BRIDGE SCOUR EVALUATIONS

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

Queen Creek Road Bridge over the East Maricopa Floodway

(SN8041)

Preliminary Report

Submitted to:

Maricopa County
Department of Transportation

Submitted by:

PB PARSONS BRINCKERHOFF
100 YEARS

1. Need to provide HEC-2 distett.
2. Local scour should consider debris factor while calculating local scour (use min. 1' of debris on both side of pier.)
3.

HYDRAULIC ANALYSIS FOR THE QUEEN CREEK ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

MARICOPA COUNTY, ARIZONA

April 1, 1995

Submitted by:

Parsons Brinckerhoff Quade & Douglas

Tempe, Arizona

PB 100 YEARS

Table of Contents

1.0 INTRODUCTION

The existing Queen Creek Road Bridge carries vehicular traffic over the East Maricopa Floodway in Maricopa County, Arizona. The total length of the bridge is approximately 344'-8.75". Construction plans for the Queen Creek Road Bridge over the East Maricopa Floodway are by Benham, Blair, Ditzler & Sayler, dated September 1974. The plans are for eight spans, with spans between an abutment and a pier at 36.5 feet in length and spans between piers at 45.0 feet in length. The bridge carries two lanes of traffic and is approximately 55'-1" wide. The roadway is oriented in a east-west direction and the profile is flat. All elevations in the plans are by S.C.S. datum. These elevations were converted the M.C.H.D. datum given on the plans. The elevations referred to in this report are referenced from the M.C.H.D. datum. There is a discrepancy between the plan channel bed elevation and the survey taken on April 20, 1995. The plans show an S.C.S. elevation of 1290.55' (1293.41' M.C.H.D.) which is significantly lower than the elevation of +- 1303' taken in the field. This elevation difference could not be explained since it is not believed aggradation of this magnitude has occurred at the bridge. The bed elevation of +- 1303' taken from the field survey was used to calculate remaining pile depths.

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 Queen Creek Road Bridge.

Total scour depths for the 100-year flood are estimated to be 10.7 feet and 10.5 feet respectfully at the east and west abutments and 4 feet for all piers. Total scour for the 500-year flood is estimated to be 11.6 feet and 11.4 feet respectfully at the east and west abutments and 4 feet for all piers.

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 Queen Creek Road Bridge at the East Maricopa Floodway, project number 71102 dated 1978. 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.

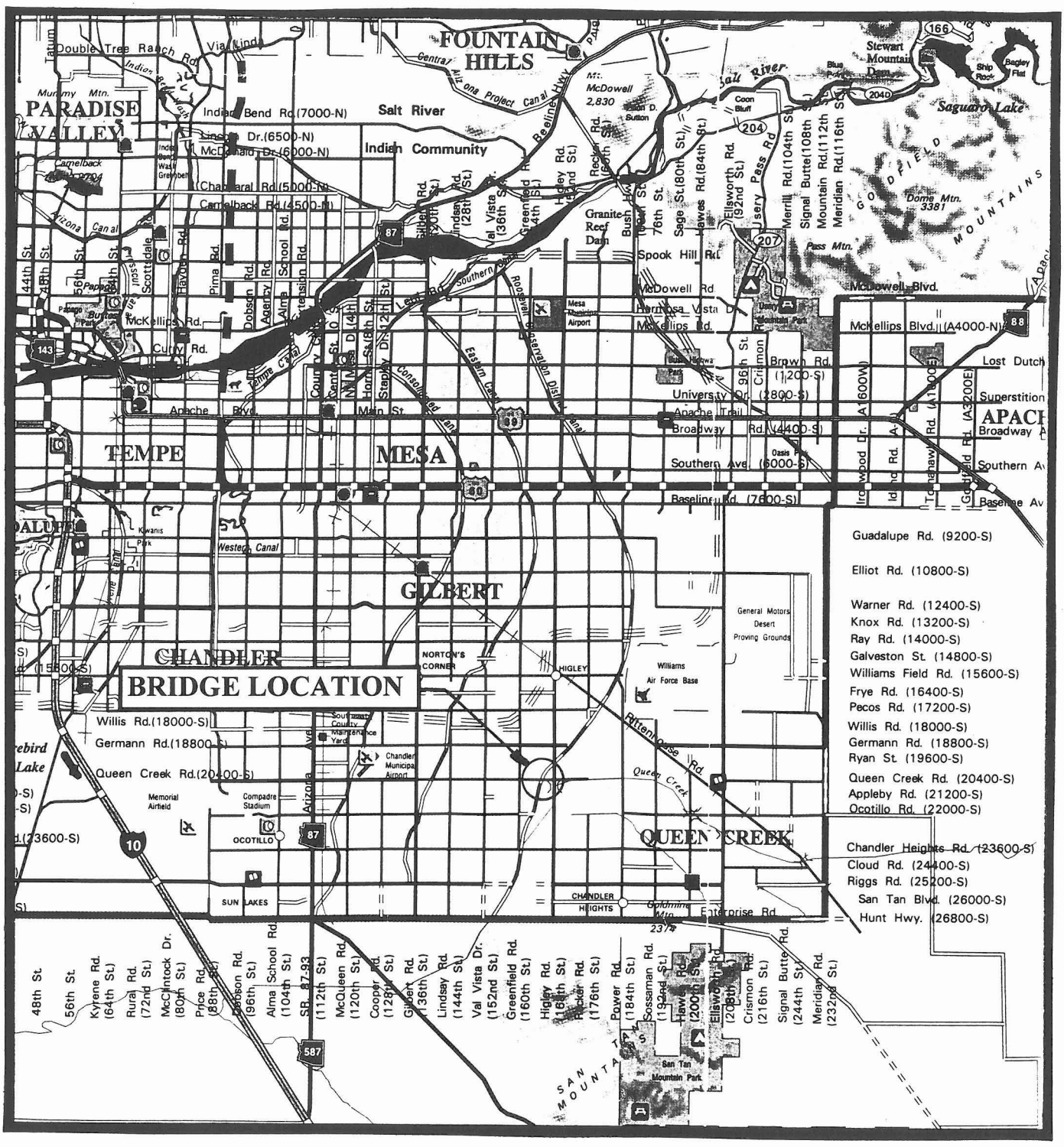
Parsons Brinckerhoff conducted a site visit on April 20, 1995. Extensive photographs of the site were taken and a visual survey of the bridge and surrounding area was made. A simple survey of the channel cross section was performed on April 20, 1995.

