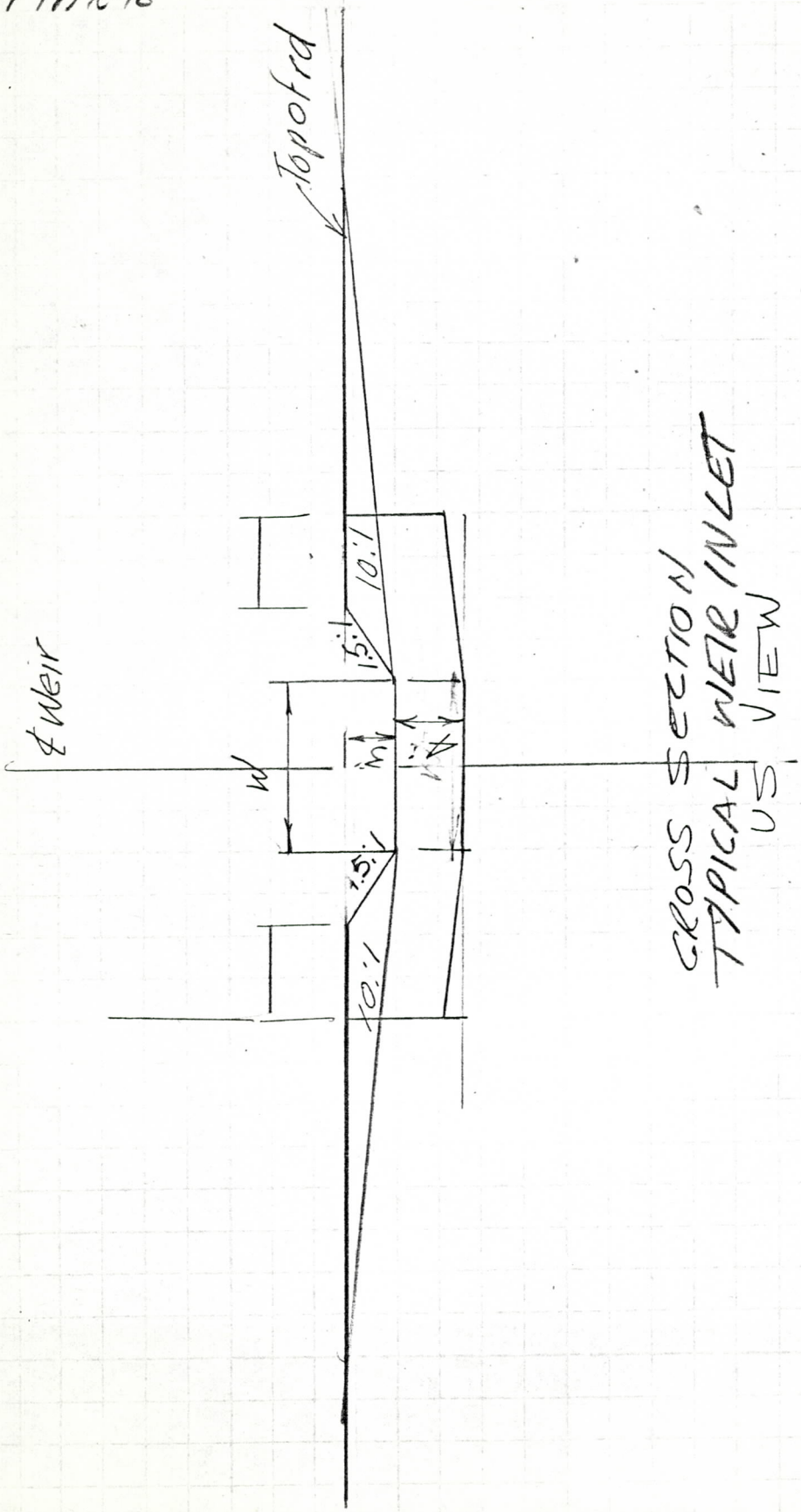
U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GPO . 1958 O—470868

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill Fldwy		
BY	DATE	CHECKED BY	DATE	JOB NO.
PJM	11/22/76			

SUBJECT Weir Inlets



CROSS SECTION
TYPICAL WEIR INLET
US VIEW

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

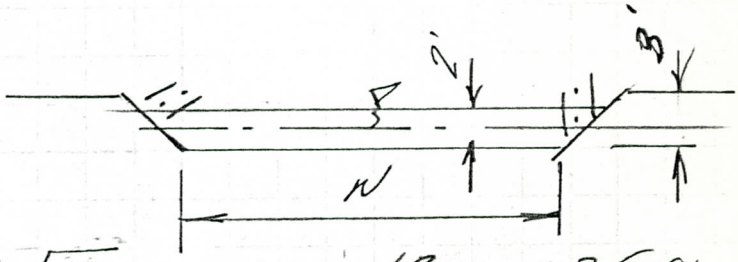
STATE		PROJECT		
Ariz		Buckhorn Mesa WPP Spook Hill Fldwy		
BY RJM	DATE 1/26/76	CHECKED BY ac	DATE 7/22/76	JOB NO.

SUBJECT Weir Inlet

SHEET 3 OF 6

Inlet No	Station	Q CFS	W ft	E/A ft	E/B ft	W(act)
✓ 7	137+70	96	8.95			10
✓ 10	143+80	66	5.53			10
12	148+00	99	9.29			10
13	152+30	84	7.58			10
21	164+10	116	11.23			12
22	178+70	41	2.67			10
25	193+10	41	2.67			10
11	145+70	63	5.18			10

Determine: W.



$Q = 3.1 A \sqrt{H}$ Kings HB p 5-3 (Flat head)

$H = 2'$

$A = H(W+H) = 2(W+2)$

$Q = 3.1[2(W+2)\sqrt{2}$
$= 8.77(W+2)$

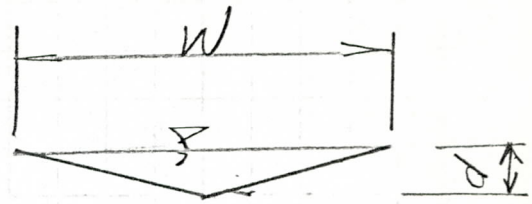
$W = Q/8.77 - 2$

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP Spook Hill Fhwy			
BY RJM	DATE 1/26/76	CHECKED BY A.C.	DATE 7/22/76	JOB NO.

SUBJECT Weir Inlet

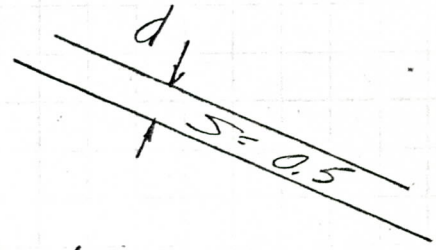
SHEET 4 OF 6

Determine: depth d of trough



Solution:

Assume uniform flow @ z = 2



$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$n = 0.035$

$A = Wd/2$

$R = \frac{zD}{2}\sqrt{1+z^2}$

$z = W/2d$

King's HB p7-4

$$\therefore R = \frac{\left(\frac{W}{2d}\right)d}{2}\sqrt{1+\left(\frac{W}{2d}\right)^2}$$

$$= \frac{W}{4}\sqrt{1+\left(\frac{W}{2d}\right)^2}$$

$S^{1/2} = (0.5)^{1/2} = 0.707$

$$Q = \frac{1.486}{0.035}\left(\frac{Wd}{2}\right)\left(\frac{W}{4}\sqrt{1+\left(\frac{W}{2d}\right)^2}\right)^{2/3}(0.707)$$

$$= 15.01\, Wd\left[\frac{W}{4}\sqrt{1+\left(\frac{W}{2d}\right)^2}\right]^{2/3}$$

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP Spook Hill Fldwy			
BY RJM	DATE 7/26/76	CHECKED BY A.C	DATE 7/22/76	JOB NO.
SUBJECT Weir Inlet				SHEET 5 OF 6

For $W = 10$

$$Q = 15.01(10)d\left[\frac{10}{4}\sqrt{1+\left(\frac{10}{2d}\right)^2}\right]^{2/3}$$

$$\left[(\quad)^{1/2}\right]^{2/3}$$

$$= 150.1d\left[2.5\sqrt{1+\frac{25}{d^2}}\right]^{2/3}$$

$$= 276d\left(1+\frac{25}{d^2}\right)^{1/3}$$

$$\frac{d}{d^{2/3}} = d^{1/3}$$

$$= 276d^{1/3}(d^2+25)^{1/3}$$

$$= 276(d^3+25d)^{1/3}$$

Try $d = 1$

$$Q = 276(1+25)^{1/3}$$

$$= \underline{\underline{818 \text{ cfs}}}$$

Check

$$Q = 150.1(1)\left[2.5\sqrt{1+\frac{25}{(1)^2}}\right]^{2/3}$$

$$= 150.1\left[2.5\sqrt{26}\right]^{2/3}$$

$$= \underline{\underline{819 \text{ cfs}}} \quad \checkmark \qquad \text{OK}$$

Try $d = .5'$

$$Q = 276\left[\left(\frac{1}{2}\right)^3 + 25\left(\frac{1}{2}\right)\right]^{1/3}$$

$$= \underline{\underline{643 \text{ cfs}}} \qquad \text{OK}$$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

STATE	PROJECT			
Ariz	Buckhorn Mesa WRP Spook Hill Fldway			
BY RJM	DATE 1/26/76	CHECKED BY A.C.	DATE 7/22/76	JOB NO.
SUBJECT Weir Inlets				SHEET 6 OF 6

Try $d = 1/4'$

$$Q = 276\left[\left(\frac{1}{4}\right)^3 + 25\left(\frac{1}{4}\right)\right]^{1/3}$$

$= 509$ cfs

USE $d = 0.5'$

Should be good for $W = 12$ also

Revise: 4/76 PJM

USE $d = 1.0'$

Revised 7/76 A.C.

use $d = 2.0'$ for discharges > 500 cfs

STATE ARIZONA		PROJECT BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-6-76	CHECKED BY RJM	DATE 7-9-76	JOB NO. 2005
SUBJECT JUNCTION STRUCTURES				SHEET 1 OF 4

Junction Structures are unnecessary in the Spook Hill Floodway. Backwater Curves show that the floodway has adequate capacity to enter the flow from the natural washes normal (⊥) to the flow in the channel. The major washes can then be designed as wide weirs

STA 109+80 $Q = 691$ cfs the energy head is limited to 2'

H_e $V^2/2g + d = 2.0$ at critical depth $H_e = 1\frac{1}{2} d_c$ so $d_c = 1.33'$

and $d_c = \sqrt[3]{q^2/g}$ for rectangular channels $q^2 = 76.23$

width = 7.9' use 80' weir width with center line at 109+80
(channel bottom is caliche)
erroson on the 4:1 slope to the roadway will occur, this is not expected to be a problem. -No rock will be used upstream

STA 182+70 $Q = 560$ cfs, $H_e = 2'$ $d_c = 1.33'$, $q^2 = 76.23$

width = 64' use 70' weir width with center line a 182+70

Flow in the neighborhood of this junction could spread over a considerable area. Dike will have to be designed to channel the flow into the junction Rock will be used on the 4:1 slope and on the toe of the dike.
(SP-SM soils)

STA 189+40 $Q = 560$ cfs width = 70'

The invert of the wash is below the weir crest. This area will be used as a waste area. Rock Riprap and filterblankets will be used on the embankment material for the channel sideslopes to eliminate the possibility of a piping failure.

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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☆ GPO : 1969—O—357-545

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	5-6-76	PJM	7-9-76	
SUBJECT				SHEET 2 OF 4
JUNCTION STRUCTURES				

WEIR DEPTHS - It is necessary to determine the normal depth of flow for flow down the sideslopes of the channel - a triangular section has been proposed for these weirs. The larger junctions will require greater depths. 2' depths will be used for the triangular rip rap section.

2,304.	2,304.
FLOW	FLOW
560.0000	691.0000
n	n
0.0300	0.0300
S	S
0.5000	0.5000
W	W
0.00001	0.00001
L Z	L Z
17.5000	20.0000
R Z	R Z
17.5000	20.0000
df	df
*	*
1.1500 df	1.1834 df
24.1938 ◇	24.6667 ◇

Grouted rock will be used on the sideslopes and loose rip rap will be placed on the opposite sideslope.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-14-76	CHECKED BY PJM	DATE 7-9-76	JOB NO.
SUBJECT JUNCTION STRUCTURES			SHEET 3 OF 4

STA 182+70 Dikes will have to be constructed upstream (along the wash) from the junction structure inlet to divert floodwaters into the weir openning. These dikes will have to be high enough to protect for the maximum anticipated flow, including bulking*.

depth + bulking + velocity head = .6 + .6 + 1 = 2.2'

adding 1' of freeboard gives 3.2 feet, 4 feet is a good estimate

Other factors to consider include, scour, impact and foundation settlement. * Bulking is the massive movement of sediment with the flow of water. Estimates came from discussion with Greg Cunningham.

Est. of Nat. Channel flow

```
2,304.
.................
     FLOW
   560.0000
.................
                    n
    0.0240
.................
                    S
    0.0400
.................
      W
  120.0000
.................
      L             Z
   10.0000
.................
      R             Z
   10.0000
.................
                   df
                    *
.................
    0.5514         df
    8.0901          ◇
```

Flow on 4:1 slope - approach to weir

```
     FLOW
   560.0000
.................
                    n
    0.0350
.................
                    S
    0.2500
.................
      W
   70.0000
.................
      L             Z
    2.0000
.................
      R             Z
    2.0000
.................
                   df
                    *
.................
    0.5558         df
   14.1685          ◇
    1.2422         dfQ
    0.0169         SQ
    6.2189          ◇ Q
```

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO : 1969—O-357-545

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	5-6-76	PJM	7-9-76	
SUBJECT				SHEET 2 OF 4
JUNCTION STRUCTURES				

WEIR DEPTHS - It is necessary to determine the normal depth of flow for flow down the sideslopes of the channel - a triangular section has been proposed for these weirs. The larger junctions will require greater depths. 2' depths will be used for the triangular rip rap section.

2,304.	2,304.
FLOW	FLOW
560.0000	691.0000
n	n
0.0300	0.0300
S	S
0.5000	0.5000
W	W
0.00001	0.00001
L Z	L Z
17.5000	20.0000
R Z	R Z
17.5000	20.0000
df	df
*	*
1.1500 df	1.1834 df
24.1938 ◇	24.6667 ◇

Grouted rock will be used on the sideslopes and loose rip rap will be placed on the opposite sideslope.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 73

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-76	CHECKED BY HJM	DATE 7-9-76	JOB NO.
SUBJECT JUNCTION STRUCTURES			SHEET 4 OF 4

Flow along Dike

```
.................
2,304.
.................
    FLOW
  200.0000
.................
                    n
   0.0350
.................
                    S
   0.0100
.................
     W
  10.0000
.................
    L               Z
  30.0000
.................
   R                Z
   2.0000
.................
                    df
                    *
.................
   1.5070           df
   3.8905           ◇
```

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	5-5-76			
SUBJECT				SHEET 1 OF 5
RIP RAP DESIGN - JUNCTION STRUCTURES				

From Blaisdell, St Anthony Falls 3-22-72, Tillatebo Creek - Mississippi

$$D_{50} = \frac{0.00116\,V^3}{\sqrt{d}} \quad \text{and} \quad n = 0.0395\,(D_{50})^{1/6}$$

<u>STA 109+80</u> - Junction is in caliche with allowable velocity of 6-8 ft/sec

Natural channel velocities are on the order of 7-9 ft/sec. This is based on the following Q=691 ft/sec, y≈2' and natural channel x-section and slopes (roughness .030). At the approach to the junction, the slope is 10:1

```
. . . . . . . . . . . . . . . . .
2,304 . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . .
      FLOW
    691.0000
. . . . . . . . . . . . . . . . .
                              n
     0.0420
. . . . . . . . . . . . . . . . .
                              S
     0.1000
. . . . . . . . . . . . . . . . .
      W
    60.0000
. . . . . . . . . . . . . . . . .
      L                       Z
     4.0000
. . . . . . . . . . . . . . . . .
      R                       Z
     4.0000
. . . . . . . . . . . . . . . . .
                              df
                              *
. . . . . . . . . . . . . . . . .
     1.0042                   df
    10.7480                   ◇
     1.5468                   dfQ
     0.0230                   SQ
     6.7491                   ◇ Q
```

n = .042 and D_{50} = 1.45 with a velocity of 10.75 ft/sec satisfy the above equations.

A one foot flow depth should not require 18" rock, 8" to 12" rock or less will easily do. (actual effective roughness will be much greater due to turbulance)

<u>Use available rock</u>

caliche

D_{75} = 3" then

From TR25

V_a = 9.5, D = .8, B = .8

F = 1.64

$V_{allowable}$ = <u>10.0 ft/sec</u>

(see Channel stability)

No rock should be required on roadway or weir, except on sideslopes of channel - minimum rock may be used over weir as in typical weir junction

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-5-76	CHECKED BY	DATE	JOB NO.
SUBJECT RIP RAP DESIGN - JUNCTION STRUCTURES				SHEET 2 OF 5

STA 183+70 Because of the nature of this junction, flow was concentrated in the wash expected to carry a major part of the flow. 560cfs enters over 400 ft, while 200cfs in 100 ft was used.

```
..................
2,304.
..................
     FLOW
   200.0000
..................
                    n
     0.0350
..................
                    S
     0.2500
..................
      W
   100.0000
..................
      L             Z
    10.0000
..................
      R             Z
    10.0000
..................
                   df
                    *
..................
     0.2411         df
     8.0973          ◇
     0.4907         df CL
     0.0230          S CL
     3.8851          Q  CL
```

$$D_{50} = \frac{0.00116\,(8.1)^3}{\sqrt{.24}} = 15''$$

This is rediculous. Three inches of flow will not move a 15" rock.

Rock size will have to be based on some practical values estimate a 6" to 8" rock should do.

STA 189+35 - No change in the natural channel is made. Rock is required only on the channel sideslopes where fill exists. $V_{allow} \simeq 13\text{-}15$ ft/sec

$V_{wash} \simeq 9.0$ ft/sec Filter requirements depend on embankment material.

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	5-5-76			

SUBJECT RIP RAP - FILTER DESIGN - JUNCTION STRUCTURE SHEET 3 OF 5

Criteria $\frac{d_{50}\text{ filter}}{d_{50}\text{ base}} < 40$ and $\frac{d_{15}\text{ filter}}{d_{85}\text{ base}} < 5 < \frac{d_{15}\text{ filter}}{d_{15}\text{ base}} < 40$

STA 109+80 - Base material $d_{75} = 3''$ (est $d_{85} = 4''$, $d_{15} = 1.2''$) $d_{50} = 2''$

$d_{50\,\text{riprap}} = 8''$ (est. $d_{15} = 4''$ $d_{85} = 12''$)

$\frac{8''}{2''} = 4 < 40$ and $\frac{4''}{4''} < 5 < \frac{4''}{1.2''} < 40$

No filter is necessary - Rock thickness ≈ 1½ to 2'

STA 183+70 Base material $D_{15} = .27\text{mm} = .011''$ $D_{50} = 1.6\text{mm} = .063''$ $D_{85} = 4.9\text{mm} = .193''$

rip rap $D_{50} = 6''$ $D_{15} = 3''$ $D_{85} = 9''$

$\frac{6''}{.063} = 95 \not< 40$ $\frac{3''}{.193''} = 15 \not< 5 < \frac{3''}{.011''} = 272 \not< 40$ FILTER REQUIRED

filter requirements

rip rap	base	
$d_{50} > \frac{6''}{40}$	$d_{50} < 40(.063'')$	$\Rightarrow$ $2.52'' > d_{50} > .15''$
$d_{85} > 3''/5$	$d_{15} < 5(.193'')$	$\Rightarrow$ $d_{85} > .6''$
$d_{15} < 3''/5$	$d_{15} > 5(.011)$	$\Rightarrow$ $0.44'' > d_{15} > .075''$
$d_{15} > 3''/40$	$d_{15} < 40(.011)$	

$11.2\text{mm} > d_{15} > 1.9\text{mm}$, $64\text{mm} > d_{50} > 3.81\text{mm}$, $d_{85} > 15.2\text{mm}$

GM soil logged fits requirements for d_{50} and d_{85} but not d_{15}

GP soil, (not logged but located) may meet filter criteria

A fairly uniform gravel is needed.

(GM soil sifted through #4 sieve will work)

Filter thickness governed by practicallity - ≈ 3"

Rock thickness 1' or maximum particle size (larger value)

Form SCS 353
9-64

~~MATERIALS TESTING REPORT~~

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 4 of 5

77

PROJECT and STATE: BUCKHORN MESA WPP SPOOK HILL FLOODWAY ARIZONA

FIELD SAMPLE NO.: by A. C.

TYPE OF SAMPLE: STA 183+70

DEPTH: 5-6-76

GEOLOGIC ORIGIN: JUNCTION STRUCTURES

SAMPLE LOCATION: FILTER DESIGN CRITERIA - RIP RAP DESIGN

TESTED AT:

APPROVED BY: CHECKED BY:

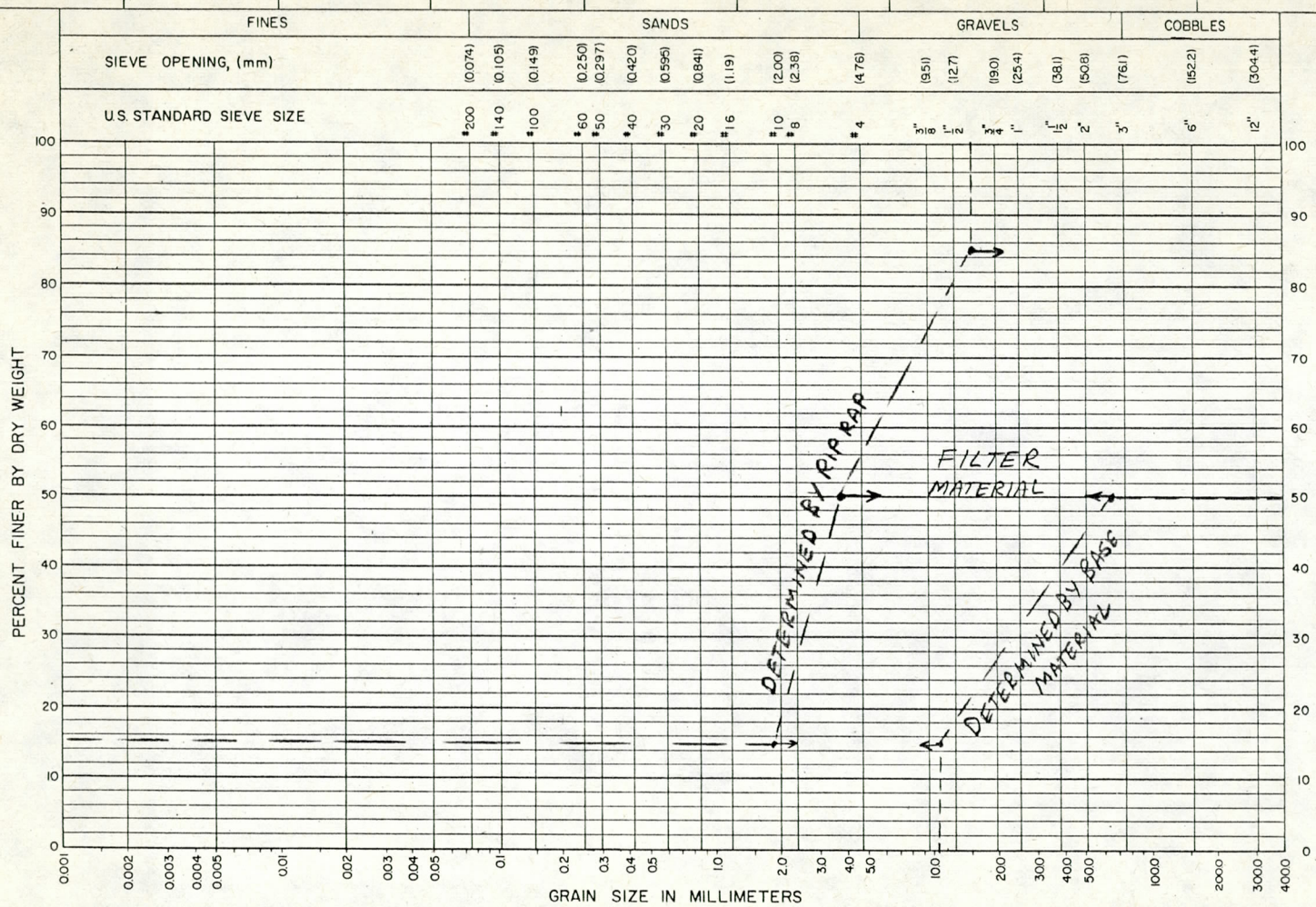
DATE:

SYMBOL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				% MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS:

STATE	PROJECT		
ARIZONA	SIGNAL BUTTE FLOODWAY - BUCKHORN MESA WPP		
BY A.C. / DATE 6-16-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT FILTER BLANKETS FOR RIPRAP			SHEET 5 OF 5

A closer look at the reasoning behind filter blankets between rock rip rap and embankment material seems to show that it is not necessary.

Normally, filter blankets are designed to prevent piping of embankment material due to flow of water from the embankment through the rip rap. This is not the case here.

In the National Cooperative Highway Research Program Report 108, another reason for filter blankets is discussed under leaching. It is felt that eddies and jets caused by water flowing through the rip rap would erode away embankment material. This will <u>not</u> take place (or be minimized) if,

"
1. The blanket is thick enough (riprap not filter)
2. the interstices are closed or reduced in size
3. a protective layer of intermediate-sized material is interposed between the base material and the rip rap, or "
4. the base material is sufficiently cohesive . . . .

Experiment show that when "a layer of uniform material is placed three or more stones thick, leaching will be reduced to a minimum." It is also concluded that if an intermediate layer is included that only one layer of "armor" is necessary. For this case, they use the following criteria for the necessity of a filter blanket

$$\frac{d_{50}\ \text{Filter}}{d_{50}\ \text{base}} < 40$$

In our case we have a d_{50} size of 6", and a thickness of 2'. This represents approximately four times the average stone size. One places where a filter would be necessary occur in a channel that is flowing subcritically and the allowable velocity is less than one foot per second less than the actual velocity. The other places where a filter may be required is where sheet flow in natural washes flow along small diversion dikes. Flow is less than three feet in depth.

It would hardly seem worth the trouble and expense of providing filter blankets at these locations.

No filter blankets are necessary in this job.

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill FRS		
BY Burton	DATE 9/16/75	CHECKED BY	DATE 9/18/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 1 OF 8

Sta. 102+72 to Sta. 159+50

Bottom is in caliche or granite

caliche: d_{75} size = 3 inches

granite: d_{75} size = 8 inches

Fig 6-1
TR-25

Use allowable velocity procedure:
Assume 1% Frequency - As Built Condition
Using Curve #2 & D_{75} = 3 inches

V_A = 9.5 f.p.s.

Water Depth = 5.8' - Based on minimum depth in caliche area

Then D = 1.13

Side Slope = 2:1

Then B = 0.72

Frequency of Flow = 1%

Then F = 1.64

$V_{All} = V_A \times D \times B \times F$

$= (9.5)(1.13)(0.72)(1.64) = \underline{12.68 \text{ fps}}$

Max Design Velocity = 6.0 fps.

Assuming 1% Frequency - Aged Condition

Depth = 6.08' ∴ D = 1.14

With "D" greater & all other factors equal, this condition can not govern

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill FRS		
BY Burton	DATE 9/16/75	CHECKED BY [illegible]	DATE 9/18/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 2 OF 8

Assume 10% Frequency - As Built Condition

Depth = 3.5'

D = 1.02

Side Slopes: 2:1

B = 0.72

Frequency = 10%

F = 1.0

$V_{all} = (9.5)(1.02)(0.72)(1.0) = 6.98$ f.p.s.

Max. Design Velocity = 4.75 f.p.s.

∴ Channel Bottom is stable

One small section may have ML soils in the side slopes durring 1% Event.

Assume D_{75} Size = 3.0 mm.

∴ V = 3.8 f.p.s.

D = 1.13

B = 0.72

F = 1.64

$V_{All} = (3.8)(1.13)(0.72)(1.64) = 5.07$ f.p.s.

V_{max} in ML section = 3.13 fps.

∴ Channel Sides are stable

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill F.R.S		
BY Burton	DATE 9/16/75	CHECKED BY D. Rudd	DATE 9/18/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 3 OF 8

Sta. 159+50 to Sta. 183+85

Channel Bottom is in Granite

d_{75} size = 8 inches

Using Curve # 2 & d_{75} = 8"

Assume 1% Frequency - As Built Condition

V = 13.0 ✓

Water Depth = 2.71'

∴ D = 0.96' ✓

Side Slope = 2.0

∴ B = 0.72 ✓

Frequency = 1.0%

∴ F = 1.64 ✓

Then V_{All} = (13.0)(0.96)(0.72)(1.64) =

= 14.74 f.p.s. ✓

Max. Design Velocity = 8.38 f.p.s.

Assume 10% Frequency - As Built Condition:

Depth = 1.48 ft. ✓ D = 0.86 ✓

B = 0.72 ✓ F = 1.0 ✓

V_{All} = (13.0)(0.86)(0.72)(1.0) = 8.05 fps. ✓

Max Design Velocity = 5.85 f.p.s. ✓

Channel Section is Stable ✓

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill F.R.S.		
BY Burton	DATE 9/16/75	CHECKED BY [illegible]	DATE 9/19/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 4 OF 8

One short section of side slopes will be in SP Material durring 1% Event.

