BRIDGE
SCOUR
EVALUATIONS

Work Order No. 80407
Contract No. CY 1995-11

Higley Road Bridge over the East Maricopa Floodway

(SN9504)

Preliminary Report

Submitted to:

Maricopa County
Department of Transportation

Submitted by:

PARSONS BRINCKERHOFF

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HYDRAULIC ANALYSIS FOR THE HIGLEY ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

MARICOPA COUNTY, ARIZONA

October, 1995

Submitted by:

Parsons Brinckerhoff Quade & Douglas

Tempe, Arizona

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1.0 INTRODUCTION

The existing Higley Road Bridge carries two-way vehicular traffic over the East Maricopa Floodway in Maricopa County, Arizona. Construction plans for the Higley Road Bridge over the East Maricopa Floodway were prepared by Boyle Engineering, dated January 1975; as-built drawings are dated September 7, 1977. The total length of the bridge is 376'-4.5". The plans shows six spans at approximately 62.8 foot spacing. The abutments are supported on battered piles with a tip elevation of approximately 1,284. The piers are supported on cast-in-place concrete piles with a tip elevation of approximately 1,256. Plan bed elevation is about 1,310. The field survey shows the channel bottom to be at elevation 1,305, approximately. The bridge carries two lanes of traffic and is approximately 59 feet wide. The roadway is oriented in a north-south direction and the profile is a vertical curve, except for the bridge approaches. The north approach roadway has a 0.88 percent grade, while the south approach roadway has a 0.16 percent grade. The bridge is located on a 40° skew angle, left.

Evaluating scour potential of the existing bridge is the primary goal of the project. This report provides data on East Maricopa Floodway hydrology and hydraulics in the bridge vicinity. Using the hydraulic data, a complete scour analysis is performed for the Higley Road Bridge.

Total scour depths for the 100-year flood are estimated to be 8.6 feet at the north and south abutments and 9 feet for all piers. Total scour for the 500-year flood is estimated to be 9.5 feet at the north and south abutments and 9 feet for all piers. It is expected that actual abutment scour will be less than the calculated depths.

Section 2.0 describes data collection followed by the site description in section 3.0. Section 4.0 summarizes the results of the hydraulic HEC-2 modeling. Section 5.0 explains scour processes and procedures for calculating bridge scour. Section 6.0 provides the results of the scour calculations. Section 7.0 provides an initial evaluation of the bridge and lists any deficiencies. No recommendations are provided in this report, they will be deferred to the final report.

2.0 DATA COLLECTION

Data was supplied by the Maricopa County Department of Transportation in the form of final plans for the Higley Road Bridge at the East Maricopa Floodway, project number 71103 dated January, 1975. The US Army Corps of Engineers HEC-2 output data files for the 100-year flood were supplied by the Maricopa County Flood Control District. Floodplain maps prepared by the Corps of Engineers for the Flood Control District were obtained along with USGS topographic maps for the bridge site.

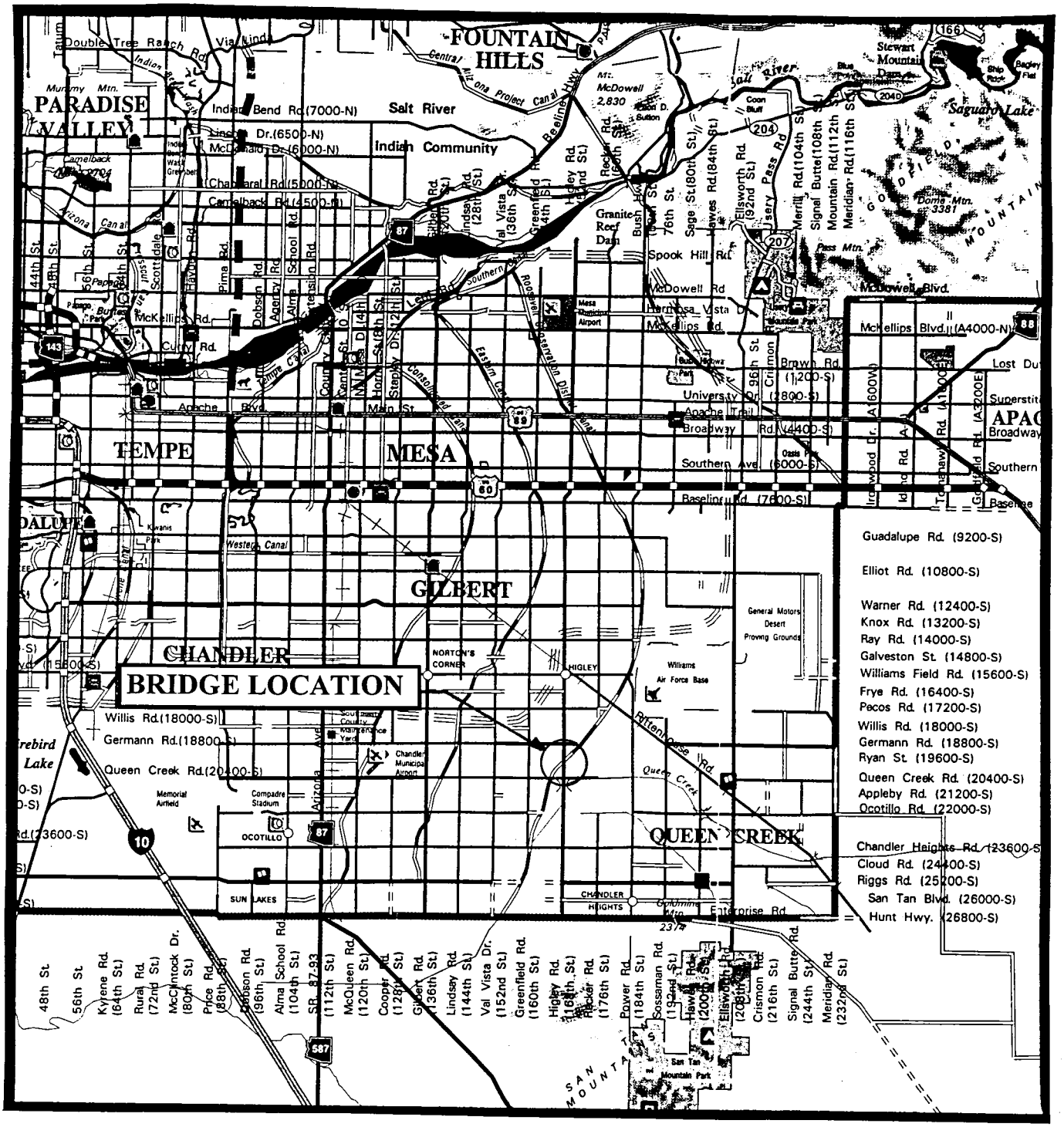
Parsons Brinckerhoff conducted a site visit on April 20, 1995. Extensive photographs of the site were taken and a visual survey of the bridge and surrounding area was made. A simple survey of the channel cross section was performed at that time.

The scour screening procedure for the National Bridge Inventory System is completed for the Higley Road Bridge. The screening forms are included in the Appendix. The Higley Road Bridge is rated as a low risk bridge with a recommended Item 113 rating of 8L and does not need a detailed scour analysis. No additional scour countermeasures are recommended as a result of the screening. In order to verify the screening results and demonstrate the validity of the screening procedures, a scour analysis was performed for the Higley Road Bridge. This information may be used in a structural stability analysis to verify the bridge has an adequate foundation. PB does not see this as necessary at this time.

3.0 SITE DESCRIPTION

As shown in Figure 1, the site lies in the southeast portion of Gilbert on the east side of Maricopa County. The bridge lies just upstream of the Queen Creek Road Bridge over the East Maricopa Floodway. The East Maricopa Floodway in the vicinity of the bridge is a man-made channel of trapezoidal shape and the terrain in the immediate area is relatively flat.

FIGURE 1


BRIDGE LOCATION
FOUNTAIN HILLS
PARADISE VALLEY
Salt River
Indian Community
TEMPE
MESA
GILBERT
CHANDLER
QUEEN CREEK
Guadalupe Rd. (9200-S)
Elliot Rd. (10800-S)
Warner Rd. (12400-S)
Knox Rd. (13200-S)
Ray Rd. (14000-S)
Galveston St. (14800-S)
Williams Field Rd. (15600-S)
Frye Rd. (16400-S)
Pecos Rd. (17200-S)
Willis Rd. (18000-S)
Germann Rd. (18800-S)
Ryan St. (19600-S)
Queen Creek Rd. (20400-S)
Appleby Rd. (21200-S)
Ocotillo Rd. (22000-S)
Chandler Heights Rd. (23600-S)
Cloud Rd. (24400-S)
Riggs Rd. (25200-S)
San Tan Blvd. (26000-S)
Hunt Hwy. (26800-S)

3.1 Geotechnical Evaluation

The original geotechnical investigation for this bridge was performed by Engineers Testing Laboratories, report dated May 24, 1974. Six borings were advanced to depths of from approximately 70 to 110 feet below adjacent existing ground surface. The materials encountered in the borings consisted predominantly of silty to clayey sands and gravels, with occasional lenses or layers of silty to sandy clay. Bedrock was not encountered in any of the borings. The estimated D_{50} particle size is 4 mm for bed, banks and overbanks.

