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HYDROLOGIC/HYDRAULIC DESIGN ANALYSIS OF PROPOSED SUN VALLEY PARKWAY CROSSING OF THE BUCKEYE WATERSHED STRUCTURE

(REV. 1 - 8/26/87)

A211 701

Collar, Williams & White Engineering, Inc.

HYDROLOGIC/HYDRAULIC

DESIGN ANALYSIS OF PROPOSED

SUN VALLEY PARKWAY CROSSING

OF THE BUCKEYE WATERSHED STRUCTURE

REV 1 8/26/87

PREPARED BY:

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AUGUST 1987

SUN VALLEY PARKWAY-BUCKEYE WATERSHED STRUCTURE

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SUN VALLEY PARKWAY-BUCKEYE WATERSHED STRUCTURE

Introduction

This is a brief summary of the hydrologic/hydraulic design analysis of the proposed improvement of 291st Avenue (Palo Verde Road) and I-10 Interchange on the Buckeye Watershed Structure. The Buckeye Watershed Structure is a floodwater retarding dam designed and built by the Soil Conservation Service (SCS), now operated and maintained by the Flood Control District of Maricopa County. It intercepts floodwaters flowing south and southwest out of the White Tanks Mountains diverting it west to the Hassayampa River.

The structure was designed for the 100 year frequency event and has been evaluated for passage of the probable maximum flood by the Division of Dam Safety, Arizona Department of Water Resources and by the SCS. The water surface elevation for the 100 year flood retarding pool is 1079.8 feet. (SCS and ADOT Datum).

The existing crossing of the Buckeye Structure will be widened and raised slightly and enlarged culverts installed.

The existing culverts were originally just planned to be extended, however, research of SCS's design files indicated that they were only sized to pass the five year frequency event. (See appendix for SCS's Original Calculations).

The 100 year discharge crossing Palo Verde Road (291st Avenue) was never analyzed by the SCS, therefore, it was determined in our analysis. The same assumptions and similar approach to modeling the watershed were used by C.W.W. as those used by the SCS in their most recent analysis, conducted in 1980 in Response to Arizona Water Commission Phase I study of the dam safety inspection.

Methods

The Corp's HEC-1 computer program was used to model the tributary watershed. The six hour duration storm and the same precipitation amount used by the SCS was used in our model. The same average curve number of 83 was used and the maximum capacity for Floodway No. 2 of 1950 c.f.s. was used as the maximum peak flow routed from Drainage Area No. 1 to the 291st Avenue crossing, where it was combined with the peak from Area No. 2, to generate the design inflow to the area above the culverts. The area and time of concentration for subdrainage area No. 1 was taken directly from the SCS's 1980 analysis done for Dam Safety Considerations. Area 2 is the drainage area to the west

Between Area 1 and the 291st Avenue alignment. This area originates in the White Tank Mountains, therefore, the time of concentration was determined by subdividing the channel length into similar segments and calculating the time of travel for each then added together to get the total time of concentration. Area 2 was treated as one watershed, as was done by the SCS, using an average runoff curve number and total time of concentration.

Culverts were then sized using the Federal Highway Administration's HEC No. 5 procedures and utilizing the same invert elevation and zero slope as on the existing culverts. The allowable headwater depth used to size the culverts was the maximum water surface elevation of the water ponded on the upstream side of culverts obtained from HEC-1 storage routing model.

Effect on Reservoir Storage Capacity

Total reservoir floodwater-retarding capacity for the Site I reservoir area, which 291st Avenue crosses through is 6,345 acre feet. The additional fill being added within the reservoir area by the proposed parkway improvements is 37,000 cubic yards or 0.85 acre feet. This is 0.01% of the total capacity and would certainly not have any perceptable affect on the reservoir and operation of the structure.

Peak Discharge and Culvert Size Analysis

The HEC-1 Watershed Model produced a 100 year peak discharge at the 291st Avenue crossing of 6,417 c.f.s. Because of the significant reservoir storage area upstream of culverts at Palo Verde Road a flood routing procedure, with HEC-1, was used to determine the culvert design discharge value. The result was a reduction in the peak inflow from 6,417 cfs to 4,677 cfs peak outflow. The maximum water surface elevation was 77.27 and the volume of storage was 292 acre feet. Four 10 foot by 10 foot reinforced concrete box culverts are recommended for the crossing. This will provide passage of the 100 year peak discharge coming from the east without creating a backwater greater than the 100 year design water surface elevation of the structure's reservoir area (plus one foot of freeboard). The zero percent slope on the culverts will also allow free movement of water between both sides of the reservoir when the reservoir fills and actually backs water up to the east as it reaches its design capacity.

Culvert inlet and outlet protection was designed based on the outlet velocity of the culverts and the concrete lined channel outletting into the reservoir area's low flow channel just upstream from the inlet. See calculation sheets in the Appendix.

Conclusions

The proposed parkway will have a negligible effect on reservoir storage capacity and the proposed culverts will allow passage of design discharges without causing any adverse impacts on the reservoirs operations or to adjacent surrounding lands.

HYDROLOGIC DATA SUMMARY TABLE

PROJECT NAME SUN VALLEY PARKWAY **JOB NO.** 850840

HYDROLOGIC DATA SUMMARY TABLE **DATE** 4-24-87

BUCKEYE WTSD STRUCTURE AT 291st AVE

WTSD AREA	AREA SQ. MI.	CHANNEL LENGTH	TOP ELEV.	BOTTOM ELEV.	PERCENT SLOPE	Tc* (HRS)	RCCN	METHOD USED
1	6.8	-FROM	SCS	DATA	—	1.96	83	HEC-1
2a	13.71	23,700	3152	1582	6.60	0.86*	83	HEC-1
2b		38,500	1582	1070	1.33	2.33*	83	HEC-1
				COMBINED Tc		=3.29		
		Routing	Data					
1 to	291stAve	10,000 ft	n=.035		1.2%	3:1 SS	100' B.W.	Trapezoidal
2 to	291stAve	4500			1.2%	3:1 SS	100 B.W.	"

* Kirpich's Equa. Used; Velocity checked based on calc'd Tc

$$T_c \text{ (minutes)} = \frac{.04593\, L^{.77}}{S^{.385}}$$

Velocity for time of travel:

$$V \text{ (ft/sec)} = \frac{L}{T_c \times 3600}$$

V for Reach 2a = 7.6 fps

Reach 2b = 4.5 fps

Both values for respective slopes seem reasonable therefore Tc values assumed correct.

HEC-1 COMPUTER MODEL

1

****
FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1 HEC-1 INPUT PAGE 1

```
         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           1           ID   SVCP3 AND OSVCP3
           2           ID   BUCKEYE WTSHD STRUCTURE 291 ST AVE AND I-10
           3           ID   SUN VALLEY PARKWAY Q100 6 HR DURATION
*** FREE ***
                       *DIAGRAM
           4           IT       5 09APR87    1200     200
           5           IO       3

           6           KK     DA1
           7           BA    6.80
           8           PH                    0.71    1.40    2.46     2.7     2.9     3.2
           9           LS              83
          10           UD    1.17

          11           KK    DIV1
          12           DT     DIV
          13           DI       0    1200    1201    1300    1500    2000    2500    3000
          14           DQ       0       0       0       0       0      50     550    1050

          15           KK      R1
          16           RK   10000   .0012    .035            TRAP     100       3

          17           KK     DA2
          18           BA   13.71
          19           LS              83
          20           UD    1.91

          21           KK    C1+2
          22           HC       2

          23           KK ROUTINGUNDER PALO VERDE ROAD
          24           KM       FOUR BARREL 10 X 10 CBC
          25           KM       FLOW LINE @ 1065
          26           RS       1    ELEV    1064       0
          27           SQ       0     640    1320    2280    3200    4120    5000    5800
          28           SE    1064    1068    1070    1072    1074    1076    1078    1080
          29           SA       0     1.1     8.3    79.2   159.4
          30           SE    1064    1068    1072    1076    1080
          31           ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   6         DA1
               .
               .
  12           .-------)     DIV
  11        DIV1
              V
              V
  15          R1
               .
               .
  17           .         DA2
               .           .
               .           .
  21        C1+2............
              V
              V
  23      ROUTING
```

COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	1.47	18.03	168.88	636.83
ELEVATION	1064.00	1068.00	1072.00	1076.00	1080.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.47	6.15	18.03	58.00	168.88	362.75	636.83
OUTFLOW	.00	640.00	1320.00	2280.00	3200.00	4120.00	5000.00	5800.00
ELEVATION	1064.00	1068.00	1070.00	1072.00	1074.00	1076.00	1078.00	1080.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 0. TO 640.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION ROUTING

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
4677.	6.08	(CFS)	3065.	1145.	1145.	1145.
		(INCHES)	1.389	1.434	1.434	1.434
		(AC-FT)	1520.	1569.	1569.	1569.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	16.58-HR
292.	6.08	124.	45.	45.	45.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	16.58-HR
1077.27	6.08	1073.59	1067.69	1067.69	1067.69

CUMULATIVE AREA = 20.51 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	DA1	3444.	4.33	1142.	414.	414.	6.80		
+	DIVERSION TO	DIV	1494.	3.75	230.	83.	83.	6.80		
+	HYDROGRAPH AT	DIV1	1950.	3.75	912.	331.	331.	6.80		
+	ROUTED TO	R1	1944.	5.25	887.	330.	330.	6.80		
+	HYDROGRAPH AT	DA2	4475.	5.17	2182.	814.	814.	13.71		
+	2 COMBINED AT	C1+2	6417.	5.17	3065.	1145.	1145.	20.51		
+	ROUTED TO	ROUTING	4677.	6.08	3065.	1145.	1145.	20.51	1077.27	6.08