Assume $D_{75} = 4.0$ mm.

Assume 1% Frequency - As Built Condition

$V = 4.0$ fps. ✓

$D = 0.96$ f.p.s. ✓

$B = 0.72$ f.p.s. ✓

$F = 1.64$ fps ✓

$V_{All} = (4.0)(.96)(.72)(1.64) = 4.53$ f.p.s. ✓

Max. Design Velocity = 3.9 fps ✓ in this section.

∴ Channel Section is Stable

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill F.R.S.		
BY Burton	DATE 9/16/75	CHECKED BY [illegible]	DATE 9/18/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 5 OF 8

Station 183+85 to Sta. 192+00

Channel Bottom & Sides are in Granite.

d_{75} size = 8 inches

Assume 1% Frequency - As Built Condition

Using Curve #2 & $d_{75} = 8''$

$V = 13.0$ ✓

Minimum Depth = 6.7'

$\therefore D = 1.17$ ✓

Side Slope = 2:1

$\therefore B = 0.72$ ✓

Frequency = 1.0%

$\therefore F = 1.64$ ✓

Then: $V_{All} = (13)(1.17)(0.72)(1.64) = 17.96$ fps. ✓

Max Design Velocity = 5.57 fps. ✓

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill F.R.S.		
BY Burton	DATE 9/16/75	CHECKED BY [illegible]	DATE 9/18/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 6 OF 8

Assume 10% Frequency - As Built Condition

$V = 13.0$ ✓

Minimum Depth = 3.4 ft.

$\therefore D = 1.01$ ✓

Side Slope = 2:1

$\therefore B = 0.72$ ✓

Frequency = 10%

$\therefore F = 1.0$ ✓

Then $V_{All} = (13.0)(1.01)(.72)(1.0) = 9.45$ fps. ✓

Max. Design Velocity = 5.06 fps. ✓

$\therefore$ Channel Section is Stable

STATE Arizona		PROJECT Buckhorn Mesa W.P.P.- Spook Hill F.R.S.	
BY Burton	DATE 9/17/75	CHECKED BY [illegible]	DATE 9-18-75	JOB NO. 2005
SUBJECT Channel Stability			SHEET 7 OF 8

Sta. 192+00 to Sta. 207+70.

Sta 192+00 to Sta 193+00 – Side slopes vary from 2:1 to 1:1 – Use 1:1 side slopes for stability design.

Channel Bottom & Sides are in Granite

d_{75} size = 8 inches

Assume 1% Frequency – As Built Condition

Using Curve # 2 & d_{75} = 8"

V = 13.0 ✓

Use minimum depth = 5.7 ft.

∴ D = 1.13 ✓

Side Slopes = 1:1

∴ B = 0.4 ✓

Frequency = 1.0%

∴ F = 1.64 ✓

Then: $V_{All} = (13.0)(1.13)(0.4)(1.64) = 9.64$ f.p.s. ✓

Design Velocities at the outlet may be 10.6 fps. ∴ Some protection required at outlet to natural channel.

Remainder of Section is stable

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill F.R.S.		
BY Burton	DATE 9/17/75	CHECKED BY [illegible]	DATE 9/18/75	JOB NO. 2005
SUBJECT Channel Stability				SHEET 8 OF 8

Assume 10% Frequency - As Built Condition.

$V = 13.0$ ✓

Use minimum depth = 3.5 ft.

$\therefore D = 1.02$ ✓

Side Slopes = 1:1

$\therefore B = 0.4$ ✓

Frequency = 10%

$\therefore F = 1.0$ ✓

Then: $V_{All} = (13.0)(1.02)(0.4)(1.0) = 5.30$ fps. ✓

Design velocity at outlet is greater than allowable. This is based on fractured weathered granite. The section near the outlet is considerably harder granite. It is planned to use this granite for rock riprap in other sections. ∴ It seems unlikely that additional protection will be required.

Recomendations

1. Use unprotected channel entire length
2. Provide rock riprap protection at outlet to natural channel.
3. Provide rock riprap protection at junctions, inlets etc. where needed.

Stability Analysis

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 1

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 20770. STARTING DEPTH = 2.900 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
20769.	3.449	1550.479	7.677 VC	115.402	30.000	1.000	0.00001	0.00001

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
886.	0.000519	30.0	1.0 / 1	0.0240	-3.000	-0.006

CONTRACTION OR EXPANSION COEFF = 1.00

Additional Water Surface Profiles used in stability calculations are included in supplementary design data

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 2

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 20767. STARTING DEPTH = 3.449 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
20764.0	3.472	1550.505	7.622	116.237	30.000	1.000	0.00780	1.21287
20725.9	3.694	1550.746	7.117	124.476	30.000	1.000	0.00836	1.31853
20687.7	3.848	1550.919	6.800	130.275	30.000	1.000	0.00876	1.43017
20649.6	3.970	1551.060	6.568	134.894	30.000	1.000	0.00907	1.54633
20611.5	4.073	1551.182	6.384	138.784	30.000	1.000	0.00933	1.66619
20573.3	4.161	1551.289	6.232	142.167	30.000	1.000	0.00956	1.78922
20535.2	4.239	1551.386	6.103	145.173	30.000	1.000	0.00977	1.91504
20497.0	4.310	1551.476	5.991	147.885	30.000	1.000	0.00995	2.04336
20458.9	4.374	1551.559	5.892	150.360	30.000	1.000	0.01012	2.17395
20420.7	4.432	1551.637	5.804	152.639	30.000	1.000	0.01027	2.30662
20382.6	4.487	1551.710	5.725	154.751	30.000	1.000	0.01041	2.44121
20344.5	4.537	1551.780	5.653	156.722	30.000	1.000	0.01055	2.57758
20306.3	4.584	1551.846	5.587	158.569	30.000	1.000	0.01067	2.71562
20268.2	4.629	1551.909	5.526	160.307	30.000	1.000	0.01079	2.85523
20230.0	4.671	1551.970	5.470	161.949	30.000	1.000	0.01090	2.99632
20191.9	4.710	1552.029	5.418	163.504	30.000	1.000	0.01100	3.13881
20153.7	4.747	1552.085	5.370	164.982	30.000	1.000	0.01110	3.28263
20115.6	4.783	1552.140	5.324	166.389	30.000	1.000	0.01120	3.42771
20077.5	4.817	1552.193	5.282	167.732	30.000	1.000	0.01129	3.57399
20039.3	4.849	1552.244	5.242	169.016	30.000	1.000	0.01138	3.72143
20001.2	4.880	1552.294	5.204	170.247	30.000	1.000	0.01146	3.86996
19963.0	4.910	1552.343	5.168	171.427	30.000	1.000	0.01154	4.01955
19924.9	4.938	1552.390	5.134	172.561	30.000	1.000	0.01162	4.17015
19886.8	4.966	1552.437	5.102	173.652	30.000	1.000	0.01169	4.32172
19848.6	4.992	1552.482	5.071	174.703	30.000	1.000	0.01176	4.47423
19810.5	5.017	1552.526	5.042	175.716	30.000	1.000	0.01183	4.62764
19772.3	5.042	1552.570	5.014	176.694	30.000	1.000	0.01189	4.78193
19734.2	5.065	1552.612	4.987	177.639	30.000	1.000	0.01196	4.93706
19696.0	5.088	1552.654	4.962	178.553	30.000	1.000	0.01202	5.09300
19657.9	5.110	1552.695	4.937	179.438	30.000	1.000	0.01208	5.24973
19619.8	5.131	1552.736	4.914	180.295	30.000	1.000	0.01214	5.40722
19581.6	5.152	1552.775	4.891	181.125	30.000	1.000	0.01219	5.56545
19543.5	5.172	1552.814	4.869	181.931	30.000	1.000	0.01225	5.72439
19505.3	5.191	1552.853	4.849	182.713	30.000	1.000	0.01230	5.88403
19467.2	5.210	1552.891	4.829	183.472	30.000	1.000	0.01235	6.04435
19429.0	5.228	1552.928	4.809	184.210	30.000	1.000	0.01240	6.20532
19390.9	5.246	1552.965	4.791	184.928	30.000	1.000	0.01245	6.36693
19352.8	5.263	1553.001	4.773	185.626	30.000	1.000	0.01250	6.52916
19314.6	5.280	1553.037	4.755	186.306	30.000	1.000	0.01254	6.69199
19300.0	5.287	1553.050	4.749	186.562	30.000	1.000	0.01256	6.75477

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
886.	0.000519	30.0	1.0 / 1	0.0240	-1467.000	-2.934

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 3

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 19300. STARTING DEPTH = 5.287 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
19299.8	5.287	1553.051	4.747	186.633	30.000	1.002	0.00085	6.75563
19297.2	5.292	1553.056	4.723	187.561	30.000	1.027	0.00086	6.76679
19294.6	5.297	1553.060	4.700	188.487	30.000	1.053	0.00086	6.77801
19292.0	5.301	1553.065	4.677	189.412	30.000	1.079	0.00086	6.78928
19289.4	5.306	1553.070	4.654	190.337	30.000	1.105	0.00087	6.80061
19286.8	5.311	1553.074	4.632	191.262	30.000	1.131	0.00087	6.81199
19284.2	5.315	1553.079	4.610	192.185	30.000	1.157	0.00088	6.82343
19281.6	5.319	1553.083	4.588	193.108	30.000	1.183	0.00088	6.83492
19279.0	5.324	1553.088	4.566	194.030	30.000	1.209	0.00089	6.84647
19276.4	5.328	1553.092	4.544	194.951	30.000	1.235	0.00089	6.85807
19273.8	5.332	1553.096	4.523	195.872	30.000	1.261	0.00089	6.86973
19271.2	5.336	1553.100	4.502	196.792	30.000	1.287	0.00090	6.88144
19268.6	5.340	1553.104	4.481	197.711	30.000	1.313	0.00090	6.89321
19266.0	5.344	1553.108	4.460	198.630	30.000	1.339	0.00091	6.90503
19263.4	5.348	1553.112	4.440	199.547	30.000	1.365	0.00091	6.91691
19260.8	5.352	1553.116	4.419	200.464	30.000	1.391	0.00092	6.92884
19258.2	5.356	1553.120	4.399	201.381	30.000	1.417	0.00092	6.94082
19255.6	5.360	1553.124	4.379	202.297	30.000	1.443	0.00092	6.95287
19253.0	5.363	1553.127	4.359	203.212	30.000	1.469	0.00093	6.96496
19250.4	5.367	1553.131	4.340	204.127	30.000	1.495	0.00093	6.97711
19247.8	5.371	1553.135	4.321	205.040	30.000	1.521	0.00094	6.98931
19245.2	5.374	1553.138	4.301	205.954	30.000	1.547	0.00094	7.00158
19242.6	5.378	1553.141	4.282	206.866	30.000	1.573	0.00094	7.01389
19240.0	5.381	1553.145	4.264	207.778	30.000	1.599	0.00095	7.02626
19237.4	5.384	1553.148	4.245	208.689	30.000	1.625	0.00095	7.03868
19234.8	5.388	1553.151	4.227	209.600	30.000	1.651	0.00096	7.05116
19232.2	5.391	1553.155	4.208	210.510	30.000	1.677	0.00096	7.06369
19229.6	5.394	1553.158	4.190	211.419	30.000	1.703	0.00097	7.07627
19227.0	5.397	1553.161	4.172	212.327	30.000	1.729	0.00097	7.08892
19224.4	5.400	1553.164	4.155	213.235	30.000	1.755	0.00097	7.10161
19221.8	5.403	1553.167	4.137	214.143	30.000	1.781	0.00098	7.11436
19219.2	5.406	1553.170	4.119	215.049	30.000	1.807	0.00098	7.12716
19216.6	5.409	1553.173	4.102	215.955	30.000	1.833	0.00099	7.14002
19214.0	5.412	1553.176	4.085	216.861	30.000	1.859	0.00099	7.15293
19211.4	5.415	1553.179	4.068	217.765	30.000	1.885	0.00099	7.16589
19208.8	5.418	1553.181	4.051	218.669	30.000	1.911	0.00100	7.17891
19206.2	5.420	1553.184	4.035	219.573	30.000	1.937	0.00100	7.19198
19203.6	5.423	1553.187	4.018	220.475	30.000	1.963	0.00101	7.20511
19201.0	5.426	1553.189	4.002	221.377	30.000	1.989	0.00101	7.21829
19200.0	5.427	1553.190	3.995	221.724	30.000	1.999	0.00101	7.22337

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
886.	0.000519	30.0	1.9 / 1	0.0240	-100.000	-0.200

CONTRACTION OR EXPANSION COEFF = 1.15

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 4

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 19200. STARTING DEPTH = 5.427 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
19199.8	5.427	1553.191	3.995	221.728	30.000	2.000	0.00091	7.22428
19197.4	5.427	1553.191	3.995	221.744	30.000	2.000	0.00091	7.23619
19195.1	5.427	1553.191	3.995	221.760	30.000	2.000	0.00091	7.24809
19192.8	5.428	1553.191	3.995	221.776	30.000	2.000	0.00091	7.25999
19190.4	5.428	1553.192	3.994	221.792	30.000	2.000	0.00091	7.27190
19188.1	5.428	1553.192	3.994	221.808	30.000	2.000	0.00091	7.28381
19185.7	5.429	1553.192	3.994	221.824	30.000	2.000	0.00091	7.29572
19183.4	5.429	1553.193	3.993	221.840	30.000	2.000	0.00091	7.30764
19181.1	5.429	1553.193	3.993	221.856	30.000	2.000	0.00091	7.31955
19178.7	5.430	1553.193	3.993	221.872	30.000	2.000	0.00091	7.33147
19176.4	5.430	1553.194	3.992	221.888	30.000	2.000	0.00091	7.34338
19174.0	5.430	1553.194	3.992	221.904	30.000	2.000	0.00091	7.35529
19171.7	5.430	1553.194	3.992	221.920	30.000	2.000	0.00091	7.36721
19169.4	5.431	1553.195	3.992	221.935	30.000	2.000	0.00091	7.37912
19167.0	5.431	1553.195	3.991	221.951	30.000	2.000	0.00091	7.39104
19164.7	5.431	1553.195	3.991	221.966	30.000	2.000	0.00091	7.40295
19162.3	5.432	1553.196	3.991	221.981	30.000	2.000	0.00091	7.41487
19160.0	5.432	1553.196	3.991	221.997	30.000	2.000	0.00091	7.42678
19157.7	5.432	1553.196	3.990	222.012	30.000	2.000	0.00091	7.43869
19155.3	5.433	1553.196	3.990	222.028	30.000	2.000	0.00091	7.45062
19153.0	5.433	1553.197	3.990	222.043	30.000	2.000	0.00091	7.46254
19150.6	5.433	1553.197	3.989	222.058	30.000	2.000	0.00091	7.47447
19148.3	5.433	1553.197	3.989	222.074	30.000	2.000	0.00091	7.48640
19146.0	5.434	1553.198	3.989	222.089	30.000	2.000	0.00091	7.49832
19143.6	5.434	1553.198	3.989	222.105	30.000	2.000	0.00091	7.51025
19141.3	5.434	1553.198	3.988	222.120	30.000	2.000	0.00091	7.52218
19138.9	5.435	1553.198	3.988	222.135	30.000	2.000	0.00091	7.53410
19136.6	5.435	1553.199	3.988	222.151	30.000	2.000	0.00091	7.54603
19134.3	5.435	1553.199	3.987	222.166	30.000	2.000	0.00091	7.55796
19131.9	5.436	1553.199	3.987	222.182	30.000	2.000	0.00091	7.56988
19129.6	5.436	1553.200	3.987	222.197	30.000	2.000	0.00091	7.58181
19127.2	5.436	1553.200	3.987	222.212	30.000	2.000	0.00091	7.59374
19124.9	5.436	1553.200	3.986	222.228	30.000	2.000	0.00091	7.60566
19122.6	5.437	1553.200	3.986	222.243	30.000	2.000	0.00091	7.61759
19120.2	5.437	1553.201	3.986	222.259	30.000	2.000	0.00091	7.62952
19117.9	5.437	1553.201	3.986	222.274	30.000	2.000	0.00091	7.64146
19115.5	5.438	1553.201	3.985	222.289	30.000	2.000	0.00091	7.65340
19113.2	5.438	1553.202	3.985	222.305	30.000	2.000	0.00091	7.66534
19110.9	5.438	1553.202	3.985	222.320	30.000	2.000	0.00091	7.67728
19110.0	5.438	1553.202	3.985	222.326	30.000	2.000	0.00091	7.68187

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
886.	0.000519	30.0	2.0 / 1	0.0240	-90.000	-0.180

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 5

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 19110. STARTING DEPTH = 5.438 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
19109.1	5.438	1553.202	2.878	222.318	30.000	2.000	0.00418	7.68606
19098.5	5.436	1553.203	2.880	222.207	30.000	2.000	0.00418	7.74044
19087.8	5.434	1553.204	2.881	222.096	30.000	2.000	0.00418	7.79480
19077.2	5.432	1553.205	2.883	221.986	30.000	2.000	0.00417	7.84913
19066.5	5.430	1553.206	2.884	221.875	30.000	2.000	0.00417	7.90344
19055.8	5.427	1553.208	2.885	221.766	30.000	2.000	0.00417	7.95772
19045.2	5.425	1553.208	2.887	221.656	30.000	2.000	0.00417	8.01197
19034.5	5.423	1553.209	2.888	221.547	30.000	2.000	0.00417	8.06619
19023.9	5.421	1553.211	2.890	221.438	30.000	2.000	0.00416	8.12038
19013.2	5.419	1553.212	2.891	221.329	30.000	2.000	0.00416	8.17454
19002.5	5.417	1553.213	2.893	221.221	30.000	2.000	0.00416	8.22868
18991.9	5.415	1553.214	2.894	221.112	30.000	2.000	0.00416	8.28279
18981.2	5.413	1553.215	2.895	221.005	30.000	2.000	0.00416	8.33688
18970.6	5.411	1553.216	2.897	220.897	30.000	2.000	0.00415	8.39094
18959.9	5.409	1553.217	2.898	220.790	30.000	2.000	0.00415	8.44497
18949.2	5.407	1553.218	2.900	220.683	30.000	2.000	0.00415	8.49898
18938.6	5.404	1553.219	2.901	220.576	30.000	2.000	0.00415	8.55296
18927.9	5.402	1553.220	2.902	220.470	30.000	2.000	0.00415	8.60691
18917.3	5.400	1553.221	2.904	220.364	30.000	2.000	0.00414	8.66084
18906.6	5.398	1553.223	2.905	220.258	30.000	2.000	0.00414	8.71474
18895.9	5.396	1553.224	2.907	220.152	30.000	2.000	0.00414	8.76862
18885.3	5.394	1553.225	2.908	220.047	30.000	2.000	0.00414	8.82247
18874.6	5.392	1553.226	2.909	219.942	30.000	2.000	0.00414	8.87629
18864.0	5.390	1553.227	2.911	219.837	30.000	2.000	0.00413	8.93009
18853.3	5.388	1553.228	2.912	219.733	30.000	2.000	0.00413	8.98386
18842.6	5.386	1553.229	2.914	219.628	30.000	2.000	0.00413	9.03761
18832.0	5.384	1553.231	2.915	219.524	30.000	2.000	0.00413	9.09133
18821.3	5.382	1553.232	2.916	219.421	30.000	2.000	0.00413	9.14503
18810.7	5.380	1553.233	2.918	219.317	30.000	2.000	0.00412	9.19870
18800.0	5.378	1553.234	2.919	219.215	30.000	2.000	0.00412	9.25235
18789.3	5.376	1553.235	2.920	219.112	30.000	2.000	0.00412	9.30597
18778.7	5.374	1553.237	2.922	219.009	30.000	2.000	0.00412	9.35957
18768.0	5.372	1553.238	2.923	218.907	30.000	2.000	0.00412	9.41314
18757.4	5.370	1553.239	2.924	218.805	30.000	2.000	0.00411	9.46669
18746.7	5.368	1553.240	2.926	218.703	30.000	2.000	0.00411	9.52021
18736.0	5.366	1553.241	2.927	218.602	30.000	2.000	0.00411	9.57370
18725.4	5.364	1553.242	2.929	218.501	30.000	2.000	0.00411	9.62718
18714.7	5.362	1553.244	2.930	218.400	30.000	2.000	0.00411	9.68062
18704.1	5.360	1553.245	2.931	218.299	30.000	2.000	0.00410	9.73405
18700.0	5.360	1553.245	2.932	218.261	30.000	2.000	0.00410	9.75459

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
640.	0.000519	30.0	2.0 / 1	0.0240	-410.000	-0.820

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 6

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 18700. STARTING DEPTH = 5.360 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
18699.3	5.356	1553.245	2.934	218.062	30.000	2.000	0.00315	9.75774
18691.1	5.305	1553.243	2.970	215.486	30.000	2.000	0.00311	9.79849
18682.9	5.255	1553.240	3.005	212.919	30.000	2.000	0.00308	9.83875
18674.8	5.205	1553.238	3.042	210.363	30.000	2.000	0.00304	9.87853
18666.6	5.155	1553.235	3.079	207.817	30.000	2.000	0.00300	9.91783
18658.4	5.105	1553.232	3.117	205.280	30.000	2.000	0.00297	9.95665
18650.2	5.054	1553.230	3.156	202.753	30.000	2.000	0.00293	9.99500
18642.0	5.004	1553.227	3.196	200.237	30.000	2.000	0.00289	10.03287
18633.8	4.954	1553.224	3.236	197.730	30.000	2.000	0.00286	10.07027
18625.6	4.904	1553.222	3.278	195.234	30.000	2.000	0.00282	10.10720
18617.4	4.854	1553.219	3.320	192.747	30.000	2.000	0.00278	10.14366
18609.2	4.803	1553.217	3.363	190.270	30.000	2.000	0.00275	10.17965
18601.0	4.753	1553.214	3.407	187.803	30.000	2.000	0.00271	10.21518
18592.9	4.703	1553.211	3.452	185.347	30.000	2.000	0.00268	10.25025
18584.7	4.653	1553.209	3.499	182.900	30.000	2.000	0.00264	10.28485
18576.5	4.602	1553.206	3.546	180.464	30.000	2.000	0.00261	10.31900
18568.3	4.552	1553.204	3.594	178.037	30.000	2.000	0.00257	10.35269
18560.1	4.502	1553.201	3.644	175.622	30.000	2.000	0.00254	10.38593
18551.9	4.452	1553.198	3.694	173.216	30.000	2.000	0.00250	10.41871
18543.7	4.402	1553.196	3.746	170.821	30.000	2.000	0.00247	10.45103
18535.5	4.351	1553.193	3.799	168.435	30.000	2.000	0.00243	10.48291
18527.3	4.301	1553.190	3.854	166.061	30.000	2.000	0.00240	10.51435
18519.1	4.251	1553.188	3.909	163.696	30.000	2.000	0.00236	10.54533
18511.0	4.201	1553.185	3.966	161.342	30.000	2.000	0.00233	10.57588
18502.8	4.151	1553.183	4.025	158.999	30.000	2.000	0.00230	10.60598
18494.6	4.101	1553.180	4.085	156.666	30.000	2.000	0.00226	10.63564
18486.4	4.050	1553.178	4.146	154.344	30.000	2.000	0.00223	10.66487
18478.2	4.000	1553.175	4.209	152.033	30.000	2.000	0.00220	10.69366
18470.0	3.950	1553.173	4.274	149.733	30.000	2.000	0.00216	10.72201
18461.8	3.900	1553.170	4.340	147.444	30.000	2.000	0.00213	10.74994
18453.6	3.850	1553.168	4.408	145.166	30.000	2.000	0.00210	10.77744
18445.4	3.800	1553.165	4.478	142.900	30.000	2.000	0.00206	10.80451
18437.2	3.750	1553.163	4.550	140.645	30.000	2.000	0.00203	10.83115
18429.1	3.700	1553.161	4.624	138.401	30.000	2.000	0.00200	10.85737
18420.9	3.650	1553.158	4.699	136.170	30.000	2.000	0.00197	10.88317
18412.7	3.600	1553.156	4.777	133.951	30.000	2.000	0.00193	10.90855
18404.5	3.550	1553.154	4.857	131.744	30.000	2.000	0.00190	10.93352
18396.3	3.501	1553.152	4.940	129.550	30.000	2.000	0.00187	10.95807
18388.1	3.451	1553.150	5.024	127.369	30.000	2.000	0.00184	10.98221
18385.0	3.432	1553.149	5.057	126.534	30.000	2.000	0.00183	10.99138

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
640.	0.006090	30.0	2.0 / 1	0.0240	-315.000	-0.630

CONTRACTICN OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 7

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 18385. STARTING DEPTH = 3.432 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
18380.1	3.402	1553.149	2.283	125.240	30.000	2.000	0.01407	11.00546
18316.8	3.018	1553.148	2.629	108.762	30.000	2.000	0.01222	11.17542
18253.5	2.635	1553.150	3.076	92.959	30.000	2.000	0.01045	11.32191
18190.2	2.258	1553.156	3.669	77.949	30.000	2.000	0.00877	11.44598
18126.8	1.896	1553.179	4.462	64.090	30.000	2.000	0.00722	11.54901
18063.5	1.593	1553.259	5.409	52.874	30.000	2.000	0.00594	11.63347
18000.2	1.485	1553.535	5.840	48.965	30.000	2.000	0.00547	11.70643
17936.9	1.481	1553.916	5.854	48.851	30.000	2.000	0.00546	11.77746
17873.6	1.481	1554.300	5.854	48.851	30.000	2.000	0.00546	11.84844
17810.3	1.481	1554.684	5.854	48.851	30.000	2.000	0.00546	11.91943
17747.0	1.481	1555.068	5.854	48.851	30.000	2.000	0.00546	11.99042
17683.7	1.481	1555.452	5.854	48.851	30.000	2.000	0.00546	12.06141
17620.4	1.481	1555.836	5.854	48.851	30.000	2.000	0.00546	12.13240
17557.1	1.481	1556.220	5.854	48.851	30.000	2.000	0.00546	12.20339
17493.7	1.481	1556.604	5.854	48.851	30.000	2.000	0.00546	12.27438
17430.4	1.481	1556.989	5.854	48.851	30.000	2.000	0.00546	12.34537
17367.1	1.481	1557.373	5.854	48.851	30.000	2.000	0.00546	12.41636
17303.8	1.481	1557.757	5.854	48.851	30.000	2.000	0.00546	12.48735
17240.5	1.481	1558.141	5.854	48.851	30.000	2.000	0.00546	12.55834
17177.2	1.481	1558.525	5.854	48.851	30.000	2.000	0.00546	12.62933
17113.9	1.481	1558.909	5.854	48.851	30.000	2.000	0.00546	12.70032
17050.6	1.481	1559.293	5.854	48.851	30.000	2.000	0.00546	12.77131
16987.3	1.481	1559.677	5.854	48.851	30.000	2.000	0.00546	12.84230
16924.0	1.481	1560.061	5.854	48.851	30.000	2.000	0.00546	12.91329
16860.6	1.481	1560.445	5.854	48.851	30.000	2.000	0.00546	12.98428
16797.3	1.481	1560.829	5.854	48.851	30.000	2.000	0.00546	13.05527
16734.0	1.481	1561.213	5.854	48.851	30.000	2.000	0.00546	13.12626
16670.7	1.481	1561.597	5.854	48.851	30.000	2.000	0.00546	13.19725
16607.4	1.481	1561.981	5.854	48.851	30.000	2.000	0.00546	13.26824
16544.1	1.481	1562.365	5.854	48.851	30.000	2.000	0.00546	13.33923
16480.8	1.481	1562.749	5.854	48.851	30.000	2.000	0.00546	13.41022
16417.5	1.481	1563.133	5.854	48.851	30.000	2.000	0.00546	13.48121
16354.2	1.481	1563.517	5.854	48.851	30.000	2.000	0.00546	13.55220
16290.9	1.481	1563.901	5.854	48.851	30.000	2.000	0.00546	13.62318
16227.5	1.481	1564.285	5.854	48.851	30.000	2.000	0.00546	13.69417
16164.2	1.481	1564.669	5.854	48.851	30.000	2.000	0.00546	13.76516
16100.9	1.481	1565.053	5.854	48.851	30.000	2.000	0.00546	13.83615
16037.6	1.481	1565.437	5.854	48.851	30.000	2.000	0.00546	13.90714
15974.3	1.481	1565.821	5.854	48.851	30.000	2.000	0.00546	13.97813
15950.0	1.481	1565.969	5.854	48.851	30.000	2.000	0.00546	14.00544

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
286.	0.006090	30.0	2.0 / 1	0.0240	-2435.000	-4.870