The scour screening procedure for the National Bridge Inventory System is completed for the Queen Creek Road Bridge. The screening forms are included in the Appendix. The Queen Creek 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 Queen Creek Road Bridge. This information may be used in a structural stability analysis to verify the bridge has an adequate foundation. However, a structural stability analysis is not necessary for this bridge.

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 Queen Creek Road Bridge lies just downstream of the Higley 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 is relatively dry most of the year. The terrain in the immediate area is relatively flat. The soil at this location is generally clayey/silty sand with some fine gravel. There is no apparent blockage of the waterway upstream or downstream of the structure.

FIGURE 1


BRIDGE LOCATION
PARADISE VALLEY
FOUNTAIN HILLS
TEMPE
MESA
GILBERT
CHANDLER
QUEEN CREEK
Salt River
Indian Community
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 geotechnical investigation for this bridge was performed by ATL Testing Laboratories in March 1974. Five borings were advanced to depths of from approximately 70 to 75 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 bed is grass-lined in the vicinity of the bridge. The channel side slopes are about 3:1. The banks and waterway are densely vegetated with low height grass and there is minor bank erosion upstream of the west bank. 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 Queen Creek Road Bridge over East Maricopa Floodway is located on Queen Creek Road between stations 35+52 to 39+27. This structure is a eight-span, skew, reinforced concrete slab bridge with a span length of 45 feet between the piers and 36.5 feet between the abutment and adjacent pier. The substructure consists of wall piers resting on a spread footing at elevations ranging from 1276.6' to 1279.6'. The bottom of channel is at an elevation of 1,303'. ±

The piers are supported on concrete spread footings 10.0 feet by 62.0 feet in plan, 2.0-foot thick and founded at nominal elevations 1,276.57 to 1,279.57 feet. The piers are solid rectangles with rounded upstream and downstream edges, skewed approximately 30 degrees right. Each abutment is supported by 10-16 inch diameter cast-in-place concrete piers, founded at approximate nominal elevation 1,277.9 feet. There is no riprap or scour protection at piers or abutments at this structure. There was no apparent degradation or scour at piers. There is evidence of fill erosion in front of the abutments and in the vicinity of the adjacent piers.

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.

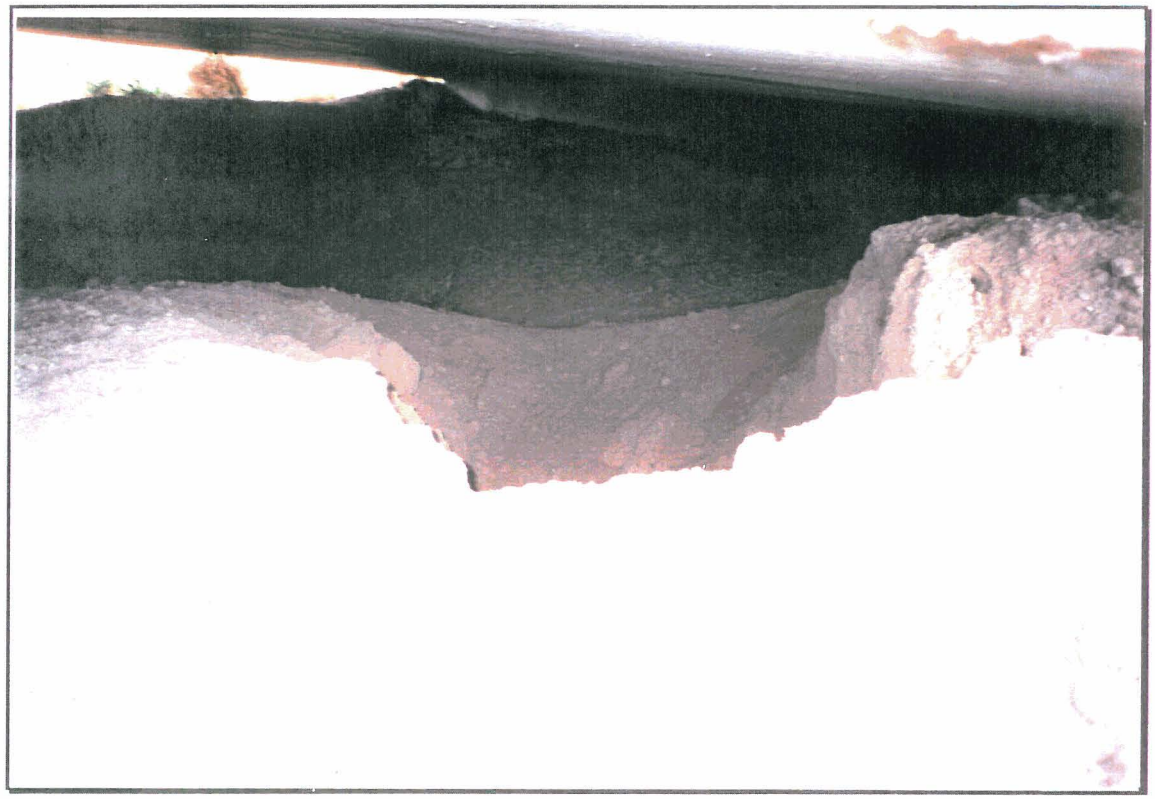
QUEEN CREEK ROAD

Upstream face looking West.

Downstream face of bridge looking East.

QUEEN CREEK ROAD

Third pier from West end of bridge.



West abutment.

4.0 HYDRAULIC ANALYSIS

The 100-year and 500-year flood discharges are 6,900 cfs and 8,300 cfs, respectively. A chosen multiplication factor of 1.2 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 3.3 fps for the 100-year flood event. The water surface elevation at the bridge is 1,312.3 feet for the 100-year flood at existing conditions. Average velocity at the bridge is calculated as 3.9 fps for the 500-year flood. Computed water surface elevation at the bridge is 1,312.6 feet for the 500-year flood. The minimum freeboard requirement of 3 feet for the 100-year flood event is not met at the Queen Creek Road Bridge.

