BRIDGE SCOUR EVALUATIONS

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

Chandler Heights Road Bridge over the East Maricopa Floodway

(SN9409)

Preliminary Report

Submitted to:

Maricopa County
Department of Transportation

Submitted by:

PB 100 YEARS PARSONS BRINCKERHOFF

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HYDRAULIC ANALYSIS FOR THE CHANDLER HEIGHTS ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

MARICOPA COUNTY, ARIZONA

October, 1995

Submitted by:

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Tempe, Arizona

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1.0 INTRODUCTION

The existing Chandler Heights Road Bridge carries vehicular traffic over the East Maricopa Floodway in Maricopa County, Arizona. Construction plans for the Chandler Heights Road Bridge over the East Maricopa Floodway were prepared by Engineering Corporation of America, Phoenix, Arizona, dated November 1974. The total length of the bridge is 312 feet. The plans show four spans each 78.0 feet in length. The abutments are supported on 13 drilled shafts with a 2-foot diameter and a tip elevation of 1,271. The piers are supported on 22 drilled shafts with a tip elevation of 1,257. Plan bed elevation is about 1,291, which is approximately 2.5 feet lower than the elevation of the channel obtained from the field survey. Drawing 1 of 12 of Engineering Corp. plans shows a 100-year flowrate of 24,000 cubic feet per second (cfs) and corresponding velocity of 5 feet per second (fps). High water elevations are also given on the plan, corresponding to this flowrate. The Flood Control District of Maricopa County supplied PB with a peak flow of 8,100 cfs for the 100 year event. The district was contacted to inquire as to the nature of the discrepancy (24,000 - 8,100 = 15,900 cfs). PB was informed that the channel/bridge was never constructed to convey the higher flowrate and it's use in this analysis would be inappropriate. In addition, since the plan bed elevation given is 2.5 feet lower than the field survey, comparisons between present channel/flowrates and that of the design plans prepared in 1974 are difficult. Since the present flowrate is about 1/3 of that previously used and velocities are low, PB does not expect that any serious scour problems will be encountered at this bridge. Nevertheless, we shall go through the computation procedure. The bridge carries two lanes of traffic and is approximately 57'-7" wide. The roadway is oriented in a east-west direction and the profile is in a tangent section, except for the bridge approaches which are on vertical curves. The east approach roadway has a 1.83 percent grade, while the west approach roadway has a 3.17 percent grade.

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 Chandler Heights Road Bridge.

Total scour depths for the 100-year flood are estimated to be 2.7 feet at the east and west abutments and 3 feet for all piers. Total scour for the 500-year flood is estimated to be 5 feet at the east and west abutments and 5 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 Chandler Heights Road Bridge at the East Maricopa Floodway, project number 71101 dated 1974. 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.

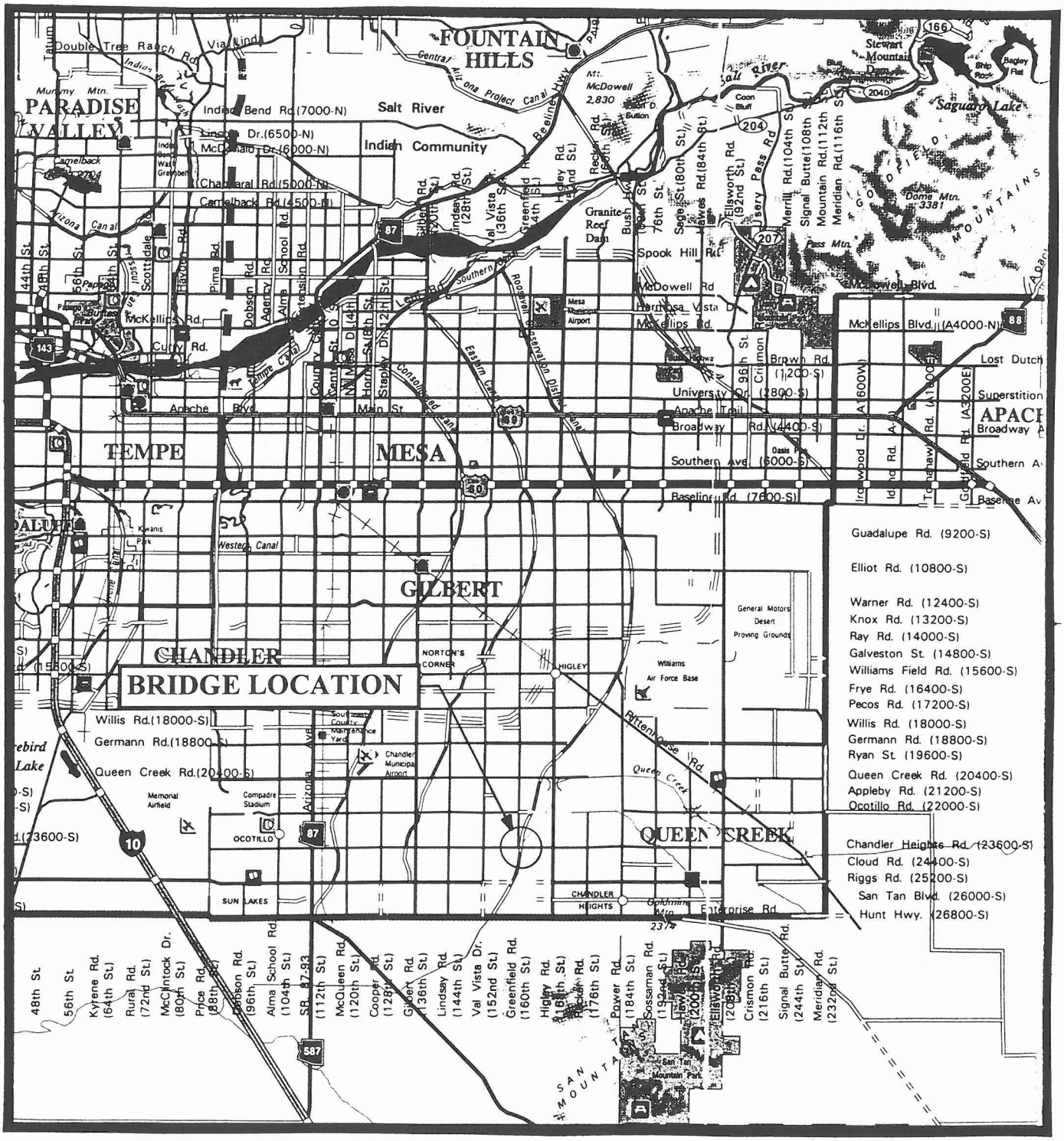
Parsons Brinckerhoff conducted a site visit on April 20, 1995. Extensive photographs of the site were taken and a visual survey of the bridge and surrounding area was made. A simple survey of the channel cross section was performed on that date.