*** NORMAL END OF HEC-1 ***

```
(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1                                                                                    ****
                                FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
                U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                                                                    ****



                          SVCP3 AND OSVCP3
                          BUCKEYE WTSHD STRUCTURE 291 ST AVE AND I-10
                          SUN VALLEY PARKWAY Q100 6 HR DURATION

   5 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      9APR87  STARTING DATE
                       ITIME        1200  STARTING TIME
                          NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     10APR87  ENDING DATE
                      NDTIME        0435  ENDING TIME

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   16.58 HOURS

         ENGLISH UNITS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   6 KK     *      DA1   *
            *            *
            **************

              SUBBASIN RUNOFF DATA

   7 BA          SUBBASIN CHARACTERISTICS
                       TAREA        6.80  SUBBASIN AREA

                 PRECIPITATION DATA

   8 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   .71    1.40    2.46    2.70    2.90    3.20     .00     .00     .00     .00     .00     .00

                                                   STORM AREA =    6.80

   9 LS          SCS LOSS RATE
                       STRTL         .41  INITIAL ABSTRACTION
                      CRVNBR       83.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  10 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG        1.17  LAG

                                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG        6.00000        .01667        6.00000

                                                   UNIT HYDROGRAPH
                                              72 END-OF-PERIOD ORDINATES
              56.      153.      287.      454.      658.      895.     1193.     1533.     1871.     2170.
            2391.     2562.     2674.     2701.     2702.     2683.     2571.     2449.     2317.     2167.
            1994.     1801.     1577.     1381.     1210.     1080.      965.      860.      766.      696.
             628.      560.      505.      449.      395.      357.      320.      285.      257.      229.
             203.      182.      162.      144.      130.      116.      104.       93.       83.       74.
              67.       59.       53.       48.       42.       38.       34.       30.       28.       26.
              23.       21.       19.       17.       15.       12.       11.        9.        7.        5.
               3.        1.

     ***           ***           ***           ***           ***
```

HYDROGRAPH AT STATION DA1

TOTAL RAINFALL = 3.15, TOTAL LOSS = 1.58, TOTAL EXCESS = 1.57

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
+		(CFS)				
+ 3444.	4.33		1142.	414.	414.	414.
		(INCHES)	1.562	1.566	1.566	1.566
		(AC-FT)	566.	568.	568.	568.

CUMULATIVE AREA = 6.80 SQ MI

*** ***

```
            **************
            *            *
  11 KK     *     DIV1   *
            *            *
            **************
```

DT DIVERSION ISTAD DIV DIVERSION HYDROGRAPH IDENTIFICATION

DI	INFLOW	.00	1200.00	1201.00	1300.00	1500.00	2000.00	2500.00	3000.00
DQ	DIVERTED FLOW	.00	.00	.00	.00	.00	50.00	550.00	1050.00

*** *** *** *** ***

DIVERSION HYDROGRAPH DIV

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
+		(CFS)				
+ 1494.	4.33		230.	83.	83.	83.
		(INCHES)	.315	.315	.315	.315
		(AC-FT)	114.	114.	114.	114.

CUMULATIVE AREA = 6.80 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DIV1

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
+		(CFS)				
+ 1950.	3.75		912.	331.	331.	331.
		(INCHES)	1.247	1.251	1.251	1.251
		(AC-FT)	452.	454.	454.	454.

CUMULATIVE AREA = 6.80 SQ MI

*** ***

```
            **************
            *            *
  15 KK     *       R1   *
            *            *
            **************
```

HYDROGRAPH ROUTING DATA

16 RK KINEMATIC WAVE STREAM ROUTING

L	10000.	CHANNEL LENGTH
S	.0012	SLOPE
N	.035	CHANNEL ROUGHNESS COEFFICIENT
CA	.00	CONTRIBUTING AREA
SHAPE	TRAP	CHANNEL SHAPE
WD	100.00	BOTTOM WIDTH OR DIAMETER
Z	3.00	SIDE SLOPE

KINEMATIC STREAM ROUTING USED FOR THIS REACH

COMPUTED KINEMATIC PARAMETERS

ALPHA	M	DT (MIN)	DX (FT)
.0872	1.600	5.00	5000.00

*** *** *** *** ***

HYDROGRAPH AT STATION R1

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
+ 1944.	5.25	(CFS)	887.	330.	330.	330.
		(INCHES)	1.213	1.248	1.248	1.248
		(AC-FT)	440.	453.	453.	453.

CUMULATIVE AREA = 6.80 SQ MI

*** ***

```
            **************
            *            *
 17 KK      *      DA2   *
            *            *
            **************
```

SUBBASIN RUNOFF DATA

18 BA SUBBASIN CHARACTERISTICS

TAREA 13.71 SUBBASIN AREA

PRECIPITATION DATA

8 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
.71	1.40	2.46	2.70	2.90	3.20	.00	.00	.00	.00	.00	.00

STORM AREA = 13.71

19 LS SCS LOSS RATE

STRTL .41 INITIAL ABSTRACTION
CRVNBR 83.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

20 UD SCS DIMENSIONLESS UNITGRAPH

TLAG 1.91 LAG

***

VALUE EXCEEDS TABLE IN LOGLOG 6.00000 .01667 6.00000

UNIT HYDROGRAPH
117 END-OF-PERIOD ORDINATES

43.	87.	169.	270.	381.	511.	641.	814.	988.	1198.
1430.	1675.	1950.	2225.	2459.	2691.	2879.	3038.	3179.	3266.
3353.	3373.	3387.	3385.	3370.	3339.	3252.	3165.	3065.	2963.
2854.	2738.	2616.	2471.	2326.	2156.	1982.	1824.	1679.	1542.
1441.	1339.	1250.	1163.	1083.	1011.	942.	889.	836.	783.
730.	682.	638.	595.	551.	508.	476.	447.	418.	389.
361.	339.	317.	296.	274.	255.	239.	223.	207.	191.
179.	168.	157.	146.	135.	127.	119.	111.	103.	96.
90.	85.	79.	73.	68.	64.	60.	55.	51.	48.
45.	42.	39.	37.	35.	33.	32.	30.	28.	26.
25.	23.	21.	19.	18.	16.	15.	13.	12.	10.
9.	7.	6.	4.	3.	2.	0.			

*** *** *** *** ***

```
                    HYDROGRAPH AT STATION      DA2

    TOTAL RAINFALL =    3.10, TOTAL LOSS =    1.57, TOTAL EXCESS =    1.53

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    4475.      5.17                2182.        814.        814.        814.
                         (INCHES)   1.479       1.527       1.527       1.527
                          (AC-FT)   1082.       1116.       1116.       1116.

                         CUMULATIVE AREA =   13.71 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  21 KK     *     C1+2   *
            *            *
            **************

  22 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION     C1+2

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    6417.      5.17                3065.       1145.       1145.       1145.
                         (INCHES)   1.389       1.434       1.434       1.434
                          (AC-FT)   1520.       1569.       1569.       1569.

                         CUMULATIVE AREA =   20.51 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  23 KK     *  ROUTING   *     UNDER PALO VERDE ROAD
            *            *
            **************
                                FOUR BARREL 10 X 10 CBC
                                FLOW LINE @ 1065

              HYDROGRAPH ROUTING DATA

  26 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC    1064.00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

  29 SA              AREA          .0       1.1       8.3      79.2     159.4

  30 SE          ELEVATION    1064.00   1068.00   1072.00   1076.00   1080.00

  27 SQ          DISCHARGE         0.       640.      1320.     2280.     3200.     4120.     5000.     5800.

  28 SE          ELEVATION    1064.00   1068.00   1070.00   1072.00   1074.00   1076.00   1078.00   1080.00

                                                          ***
```

CULVERT DESIGN SHEET

ARIZONA DEPARTMENT OF TRANSPORTATION

CULVERT COMPUTATION RECORD

PROJECT: Sun Valley

STATION: 11+07

DESIGNER: JEK

DATE: 7/8/87

HYDROLOGIC AND CHANNEL INFORMATION

DRAINAGE AREA Buckeye FRS-I East of Palo Verde Road

Q_{100} = 4677 cfs (per HEC-1)

Q_2 = _____

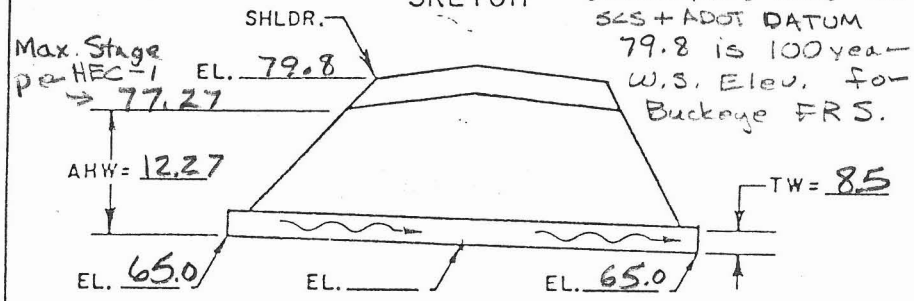
TW_1 = 8.50

TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25})
(Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH

Elevations are from SCS + ADOT DATUM 79.8 is 100 year W.S. Elev. for Buckeye FRS.



S_o = 0 L = 196 L/100 S_o = 0

MEAN STREAM VELOCITY = _____

	CULVERT DESCRIPTION		Q	CAP. CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
					INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$												
	SIZE	ENTR. TYPE			HW/D	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_o	LS_o	HW					
4	10'x10'	CBC ADOT STAND.	1169		1.21	12.1	0.35	3.3	7.5	8.75	8.5	8.75	0	12.06	12.1	14*		77.1	

SUMMARY & RECOMMENDATIONS * See attached outlet velocity calculations

Recommend 4 - 10' x 10' CBC

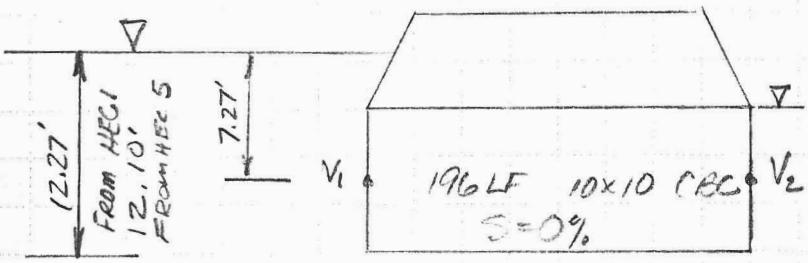
To convert to Palo Interchange Plan Datum you must add 2.12 ft to Elevation on ADOT/SCS Datum

Collar, Williams & White Engineering
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433

JOB NO.