Table 1

	100-Year Flood Existing Conditions	500-year Flood Existing Conditions
Discharge (cfs)	**6,900**	**8,300**
Velocity (fps)	**3.3**	**3.9**
WSEL (feet)	**1,312.3**	**1,312.6**

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 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 slightly less than the average channel velocity. The grass-lined channel should help hold the soil in place as long as the coverage is dense, however, it is believed live-bed conditions will control.

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 has some suspended 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 piers are skewed 30° right, however, the angle of attack at the Queen Creek 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 its 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 = 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.

The East Maricopa Floodway flows in a relatively straight line in the vicinity of the bridge. Therefore, no bend scour is predicted to occur at the Queen Creek Road 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. However, no debris blockage is predicted to occur at this bridge. 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 of the channel obtained in the field is approximately 12 feet higher than the S.C.S. elevation of the channel on the bridge plans. It is not known why the channel bed elevations differ by this amount, since the top of road elevations from the plan sheets and the field agree. From the field visit it does not seem likely that 12 feet of aggradation has occurred since the bridge was built. However, in the area along the abutments there is evidence of minor aggradation (less than 1 foot). The HEC-2 run utilized the elevations obtained from the field visits.

The man-made channel will prevent any lateral migration of the floodway. A constant elevation of 1,303 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 291 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 flow upstream 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.

Table 2

100-Year Flood Existing Conditions	East Abutment	Pier	West Abutment
Local Scour	10.7 feet	4.0 feet	10.5 feet
Contraction	0 feet	0 feet	0 feet
Total Scour	**10.7 feet**	**4.0 feet**	**10.5 feet**
Remaining Pile Depth	14.4 feet	19.4 feet	14.6 feet
500-year Flood Existing Conditions	**East Abutment**	**Pier**	**West Abutment**
Local Scour	11.6 feet	4.0 feet	11.4 feet
Contraction	0 feet	0 feet	0 feet
Total Scour	**11.6 feet**	**4.0 feet**	**11.4 feet**
Remaining Pile Depth	13.5 feet	19.4 feet	13.7 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 bridge's location. 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.

As shown in table 2, the scour estimates for the 100-year flood at the east and west abutments are 10.7 feet and 10.5 feet respectively. The scour estimates for the 500-year flood at the east and west abutments are 11.6 feet and 11.4 feet respectively.

Please note that the abutment scour equation recommended by HEC-18 is inherently conservative and includes a large factor of safety. Only minor abutment scour depths were calculated, so the lack of riprap protection is not expected to be a problem.

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.

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 Queen Creek Road Bridge.

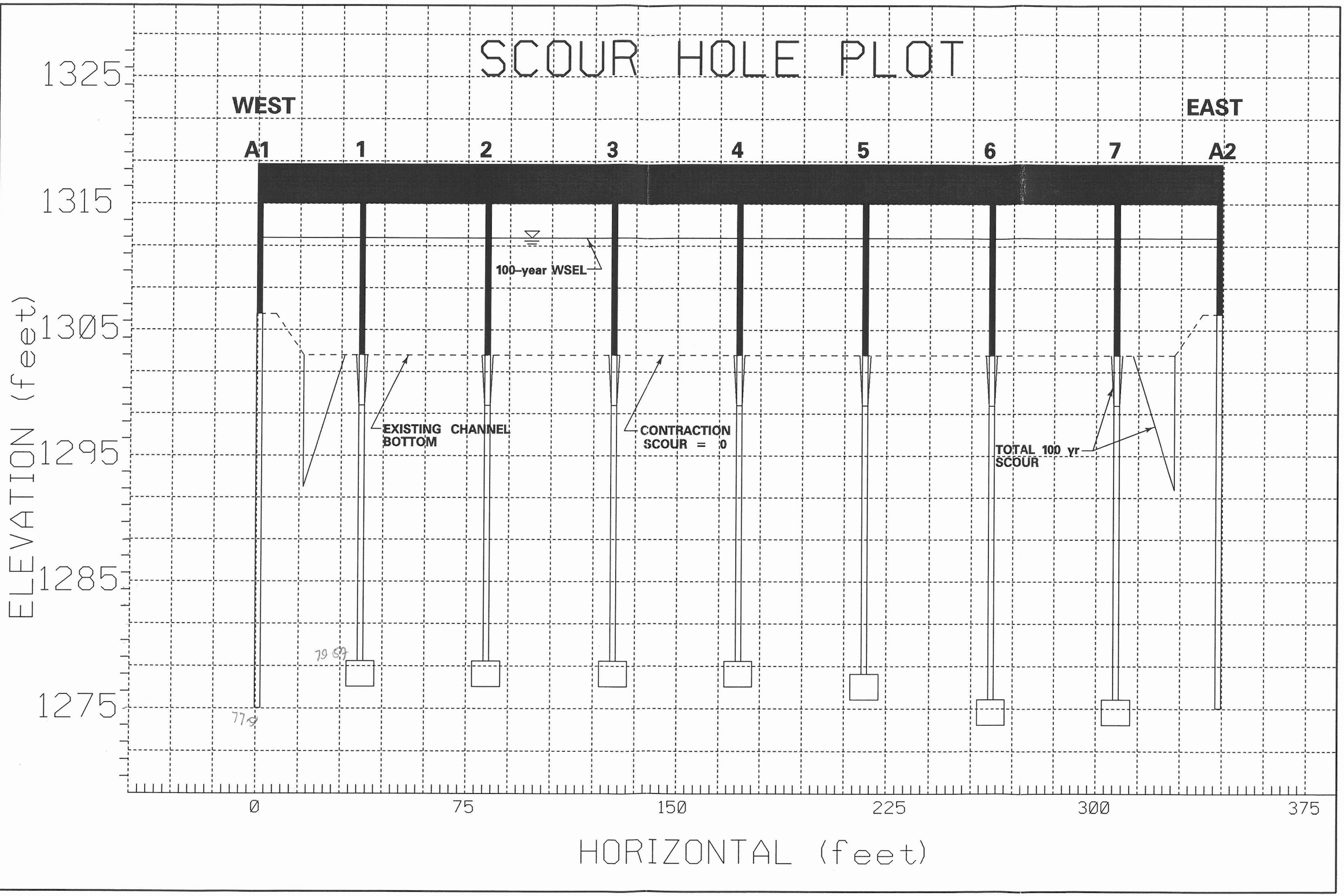
7.0 INITIAL EVALUATION

The existing pier configuration should adequately protect the piers during both the 100-year and 500-year floods. Riprap is not present on the abutments. The abutments need to be checked after each flood event to ensure excessive erosion does not occur since scour depths calculated at the abutments were moderate. Abutment scour is not expected to be a problem at the Queen Creek Road Bridge. Table 2 shows adequate remaining pile depth for both the 100-year and 500-year floods.