The channel banks in the vicinity of the bridge, and the bed between the piers, are protected with riprap. The bed is grass-lined in the vicinity of the bridge. The floodway is densely vegetated with low height grass and there is no evidence of significant degradation at the bridge piers. There is no debris blockage upstream of the bridge piers. The channel bed load consist of sandy silty soil. During the field reconnaissance on April 20, 1995, no evidence of scour was noted. No accumulated debris was noted on the bridge structure.

3.2 Structural Evaluation

The Higley Road Bridge over East Maricopa Floodway is located on Higley Road between stations 127+44 and 131+20. The bridge structure is a six-span, skew, precast prestressed concrete box girder with an average span length of 62.75 feet. Each superstructure span is a pin at one end and expansion at the other end.

Each pier is supported by twenty 2.0-foot diameter cast-in-place concrete piles with nominal tip elevations at 1,256.00 feet. Top of pile caps are at nominal elevation 1,287.55 feet. The piers in plan above the pile caps are solid rectangles (vertical walls) with rounded upstream and downstream edges, skewed approximately 42 degrees left. Each abutment is supported by twenty 2.0-foot diameter cast-in-place concrete piles with nominal tip elevations at 1,284.00 feet.

The scour protection at abutments consist of riprap with slope of 2:1 extending from the face of the abutment to the adjacent pier at each abutment. At the south abutment there is evidence of top soil erosion due to local drainage runoff. The bridge structure seems to be sound with no visible sign of cracking or concrete spalling.

Looking uptream.

Looking downstream.

HIGLEY ROAD

Upstream face looking East.

Downstream face looking West.

HIGLEY ROAD

4.0 HYDRAULIC ANALYSIS

The 100-year and 500-year flood discharges are 6,900 cfs and 10,500 cfs, respectively. A chosen multiplication factor of 1.5 was used to obtain the 500-year discharge, as this information could not be supplied by FCDMC. As displayed in Table 1, the HEC-2 output for the existing conditions calculates the average velocity at the bridge to be 4.2 fps for the 100-year flood event. The water surface elevation at the bridge is 1,313.0 feet for the 100-year flood at existing conditions. Average velocity at the bridge is calculated as 4.8 fps for the 500-year flood. Computed water surface elevation at the bridge is 1,315.4 feet for the 500-year flood. The minimum freeboard requirement of 3 feet for the 100-year flood event is met at the Higley Road Bridge.

Table 1

	100-Year Flood Existing Conditions	*500-year Flood Existing Conditions*
Discharge (cfs)	6,900	10,500
Velocity (fps)	4.2	4.8
WSEL (feet)	1,313.0	1,315.4

5.0 SCOUR ANALYSIS

A scour analysis is performed for the proposed conditions for both the 100-year and 500-year flood scenarios. The potential for scour damage to the bridge piers and abutments is evaluated using the guidelines and procedures presented in Hydraulic Engineering Circular Number 18 (HEC-18). Total scour is comprised of four components: long-term trends, contraction scour, bend scour (where applicable), and local abutment and pier scour.

5.1 Long-Term Trends

Long-term trends in channel aggradation, degradation, and lateral migration are predicted qualitatively based on available sources of information including mapping, field observations, history of flooding and erosion, previous inspection reports, geomorphology, soil characteristics, land uses, flow patterns, control works, and any other factors which may have an influence on the river. The prediction of long-term trends is given in section 6.1.

5.2 Contraction Scour

Contraction scour is caused by the channel width decreasing at the bridge crossing. Contraction scour occurs when the area of flow is decreased, resulting in increases in both velocity and bed shear stress in the contracted area. There are two basic forms of contraction scour, live-bed and clear-water, both of which are based on the principle of conservation of sediment transport. Live-bed is the condition where bed material upstream of the crossing is being transported. For live-bed scour, material is removed until equilibrium is reached between sediment transported into and out of the contracted section. Clear-water is the condition where there is no transportation of upstream bed material.

Live bed conditions exist at the site because the critical velocity for beginning sediment motion is less than the average channel velocity. Critical velocities for the flood conditions are well below the average flow velocities calculated in the hydraulic analysis.

FHWA recommends the modified version of Laursen's 1960 equation for estimating live-bed contraction scour. Input parameters for the equation include average depth, discharge, bottom width, and D_{50} of the bed material. It should be noted that Laursen's equation will overestimate scour if the contraction is the result of bridge piers and abutments. Using the median grain size, k_1 conservatively assumes transported sediment is mostly contact bed material discharge. The equation is

$$\frac{Y_2}{Y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{k_1}$$

where

Y_1 = average depth in the upstream main channel
Y_2 = average depth in the contracted section
W_1 = bottom width of the upstream main channel
W_2 = bottom width of the contracted section
Q_1 = flow in the upstream channel transporting sediment
Q_2 = flow in the contracted channel
k_1 = relates to the mode of bed material transport (contact bed material vs. suspended bed load.
$Y_S = Y_2 - Y_1$ = average scour depth.

Since the bridge opening is the same as the floodway channel, construction scour is not applicable for this bridge.

5.3 Local Scour

Local scour is the result of water flowing around a pier, abutment, or other obstruction. These obstructions induce the formation of vortex systems caused by the acceleration of the flow around the obstruction. A horseshoe vortex is formed by water hitting the upstream surface of the obstruction and then traveling down the pier. In addition, piers have horizontal vortices, referred to as wake vortices, acting transverse to the pier downstream of the obstruction. Both vortices remove material from the base of the obstruction. However, the intensity of the vortices diminishes downstream from the obstruction.

The Colorado State University (CSU) equation is recommended for both live-bed and clear water pier scour. The basic input parameters are flow depth, pier shape, Froude number, pier width, and angle of attack. The angle of attack at the Higley Road Bridge Piers over the East Maricopa Floodway is 0°. The pier width used for scour calculations is two feet. No debris blockage is anticipated for the bridge because of the man-made channel and the bridge's location.

The CSU equation estimates equilibrium scour depths. Depending on the bed configuration, adding a recommended correction factor to the equilibrium scour yields the estimated maximum scour. The general lack of large vegetation precludes debris collecting at the bridge piers. The CSU equation is

$$\frac{Y_s}{Y_1} = 2.0 K_1 K_2 K_3 \left(\frac{a}{Y_1}\right)^{0.65} Fr_1^{0.43}$$

where

Y_s = scour depth
Y_1 = flow depth just upstream of the pier
K_1 = correction for pier nose shape
K_2 = correction for angle of attack
K_3 = correction for bed configuration
a = pier width
Fr_1 = Froude number; $Fr_1 = V_1/(gY_1)^{1/2}$
V_1 = max. mean velocity of flow directly upstream of the pier.

Froehlich's live-bed equation, shown below, is used for estimating live-bed and clear-water scour at abutments. The equation is based entirely on laboratory data and provides very conservative estimates of scour. The basic input parameters are Froude number, shape, and projection of abutment, skew, and depth of flow. The use of engineering judgment is recommended in using these estimates of abutment scour depth, because cost will be the deciding factor between greater foundation depth or protection of the abutment area.

$$\frac{Y_s}{Y_a} = 2.27 K_1 K_2 \left(\frac{a'}{Y_a}\right)^{0.43} Fr^{0.61} + 1$$

Where

K_1 = coefficient for abutment shape

K_2 = coefficient for angle of embankment to flow

$a' = A_e/Y_a$ = length of abutment projected normal to flow

A_e = flow area of the approach cross section obstructed by the embankment

$Fr_e = V_e/(gY_a)$ = Froude number of approach flow upstream of the abutment

$V_e = Q_e/A_e$ = local velocity at abutment

Q_e = flow obstructed by the abutment and approach embankment

Y_a = average depth of flow on the floodplain

Y_s = scour depth.

No bend scour is predicted to occur at the Higley Road Bridge because the East Maricopa Floodway flows in a straight line in the vicinity of the bridge.

5.4 Total Scour

Total scour at any location is estimated as the sum of any long term trends, contraction scour, and local scour. The total scour is then plotted on a cross section view of the bridge. Any estimated scour depth due to long-term trend predictions is plotted below the existing channel bottom. The estimated scour depth due to contraction scour is then plotted a computed distance below the revised channel bottom. Local scour is plotted for each pier and abutment in the shape of a scour hole. The top width of a scour hole is estimated to be 2.8 times the predicted scour depth. Debris blockage will add to the effective width of the piers and thus increase the scour depth. This increase in the scour depth has a direct result on the width of the scour hole as noted above. If the estimated limits of scour holes overlap, the resulting scour may be deeper than originally estimated.

6.0 RESULTS

6.1 Long-Term Trends

The elevation obtained in the field is approximately 5 feet lower than the elevation of the channel on the bridge plans. Degradation was not apparent from the field visit however to show maximum scour depths the degradation will be considered. No further degradation of the channel is expected to occur. Also, it is not known if there could be a datum difference accounting for some or all of the discrepancy.

The man-made channel will help prevent any lateral migration of the floodway. A constant elevation of 1,305 feet will be used for the invert for all scour calculations. This will allow remaining pile depths to be estimated and will help indicate critical scour depths.