CONTRACTION OR EXPANSION COEFF = 1.00

TRAPW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICAL INTEGRATION VC = CRITICAL VELOCITY

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY PROFILE = 3 REACH= 8

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CONTRACTION COEFF.= 0.15

BEG. STATION = 15950. STARTING DEPTH = 1.481 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)	SID SLP (RATIO)	DELTA VOL (AC.FT)	ACC VOL (AC.FT)
15938.6	1.790	1566.280	4.755	60.138	30.000	2.000	0.01420	14.01964
15791.0	2.217	1566.735	3.746	76.344	30.000	2.000	0.01979	14.25590
15643.3	2.423	1566.970	3.386	84.461	30.000	2.000	0.02195	14.52933
15495.7	2.568	1567.144	3.168	90.257	30.000	2.000	0.02347	14.82582
15348.1	2.681	1567.285	3.015	94.835	30.000	2.000	0.02468	15.13972
15200.5	2.774	1567.407	2.899	98.639	30.000	2.000	0.02567	15.46773
15052.8	2.853	1567.514	2.806	101.901	30.000	2.000	0.02653	15.80767
14905.2	2.922	1567.612	2.730	104.758	30.000	2.000	0.02728	16.15794
14757.6	2.983	1567.701	2.665	107.298	30.000	2.000	0.02794	16.51733
14609.9	3.037	1567.784	2.609	109.583	30.000	2.000	0.02854	16.88489
14462.3	3.086	1567.862	2.561	111.659	30.000	2.000	0.02908	17.25982
14314.7	3.131	1567.935	2.518	113.557	30.000	2.000	0.02958	17.64148
14167.1	3.172	1568.004	2.480	115.304	30.000	2.000	0.03004	18.02931
14019.4	3.210	1568.071	2.446	116.920	30.000	2.000	0.03046	18.42284
13871.8	3.245	1568.134	2.415	118.421	30.000	2.000	0.03085	18.82164
13724.2	3.277	1568.195	2.386	119.822	30.000	2.000	0.03122	19.22534
13576.5	3.308	1568.254	2.361	121.132	30.000	2.000	0.03156	19.63365
13428.9	3.336	1568.311	2.337	122.361	30.000	2.000	0.03188	20.04626
13281.3	3.363	1568.366	2.315	123.518	30.000	2.000	0.03218	20.46291
13133.7	3.388	1568.420	2.295	124.608	30.000	2.000	0.03247	20.88336
12986.0	3.411	1568.472	2.276	125.638	30.000	2.000	0.03274	21.30741
12838.4	3.434	1568.523	2.258	126.613	30.000	2.000	0.03299	21.73485
12690.8	3.455	1568.573	2.242	127.537	30.000	2.000	0.03323	22.16551
12543.2	3.475	1568.621	2.227	128.415	30.000	2.000	0.03346	22.59922
12395.5	3.494	1568.669	2.212	129.249	30.000	2.000	0.03368	23.03583
12247.9	3.512	1568.716	2.199	130.044	30.000	2.000	0.03389	23.47521
12100.3	3.529	1568.761	2.186	130.801	30.000	2.000	0.03409	23.91721
11952.6	3.545	1568.806	2.174	131.523	30.000	2.000	0.03428	24.36171
11805.0	3.561	1568.850	2.163	132.213	30.000	2.000	0.03446	24.80861
11657.4	3.576	1568.894	2.152	132.873	30.000	2.000	0.03463	25.25779
11509.8	3.590	1568.937	2.142	133.504	30.000	2.000	0.03479	25.70916
11362.1	3.604	1568.979	2.132	134.108	30.000	2.000	0.03495	26.16263
11214.5	3.617	1569.020	2.123	134.687	30.000	2.000	0.03510	26.61810
11066.9	3.629	1569.062	2.114	135.242	30.000	2.000	0.03525	27.07548
10919.2	3.641	1569.102	2.106	135.775	30.000	2.000	0.03539	27.53471
10771.6	3.653	1569.142	2.098	136.286	30.000	2.000	0.03552	27.99571
10624.0	3.664	1569.182	2.090	136.778	30.000	2.000	0.03565	28.45841
10476.4	3.674	1569.221	2.083	137.250	30.000	2.000	0.03577	28.92274
10328.7	3.684	1569.260	2.076	137.704	30.000	2.000	0.03589	29.38864
10272.0	3.688	1569.274	2.074	137.874	30.000	2.000	0.03593	29.56824

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE	REACH LEN (FT)	DELTA LENGTH (FT)
286.	0.000200	30.0	2.0 / 1	0.0240	-5678.000	-11.356

CONTRACTION OR EXPANSION COEFF = 1.00

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO : 1969—O-357-545

STATE ARIZONA		PROJECT BUCKHORN MESA WPP SPOOK HILL FLOODWAY	
BY A.C.	DATE 5-11-76	CHECKED BY	DATE	JOB NO.
SUBJECT Channel Stability			SHEET 1 OF 2

From Junction Structures water surface profiles

STATION	VELOCITY	Velocity (from TRAPW low flow)	
202+00	10.5	7.6	
190+00	4.4	2.9	
189+00	3.9	2.9	Granite
187+00	4.2	2.9	
185+00	4.6	4.0	SM-SP
181+00	4.7 *	4.5	
180+00	5.4	5.8	
179+00	6.2	5.9	
178+00	7.1	5.9	
177+00	8.1	5.9	
176+00	8.8	5.9	
175+00	8.9 *	5.9	
159+00	7.8	4.8	
158+00	6.6	3.7	
157+00	6.1	3.5	
156+00	5.8	3.3	Granite
155+00	5.5	3.2	
153+00	5.2	–	
152+00	3.3	2.9	
151+00	3.2	–	
146+00	3.1 *	2.6	(some GP at Sta 145+00)
141+00	3.0 *	2.5	(some caliche to ≈ Sta 140+00)
135+00	2.9 *	2.4	
125+00	2.8 *	2.2	caliche (some ML at high water depths)
110+00	1.6	2.1	

TR25 Figure 6-1

Material	D_{75}	V	from	For B	A	D	Vall	
Granite	≈ 6"	12 ft/sec	Curve 2	.72	1.0	1.04	9.0	O.K.
Caliche	≈ 2"	8 ft/sec	Curve 2	.72	1.0	1.16	6.7	O.K.
	½"	5.5	"	"	"	"	4.6	O.K.
ML	≈ 3mm	3.7	Curve 2	.72	1.0	(1.0) 1.16	2.7 3.1	O.K.
GP	≈ ½"	5.5	Curve 2	.72	1.0	(1.0) 1.15	4.0 4.6	O.K.
SM-SP	3.5mm	3.9	Curve 2	.72	.97	1.14	3.1	No good

STATE ARIZONA		PROJECT BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-11-76	CHECKED BY	DATE	JOB NO.
SUBJECT CHANNEL Stability - (JUNCTIONS)				SHEET 2 OF 2

Rip Rap Locations (For 3 junctions)

STA 109+30 to 110+30 Left side only

STA 181+00 to 185+00 both sides

STA 188+80 to 189+90 both sides

Rip Rap Size

STA 109+30 to 110+30 Junction Protection use 6" rock
STA 188+80 to 189+90 " " " 6" "

STA 181+00 to 185+00 $V = 4.7$ $R = A/P = \frac{y(b+2y)}{2\sqrt{5}y + b}$

$b = 30'$, $y \cong 6.0'$ $R = 4.43$

$$D_{50} = \frac{0.00116\ V^3}{\sqrt{R}} = \frac{0.00116\ (4.7)^3}{\sqrt{4.43}} = .06' = .7''$$

need 6" rock for junction <u>use</u>

FILTER BLANKET DESIGN

STA 109+30 to 110+30 no filters needed
between rock riprap caliche

STA 181+00 to 185+00 - Filter blanket is required, see previous work

STA 188+80 to 189+90 - Rip Rap and Filter blanket is needing in areas of fill - blanket design depends on fill material

Revised: No blankets needed A.C. 6/76

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 7-14-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Check for channel protection				SHEET 1 OF 1

looking for embankment fill below w.s.

Sta 129+50	- fill 3.5' above bottom	V=2.8	Va=3.1	ok
Sta 174+90	5.5' "	d = 3.73		ok
Sta 178+70	5.8' "	d = 4.74'		ok
Sta 181+60	5.2' "	rock already		
Sta 185+65	10' "	depth = 8'		
Sta 186+20	6.4' "	d = 8.5'	- not ok	(left only)
Sta 187+00	10.4' "	d = 9'		ok
Sta 187+65	6.9' "	d = 9.4'	not ok	both
Sta 188+30	6.0 "	d = 9.4	not ok	both
Sta 189+00	0' "	rock provided		
Sta 189+60	✓			

Area 186+00 to 188+80 V ≅ 4.4 Vall. ≅ 3.1

This would only be a problem for the maximum flows only about the top two feet of the flow would be on fill

Add protection on the left side from 185+80 to 186+60

Add protection on both sides from 187+40 to 188+80.

COMPUTATION SHEET
SCS–ENG–522 REV. 3–69

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1968—O-337-998

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill Floodway		
BY RJM	DATE 11-3-75	CHECKED BY	DATE	JOB NO.
SUBJECT Hydraulics				SHEET 1 OF 8

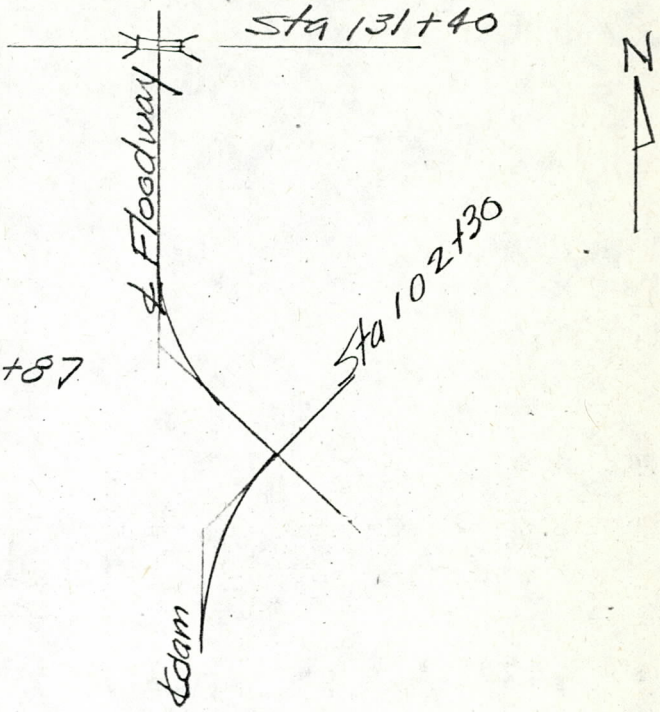
Check Influence of County Bridge @ Sta 131+40 +1 (Attached sketch)

145+00
1565.15
+.2548
1565.405 Elev for sta 132+26

5.864

Given

Q = 808 cfs
n = 0.027
Begin Sta 132+10
d = 5.864'
End Sta 102+87
S = 0.0002



Solution

n	Reach	Sta	to Sta	b	z
0.027	1	132+26	132+06	30-33.3'	2
	2	132+06	131+62	33.3	2
	3	131+62	131+56	33.3	0-2
	4	131+56	131+24	Bridge	0
	5	131+24	131+18	33.3	2-0
	6	131+18	130+74	33.3	2
	7	130+74	130+54	33.3-30	2
	8	130+54	102+87	30	2

PW PROGRAM DATE = 12/07/72 NON-UNIFORM FLOW PROFILE BY NUMERICA

E BUCKHORN MESA WPP ARIZ-SPOOK HILL FLOODWAY

INVERT ELEV. = 1547.03 INPUT EXPANSION COEFF. = 0.25 INPUT CON

BEG. STATION = 15950. STARTING DEPTH = 2.910 FEET

STATION	DEPTH (FT)	W.S. ELEV (FT)	VELOCITY FT/SEC	AREA (SQ.FT)	BTM WID (FT)
15938.6	3.173	1567.663	7.005	115.344	30.000
15791.0	3.895	1568.413	5.488	147.225	30.000
15643.3	4.233	1568.779	4.962	162.832	30.000
15495.7	4.472	1569.047	4.639	174.157	30.000
15348.1	4.660	1569.264	4.409	183.243	30.000
15200.5	4.816	1569.449	4.232	190.903	30.000
15052.8	4.951	1569.612	4.089	197.561	30.000
14905.2	5.069	1569.758	3.971	203.467	30.000
14757.6	5.174	1569.892	3.870	208.783	30.000
14609.9	5.269	1570.016	3.782	213.622	30.000
14462.3	5.356	1570.131	3.705	218.066	30.000
14314.7	5.435	1570.239	3.636	222.176	30.000
14167.1	5.509	1570.342	3.575	226.000	30.000
14019.4	5.578	1570.438	3.519	229.574	30.000
13871.8	5.642	1570.531	3.468	232.929	30.000
13724.2	5.702	1570.620	3.422	236.090	30.000
13576.5	5.758	1570.705	3.379	239.078	30.000
13428.9	5.811	1570.787	3.340	241.909	30.000
13281.3	5.862	1570.865	3.303	244.598	30.000
13133.7	5.910	1570.942	3.269	247.159	30.000
12986.0	5.955	1571.016	3.237	249.601	30.000
12838.4	5.998	1571.088	3.207	251.935	30.000
12690.8	6.040	1571.158	3.178	254.168	30.000
12543.2	6.079	1571.226	3.152	256.309	30.000
12395.5	6.117	1571.292	3.127	258.364	30.000
12247.9	6.153	1571.357	3.103	260.339	30.000
12100.3	6.188	1571.420	3.081	262.239	30.000
11952.6	6.221	1571.482	3.059	264.068	30.000
11805.0	6.253	1571.543	3.039	265.832	30.000
11657.4	6.284	1571.602	3.020	267.534	30.000
11509.8	6.314	1571.660	3.001	269.177	30.000
11362.1	6.343	1571.718	2.984	270.765	30.000
11214.5	6.370	1571.774	2.967	272.301	30.000
11066.9	6.397	1571.829	2.951	273.787	30.000
10919.2	6.423	1571.884	2.935	275.227	30.000
10771.6	6.448	1571.937	2.920	276.622	30.000
10624.0	6.472	1571.990	2.906	277.974	30.000
10476.4	6.496	1572.042	2.893	279.286	30.000
10328.7	6.518	1572.093	2.879	280.559	30.000
10272.0	6.527	1572.113	2.875	281.039	30.000

DISCHARGE (CFS)	GRADIENT FT/FOOT	BTM WIDTH (FT)	SIDE SLOPE	N-VALUE
808.	0.000200	30.0	2.0 / 1	0.0270

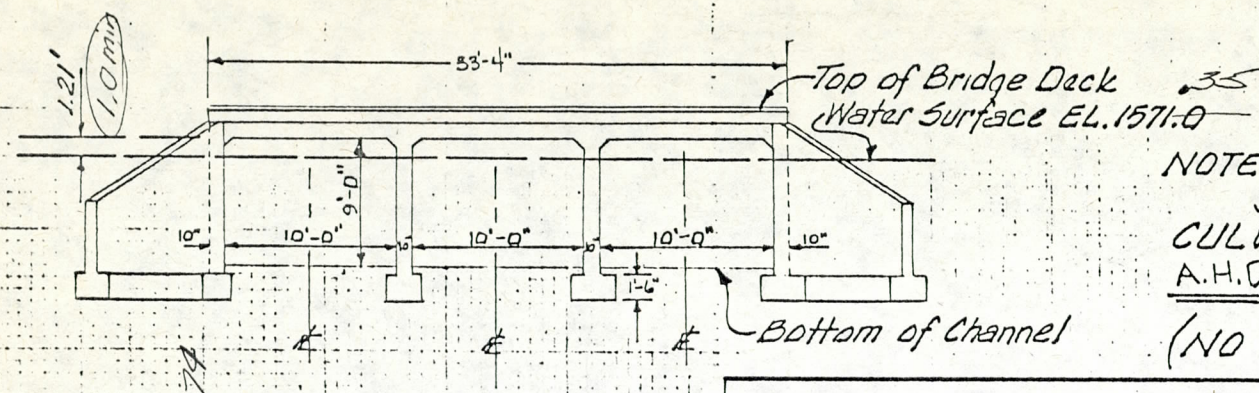
CONTRACTION OR EXPANSION COEFF = 1.00

Sheet 3 of 8 100

10-22-75

Rec'd 10/31/75

FLOOD CONTROL OF MARICOPA CO. 3325 W. DUR. PHOENIX, ARIZO

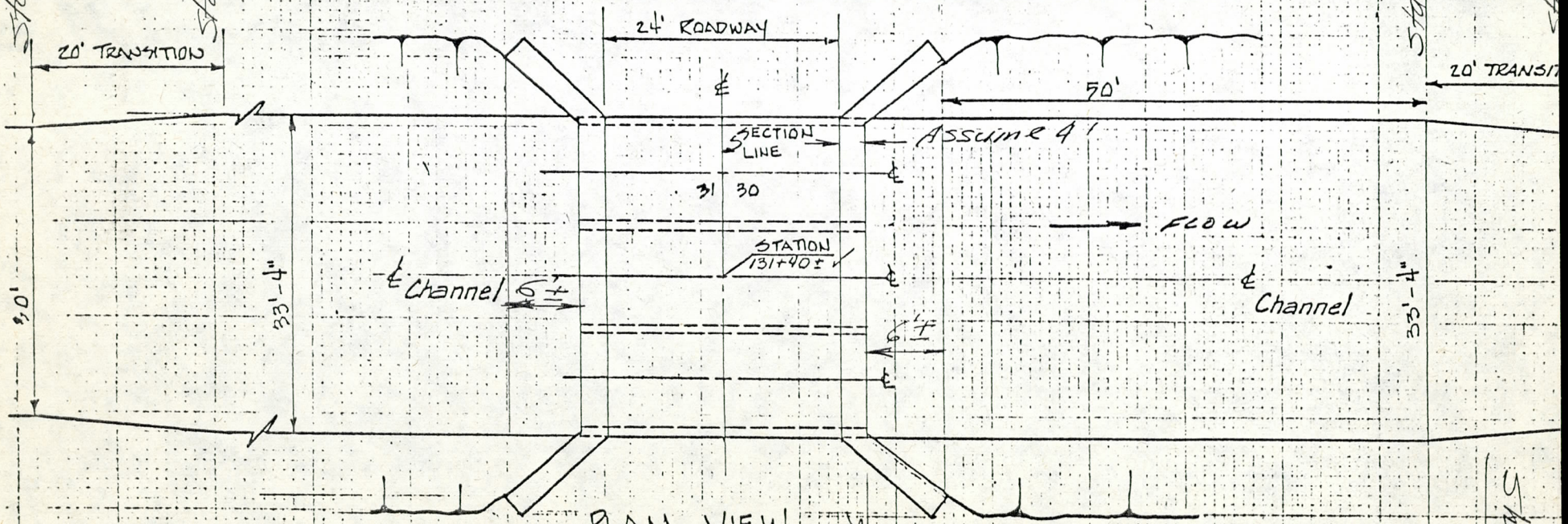


NOTE:
3 SPAN 9'-0" x 10'-0"
CULVERT BOX & BRIDGE
A.H.D. STD. DET. C1-10-3

(NO SCALE)

ELEV. PLAN

CONCRETE BRIDGE STRUCTURE
FOR
PRIVATE R.D. to RED MOUNTAIN RANCH
SPOOK HILL CHANNEL OUTLET



PLAN VIEW

Sheet 2 of

COMPUTATION SHEET
SCS-ENG-522 REV. 3-69

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1968—O-337-998

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP Spook Hill FRS			
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	10-3-75			
SUBJECT				SHEET 4 OF 8
Hydraulics				

Bridge Pier Losses

T-N Eng 248 ED 5 FWS p 6/5 c

$d_3 = 3.39$ For class A Flow
$> d_c = 2.50'$

$A_1 = A_3 = 33.3d$

$M_1 = M_3 = A_1 d/2 = 16.67d^2$

$A_0 = 4(.833)d = 3.33d$

$M_0 = A_0 d/2 = 1.667d^2$

$d = 1'$ through $8'$

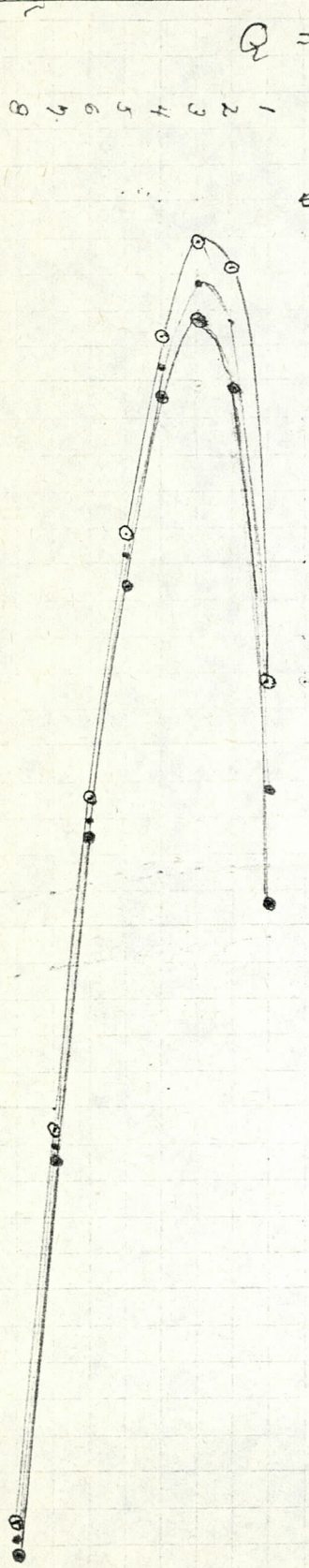
$Q = 808$ cfs

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

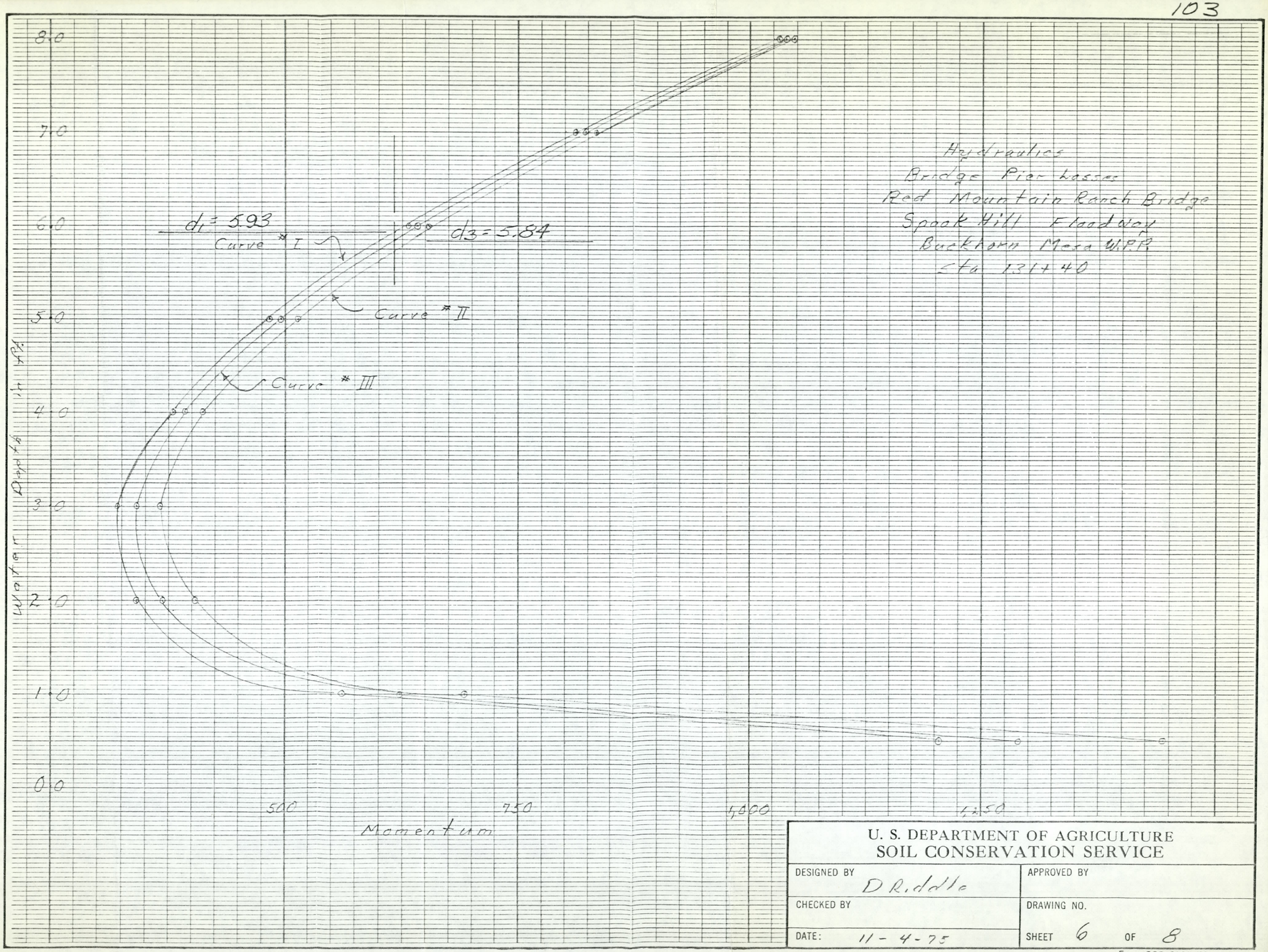
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT Buckhorn Mesa WPP-Spookhill Fwd	
BY D Riddle	DATE 11-4-75	CHECKED BY	DATE
JOB NO. 2005			
SUBJECT Hydraulics Bridge Pier Losses		SHEET 5 OF 8	

Q = 808



d	$A_1 = A_3$ $33.3d$	$M_1 = M_3$ $16.67d^2$	A_0 $3.33d$	M_0 $1.67d^2$	$A_1 - A_0$	$M_1 - M_0$ (1)	$\frac{Q^2}{g(A_1-A_0)}$ (2)	$\frac{Q^2}{gA_1^2}$	$\frac{Q^2(A_1-A_0)}{gA_1^2}$ (3)	$\frac{Q^2}{gA_3}$ (4)	I (1)+(3)	II (1)+(2)	III (1)+(4)
1	33.3	16.67	3.33	1.67	30	15	675.84	18.287	5.47	609	15,63	691	624
2	66.6	66.68	6.66	6.67	60	65	337.92	4.57	2.74	304	339	403	369
3	99.9	150.03	9.99	15.00	90	140	225.28	2.032	183	203	323	365	343
4	133.2	266.72	13.32	26.67	120	240	168.96	1.143	137	152	377	409	392
5	166.5	416.75	16.65	41.68	150	375	135.17	0.7314	110	122	485	510	497
6	199.8	600.12	19.98	60.01	180	540	112.64	0.5079	91	101	631	653	641
7	233.1	816.83	23.31	81.68	210	735.15	96.55	0.3731	78	87	813	832	822
8	266.4	1,066.88	26.64	106.69	240	960.19	84.48	0.2857	69	76	1,029	1,045	1,036



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY D Riddle	APPROVED BY
CHECKED BY	DRAWING NO.
DATE: 11-4-75	SHEET 6 OF 8

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Sheet 7 of 8

104

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP - Spook Hill F.R.S.			
BY	DATE	CHECKED BY	DATE	JOB NO.
J.E.B.	4-Nov-1975			2005
SUBJECT				SHEET 1 OF 2
Red Ranch Bridge water surface profile				

808.00 o
0.0270 n
0.000200 SI

0.05 t
1.15 A
.....
13,226.00 S1
1,565.40 e

30.00 X
2.00 z
From print out 5.864 D1
3.30 Λ
2.77 Da
0.27 F

808.00 o
0.0270 n
0.000200 SI

0.00 t
1.15 A
.....
13,206.00 S2
1,565.40 e

33.30 X
2.00 z
5.899 D2
3.03 Λ
2.61 Da
0.24 F
.....
.....
13,162.00 S2
1,565.41 e

33.30 X
2.00 z
5.909 D2
3.03 Λ
2.61 Da
0.24 F
.....
.....
808.00 o
0.0270 n
0.000200 SI

0.50 t
1.15 A
.....
13,156.00 S2
1,565.41 e

33.30 X
0.00 z
— 5.839 — D2
4.15 Λ
2.76 Da
0.30 F
.....

Bridge loss is on a momentum curve

Depth 5.839 ft outlet
Depth 5.93 ft. inlet

proceed with 1880 program

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Sheet 8 of 8
105

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP - Spook Hill F.R.S.			
BY J.E.B.	DATE 4 Nov 1975	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Red Ranch Bridge water surface profile				SHEET 2 OF 2

808.00	o
0.0270	n
0.000200	SI
0.50	t
1.00	A
.....	
13,124.00	S1
1,565.42	e
33.30	X
0.00	z
5.930	D1
4.09	Λ
2.63	Da
0.29	F
13,118.00	S2
1,565.42	e
33.30	X
2.00	z
6.126	D2
2.89	Λ
2.50	Da
0.23	F
.....	
.....	
808.00	o
0.0270	n
0.000200	SI
0.05	t
1.00	A
.....	
13,074.00	S2
1,565.43	e
33.30	X
2.00	z
6.134	D2
2.89	Λ
2.50	Da
0.23	F
.....	
.....	
13,054.00	S2
1,565.43	e
30.00	X
2.00	z
6.117	D2
3.12	Λ
2.65	Da
0.25	F
.....	
.....	
808.00	o
0.0270	n
0.000200	SI
0.00	t
1.00	A
.....	
10,287.00	S2
1,565.98	e
30.00	X
2.00	z
6.630	D2
2.81	Λ
2.65	Da
0.22	F

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE	PROJECT		
Arizona	Buckhorn Mesa - Spook Hill Floodway		
BY J.E.R.	DATE 10-8-75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Red Ranch Road crossing			SHEET ____ OF ____

Sta 132+00 Floodway
Q = 808 c.f.s.
Bottom width = 30.0 ft.
Side slopes = 2:1 both sides
Gradient (s) = 0.0002
n = 0.027

From print out
Depth = 5.9 ft.
Velocity = 3.3 ft.