The scour screening procedure for the National Bridge Inventory System is completed for the Chandler Heights Road Bridge. The screening forms are included in the Appendix. The Chandler Heights 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 Chandler Heights Road Bridge. This information may be used in a structural stability analysis to verify the bridge has an adequate foundation. However, no stability analysis is necessary.

3.0 SITE DESCRIPTION

As shown in Figure 1, the site lies in the south portion of Gilbert east of the Queen Creek community on the east side of Maricopa County. The terrain in the immediate area is relatively flat. The East Maricopa Floodway in the vicinity of the bridge is a man-made channel of trapezoidal shape and is relatively dry most of the year. At the east bank of the waterway there are irrigation runoff channels upstream and downstream of the structure. The irrigation channel

FIGURE 1


BRIDGE LOCATION
FOUNTAIN HILLS
PARADISE VALLEY
Salt River Indian Community
TEMPE
MESA
GILBERT
CHANDLER
QUEEN CREEK
SUN LAKES
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)
Willis Rd.(18000-S)
Germann Rd.(18800-S)
Queen Creek Rd.(20400-S)
(23600-S)
48th St
56th St
Kyrene Rd. (64th St)
Rural Rd. (72nd St)
McClintock Dr. (80th St)
Price Rd. (88th St)
Dobson Rd. (96th St)
Alma School Rd. (104th St)
SR 87-93 (112th St)
McQueen Rd. (120th St)
Cooper Rd. (128th St)
Gilbert Rd. (136th St)
Lindsay Rd. (144th St)
Val Vista Dr. (152nd St)
Greenfield Rd. (160th St)
Higley Rd. (168th St)
Recker Rd. (176th St)
Power Rd. (184th St)
Sossaman Rd. (192nd St)
Ellsworth Rd. (208th St)
Crismon Rd. (216th St)
Signal Butte Rd. (244th St)
Meridian Rd. (232nd St)

outlets are stabilized by grouted riprap and do not indicate any erosion in the vicinity of the outlets. There is a grade control drop structure upstream of the waterway. The waterway is densely vegetated by a low grass type of vegetation.

3.1 Geotechnical Evaluation

The original geotechnical investigation for this bridge was performed by Engineering Corporation of America in 1974 (date of investigation not noted on plans). Five borings were advanced to depths of 75 to 110 feet below adjacent existing ground surface. The materials encountered in the borings consisted predominantly of silty to clayey sands and gravels, with some cobbles near the surface and occasional lenses or layers of silty to sandy clay. Bedrock was not encountered in any of the borings, nor was groundwater. The estimated D_{50} particle size is 4 mm for bed, banks and overbanks.

There is a concrete drop structure upstream of the bridge, and the channel banks are protected with riprap or grouted riprap between the drop structure and the bridge. The bed is grass-lined in the vicinity of the bridge. During the field reconnaissance on April 20, 1995, no evidence of scour was noted. Vegetation consists of grass and weeds. No accumulated debris was noted on the bridge structure.

3.2 Structural Evaluation

The Chandler Heights Road Bridge over the East Maricopa Floodway is located on Chandler Heights Road, between stations 22+12 and 25+24. The total length of the bridge is 312 feet and total width is 57'-7". The bridge crosses the East Maricopa Floodway at an 18.5° skew angle, right.

The bridge structure is a four-span precast, prestressed AASHTOI-girder beam composite with a cast-in-place reinforced concrete deck slab. The superstructure is made continuous over the

piers and is pin connected to pier bents. The supports at abutments are expansion type simple supports. Each pier is supported by 22 2.0-foot diameter cast-in-place concrete piles, founded at nominal elevation 1,257 feet. The tops of the pile caps are at a nominal elevation 1,281.42 feet. Above the pile caps, the piers in plan are solid rectangles with rounded upstream and downstream edges, skewed approximately 7 1/2 degrees right. Each abutment is supported by 13 2.0-foot diameter cast-in-place concrete piles, founded at approximate nominal elevation 1,271 feet.

There is no evidence of degradation or scour at the piers or abutments. There is no debris blockage upstream or downstream of the bridge. In general, the bridge seems to be in good condition and the joints do not indicate any unusual movement or settlements.