6.2 Contraction Scour

As shown in Table 2, contraction scour is not predicted to occur for the flood events. The upstream width is taken as approximately 213 feet, which represents the distance across the top of the main channel. The two flood events have no contraction scour depths, because flow through the contracted section is equal to the total main channel approach flow for the 100-year and 500-year floods. All of the 100-year and 500-year flows are contained within the bridge structure. No flow overtops the approach roadway.

6.3 Local Scour

Local pier scour is predicted to occur at the bridge site for each of the flood events. The pier width used in the calculations was two feet. No significant debris accumulation was predicted to occur at this bridge because of the man-made channel and the location of the bridge. Maximum pier scour is estimated to be approximately 4 feet for both the 100-year and 500-year flood scenarios. The maximum estimated pier scour may occur at any of the piers. Calculations for pier scour are included in the Appendix.

Table 2

100-Year Flood Existing Conditions	*North Abutment*	*Pier*	*South Abutment*
Degradation	5 feet	5 feet	5 feet
Local Scour	3.6 feet	4 feet	3.6 feet
Contraction	0 feet	0 feet	0 feet
Total Scour	***8.6 feet***	***9 feet***	***8.6 feet***
Remaining Pile Depth	17.4 feet	28.4 feet*	17.4 feet
500-year Flood Existing Conditions	*North Abutment*	*Pier*	*South Abutment*
Degradation	5 feet	5 feet	5 feet
Local Scour	4.5 feet	4 feet	4.5 feet
Contraction	0 feet	0 feet	0 feet
Total Scour	***9.5 feet***	***9 feet***	***9.5 feet***
Remaining Pile Depth	16.5 feet	28.4 feet*	16.5 feet

* Additionally, there is 13.5 feet of remaining pier wall depth above the top of the pile caps.

As shown in table 2, the scour estimates for the 100-year flood at the north and south abutments are 3.6 feet. The scour estimates for the 500-year flood at the north and south abutments are 4.5 feet.

Please note that the abutment scour equation recommended by HEC-18 is inherently conservative and includes a large factor of safety. The riprap should adequately protect the abutments and should greatly reduce the predicted maximum scour depth.

6.4 Total Scour

Table 2 summarizes the total scour predicted at each pier and abutment for the 100-year and 500-year flood event. The effective pier width used in the scour calculations was the actual

width of the pier because debris accumulation was not predicted to occur at this bridge. It is possible for the maximum pier scour depth to occur at each pier, therefore only one representative pier is displayed in the table. Figure 2 shows the plotted scour holes associated with the 100-year flood. The 500-year flood is not plotted because the scour depths are similar to the 100-year flood event. Scour computations are included in the appendix.

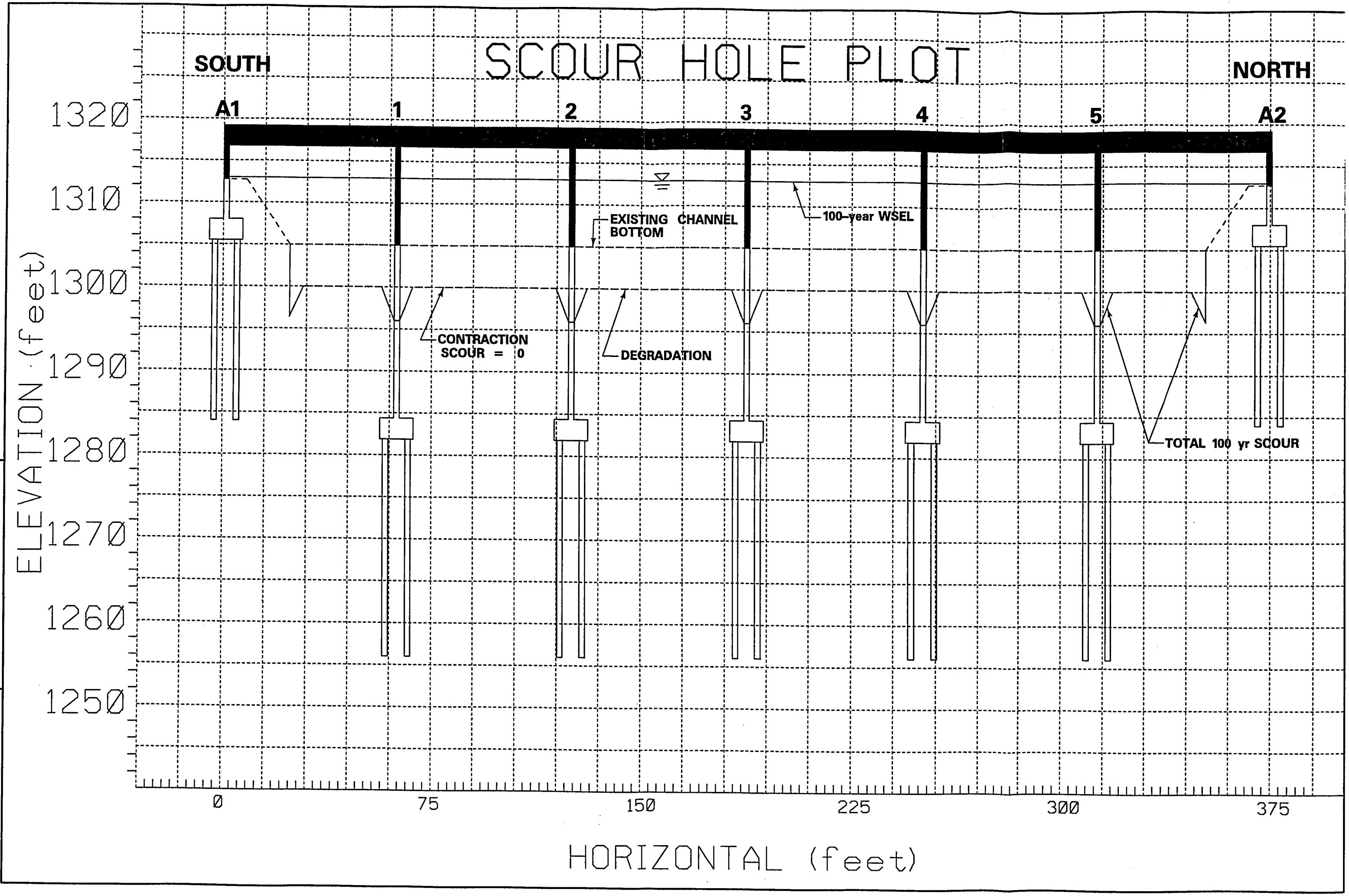
Abutment scour is not expected to be as severe as predicted in the scour computations or as shown in Figure 2. HEC-18 recommends placing abutment footings at least 6 feet below the depth reached by long-term degradation and contraction scour. The abutment pile tips extend well below the recommended depth. Abutment scour is not expected to be problematic at the Higley Road Bridge.

7.0 INITIAL EVALUATION

The existing pier configuration should adequately protect the piers during both the 100-year and 500-year floods with only minor scour depths occurring. Shallow scour depths are calculated at both abutments, however the riprap protection should prevent scour of the magnitude calculated. Abutment scour is not expected to be a problem at the Higley Road Bridge. Table 2 shows adequate remaining pile depth for both the 100-year and 500-year floods.

At the south abutment there is evidence of top soil erosion due to local drainage runoff. Preventive measures may need to be taken to ensure further erosion does not occur.

The Higley Road Bridge is rated as a low-risk bridge with a recommended Item 113 rating of 8L and does not need a detailed scour analysis. No additional scour countermeasures are recommended as a result of the screening.


SCOUR HOLE PLOT
SOUTH
NORTH
A1
1
2
3
4
5
A2
1320
1310
1300
1290
1280
1270
1260
1250
ELEVATION (feet)
EXISTING CHANNEL BOTTOM
100-year WSEL
CONTRACTION SCOUR = 0
DEGRADATION
TOTAL 100 yr SCOUR
0
75
150
225
300
375
HORIZONTAL (feet)
PREPARED BY
DATE
CHECKED BY
DATE
APPROVED BY
DATE
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11/13/95

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HIGLEY ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

CONTRACTION SCOUR

CASE 1 - LIVE BED	SEE NOTE	100-YEAR	500-YEAR
Y1 - AVE. DEPTH IN UPSTREAM MAIN CHANNEL(FT)	1	5.9	7.7
W1 - WIDTH OF UPSTREAM MAIN CHANNEL(FT)		213	213
W2 - WIDTH OF CONTRACTED SECTION(FT)	2	240	240
N1 - AT MAIN CHANNEL		0.035	0.035
N2 - AT CONTRACTED SECTION		0.035	0.035
Q_1 - FLOW IN UPSTREAM MAIN CHANNEL (CFS)		6,900	10,500
Q_2 - FLOW IN CONTRACTED SECTION (CFS)		6,900	10,500
(Q_2/Q_1)^6/7		1.00	1.00
S1 - SLOPE OF ENERGY GRADE LINE IN US CHANNEL (FT/FT)	3	0.00198	0.00168
V*c - SHEAR VELOCITY(FPS) = [32.2(Y1)(S1)]^0.5		0.61	0.65
K1	4	0.59	0.59
(W1/W2)^K1		0.93	0.93
Y2/Y1 = Q_2/Q_1^(6/7)(W1/W2)^K1		0.93	0.93
Ys = Y2-Y1 = SCOUR (FT)	5,6	0	-1

Not a significant scour.