JOB Sun Valley Parkway, Palo Verde T. I.
SHEET NO. _____ OF _____
CALCULATED BY WEK DATE _____
CHECKED BY CJL DATE _____
SCALE _____

OUTLET VELOCITY CALCULATION
FROM 4 BARREL 10X10



Assume BOX IS FLOWING FULL AND TW IS ≤ 10'

$P_1 = 7.27'$ or $7.10'$ $\quad P_2 = 5'$

$V_1 = 11.69$ cfs/100 ft² = 11.69 fps (from HEC 1)

$Z_1 = Z_2$

USING $P_1 = 12.27 - 5.0$ From HEC 1 :

$$P_1 + \frac{(V_1)^2}{2g} = P_2 + \frac{(V_2)^2}{2g} + h_f + h_e$$

$$7.27 + \frac{(11.69)^2}{2 \times 32.2} = 5' + \frac{(V_2)^2}{2 \times 32.2} + \left(\frac{29 \times (.013)^2 \times 196}{(100/40)^{1.33}}\right)\left(\frac{(11.69)^2}{2 \times 32.2}\right) + 0.35 \times \frac{(11.69)^2}{2 \times 32.2}$$

$$9.39 = 6.321 + \frac{(V_2)^2}{64.4}$$

$$\underline{V_2 = 14.06 \text{ fps}}$$

velocity @ $d_c = 15.57$ fps

USING $P_1 = 7.10$ FROM HEC 5 :

$$9.39 - .17 = 6.321 + \frac{V_2^2}{64.4}$$

$V_2 = \underline{13.66 \text{ fps}}$ $\quad$ Assume $V_2 = 14$ fps

FORM 204-1

Collar, Williams & White Engineering
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433

JOB NO.

JOB _____
SHEET NO. _____ OF _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

DISCHARGE RATING CURVE - 4 BAR. 10 x 10 CBC

FL @ 1065 : Q = 0

1068 ,	H = 3 ,	Q/B = 16 ,	Q = 165 x 4 =	640 cfs
1070 ,	4 = 5 ,	Q/B = 33	330 x 4	1320
72	7	57	570 x 4	2280
74	9	80	800 x 4	3200
76	11	103	1030 x 4	4120
78	13	125	1250 x 4	5000
80	15	145	1450 x 4	5800

FORM 204-1

Collar, Williams & White Engineering
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433

JOB NO.

JOB: BUCKEYE STRUCTURE AT PALO VERDE ROAD
SHEET NO. ____ OF ____
CALCULATED BY: KORNFELD DATE: 7/9/87
CHECKED BY ____ DATE ____
SCALE ____

OUTLET PROTECTION CALCULATIONS FOR PROPOSED 4 BARREL 10'x10' AT STA. 9+02.17

Q_{100} = 1169 cfs / 10x10

Q average maximum for 30 minutes = 0.77 x 1169 = 900 cfs

$Y_c = (A/2)^{.5} = (100/2)^{.5} = 7.07$ (assume full flow)

$K = Q/(g^{.5}(Y_c)^{2.5}) = 900/[(32.2)^{.5}(7.07)^{2.5}] = 1.193$

depth: $\frac{h_s}{D} = 7.67(1.193)^{.377}(30/316)^{0.099}$

$= 2.26'$

or $h_s = 2.26 \times (100/2)^{.5} = \underline{15.98 \text{ ft.}}$

width: $\frac{W_s}{D} = 11.55(1.193)^{0.900}(30/316)^{0.145}$

$= 9.62$

or $W_s = 9.62 \times 7.07 = \underline{68.03 \text{ ft.}}$

length: $\frac{L_s}{D} = 16.90(1.193)^{0.700}(30/316)^{0.128}$

$= 14.15$

or $L_s = 14.15 \times 7.07 = \underline{100.02 \text{ ft.}}$

volume: $\frac{V_s}{D} = 197.70(1.193)^{1.97}(30/316)^{0.373}$

$= 116.30$

or $V_s = 116.30 \times 7.07 = \underline{822.23 \text{ ft}^3}$

Location of the max. scour = 0.4 x Ls = 0.4 x 100.02 = 40 feet.

FORM 204-1

Collar, Williams & White Engineering
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433

JOB NO.

JOB _____
SHEET NO. _____ OF _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

PER FIG. II-C-1 PAGE I-9, the spherical diameter of stone = 18" ±.
(FOR OUTLET VELOCITY 14.5-15 fps).

RIPRAP GRADATION

d_{100}	36"
d_{85}	32"
d_{50}	18"
d_{35}	12"
d_{15}	8"

Collar, Williams & White Engineering
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433

JOB NO.

JOB _____
SHEET NO. _____ OF _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

EROSION PROTECTION CALCULATIONS FOR CHANNEL OUTLET
(FLOWING CHANNEL & 4 BARREL 10X10)

$Q = 881 \text{ cfs} \times 0.77 = 678 \text{ cfs}$ (average max. for 30 min.)

$d = 2.5$ (channel) and $A = (20 \times 2.5) + (2.5 \times 5)$
$= 62.5 \text{ ft}^2$

$V_c = (62.5/2)^{0.5} = 5.59$

$K = 678 \Big/ \left[(32.2)^{.5} (5.59)^{2.5} \right] = 1.617$

Depth: $h_s/D = 2.67 (1.617)^{0.379} (0.0949)^{0.099}$
$= 2.54$
or $h_s = 2.54 \times 5.59 = 14.18 \text{ ft}$

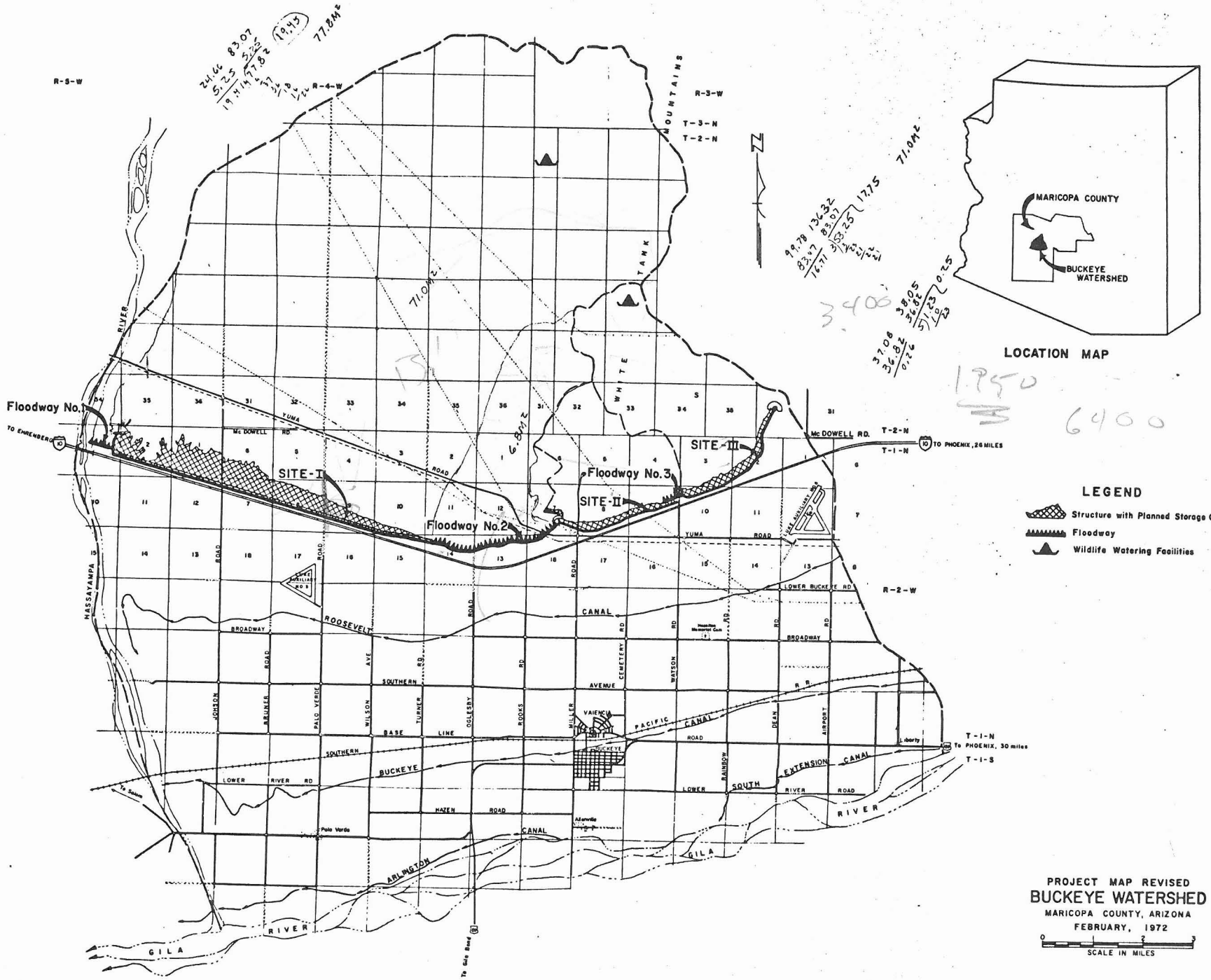
Width: $W_s/D = 11.55 (1.617)^{0.900} (0.0949)^{0.145}$
$= 12.65$
or $h_s = 12.65 \times 5.59 = 70.72 \text{ ft}$

Length: $L_s/D = 16.90 (1.617)^{0.700} (0.0949)^{0.128}$
$= 17.50$
or $L_s = 17.50 \times 5.59 = 97.83 \text{ ft}$

Volume: $V_s/D = 197.70 (1.617)^{1.97} (0.0949)^{0.373}$
$= 211.68$
$V_s = 211.68 \times 5.59 = 1183.31 \text{ ft}^3$