Looking upstream.

Looking downstream.

CHANDLER HEIGHTS ROAD

Upstream face looking East.

Downstream face looking East.

CHANDLER HEIGHTS ROAD

4.0 HYDRAULIC ANALYSIS

The 100-year and 500-year flood discharges at the bridge are 8,100 cfs and 12,500 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 4.8 fps for the 100-year flood event. The water surface elevation at the bridge is 1,301.18 feet for the 100-year flood at existing conditions. This is based on the survey bed elevation of approximately 1,293.5. Average velocity at the bridge is calculated as 5.2 fps for the 500-year flood. Computed water surface elevation at the bridge is 1,304.21 feet for the 500-year flood. The minimum freeboard requirement of 3 feet for the 100-year flood event is met at the Chandler Heights Road Bridge.

Table 1

	100-Year Flood Existing Conditions	***500-year Flood Existing Conditions***
Discharge (cfs)	8,100	12,500
Velocity (fps)	4.8	5.2
WSEL (feet)	1,301.18	1,304.21

5.0 SCOUR ANALYSIS

A scour analysis is performed 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 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.

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 Chandler Heights Road Bridge over the East Maricopa Floodway is 0 degrees, i.e. the flow is normal to the bridge. Since the angle of attack is 0 degrees and because the piers are continuous columns, the pier width used for calculations is the width of the column. 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 location of the bridge.

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

$$\frac{Y_s}{Y_1} = 2.0K_1K_2K_3\left(\frac{a}{Y_1}\right)^{0.65} Fr_1^{0.43}$$

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 = 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

$V_e = Q_e/A_e$

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 Chandler Heights Road Bridge because the East Maricopa Floodway flows in a relatively 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 2.5 feet higher than the elevation of the channel on the bridge plans. No further aggradation is expected to occur beyond this point.

The man-made channel will help prevent any lateral migration of the floodway. A constant elevation of 1,293 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, minimal contraction scour is predicted to occur for the flood events. The upstream width is taken as approximately 271 feet, which represents the distance across the top of the main channel. The two flood events have minimal contraction scour depths, because flow through the contracted section is greater than the total main channel approach flow for the 100-year and 500-year floods. This is due to irrigation outfalls and runoffs just upstream of the bridge. All of the 100-year and 500-year flows are contained within the bridge structure. No flow overtops the approach roadway.

Table 2

100-Year Flood Existing Conditions	East Abutment	Pier	West Abutment
Aggradation	2 feet	2 feet	2 feet
Local Scour	3.7 feet	4 feet	3.7 feet
Contraction	1 foot	1 foot	1 foot
Total Scour	**2.7 feet**	**3 feet**	**2.7 feet**
Remaining Pile Depth	31.3 feet	17 feet	31.3 feet
500-year Flood Existing Conditions	**East Abutment**	**Pier**	**West Abutment**
Aggradation	2 feet	2 feet	2 feet
Local Scour	5 feet	5 feet	5 feet
Contraction	2 feet	2 feet	2 feet
Total Scour	**5 feet**	**5 feet**	**5 feet**
Remaining Pile Depth	29 feet	15 feet	29 feet

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 the 100-year flood and 5 feet for the 500-year flood scenario. The maximum estimated pier scour may occur at any of the piers. Calculations for pier scour are included in the Appendix.

As shown in table 2, the scour estimates for the 100-year flood at the east and west abutments are 3.7 feet. The scour estimates for the 500-year flood at the east and west abutments are 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. 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 piles extend well below the recommended depth. Abutment scour is not expected to be problematic at the Chandler Heights Road Bridge.

7.0 INITIAL EVALUATION

The existing pier configuration should adequately protect the piers during both the 100-year and 500-year floods. 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 Chandler Heights Road Bridge. Table 2 shows adequate remaining pile depth for both the 100-year and 500-year floods.

The Chandler Heights 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.

Ok Agree

SCOUR HOLE PLOT

WEST

EAST

A1

1

2

3

A2

100-year WSEL

AGGRADATION

EXISTING CHANNEL BOTTOM

CONTRACTION SCOUR

TOTAL 100 yr SCOUR

ELEVATION (feet)

1315
1310
1305
1300
1295
1290
1285
1280
1275

0
60
120
180
240
300

HORIZONTAL (feet)

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CHANDLER HEIGHTS 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	5.8	8.0
W1 - WIDTH OF UPSTREAM MAIN CHANNEL(FT)		271	271
W2 - WIDTH OF CONTRACTED SECTION(FT)	2	245	245
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)		8,100	12,500
$(Q_2/Q_1)^{6/7}$		1.15	1.16
S1 - SLOPE OF ENERGY GRADE LINE IN US CHANNEL (FT/FT)	3	0.00131	0.00093
V*c - SHEAR VELOCITY(FPS) = [32.2(Y1)(S1)]^0.5		0.49	0.49
K1	4	0.59	0.59
(W1/W2)^K1		1.06	1.06
$Y2/Y1 = Q_2/Q_1^{(6/7)}(W1/W2)^{K1}$		1.22	1.23
Ys = Y2-Y1 = SCOUR (FT)	5,6	1	2

NOTES:

1. Y1 IS AVE. DEPTH IN MAIN CHANNEL.

2. W2 = (BOTTOM WIDTH)-(SUM OF EFFECTIVE PIER WIDTHS). 251'-(3x2') = 245'

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.
   Vc=10.95Y1^(1/6)(D50)^(1/3)

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CHANDLER HEIGHTS 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)			1-3			1-3	
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		4.8			5.2	
Y1 - DEPTH OF FLOW UPSTRM. FACE OF PIER (FT)	4		7.3			9.9	
Fr1 - FROUDE NUMBER = V1/(32.2*Y1)^1/2			0.31			0.29	
[a/Y1]^0.65			0.43			0.35	
Ys/Y1 = 2K1K2K3(a/Y1)^.65(Fr1)^.43	5		0.58			0.46	
Ys SCOUR DEPTH (FT)			4			5	

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.