NOTES:

1. Y1 IS AVE. DEPTH IN MAIN CHANNEL.

2. W2 = (BOTTOM WIDTH)-(SUM OF EFFECTIVE PIER WIDTHS). 250'-(5x2') = 240'

3. ENERGY GRADE LINE (USED TO OBTAIN K1).TAKEN FROM HEC-2.

4. K1 VALUE ASSUMES MOSTLY CONTACT BED MATERIAL DISCHARGE.

5. EQ. ASSUMES SEDIMENT TRANSPORT IN CHANNEL UPSTRM = SEDIM. TRANSP. AT CONTRACTED SECTION.

6. ASSUMES LIVE BED CONTRACTION SCOUR BECAUSE Vc<Vmean.

HIGLEY ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

PIER SCOUR - EXISTING CONDITIONS

		100-YEAR			500-YEAR		
CONTINUOUS BENT	SEE NOTE	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK
PIER NUMBER(S)			1-5			1-5	
SKEW ANGLE (DEGREES)			0			0	
a - PIER WIDTH (FT)	1		2			2	
K1	2		1.0			1.0	
K2	2		1.0			1.0	
K3	2		1.1			1.1	
V1 - VELOCITY, UPSTREAM FACE OF PIER (FT)	3		4.2			4.8	
Y1 - DEPTH OF FLOW UPSTRM. FACE OF PIER (FT)	4		7.1			8.9	
Fr1 - FROUDE NUMBER = V1/(32.2*Y1)^1/2			0.28 .278			0.28 .284	
[a/Y1]^0.65			0.44			0.38	
Ys/Y1 = 2K1K2K3(a/Y1)^.65(Fr1)^.43	5		0.56			0.48	
Ys SCOUR DEPTH (FT)			3.8' 4			4.3' 4	

NOTES:

1. PIER WIDTH IS THE PROJECTED WIDTH OF COLUMN, NORMAL TO FLOW.
   PIER WIDTH ASSUMES NO DEBRIS COLLECTS AT PIER.

2. K1=1.0 SINCE PIERS HAVE A ROUNDED NOSE.
   K2=1.0 SINCE ANGLE OF ATTACK IS 0.
   K3=1.1 FOR PLANE BED

3. VELOCITY IS AVERAGED OVER CHANNEL. VELOCITY OBTAINED FROM HEC-2 OUTPUT.

4. DEPTH VARIES AT DIFF. PIERS. AVG. VALUE IS OBTAINED FROM HEC-2 OUTPUT.

5. THE C.S.U. EQ. ESTIMATES EQUILIBRIUM SCOUR.

HIGLEY ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

ABUTMENT SCOUR

SPILLTHROUGH	SEE NOTE	100-YEAR NORTH ABUTMENT	100-YEAR SOUTH ABUTMENT	500-YEAR NORTH ABUTMENT	500-YEAR SOUTH ABUTMENT
Ya - DEPTH AT ABUT. (FT)		3.55	3.55	4.45	4.45
a'- ABUT. LENGTH NORMAL TO FLOW (FT)		35	25	40	30
(a'/Ya)^0.43		2.68	2.31	2.57	2.27
Ve = Qe/Ae	1	0.00	0.00	0.00	0.00
Fre = Ve/(32.2*Ya)^(1/2) = FROUDE NO.		0.00	0.00	0.00	0.00
Fre^0.61		0.00	0.00	0.00	0.00
(THETA) = ANGLE BTWN. ABUT. AND FLOW	2	0	0	0	0
K2 = ((THETA)/90)^0.13		0	0	0	0
K1	3	0.55	0.55	0.55	0.55
Ys/Ya=2.27K1K2* (a'/Ya)^0.43(Fre^0.61)+1		1.0	1.0	1.0	1.0
Ys SCOUR (FT)		3.6	3.6	4.5	4.5

NOTES:

1. Ve TAKEN FROM HEC-2 VELOCITY IN MAIN CHANNEL.

2. THETA < 90 IF POINTED DOWNSTREAM, > 90 IF POINTED UPSTREAM. THE ABUTMENT DOES NOT OBSTRUCT FLOW.

3. K1 = 0.55 FOR SPILLTHROUGH ABUTMENT.

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*       HIGLEY ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY
*       FILE NAME HIGLEY
*       PARSONS BRINCKERHOFF - TEMPE, ARIZONA
*       PREVIOUS HEC-2 RUN SUPPLIED BY THE MARICOPA COUNTY FLOOD
*       CONTROL DISTRICT WAS USED FOR THE UPSTREAM AND DOWNSTREAM
*       CROSS-SECTIONS.
*       NO EXTRA WIDTH WAS USED TO ACCOUNT FOR DEBRIS BLOCKAGE.
C
C    4
C 68500 EXIT SECTION - 1050' FROM DOWNSTREAM FACE OF BRIDGE
C 67450 DOWNSTREAM FACE OF BRIDGE
C 67400 UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD
C 66500 APPROACH SECTION - 900' FROM UPSTREAM FACE OF BRIDGE
T1     MCDOT HYDRAULIC ANALYSIS
T2     100-yr SUB-CRITICAL RUN FOR HIGLEY ROAD BRIDGE
T3     EAST MARICOPA FLOODWAY
J1            2                                                1312.17
J2     1             -1                                                  15
J3   100     105     150
NC 0.035   0.035   0.035     0.1     0.3
QT     2    6900   10500
X1 68500       6    93.5   306.5       0       0       0
GR1313.3    86.5  1313.3    93.5 1302.75     125 1302.75     275  1313.3   306.5
GR1313.3   313.5
X1 67700                             800     800     800             1.6
X1 67450       4     100     350     250     250     250
X3    10
GR  1316     100  1305.3     140  1304.5     320  1315.2     350
SB   0.9     1.5       3       0     180      10    2600       3    1305  1304.9
X1 67400       4     100     350      50      50      50
X2                     1    1317 1319.23
X3    10
BT     2     100 1319.23             350 1319.23
GR1316.1     100  1305.4     140  1304.6     320  1315.3     350
X1 67100       4     100     350     300     300     300
GR1315.1     100  1305.9     140  1304.9     320  1313.1     350
X1 66500       6    93.5   306.5     600     600     600
GR1317.6    86.5  1317.6    93.5 1307.07     125 1307.07     275  1317.6   306.5
GR1317.6   313.5
EJ
T1     MCDOT HYDRAULIC ANALYSIS
T2     500-yr SUB-CRITICAL RUN FOR HIGLEY ROAD BRIDGE
T3     EAST MARICOPA FLOODWAY
J1            3                                                1314.51
J2     2             -1                                                  15
ER
```

```
1*****************************************
 *  HEC-2 WATER SURFACE PROFILES          *
 *                                        *
 *  Version   4.6.2;  May 1991            *
 *                                        *
 *  RUN DATE    13OCT95    TIME   10:27:41  *
 *****************************************
```

