Local Government
Bridge Scour Evaluation Study
Contract No. 95-42

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Summary Report for City of Peoria

(New River)
AREA

Prepared for:

Arizona Department of Transportation

February 1997

Prepared by:

Baker

Michael Baker Jr., Inc.

SUMMARY REPORT
FOR
CITY OF PEORIA

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
21674
ROBERT L. DAVIES
Date Signed 2-28-97
ARIZONA, U.S.A.

SUMMARY REPORT
FOR
CITY OF PEORIA

Introduction

The USDOT Federal Highway Administration Technical Advisory T 5140.23 (October 28, 1991), established guidelines for developing and implementing scour evaluation programs. The Local Government Bridge Scour Evaluation Study, ADOT Contract No. 95-42, was developed in response to the bridge scour evaluation requirements established by this Advisory. Contract No. 95-42, Phase II requires all local government bridges within the State of Arizona to be evaluated for scour susceptibility following the Procedures Manual developed in Phase I, ADOT Contract No. 95-29.

The bridge scour evaluation utilizes any existing information available and field view data collected to determine the appropriate scour classification for each bridge. Existing data used may include as-built plans, geotechnical information, survey data, bridge inspection reports, and hydrology/hydraulic reports. Each bridge is given a classification of either Declared or Calculated, Scour Stable or Scour Critical. If not enough foundation data is available, the structure is classified as Unknown Foundation.

The bridge scour evaluation report summarizes the evaluation of each bridge including the data collected, primary calculations performed and the resulting evaluation classification. Each individual bridge report contains a location map, data summary forms, field notes, process flow charts, calculations (if required), bridge inspection report (including cross-section), and field photographs. Color photographs are contained in the local government summary file kept in the ADOT Bridge Maintenance Department.

The primary evaluation data is included in each report. Supporting data utilized or collected to complete each evaluation, such as, survey notes, complete hydrologic/hydraulic computer output, hydrology/hydraulic reports, geotechnical evaluations and structural evaluations, are stored in the ADOT Bridge Maintenance Department in the local government summary file. Interested parties may refer to these files for more detailed data.

This Summary Report consolidates the evaluation results for all the bridges in City of Peoria. These results are summarized in the following table:

City of Peoria

FINAL BRIDGE SCOUR CLASSIFICATIONS

Str. No.	Waterway	Roadway	Decl.	Calc.	Classification	Evaluation Req'd. Struct.	Geotech.
8977	Waddell Canal	Carefree Highway	X		NSC		
9125	New River	Bell Road		X	NSC		
9680	CAP Canal	Lake Pleasant Road	X		NSC		
9684	New River	Thunderbird Road		X	NSC	X	
9850	Skunk Creek	83rd Avenue		X	NSC	X	
9923	Arizona Canal Diversion Channel	75th Avenue		X	NSC	X	

Decl. - Declared
NSC - Not Scour Critical
SC - Scour Critical
Calc. - Calculated
UNK - Unknown Foundation
NIP - Not In Progress

Data Collection

The structure evaluation data collected was compiled by the Phase I consultant and typically consisted of the as-built/design plans and bridge inspection reports found in the ADOT Bridge Maintenance files. Some local government agencies provided what records were available to supplement the data contained in the Bridge Maintenance files. In the Phase II (evaluation phase) portion of the project, key information such as, as-built data, foundation plans, countermeasure plans, and topography, was missing for many of the structures. Obtaining missing data was important for the Category B (natural waterway) bridge evaluations.

Collection of all pertinent missing data was attempted through two primary means. The first means was a phone call to the local government followed by a letter detailing what data was needed for which structure. The letter described the importance as-built data has to the evaluation process. It also stressed the potential cost associated with performing an evaluation without foundation information. A geotechnical evaluation is the most costly element of determining scour susceptibility. The second means of collecting data was to search through local government files to secure relevant data.

If as-built data could not be found, but design plans were available, the scour evaluation was performed according to the procedures. If geotechnical or structural evaluations were not required, the evaluations were completed using design data. Using design information rather than as-built data assumed the structures were constructed according to the design plans. The design elements critically important to the scour evaluation include the foundation type and depth and the waterway opening.

If design plans were used to perform an evaluation, the local government representative was informed by phone. The local government then directed Baker to base the evaluation on design data to avoid expensive geotechnical exploration costs. The phone call report is included in the Appendix.

Additional Funding Requests

The Local Government Bridge Scour Evaluation Study procedures may necessitate performing a geotechnical and/or structural evaluation to complete a scour susceptibility determination. The procedures require the Phase II consultant to prepare and submit, to ADOT and the local government, a cost estimate to perform the geotechnical or structural evaluations. If the additional funding request is denied, the structure is classified as 'Declared Unknown Foundation'. The local government will need to address the ramifications of this declaration at a later date. The resulting geotechnical/structural evaluation data will be included in the Bridge Maintenance local government summary files.