CHANDLER HEIGHTS ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

ABUTMENT SCOUR

		100-YEAR		500-YEAR	
SPILLTHROUGH	SEE NOTE	EAST ABUTMENT	WEST ABUTMENT	EAST ABUTMENT	WEST ABUTMENT
Ya - DEPTH AT ABUT. (FT)		3.65	3.65	4.95	4.95
a'- ABUT. LENGTH NORMAL TO FLOW (FT)		30	30	37	37
(a'/Ya)^0.43		2.47	2.47	2.37	2.37
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)		3.7	3.7	5.0	5.0

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.

```
*         CHANDLER HEIGHTS ROAD OVER THE EAST MARICOPA FLOODWAY
*         FILE NAME CHANDLER
*         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  88000 EXIT SECTION - 2000' FROM DOWNSTREAM FACE OF BRIDGE
C  85970 DOWNSTREAM FACE OF BRIDGE
C  85910 UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD
C  84000 APPROACH SECTION - 1910' FROM UPSTREAM FACE OF BRIDGE
T1       MCDOT HYDRAULIC ANALYSIS
T2       100-yr SUB-CRITICAL RUN FOR CHANDLER HEIGHTS ROAD BRIDGE
T3       EAST MARICOPA FLOODWAY
J1             2                                                 1300.67
J2     1       0      -1                                                 15
J3   100     105     150
NC 0.035   0.035   0.035     0.1     0.3
QT     2    8100   12500
X1 88000       6   65.35  334.65       0       0       0
GR1301.6   58.35  1301.6   65.35 1290.05     100 1290.05     300  1301.6  334.65
GR1301.6  341.65
X1 86000       6   69.85  330.15    2000    2000    2000
GR1300.7   62.85  1300.7   69.85 1290.65     100 1290.65     300  1300.7  330.15
GR1300.7  337.15
X1 85970       5     100     327      30      30      30
X3    10
GR1303.4     100    1293     127    1294     327  1302.6     356  1310.7     378
SB   0.9    1.56       3       0     200       6    3700     2.5  1293.4  1293.4
X1 85910       4     100     354      60      60      60
X2                     1    1309    1312                   1.33
X3    10
BT     2     100    1312             354  1312.5
GR1304.9     100  1293.4     129  1293.4     329  1310.4     354
X1 85610                               300     300     300
QT          6900   10500
X1 84000       6   64.09  335.91    1610    1610    1610
GR1308.7   57.09  1308.7   64.09 1296.73     100 1296.73     300  1307.2  335.91
GR1307.2  342.91
EJ
T1       MCDOT HYDRAULIC ANALYSIS
T2       500-yr SUB-CRITICAL RUN FOR CHANDLER HEIGHTS ROAD BRIDGE
T3       EAST MARICOPA FLOODWAY
J1             3                                                 1303.74
J2     2       0      -1                                                 15

ER
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1*****************************************
 *  HEC-2 WATER SURFACE PROFILES           *
 *                                         *
 *  Version   4.6.2;  May 1991             *
 *                                         *
 *  RUN DATE    13OCT95    TIME   10:32:05  *
 *****************************************
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**************************************
*  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

THIS RUN EXECUTED 13OCT95 10:32:05

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

  Version   4.6.2;  May 1991
 ************************************
```

CHANDLER HEIGHTS ROAD OVER THE EAST MARICOPA FLOODWAY
FILE NAME CHANDLER
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 CHANDLER HEIGHTS ROAD BRIDGE
T3 EAST MARICOPA FLOODWAY