```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

1

13OCT95 10:27:41 PAGE 1

THIS RUN EXECUTED 13OCT95 10:27:41

```
*************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
*************************************
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```
        HIGLEY ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY
        FILE NAME HIGLEY
        PARSONS BRINCKERHOFF - TEMPE, ARIZONA
        PREVIOUS HEC-2 RUN SUPPLIED BY THE MARICOPA COUNTY FLOOD
        CONTROL DISTRICT WAS USED FOR THE UPSTREAM AND DOWNSTREAM
        CROSS-SECTIONS.
        NO EXTRA WIDTH WAS USED TO ACCOUNT FOR DEBRIS BLOCKAGE.
T1      MCDOT HYDRAULIC ANALYSIS
T2      100-yr SUB-CRITICAL RUN FOR HIGLEY ROAD BRIDGE
T3      EAST MARICOPA FLOODWAY

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

                2                                                                 1312.17

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      1                  -1                                                                      15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    100        105        150

NC    0.035      0.035      0.035        0.1         0.3
```

```
QT        2       6900      10500
        EXIT SECTION - 1050' FROM DOWNSTREAM FACE OF BRIDGE
X1    68500          6       93.5      306.5          0          0          0
GR   1313.3       86.5     1313.3       93.5    1302.75        125    1302.75        275     1313.3      306.5
GR   1313.3      313.5

X1    67700                                        800        800        800                   1.6

        DOWNSTREAM FACE OF BRIDGE
X1    67450          4        100        350        250        250        250
X3       10
GR     1316        100     1305.3        140     1304.5        320     1315.2        350

SB      0.9        1.5          3          0        180         10       2600          3       1305     1304.9
        UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD
X1    67400          4        100        350         50         50         50
X2                             1       1317    1319.23
X3       10
BT        2        100    1319.23                   350    1319.23
GR   1316.1        100     1305.4        140     1304.6        320     1315.3        350
1
   13OCT95      10:27:41                                                                                  PAGE    2


X1    67100          4        100        350        300        300        300
GR   1315.1        100     1305.9        140     1304.9        320     1313.1        350

        APPROACH SECTION - 900' FROM UPSTREAM FACE OF BRIDGE
X1    66500          6       93.5      306.5        600        600        600
GR   1317.6       86.5     1317.6       93.5    1307.07        125    1307.07        275     1317.6      306.5
GR   1317.6      313.5
1
   13OCT95      10:27:41                                                                                  PAGE    3


    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*PROF 1
0

CCHV=     .100 CEHV=     .300
*SECNO 68500.000
        EXIT SECTION - 1050' FROM DOWNSTREAM FACE OF BRIDGE
 68500.000      9.42   1312.17       .00   1312.17   1312.43       .26       .00       .00   1313.30
    6900.0        .0    6900.0        .0        .0    1678.0        .0        .0        .0   1313.30
       .00       .00      4.11       .00      .000      .035      .000      .000   1302.75     96.87
   .000585        0.        0.        0.         0         0         0       .00    206.25    303.13


FLOW DISTRIBUTION FOR SECNO=  68500.00          CWSEL=   1312.17

STA=       97.      307.
  PER Q=    100.0
   AREA=   1678.0
    VEL=      4.1
```

```
  DEPTH=      8.1

*SECNO 67700.000
 67700.000      8.33   1312.68       .00       .00   1313.03       .35       .57       .03   1314.90
    6900.0        .0    6900.0        .0        .0    1457.2        .0      28.8       3.7   1314.90
       .05       .00      4.74       .00      .000      .035      .000      .000   1304.35    100.12
   .000895      800.      800.      800.         2         0         0       .00    199.76    299.88


FLOW DISTRIBUTION FOR SECNO=  67700.00          CWSEL=   1312.68

STA=     100.     307.
  PER Q=    100.0
   AREA=   1457.2
    VEL=      4.7
  DEPTH=      7.3

*SECNO 67450.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1316.00 ELREA=      1315.20

        DOWNSTREAM FACE OF BRIDGE
 67450.000      8.47   1312.97       .00       .00   1313.24       .27       .20       .01   1316.00
    6900.0        .0    6900.0        .0        .0    1662.9        .0      37.7       5.0   1315.20
       .06       .00      4.15       .00      .000      .035      .000      .000   1304.50    111.33
   .000703      250.      250.      250.         2         0         0       .00    232.41    343.74


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   13OCT95      10:27:41                                                                          PAGE    4


    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


FLOW DISTRIBUTION FOR SECNO=  67450.00          CWSEL=   1312.97

STA=     111.     350.
  PER Q=    100.0
   AREA=   1662.9
    VEL=      4.1
  DEPTH=      7.2


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
      .90      1.50      3.00       .00    180.00     10.00   2600.00      3.00   1305.00   1304.90

*SECNO 67400.000
CLASS A LOW FLOW

3420 BRIDGE W.S.=    1312.99 BRIDGE VELOCITY=       4.42     CALCULATED CHANNEL AREA=      1549.

 EGPRS      EGLWC       H3        QWEIR      QLOW      BAREA   TRAPEZOID      ELLC      ELTRD     WEIRLN
                                                                  AREA
       .00   1313.26       .01        0.     6900.     2600.     2472.     1317.00   1319.23        0.
```

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1316.10 ELREA= 1315.30

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

67400.000	8.38	1312.98	.00	.00	1313.26	.27	.02	.00	1316.10
6900.0	.0	6900.0	.0	.0	1643.1	.0	39.6	5.2	1315.30
.07	.00	4.20	.00	.000	.035	.000	.000	1304.60	111.65
.000729	50.	50.	50.	0	0	0	.00	231.86	343.51

FLOW DISTRIBUTION FOR SECNO= 67400.00 CWSEL= 1312.98

STA= 112. 350.
PER Q= 100.0
AREA= 1643.1
VEL= 4.2
DEPTH= 7.1

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 67100.000
3280 CROSS SECTION 67100.00 EXTENDED .10 FEET

67100.000	8.31	1313.21	.00	.00	1313.48	.27	.22	.00	1315.10
6900.0	.0	6900.0	.0	.0	1646.7	.0	51.0	6.9	1313.10
.09	.00	4.19	.00	.000	.035	.000	.000	1304.90	108.25
.000763	300.	300.	300.	1	0	0	.00	241.75	350.00

FLOW DISTRIBUTION FOR SECNO= 67100.00 CWSEL= 1313.21

STA= 108. 350.
PER Q= 100.0
AREA= 1646.7
VEL= 4.2
DEPTH= 6.8

*SECNO 66500.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .62

APPROACH SECTION - 900' FROM UPSTREAM FACE OF BRIDGE

66500.000	6.62	1313.69	.00	.00	1314.27	.59	.70	.09	1317.60
6900.0	.0	6900.0	.0	.0	1123.4	.0	70.0	9.8	1317.60
.11	.00	6.14	.00	.000	.035	.000	.000	1307.07	105.21
.001981	600.	600.	600.	2	0	0	.00	189.59	294.79

FLOW DISTRIBUTION FOR SECNO= 66500.00 CWSEL= 1313.69

```
 STA=      105.      307.
   PER Q=    100.0
    AREA=   1123.4
     VEL=      6.1
   DEPTH=      5.9

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 T1      MCDOT HYDRAULIC ANALYSIS
 T2      500-yr SUB-CRITICAL RUN FOR HIGLEY ROAD BRIDGE
 T3      EAST MARICOPA FLOODWAY

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

                 3                                                                  1314.51

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       2                  -1                                                                     15

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    13OCT95      10:27:41                                                                                    PAGE    7


     SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
     Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
     TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
     SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


 *PROF 2
0

 CCHV=      .100 CEHV=      .300
 *SECNO 68500.000
 3280 CROSS SECTION  68500.00 EXTENDED      1.21 FEET

         EXIT SECTION - 1050' FROM DOWNSTREAM FACE OF BRIDGE
  68500.000     11.76   1314.51       .00   1314.51   1314.87       .36       .00       .00   1313.30
    10500.0       9.0   10482.1       9.0       8.5    2172.6       8.5        .0        .0   1313.30
        .00      1.06      4.82      1.06      .035      .035      .035      .000   1302.75     86.50
    .000596        0.        0.        0.         0         0         0       .00    227.00    313.50


 FLOW DISTRIBUTION FOR SECNO=  68500.00          CWSEL=   1314.51

 STA=       87.       94.      307.      314.
   PER Q=        .1      99.8        .1
    AREA=       8.5    2172.6       8.5
     VEL=       1.1       4.8       1.1
   DEPTH=       1.2      10.2       1.2

 *SECNO 67700.000
 3280 CROSS SECTION  67700.00 EXTENDED       .12 FEET

  67700.000     10.67   1315.02       .00       .00   1315.47       .46       .57       .03   1314.90
    10500.0        .2   10499.5        .2        .8    1939.6        .8      37.9       4.2   1314.90
        .04       .30      5.41       .30      .035      .035      .035      .000   1304.35     86.50
```

.000873	800.	800.	800.	2	0	0	.00	227.00	313.50

FLOW DISTRIBUTION FOR SECNO= 67700.00 CWSEL= 1315.02

STA=	87.	94.	307.	314.
PER Q=	.0	100.0	.0	
AREA=	.8	1939.6	.8	
VEL=	.3	5.4	.3	
DEPTH=	.1	9.1	.1	

*SECNO 67450.000

1

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3280 CROSS SECTION 67450.00 EXTENDED .13 FEET

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1316.00 ELREA= 1315.20

DOWNSTREAM FACE OF BRIDGE

67450.000	10.83	1315.33	.00	.00	1315.67	.34	.19	.01	1316.00
10500.0	.0	10500.0	.0	.0	2229.4	.0	49.9	5.5	1315.20
.06	.00	4.71	.00	.000	.035	.000	.000	1304.50	102.51
.000668	250.	250.	250.	2	0	0	.00	247.49	350.00

FLOW DISTRIBUTION FOR SECNO= 67450.00 CWSEL= 1315.33

STA=	103.	350.
PER Q=	100.0	
AREA=	2229.4	
VEL=	4.7	
DEPTH=	9.0	

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.50	3.00	.00	180.00	10.00	2600.00	3.00	1305.00	1304.90

*SECNO 67400.000

3280 CROSS SECTION 67400.00 EXTENDED .05 FEET

CLASS A LOW FLOW

3420 BRIDGE W.S.= 1315.34 BRIDGE VELOCITY= 5.02 CALCULATED CHANNEL AREA= 2078.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1315.70	.02	0.	10500.	2600.	2472.	1317.00	1319.23	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1316.10 ELREA= 1315.30

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

67400.000	10.75	1315.35	.00	.00	1315.70	.35	.02	.00	1316.10
10500.0	.0	10500.0	.0	.0	2209.2	.0	52.4	5.8	1315.30
.06	.00	4.75	.00	.000	.035	.000	.000	1304.60	102.82
.000687	50.	50.	50.	0	0	0	.00	247.18	350.00

1

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 67400.00 CWSEL= 1315.35

STA= 103. 350.
PER Q= 100.0
AREA= 2209.2
VEL= 4.8
DEPTH= 8.9

*SECNO 67100.000
3280 CROSS SECTION 67100.00 EXTENDED 2.45 FEET

67100.000	10.66	1315.56	.00	.00	1315.90	.35	.21	.00	1315.10
10500.0	.0	10500.0	.0	.0	2225.4	.0	67.7	7.5	1313.10
.08	.00	4.72	.00	.000	.035	.000	.000	1304.90	100.00
.000687	300.	300.	300.	0	0	0	.00	250.00	350.00