There is visible erosion present near the top of the abutment as shown in the pictures. Corrective measures may need to be taken to prevent further erosion from occuring.

The Queen Creek 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



PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____

g:\projects\arizona\queen.dgn
01/01/96

REFERENCES

1. *Design Manual for Engineering Analysis of Fluvial Systems*, Arizona Department of Water Resources, 1985.

2. *Hydrology and Floodplain Analysis.* Bedient, Philip B., and Wayne C. Huber. New York: Addison-Wesley Publishing Company, 1988.

3. *Drainage Design Manual*, Volumes I, II, III., Flood Control District

4. *HEC-2 Water Surface Profiles*. Davis, California: United States Army Corps of Engineers, September 1982.

5. *Stream Stability at Highway Structures*, Lagasse, P.F., D.F. Schall, F. Johnson, E.V. Richardson, J.R. Richardson, and F. Chang, U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No. 20, Publication No. FHWA-IP-90-014, February 1991.

6. *Stream Stability and Scour at Highway Bridges: Participant Workbook*, National Highway Institute, Federal Highway Administration, April 1993.

7. *Evaluating Scour at Bridges: Second Edition*, Richardson, E.V., L.J. Harrison, J.R. Richardson, and S.R. Davis, U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No. 18, Publication No. FHWA-IP-90-017, Revised April 1993.

8. *Highways in the River Environment: Participant Notebook*, Richardson, E.V., D.B. Simons, and P.Y. Julien, NHI Course No. 13010, National Highway Institute, Federal Highway Administration, McLean, Virginia 1990.

QUEEN CREEK 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	7.4	7.7
W1 - WIDTH OF UPSTREAM MAIN CHANNEL(FT)		291	291
W2 - WIDTH OF CONTRACTED SECTION(FT)	2	277	277
N1 - AT MAIN CHANNEL		0.03	0.03
N2 - AT CONTRACTED SECTION		0.03	0.03
Q_1 - FLOW IN UPSTREAM MAIN CHANNEL (CFS)		6,900	8,300
Q_2 - FLOW IN CONTRACTED SECTION (CFS)		6,900	8,300
$(Q_2/Q_1)^{6/7}$		1.00	1.00
S1 - SLOPE OF ENERGY GRADE LINE IN US CHANNEL (FT/FT)	3	0.00034	0.00045
V*c - SHEAR VELOCITY(FPS) = [32.2(Y1)(S1)]^0.5		0.29	0.33
K1	4	0.64	0.64
(W1/W2)^K1		1.03	1.03
$Y2/Y1 = Q_2/Q_1^{(6/7)}(W1/W2)^{K1}$		1.03	1.03
Ys = Y2-Y1 = SCOUR (FT)	5,6	0	0

No contraction scour

NOTES:

1. Y1 IS AVE. DEPTH IN MAIN CHANNEL.

2. W2 = (TOP WIDTH)-(SUM OF EFFECTIVE PIER WIDTHS). 291'-(7x2') = 277'

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

4. K1 VALUE ASSUMES SOME SUSPENDED 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)

QUEEN CREEK ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

PIER SCOUR - EXISTING CONDITIONS

CONTINUOUS COLUMN	SEE NOTE	100-YEAR LEFT OVERBANK	100-YEAR MAIN CHANNEL	100-YEAR RIGHT OVERBANK	500-YEAR LEFT OVERBANK	500-YEAR MAIN CHANNEL	500-YEAR RIGHT OVERBANK
PIER NUMBER(S)			1-7			1-7	
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		3.30			3.90	
Y1 - DEPTH OF FLOW UPSTRM. FACE OF PIER (FT)	4		7.7			7.9	
Fr1 - FROUDE NUMBER = V1/(32.2*Y1)^1/2			0.21			0.24	
[a/Y1]^0.65			0.42			0.41	
Ys/Y1 = 2K1K2K3(a/Y1)^.65(Fr1)^.43	5		0.47			0.49	
Ys SCOUR DEPTH (FT)			4			4	

add debris on both side

6'

$Y_s = 2.0 \times 1.1 \left(\frac{4}{7.7}\right)^{.65} (.21)^{.43}$

NOTES:

1. NO EXTRA PIER WIDTH IS USED TO ACCOUNT FOR DEBRIS ACCUMULATION.

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 OBTAINED FROM HEC-2 OUTPUT.

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

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

$= 2.2 * 0.65 \times 0.54$

$= 0.78 * Y_1$

Pier Scour $= 0.78 \times 7.7$

$= 5.98$

1303.0 − 7.8 = 1295.2

16.7 + 4.8 = 21.5

Abutment

Total = $1.3(5.98 + 10.7) = 1.3(16.7)$

Pier = $1.3(6)$ 6 × 1.8 = 7.8

Pier Scour

1303.0 − 21.5 = 1281.5

Abutment Scour.