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
		2							1300.67	

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1	0	-1							15

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

100 105 150

NC					
	0.035	0.035	0.035	0.1	0.3

```
 QT        2       8100      12500
          EXIT SECTION - 2000' FROM DOWNSTREAM FACE OF BRIDGE
 X1    88000          6      65.35     334.65          0          0          0
 GR   1301.6      58.35     1301.6      65.35    1290.05        100    1290.05        300     1301.6     334.65
 GR   1301.6     341.65

 X1    86000          6      69.85     330.15       2000       2000       2000
 GR   1300.7      62.85     1300.7      69.85    1290.65        100    1290.65        300     1300.7     330.15
 GR   1300.7     337.15

          DOWNSTREAM FACE OF BRIDGE
 X1    85970          5        100        327         30         30         30
 X3       10
 GR   1303.4        100       1293        127       1294        327     1302.6        356     1310.7        378

 SB      0.9       1.56          3          0        200          6       3700        2.5     1293.4     1293.4
          UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD
 X1    85910          4        100        354         60         60         60
 X2                             1       1309       1312                             1.33
 X3       10
 BT        2        100       1312                   354     1312.5
 GR   1304.9        100     1293.4        129     1293.4        329     1310.4        354
1
   13OCT95      10:32:05                                                                                    PAGE    2


 X1    85610                                          300        300        300

 QT                6900      10500
          APPROACH SECTION - 1910' FROM UPSTREAM FACE OF BRIDGE
 X1    84000          6      64.09     335.91       1610       1610       1610
 GR   1308.7      57.09     1308.7      64.09    1296.73        100    1296.73        300     1307.2     335.91
 GR   1307.2     342.91
1
   13OCT95      10:32:05                                                                                    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 88000.000
          EXIT SECTION - 2000' FROM DOWNSTREAM FACE OF BRIDGE
  88000.000     10.62   1300.67       .00   1300.67   1300.84       .17       .00       .00   1301.60
     8100.0        .0    8100.0        .0        .0    2462.4        .0        .0        .0   1301.60
        .00       .00      3.29       .00      .000      .035      .000      .000   1290.05     68.14
    .000311        0.        0.        0.         0         0         0       .00    263.72    331.86


 FLOW DISTRIBUTION FOR SECNO=  88000.00          CWSEL=   1300.67

 STA=      68.     335.
   PER Q=    100.0
```

```
    AREA=   2462.4
     VEL=      3.3
   DEPTH=      9.3

*SECNO 86000.000
3280 CROSS SECTION  86000.00 EXTENDED       .59 FEET

 86000.000     10.63   1301.28       .00       .00   1301.45       .17       .61       .00   1300.70
    8100.0       2.0    8095.9       2.0        4.1    2466.9       4.1     113.4      12.4   1300.70
       .17       .49       3.28      .49       .035      .035      .035      .000   1290.65     62.85
   .000303    2000.     2000.     2000.          0         0         0       .00    274.30    337.15


FLOW DISTRIBUTION FOR SECNO=  86000.00          CWSEL=   1301.28

STA=      63.      70.     330.     337.
  PER Q=      .0     99.9       .0
   AREA=     4.1   2466.9      4.1
    VEL=      .5      3.3       .5
  DEPTH=      .6      9.5       .6

*SECNO 85970.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .57

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


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1303.40 ELREA=      1294.00

         DOWNSTREAM FACE OF BRIDGE
 85970.000      8.17   1301.17       .00       .00   1301.52       .36       .01       .06   1303.40
    8100.0        .0    7845.6     254.4        .0    1619.8      86.6     114.8      12.5   1294.00
       .17       .00       4.84      2.94      .000      .035      .035      .000   1293.00    105.80
   .000923      30.       30.       30.          2         0         0       .00    245.37    351.17


FLOW DISTRIBUTION FOR SECNO=  85970.00          CWSEL=   1301.17

STA=     106.     327.     351.
  PER Q=     96.9      3.1
   AREA=   1619.8     86.6
    VEL=      4.8      2.9
  DEPTH=      7.3      3.6


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
      .90      1.56      3.00       .00    200.00      6.00   3700.00      2.50   1293.40   1293.40

*SECNO 85910.000
```

CLASS A LOW FLOW

3420 BRIDGE W.S.= 1301.14 BRIDGE VELOCITY= 4.90 CALCULATED CHANNEL AREA= 1652.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1301.54	.01	0.	8100.	3700.	3635.	1309.00	1312.00	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1304.90 ELREA= 1310.40

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

85910.000	7.78	1301.18	.00	.00	1301.54	.36	.02	.00	1304.90
8100.0	.0	8100.0	.0	.0	1676.7	.0	117.1	12.9	1310.40
.17	.00	4.83	.00	.000	.035	.000	.000	1293.40	109.38
.000942	60.	60.	60.	0	0	0	.00	231.06	340.44

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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= 85910.00 CWSEL= 1301.18

STA= 109. 354.
PER Q= 100.0
AREA= 1676.7
VEL= 4.8
DEPTH= 7.3

*SECNO 85610.000

85610.000	8.07	1301.47	.00	.00	1301.81	.34	.27	.00	1304.90
8100.0	.0	8100.0	.0	.0	1743.3	.0	128.9	14.5	1310.40
.19	.00	4.65	.00	.000	.035	.000	.000	1293.40	108.66
.000833	300.	300.	300.	1	0	0	.00	232.21	340.86

FLOW DISTRIBUTION FOR SECNO= 85610.00 CWSEL= 1301.47

STA= 109. 354.
PER Q= 100.0
AREA= 1743.3
VEL= 4.6
DEPTH= 7.5

*SECNO 84000.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .68

APPROACH SECTION - 1910' FROM UPSTREAM FACE OF BRIDGE

84000.000	6.35	1303.08	.00	.00	1303.45	.38	1.63	.01	1308.70
6900.0	.0	6900.0	.0	.0	1398.4	.0	187.0	23.2	1307.20
.28	.00	4.93	.00	.000	.035	.000	.000	1296.73	80.97

```
    .001308     1610.     1610.     1610.         2         0         0       .00    240.80    321.76


 FLOW DISTRIBUTION FOR SECNO=  84000.00          CWSEL=   1303.08

 STA=      81.     336.
   PER Q=    100.0
    AREA=   1398.4
     VEL=      4.9
   DEPTH=      5.8

1
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 T1      MCDOT HYDRAULIC ANALYSIS
 T2      500-yr SUB-CRITICAL RUN FOR CHANDLER HEIGHTS ROAD BRIDGE
 T3      EAST MARICOPA FLOODWAY

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

                 3                                                                  1303.74

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       2         0        -1                                                                     15


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    13OCT95      10:32:05                                                                                    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 88000.000
 3280 CROSS SECTION  88000.00 EXTENDED      2.14 FEET

          EXIT SECTION - 2000' FROM DOWNSTREAM FACE OF BRIDGE
  88000.000     13.69   1303.74       .00   1303.74   1303.96       .22       .00       .00   1301.60
    12500.0      15.0   12469.9      15.0      15.0    3286.5      15.0        .0        .0   1301.60
        .00      1.00      3.79      1.00      .035      .035      .035      .000   1290.05     58.35
    .000289        0.        0.        0.         0         0         0       .00    283.30    341.65


 FLOW DISTRIBUTION FOR SECNO=  88000.00          CWSEL=   1303.74

 STA=      58.      65.     335.     342.
   PER Q=       .1     99.8       .1
    AREA=     15.0   3286.5     15.0
     VEL=      1.0      3.8      1.0
   DEPTH=      2.1     12.2      2.1
```