From Far West States
Freeboard = 0.2 He for Trapezoid channel

$$He = \frac{V^2}{2g} = \frac{3.3^2}{64.4} = 0.17$$

Free board = (0.2)(0.17 + 5.9 ft. depth) = 1.214 ft.

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	6-11-76			2005
SUBJECT				SHEET 1 OF
Thomas Road Crossing (Red Ranch Road)				

Bridge losses at Thomas Road

Bottom elev. 1565.47 (≈ sta 131+38)
Maint. road elev. 1576.6
w.s. elevation (6.4' deep) 1571.87 + losses

exiting $v \simeq 2.95$ ft/sec $A = 273.92$ ft^2 $Q = 808$ cfs

$$\Delta h = K_B \frac{V_2^2}{2g} + \frac{SL}{m} - \alpha \frac{V_1^2}{2g}$$

From "Water Resources Engineering" p 547 by Linsley + Franzini McGraw Hill

$$k = \frac{1.486}{n} A R^{2/3} \qquad m = K_q/K_a \qquad m = f(K_B) \text{ shown in table 18-2}$$

K_a = K of approach channel, K_q = K of projection of openning in approach channel

$$K_a = \frac{1.486}{.027}(273.92)\left(\frac{273.92}{58.62}\right)^{2/3} = 42,136.24$$

$$K_q = \frac{1.486}{.027}(225.90)(4.63)^{2/3} = 34,533.10$$

$m = .82$ table 18-2 $K_B = 1.32$

$$\alpha = \frac{\Sigma(K_i^3/A_i^2)}{K_1^3/A_1^3} = .81 \qquad V_1 \simeq V_2$$

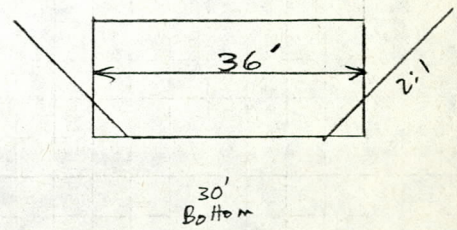
L = length of constriction
S = slope of channel

$$\Delta h = 1.32\frac{(2.95)^2}{2g} + \frac{(.0002)(26)}{.82} - .81\frac{(2.95)^2}{2g}$$

$\Delta h = .29$

ESTIMATES

channel bottom elevation = 1565.47
water surface " (D.S.) = 1571.87
water surface " (U.S.) = 1572.16
maint. road " = 1576.6
bottom of bridge " = 1573.16
top of bridge " = 1574.66

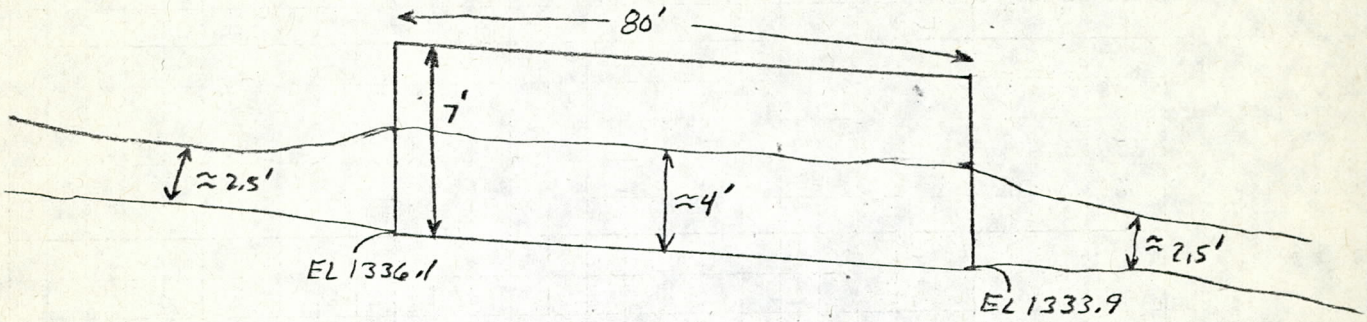


COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 108
GPO:1969—O-357-545

STATE AZ		PROJECT Buckhorn Mesa WPP Spook Hill F.R.S.		
BY A.C.	DATE 4-14-76	CHECKED BY	DATE	JOB NO.
SUBJECT Bosh Highway Culverts				SHEET 1 OF 3

NEED TO PASS 2136 cfs through twin 10x7 box culverts



$n = .015 \qquad S = \frac{1336.1 - 1333.9}{80'} = .0275$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

try $y = 4'$ $\quad A = 4 \times 20 = 80 \quad p = 20 + 4(4) = 36 \quad R = 80/36 = 2.22$

$R^{2/3} = 1.70$

$$Q = \frac{1.486}{.015}(80)(1.70)(.0275)^{1/2} = 2238 \text{ cfs}$$

The normal depth in the culvert is about 4'

Upstream from the culvert $\quad Q = 2136,\ n = .035,\ b = 40,\ z = 2.5$
$S = .06$

try $y = 3'$ $\quad A = 187.5 \quad p = 85.4 \quad R = \frac{187.5}{85.4} = 2.196$

$R^{2/3} = 1.69 \qquad Q = \frac{1.486}{.035}(187.5)(1.69)(.06)^{1/2} = 3294$

depth in channel is considerably less than in culvert

<u>No Problem</u> - Existing Culverts will do for 100yr storm.

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

☆ GPO : 1969—O-357-545

STATE		PROJECT		
AZ		BUCKHORN MESA WPP - SPOOK HILL FRS		
BY A.C.	DATE 4-19-76	CHECKED BY	DATE	JOB NO.
SUBJECT Bush Highway Culverts				SHEET 2 OF 3

Upstream from Culvert
STATION 261+50

At Culvert
Station 262+10 to 282+90

2,304.

FLOW
2,136.0000

n
0.0350

S
0.0600

W
40.0000

L Z
7.5000

R Z
7.5000

df
*
2.3850
15.4710 ◇

2,304.

FLOW
1,068.0000

n
0.0150

S
0.0275

W
10.0000

L Z
0.0001

R Z
0.0001

df
*
3.8661
27.6235 ◇

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE 110

☆ GPO: 1969—O-357-545

STATE		PROJECT		
AZ		BUCKHORN MESA WRP -SPOOK HILL FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	4-14-96			
SUBJECT BUSH HIGHWAY CULVERTS				SHEET 3 OF 3

DOWNSTREAM FROM CULVERT
STATION 263+50

```
.................
2,304.
.................
     FLOW
  2,136.0000
.................
                    n
     0.0350
.................
                    S
     0.0440
.................
     W
    20.0000
.................
     L              Z
    16.0000
.................
     R              Z
    16.0000
.................
                   df
                    *
.................
     2.7318         df
    12.2726         ◇
```

7/2/75

Note to Files:

I discussed expected sediment yields from the drainages above Spook Hill Floodway with Don Clarke.
Don suggested using the following values:

(1.) 0.1 Acre Ft/Mi^2/Yr for area from dam to a point about 2/3 of way through Section 30 or about Sta.

(2.) 0.4 Acre Ft/Mi^2/Yr for the remainder of the Floodway.

Lew Burton

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO:1969—O-357-545

STATE		PROJECT		
AZ		BUCKHORN MESA - SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-12-76	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN				SHEET 1 OF

The ten year pool elevation is approximately 1579.5 which is about 2' above the top of the riser (El 1577.5). Most of the sediment will have dropped to the lower 10-12' feet of the reservior pool by the time the flow reaches principal spillway outlet. (Invert El 1566). Some sediment will move through the jack gate as the sediment pool is drained. Don Clark has estimated that 95% of the sediment will remain in the reservior. (His figures are based on preliminary design figures).

Drainage Area 13.57 sq mi ⇐ (Lew Burton 3/25/75)
Sediment yield .2 Acft/sqmi/yr

2.71 Acft/yr x .05 = .14 Acft/yr

From hydrology -

Drainage Area #26 represents the natural wash that flow will be added to. Only information found was from 1974 workplan supplement data and support (D. Hanley 6-26-73)

Area No	Area
23	1.19
24	1.26
25	0.78
	3.23
26	0.66

Areas 23, 24 and 25 represent additional drainage areas that add flow to the floodway.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO:1969—O-357-545

STATE	PROJECT		
Az	Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C. / DATE 4-12-76	CHECKED BY	DATE	JOB NO.
SUBJECT Sediment Basin			SHEET 2 OF

The following estimates have been taken from work done by Don Clark.

errosion rate is .25 ac.ft./sq.m./yr.
50% bed load and 50% suspended

90% of the suspended load is delivered to the marsh
70% of the bed load is delivered to the marsh

.66 sq.mi x .25 acft/sq mi/yr = .165 acft/yr

90% x .083 Acft/yr = .074

70% x .083 Acft/yr = .058

Natural movement of sediment = 0.13 Ac ft/yr

When the project is developed an additional 3.23 sq mi of area will be added. A decrease in the percentage of sediment delivered to marsh is justifiable since some sediment will be trapped and not allowed to enter the floodway, Junction structure have been designed for some of the major washes, such that a large percentage of bedload will enter the floodway.

80% of suspended load and 50% of bed load will be delivered to the marsh

3.23 sq mi x .25 Ac ft/sq mi/yr x .5 x .8 = .32 suspended load
3.23 " x .25 " x .5 x .5 = .20 bed load
.52 Ac ft

Total Sediment for project

Suspended load	Bed load	
.14 Ac ft from FRS	0 Ac ft from FRS	
.07 " " #26	.06 " from #26	
.32 " from floodway	.20 Ac ft from floodway	Total
.53 Ac ft	.26 Ac ft	.79 Ac ft/yr

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 114
☆GPO:1969—O-357-545

STATE	PROJECT		
Az	BOCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A. C. / DATE 4-12-76	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN			SHEET 3 OF

A sediment basin would immedrately remove all bed load (.26 Acft/yr)
Don Clark has estimated that sediment will accumulate in a 50 ac. area without the project and in a 100 ac. area with the project. Only 3 ac. however are in cattails which harbor the Yuma Clapper Rail.

No Project		With Project	
Sed Yield	0.13 Acft/yr	Sed. Yield	0.53 Ac ft
Percent of Area in cattails	6%	Percent of Area in cattails	3%
	.008 Acft/yr		.016 Acft/yr

To make sediment yields equal half of the suspended load must be removed or .27 Ac ft/yr. Total necessary storage area is

$$(\underset{\text{Susp.}}{.27\ \text{Ac ft}} + \underset{\text{dead load}}{.26\ \text{Ac ft}})/\text{yr} \times 10\ \text{yrs} = 5.3\ \text{Ac ft}$$

requiring that .27 Ac ft out of .53 Ac ft suspended load be remov

— need to find 10 yr cfs

Prime spillway ~~276 cfs~~ (No)

floodway area 3.89 sq. mi. @ 10 yr rainfall,

2490 Ac, CN = 80 (Average from 1974 Work Plan Report)
Burton 7-11-73

from Lou Burton 3/13/75 10y-24 hr rainfall = 2.33"

from Es 1026 Sheet 12 2000 Ac ⇒ 240 cfs
500 Ac ⇒ 85 cfs

Extrapolating gives 2490 Ac ⇒ 290 cfs

10 yr discharge ≃ ~~566 cfs~~ (886 cfs, found 10yr flow)

100 yr discharge = 2136 cfs

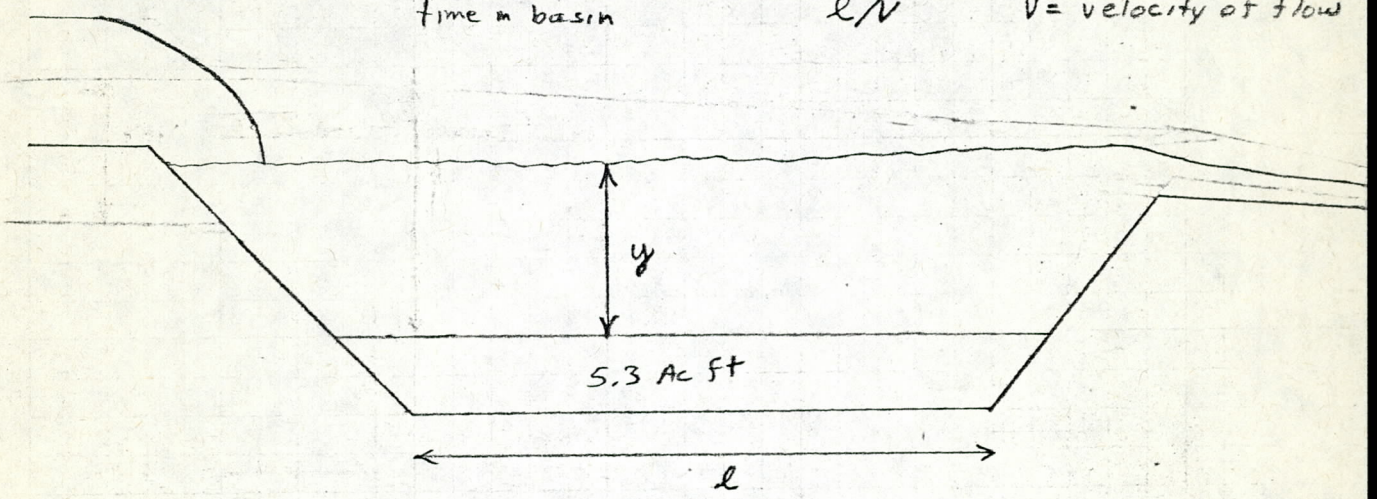
STATE	PROJECT		
AZ	BUCKHORN MESA WPP - SPOOKHILL FLOODWAY		
BY A.C. / DATE 4-13-76	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN			SHEET 4 OF

Object: to slow the flow down such that all particles larger than a #200 sieve will settle out

$d = .074\,mm = 7.4 \times 10^{-3}\,cm$

$v_s < .5$ ft/sec from Fig 13-4 Elements of Water Supply and waste-water disposal (Fair and Geyer).

$v_s = \dfrac{\text{depth of water}}{\text{time in basin}} = \dfrac{y}{l/V}$ $\quad l$ = length of basin, V = velocity of flow



$$v_s = \frac{yV}{l} = \frac{yQ}{lA} = \frac{yQ}{lyb} = \frac{Q}{lb}$$

where b is the basin width

for $Q = 886$ cfs and $v_s < .5$ ft/sec (10yr)

$$lb > Q/v_s = \frac{886\text{ cfs}}{.5\text{ ft/sec}} = 1772\text{ ft}^2$$

$lb > 1800\text{ ft}^2 \Rightarrow$ This will drop out all sediment larger than #200 sieve (7.4×10^{-3} cm)

For $Q = 2136$ cfs and $lb = 1800\text{ ft}^2$ $\quad v_s = 1.19$, will settle out all sediment greater than 1.5×10^{-2} cm. to settle out all of the sediment greater than #200 sieve, $lb > 4272\text{ ft}^2$

STATE	PROJECT		
Az	Buckhorn Mesa WPP - Spook Hill FRS		
BY A.C. / DATE 4-13-76	CHECKED BY	DATE	JOB NO.
SUBJECT Sediment Basin			SHEET 5 OF

Shoot for 2000 sq ft basin – Must assume that all of the sediment is trapped - 7.9 Ac ft in 10 yrs (344,124 cu ft)

depth of basin = $\frac{7.9 \text{ Ac ft}}{2000 \text{ ft}^2} \frac{43{,}560 \text{ ft}^2}{\text{Ac.}}$ = 172 ft deep

if basin is 4' deep the Area = $\frac{7.9 \times 43{,}560}{4}$ = 86,000 ft²

about 300' x 300' x 4'

$v_s = \frac{2136}{90000} = .024$ ft/sec $\quad 2 \times 10^{-3}$ cm

A basin this size will settle all particles larger than 0.02 mm for the maximum possible flow rate

Sediment Storage seems to dominate (for practicle depths)

LOCATION MAY DICTATE AREA

150' x 800' Basin

Actual Area = 120,000 ft² (150' x 800')

$v_s = \frac{2136}{120{,}000} = .018$

particle size removed for 100 yr storm flow is 1.5×10^{-3} cm

.015 mm (#200 sieve is .074 mm)

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆GPO:1969—O-357-545

STATE	PROJECT		
Az	Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 4-13-76	CHECKED BY	DATE	JOB NO.
SUBJECT			SHEET 6 OF

Removing the sediment from the flow is one problem. The other problem is to get the floodwater to the river without causing erosion. According to John York there is a bench of fine sediments between our proposed sediment pool and the river. He is of the opinion that sheet flow from our pool would strip away these sediments and damage the environment of the Yuma Clapper rail. A short rip rapped channel is proposed to take the floodwater past this bench. A long sediment pool has the advantage of small cuts. It also moves the floodwater downstream, causing less effect on the marsh. A dike is proposed to help channel the water into the basin and away from the forest service campground and the marsh. A power line, a fence and a road will all have to be relocated or abandoned. The road appears to be abandoned. The powerline doesn't seem to go anywhere. These need to be checked.

STATE Az		PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 4-13-76	CHECKED BY	DATE	JOB NO.
SUBJECT Sediment Basin				SHEET 7 OF

Calculations for 150'x 800' Basin

Basin Size - 150' x 800' x 3' = 360,000 cuft

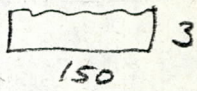
size required 344,000 cuft - size o.k.

Dike Size - Q = 2136 width is about 100-200'

Slope = 18'/500' n = .035

proposed dike is 5' above natural ground. - channel. 150' x 3' will carry

7350 cfs from the Manning equation



5' dike is o.k. although extra protection may be needed around the culvert outlet. $\left(Q = \frac{1.486}{n} A R^{2/3} S^{1/2}\right)$
(3' dike would propably be o.k., but may not be realistic) ?

Basin Outlet channel

2736 cfs, B = 40', z = 2:1, n = .035, S = 2'/150' = .013

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

let y = 4' A = y(b+zy) = 192 p = 40 + 2√5 = 44.47 R = 4.32

Q = 2493 channel size is o.k.

Weir flow - $Q = H^{3/2} C W$ W = 150' C = 3.1

Q = 2136 then H = 2.76

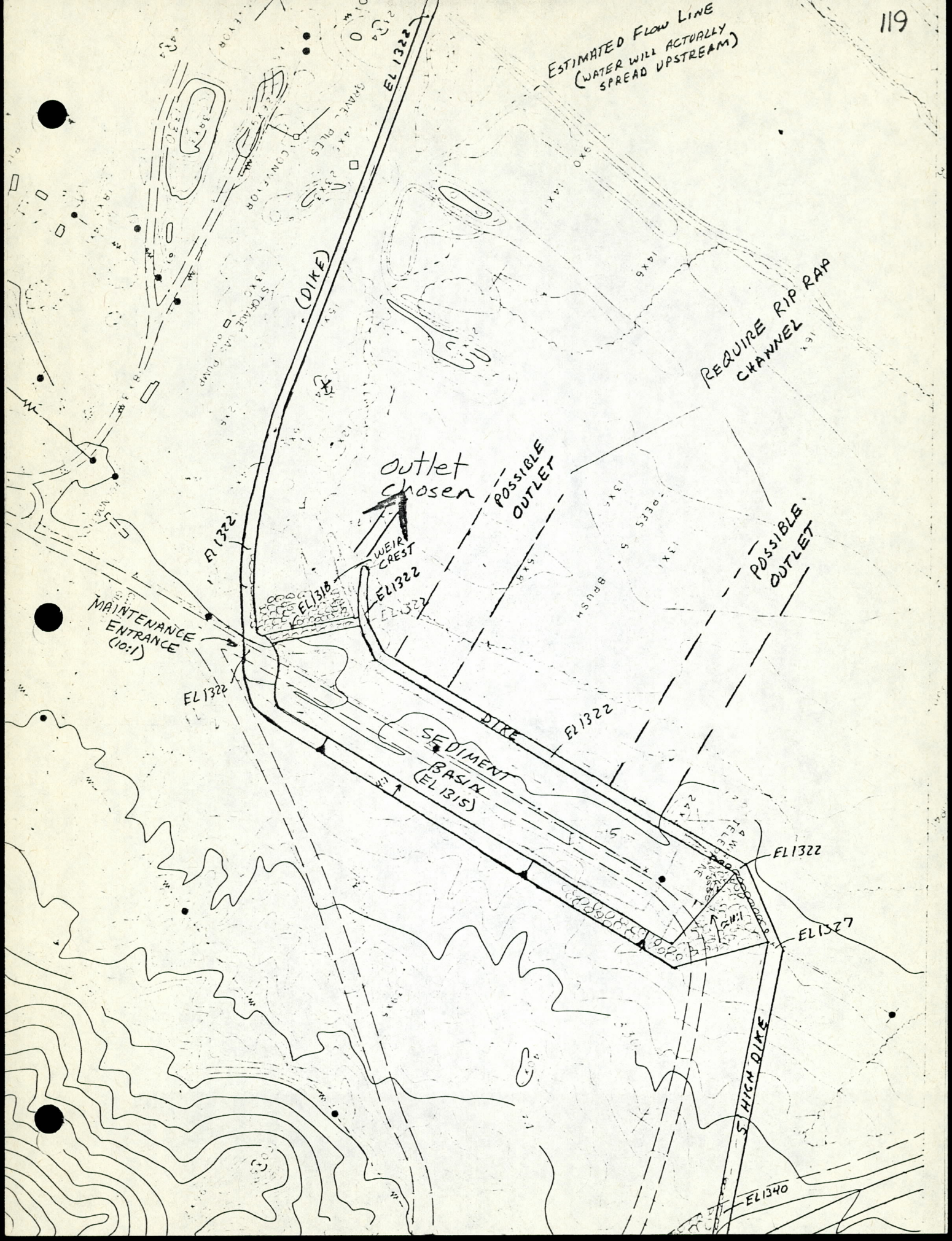
At beginning of channel, bottom el = 1316

water surface elevation = 1320

set weir crest at 1318 and pool bottom at 1315

pool water surface is 1321 and

top of dike is at 1322.


ESTIMATED FLOW LINE
(WATER WILL ACTUALLY SPREAD UPSTREAM)
EL 1322
(DIKE)
REQUIRE RIP RAP CHANNEL
Outlet Chosen
POSSIBLE OUTLET
POSSIBLE OUTLET
WEIR CREST
EL1318
EL1322
EL1322
MAINTENANCE ENTRANCE (10:1)
EL1324
DIKE
EL1322
SEDIMENT BASIN (EL 1315)
EL1322
EL1327
HIGH DIKE
EL1340

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE ARIZONA		PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 7-21-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Sediment Basin Efficiency				SHEET 1 OF 1

Basin size ≅ 124' x 800' = 99,200 sq ft

Volume = 3' x 99,200 ft = 6.83 Ac-ft

suspended load in 10 years 5.3 Ac-ft

$v_s = \frac{2136}{99,200} = 0.0215$ ft/sec S = 2.65 (specific gravity)

from Figure 13-4 "Elements of Water Supply + Waste water disposal"

d = .0015 cm = .015 mm .002 clay

silt to clay is about 3.3:1 for soils in area

.015 would be about at 60% so that would mean

total removal of 40% plus partial removal of the rest.

basin efficiency at 100 yr. storm is about 50 - 60%

it would be greater for lesser flows

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

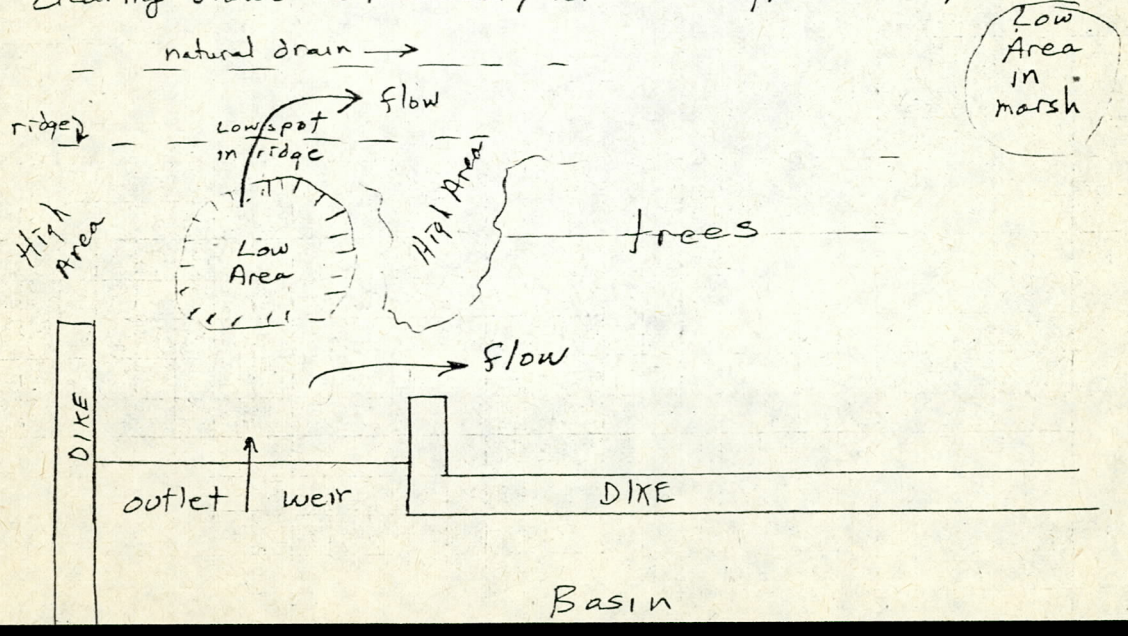
☆ GPO: 1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA W.P.P. - SPOOK HILL FRS		
BY A.C.	DATE 6-15-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT SEDIMENT BASIN OUTLET HYDRAULICS			SHEET 1 OF 3

The Basin has a 100yr flow capacity, presently the outlet will be designed for the 10yr event. If the full 100 year flow is to leave the basin without causing water to back up and over top its dikes, a closer look at the hydraulics of the marsh immediately below the outlet will be necessary. A quick look at the flow (from the standpoint of normal depth), shows that more water will back along the side of the basin than will flow directly through the trees in front of the outlet. Even using the most conservative values, the 10yr discharge will flow away from the outlet weir without significantly changing the depth of flow over the weir. Should it be decided later that the 100year discharge should pass through this basin, then a closer look should be taken at the area below the outlet. Some suggestions for improvement are,

1. clear the area in front of the outlet - remove trees, lower ridge
2. make a wider openning for water to flow back along the basin

No clearing should be necessary for the design of the 10yr flow.



COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 122
GPO:1969—O-357-545

STATE	PROJECT		
ARIZONA	Buckhorn Mesa WPP - Spook Hill Floodway		
BY A.C.	DATE 6-15-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Sediment Basin Outlet Hydraulics			SHEET 2 OF 3

All the flow back along basin

```
2,304.
FLOW
808.0000
                n
0.0300
                S
0.0050
W
40.0000
L               Z
4.0000
R               Z
2.0000
                df
                *
2.7428          df
6.1080          ◇
2.2007          dfQ
0.0107          SQ
7.8784          ◇Q
```

Quantity of flow

roughness

slope

bottom width

Left side slopes

right side slopes

(unknown)

normal depth
velocity
critical depth
" slope
" velocity

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE 123

☆ GPO:1969—O-357-545

STATE		PROJECT		
Az		Buckhorn Mesa WPP Spook Hill Floodway		
BY	DATE	CHECKED BY	DATE	JOB NO.
A. C.	6-15-76			2005
SUBJECT				SHEET 3 OF 3
Sediment Basin Outlet Hydraulics				

flow through opening

```
.................
2,304.
.................
    FLOW
  808.0000
.................
                  n
    0.0500
.................
                  S
    0.0050
.................
      W
   10.0000
.................
    L             Z
   10.0000
.................
    R             Z
   10.0000
.................
                 df
                  *
.................
   4.2113         df
   3.6816         ◇
   2.8682         dfa
   0.0310         Sa
   7.2824         ◇ a
```

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

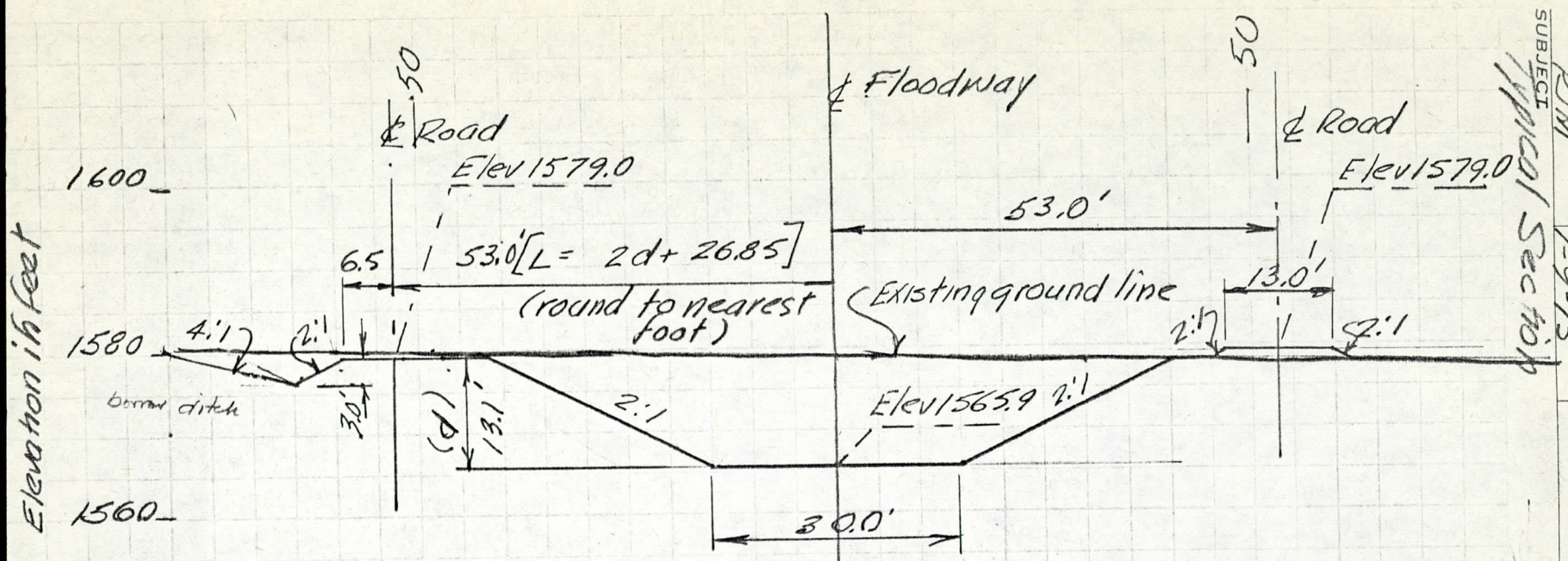
STATE		PROJECT		
Arizona		Buckhorn Mesa W.P.P. - Spook Hill Floodway		
BY J.E.B.	DATE July 76	CHECKED BY AC	DATE July 76	JOB NO. 2005

SUBJECT Invert and Road Elevations for Floodway Design

SHEET ____ OF ____

sta	Dist.	invert S=	Elev. invert	Left Rd. S=	Elev. Lf. Road	Rt Road S=	Elev. Rt. Road
102+72			1566.00		~~1579~~		
	228	0.0002		~~0.00109~~			
105+00			1565.95		1579.5		1579.5
	2650			0.00109			
131+50			1565.42		1576.6115		1576.6115
	200			0.00875		0.00875	
133+50			1565.38		1578.3615		1578.3615
	1100			0.0002		"	
144+50			1565.16		1578.1415		1587.9865
	50					0.0013	
145+00			1565.15		1578.1315		1587.9215
	14+50						
159+50			1564.86		1577.8415		1586.0365
	800	0.00609		0.00609			
167+50			1559.99		1572.9695		1584.9965
	1240					0.01577	
179+90			1552.436		1565.4179		1565.4417
	85			0.01577			
180+75			1551.919		1564.07145		1564.10125
	625			0.00609		0.00609	
187+00			1548.113		1560.2712		1560.295
	300'	0.000519		0.000519		0.000519	
190+00			1547.957		1560.1155		1560.1393
	160			0.000519			
191+60			1547.874		1560.03246		1560.
	1040			+0.0268		+0.0268	
202+00			1547.3345		1587.9045		
	300			-0.0933		-0.0933	
205+00			1547.1788		1559.9145		
	270			-0.0478		-0.0478	
207+70			1547.0387		1547.008		
	5						
207+75			1547.036		1546.769		

Information from Plan profile sheets



STA 107+00
LOOKING UPSTREAM

Require cross sections at following sections @ 1" = 10'

Sta 107+00	Sta 187+00
117+00	191+60
133+50	
144+50	
159+50	
167+50	
180+75	

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz
BY RJM
DATE 1-9-75
SUBJECT Typical Section
PROJECT Buckhorn Mesa WPP Spook Hill Addn
CHECKED BY
DATE
JOB NO.
SHEET 1 OF

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GPO 1958 O—470868

COMPUTATION SHEET

SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

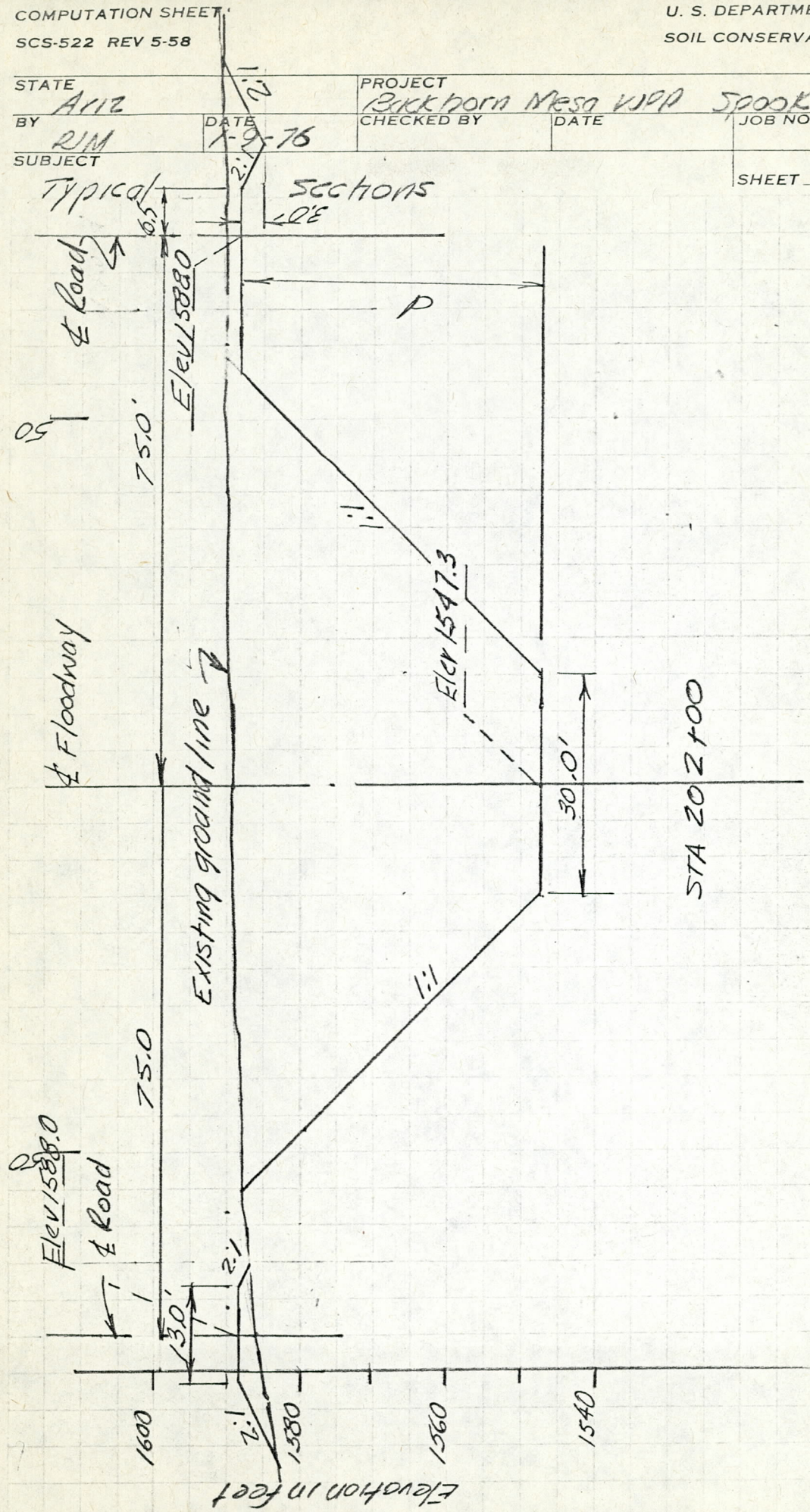
126

GPO 1958 O—470868

STATE	PROJECT			
Ariz	Bighorn Mesa WSP Spook Hill Floodway			
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	1-9-76			

SUBJECT

SHEET 1 OF 2



COMPUTATION SHEET
SCS-522 REV 5-58

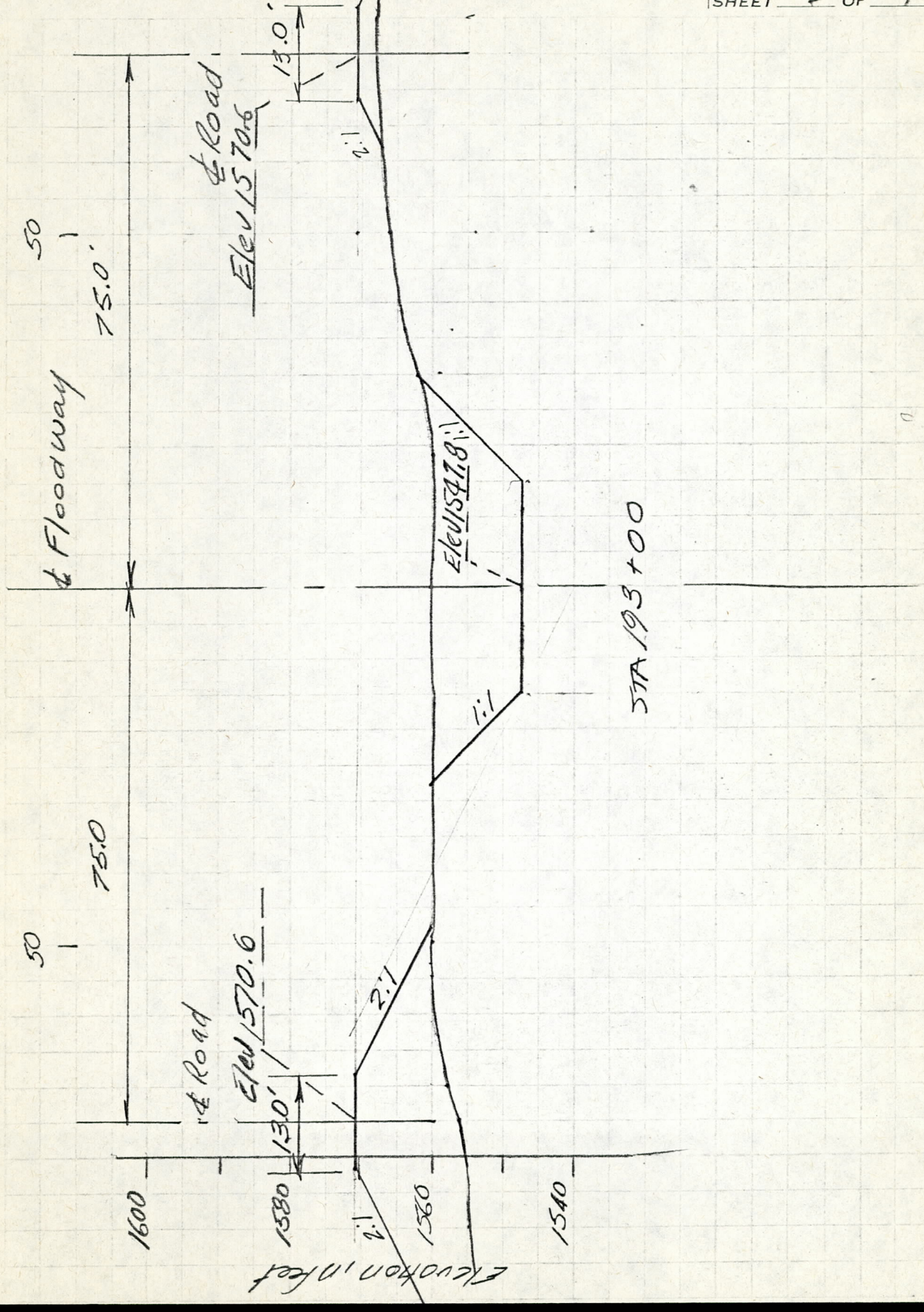
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 127

GPO 1958 O—470868

STATE	PROJECT		
Ariz	Buckhorn Mesa Spook Hill Floody		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	1/9/76			

SUBJECT

SHEET 2 OF 7



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

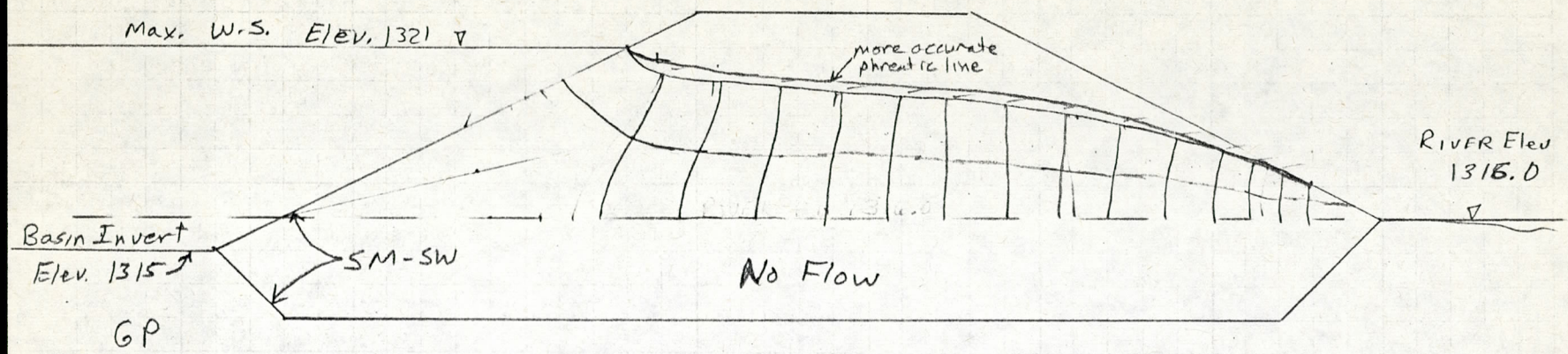
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT
BY A.C. | DATE 7-13-76 | CHECKED BY | DATE | JOB NO.
SUBJECT SEDIMENT BASIN Dikes | SHEET ___ OF ___

128

WORST CONDITION

The worst embankment condition is when the river has risen to the toe of the dike. No free flow from the embankment (SM-SW) to the foundation (GP) will exist. We expect these dikes to leak considerably (this is not a problem).



$M = 12'$ $\quad d = 25.6$ $\quad h = 5'$ $\quad \alpha = 26.57$

$$a = \frac{d}{\cos\alpha} - \sqrt{\left(\frac{d}{\cos\alpha}\right)^2 - \left(\frac{h}{\sin\alpha}\right)^2}$$

$$= 28.62 - \sqrt{(28.62)^2 - (11.18)^2}$$

$$= 28.62 - 26.35$$

$$= 2.27'$$

flow net is crude $\quad h = 5' \quad N_f = 2 \quad N_e = 15 \quad \Delta h = 5'/15 = .33$

$$i = \Delta h / \Delta \ell = .33/.6 = .55 \qquad S.F = 1.82$$

This is too close for a crude flow net. Coarse grain material is to be used. This material is not subject to piping, it should not be a problem

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

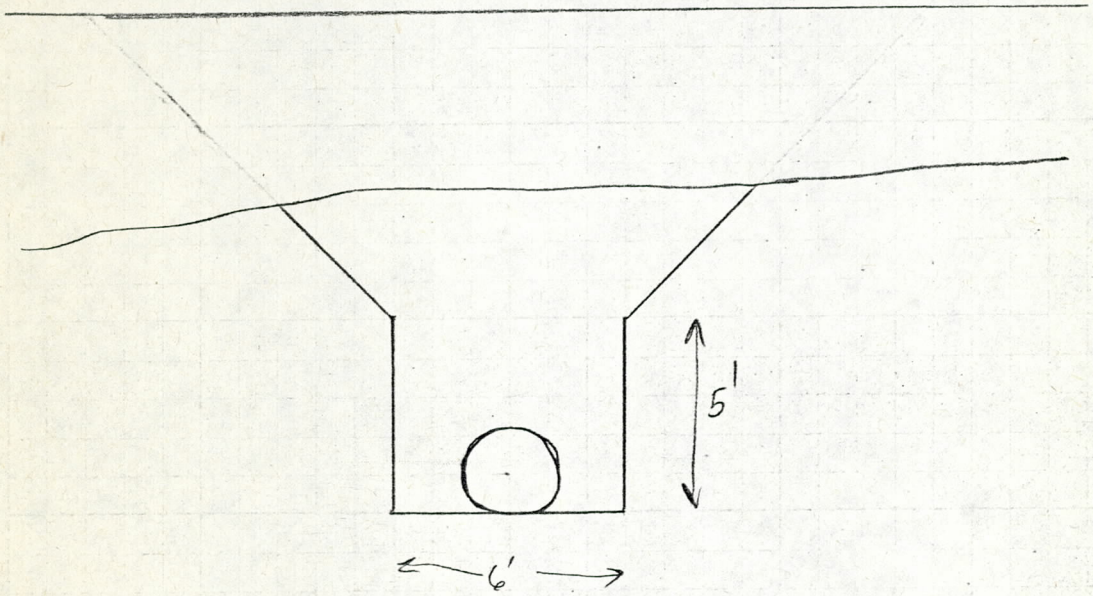
☆ GPO : 1969—O-357-545

STATE		PROJECT		
BY A.C.	DATE 6-26-76	CHECKED BY	DATE	JOB NO.
SUBJECT Trench Excavation				SHEET 1 OF 2

US BRec. Fig 29, Par 2.35 - Canals and Related Structures

trench width (24" pipe) = 0.083 ID + 3.33 = 5.32'
(30" pipe) 0.097 ID + 3.0 = 5.91'

use 6' wide excavation



Thompson Pipe + Steel Co. Denver - Chart on p14

shows 14 ga. is acceptable for both

(for 30", 30' of cover would be necessary to increase gage)

for 2 2/3 by 1/2 (Pitch by Depth

National Corrug. Steel Pipe Assoc. $\frac{30^2}{30\times10^6\times.00239} = .13$ $\frac{24^2}{30\times10^6\times.00239} = .080$

Load = LL + DL ≅ 1000 psf Load = $\frac{1}{2}\times1000\times\frac{30}{12}$ = 1250 p/ft

S.F. = $\frac{18,200}{1,250}$ = 14 14 gage is acceptable

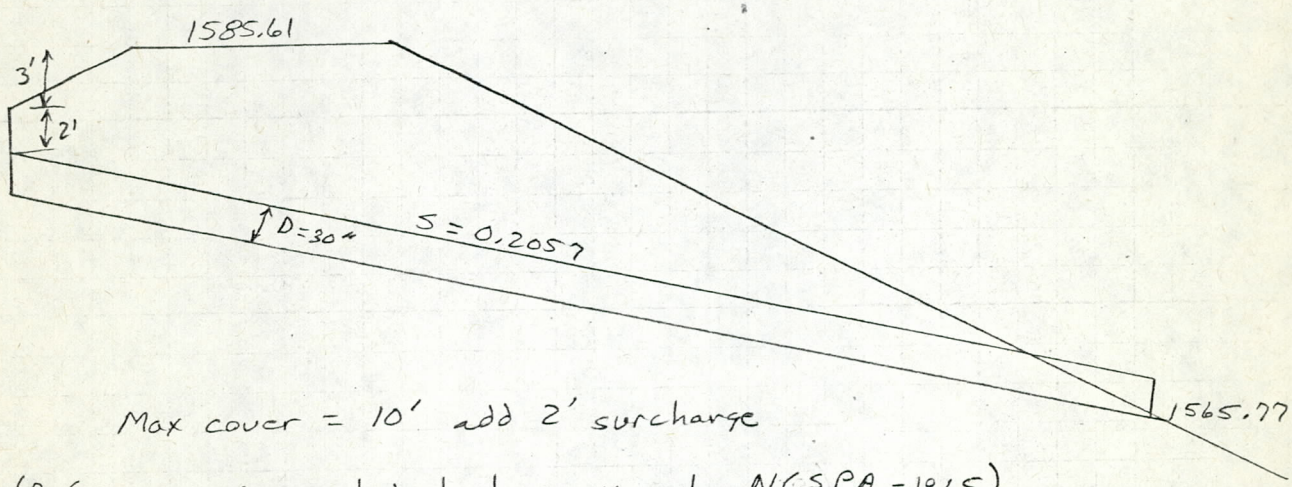
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE ARIZONA		PROJECT Buckhorn Mesa WPP Spook Hill Floodway		
BY A.C.	DATE 7-19-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Pipe gage. - CMP				SHEET 2 OF 2

Worst condition for pipe strength is at Sta 162+80

30" pipe with S = 0.2057



Max cover = 10' add 2' surcharge

(Reference - Corrugated steel pipe Manual - NCSPA - 1965)

verticle load = 12' × 130 lb/ft³ = 1560 lb/ft²

load factor = 1.0 , P = load = 1560 lb/ft²

ring compression C = P × R = 1560 × $\frac{2.5}{2}$ = 1950

$f_b = \frac{33,000}{4}$ psi = 8,250 strength

required area $\frac{1950 \text{ lb/ft}}{8,250 \text{ lb/in}^3}$ = 0.236 sq in/ft any will do

<u>16 gage</u> is the smallest for 24" and 30" pipes <u>Use</u>!

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 131
☆GPO:1969—O-357-545

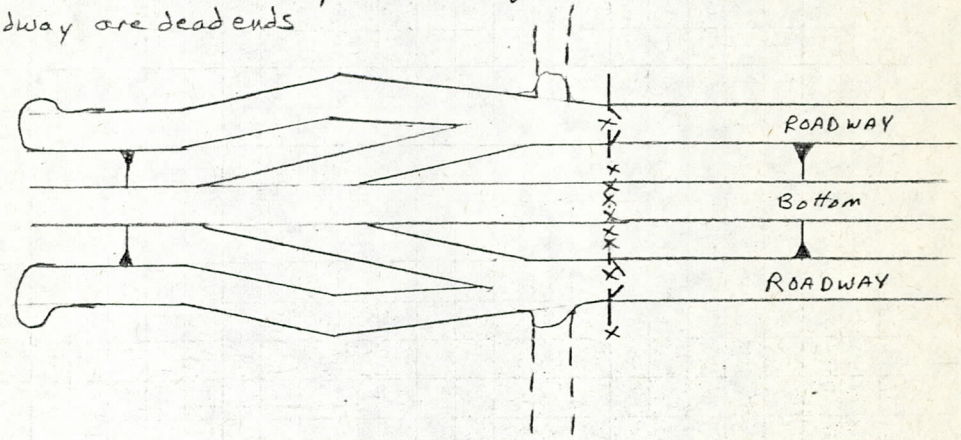
STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C.	DATE 6-3-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT ACCESS FOR FOREST SERVICE				SHEET 1 OF 3

Alternatives for problems solution at the Forest Service Boundary

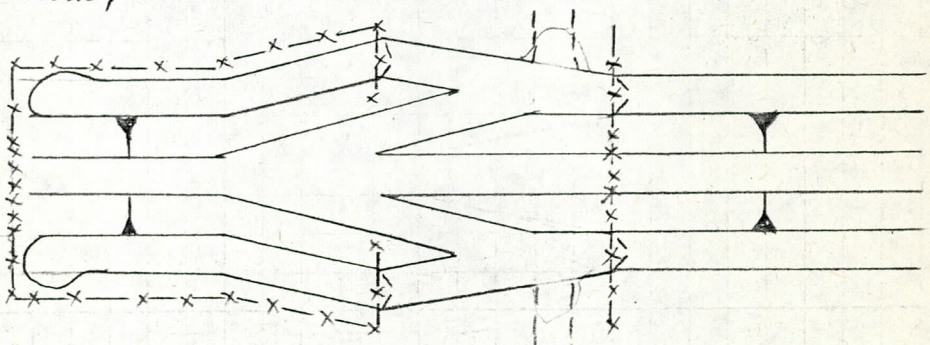
1. Allow access for vehicles and cattle to cross floodway
2. Allow access around floodway
3. Allow access from another point

Alternatives

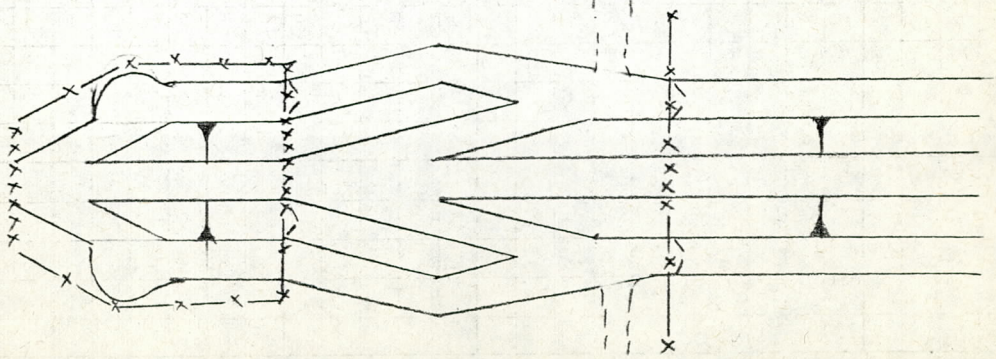
1. Fence up to Forest Service Boundary - allowing access to bottom - Maintenance roads and floodway are dead ends



2. Fence roadways on both sides of ramps - flood gates upstream from ramps at at end of floodway (no access to bottom at end of roadways



3.



COMPUTATION SHEET

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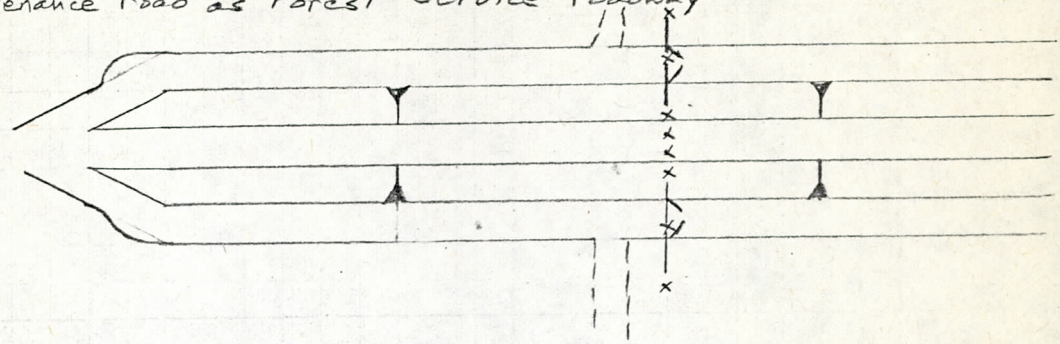
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 132

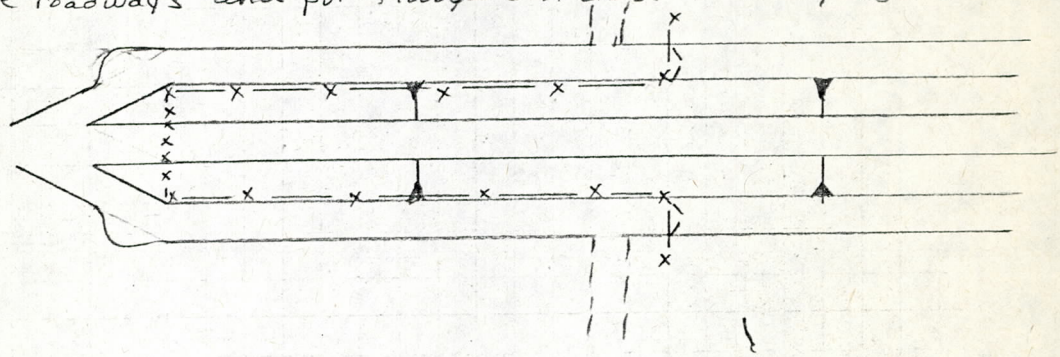
GPO: 1969—O-357-545

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP- SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	6-3-76			2005
SUBJECT				SHEET 2 OF 3
ACCESS FOR FOREST SERVICE				

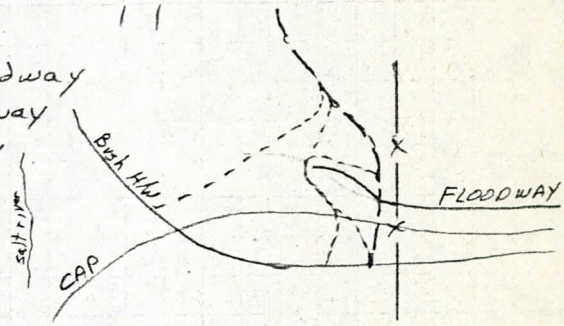
4. Use maintenance road as Forest Service roadway



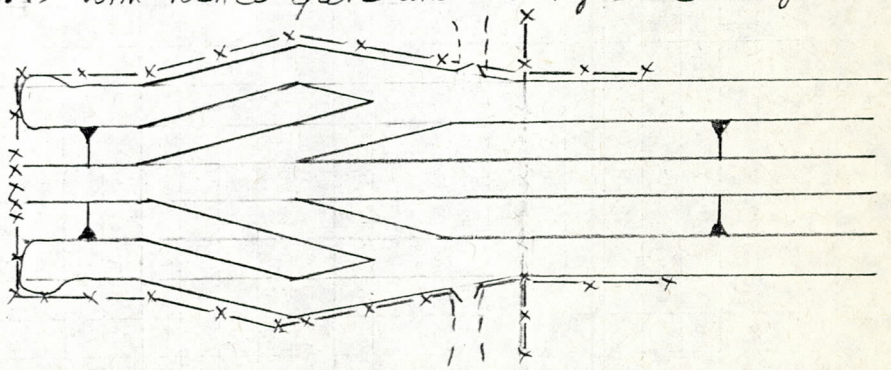
5. Fence inside roadways and put floodgate at end of floodway (same as 3



6. Locate alternative roadway around floodway
   a) tie into existing access to Bush Highway
   b) locate new access to Bush Highway



7. Alternate roadway (Alt. 6) with locked gate and crossing at existing roadway



COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE 133

☆ GPO: 1969—O-357-545

STATE	PROJECT			
ARIZONA	BOCKHORN MESA WPP - SPOOK HILL FLOODWAY			
BY A.C.	DATE 6-3-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT ACCESS FOR FOREST SERVICE				SHEET 3 OF 3

SPECIFIC PROBLEMS (OR NEEDS)

1. Vehicle Access to both Sides
2. Animal crossings
3. limited vehicle travel
4. protection from accidents (up to 25' drop @ 2:1 slope)
5. controlled maintenance (control of access, ease of maintenance)
6. acess to bottom of floodway from maintenance roads

Alt 1 solves 1, 2, 6

Alt 2 solves 1, 2, 4, 5, 6

Alt 3 solves 1, 2, 3, 4, 5, 6

Alt 4 solves 1, 2, 6

Alt 5 solves 1, 2, 4, 6

Alt 6 solves 1, 2, 3, 4, 5, 6

Alt 7 solves 1, 2, 3, 4, 5, 6

Other factors

1. speed of access to land
2. expense of FCD and SCS
3. convenience to F.S.
4. convenience to F.C.D.