FORM 204-1

SCS ASSESSMENT OF PHASE I DAM SAFETY STUDY


Floodway No.1
Floodway No.2
Floodway No.3
SITE-I
SITE-II
SITE-III
R-5-W
R-4-W
R-3-W
R-2-W
T-3-N
T-2-N
T-1-N
T-1-S
WHITE TANK MOUNTAINS
MASSAYAMPA RIVER
TO EHRENBERG
TO PHOENIX, 26 MILES
To PHOENIX, 30 miles
Mc DOWELL RD.
YUMA ROAD
LOWER BUCKEYE RD.
ROOSEVELT CANAL
BROADWAY
SOUTHERN AVENUE
BASE LINE
PACIFIC RR
SOUTHERN PACIFIC ROAD
BUCKEYE EXTENSION CANAL
LOWER SOUTH RIVER ROAD
LOWER RIVER RD
HAZEN ROAD
ARLINGTON CANAL
GILA RIVER
JOHSON ROAD
BRUNER ROAD
PALO VERDE AVE
WILSON RD
TURNER RD
OGLESBY RD
ROOKS RD
MILLER ROAD
CEMETERY RD
WATSON RD
RAINBOW RD
DEAN RD
AIRPORT RD
VALENCIA
BUCKEYE
Liberty
Palo Verde
Arlinville
To Gila Bend
71.0M2
77.8M2
6.8M2
LOCATION MAP
MARICOPA COUNTY
BUCKEYE WATERSHED
LEGEND
Structure with Planned Storage Capacity
Floodway
Wildlife Watering Facilities
PROJECT MAP REVISED
BUCKEYE WATERSHED
MARICOPA COUNTY, ARIZONA
FEBRUARY, 1972
SCALE IN MILES

EMERGENCY SPILLWAY ADEQUACY
BUCKEYE FRS SITE NO. 1
ASSESSMENT OF RESULTS FROM
DAM SAFETY INSPECTION PHASE I STUDY

R. P. McArthur
Hydraulic Engineer, SCS
January, 1980

Summary

The Phase I study results of the dam safety inspection performed by the Arizona Water Commission for the Corps of Engineers showed the emergency spillway to have an inadequate capacity to pass the probably maximum flood (PMF). The reasons for this are primarily due to differences in criteria between the Corps of Engineers and the Soil Conservation Service. A major difference is related to the Corps of Engineers' non-allowance of floodwater storage below the crest of the emergency spillway for routing the PMF. Another difference is the higher rainfall intensities resulting from the storm specified by the Corps of Engineers. A third difference is the reduction of runoff volume attributed to floodplain transmission losses within the contributing area accounted for in the SCS studies, but not credited in the Corps of Engineers' study.

Differences in Inflow Hydrographs

The difference in the hydrograph used by the SCS in the design of the top of the dam (termed the freeboard hydrograph) and the hydrograph used by the AWC in evaluating the safety of the structure (termed the probable maximum flood) is due to two items - storm distribution or intensities and transmission losses in the stream channels within the contributing drainage area.

The difference in peak discharge between 124,260 cfs (AWC study) and 96,660 cfs (SCS design), is attributed to 52% due to consideration of transmission losses and 48% due to storm distribution. Refer to Figure 1.

In the SCS design hydrology studies, of the total runoff of 8.98 inches from the areal probable maximum precipitation of 10.45 inches, 1.0 inch was deducted for transmission losses. The net runoff was, therefore, 7.98 inches or 31,450 ac/ft.

The Arizona Water Commission studies derived a runoff of 9.02 inches from an areal precipitation of 10.5 inches. No transmission losses were considered, therefore, a total runoff of 35,540 ac/ft. was used.

The standard six-hour storm distribution used by the SCS produced a maximum 15-minute intensity of 5.7 in/hr. The storm distribution developed by the AWC using Hydrometeorological Report No. 49 resulted in a maximum 15-minute intensity of 12.8 in/hr.

Differences in Flood Routing

A major difference exists in the assumed beginning conditions for flood routing the hydrographs. The Corps of Engineers requires that the flood routing begin at the crest of the emergency spillway. That is, it is assumed that the floodwater

retarding pool (100-year flood runoff) is full when the probable maximum flood occurs.

The SCS criteria allows the routing of the freeboard hydrograph for a class C (high hazard) dam to begin at the lowest ungated crest of the principal spillway. This allows the use of the floodwater retarding pool for storing part of the freeboard flood hydrograph. Although a minor effect, it also credits the principal spillway release of floodwater during the routing.

This criteria difference accounts for 50 percent of the dam height difference.

Top of Dam Requirements

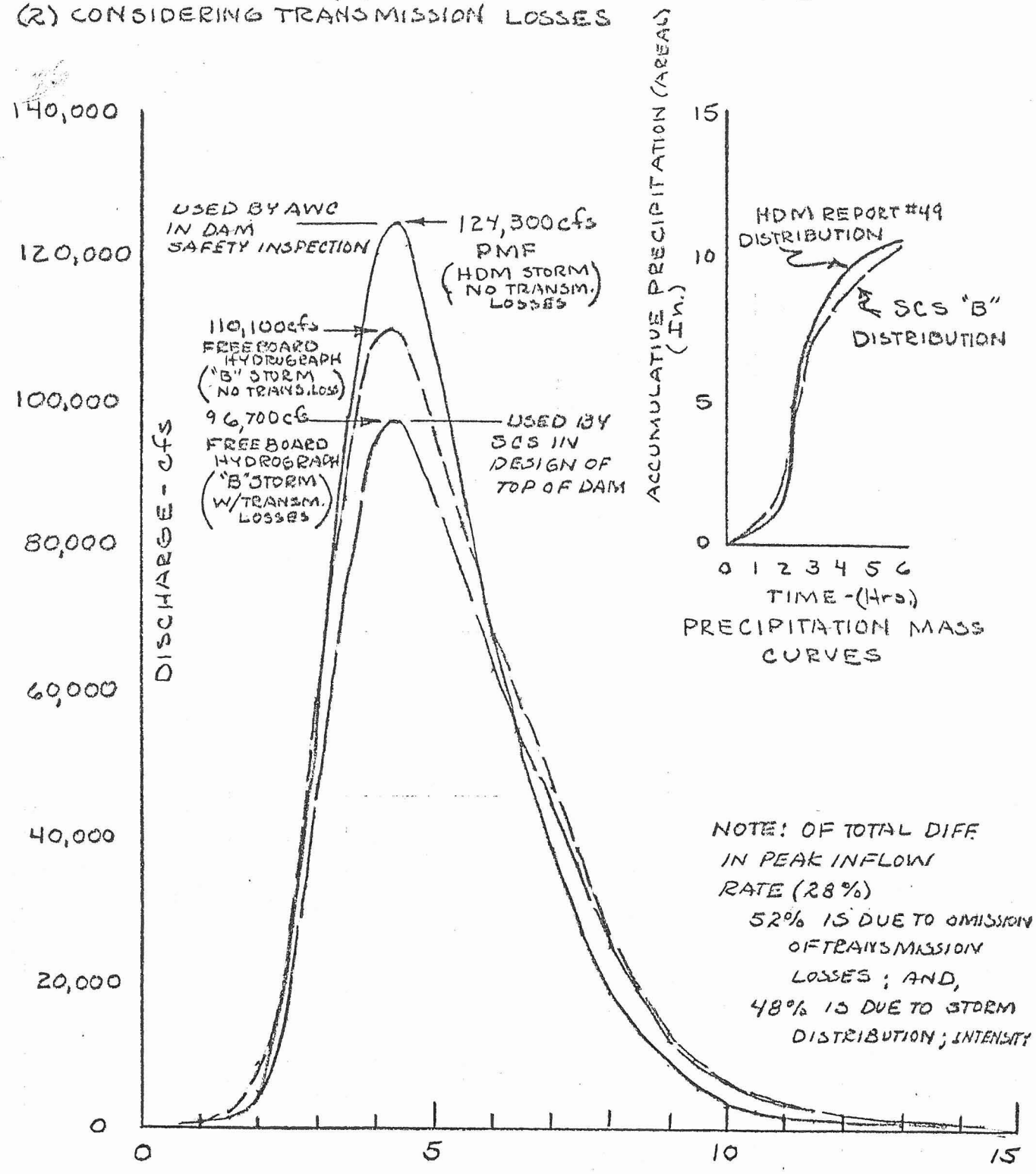
The dam safety inspection shows a need to raise the top of the dam by 2.2 feet, assuming the spillway width of 800 feet to be maintained. This would raise the top of the dam from elevation 1088.5 to 1090.7. Refer to Figure 2.

Of the 2.2 feet difference, 1.1 feet or 50 percent is due to not using the floodwater retarding pool below the crest of the emergency spillway for floodrouting; 0.8 feet or 36 percent is due to omitting transmission losses within the stream channel system of the contributing drainage area; and 0.3 feet or 14 percent is due to the more severe precipitation distribution specified by Hydrometeorological Report No. 49.