*SECNO 86000.000
3280 CROSS SECTION 86000.00 EXTENDED 3.62 FEET

86000.000	13.66	1304.31	.00	.00	1304.54	.23	.57	.00	1300.70
12500.0	32.3	12435.3	32.3	25.3	3255.0	25.3	152.0	12.8	1300.70
.15	1.28	3.82	1.28	.035	.035	.035	.000	1290.65	62.85
.000284	2000.	2000.	2000.	0	0	0	.00	274.30	337.15

FLOW DISTRIBUTION FOR SECNO= 86000.00 CWSEL= 1304.31

STA=	63.	70. 330.	337.
PER Q=	.3	99.5	.3
AREA=	25.3	3255.0	25.3
VEL=	1.3	3.8	1.3
DEPTH=	3.6	12.5	3.6

*SECNO 85970.000
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

3280 CROSS SECTION 85970.00 EXTENDED .80 FEET

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

DOWNSTREAM FACE OF BRIDGE

85970.000	11.20	1304.20	.00	.00	1304.60	.40	.01	.05	1303.40
12500.0	.0	11893.1	606.9	.0	2301.8	174.5	154.0	13.0	1294.00
.15	.00	5.17	3.48	.000	.035	.035	.000	1293.00	100.00
.000686	30.	30.	30.	2	0	0	.00	260.34	360.34

FLOW DISTRIBUTION FOR SECNO= 85970.00 CWSEL= 1304.20

STA=	100.	327.	356.	360.
PER Q=	95.1	4.8	.0	
AREA=	2301.8	171.1	3.5	
VEL=	5.2	3.5	.9	
DEPTH=	10.1	5.9	.8	

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.56	3.00	.00	200.00	6.00	3700.00	2.50	1293.40	1293.40

*SECNO 85910.000
CLASS A LOW FLOW

3420 BRIDGE W.S.= 1304.18 BRIDGE VELOCITY= 5.25 CALCULATED CHANNEL AREA= 2381.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID	ELLC	ELTRD	WEIRLN

						AREA			
.00	1304.63	.01	0.	12500.	3700.	3635.	1309.00	1312.00	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1304.90 ELREA= 1310.40

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

85910.000	10.81	1304.21	.00	.00	1304.63	.42	.03	.00	1304.90
12500.0	.0	12500.0	.0	.0	2395.8	.0	157.4	13.3	1310.40
.15	.00	5.22	.00	.000	.035	.000	.000	1293.40	101.73
.000736	60.	60.	60.	0	0	0	.00	243.17	344.90

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

FLOW DISTRIBUTION FOR SECNO= 85910.00 CWSEL= 1304.21

STA= 102. 354.
PER Q= 100.0
AREA= 2395.8
VEL= 5.2
DEPTH= 9.9

*SECNO 85610.000

85610.000	11.05	1304.45	.00	.00	1304.85	.40	.21	.00	1304.90
12500.0	.0	12500.0	.0	.0	2452.8	.0	174.1	15.0	1310.40
.17	.00	5.10	.00	.000	.035	.000	.000	1293.40	101.14
.000684	300.	300.	300.	2	0	0	.00	244.10	345.24

FLOW DISTRIBUTION FOR SECNO= 85610.00 CWSEL= 1304.45

STA= 101. 354.
PER Q= 100.0
AREA= 2452.8
VEL= 5.1
DEPTH= 10.0

*SECNO 84000.000

APPROACH SECTION - 1910' FROM UPSTREAM FACE OF BRIDGE

84000.000	8.97	1305.70	.00	.00	1306.11	.41	1.26	.00	1308.70
10500.0	.0	10500.0	.0	.0	2053.1	.0	257.3	24.3	1307.20
.25	.00	5.11	.00	.000	.035	.000	.000	1296.73	73.09
.000925	1610.	1610.	1610.	2	0	0	.00	257.69	330.77

FLOW DISTRIBUTION FOR SECNO= 84000.00 CWSEL= 1305.70

STA= 73. 336.
PER Q= 100.0
AREA= 2053.1

VEL= 5.1
DEPTH= 8.0

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THIS RUN EXECUTED 13OCT95 10:32:07

****
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

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 100

SECNO	EGLWC	ELLC	EGPRS	ELTRD	QPR	QWEIR	CLASS	H3	DEPTH	CWSEL	VCH	EG
85910.000	1301.54	1309.00	.00	1312.00	8100.00	.00	1.00	.01	7.78	1301.18	4.83	1301.54
85910.000	1304.63	1309.00	.00	1312.00	12500.00	.00	1.00	.01	10.81	1304.21	5.22	1304.63

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EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 105