QUEEN CREEK ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

ABUTMENT SCOUR

SPILLTHROUGH	SEE NOTE	100-YEAR EAST ABUTMENT	100-YEAR WEST ABUTMENT	500-YEAR EAST ABUTMENT	500-YEAR WEST ABUTMENT
Ya - DEPTH AT ABUT. (FT)		3.85	3.85	3.95	3.95
a'- ABUT. LENGTH NORMAL TO FLOW (FT)		49.4	46.1	49.4	46.1
(a'/Ya)^0.43		3.00	2.91	2.96	2.88
Ve = Qe/Ae	1	3.30	3.30	3.90	3.90
Fre = Ve/(32.2*Ya)^(1/2) = FROUDE NO.		0.30	0.30	0.35	0.35
Fre^0.61		0.48	0.48	0.52	0.52
(THETA) = ANGLE BTWN. ABUT. AND FLOW	2	90	90	90	90
K2 = ((THETA)/90)^0.13		1	1	1	1
K1	3	0.55	0.55	0.55	0.55
Ys/Ya = 2.27K1K2* (a'/Ya)^0.43(Fre^0.61) + 1		2.8	2.7	2.9	2.9
Ys SCOUR (FT)		10.7	10.5	11.6	11.4

NOTES:

1. Ve TAKEN FROM HEC-2 VELOCITY IN MAIN CHANNEL. Ve = 0 BECAUSE ABUTMENT DOES NOT OBSTRUCT FLOW.

2. THETA < 90 IF POINTED DOWNSTREAM, > 90 IF POINTED UPSTREAM. THE ABUTMENTS DO NOT OBSTRUCT FLOW.

3. K1 = 0.55 FOR SPILLTHROUGH ABUTMENT.

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    04APR96    TIME   14:31:36  *
*******************************************
```

```
***************************************
*  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 04APR96 14:31:36

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

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

QUEEN CREEK ROAD BRIDGE OVER EAST MARICOPA FLOODWAY
FILE NAME QUEEN
PARSONS BRINCKERHOFF - TEMPE, ARIZONA
Benchmark elevation of 1318.63' from sidewalk on NW corner of
bridge was used to establish top of road elevation.
The gradient slope from the 100-year HEC-2 run was used to
approximate the 500-year flood.
No extra width was used for debris blockage since the bridge
is located on the East Maricopa Floodway.

```
T1      MCDOT HYDRAULIC ANALYSIS
T2      100-yr SUB-CRITICAL RUN FOR QUEEN CREEK ROAD BRIDGE
T3      EAST MARICOPA FLOODWAY

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

        0         2         0         0      .0003        0         0         0    1306.6         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

        1         0        -1         0         0         0         0         0         0        15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

      100       105       150         0         0         0         0         0         0         0
```

```
QT        2       6900       8300          0          0          0          0          0          0          0
NC    0.032      0.032      0.032        0.1        0.3          0          0          0          0          0
                EXIT SECTION -  345' DOWNSTREAM OF BRIDGE
X1     1000          4        500        791          0          0          0          0       -.51          0
GR   1314.9        500     1303.1        543     1304.3        748     1314.5        791          0          0

X1     1255          0          0          0        255        255        255          0        .51          0

                DOWNSTREAM FACE OF BRIDGE
X1     1345          0          0          0        175          1         90          0        .18          0
X3       10          0          0          0          0          0          0    1314.75    1314.75          0

SB      0.9        1.5        3.0          0        205         14     2658.4        3.6     1303.6     1303.7
              UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD
X1     1410          4        500        791         65         65         65          0          0          0
X2        0          0          1       1315    1318.13          0          0       1.33          0          0
X3       10          0          0          0          0          0          0    1318.13    1318.13          0
BT        2        500    1318.13       1315        791    1318.13       1315          0          0          0
GR   1317.7        500     1303.5        543     1303.7        748     1313.8        791          0          0

   04APR96       14:31:36                                                                        PAGE     2


X1     1500          0          0          0          1        175         90          0        .18          0

             APPROACH SECTION - 200' UPSTREAM OF BRIDGE
X1     1610          0          0          0        110        110        110          0        .22          0

   04APR96       14:31:36                                                                        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

CCHV=      .100 CEHV=      .300
*SECNO 1000.000
             EXIT SECTION -  345' DOWNSTREAM OF BRIDGE
  1000.000       9.63   1312.22        .00   1306.60   1312.38        .16        .00        .00   1314.39
    6900.0         .0     6900.0         .0         .0    2171.3         .0         .0         .0   1313.99
       .00        .00       3.18        .00       .000       .032       .000       .000    1302.59    507.89
   .000302         0.         0.         0.          0          0          5        .00     275.67    783.56


FLOW DISTRIBUTION FOR SECNO=    1000.00          CWSEL=    1312.22

STA=      508.      791.
  PER Q=     100.0
   AREA=    2171.3
     VEL=       3.2
  DEPTH=       7.9

*SECNO 1255.000
  1255.000       9.20   1312.30        .00        .00   1312.47        .18        .08        .01   1314.90
```

6900.0	.0	6900.0	.0	.0	2052.6	.0	12.4	1.6	1314.50
.02	.00	3.36	.00	.000	.032	.000	.000	1303.10	509.47
.000358	255.	255.	255.	0	0	0	.00	272.27	781.73

FLOW DISTRIBUTION FOR SECNO= 1255.00 CWSEL= 1312.30

STA= 509. 791.
PER Q= 100.0
AREA= 2052.6
VEL= 3.4
DEPTH= 7.5

*SECNO 1345.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1314.75 ELREA= 1314.75

DOWNSTREAM FACE OF BRIDGE

1345.000	9.04	1312.32	.00	.00	1312.51	.18	.03	.00	1315.08
6900.0	.0	6900.0	.0	.0	2010.0	.0	16.6	2.2	1314.68
.03	.00	3.43	.00	.000	.032	.000	.000	1303.28	510.04
.000382	175.	90.	1.	0	0	0	.00	271.03	781.07

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= 1345.00 CWSEL= 1312.32

STA= 510. 791.
PER Q= 100.0
AREA= 2010.0
VEL= 3.4
DEPTH= 7.4

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.50	3.00	.00	205.00	14.00	2658.40	3.60	1303.60	1303.70

*SECNO 1410.000
CLASS A LOW FLOW

3420 BRIDGE W.S.= 1312.25 BRIDGE VELOCITY= 3.61 CALCULATED CHANNEL AREA= 1921.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1312.51	.01	0.	6900.	2658.	2645.	1315.00	1318.13	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1318.13 ELREA= 1318.13