ARIZONA BUCKEYE WATERSHED

R.P. McArthur 12/79

COMPARISON OF INFLOW HYDROGRAPHS AS AFFECTED BY (1) STORM DISTRIBUTION AND (2) CONSIDERING TRANSMISSION LOSSES



FLOOD HYDROGRAPHS

Fig. 1

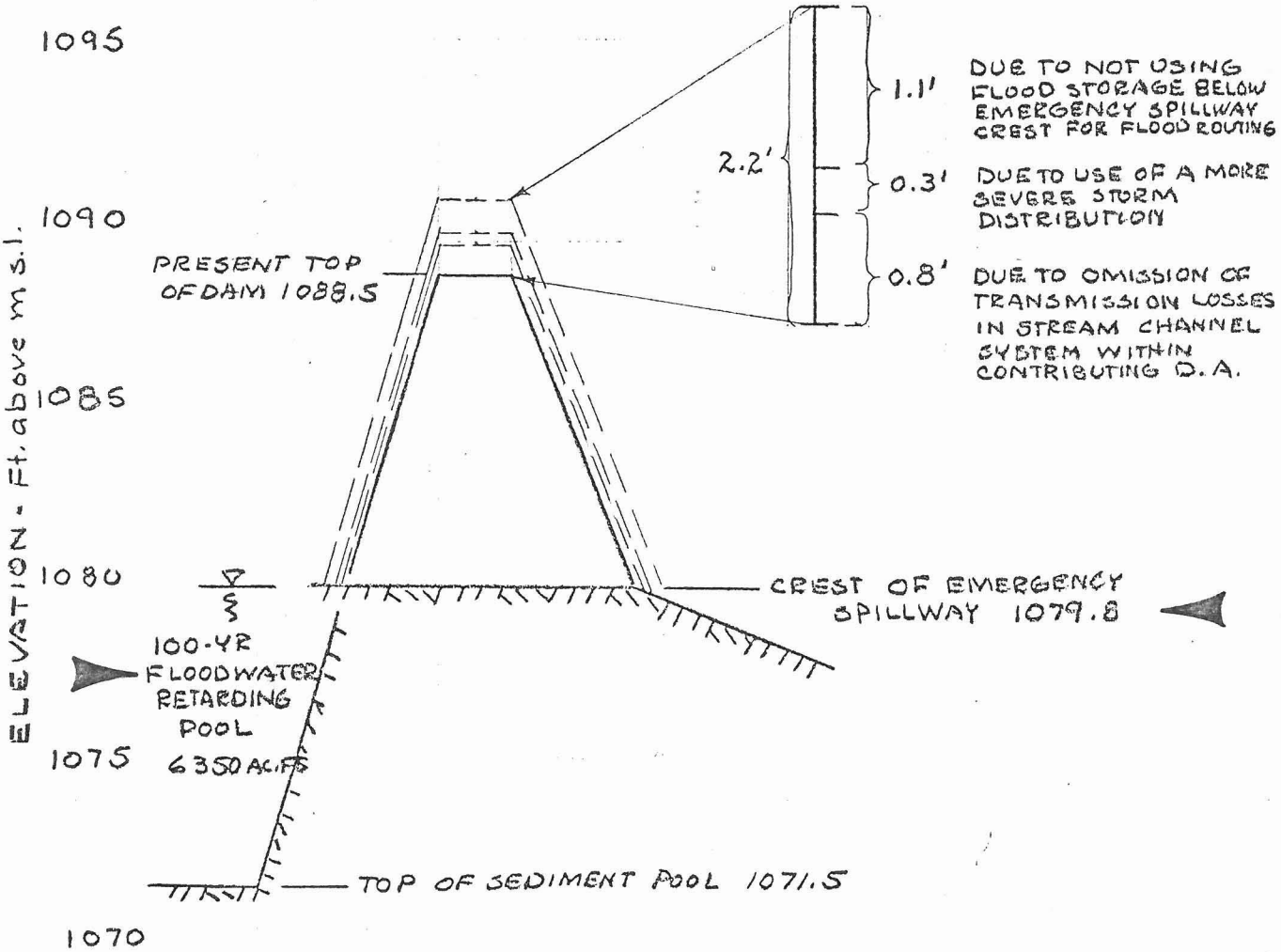
ARIZONA BUCKEYE WATERSHED

R. McArthur 12/79

COMPARISON OF TOP OF DAM REQUIREMENTS
AS DETERMINED FROM (1) DAM SAFETY INSPECTION STUDY AND
(2) SCS DESIGN ANALYSIS

ACCOUNTING FOR DIFFERENCES IN TOP OF DAM
REQUIREMENTS ASSUMING SPILLWAY WIDTH OF 800 Ft.:

DAM SAFETY INSPECTION REQUIRES TOP @ ELEV. 1090.7
SCS DESIGN ANALYSIS " " " " 1088.5
DIFFERENCE = 2.2'



SCHEMATIC DAM CROSS-SECTION
AT EMERGENCY SPILLWAY

Fig. 2

DAM SAFETY ANALYSIS
for the
BUCKEYE SITE 1 FRS
RPM 12/79

PURPOSE: This study was made as a result of the joint Corps of Engineers - Arizona Water Commission dam safety inspection of this structure. Their results indicated two problems (1) cracking of the embankment and (2) an inadequate emergency spillway.

This work was done to determine the reasons for the emergency spillway deficiencies pointed out in their studies

PROCEDURE: On Dec. 18, 1979, I met with David Creighton and William Jenkins, Safety of Dams Division, Arizona Water Commission, state of Arizona to discuss their procedures and the results of their analysis. I got a copy of a portion of their report and of the TR-20 output resulting from their work.

I reviewed the Buckeye Work Plan and design study documentation and made a copy of the pertinent data to enclose with this material.

A TR-20 analysis was made using the

original structural data which included stage-storage-discharge data from the crest of the principal spillway to the top of the dam. Another condition used the AWC's alteration of the structural data which eliminated the storage below the crest of the emergency spillway as well as the principal spillway discharge. This is the criteria furnished by the Corps of Engineers.

Two storm distributions were also used. The SCS "B" distribution which was used in the design of the structure and the Weather Bureau distribution contained in Hydrometeorological Report No. 49 (HDM Report No. 49) used by the AWC.

It was noted in a tabular summary of findings acquired Dec. 18 from the AWC that there was an inch difference in runoff depth. The SCS design showed 8.01 inches while the AWC analysis showed 9.02 inches; all other values were essentially the same. Review of the design documentation showed an allowance of 1" of runoff had been deducted for transmission losses. Therefore, the TR-20 runs includes an adjustment of runoff curve numbers to account for 1 inch of additional loss due to transmission losses.

In the basic TR-20 analyses a base flow

of 150 cfs was included to account for outflow from FRS site no. 2. Also a divert subroutine was used to pass discharges from the area contributing to the floodway between sites 1 and 2 in excess of 1800 cfs over the floodway and away from the reservoir. The design capacity for the floodway is 1200 cfs but with freeboard and accounting for the outflow from site 2 a total flow of 1800 plus 150 cfs or a total of 1950 cfs was allowed from the floodway into site 1. This assumes that the floodway doesn't breach and completely by-pass site 1

The following alternatives were analyzed for site 1:

Alternate No.	STORM DISTRIBUTION		FLOODWATER STORAGE		TRANSMISSION LOSSES	
	SCS "B"	HDM REPORT NO. 49	ABOVE THE PRINCIPAL SPILLWAY CREST	ABOVE THE EMERGENCY SPILLWAY CREST	NOT CONSIDERED	CONSIDERED
1	X		X		X	
2		X	X		X	
3	X			X	X	
4		X		X	X	
5	X			X		X
6		X		X		X
7	X		X			X
8		X	X			X

RESULTS: The following summary table presents the results of the TR-20 analysis

Alternate No.	Inflow		Outflow		
	Peak Discharge (cfs)	Runoff Volume (Ac.Ft.)	Peak Discharge (cfs)	Runoff Volume (Ac.Ft.) (@ 60 Hrs.)	Maximum Water Surface (Elev.)
1	110,120	37,030	48,150	31,270	1089.37
2	123,450	37,140	51,000	31,390	1089.63
3	110,120	37,030	58,420	36,750	1090.35
4	123,450	37,140	62,690	36,860	1090.73
5	97,330	33,000	50,430	32,710	1089.64
6	109,080	33,100	53,870	32,820	1089.94
7	97,330	33,000	39,850	27,240	1088.64
8	109,080	33,100	41,880	27,350	1088.82

CONCLUSIONS: The criteria used by the Corps of Engineers is more demanding than that of the SCS. Ignoring the flood storage below the crest of the emergency spillway in flood routing the spillway hydrograph has the largest affect. The use of the HDM Report 49 storm distribution also significantly increases the inflow hydrograph peak. Not allowing the transmission losses also had a significant affect upon the inflow hydrograph. These affects are summarized as follows:

Affect upon the inflow hydrograph:

124,260 cfs AWC
96,660 cfs SCS
Diff = 27,660

27,660/96,660 (100) = 28.6% Increase

48% or 13.7% is attributed to storm distribution

52% or 14.9% is due to transmission losses

Affect upon height of dam:

Ignoring transmission losses: 0.8' or 36%

Non use of flood storage below the emergency spillway crest } 1.1' or 50%

Use of HDM Report 49 storm distribution in lieu of "B" distribution } 0.3 or 14%

2.2 ft.

RECOMMENDATION: Until national policy alters the current SCS criteria there is no need to make modifications because apparently the top of dam is within one-half foot of design or planned elevation. The risk of overtopping is small.

If modification is considered necessary it appears that enlargement of the spillway would be the least costly due to the length of the embankment.

TABLE 3A - STRUCTURE DATA (Revised)

CHANNELS

Buckeye Watershed, Arizona

Channel Designation	Stations or Reach	Drainage Area Sq. Mi.	Capacity cfs Design	Hydraulic Gradient (ft/ft)	Average Channel Dimensions Bottom (ft)	Depth (ft)	Side Slope	"n" Value As Built	Velocities As Built	Excavation (Cu. Yd.)	Type of Improvement 1/
Floodway											
No. 1	Floodway No. 1	Sta. 908+63 = Site I Sta. 910+67									
	909+55.5-918+82	91.7	640	0.028	6 Diameter			0.015	29.5	58,400	L
	918+82 -918+08	91.7	640		PWD Basin						L
	918+08 -928+00	91.7	640	0.001	22	5.2	2:1	0.03	3.8	21,400	E
	Sta. 928+00 = Hassayampa River										
No. 2	Floodway No. 2	Sta. 416+00 = Site II Sta. 224+00									
	416+00 -438+00	15.0	150	0.01	4 Diameter			0.012	12.4	7,700	L
	438+00 -462+00	17.5	1,200	0.00012	75	8.0	2:1	0.035	1.64	3,900	E
	462+00 -476+00	17.5	1,200	0.00071	40	7.2	2:1	0.04	3.06	11,000	L
	476+00 -484+00	17.7	1,200	0.00019	75	7.0	2:1	0.035	1.92	1,800	E
	484+00 -498+00	17.7	1,200	0.00078	40	7.0	2:1	0.04	3.17	10,700	L
	498+00 -515+00	17.8	1,200	0.00022	75	6.7	2:1	0.035	2.02	2,400	E
	515+00 -525+00	18.0	1,200	0.0013	40	6.1	2:1	0.04	3.77	10,000	L
	515+00 -562+00	18.0	1,200	0.001	50	5.4	2:1	0.035	3.65	40,400	E
No. 3	Floodway No. III	Sta. 10+00 = Site III Sta. 169+00									
	10+00 - 15+00	9.3	100	0.032	3 Diameter			0.012	14	1,600	L
	15+00 - 21+00	9.3	100	0.014	3 Diameter			0.012	14	1,900	L
	21+00 - 21+15	9.3	100		PWD Basin					20	L