FLOW DISTRIBUTION FOR SECNO= 67100.00 CWSEL= 1315.56

STA= 100. 350.
PER Q= 100.0
AREA= 2225.4
VEL= 4.7
DEPTH= 8.9

*SECNO 66500.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .64

APPROACH SECTION - 900' FROM UPSTREAM FACE OF BRIDGE

66500.000	8.85	1315.92	.00	.00	1316.62	.70	.61	.11	1317.60
10500.0	.0	10500.0	.0	.0	1562.3	.0	93.8	10.6	1317.60
.10	.00	6.72	.00	.000	.035	.000	.000	1307.07	98.52
.001680	600.	600.	600.	2	0	0	.00	202.96	301.48

FLOW DISTRIBUTION FOR SECNO= 66500.00 CWSEL= 1315.92

STA= 99. 307.
PER Q= 100.0

AREA= 1562.3
VEL= 6.7
DEPTH= 7.7

1

THIS RUN EXECUTED 13OCT95 10:27:43

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

AST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 100

SECNO	EGLWC	ELLC	EGPRS	ELTRD	QPR	QWEIR	CLASS	H3	DEPTH	CWSEL	VCH	EG
67400.000	1313.26	1317.00	.00	1319.23	6900.00	.00	1.00	.01	8.38	1312.98	4.20	1313.26
67400.000	1315.70	1317.00	.00	1319.23	10500.00	.00	1.00	.02	10.75	1315.35	4.75	1315.70

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AST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 105

SECNO	CWSEL	HL	OLOSS	TOPWID	QLOB	QCH	QROB
67700.000	1312.68	.57	.03	199.76	.00	6900.00	.00
67700.000	1315.02	.57	.03	227.00	.24	10499.52	.24
67450.000	1312.97	.20	.01	232.41	.00	6900.00	.00
67450.000	1315.33	.19	.01	247.49	.00	10500.00	.00
67400.000	1312.98	.02	.00	231.86	.00	6900.00	.00
67400.000	1315.35	.02	.00	247.18	.00	10500.00	.00
67100.000	1313.21	.22	.00	241.75	.00	6900.00	.00
67100.000	1315.56	.21	.00	250.00	.00	10500.00	.00

1

AST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	68500.000	.00	.00	.00	1302.75	6900.00	1312.17	.00	1312.43	5.85	4.11	1677.96	2853.67
	68500.000	.00	.00	.00	1302.75	10500.00	1314.51	.00	1314.87	5.96	4.82	2189.50	4299.85
	67700.000	800.00	.00	.00	1304.35	6900.00	1312.68	.00	1313.03	8.95	4.74	1457.16	2306.28
	67700.000	800.00	.00	.00	1304.35	10500.00	1315.02	.00	1315.47	8.73	5.41	1941.19	3553.18
	67450.000	250.00	.00	.00	1304.50	6900.00	1312.97	.00	1313.24	7.03	4.15	1662.86	2603.16
	67450.000	250.00	.00	.00	1304.50	10500.00	1315.33	.00	1315.67	6.68	4.71	2229.37	4062.08
	67400.000	50.00	1319.23	1317.00	1304.60	6900.00	1312.98	.00	1313.26	7.29	4.20	1643.08	2555.99
	67400.000	50.00	1319.23	1317.00	1304.60	10500.00	1315.35	.00	1315.70	6.87	4.75	2209.17	4005.16
	67100.000	300.00	.00	.00	1304.90	6900.00	1313.21	.00	1313.48	7.63	4.19	1646.66	2498.28
	67100.000	300.00	.00	.00	1304.90	10500.00	1315.56	.00	1315.90	6.87	4.72	2225.42	4004.86
*	66500.000	600.00	.00	.00	1307.07	6900.00	1313.69	.00	1314.27	19.81	6.14	1123.45	1550.33
*	66500.000	600.00	.00	.00	1307.07	10500.00	1315.92	.00	1316.62	16.80	6.72	1562.34	2561.99

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AST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	68500.000	6900.00	1312.17	.00	.00	.00	206.25	.00
	68500.000	10500.00	1314.51	2.34	.00	.00	227.00	.00
	67700.000	6900.00	1312.68	.00	.51	.00	199.76	800.00
	67700.000	10500.00	1315.02	2.33	.51	.00	227.00	800.00
	67450.000	6900.00	1312.97	.00	.29	.00	232.41	250.00
	67450.000	10500.00	1315.33	2.36	.31	.00	247.49	250.00
	67400.000	6900.00	1312.98	.00	.01	.00	231.86	50.00
	67400.000	10500.00	1315.35	2.36	.02	.00	247.18	50.00
	67100.000	6900.00	1313.21	.00	.22	.00	241.75	300.00
	67100.000	10500.00	1315.56	2.35	.21	.00	250.00	300.00
*	66500.000	6900.00	1313.69	.00	.48	.00	189.59	600.00
*	66500.000	10500.00	1315.92	2.24	.36	.00	202.96	600.00

1

SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO=  66500.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=  66500.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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MARYLAND SHA CODING GUIDE FOR ITEM 113
SCOUR CRITICAL BRIDGES

CODE		DESCRIPTION
1ST DIGIT	2ND DIGIT	
N	-	BRIDGE NOT OVER WATERWAY
9	-	BRIDGE FOUNDATIONS (INCLUDING PILES) WELL ABOVE FLOOD WATER ELEVATIONS (SEE NOTE 1)
8	P	BRIDGE IS A STRUCTURE WITH A FULL LENGTH PAVED BOTTOM
8	L	BRIDGE HAS BEEN EVALUATED/ASSESSED IN THE FIELD AND OFFICE AS A LOW RISK STRUCTURE; NO FURTHER STUDY IS PLANNED
7	-	COUNTERMEASURES HAVE BEEN INSTALLED SINCE THE ORIGINAL CONSTRUCTION TO CORRECT A PROBLEM WITH SCOUR; BRIDGE IS NO LONGER SCOUR CRITICAL
6	-	BRIDGE HAS NOT BEEN EVALUATED FOR SCOUR
6	R	BRIDGE IS SCHEDULED FOR MAJOR REHABILITATION OR REPLACEMENT WITHIN THE NEXT 5 YEARS; THE SCOUR STUDY IS DEFERRED TO THE LOCATION/DESIGN PHASE OF THE BRIDGE PROJECT
6	T	TIDAL FLOW PREDOMINATES FOR WORST SCOUR CONDITIONS; THE ITEM 113 RATING IS DEFERRED WHERE THERE IS NO INDICATION OF SEVERE SCOUR CONDITIONS
6	U	THE BRIDGE FOUNDATIONS ARE UNKNOWN. THE BRIDGE SITE CONDITIONS HAVE BEEN EVALUATED/ASSESSED WITH CURSORY STUDY IN THE FIELD AND OFFICE AND THE RISK OF POTENTIAL DAMAGE FROM SCOUR IS JUDGED TO BE MODERATE OR MILD. STRUCTURE HAS NO HISTORY OF SCOUR PROBLEMS. FURTHER EVALUATION IS DEFERRED. (SEE NOTE 1)
5	-	A DETAILED SCOUR STUDY (ANALYSIS) HAS BEEN MADE AND THE STRUCTURE IS RATED AS STABLE.
4	-	BRIDGE FOUNDATIONS DETERMINED TO BE STABLE ON THE BASIS OF A FIELD AND OFFICE SCOUR EVALUATION OR ANALYSIS; BRIDGE INSPECTION REVEALS THAT ACTION IS REQUIRED TO PROTECT EXPOSED PILES FROM EFFECTS OF ADDITIONAL EROSION AND CORROSION

3	A	BRIDGE IS RATED AS SCOUR CRITICAL ON THE BASIS OF A FIELD AND OFFICE EVALUATION OR AN ANALYSIS; THE POTENTIAL RISK IS JUDGED TO BE MILD, AND NO ACTIONS ARE PLANNED OTHER THAN MONITORING.
3	B	BRIDGE IS RATED AS SCOUR CRITICAL ON THE BASIS OF A FIELD AND OFFICE EVALUATION OR AN ANALYSIS; THE POTENTIAL RISK IS JUDGED TO BE MODERATE AND NO ACTIONS ARE PLANNED OTHER THAN MONITORING.
3	C	BRIDGE IS RATED AS SCOUR CRITICAL ON THE BASIS OF A FIELD AND OFFICE EVALUATION OR AN ANALYSIS; THE POTENTIAL RISK IS JUDGED TO BE SEVERE AND SCOUR COUNTERMEASURES ARE PLANNED. MONITORING IS TO BE UTILIZED UNTIL SCOUR COUNTERMEASURES ARE IN PLACE.
2	-	BRIDGE IS SCOUR CRITICAL; FIELD REVIEW INDICATES THAT EXTENSIVE SCOUR HAS OCCURRED AT A BRIDGE FOUNDATION. IMMEDIATE ACTION IS REQUIRED TO PROVIDE SCOUR COUNTERMEASURES.
1	-	BRIDGE IS SCOUR CRITICAL; FIELD REVIEW INDICATES THAT FAILURE OF PIERS/ABUTMENTS IS IMMINENT. BRIDGE IS CLOSED TO TRAFFIC.
0	-	BRIDGE IS SCOUR CRITICAL; BRIDGE HAS FAILED AND IS CLOSED TO TRAFFIC.