	SECNO	CWSEL	HL	OLOSS	TOPWID	QLOB	QCH	QROB
	86000.000	1301.28	.61	.00	274.30	2.04	8095.92	2.04
	86000.000	1304.31	.57	.00	274.30	32.34	12435.33	32.34
*	85970.000	1301.17	.01	.06	245.37	.00	7845.64	254.36
*	85970.000	1304.20	.01	.05	260.34	.00	11893.09	606.91
	85910.000	1301.18	.02	.00	231.06	.00	8100.00	.00
	85910.000	1304.21	.03	.00	243.17	.00	12500.00	.00
	85610.000	1301.47	.27	.00	232.21	.00	8100.00	.00
	85610.000	1304.45	.21	.00	244.10	.00	12500.00	.00

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EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	88000.000	.00	.00	.00	1290.05	8100.00	1300.67	.00	1300.84	3.11	3.29	2462.35	4595.98
	88000.000	.00	.00	.00	1290.05	12500.00	1303.74	.00	1303.96	2.89	3.79	3316.46	7346.75
	86000.000	2000.00	.00	.00	1290.65	8100.00	1301.28	.00	1301.45	3.03	3.28	2475.19	4654.45
	86000.000	2000.00	.00	.00	1290.65	12500.00	1304.31	.00	1304.54	2.84	3.82	3305.65	7422.80
*	85970.000	30.00	.00	.00	1293.00	8100.00	1301.17	.00	1301.52	9.23	4.84	1706.41	2665.45
*	85970.000	30.00	.00	.00	1293.00	12500.00	1304.20	.00	1304.60	6.86	5.17	2476.34	4774.10
	85910.000	60.00	1312.00	1309.00	1293.40	8100.00	1301.18	.00	1301.54	9.42	4.83	1676.69	2638.95
	85910.000	60.00	1312.00	1309.00	1293.40	12500.00	1304.21	.00	1304.63	7.36	5.22	2395.78	4607.26
	85610.000	300.00	.00	.00	1293.40	8100.00	1301.47	.00	1301.81	8.33	4.65	1743.28	2805.66
	85610.000	300.00	.00	.00	1293.40	12500.00	1304.45	.00	1304.85	6.84	5.10	2452.82	4778.07
*	84000.000	1610.00	.00	.00	1296.73	6900.00	1303.08	.00	1303.45	13.08	4.93	1398.42	1908.19
	84000.000	1610.00	.00	.00	1296.73	10500.00	1305.70	.00	1306.11	9.25	5.11	2053.08	3453.05

1

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	88000.000	8100.00	1300.67	.00	.00	.00	263.72	.00
	88000.000	12500.00	1303.74	3.07	.00	.00	283.30	.00
	86000.000	8100.00	1301.28	.00	.61	.00	274.30	2000.00
	86000.000	12500.00	1304.31	3.03	.57	.00	274.30	2000.00
*	85970.000	8100.00	1301.17	.00	-.12	.00	245.37	30.00
*	85970.000	12500.00	1304.20	3.03	-.11	.00	260.34	30.00
	85910.000	8100.00	1301.18	.00	.01	.00	231.06	60.00
	85910.000	12500.00	1304.21	3.03	.01	.00	243.17	60.00
	85610.000	8100.00	1301.47	.00	.30	.00	232.21	300.00
	85610.000	12500.00	1304.45	2.97	.23	.00	244.10	300.00
*	84000.000	6900.00	1303.08	.00	1.60	.00	240.80	1610.00
	84000.000	10500.00	1305.70	2.63	1.26	.00	257.69	1610.00