1/ E - Excavated unlined channel
L - Lined channel (concrete or riprap)

with 1.5' freeboard

$q = 1827$ cfs

$a = \frac{50+50+2(2\times6.9)}{2}(6.9) = 440.0'$

$wp = 50+2\sqrt{5}(6.9) = 79.9$

$q = \frac{1.486}{0.025^{1/2}}$

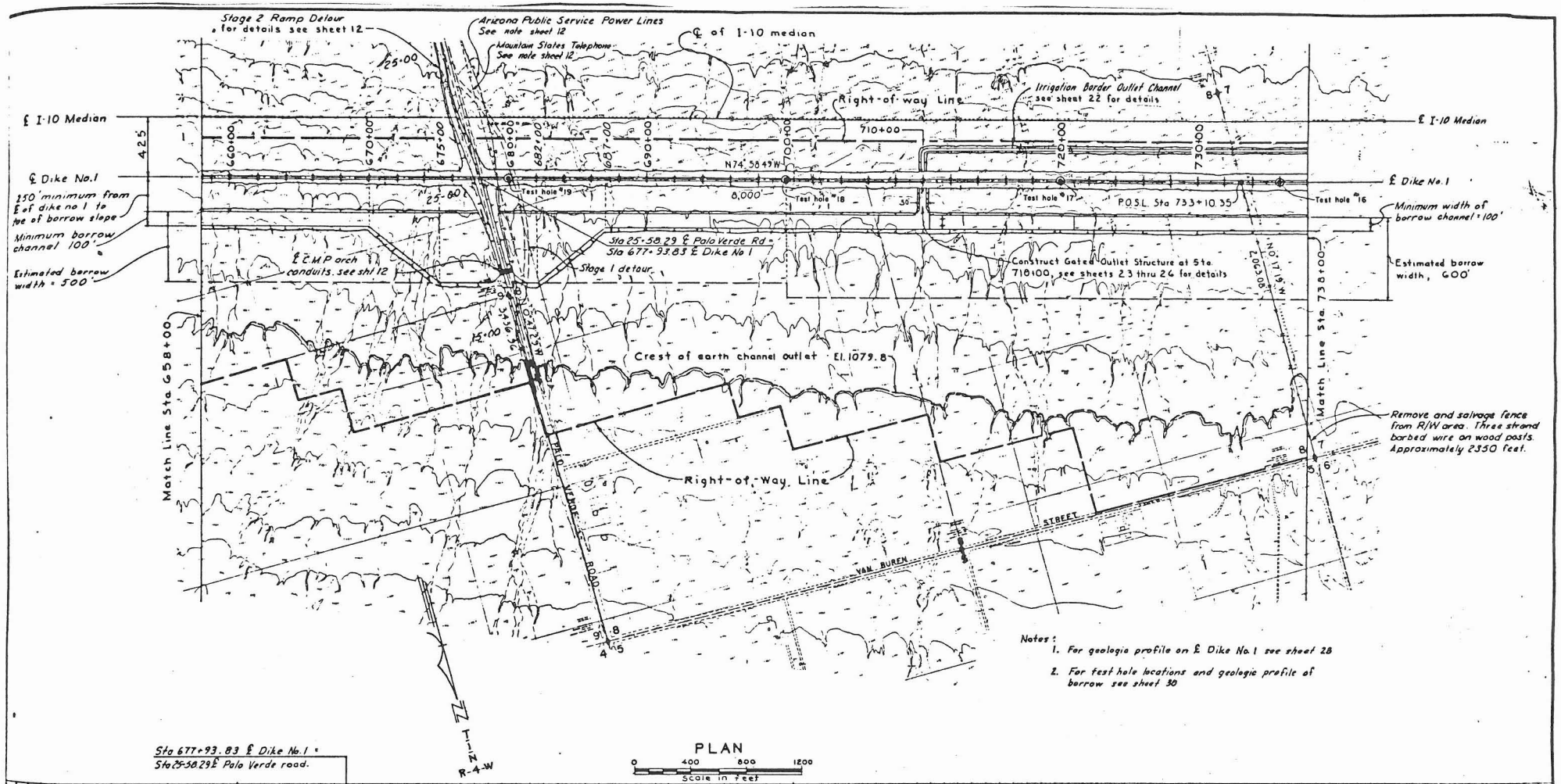
$\sqrt{2^2+1^2} = \sqrt{5}$

$a = \frac{50+50+2(2\times5.4)}{2}(5.4) = 328.0'$

$wp = 50+2\sqrt{5}(5.4) = 74.1$

$r = \frac{328}{74.1} = 4.42$

February 1972



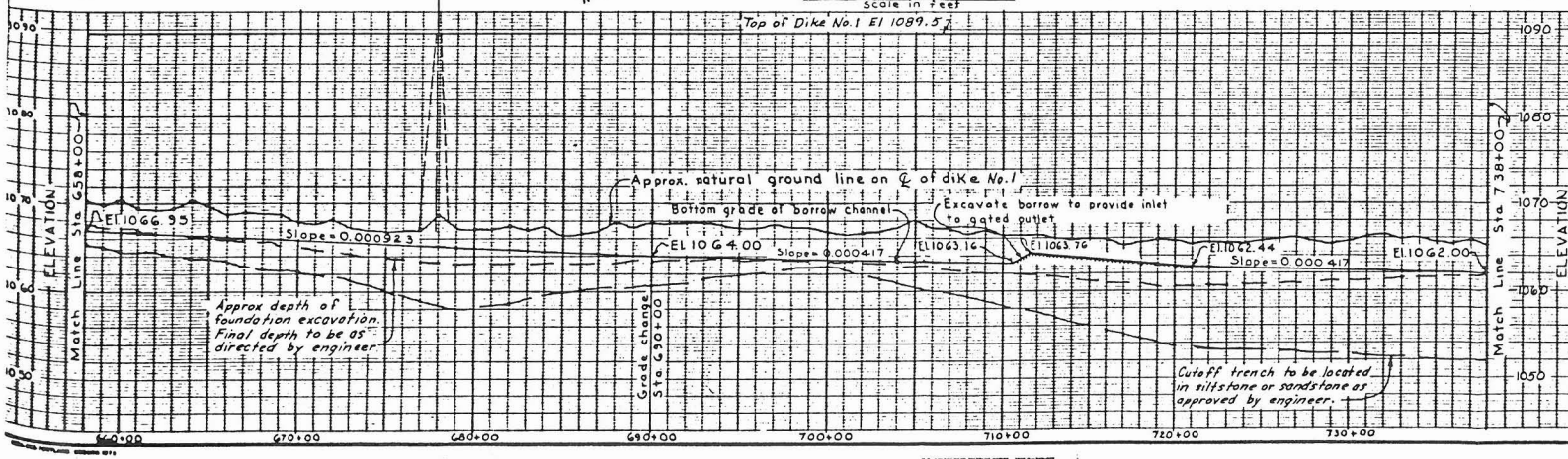
Notes:

1. For geologic profile on ℄ Dike No. 1 see sheet 28
2. For test hole locations and geologic profile of borrow see sheet 30

PLAN

0 400 800 1200

Scale in feet



PLAN & PROFILE ON DIKE NO. 1

SITE 1

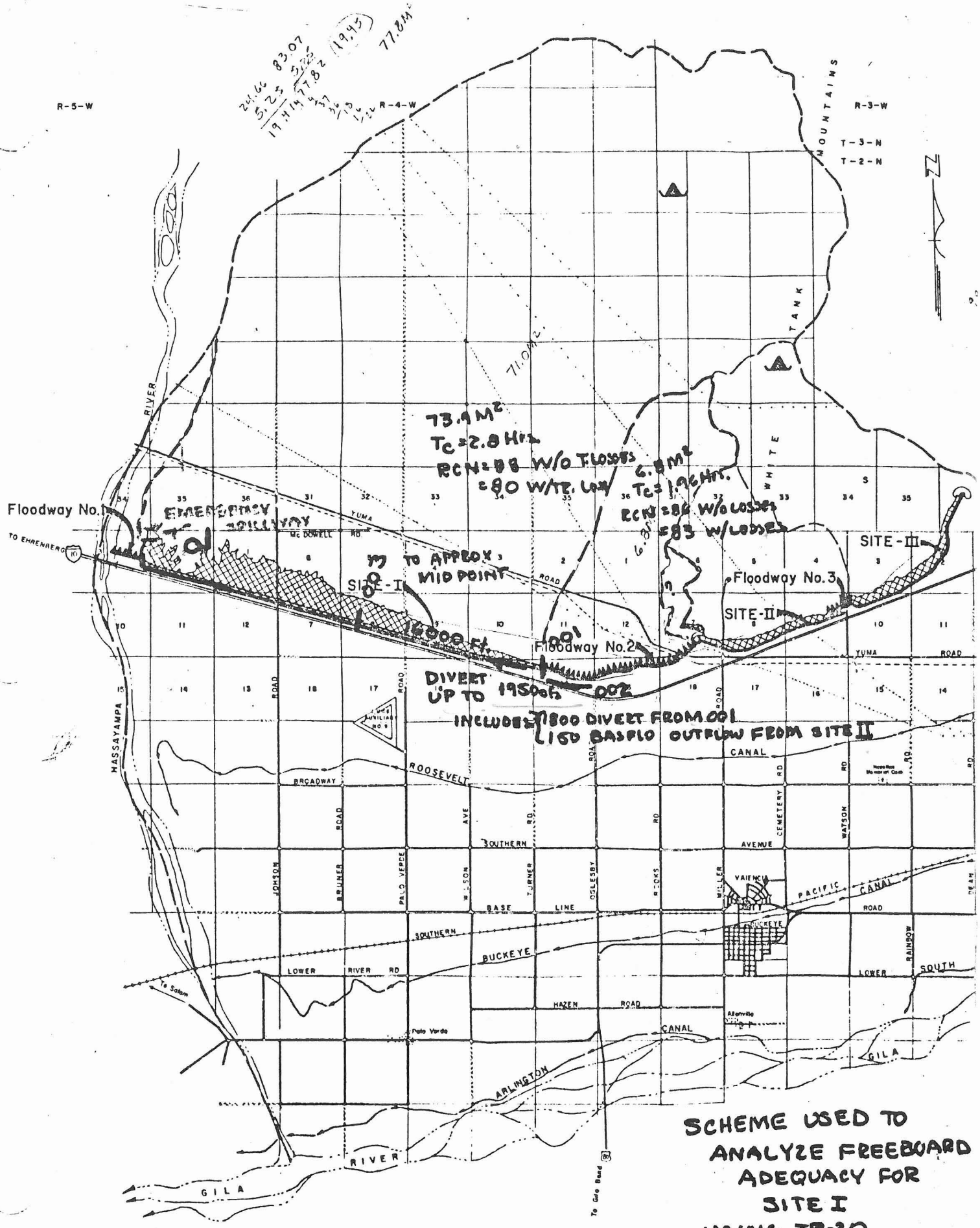
BUCKEYE W. P. P.