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

1410.000	8.83	1312.33	.00	.00	1312.51	.17	.00	.00	1317.70
6900.0	.0	6900.0	.0	.0	2067.2	.0	19.6	2.6	1313.80
.03	.00	3.34	.00	.000	.032	.000	.000	1303.50	516.25
.000344	65.	65.	65.	0	0	0	.00	268.51	784.76

FLOW DISTRIBUTION FOR SECNO= 1410.00 CWSEL= 1312.33

STA= 516. 791.
PER Q= 100.0
AREA= 2067.2
VEL= 3.3
DEPTH= 7.7

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

*SECNO 1500.000

1500.000	8.68	1312.36	.00	.00	1312.54	.18	.03	.00	1317.88
6900.0	.0	6900.0	.0	.0	2027.6	.0	23.8	3.1	1313.98
.04	.00	3.40	.00	.000	.032	.000	.000	1303.68	516.70
.000365	1.	90.	175.	0	0	0	.00	267.43	784.13

FLOW DISTRIBUTION FOR SECNO= 1500.00 CWSEL= 1312.36

STA= 517. 791.
PER Q= 100.0
AREA= 2027.6
VEL= 3.4
DEPTH= 7.6

*SECNO 1610.000

APPROACH SECTION - 200' UPSTREAM OF BRIDGE

1610.000	8.50	1312.40	.00	.00	1312.58	.19	.04	.00	1318.10
6900.0	.0	6900.0	.0	.0	1977.9	.0	28.9	3.8	1314.20
.05	.00	3.49	.00	.000	.032	.000	.000	1303.90	517.26
.000393	110.	110.	110.	0	0	0	.00	266.07	783.33

FLOW DISTRIBUTION FOR SECNO= 1610.00 CWSEL= 1312.40

STA= 517. 791.
PER Q= 100.0
AREA= 1977.9
VEL= 3.5
DEPTH= 7.4

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

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

        0         3         0         0      .0004         0         0         0      1307         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

        2         0        -1         0         0         0         0         0         0        15
```



```
    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

CCHV=      .100 CEHV=      .300
*SECNO 1000.000
            EXIT SECTION -  345' DOWNSTREAM OF BRIDGE
  1000.000      9.86   1312.45       .00   1307.00   1312.66       .21       .00       .00   1314.39
    8300.0        .0    8300.0        .0        .0    2232.6        .0        .0        .0   1313.99
       .00       .00      3.72       .00      .000      .032      .000      .000   1302.59    507.08
   .000402        0.        0.        0.         0         0         5       .00    277.41    784.49


FLOW DISTRIBUTION FOR SECNO=   1000.00          CWSEL=   1312.45

STA=      507.      791.
  PER Q=     100.0
   AREA=    2232.6
    VEL=       3.7
  DEPTH=       8.0

*SECNO 1255.000
  1255.000      9.44   1312.54       .00       .00   1312.78       .24       .11       .01   1314.90
    8300.0        .0    8300.0        .0        .0    2120.1        .0      12.7       1.6   1314.50
       .02       .00      3.91       .00      .000      .032      .000      .000   1303.10    508.57
   .000470      255.      255.      255.         0         0         0       .00    274.21    782.77


FLOW DISTRIBUTION FOR SECNO=   1255.00          CWSEL=   1312.54

STA=      509.      791.
  PER Q=     100.0
   AREA=    2120.1
    VEL=       3.9
  DEPTH=       7.7
```

*SECNO 1345.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1314.75 ELREA= 1314.75

DOWNSTREAM FACE OF BRIDGE

1345.000	9.30	1312.58	.00	.00	1312.83	.25	.04	.00	1315.08
8300.0	.0	8300.0	.0	.0	2079.2	.0	17.1	2.2	1314.68
.02	.00	3.99	.00	.000	.032	.000	.000	1303.28	509.11
.000498	175.	90.	1.	0	0	0	.00	273.03	782.14

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= 1345.00 CWSEL= 1312.58

STA= 509. 791.
PER Q= 100.0
AREA= 2079.2
VEL= 4.0
DEPTH= 7.6

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.50	3.00	.00	205.00	14.00	2658.40	3.60	1303.60	1303.70

*SECNO 1410.000
CLASS A LOW FLOW

3420 BRIDGE W.S.= 1312.49 BRIDGE VELOCITY= 4.21 CALCULATED CHANNEL AREA= 1984.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1312.83	.02	0.	8300.	2658.	2645.	1315.00	1318.13	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1318.13 ELREA= 1318.13

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

1410.000	9.09	1312.59	.00	.00	1312.83	.23	.00	.00	1317.70
8300.0	.0	8300.0	.0	.0	2137.1	.0	20.2	2.6	1313.80
.03	.00	3.88	.00	.000	.032	.000	.000	1303.50	515.46
.000450	65.	65.	65.	0	0	0	.00	270.40	785.86

FLOW DISTRIBUTION FOR SECNO= 1410.00 CWSEL= 1312.59

STA= 515. 791.
PER Q= 100.0
AREA= 2137.1

```
   VEL=      3.9
  DEPTH=     7.9


  04APR96      14:31:36                                                                    PAGE    9


   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 1500.000
  1500.000      8.95    1312.63       .00        .00    1312.87        .24        .04        .00    1317.88
    8300.0        .0     8300.0        .0         .0     2099.9         .0       24.6        3.1    1313.98
       .04        .00       3.95       .00        .000       .032       .000       .000    1303.68     515.88
   .000474         1.        90.       175.          0          0          0        .00     269.39     785.27


FLOW DISTRIBUTION FOR SECNO=   1500.00          CWSEL=   1312.63

STA=      516.      791.
  PER Q=     100.0
   AREA=    2099.9
    VEL=       4.0
  DEPTH=       7.8

*SECNO 1610.000
            APPROACH SECTION - 200' UPSTREAM OF BRIDGE
  1610.000      8.77    1312.67       .00        .00    1312.93        .25        .05        .00    1318.10
    8300.0        .0     8300.0        .0         .0     2052.7         .0       29.8        3.8    1314.20
       .04        .00       4.04       .00        .000       .032       .000       .000    1303.90     516.41
   .000508       110.       110.       110.          0          0          0        .00     268.11     784.53