1

SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO=  85970.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=  85970.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=  84000.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
```

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: *CHANDLER HEIGHTS 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	0
• 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;CHANDLER HEIGHTS ROAD BRIDGE*

Attendees:

Bridge No.: *8883* Date Built on Bridge Plans: *11/74*

Description of Bridge/Bridge Type: *AASHTO GIRDER; SOLID WALL PIERS ON DRILLED SHAFTS - 21' DEEP*

Route: *CHANDLER HEIGHTS ROAD* Water Course: *EAST MARICOPA FLOODWAY*

Underclearance at thalweg (ft): *+-15*

Elevation of stream thalweg (ft): *+-1293.5*

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

Reported high water elevation: *1306*

Description of flood: *100-year; 24000 cfs*

Description of approach and "getaway" conditions: *CLEAR APPROACH WITH A DROP STRUCTURE UPSTREAM.*

Description of bed load: *SILTY-SAND AND SMALL GRAVEL.*

Condition of banks; evidence of lateral movement, degradation or aggradation: *NO EVIDENCE OF 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		
EXPOSED FOOTINGS	*NO*	*NO*
FOOTING ELEVATION	*1270.5*	*1271*
ROCK ELEVATION AND DESCRIPTION	*N/A*	*N/A*
SOIL ELEVATION AND DESCRIPTION	*1293.5' SILTY-SAND*	*1293.5' SILTY-SAND*
ANGLE OF ATTACK OF FLOOD FLOWS ON ABUTMENT	*0*	*0*
DESCRIPTION OF RIPRAP OR OTHER SCOUR PROTECTION	*12" DIA. RIPRAP AND BANK PROTECTION*	*12" DIA. RIPRAP AND BANK PROTECTION*
ITEM 113 RATING	*9*	*9*

GENERAL COMMENTS:

1.) *BOTH ABUTMENTS ARE PROTECTED BY RIPRAP UP AND DOWNSTREAM.*

2.) *NO APPARENT DAMAGE TO THE CHANNEL OR THE BANKS.*

3.) *UPSTREAM LEFT BANK HAS A SPILLWAY TO THE CHANNEL LINED WITH CONCRETE AND COBBLES.*

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	*2'*					
FOOTING ELEVATION AND WIDTH	*1279'* *8'x62'-6"*					
ROCK ELEVATION/TYPE	*N/A*					
ELEVATION OF TOP OF GROUND OR CHANNEL; SOIL TYPE	*1293.5* *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) *GOOD CONDITION, NO APPARENT SCOUR OR DEGRADATION.*

Recommended Item 113 and Risk Ratings:

9

BRIDGE NUMBER 8883

SCREEN 3 - HYDRAULIC ENGINEER'S SCREEN

NAME: *CHANDLER HEIGHTS 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: *CHANDLER HEIGHTS 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

:

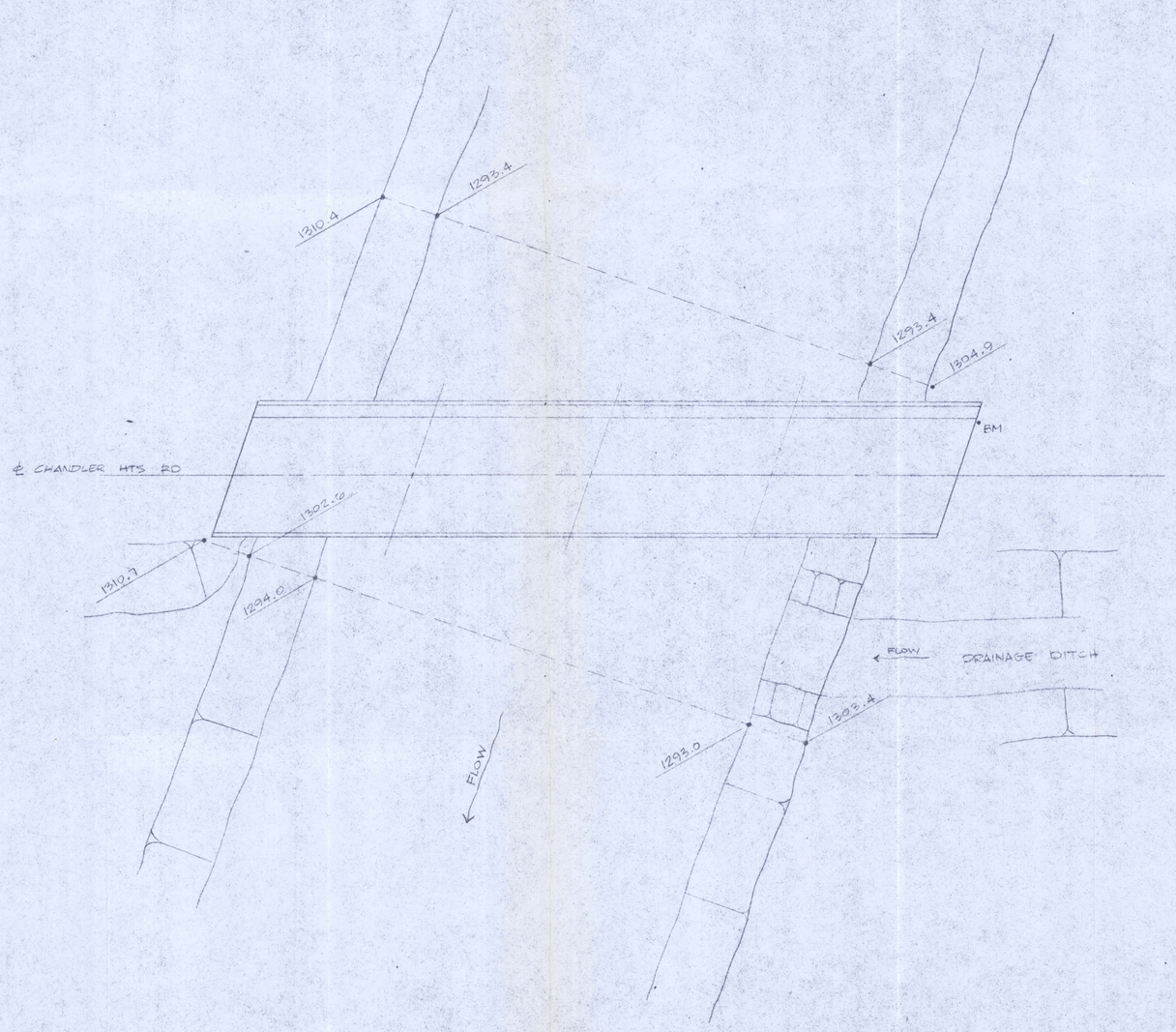
I HAVE REVIEWED SCREENS 1-4 AND CONCUR WITH THE FOLLOWING RATINGS:

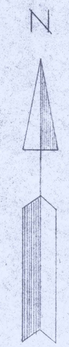
- ITEM 113 RATING: *8L* DESCRIPTION:
- RISK RATING (FOR ITEM 113 RATING CODES 3 AND 6): *N/A*

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.





1" = 30'

BM = MARICOPA COUNTY DEPT. OF TRANS. BRASS CAP ON BRIDGE DECK ABUTMENT JOINT NE CORNER
ELEV. = 1312.19

SCHEMATIC
NOT FOR CONSTRUCTION

CHANDLER HTS BRIDGE

SURVEYED BY : KJS, DB 4-20-95

DRAWN BY : KJS 4-21-95