NOTE 1: IF THE RISK OF DAMAGE FROM POTENTIAL OR ACTUAL SCOUR DAMAGE IS JUDGED TO BE SEVERE, ADDITIONAL SCOUR STUDIES WILL BE UNDERTAKEN INCLUDING BORINGS OR OTHER MEANS OF SUBSURFACE EXPLORATION TO ASCERTAIN FOUNDATION AND SUPPORTING SOIL CONDITIONS.

STRUCTURES INVENTORY AND APPRAISAL
(NATIONAL BRIDGE INVENTORY SYSTEM)

SCREENING PROCEDURE FOR
RATING BRIDGES FOR ITEM 113, SCOUR CRITICAL BRIDGE

AGENCY: *PARSONS BRINCKERHOFF* BRIDGE NO.: *8883*
ROUTE: *HIGLEY ROAD* STREAM: *EAST MARICOPA FLOODWAY*

SCREEN 1 - BRIDGE INSPECTOR'S SCREEN

EVALUATOR'S NAME: _____ DATE: *4/20/95*
RECOMMENDATION: ☐ RATE BRIDGE: 8L ☒ GO TO SCREEN 2

CRITERIA	RESPONSE		ITEM 113 RATING
	YES	NO	
1-1. BRIDGE OVER WATERWAY?	CONTINUE	RATE BRIDGE	N
1-2. BRIDGE INSPECTION REPORTS INDICATE:			
• BRIDGE FAILED/CLOSED DUE TO SCOUR	RATE BRIDGE	CONTINUE	O
• BRIDGE CLOSED; FAILURE IMMINENT DUE TO SCOUR	RATE BRIDGE	CONTINUE	1
• FOOTING EXPOSED; PROMPT ACTION REQUIRED TO PROTECT BRIDGE FROM SCOUR	NOTIFY OWNER; RATE BR.	CONTINUE	2
• SCOUR HOLES HAVE FORMED TO DEPTHS NEAR BOTTOM OF SPREAD FOOTINGS	NOTIFY OWNER; RATE BR.	CONTINUE	2
• EXPOSED PILES REQUIRE PROTECTION	NOTIFY OWNER; RATE BR.	CONTINUE	4
1-3. BRIDGE IS A CULVERT WITH A PAVED INVERT	RATE BRIDGE	CONTINUE	8C
1-4. TIDAL FLOWS GOVERN BRIDGE HYDRAULICS FOR WORST SCOUR CONDITIONS	RATE BRIDGE (INTERIM RATING)	CONTINUE	6T

1-5. BRIDGE IS ON THE 5 YEAR CAPITAL REPLACE. PROGRAM	RATE BRIDGE	CONTINUE	6R
1-6 BRIDGE IS ON THE 2 YEAR PROGRAM FOR REMEDIAL WORK	RATE BRIDGE	CONTINUE SCREEN 2	6R

SCOUR EVALUATION FORM FOR
RATING BRIDGES FOR ITEM 113

SCREEN 2 - BRIDGE ENGINEER'S SCREEN

Agency: *PARSONS BRINCKERHOFF*

Date/Placeof Meeting: *APRIL 20, 1995;HIGLEY ROAD BRIDGE*

Attendees:

Bridge No.: *8883* Date Built on Bridge Plans: *1/77*

Description of Bridge/Bridge Type: *6 SPANS; PIERS SUPPORTED ON 20 2' DIA CIP CONCRETE PILES WITH NOMINAL TIP ELEVATION AT 1256.*

Route: *HIGLEY ROAD* Water Course: *EAST MARICOPA FLOODWAY*

Underclearance at thalweg (ft): *+-12*

Elevation of stream thalweg (ft): *+-1305*

Normal water elevation (ft): *N/A*

Reported high water elevation: *1315.05*

Description of flood: *100-year;*

Description of approach and "getaway" conditions: *CLEAN CHANNEL, LOW VEGETATION.*

Description of bed load: *SILTY TO SANDY CLAY.*

Condition of banks; evidence of lateral movement, degradation or aggradation: *NO EVIDENCE OF SCOUR OR EROSION, LATERAL MOVEMENT, OR DEGRADATION.*

Overtopping Q (cfs)/Recurrence interval: *> Q500 cfs/*

Stage rise to overtopping: ____

Depth/velocity through bridge at overtopping: *> Q500*

Confluences: *N/A*

BRIDGE NUMBER 8883

Description of flood plain: *WIDE FLAT FLOODPLAIN WITH SPARSE VEGETATION*

Item 321 rating: *8*
Item 71 rating: *9*
Item 61 rating: *9*

ABUTMENTS		
	LEFT	RIGHT
TYPE	*SPILL THROUGH*	*SPILL THROUGH*
SPREAD/PILES	*2' DIA. PILES*	*2' DIA. PILES*
EXPOSED FOOTINGS	*NO*	*NO*
FOOTING ELEVATION	*1305 TO 1284 TIP*	*1305 TO 1284 TIP*
ROCK ELEVATION AND DESCRIPTION	*N/A*	*N/A*
SOIL ELEVATION AND DESCRIPTION	*1305' SILTY SAND*	*1305' SILTY SAND*
ANGLE OF ATTACK OF FLOOD FLOWS ON ABUTMENT	*0*	*0*
DESCRIPTION OF RIPRAP OR OTHER SCOUR PROTECTION	*BOULDERS 12" DIA.; AND EXTEND TO PIER*	*BOULDERS 12" DIA.; AND EXTEND TO PIER*
ITEM 113 RATING	*9*	*9*

GENERAL COMMENTS:

1.) *ABUTMENTS ARE PROTECTED AND THE PROTECTION EXTENDS TO THE FIRST PIER.*

BRIDGE NUMBER 8883

PIERS						
	1	2	3	4	5	6
CHANNEL/FLOODPLAIN	*CH.*					
PIER WIDTH	*24" DIA*					
SPREAD/PILES	*P*					
EXPOSED FOOTINGS	*NO*					
FOOTING HEIGHT	*N/A*					
FOOTING ELEVATION AND WIDTH	*1284 TO 1256* *12'x62'-6"*					
ROCK ELEVATION/TYPE	*N/A*					
ELEVATION OF TOP OF GROUND OR CHANNEL; SOIL TYPE	*1305* *SILTY SAND*					
ANGLE OF ATTACK (DEG)	*0*					
RIPRAP OR OTHER PROTECTION	*NONE*					
ITEM 113 RATING	*9*					

General Comments/Assessment:

1.) *PIER 1 IS TYPICAL FOR ALL PIERS.*

2) *NO RIPRAP PROTECTION IS PRESENT FOR PIERS 2-4.*

Recommended Item 113 and Risk Ratings:

9

BRIDGE NUMBER 8883

SCREEN 3 - HYDRAULIC ENGINEER'S SCREEN

NAME: *HIGLEY ROAD* DATE: *4/20/95*

AGENCY: *PARSONS BRINCKERHOFF*

THE RECOMMENDED ITEM 113 RATING FOR THIS STRUCTURE IS: *8L*

THIS RECOMMENDATION IS BASED ON:

X A SCOUR EVALUATION

X A FULL OR DETAILED SCOUR ANALYSIS

THE RECOMMENDATION HAS BEEN APPROPRIATELY COORDINATED WITH THE BRIDGE/FOUNDATION/GEOTECHNICAL ENGINEERS WHO HAVE PREPARED SCREENS 1, 2 AND 4.

COMMENTS ON SCREEN 3:

- USE OF SCREEN 3 IS RECOMMENDED WHEN THERE ARE QUESTIONS OR ISSUES WHICH HAVE NOT BEEN FULLY ADDRESSED DURING THE ITEM 113 BRIDGE SCOUR EVALUATION UTILIZING SCREEN 2.

- **AS A FIRST STEP, THE HYDRAULIC ENGINEER IS ENCOURAGED TO REVIEW APPROPRIATE AVAILABLE INFORMATION AND TO INSPECT THE BRIDGE SITE TO DETERMINE IF ADEQUATE INFORMATION CAN BE DEVELOPED TO RESPOND TO THE ISSUES ON SCOUR RAISED IN THE SCREEN 2 REVIEW WITHOUT CONDUCTING A FULL OR DETAILED SCOUR ANALYSIS.**

- SINCE THE ITEM 113 RATING REQUIRES THE EVALUATION OF THE STABILITY OF THE STRUCTURE UNDER WORST CASE SCOUR CONDITIONS, THE HYDRAULIC ENGINEER WILL GENERALLY NEED TO CONDUCT THE EVALUATION/ANALYSIS IN COOPERATION WITH A FOUNDATION/GEOTECHNICAL ENGINEER, AND SCREEN 4 SHOULD BE PREPARED AS APPROPRIATE.

- THE HYDRAULIC ENGINEER SHOULD DOCUMENT THE BASIS FOR HIS OR HER RECOMMENDATION OF THE ANTICIPATED EXTENT OF SCOUR TO BE EXPECTED AT THE BRIDGE. SCOUR ANALYSES SHOULD BE BASED ON THE PROCEDURES SET FORTH IN THE MARYLAND SHA PPM ON SCOUR EVALUATION OF BRIDGES DATED 6/17/91 AND IN THE FHWA HYDRAULIC ENGINEERING CIRCULARS 18 AND 20.