Alt. 7 would seem best

COMPUTATION SHEET

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U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE 134

STATE		PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET ____ OF ____

Backup work on Junction Structures

STATE ARIZONA		PROJECT BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-21-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Water Surface Profiles - (Junctions)				SHEET 1 OF 8

From TRAPW routing program at Sta 191+50 $d_3 = 9.069$ and $Q_3 = 2136$

from this station a backwater curve will be run upstream through the 3 proposed junctions. The following are the proposed discharges

(J) denotes a junction

station	$Q_{1 or 3}$	Q_2	S	n	$\theta = 45°$ d
191+50	2136				9.069
	(J)		.000519	.035	
190+50	1768	368			9.344
			.000519	.027	
187+00	1768				9.310
			.00609	.027	
184+25	1768				7.630
	(J)		.00609	.035	
183+25	1246	522			7.490
			.00609	.027	
159+50	1246				3.73 (reaches normal depth)
			.00020	.027	
152+00	808				6.053
			.00020	.027	
111+00	808	691			7.54 (normal depth assumed)
	(J)		.00020	.035	
110+00	117				7.613

The following equation from TR25 is used (Figure 5-1)

$$\frac{Q_3^2}{gA_3} + \left(\frac{b_3}{2} + \frac{zd_3}{3}\right) d_3^2 = \frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2}\cos\theta + \left(\frac{b_1}{2} + \frac{zd_1}{3}\right) d_1^2 + A_a h - \frac{P_a l n^2 V_a^2}{2.21 R_a^{1/3}}$$

$\cos\alpha \cong 1.0$ Main channel is of constant width 30', $z = 2.0$

laterals are assumed at 20' bottom widths and $z = 2.0$

STATE Az		PROJECT Buckhorn Mesa WBP SPOOK HILL FLOODWAY		
BY A.C.	DATE 4-21-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Water Surface Profiles				SHEET 2 OF 8

Junction Station 191+10 - 100' of riprap -

		$\theta = 45°$	$\theta = 30°$
0.03500	n	0.03500	0.03500
0.00051	S	0.00051	0.00051
2,136.00000	Q_3	2,136.00000	2,136.00000
30.00000	b_3	30.00000	30.00000
9.06900	d_3	9.06900	9.06900
2.00000	Z_3	2.00000	2.00000
436.56352	A_3	436.56352	436.56352
70.55780	P_3	70.55780	70.55780
1,768.00000	Q_1	1,768.00000	1,768.00000
30.00000	b_1	30.00000	30.00000
2.00000	Z_1	2.00000	2.00000
368.00000	Q_2	368.00000	368.00000
20.00000	b_2	20.00000	20.00000
2.00000	Z_2	2.00000	2.00000
45.00000	θ	30.00000	30.00000
100.00000	ℓ	100.00000	100.00000
0.05190	h	0.05190	0.05190
9.34400	Trial d_1	9.34000	9.34000
454.94067	A_1	454.67120	454.67120
71.78763	P_1	71.76974	71.76974
361.50067	A_2	361.27120	361.27120
445.75209	A_a	445.61736	445.61736
71.17271	P_a	71.16377	71.16377
6.26296	R_a	6.26185	6.26185
1,952.00000	Q_a	1,952.00000	1,952.00000
4.37911	V_a	4.38043	4.38043
.....		.....	.....
2,055.93215	AM_3	2,055.93215	A
2,055.81994	AM_1	2,055.57397	A
.....		.....	.....

STATE	PROJECT		
Az	Buckhorn Mesa WPP Spook Hill Floodway		
BY A.C.	DATE 4-21-76	CHECKED BY	DATE	JOB NO.
SUBJECT Water Surface Profiles			SHEET 3 OF 8

Backwater curves using momentum equation

STA 190+50 to
STA 187+00

0.02700
0.00051

1,768.00000
30.00000
9.34400
2.00000
454.94067
71.78763

1,768.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
350.00000
0.18165

9.31000
452.65220
71.63558
0.00000

453.79643
71.71161
6.32807
1,768.00000
3.89602

. . . . . .
2,067.18571 A

2,067.32173 A
. . . . . .

STA 187+00 to
STA 184+25

0.02700
0.00609

1,768.00000
30.00000
9.31000
2.00000
452.65220
71.63558

1,768.00000
30.00000
2.00000

0.00000
0.00000
0.00000

0.00000
275.00000
1.67475

7.63000
345.33379
64.12239
0.00000

398.99300
67.87899
5.87800
1,768.00000
4.43115

. . . . . .
2,052.83677 A

2,052.05563 A
. . . . . .

STATE Az		PROJECT Buckhorn Mesa WPP Spook Hill Floodway		
BY A.C.	DATE 4-21-76	CHECKED BY	DATE	JOB NO.
SUBJECT Water Surface Profiles				SHEET 4 OF 8

Junction Station 183+85 - 100' of rip rap

$\theta = 45°$	$\theta = 30°$
0.03500	0.03500
0.00609	0.00609
1,768.00000	1,768.00000
30.00000	30.00000
7.63000	7.63000
2.00000	2.00000
345.33379	345.33379
64.12239	64.12239
1,246.00000	1,246.00000
30.00000	30.00000
2.00000	2.00000
522.00000	522.00000
20.00000	20.00000
2.00000	2.00000
45.00000	30.00000
100.00000	100.00000
0.60900	0.60900
7.49000	7.47700
336.90020	336.12105
63.49629	63.43816
262.00020	261.35105
341.11700	340.72742
63.80934	63.78027
5.34587	5.34220
1,507.00000	1,507.00000
4.41783	4.42289
.....	.....
1,450.83874 A	1,450.83874 A
1,450.96036 A	1,450.64642 A
.....	.....

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE		PROJECT		
Az		BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	4-21-76			
SUBJECT				SHEET 5 OF 8
Water Surface Profiles				

Backwater curve using momentum equation - too long a reach was used and the depth passed normal depth. Assumptions of equation do not hold for this case, assume that flow reaches normal depth (STA 183+25 to 159+50)

0.02700	0.02700
0.00609	0.00609
1,246.00000	1,246.00000
30.00000	30.00000
7.49000	5.20000
2.00000	2.00000
336.90020	210.07999
63.49629	53.25510
1,246.00000	1,246.00000
30.00000	30.00000
2.00000	2.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
0.00000	0.00000
375.00000	300.00000
2.28375	1.82700
5.20000	3.60000 ← reach was too long normal depth ≈ 3.73
210.07999	133.92000
53.25510	46.09968
0.00000	0.00000
273.49010	172.00000
58.37570	49.67739
4.68499	3.46233
1,246.00000	1,246.00000
4.55592	7.24418
.....	.....
1,264.91895 A	729.13089 A
1,264.13536 A	729.68396 A
.....	.....

STATE		PROJECT		
Az		Buckhorn Mesa WPP Spook Hill Floodway		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	4-21-76			
SUBJECT				SHEET 6 OF 8
Water Surface Profiles				

Backwater curves from momentum equation

STA 159+50 to 152+00

```
    22.63930
   290.10442
     0.02700
     0.00020

 1,246.00000
    30.00000
     3.73000
     2.00000
   139.72579
    46.68106

 1,246.00000
    30.00000
     2.00000

     0.00000
     0.00000
     0.00000

     0.00000
   750.00000
     0.15000
```

STA 152+00 to 111+00

An extremely long channel length exists. It can be assumed that normal depth will be reached

$d = 7.54$

```
     6.05300
   254.86761
    57.06983
     0.00000

   197.29670
    51.87545
     3.80327
 1,246.00000
     6.31536

.................
   588.78658      A

   588.50222      A
.................
```

STATE		PROJECT		
Az		Buckhorn Mesa WPP Spook Hill Floodway		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	4-21-76			
SUBJECT				SHEET 7 OF 8
Water Surface Profiles				

Junction at station 111+50 - 100' of rip rap

$\theta = 45°$	$\theta = 30°$
0.03500	0.03500
0.00020	0.00020
808.00000	808.00000
30.00000	30.00000
7.54000	7.54000
2.00000	2.00000
339.90320	339.90320
63.71990	63.71990
117.00000	117.00000
30.00000	30.00000
2.00000	2.00000
691.00000	691.00000
20.00000	20.00000
2.00000	2.00000
45.00000	30.00000
100.00000	100.00000
0.02000	0.02000
7.61300	7.59300
344.30553	343.09729
64.04637	63.95692
268.17553	267.16729
342.10436	341.50024
63.88313	63.83841
5.35515	5.34944
462.50000	462.50000
1.35192	1.35431
.....	.....
1,198.27239 A	1,198.27239 A
1,198.39210 A	1,198.48288 A
.....	.....

STATE Az		PROJECT Buckhorn Mesa WPP Spook Hill Floodway		
BY A.C.	DATE 4-21-76	CHECKED BY	DATE	JOB NO.
SUBJECT Water Surface Profiles				SHEET 8 OF 8

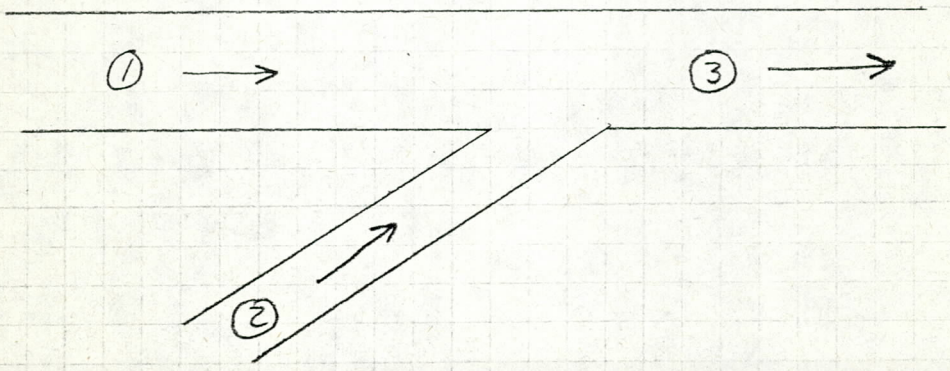
Conclusions:

The angle at which the lateral enters the channel (for subcritical junction) is relatively unimportant. Changes in depth are on the order of less than one percent. (Similarly with superelevations - not covered here, see structural information in supplementary data.)

The length of the rip rap section also has very little effect on the head losses through the junction.

* Design should be based on properties of flow in the natural wash and construction conveneyence.

Also, the momentum equation can be used for backwater and drawdown curves, including reaches through junctions.



COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1969—O-357-545

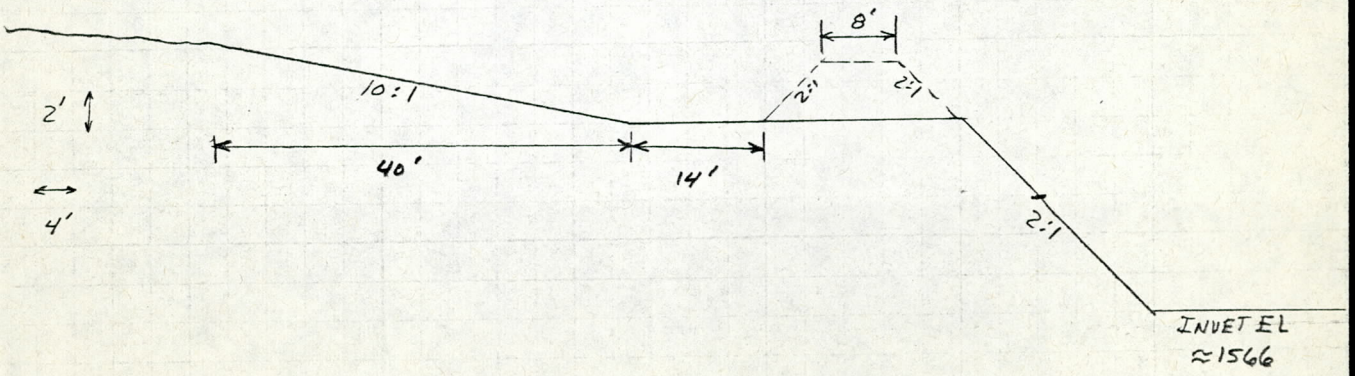
STATE ARIZONA		PROJECT BUCKHORN MESA WPP - SPOOK HILL FLOODWAY	
BY A.C.	DATE 5-4-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT JUNCTION STRUCTURES			SHEET 1 OF 7

There is ample capacity in the floodway to allow sideflows to enter the channel in any direction. The backwater curves show that there is very little change between entering the sideflows perpendicular to the floodway or entering the flow at some angle θ, say 30 or 45°.

Since hydraulics in the floodway is not a problem, the flows will be entered in a way most convenient for construction and maintenance. Where possible, the will be constructed similar to the weir inlets. Other consideration are right of way and road way locations.

STA 109+80 - Maximum Discharge is 691 cfs

natural channel velocities are on the order of 7-9 ft/sec a curved junction structure would cause right of way and roadway problems. This junction may be more suitable for design as a weir. Elevation of roadway is about 1579. Drop to 1576 at weir. The flow width in the natural channel is about 60' at maximum discharge, use this as weir width. The natural channel is still about 3-4 feet above the roadway, slope back into wash at 10:1.



COMPUTATION SHEET

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1969—O-357-545

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP - SPOOK HILL FLOODWAY		
BY A.C. / DATE 5-4-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT JUNCTION STRUCTURES			SHEET 2 OF 7

As the flow in the natural channel reaches the 10:1 slope, it will spread and accelerate slightly. It is expected that it will reach it's normal depth (velocity 12 ft/sec)

As the floodwater flows over the end of the weir, (close to critical depth), it will accelerate down the slope to some greater velocity. At normal depth in the channel for no side flow, the weir crest will be only 4-5 feet above the water surface

```
..................
2,304.
..................
     FLOW
   691.0000
..................
                  n
   0.0350
..................
                  S
   0.1000
..................
     W
   60.0000
..................
   L              Z
   4.0000
..................
   R              Z
   4.0000
..................
                 df
                  *
..................
   0.9015         df
  12.0506         ◇
   1.5468         dfCL
   0.0160         SCL
   6.7491         ◇ CL
```

```
..................
2,304.
..................
     FLOW
   691.0000
..................
                  n
   0.0350
..................
                  S
   0.5000
..................
     W
   60.0000
..................
   L              Z
   2.0000
..................
   R              Z
   2.0000
..................
                 df
                  *
..................
   0.5615         df
  20.1311         ◇
   1.5745         dfCL
   0.0158         SCL
   6.9493         ◇ CL
```

As the floodwater flows over the roadway and weir, it will slow to the critical velocity (6.7 ft/sec)

Weir flow will exist !! (see water surface profile)

It will not reach normal depth at a velocity of 20 ft/sec, but something less, 15-18 ft/sec maximum.

WATER SURFACE PROFILE CALCULATION SHEET

Project: BUCKHORN MESA WPP SPOOK HILL FLOODWAY Location: ARIZONA Appropriation:

Date: 5-4-76 By: A.C. Sheet 3 of 7

Q = 691 b = 60 z = 4 n = .035 $\left(\frac{Qn}{b^{8/3}}\right)^2$ =

Station	d = depth	b = bottom width	a = area	Velocity, $V = \frac{Q}{a}$	Velocity Head, $h_v = \frac{V^2}{2g}$	$H_e = d + h_v$	r	V_m	r_m	$\frac{1}{2.21 r_m^{4/3}}$ Kings, Table 98 4th ed.	Table 7-12 5th ed. $(nV_m)^2$	Friction slope $S_f = \left(\frac{Qn}{K}\right)^2$	S_i = invert slope	$S_i - S_f$	$H_e'' - H_e'$	(downstream) $L = \frac{H_e'' - H_e'}{S_i - S_f}$
1	1.2	60	77.76	8.89	1.23	2.43	1.11	9.85	1.02	.438	.119	.052	.10	.048	.38	7.92'
2	1.0	60	64	10.80	1.81	2.81	.94	11.44	.89	.525	.16	.084	.10	.016	.36	22.5'
3	0.9	60	57.24	12.07	2.27	3.17	.85									
	reaches normal depth (or close to it)															
4	0.9	60	57.24	12.07	2.27	3.17	.85	11.44	.89	.525	.16	.084	0	-.084	-.36	4.29'
5	1.0	60	64	10.80	1.81	2.81	.94	9.85	1.02	.438	.119	.052	0	-.052	-.38	7.31'
6	1.2	60	77.76	8.89	1.23	2.43	1.11	8.10	1.26	.331	.080	.027	0	-.027	-.1	3.76'
7	1.5	60	z=2.0 94.5	7.31	.83	2.33	1.42								→	0
8	1.55	60	97.8	7.07	.78	2.33										
	WEIR FLOW WILL EXIST															
9	1.57	60	99.13	6.97	.76	2.33	1.48	7.73	1.36	.301	.073	.022	.5	.478	.09	.19'
10	1.30	60	81.38	8.49	1.12	2.42	1.24	9.65	1.09	.403	.114	.046	.5	.454	.39	.86'
11	1.0	60	64.0	10.80	1.81	2.81	.94	13.4	.81	.599	.221	.132	.5	.368	1.91	5.20'
12	0.7	60	43.0	16.08	4.02	4.72	.68									

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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GPO:1969—O—357-545

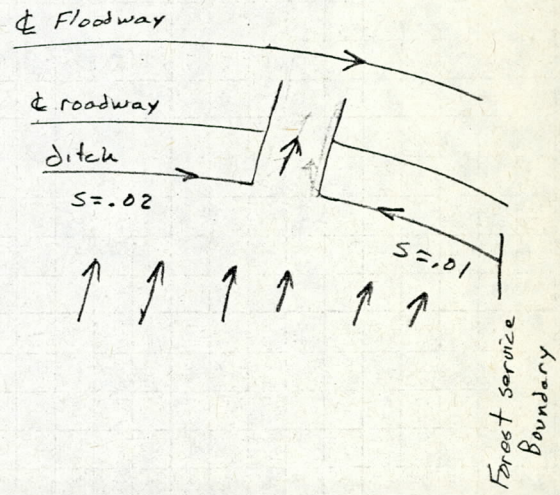
STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-4-76	CHECKED BY	DATE	JOB NO.
SUBJECT JUNCTION STRUCTURES			SHEET 4 OF 7

STATION 183+70

An extremely wide flow area is expected. It would be impossible to estimate exactly where the flow would intersect the floodway. For this reason a collector ditch is necessary. A three foot deep ditch is standard but a large quantity of flow may require a bottom width. Ten feet seems practical.

```
.................
2,304.
.................
     FLOW
   200.0000
.................
                n
    0.0350
.................
                S
    0.0100
.................
      W
   10.0000
.................
    L           Z
    4.0000
.................
   R            Z
    2.0000
.................
                df
                *
.................
    2.1711      df
    5.5783      ◇
    1.9008      dfa
    0.0166      Sa
    6.7007      ◇ a
```

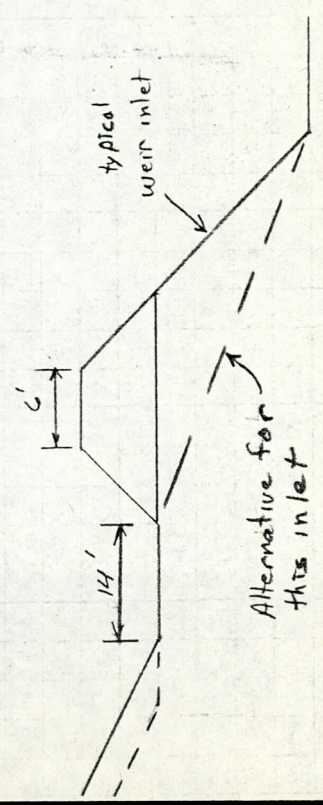
This output has assumed a 10' wide ditch at a slope of .01. It is estimated that about 1/3 of the 560 cfs (used 200) will be carried by the channel north of the inlet.



STATE ARIZONA		PROJECT BUCKHORN MESA WPA SPOOK HILL FLOODWAY		
BY A.C.	DATE 5-4-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT JUNCTION STRUCTURE				SHEET 5 OF 7

Ditch and roadway elevations determine the elevation of the roadway at the location of the inlet. Channel Invert elevation is about 1551. The roadway elevation at the inlet is 1556. An 8:1 side slope from invert to roadway allows enough distance to lower roadway while maintaining a berm at the original roadway elevation. Under full flow conditions, the roadway will be below at the water surface of the channel and high velocity inflows will not exist. This inlet is similar to the typical weir inlets except for the width of the ditch and the actual slope of the inlet.

```
2,304
FLOW
560.0000
                    n
0.0350
                    S
0.1250
W
50.0000
L                   Z
2.0000
R                   Z
2.0000
                    df
                    *
Normal depth → 0.8354        df
Normal velocity 12.9721      ◇
critical depth → 1.5406      dfCL
0.0160               SCL
6.8474               ◇ CL
```



Either is acceptable. (See Water Surface Profile). Typical section may be better

WATER SURFACE PROFILE CALCULATION SHEET

Project: BUCKHORN MESA WAP SPOOK HILL FLOODWAY Location: ARIZONA Appropriation:

Sheet 6 of 7

Date: 5-4-76 By: A.G.

Q = 560 b = 50 z = 1.0 n = .035 $\left|\frac{Qn}{b^{8/3}}\right|^2$ =

Station	d = depth	b = bottom width	a = area	Velocity, $V = \frac{Q}{a}$	Velocity Head, $h_v = \frac{V^2}{2g}$	$H_e = d + h_v$	Area/wetted perimeter r		V_m d (average of)	r_m	$\frac{1}{2.21 r_m^{1/3}}$ Kings, 98	Table 7-12 4th. ed.	Table 7-12 5th. ed. $(nV_m)^2$	Friction slope S_f	S_f = invert slope S_i	$S_f - S_i$	$H_e'' - H_e'$	(going upstream) $L = \frac{H_e'' - H_e'}{S_f - S_i}$
1	1.54	50	79.37	7.06	.77	2.31	1.46		6.72	1.53	.256	.055		.014	0	.014	.02	1.43
2	1.7	50	87.89	6.37	.63	2.33	1.60		5.88	1.73	.217	.042		.009	0	.009	.12	13.3'
3	2.0	50	104.00	5.39	.45	2.45	1.87		4.83	2.08	.170	.029		.005	0	.005	.33	68.0'
4	2.5	50	131.25	4.27	.28	2.78	2.30											

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STATE		PROJECT		
ARIZONA		BUCKHORN MESA W.P.P. SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	5-4-76			2005
SUBJECT				SHEET 7 OF 7
JUNCTION STRUCTURES				

STA 189+35

The natural wash intersects the channel bottom. No structure is necessary. The area around the intersection of the wash will require some rock to stabilize the junction. Rock will be required on the opposite wall to stop errosion. Particularly since the natural wash will be filled. The roadway should be constructed so as not to disrupt the wash. It will swing up stream dropping in elevation on a 10:1 slope to intersect the channel at about elevation 1551. (This is only 2-3 feet above the channel invert elevation. The roadway will return to its normal elevation at a 10:1 slope. The banks of the wash will contain the water surface of the floodway.

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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STATE ARIZONA		PROJECT BUCKHORN MESA WPP SPOOK HILL FLOODWAY	
BY A.C.	DATE 5-4-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Natural Channel Support Data			SHEET 1 OF 2

Junction Sta ≈ 110+00

Left Dist	ELEV	Right Dist
0'	1582	0'
30'	1584	15'
—	1585	40'

Approx. channel

$b=15'$, $z_L=13$, $z_R=10$

$s \approx 2'/80'$, $n \approx .03$ $Q=691$ cfs

Junction Sta ≈ 183+00

Left Dist	ELEV	Right Dist
0'	1567	0'
20'	1568	15'
30'	1569	40'

Approx. channel

$b=10'$ $z_L=12.5$ $z_R=15$

$S \approx 20'/515' \cong .04$ $n \approx .03$ $Q=560$

```
2,304.
FLOW
691.0000
                    n
0.0300
                    S
0.0250
W
15.0000
                    Z
L
13.0000
R                   Z
10.0000
                    df
                    *
Depth          2.0042   dt
velocity       9.0615   ◇
critical Depth 2.3848   dt CL
critical slope 0.0116   S CL
critical velocity 6.8294 ◇ CL
```

```
2,304.
FLOW
560.0000
                    n
0.0300
                    S
0.0400
W
10.0000
                    Z
L
12.5000
R                   Z
15.0000
                    df
                    *
1.6984              dt
9.8854              ◇
2.1944              dt CL
0.0122              S CL
6.3523              ◇ CL
```

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	BUCKHORN MESA WPP SPOOK HILL FLOODWAY		
BY: A.C.	DATE: 5-4-76	CHECKED BY:	DATE:
JOB NO.: 2005			
SUBJECT: Natural Channel Support Data		SHEET 2 OF 2	

Junction Sta ≈ 190+00

Left Dist	ELEV	Right Dist
10'	1552	10'
18'	1554	–
43'	1556	–
50'	1558	–
–	1560	25'

Approx. Channel
$b = 20'$ $z_L = 8.3$, $z_R = 1.9$
$S = 2'/75' = .027$, $n \approx .035$ $Q = 560$ cfs

```
.................
2,304.
.................
     FLOW
   560.0000
.................
                    n
     0.0350
.................
                    S
     0.0270
.................
       W
    20.0000
.................
     L              Z
     8.3000
.................
     R              Z
     1.9000
.................
                   df
                    *
.................
     2.0281         df
     9.0998          ◇
     2.3555         df CL
     0.0152         S CL
     7.4263          ◇ CL
```

Addendum

Preliminary Geologic Investigation

Site No. 4 (Spook Hill)

Buckhorn-Mesa Watershed

Arizona

Outlet: The principal spillway discharge of Floodwater Retarding Structure Site No. 4 will outlet into a channel to be cut into Precambrian granite with smaller intrusions of Laramide granite. The outlet channel will empty into a natural channel also in the granite outcrop. While much of the granite along the proposed outlet channel is decomposed, there are zones of hard rock sufficiently closely spaced to prevent serious degradation. The natural channel contains thin bedload deposits which are underlain by granite sufficiently durable to withstand the 100-year flow with only minor plucking. Also, the natural channel passes through a concrete box culvert under Bush Highway before spreading over the Salt River alluvium just above Granite Reef Dam.

The estimated average annual yield of bedload size material to the outlet channel is ~~0.2~~ 0.1 acre-feet.

Use of the Schoklitsch Bedload Equation indicates that the bedload will not be transported efficiently by the outlet channel. Thus, these materials should be removed periodically to insure proper functioning of the channel. The estimated average cost of removal is $200 to $300 per year.

Bedload transport analysis for the natural channel indicates that discharge from the Spook Hill FRS with the 10-year storm has the capacity to transport the available bedload to the Salt River. There are only about 1.5 acre-feet of loose bedload available, however. Upstream from Bush Highway, There is a thin horizon of compact cobbles, boulders, sand, and silt which is generally present between the loose bedload and the granite. ~~upstream from the Salt River flood plain.~~ Analysis indicates that both the 10-year and 100-year discharges have capacities to transport these coarse materials along the reach upstream from a point about 500' north of Bush Highway but will deposit the materials downstream from ~~Bush Highway~~ this point.

Geologic Investigation Addendum

Salt River flood plain deposits are primarily very fine-grained, silty sand. These soils are highly erodible, but flows on the nearly level flood plain will spread widely through dense growth of mesquite trees and cattails. Major erosion problems are not anticipated if the soils and vegetation are left undisturbed. It is recommended that (1) either the culverts under Bush Hwy be protected from undercutting as an appurtenant feature of FRS No. 4 or (2) the channel conditions downstream from the culverts be observed closely and that protection be provided only when and if warranted.