FLOW DISTRIBUTION FOR SECNO=   1610.00          CWSEL=   1312.67

STA=      516.      791.
  PER Q=     100.0
   AREA=    2052.7
    VEL=       4.0
  DEPTH=       7.7


  04APR96      14:31:36                                                                    PAGE   10


                                                                  THIS RUN EXECUTED 04APR96     14:31:37
**************************************
 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
1410.000	1312.51	1315.00	.00	1318.13	6900.00	.00	1.00	.01	8.83	1312.33	3.34	1312.51
1410.000	1312.83	1315.00	.00	1318.13	8300.00	.00	1.00	.02	9.09	1312.59	3.88	1312.83

1

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 105

SECNO	CWSEL	HL	OLOSS	TOPWID	QLOB	QCH	QROB
1255.000	1312.30	.08	.01	272.27	.00	6900.00	.00
1255.000	1312.54	.11	.01	274.21	.00	8300.00	.00
1345.000	1312.32	.03	.00	271.03	.00	6900.00	.00
1345.000	1312.58	.04	.00	273.03	.00	8300.00	.00
1410.000	1312.33	.00	.00	268.51	.00	6900.00	.00
1410.000	1312.59	.00	.00	270.40	.00	8300.00	.00
1500.000	1312.36	.03	.00	267.43	.00	6900.00	.00
1500.000	1312.63	.04	.00	269.39	.00	8300.00	.00

1

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
1000.000	.00	.00	.00	1302.59	6900.00	1312.22	.00	1312.38	3.02	3.18	2171.25	3969.75
1000.000	.00	.00	.00	1302.59	8300.00	1312.45	.00	1312.66	4.02	3.72	2232.55	4140.47
1255.000	255.00	.00	.00	1303.10	6900.00	1312.30	.00	1312.47	3.58	3.36	2052.63	3645.68
1255.000	255.00	.00	.00	1303.10	8300.00	1312.54	.00	1312.78	4.70	3.91	2120.14	3829.08
1345.000	90.00	.00	.00	1303.28	6900.00	1312.32	.00	1312.51	3.82	3.43	2009.98	3531.25
1345.000	90.00	.00	.00	1303.28	8300.00	1312.58	.00	1312.83	4.98	3.99	2079.22	3717.59
1410.000	65.00	1318.13	1315.00	1303.50	6900.00	1312.33	.00	1312.51	3.44	3.34	2067.22	3720.83
1410.000	65.00	1318.13	1315.00	1303.50	8300.00	1312.59	.00	1312.83	4.50	3.88	2137.11	3913.99
1500.000	90.00	.00	.00	1303.68	6900.00	1312.36	.00	1312.54	3.65	3.40	2027.61	3612.70
1500.000	90.00	.00	.00	1303.68	8300.00	1312.63	.00	1312.87	4.74	3.95	2099.85	3810.64

1610.000	110.00	.00	.00	1303.90	6900.00	1312.40	.00	1312.58	3.93	3.49	1977.95	3478.55
1610.000	110.00	.00	.00	1303.90	8300.00	1312.67	.00	1312.93	5.08	4.04	2052.71	3681.11

1

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
1000.000	6900.00	1312.22	.00	.00	5.62	275.67	.00
1000.000	8300.00	1312.45	.22	.00	5.45	277.41	.00
1255.000	6900.00	1312.30	.00	.07	.00	272.27	255.00
1255.000	8300.00	1312.54	.25	.09	.00	274.21	255.00
1345.000	6900.00	1312.32	.00	.03	.00	271.03	90.00
1345.000	8300.00	1312.58	.25	.04	.00	273.03	90.00
1410.000	6900.00	1312.33	.00	.01	.00	268.51	65.00
1410.000	8300.00	1312.59	.26	.02	.00	270.40	65.00
1500.000	6900.00	1312.36	.00	.03	.00	267.43	90.00
1500.000	8300.00	1312.63	.27	.04	.00	269.39	90.00
1610.000	6900.00	1312.40	.00	.04	.00	266.07	110.00
1610.000	8300.00	1312.67	.28	.05	.00	268.11	110.00

SUMMARY OF ERRORS AND SPECIAL NOTES

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
5	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.: *8041*
ROUTE: *QUEEN CREEK 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;QUEEN CREEK ROAD BRIDGE*

Attendees:

Bridge No.: *8041* Date Built on Bridge Plans: *4/78*

Description of Bridge/Bridge Type: *CONTINUOUS REINFORCED CONCRETE SLAB;CONTINUOUS PIER WALL WITH SPREAD FOOTINGS 16' DEEP*

Route: *QUEEN CREEK ROAD* Water Course: *EAST MARICOPA FLOODWAY*

Underclearance at thalweg (ft): *+-9*

Elevation of stream thalweg (ft): *+-1303.5*

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

Reported high water elevation: *1310.7*

Description of flood: *100-year;*

Description of approach and "getaway" conditions: *SANDY-SILTY BANKS; NO APPARENT EROSION. CLEAR APPROACH.*

Description of bed load: *SILTY-SAND*

Condition of banks; evidence of lateral movement, degradation or aggradation: *GENERALLY GOOD CONDITION, WEST BANK UPSTREAM HAS SMALL EVIDENCE OF EROSION.*

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

Stage rise to overtopping: _____

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

Confluences: *N/A*

BRIDGE NUMBER 8041

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

Item 321 rating: *7*
Item 71 rating: *9*
Item 61 rating: *8*

ABUTMENTS		
	LEFT	RIGHT
TYPE	*SPILL THROUGH*	*SPILL THROUGH*
SPREAD/PILES	*16" DIA. CIPx37' LONG*	*16" DIA. CIPx37' LONG*
EXPOSED FOOTINGS	*NO*	*NO*
FOOTING ELEVATION	*N/A*	*N/A*
ROCK ELEVATION AND DESCRIPTION	*1275'*	*1275'*
SOIL ELEVATION AND DESCRIPTION	*1303.5' SILTY-SAND*	*1303.5' SILTY-SAND*
ANGLE OF ATTACK OF FLOOD FLOWS ON ABUTMENT	*0*	*0*
DESCRIPTION OF RIPRAP OR OTHER SCOUR PROTECTION	*NONE 2:1 SOIL SLOPE*	*NONE 2:1 SOIL SLOPE*
ITEM 113 RATING	*8L*	*8L*