BRIDGE NUMBER 8883

SCREEN 4 - FOUNDATION/GEOTECHNICAL ENGINEER'S SCREEN

NAME: *HIGLEY ROAD* Date: *4/20/95*

AGENCY: *AGRA - EARTH AND ENVIRONMENTAL INC.*

THE RECOMMENDED ITEM 113 RATING FOR THIS STRUCTURE IS: *8L*

THIS RECOMMENDATION IS BASED ON:

X A SCOUR EVALUATION

☐ A FULL OR DETAILED SCOUR AND STRUCTURAL STABILITY ANALYSIS

THE RECOMMENDATION HAS BEEN APPROPRIATELY COORDINATED WITH THE BRIDGE AND HYDRAULIC ENGINEERS WHO HAVE PREPARED SCREENS 1, 2 AND 3.

COMMENTS ON SCREEN 4:

- USE OF SCREEN 4 IS RECOMMENDED WHEN THERE ARE QUESTIONS OR ISSUES WHICH HAVE NOT BEEN FULLY ADDRESSED DURING THE ITEM 113 BRIDGE SCOUR EVALUATION UTILIZING SCREEN 2.
- **AS A FIRST STEP, THE FOUNDATION/GEOTECHNICAL ENGINEER IS ENCOURAGED TO REVIEW APPROPRIATE AVAILABLE INFORMATION AND TO INSPECT THE BRIDGE SITE TO DETERMINE IF ADEQUATE INFORMATION CAN BE DEVELOPED TO RESPOND TO THE ISSUES ON SCOUR RAISED IN THE SCREEN 2 REVIEW WITHOUT CONDUCTING A FULL OR DETAILED SCOUR ANALYSIS.**
- SINCE THE ITEM 113 RATING REQUIRES THE EVALUATION OF THE STABILITY OF THE STRUCTURE IN ACCORDANCE WITH AASHTO STABILITY CRITERIA UNDER WORST CASE SCOUR CONDITIONS, THE FOUNDATION/GEOTECHNICAL ENGINEER WILL GENERALLY NEED TO CONDUCT THE EVALUATION/ANALYSIS IN COOPERATION WITH A HYDRAULICS ENGINEER TO ADDRESS PERTINENT SCREEN ISSUES.
- THE FOUNDATION/GEOTECHNICAL ENGINEER SHOULD DOCUMENT THE BASIS FOR HIS OR HER RECOMMENDATION REGARDING THE STABILITY OF THE BRIDGE FOR THE ANTICIPATED WORST CASE SCOUR CONDITIONS AND THE EXTENT OF SCOUR TO BE EXPECTED AT THE BRIDGE. PARTICULAR ATTENTION SHOULD BE GIVEN TO:
  - FOUNDATIONS ON ROCK AND THE DEGREE TO WHICH THE ROCK IS SCOUR- RESISTANT.
  - THE STABILITY OF FOUNDATIONS ON PILES, IF THE PILING CAN BE EXPECTED TO BE EXPOSED BY SCOUR.
  - EVALUATION OF EXISTING INFORMATION TO DETERMINE OR ESTIMATE FOUNDATION CONDITIONS WHEN THE BRIDGE PLAN DETAILS ARE INCOMPLETE.

BRIDGE NUMBER 8883

REVIEW BY INTERDISCIPLINARY SCOUR EVALUATION TEAM

DATE: _____ ITEM 113 RATING: _____

RISK RATING: _____

PROPOSED ACTIONS:

1.) _____

_____

_____

Notes:

BRIDGE NUMBER 8883

SCREEN 5 - BRIDGE MANAGER'S SCREEN

NAME/SIGNATURE : *PARSONS BRINCKERHOFF* DATE: 4/20/95

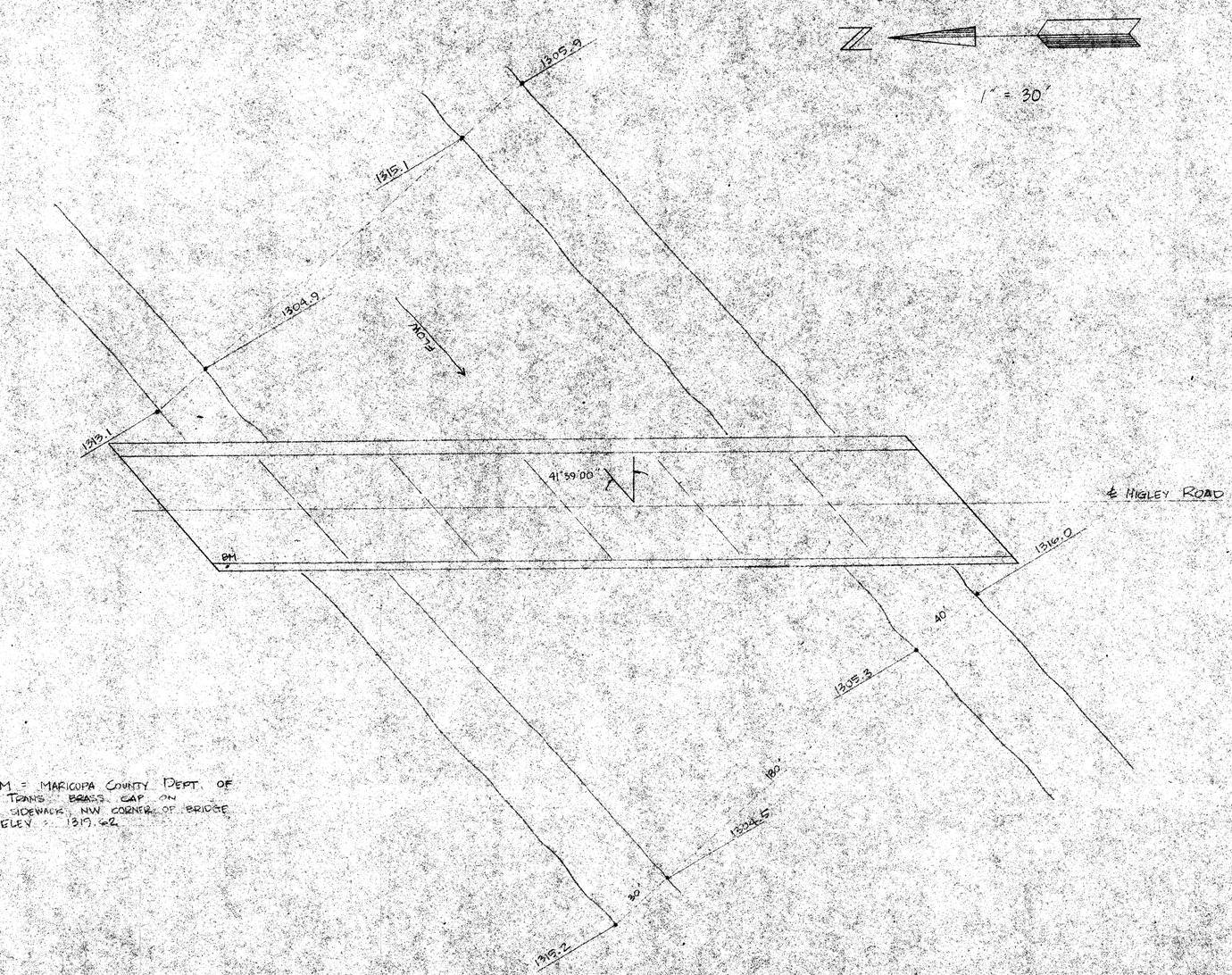
I HAVE REVIEWED SCREENS 1-4 AND CONCUR WITH THE FOLLOWING RATINGS:

- ITEM 113 RATING: *8L* DESCRIPTION:
- RISK RATING (FOR ITEM 113 RATING CODES 3 AND 6): *N/A*

COMMENTS ON SCREEN 5:

1. THE CODES SET FORTH IN TABLE 1, ARE TO BE USED IN RATING BRIDGES FOR ITEM 113.

2. EACH BRIDGE MANAGER/OWNER NEEDS TO DEVELOP AN ACTION PLAN FOR SCOUR CRITICAL BRIDGES (SEE FHWA HEC- 18, CHAPTER 7) THIS PLAN SHOULD ADDRESS MONITORING OF SCOUR CRITICAL BRIDGES DURING HIGH WATER AND SCHEDULING AND INSTALLATION OF SCOUR COUNTERMEASURES WHERE DETERMINED TO BE NECESSARY. IT IS RECOMMENDED THAT SCOUR CRITICAL BRIDGES BE PRIORITIZED (ACCORDING TO THE ENGINEER'S JUDGMENT AS TO THE RELATIVE RISK OF SUSTAINING DAMAGE DUE TO SCOUR IN A FUTURE FLOOD) AS SEVERE (3), MODERATE (2) OR MILD (1). BRIDGES CODED AS 6 U SHOULD ALSO BE GIVEN A RISK RATING AS DESCRIBED IN TABLE 1.



BM = MARICOPA COUNTY DEPT. OF TRANS. BRASS CAP ON SIDEWALK, NW CORNER OF BRIDGE
ELEV. = 1319.62

SCHEMATIC
NOT FOR CONSTRUCTION

HIGLEY ROAD BRIDGE

SURVEYED - APRIL 20, 1995 KJS, DB

DRAWN - APRIL 24, 1995 KJS