Charles D. Clarke

Charles D. Clarke
Geologist

7/15/75

SCS-ENG-F
REV. 7-72

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

WATERSHED: Buckhorn-Mesa		SUB-WATERSHED	SITE NO.: Spook Hill
LOCATION		OWNER	STATE: AZ
LOGGED BY: Charles D. Clarke	DATE: 7/10/75	PROJECT: WP-07 ____ WP-08 X FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: Hand Auger		LOCATION OF HOLES: Outlet (Natural Wash)	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
404	266+00	0.0	0.3	Like 401.1		SW								
	℄ Wash	0.3	1.0	Like 401.2		SW								
	(150' DS fr. culvert	1.0	1.5	Sand, cbl., bld., M. mixture (like 402.3) unable to penetrate		GP								
3010	269+00			Like 402.3 (unable to penetrate) max. size 2'										
405	271+00	0.0	0.8	Sand, G., M., sl./cbl. (like 402.3)		GP								
	℄ Wash	0.8	+	Like 402.3 (unable to penetrate)										
406	271+50	0.0	0.2	Silt, v./Fn. S., lse, gray-brown		ML								
	℄ Wash	0.2	1.2	Sand, G., M., W., lse-mod. dns., gray		SW-SM								
		1.2	4.8	Sand, v/Fn. Grn., v/M, lse-med., thin lenses gravelly SM, reddish tan (cbl. horizon @ 4.8-unable to penetrate)		SM		406.1		1.2	4.8			
407	273+00	0.0	0.5	Sand, v/Fn. Grn., v/M, lse., reddish tan (like 406.1)		SM								
		0.5	2.8	Sand, v/Fn. Grn., sl./M, lse, tan		SP								
		2.8	4.0	Sand, v/Fn. Grn., v/M, lse-med., sl./moist, reddish tan		SM		407.1	D	3.0	4.0			
				(Unable to penetrate, root at 4.0)										
408	273+75	0.0	3.0	Sand, Fn. Grn., sl./M-M, lse., tan		SM		408.1	D	0.0	3.0			
	5' fr	3.0	4.5	Silt, v/Fn. S., Med., moist mottled, rust-tannish gray		ML		408.2	D	3.0	4.5			
	edge marsh	4.5	6.0	Sand, v/M, sl./C, thin C lenses, wt @ 6.0, dk gray		SM		408.3	D	4.5	6.0			

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

CS-533
REV. 3-67

WATERSHED: Buckhorn-Mesa		SUB-WATERSHED	SITE NO.: Spook Hill
LOCATION		OWNER	STATE
LOGGED BY: C. Don Clarke	DATE: 7/3/75	PROJECT: WP-07 ____ WP-08 X FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: Hand		LOCATION OF HOLES: Outlet (Natural Wash)	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
401	50' u.s. fr. culvert	0.0	0.5	Sand, cse. grn. sl/G., W., lse., granitic, bedload, tan-gray		SW		401.1		0.0	0.5	10	3"	
	℄ channel (263+20)	0.5	1.0	Sand, M, cse. grn., sl/G. & cbl., dns., sl./ind., lt. brown. Ch. width - 20'		SM		401.2		0.5	1.0	10	3"	
402	2000' u.s. Fr. culvert	0.0	0.4	Sand, cse. grn., sl/G. W., lse., granitic, bedload, tan-gray		SW		402.1		0.0	0.4			
	℄ channel	0.4	1.5	Sand, cse. grn., sl/G., W., mod. dns., bedload, gray		SW		402.2		0.4	1.5			
	(244+00)	1.5	2.0	Gravel, S., cse. grn., sl/cbl., lse., tan-gray Ch. width - 20'		GP		402.3		1.5	2.0			
403	3000' u.s.	0.0	0.4	Sand, cse. grn., lse., bedload, tan-gray (like 402.1)		SW								
	Fr. culvert	0.4	0.8	Sand, cse. grn., mod. dns., bedload, gray (like 402.2)		SW								
	℄ channel	0.8	1.0	Sand, sl/C., M., G., sl/cbl., med., wea. granite, red		SM		403.1		0.8	1.0			
	(234+00)	1.0	+	Granite, Hd. 5, frac., gray Ch. width - 15'										
				Note: At point of discharge into natural wash, rock at surface is moderately fractured, gray granite (Hd. 5). Should withstand flows with only minor plucking. Ch. width - 7'										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

USDA-SCS-HYATTSVILLE, MD. 15

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SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO 156

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION: 50' u.s. fr. Bush Hwy., Outlet (Natural Wash)

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
401.1	0.0 - 0.5		

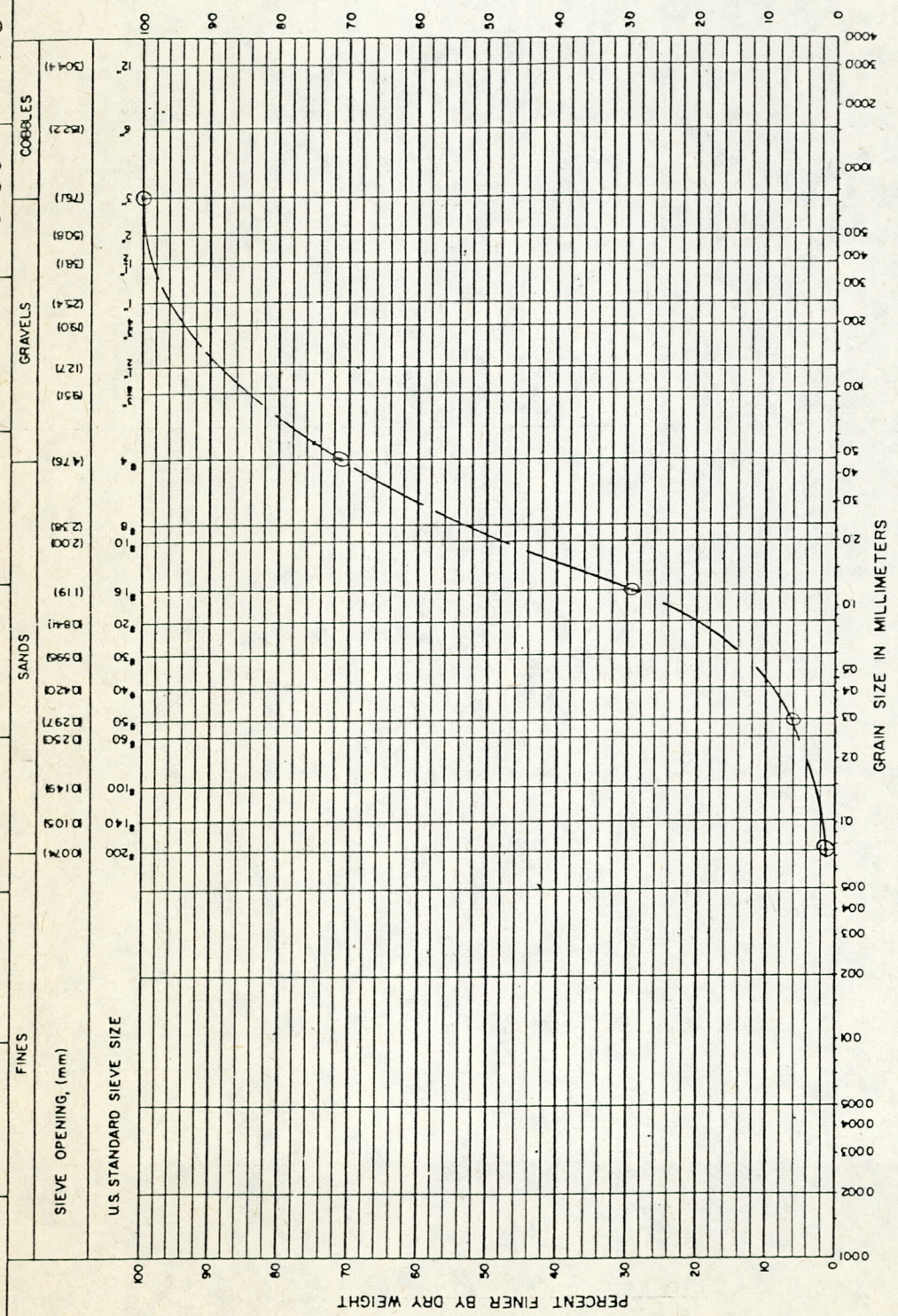
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
D	Phoenix	DC	7/8/75

SYMBOL: SW

DESCRIPTION: Loose, gravelly, granitic sand (bedload)

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
.47		1.5	2.2 mm	3.0 mm			6.38	1.6



UNDISTURBED CONDITION: DRY UNIT WEIGHT g/cc pcf; MOISTURE %

SHRINKAGE LIMIT %

SOLUBLE SALTS %

ATTERBERG LIMITS: NATURAL MOISTURE LL PI; AIR DRY LL PI; OVEN DRY LL PI

SPECIFIC GRAVITY (G_s): (-) #4 (+) #4

D_{75} = 5.8 mm

REMARKS:

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO 157

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION: 50' u.s. fr. Bush Hwy. culvert; & Channel (nat. wash)

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
401.2	0.5-1.0	

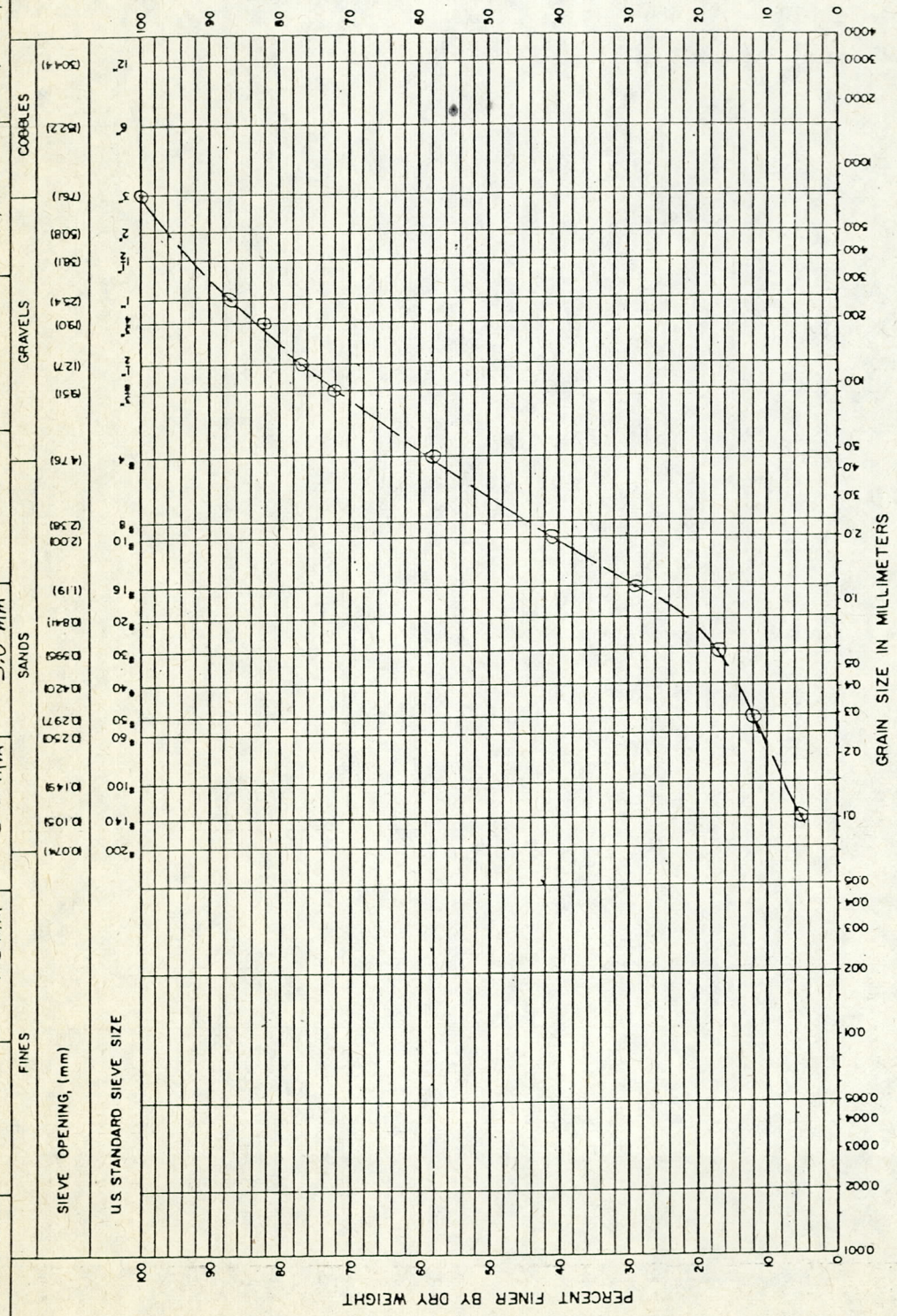
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
D	Phoenix	CDC	7/9/75

SYMBOL: SW-SM

DESCRIPTION: Loose, gravelly, slightly silty, dense sand (old bedload)

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
.22 mm		1.3 mm	3.2 mm	5.0 mm			22.7	1.54



UNDISTURBED CONDITION: MOISTURE %; DRY UNIT WEIGHT g/cc pcf

SHRINKAGE LIMIT %

SOLUBLE SALTS %

ATTERBERG LIMITS: NATURAL MOISTURE LL PI; AIR DRY LL PI; OVEN DRY LL PI

SPECIFIC GRAVITY (G_s): (+) #4; (-) #4

REMARKS: D_{75} = 12 mm

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO _____

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION: 2000' u.s. fr. Bush Hwy. culvert; ℄ Channel (nat. wash)

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
402.1	0.0-0.4	

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
D	Phoenix	CDC	7/9/75

SYMBOL: SW

DESCRIPTION: Loose, gravelly, granitic sand (bedload)

GRAIN SIZE DISTRIBUTION

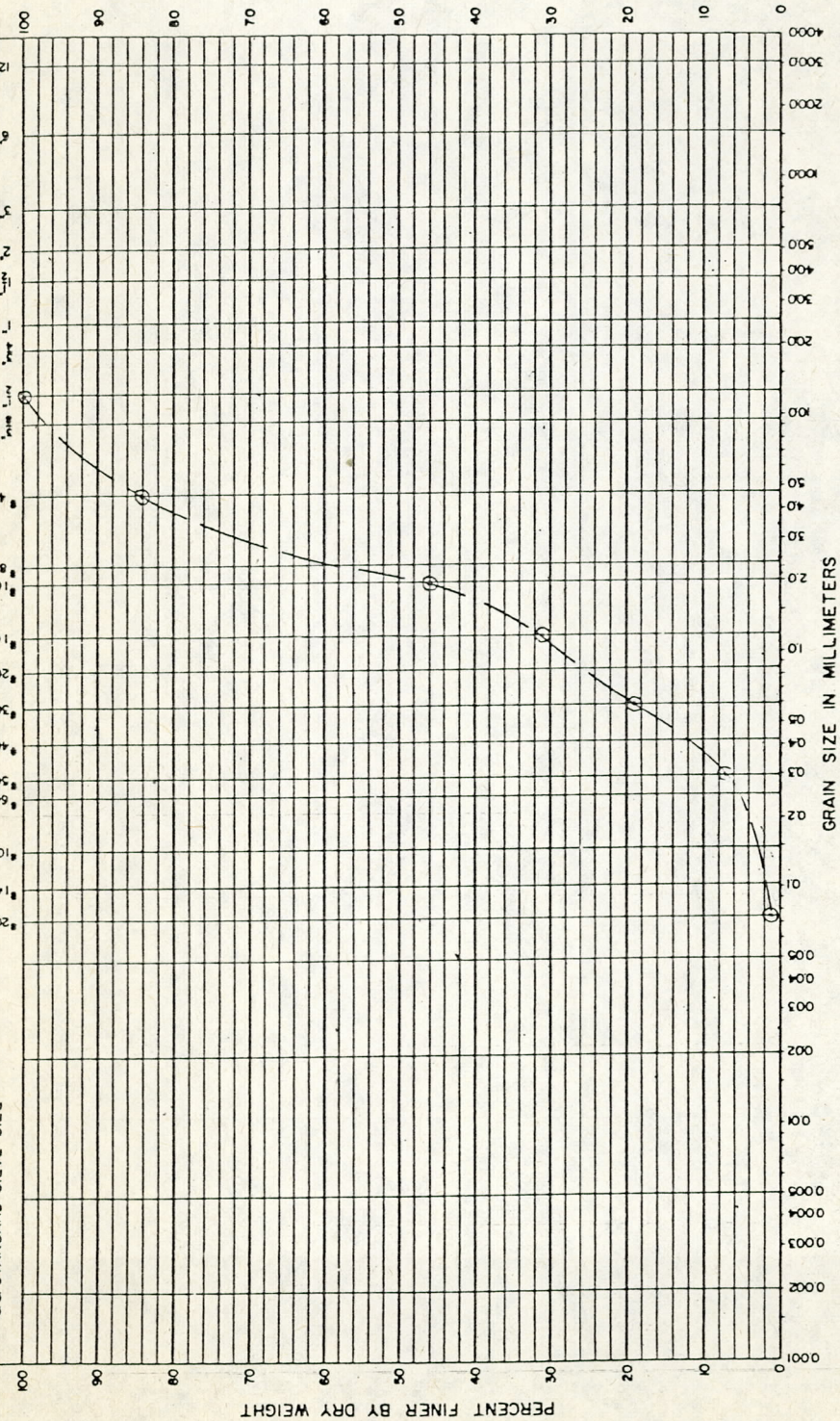
C_c 1.56

C_u 6.75

D_{MAX} | D_{85} | D_{60} 2.5 mm. | D_{50} 2.2 mm | D_{30} 1.2 mm | D_{15} | D_{10} 0.37 mm

COBBLES | GRAVELS | SANDS | FINES

SIEVE OPENING, (mm) — U.S. STANDARD SIEVE SIZE



UNDISTURBED CONDITION: MOISTURE %; DRY UNIT WEIGHT g/cc, pcf

SHRINKAGE LIMIT %

SOLUBLE SALTS %

ATTERBERG LIMITS: NATURAL MOISTURE, LL, PI; AIR DRY, LL, PI; OVEN DRY, LL, PI

SPECIFIC GRAVITY (G_s): (+) #4, (-) #4

REMARKS: D_{75} = 3.4 mm

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

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LABORATORY NO

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

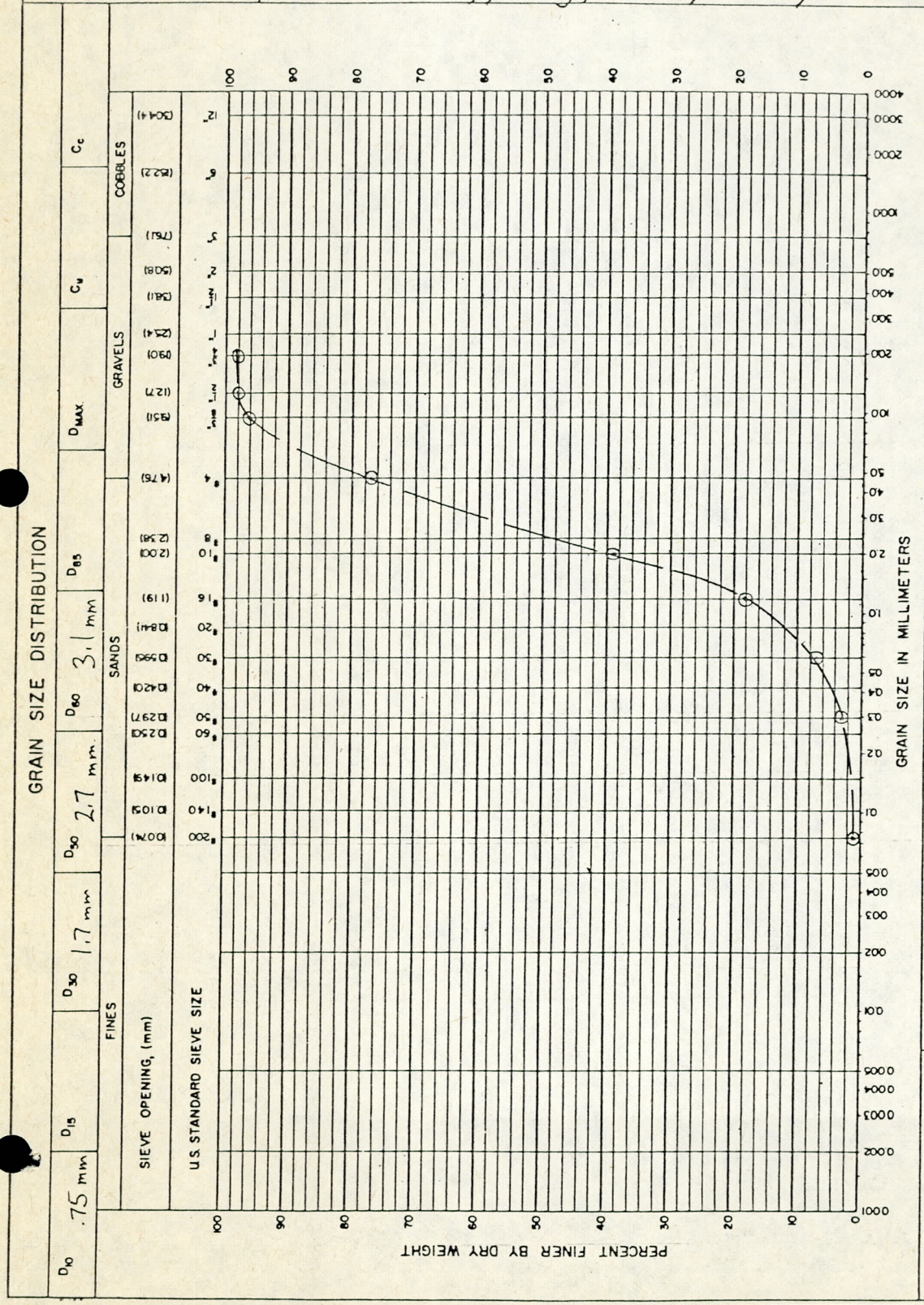
SAMPLE LOCATION: 2000' u.s. fr. Bush Hwy. culvert; ℄ Channel

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
402.2	0.4-1.5	

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
D	Phoenix	CDC	7/9/75

SYMBOL

DESCRIPTION: Loose, gravelly, moderately dense granitic sand (bedload)



UNDISTURBED CONDITION: MOISTURE %; DRY UNIT WEIGHT g/cc, pcf

SHRINKAGE LIMIT %

SOLUBLE SALTS %

ATTERBERG LIMITS: NATURAL MOISTURE, LL, PI; AIR DRY, LL, PI; OVEN DRY, LL, PI

SPECIFIC GRAVITY (G_s): (+) #4, (-) #4

REMARKS: D_{75} = 4.4 mm.

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

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LABORATORY NO

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION: 2000' U.S. fr. Bush Hwy. culvert; & Channel (nat. wash)

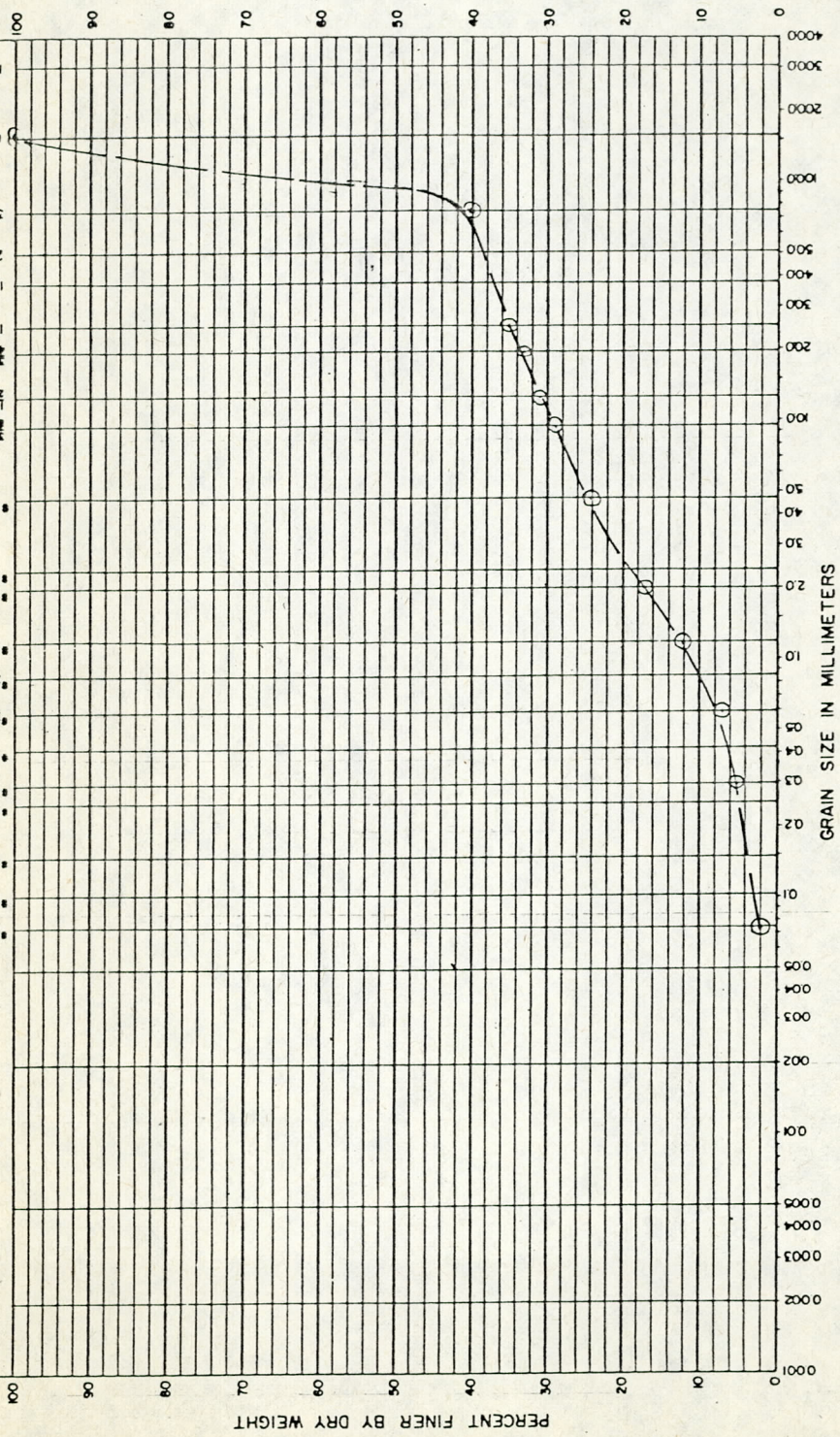
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN		
402.3	1.5-2.0			
TYPE OF SAMPLE	TESTED AT	APPROVED BY		DATE
D	Phx.	COC		7/11/75
SYMBOL GP	DESCRIPTION			

GRAIN SIZE DISTRIBUTION

D_{10} D_{15} D_{30} D_{50} (3.5 in) 90 mm D_{60} D_{85} D_{MAX} C_u C_c

FINES | SANDS | GRAVELS | COBBLES

SIEVE OPENING, (mm) | U.S. STANDARD SIEVE SIZE



UNDISTURBED CONDITION: MOISTURE %; DRY UNIT WEIGHT g/cc pcf

SHRINKAGE LIMIT %

SOLUBLE SALTS %

ATTERBERG LIMITS: NATURAL MOISTURE, LL, PI; AIR DRY, LL, PI; OVEN DRY, LL, PI

SPECIFIC GRAVITY (G_s): (+) #4, (-) #4

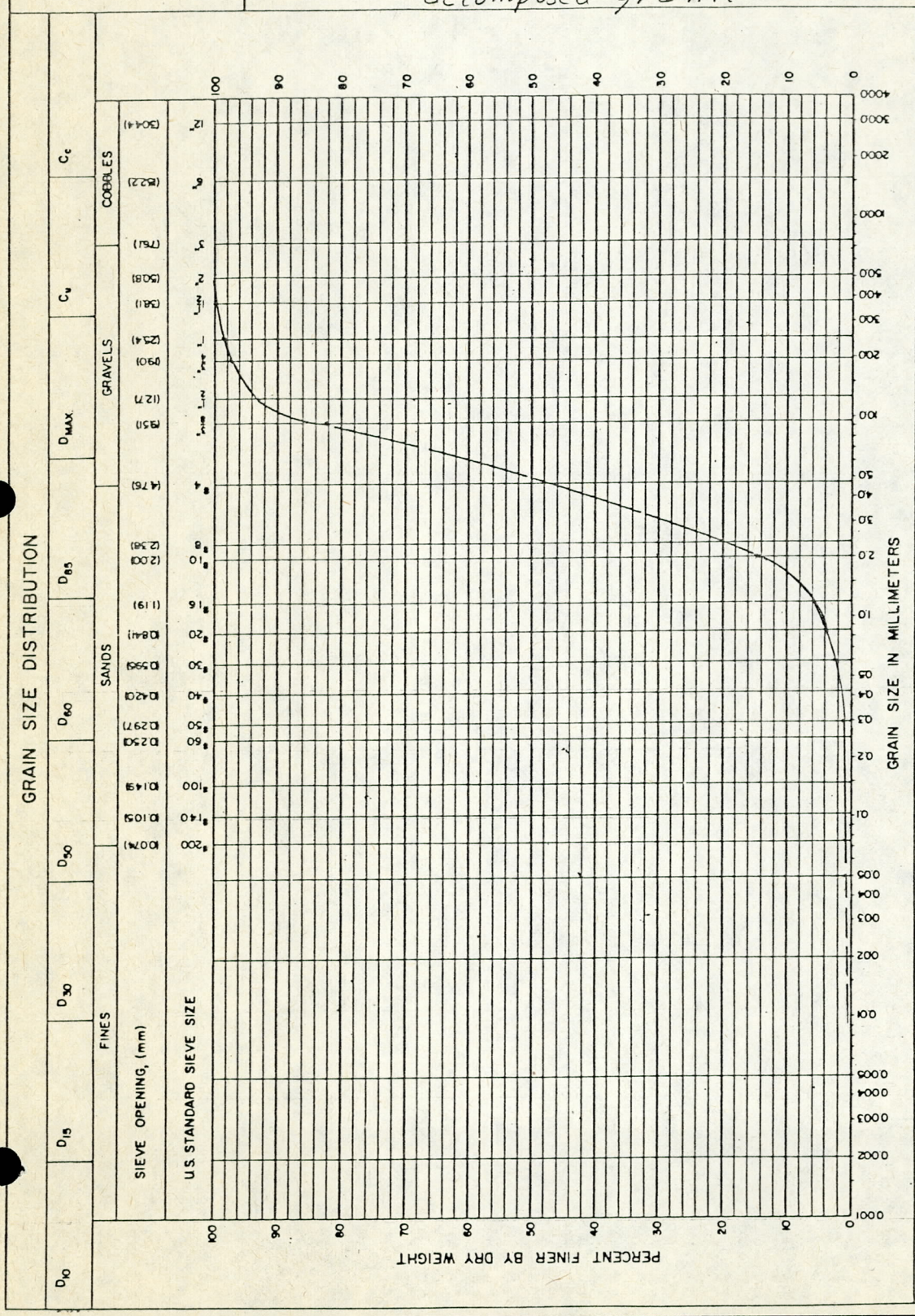
REMARKS:

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO 161

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa Ws. Spook Hill FRS site			SAMPLE LOCATION: Floodway
FIELD SAMPLE NO.: 3301	DEPTH: 6.0-8.0	GEOLOGIC ORIGIN: Precambrian Granite	
TYPE OF SAMPLE: Dist.	TESTED AT: Phx.	APPROVED BY:	DATE: 5/19/76
SYMBOL: —	DESCRIPTION: decomposed granite		



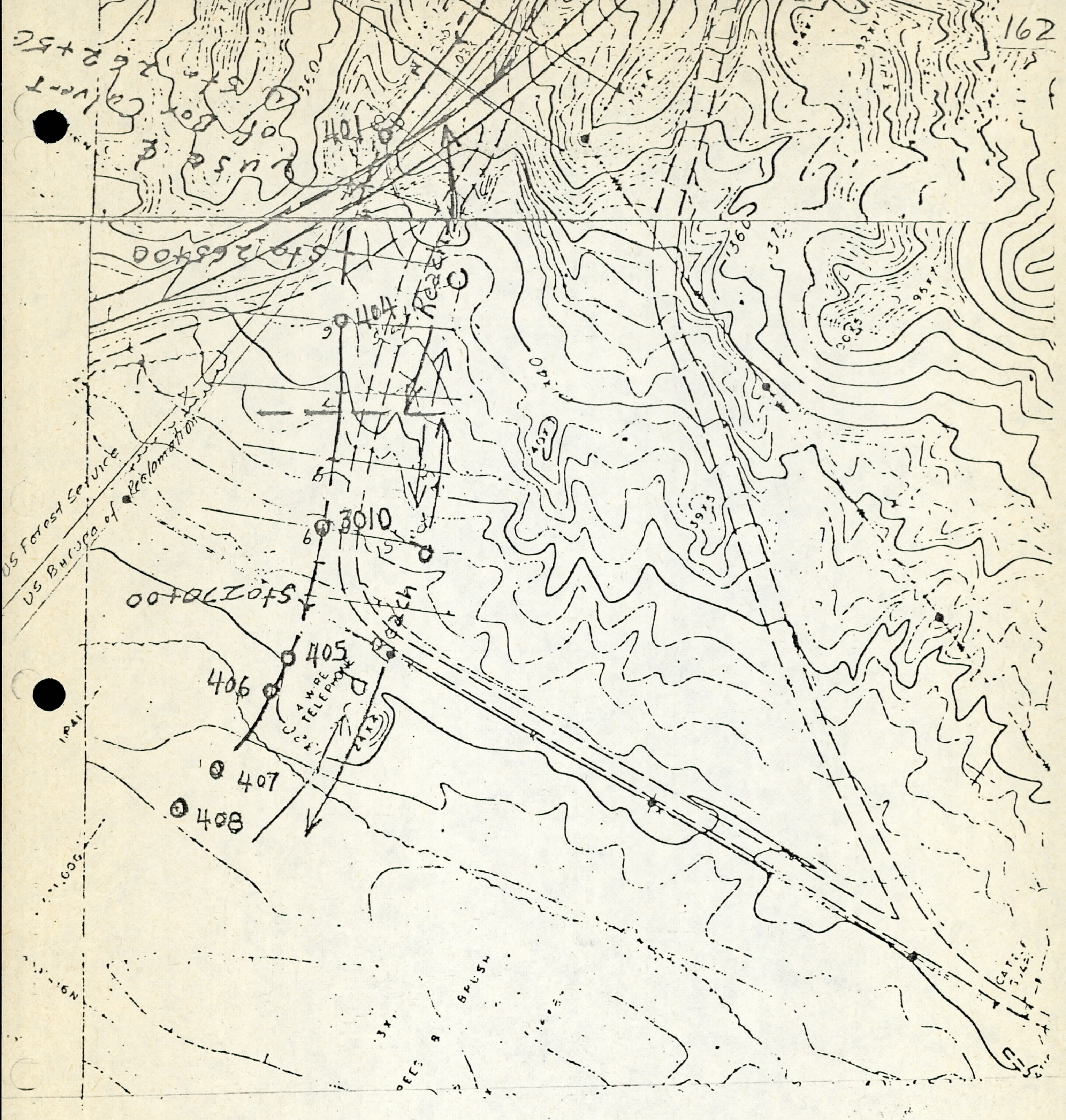
UNDISTURBED CONDITION		
MOISTURE	%	
DRY UNIT WEIGHT	g/cc	pcf

SHRINKAGE LIMIT	%
SOLUBLE SALTS	%

ATTERBERG LIMITS	NATURAL MOISTURE		AIR DRY		OVEN DRY	
	LL	PI	LL	PI	LL	PI

SPECIFIC GRAVITY (G_s)	(+) #4	(-) #4

REMARKS:



SPOOK HILL FRS SITE
LOCATION OF BORINGS
NATURAL WASH (OUTLET)
Alternate No. 1

CDC
7/10/75

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

STATE	PROJECT			
Az	Buckhorn Mesa WPP - Spook Hill Floodway			
BY A.C.	DATE 7-20-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Bid Schedule				SHEET 1 OF 1

Item #	Work or Material	Spec. No.	Quantity	Unit	Unit price	Amount
1	Clearing Grubbing + Chipping	2	34.6	Ac.		
2	Clearing + Grubbing	2	18.3	Ac.		
3	Mobilization	8	1	L.S.		
4	Stripping, Common	21	50,000	C.Y.		
5	Channel Excavation Unclassified	21	412,000	C.Y.		
6.	Structure Excavation, Unclassified	21	1,170	C.Y.		
7.	Overhaul	21	455,000	C.Y. Miles		
8.	Structure Backfill	23	1,050	C.Y.		
9.	Embankment Earth Fill	23	37,600	C.Y.		
10.	Dike Earth Fill	23	16,400	C.Y.		
11.	Top Soil Stockpiling	23	42,500	C.Y.		
may shrink → 12.	Embankment Earth Fill Stockpiling	23	270,000	C.Y.		
13.	Rock Riprap Stockpiling	25	5,000	C.Y.		
14.	Rock Fill Stockpiling	25	10,000	C.Y.		
15.	24" Corrugated Metal Pipe	51	202	Ft.		
16.	30" Corrugated Metal Pipe	51	476	Ft.		
17.	Special Fittings	51	67.5	Ft.		
18.	Loose Rock Riprap	61	7,140	C.Y.		
19.	Grouted Rock Riprap	61	325	C.Y.		
20.	Fencing	92	12,700	Ft		
21	Salvaging and Stockpiling Cactus	?	?	?		

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 176

STATE		PROJECT		
ARIZONA		BUCKHORN MESA WPP - SPOOK HILL Floodway		
BY A.C.	DATE 7-19-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Quantity changes				SHEET 12 OF 12

Clearing, grubbing and chipping $\frac{1,361,380}{43560} = 31.25$

$\frac{200 \times 500}{43560} = 2.30$ 34.55

clearing and grubbing 3.72 + 9.18 + 5.38 18.28

Embankment Earth Fill 345,000 - 5000 - 20,000 = 320,000

estimated* solid rock vol.

15% shrink gives 270,000 (15% shrinkage on top soil also.)

Re added pipe lengths 24" 200'
30" 474'
extra 67.5'

Overhaul

1000' from C.M. of stock pile ≈ STA

estimate from origional to finish grade to C.M of two stockpile areas

CM is 1000 ft from Sta 100+00

756'	×	33,186 c.y.
2150'	×	30,269 c.y.
3450'	×	31,864 c.y.
4150	×	17,520
4585	×	36,490
5035	×	24,270
5225	×	2959
5600	×	41,003
6335	×	49,615
7135	×	24,514
8325	×	29,237
9545	×	39,575
10,380	×	46,446

* A detailed analysis of excavated quantities is being made for determining materia avaliable for the dam. Quantit will be reevalvated at that time

2,399,858,736/5280 = 454,518.7 cy miles

Extra Rock Riprap - 35' wide Sta 187+40 - 189+90 both sides
and Sta 185+80 - 186+60 left

(√5 (70) + 6) (250' + 250' + 80')/27 = 1,090 c.y. Total 7,140 c.y.

COMPUTATION SHEET

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U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

☆ GPO: 1969—O-357-545

STATE Az		PROJECT Spook Hill Floodway	
BY A.C.	DATE 7-2-76	CHECKED BY	DATE
		JOB NO. 2005	
SUBJECT Bid Schedual		SHEET 1 OF 1	

Item #	Work or Material	Spec. No.	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	2	52	Acres		
2	Mobilization	8	1	L.S.		
3	Channel Excavation, Unclassified	21	412,000	C.Y.		
4	Structure Excavation	21	2,240	C.Y.		
5	Structure Backfill	23	2,140	C.Y		
6	Embankment Earthfill	23	54,000	C.Y.		
7	Salvaging Topsoil	26	50,000	C.Y.		
8	24" Corrugated Metal Pipe	51	200	Ft.		
9	30" Corrugated Metal Pipe	51	525.5	Ft.		
10	Loose Rock Riprap	61	6,050	C.Y.		
11	Grouted Rock Riprap	61	325	C.Y.		
12	Fencing	92	12,700	Ft.		

Subsidiary Items

Item #1 add Structural Removal Spec. #3
Item #12 add Concrete for Minor Structures Spec. #32

Material Specs. 521, 522, 523, 531, 551, 591, RR-F-221(G/GEN, 1, 3)

extras - Landscape salvaging of Topsoil
✓ stockpiling
✓ geology report
cactus salvaging

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO:1969—O-357-545

STATE	PROJECT		
A7	SPOOK HILL FLOODWAY		
BY: A.C.	DATE: 6-23-76	CHECKED BY	DATE	JOB NO.
SUBJECT: Quantities - Rip Rap			SHEET 1 OF 12

4 groups - channel protection, pipes, weirs, dikes (grouted rock seperate)

1. Channel protection $[\sqrt{5}(D-15)+6](S_2-S_1)/27$

CU yds

$(\sqrt{5}(15)+6)(110+30-109+30)/27 =$ 146.45

$6\times(\sqrt{5}(15)+6)(14)/27 =$ 123.02

$(\sqrt{5}(15)+6)(16)/27 =$ 23.43

$2\times(\sqrt{5}(15)+6)(400)/27 =$ 1171.59 (weir included)

$2\times(\sqrt{5}(20)+6)(110)/27 =$ 413.29 (weir included)

$(\sqrt{5}(20)+6)(14)/27 =$ 26.30

= 1,904.08
(add to total excavation)
-304.7
1599.4 cu yds

2. Dikes

Inlet No. 23

$(225') \times 10\sqrt{5}/27 =$

$(150') \times 8\sqrt{5}/27 =$

$35' \times 14\sqrt{5}/27 =$

$40 \times 10\sqrt{5}/27 =$

$2 \times 35' \times 22\sqrt{5}/27 =$

= 486.97

Sed. Basin

$852' \times 16 \times \sqrt{5}/27$ $\quad$ $130' \times 12\sqrt{5}/27$

$85' \times 90' \times 2'/27$ $\quad$ $90' \times 13\sqrt{5}/27$

$140' \times 22' \times \frac{\sqrt{17}}{2}/27$

$60' \times 150' \times 2'/27$

= 2,823.56

STATE		PROJECT		
AZ		SPOOK HILL FLOODWAY		
BY A.C.	DATE 6-23-76	CHECKED BY	DATE	JOB NO.
SUBJECT Quantities - Riprap				SHEET 2 OF 12

3 Pipe inlets

Loose $[(16' \times 1' \times \sqrt{5}/4 \times D) + 60]/27$

grouted $(4 \times 1 \times \sqrt{5}/4 \times D)/27$

D values (19, 19, 20, 17, 20, 32, 34, 44, 37, 36, 36, 36, 38, 40) $\Sigma = 428$

Cu yds

Loose rock riprap $= \frac{428 \times 16 \times \sqrt{5}}{4 \times 27} + \frac{60 \times 14}{27} =$ 172.89

grouted rock riprap $\frac{\sqrt{5} \times 428}{27} =$ 35.45 cu yds

(add to total excavation)

4 Weir Inlets $D = 2(\text{Elev A} - \text{Elev B})$

Loose $\left[W\left(36 + D\frac{\sqrt{5}}{2}\right) + 4(D\sqrt{5} + 6) + 18 \times 2(6\sqrt{2} + 2)\right]/27$

grouted $W \times D \times \sqrt{5}/2$

Inlet,	D	W	grouted	loose
1	20.3	80		691.68
7	27.6	10		119.79
10	38.4	10		153.78
11	39.4	10		
12	38.8	10		
13	38.0	10		
21	38.8	12		
22	22.4	10		
23	17.6	70	both volumes already computed in 1, take out of one 304.7	
24	18.4	70		
25	32.4	10		

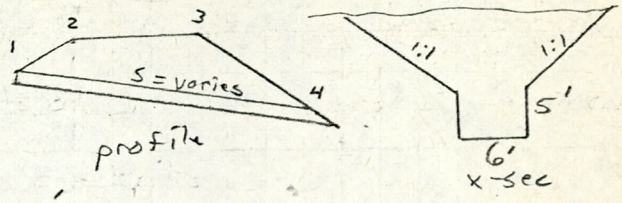
289 cu yds 965.26 cu yds

add to total excavation

Add also - slope cuts $\frac{1}{2} W \times \text{warp} \times D\sqrt{5}/4$ total for both 116.56 cu yds

STATE ARIZONA	PROJECT BUCKHORN MESA WPP - SPOOK HILL Floodway		
BY A.C. / DATE 7-22-76	CHECKED BY	DATE	JOB NO.
SUBJECT Quantities - Pipe Inlets			SHEET 3 OF 12

Structure Excavation



Excavation will be based on average end areas at 1, 2, 3 and 4 (Area at 4 = 0)

Depth at 2 = (Existing elev. - 1') - (Road elev - 5' - D) + 6S
= 6S + 5' + D' - 1 - ΔE

ΔE = (road elev - existing ground elev)
if ΔE is neg d at 2 = d_1 + 3 + 6S
d at 3 = d_1 + 3 + 20S

Depth at 3 = 20S + 5 + D - 1 - ΔE

distance 1 to 2 = 7.5' distance

Depth at 1 = 2' + D'(-1 - ΔE)

distance 1 to 3 = 14'

distance 3 to 4 = 2(~~Road elev.~~ + $\overbrace{5+D}^{d_1+3}$ + lS)

INLET	D	S	Road elev	Exist Elev	ΔE	d_1	d_2	d_3	l	l_{34}
2	24	.001	1578.7	1580	—	4	7	7	36	14.1'
3	24	.001	1577.9	1578	—	4	7	7	36	14.1'
4	24	.001	1577.6	1576	1.6	1.4	4.4	4.4	36	14.1'
5	30	.001	1576.8	1573	3.8	0	2.1	2.1	34	15.1'
6	24	.001	1578.6	1578	.6	2.4	5.4	5.4	34	14.1'
8	30	.1225	1584.7	1584	0.7	2.8	6.5	8.3	48	27.8'
9	30	.1338	1585.2	1586	—	.4	7.8	9.7	50	28.9'
14	30	.1732	1586.8	1586	.8	2.7	6.7	9.2	56	32.4'
15	30	.1739	1586.5	1586	.5	3.0	7.0	9.5	56	34.5'
16	30	.1763	1586.3	1587	—	4.5	8.5	11.0	56	29.3'
17	30	.1852	1586.1	1588	—	4.5	8.6	11.2	56	35.7'
18	24	.1974	1586.0	1585	1.0	2	6.2	9.7	58	36.9
19	30	.1979	1585.8	1585	.8	2.7	6.9	9.7	58	32.0
20	30	.2057	1585.6	1584	1.6	1.9	6.1	9.0	60	33.7

COMPUTATION SHEET

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SOIL CONSERVATION SERVICE

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STATE ARIZONA		PROJECT BUCKHORN MESA WPP - SPOOK HILL FLOODWAY	
BY A.C.	DATE 7-22-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Quantities - Pipe Inlets			SHEET 4 OF 12

INLET	A_1 (ft^2)	A_2 (ft^2)	A_3 (ft^2)	A_4 (ft^2)	Volume (ft^3)	Total (cu yds)
2	24	46	46	0	1,454.3	
3	24	46	46	0	1,454.3	
4	8.4	26.4	26.4	0	818.5	
5	0	12.6	12.6	0	509.7	
6	14.4	32.6	32.6	0	1,022.8	
8	16.8	62.7	62.7	0	2,364.0	
9	24	56.6	82.3	0	2,820.0	
14	16.2	52.8	74.8	0	2,694.8	
15	18	46	79.25	0	2,811.6	
16	27	65.3	104.0	0	3493.5	
17	27	66.6	107.6	0	3943.5	
18	12	40.6	82.3	0	2905.2	
19	16.2	47.0	82.3	0	2799.4	
20	11.4	39.8	72.0	0	2484.8	

31,576.4 /27 = 1169.5

total Struct. Exc.

$$\frac{A_1+A_2}{2}6 + \frac{A_2+A_3}{2}20 + \frac{A_3+A_4}{2}\ell_{34} = \text{Volume}$$

volume of pipe = $A_p(26+\ell_{34})$

2' diam A = 3.14 ft

2.5' " A = 4.91

24" (not pipe length)

$\Sigma\ell = \Sigma\ell_{34} + 26(5) = 93.3 + 130$

$= 223.30$

V = 701.52 cuft = 26.0 cu yds

30" not pipe length

$\Sigma\ell = \Sigma\ell_{34} + 26(9) = 269.4 + 234$

$= 503.4$

V = 2,471.69 cuft = 91.54 cu yds

Total Struct. Backfill 1051.97

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 169
GPO:1969—O-357-545

STATE	PROJECT		
A 7	SPOOK HILL FLOODWAY		
BY: AE	DATE: 6-23-76	CHECKED BY	DATE	JOB NO.

SUBJECT: Quantities – Clearing and Grubbing

SHEET 5 OF 12

		sq ft	
Sta 101+12 to 102+72	30' width to 95' width	A 10,000	
Sta 102+72 to 105+00	95' width to 100'	22,230	
Sta 105+00 to 110+00	133' to 138'	67,750	
Sta 110+00 to 115+00	138' to 131	67,250	
Sta 115+00 to 120+00	131 to 133	66,000	
Sta 120+00 to 125+00	133 to 127	65,000	
Sta 125+00 to 130+00	127 to 130	64,250	
Sta 130+00 to 133+50	130 to 142	47,600	
Sta 133+50 to 140+00	142 to 150	94,900	
Sta 140+00 to 145+00	150 to 178	82,000	
Sta 145+00 to 150+00	178 to 170	87,000	
Sta 150+00 to 155+00	170 to 168	84,500	
Sta 155+00 to 160+00	168 to 162	82,500	
Sta 160+00 to 167+50	162 to 154	118,500	
Sta 167+50 to 175+00	154 to 136	108,750	
Sta 175+00 to 180+00	136 to 139	68,750	
Sta 180+00 to 187+00	139 to 139	97,300	
Sta 187+00 to 192+00	139 to 150	72,250	
Sta 192+00 to 193+00	150 to 128	13,900	
Sta 193+00 to 196+00	128 to 145	40,950	1,361,380
Sta 196+00 to 202+00	145 to 170	94,500	
Sta 202+00 to 205+00	170 to 118	43,200	
Sta 205+00 to 208+00	118 to 44	24,300	1,523,380

Clearing and Grubbing 34.97 Ac + Stockpile areas + sediment basin + inlets

Salvaged top soil 52,421.49 cu yds

top soil

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 170
☆ GPO: 1969—O-357-545

STATE Az		PROJECT Spook Hill Floodway		
BY A.C.	DATE 7-1-76	CHECKED BY	DATE	JOB NO.
SUBJECT Quantities -(Catch all)				SHEET 6 OF 12

Fencing - (length)

right Side Sta 107+29 to 205+50 — 9,821 ft
left Side Sta 184+00 to 205+50 — 2,150 ft

less open fence at Thomas Road — -50 ft
fence to get to maintenance roads at Thomas Road — 288 ft
end fence at Sta 205+50 — 135 ft

Replaced Fences at Sed. Basin — 350 ft
12,694 ft

12,700 ft

Pipe - (length)

ΣL @ 24" = 200' — 24" pipe — 200'
ΣL @ 30" = 458' — 30" — 525.5'

risers $\Sigma\ 2.5 + \frac{D''}{12} = 67.5'$ ⇐ all 30"

Clearing and Grubbing

Floodway - 34.97 Ac (see Sheet 4) — 34.97 Ac

Stockpile Areas $\left(\frac{1000 \times 400 + 500 \times 200}{43560}\right)$ — 11.48 Ac

Sediment basin and Diver. Dikes (Sta 184+00±) $\left(\frac{1000 \times 180 + 200 \times 50 + 520 \times 40 + 200 \times 60 + 250 \times 50}{43,560}\right)$ — 5.38 Ac
51.83 Ac

use 52 Ac

Riprap - Summation from sheets 1 and 2

loose rock riprap — 6,048 cu yds
(Total Rock 6,373)

grouted rock rip rap — 325 cu yds

Excavation for rock at pipes + weirs - does not include roadways weir openings, dikes, or sed. basin

3,179 cu yds

COMPUTATION SHEET

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U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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GPO:1969—O—357-545

STATE		PROJECT		
A Z.		SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	7-2-76			

SUBJECT Quant. Clearing and Grubbing and Top Soil for Cut+Fill

SHEET 7 OF 12

	Dist	cut	sq ft	fill	Sq ft
101 + 12		0		0	
	167		7,598.5		0
102 + 79		91'		0	
	321'		29532.0		6,708.9
106+00		93.0		41.8	
	150'		13,792.5		6,450.0
107+50		90.9		44.2	
	50'		4,402.5		2,295.0
108+00		85.2		47.6	
	200'		17,280.0		8,98.0
110+00		87.6		42.2	
	300'		28,380.0		12,390
113+00		101.6		40.4	
	100'		12,190		2,020
114+00		142.2		0	
	200'		24,420		3,100
116+00		102.0		31.0	
	300'		30,420		9,150
119+00		100.8		30.0	
	100'		10,890		2340
120+00		117.0	(178,905.5)	16.8	(53,433.9)
	200'		20,160		6,080
122+00		84.6		44.0	
	100'		7,110		5,500
123+00		57.6		66.0	
	100'		6,960		5,520
124+00		81.6		44.4	
	100		7,880		4,880
125+00		76.0		53.2	
	200'		13,980		10,980
127+00		63.8		56.6	
	200'		12,660		11,960
129+00		162.8		63.0	
	250		18,375		12,625
131+50		84.2		38.0	
	150'		15,180		2,850
133+00		118.2		0	
	200'		21,380		3,900
135+00		95.6		39.0	
	150'		17,820		2,925
136+50		142.00		0	
	250'		36,175		0
139+00		147.4		0	
	250'		40,125		0

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U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE 172

☆ GPO: 1969—O—357-545

STATE		PROJECT		
Az.		SPOOK HILL FLOODWAY		
BY	DATE	CHECKED BY	DATE	JOB NO.
A.C.	7-2-76			

SUBJECT Quant. Clearing and Grubbing etc Cont.

SHEET 8 OF 12

	Dist.	Cut.	sq ft	Fill	sq ft
141+50		173.6		0	
	300'		52,560		0
144+50		176.8		0	
	170'		26,826		1,836
146+20		138.8		21.6	
	250'		37,225		4,575
148+70		159.0		15.0	
	260'		42,640		1,950
151+30		169.0		0	
	200'		33,700		0
153+30		168.0		0	
	170'		29,087		0
155+00		174.2		0	
	100'		15,350		900
156+00		137.8		18.0	
	240'		37,008		2,160
158+40		175.6		0	
	260'		40,846		2,444
161+00		138.6		18.8	
	200'		30,980		3,480
163+00		170.4		16.0	
	160'		25,024		2,592
164+60		142.4		16.4	
	260'		36,218		4,784
167+20		136.2		20.4	
	260		31,096		8,138
169+80		103.0		42.2	
	200		18,100		10,700
171+80		78.0		64.8	
	180		14,562		10,062
173+60		83.8		47.0	
	240'		22,248		10,488
176+00		101.6		40.4	
	210		24,591		6,132
178+10		132.6		18.0	
	220		26,708		4,532
180+30		110.2		23.2	
	270		28,053		9,315
183+00		97.6		45.8	
	265		28,858.5		8,506.5
185+65		120.2	25,858.5	18.4	
	265'		26,611.5		10,626.5
188+30		58.0		61.8	
	270'		25,407		10,368

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO: 1969—O-357-545

STATE	PROJECT		
A7	Spook Hill Floodway		
BY: A.C.	DATE: 7-2-76	CHECKED BY	DATE	JOB NO.

SUBJECT: Quant. Clearing and Grubbing etc. cont.

SHEET 9 OF 12

	Dist.	Cut	sq ft	cut	sq ft
191+00		130.2		15.0	
	200'		21,300		6,120
193+00		82.8		46.2	
	200		17,660		9,760
Total 195+00		93.8	(1,086,289.5)	51.4	(250,122.9)
	245'	[add	8,830 to 196+00]		[add 4,880 to 196+00]
197+45		112.0	(25,823)	50.6	(12,495)
	245'		25,786.25		13,389.25
199+90		93.5		58.7	
	210'		27,457.5		6,163.5
202+00		168.0		0	
	300'		41,400		0
205+00		108.0		0	
	200		18,770		0
207+00		79.7		0	
	110		4,383.5		0
208+10		0		0	
			1,229,909.75		282,170.65 sq ft

Take away from excavation 1,095,119.5 cu ft = 40,560.0 cu yds

Add to fill Volume 255,002.9 cu ft = 9,444.6 cu yds

Total Top Soil 50,004.5 cu yds (previous est. 50,421)

Total Area 1,512,080.4 sq ft = 34.71 Ac (previous estimate 34.97 Ac)

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 174
☆ GPO : 1969—O-357-545

STATE A7		PROJECT SPOOK HILL FLOODWAY		
BY A.C.	DATE 7-2-76	CHECKED BY	DATE	JOB NO.
SUBJECT Quantities Earth Work				SHEET 10 OF 12

Results of Monroe 1880 Program - Volumes by average Area

STATION TO STATION	Cut Vol	Fill Vol.
101+12 TO 114+00	34,740.95	1,555.44
114+00 TO 129+00	34,142.0	3,872.97
129+00 TO 140+00	33,657.47	1,792.74
140+00 TO 143+00	17,534.54	14.56
143+00 TO 148+70	36,570.72	80.72
148+70 TO 152+00	24,270.07	0.00
152+00 TO 152+50	3,016.70	58.13
152+50 to 159+50	41,214.15	211.15
159+50 to 167+20	49,727.01	112.32
167+20 to 175+50	28,906.32	4392.02
175+50 to 191+00	36,710.18	7,473.41
191+00 to 199+90	44,413.83	4,838.76
199+90 207+70	47,136.99	691.06
	432,040.93	25,093.28
minus top soil already excavated	40,560.0	plus top soil removed 9,444.6
	391,480.93	34,537.88
additional excavation in channel for rock protection	3,179	
	394,660	
minus rock for rip rap	6,048	
	388,612	

STATE Az.		PROJECT Spook Hill Floodway		
BY A.C.	DATE 7-2-76	CHECKED BY	DATE	JOB NO.
SUBJECT Quantities - Earthwork				SHEET 11 OF 12

Additional Cuts and Fills

Road Ramps - 14' x length x height

$14(112 \times 11.2 + 112 \times 11.2 + 131 \times 13.1 + 131 \times 13.1)/27 =$ 1,779.66 cu yd (cut)

Diversion Dikes

cut $(250' \times 2' \times 40' + 200' \times 2' \times 30' + 40' \times 60' \times 2')/27 =$ 1,333.33 cu yd (cut)

fill $(250' \times 22 \times 4 + 200 \times 18 \times 4)/27 + 1{,}333.33 =$ 2,681.48 (fill)

Weirs - usually minus fill (minor - no need to analyze)

$\Sigma W \times \approx 20' =$ -223.7 cu yds (-fill)

Sediment Basin

fill $9' \times 28' \times 1756.24'/27 =$ 16,391.57 cu yd (fill)

cut $2' \times 35' \times 1756.24/27 =$ 4,553.21 (cut)

cut $880 \times 120 \times 4.0'/27 =$ 15,644.44 (cut)

Basin cut v.s. fill 20,197.65 cu yds v.s. 16,391.57 fill

no haul would be necessary if 23% compaction

(rock haul will be necessary)

Total Cut = 411,923 cu yds 412,000

Total Fill = 53,388 cu yds 54,000

Stockpile Volume = (Cut - 1.25 fill) = 345,188 cu yds 345,000

25% compaction