GENERAL COMMENTS:

1.) *ABUTMENT DRILLED SHAFT TYPE 1 IS 15' BELOW THE BOTTOM OF THE CHANNEL; THIS MAY BE SUFFICIENT FOR SCOUR PROTECTION.*

BRIDGE NUMBER 8041

PIERS						
	1	2	3	4	5	6
CHANNEL/FLOODPLAIN	*CH.*					
PIER WIDTH	*24" DIA*					
SPREAD/PILES	*S*					
EXPOSED FOOTINGS	*NO*					
FOOTING HEIGHT	*N/A*					
FOOTING ELEVATION AND WIDTH	*1275'* *10'x62'*					
ROCK ELEVATION/TYPE	*N/A*					
ELEVATION OF TOP OF GROUND OR CHANNEL; SOIL TYPE	*1303.5'*					
ANGLE OF ATTACK (DEG)	*0*					
RIPRAP OR OTHER PROTECTION	*NONE*					
ITEM 113 RATING	*8L*					

General Comments/Assessment:

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

Recommended Item 113 and Risk Ratings:

8L

BRIDGE NUMBER 8041

SCREEN 3 - HYDRAULIC ENGINEER'S SCREEN

NAME: *QUEEN CREEK 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 8041

SCREEN 4 - FOUNDATION/GEOTECHNICAL ENGINEER'S SCREEN

NAME: *QUEEN CREEK 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 8041

REVIEW BY INTERDISCIPLINARY SCOUR EVALUATION TEAM

DATE: _____ ITEM 113 RATING: _____

RISK RATING: _____

PROPOSED ACTIONS:

1.) _____

_____

_____

Notes:

BRIDGE NUMBER 8041

SCREEN 5 - BRIDGE MANAGER'S SCREEN

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

:

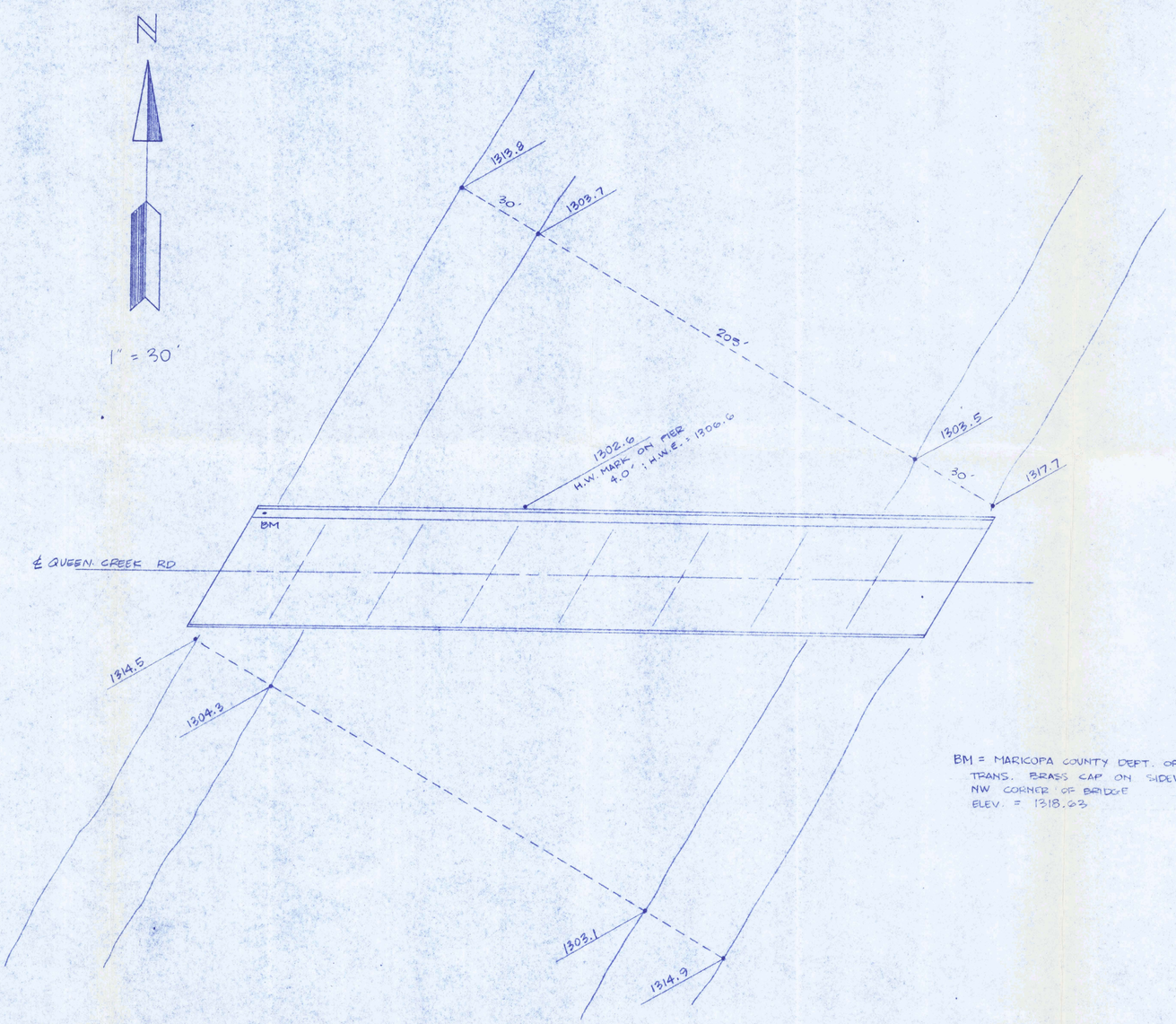
I HAVE REVIEWED SCREENS 1-4 AND CONCUR WITH THE FOLLOWING RATINGS:

- 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. = 1318.63

SCHEMATIC
NOT FOR CONSTRUCTION

QUEEN CREEK ROAD BRIDGE

SURVEYED BY : KJS DB 4-20-95

DRAWN BY KJS 4-21-95