MARICOPA COUNTY, ARIZONA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	G. WATT		Approved by:
Drawn	G. HANLEY	3-30-71	Title:
Traced			Title:
Checked	G.M.C. D.E.W.	1-73	Sheet No. 4 of 31 — Drawing No. 7-E-22084

Form SCS-318 (November 1955)



SCHEME USED TO ANALYZE FREEBOARD ADEQUACY FOR SITE I USING TR-20 FOR DAM SAFETY CONSIDER

RPM 12/79

ORIGIN OF CN 83

Az.
C.E.P 1-25-71
Weighted CN

SCS
Buckeye Wtsd Structure

4

Wt CN Values from Sheet 35 – 40 of Buckeye hydology calculations by M.S. dated 5/4/62
Area from Calc. by JK, dated 1-22-71

Drainage Area # B-1

Group	RCN	Area Sq. Mi	%	RCN.
I	83.95			
Ia	88.10			
II	87.50	0.84	29.37	= 25.70
III	90.95			
IV	91.55	0.33	11.54	= 10.56
V	91.85	1.67	58.39	= 53.63
VI	86.90	0.02	.70	= 0.61
Total		2.86	100%	90.50

Drainage Area # B-2

II	87.50	1.96	49.75	43.6
IV	91.55	0.03	0.76	.7
V	91.85	1.61	40.85	37.5
VI	86.90	.34	8.64	7.5
RCN =		3.94	100.00	89.3

6.80

say 89 for 1Hr
6Hr 86
24Hr 83

Drainage Area B – (1+2) = B-3

IV	91.55	2.02	25.90	23.7
V	91.85	5.78	74.10	68.1
RCN =		7.80	[illegible]	91.8

w/ P = 10.45
QCN = 36
Q = 8.72
Transm. 0.35
Loss
3rd Ind.
Q_{NET} = 8.37

Drainage Area B-1 + B-2

Group	RCN	Area	%	RCN
B-1	90.5	2.86	42.1	39.1
B-2	89.3	3.94	57.9	51.7
RCN =		6.80		89.8

REQUIRED
RCN = 83

RPM 12/19

Drainage Area B-1 + B-2 + B-3

B-1	90.5	2.86	21.1	19.1
B-2	89.3	3.94	29.1	25.8
B-3	91.8	6.20	50.0	45.9
RCN =		12.60	[illegible]	90.8

SCS ROAD CROSSING DESIGN AT PALO VERDE ROAD

BUCKEYE WATERSHED - STRUCTURE NO. I

DESIGN OF ROAD CROSSING AT JOHNSON AND PALO VERDE ROADS

The existing roads are of graded earth with road dips as the only existing drainage. During floods they are impassible. The roads serve only a few local residents and traffic is very light. There is another route to the area served by these roads in the event they are closed by high water in the reservoir.

The County Highway Department suggested that the crossings be designed for a five-year flood event.

We believe the culverts should be designed for existing conditions and if and when development of the area requires a better road crossing they can be improved. We used C.M.P. culverts set at borrow channel level and when sediment levels raise to where they affect their operation they can be dug out and raised.

The crossings are designed for three conditions:

1. The road elevation to be higher than five-year water surface elevation of the reservoir with no sediment storage.
2. To pass five-year storm from the area above the crossing by routing the flood through the storage upstream of the crossing.
3. The size required to lower the water on both sides of the crossing relatively evenly when the reservoir is emptying.

Although these designs are based on our hydrology procedures for a five-year event, our experience with the White Tanks project shows these crossings as designed would have only flooded once in the last 17 years. I believe that it can be said, at least, our five-year flood is a very conservative five-year flood.

4. The vertical curves were designed for a 300 foot site distance.

George Watt
State Design Engineer

June 2, 1971

SCS-ENG-522A
Rev. 8-69

SOIL CONSERVATION SERVICE

GPO: 1969—O-361-809

STATE Ariz
BY Watt
DATE 4-71
PROJECT Buckeye
DATE
JOB NO.
SUBJECT Pipes for Palo Verde Rd
SHEET ___ OF ___

Storage For 200 CFS Ave Outflow. D.A. 14.6

10 yr		5 yr	
in.	Ac Ft	in	Ac Ft
.8	622	.30	233

For 2 - 81"x59" C.M.P. 1° head $l = 84'$
For 5 yr event
Ave Q = 200 CFS W.S. Elev = 75.5

For 10 yr Event 2° head on culverts
Ave Q 300±

W.S. Elev = 79.2±

SCS-ENG-522A
Rev. 8-69

SOIL CONSERVATION SERVICE

GPO: 1969—O-361-809

STATE Arizona
BY Watt DATE 4-19-71
PROJECT Buckeye
CHECKED BY DATE
JOB NO.
SUBJECT Road Xings
SHEET ___ OF ___

Summary of Design Calculations
For 2-72" CMP Culverts.
Required Road Elevation of Crossing

	Johnson Road		Palo Verde Rd	
	5yr	10yr	5yr	10yr
Elev W.S. In Reservoir	71.5	72.0	71.5	72.0
W.S. Elev. For Flood upstream of road Xing.	70.3	72.7	75.5	79.2

Required Capacity to Lower Water in Reservoir evenly at Road Crossing

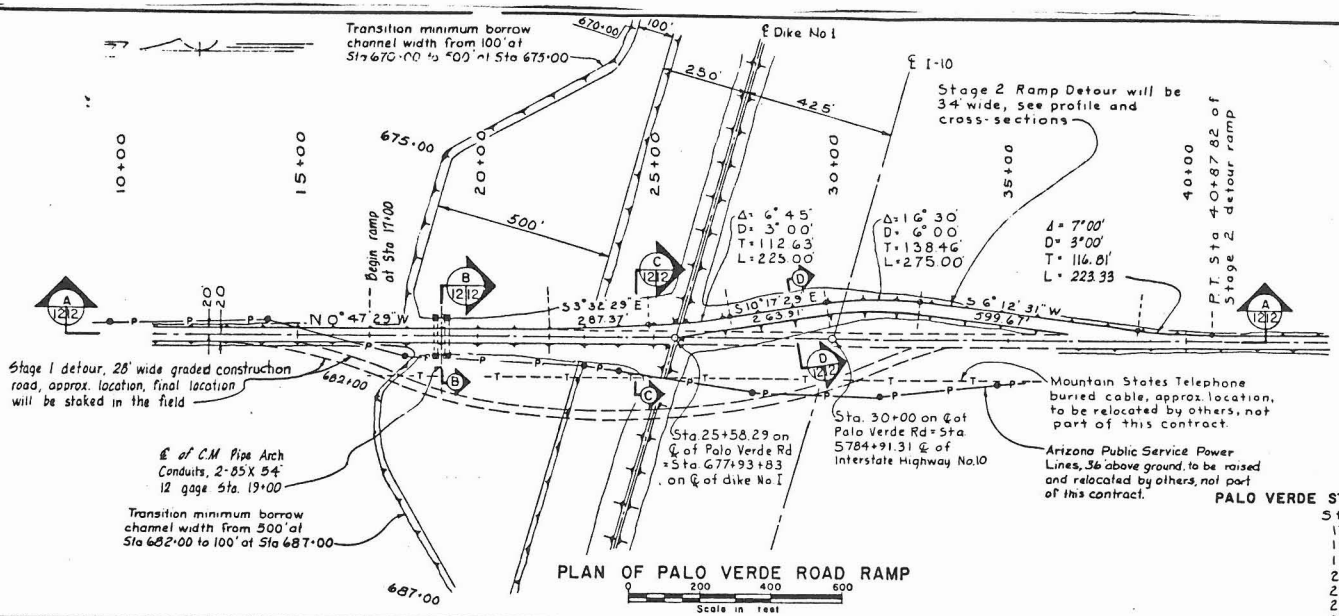
W.S. Elev	Johnson Road	Palo Verde Rd
64	106	13
68	123	18
72	132	18

Q for 2-81×59 pipes for h=.3± = 132 CFS

Use Road Elev in Reservoir

Johnson Road 73° Dip 71.5

Palo Verde Rd 76° Dip 75.0

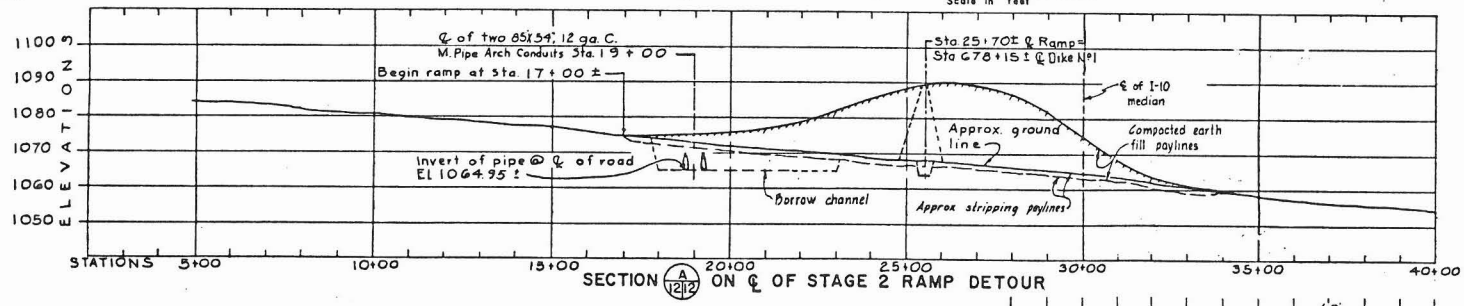


Note
Stage 1 detour to be used during construction of Stage 2 detour under this contract

Stage 2 detour is the completed Palo Verde Road ramp for this project.

PLAN OF PALO VERDE ROAD RAMP

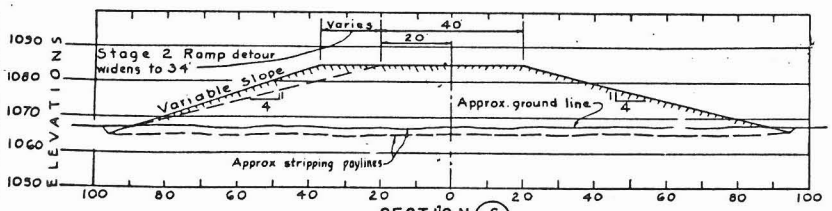
Scale in feet 0 200 400 600



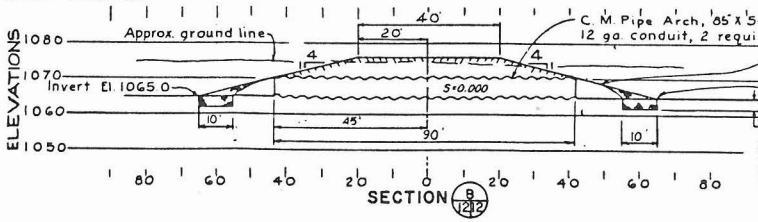
SECTION A/12|12 ON ℄ OF STAGE 2 RAMP DETOUR

PALO VERDE STAGE 2 RAMP DETOUR VERTICAL CURVES

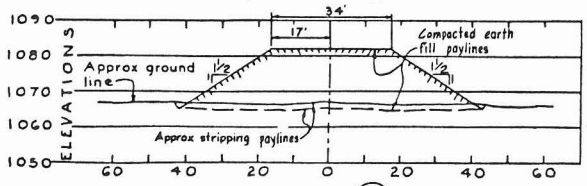
Stations	Elevations
17+00	1075.00
18+00	1075.30
19+00	1075.70
20+00	1076.00
21+00	1076.69
22+00	1078.76
23+00	1082.21
24+00	1085.89
25+00	1088.64
25+60	1089.83
26+00	1090.31
27+00	1089.98
28+00	1087.37
29+00	1082.49
30+00	1075.32
31+00	1068.27
32+00	1063.72
33+00	1061.67
34+00	1060.00



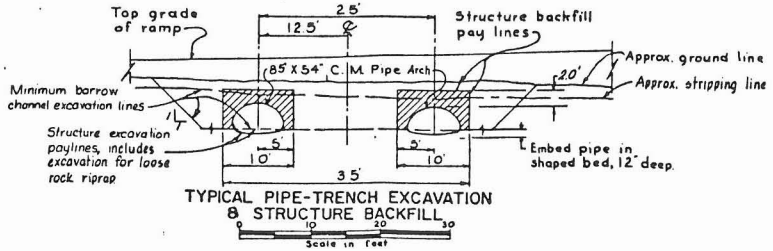
SECTION C/12|12



SECTION B/12|12



SECTION D/12|12



TYPICAL PIPE-TRENCH EXCAVATION & STRUCTURE BACKFILL

Scale in feet 0 10 20 30

PALO VERDE ROAD RAMP DETAILS

SITE 1

BUCKEYE W. P. P.
MARICOPA COUNTY, ARIZONA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. WATT	Date	Approved by	
Drawn G. HANLEY	2-8-72	Title	
Traced		Title	
Checked G.M.C.	1-73	Sheet No. 12 of 31	Drawing No. 7-E-22084

SCS-313B (APRIL 1963)

EXHIBIT II DRAINAGE AREA MAP

PROJECT COST AND FILING FEE ESTIMATE

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433
PINETOP–LAKESIDE OFFICE
LAKESIDE, ARIZONA 85929
PHONE: 334-4170

JOB NO. 850840

ENGINEER'S ESTIMATE

Date 23 April 1987

SUN VALLEY PARKWAY
I-10 & 291st AVE INTERCHANGE

DATE: 23/April/87
REVISED BY: CJL
CHECKED BY: JB
COMPILED BY: DH

No.	ITEM	QUANTITY	Unit	PRICE	AMOUNT		
1	ASPHALTIC CONCRETE PAVEMENT A.B.C. & SELECT MATERIAL 4"x4"x4"	19,342	S.Y.	9.00	$174	078	00
2	6" ADOT 5.10 Type A SINGLE CURB	4836	L.F.	4.00	19	344	00
3	CURB & GUTTER ADOT 5.10 TYPE A	4831	L.F.	5.00	24	155	00
4	DRIVEWAY APRON MAG S.D. 250	600	S.F.	3.00	1	800	00
5	CONCRETE MEDIAN ISLAND	16,915	S.F.	1.50	25	372	50
6	ROW MARKER, ADOT C-21.0	1	Ea.	150.00		150	00
7	SURVEY MARKER, ADOT C-21.0	1	Ea.	200.00		200	00
8	SURVEY MONUMENT MAG S.D. 120-2-10	1	Ea.	75.00		75	00
9	REMOVE EXIST. PULLBOX & CONDUIT	100%	L.S.	200.00		200	00
10	REMOVE A.C. PAVEMENT	4633	S.Y.	2.50	11	582	50
11	PAVEMENT MARKERS TYPE G	104	Ea.	25.00	2	600	00
12	WARNING SIGN W3-3	1	Ea.	200.00		200	00
13	CATCH BASINS ADOT C-15.30, TYPE 4 WITH GRATE	7	Ea.	1000.00	7	000	00
14	CATCH BASINS MAG S.D. 531 TYPE B	2	Ea.	1000.00	2	000	00
15	OUTLET HEADWALL	1	Ea.	500.00		500	00
16	24" CSP	392	L.F.	35.50	13	916	00
17	18" CSP	52	L.F.	29.00	1	508	00
18	15" RCRCP	258	L.F.	35.00	9	030	00
19	GUNITE CHANNEL 3" THICK	16,935	S.F.	2.80	47	418	00
20	GUNITE CHANNEL 4" THICK	15,872	S.F.	3.40	53	964	80
21	CUTOFF WALLS 2'x6'	827	L.F.	10.00	8	270	00

$
$

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433
PINETOP-LAKESIDE OFFICE
LAKESIDE, ARIZONA 85929
PHONE: 336-4170

JOB NO. 850840

ENGINEER'S ESTIMATE

Date 23 April 1987

SUN VALLEY PARKWAY
I-10 + 291st AVE. INTERCHANGE

No.	ITEM	QUANTITY	Unit	PRICE	AMOUNT		
22	FILL	37,000	C.Y	2.50	92	500	00
23	CUT	8300	C.Y.	1.50	12	450	00
24	FOUR - 10' X 10' BOX CULVERT ADOT CB-4	196	LF	1240.00	243	040	00
25	INLET WINGS ADOT CW6-1	4	Ea	1098.00	4	392	00
26	SHOULDER MATERIAL	664	TONS	6.50	4	316	00

$ 760,061 | 80

$

DATE: 23/April/87
REVISED BY: CJL
CHECKED BY: JB
COMPILED BY: DH

Collar, Williams & White Engineering, Inc.
Consulting Engineers and Land Surveyors
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
PHONE: 947-5433
PINETOP-LAKESIDE OFFICE
LAKESIDE, ARIZONA 85929
PHONE: 536-4170

ENGINEER'S ESTIMATE

JOB NO. 850840 Date 23 April 1987

Filing Fee Estimate Total Estimated Cost $760,062.00

DATE: 23 April 87
REVISED BY: CJL
CHECKED BY: JB
COMPILED BY: DH

No.	ITEM	QUANTITY	Unit	PRICE	AMOUNT		
	Filing Fee	1	EA	50.00		50	00
	1st $250,000	250,000	$	1%	2	500	00
	Next $750,000	510,062	$	0.5%	2	550	31
	(Total 760,062 - 250,000 = 510,062)						

$ 5100 31

$

SPECIFICATIONS - SPECIAL PROVISIONS

SPECIAL PROVISIONS

Crossing of Buckeye Flood Retarding Structure

1. Clearing, Grubbing and Site Preparation

Scope

The work shall consist of clearing and grubbing designated areas by removal of trees, shrubs, fences and rubbish. The limits of the area to be cleared will be marked by stakes or flags. Trees, structures, or fences to be left standing or undisturbed will be designated on the plans or with special markings in the field.

Disposal

Unless otherwise specified, all materials, removed in the clearing, grubbing and site preparation will be burned or buried, or otherwise disposed of as approved by the Engineer.

Items of Work

Items of work to be performed in conformance to this specification are:

a. Clear and grub upstream and downstream faces and top of existing dam, working areas as needed (and as approved by the Engineer).

b. Clear and grub downstream face of dam by removing all heavy brush, large plants and trees. Those areas on the downstream face that have only widely scattered trees or bushes shall be cleared by hand methods to minimize disturbance to the surface that might encourage erosion.

2. Removal of Water

Scope

The work shall consist of the removal of surface water and groundwater as needed to perform the required construction in accordance with the plans and specifications. The Contractor shall build, maintain and operate all necessary diversion or impounding work as needed to protect the construction.

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

Items of Work

This item shall consist of the temporary diversion or removal of surface water and dewatering of the construction site during the construction period.

3. Earth Fill

Earth fill construction shall conform to Section 211 of the MAG Standard Specifications except as modified as follows.

Foundation Preparation

Foundations for earth fill are composed of the natural grade at the upstream toe of the dam, the upstream slope for the existing dam, and the top of the existing dam where contact will be made between the existing and the new embankment.

Foundation surface shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill to a minimum depth of 4 inches unless otherwise specified.

The natural grade receiving new embankment at the upstream toe of the existing dam shall be processed to a depth of 2 feet. This may be accomplished by removing the native material to a depth of 1 foot, adjusting moisture in the subsoil as for embankment construction, and compacting the subsoil also the same as for embankment construction. The material previously removed can then be replaced under the same conditions relative to moisture and compaction.

The moisture content of loosened fill shall be controlled as specified for the earth fill, and the surface materials of the foundations shall be compacted with the first layer of earth fill as specified for subsequent layers of earth fill.

4. Measurement and Payment

No separate payment will be made for:

a. Clearing, Grubbing and Site Preparation
b. Removal of Water
c. Earth Fill

Compensation for this work will be included in other bid schedule items. Foundation Preparation shall be paid for at the contract unit price per square yard of "McMicken Dam Surface Preparation." Measurement shall be to a line 10 feet outside the toe of new fill as shown on the plans.