Explanation of Scour Evaluation Classification

A *stable* classification, whether declared or calculated, means the structure is not scour susceptible. This classification indicates the structure is safe from a scour standpoint. A *critical* classification, whether declared or calculated, means the structure is scour susceptible. This classification indicates the structure is not safe from a scour standpoint. An *unknown foundation* classification means the structure could not be classified as being either *stable* or *critical.* This classification indicates the evaluation could not be completed due to lack of information or funding.

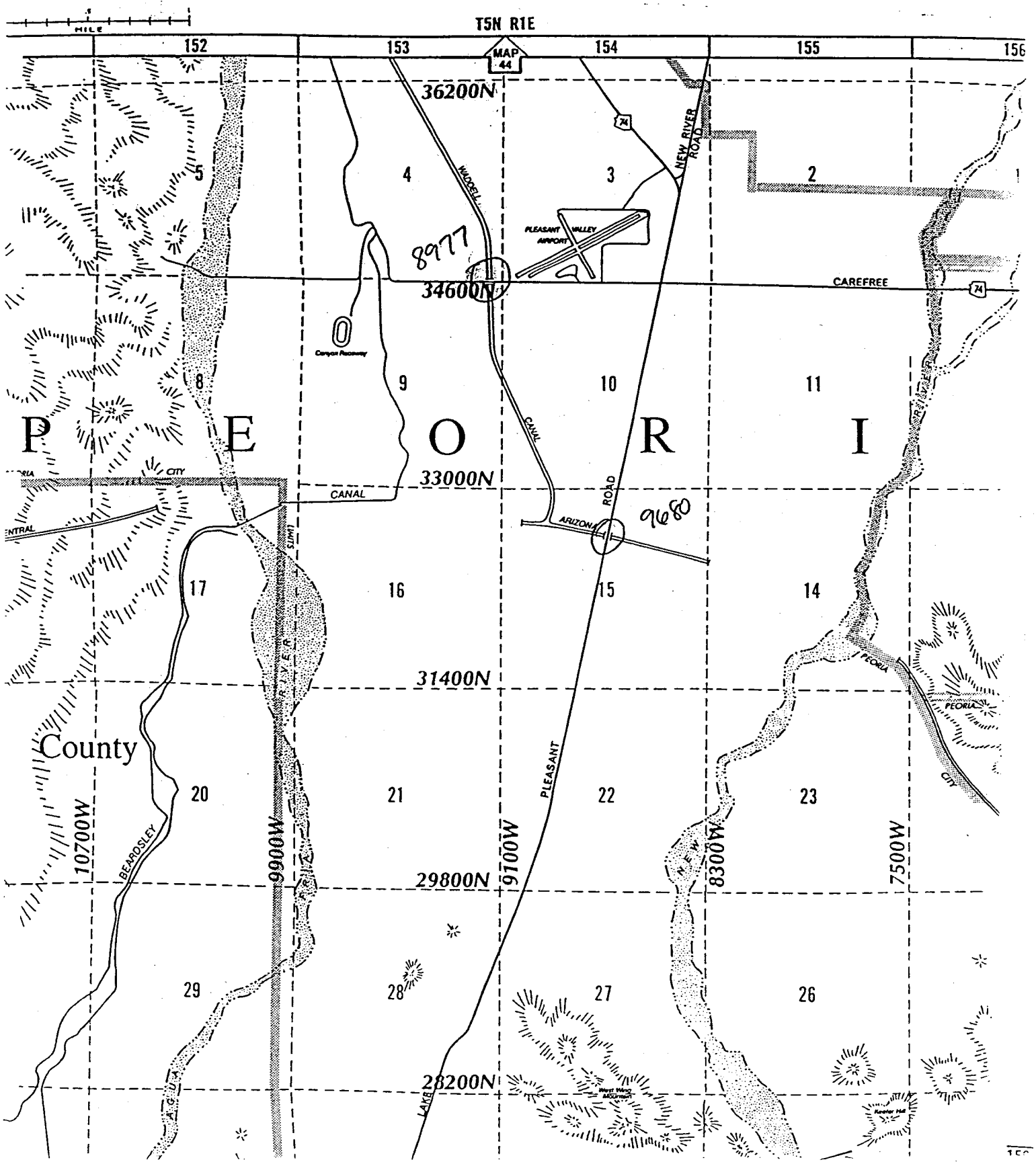
The Federal Highway Administration, in the 1988 revision of the *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (the Coding Guide), added "Item 113 - Scour Critical Bridges". Item 113 uses a single digit code to identify the current status of a bridge regarding its scour vulnerability. A scour critical bridge is one in which abutment or pier foundations are rated unstable due to either observed scour at the bridge site or potential scour determined from a scour evaluation.

A structure classified as an unknown foundation, after January 1977, may create problems for local governments trying to acquire bridge replacement funds.

Conclusion and Scope Limitations of Study

All bridge scour evaluations were performed following the accepted Local Government Bridge Scour Evaluation Study procedures. The best available data and sound engineering judgment were applied to complete the evaluations.

The scope of work for this project specifically required that countermeasure recommendations for and prioritization of the scour critical bridges not be done. These items will best be handled by the individual local governments. Each local government is most familiar with its manpower and financial resources.



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MAP 44
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WADDELL
NEW RIVER ROAD
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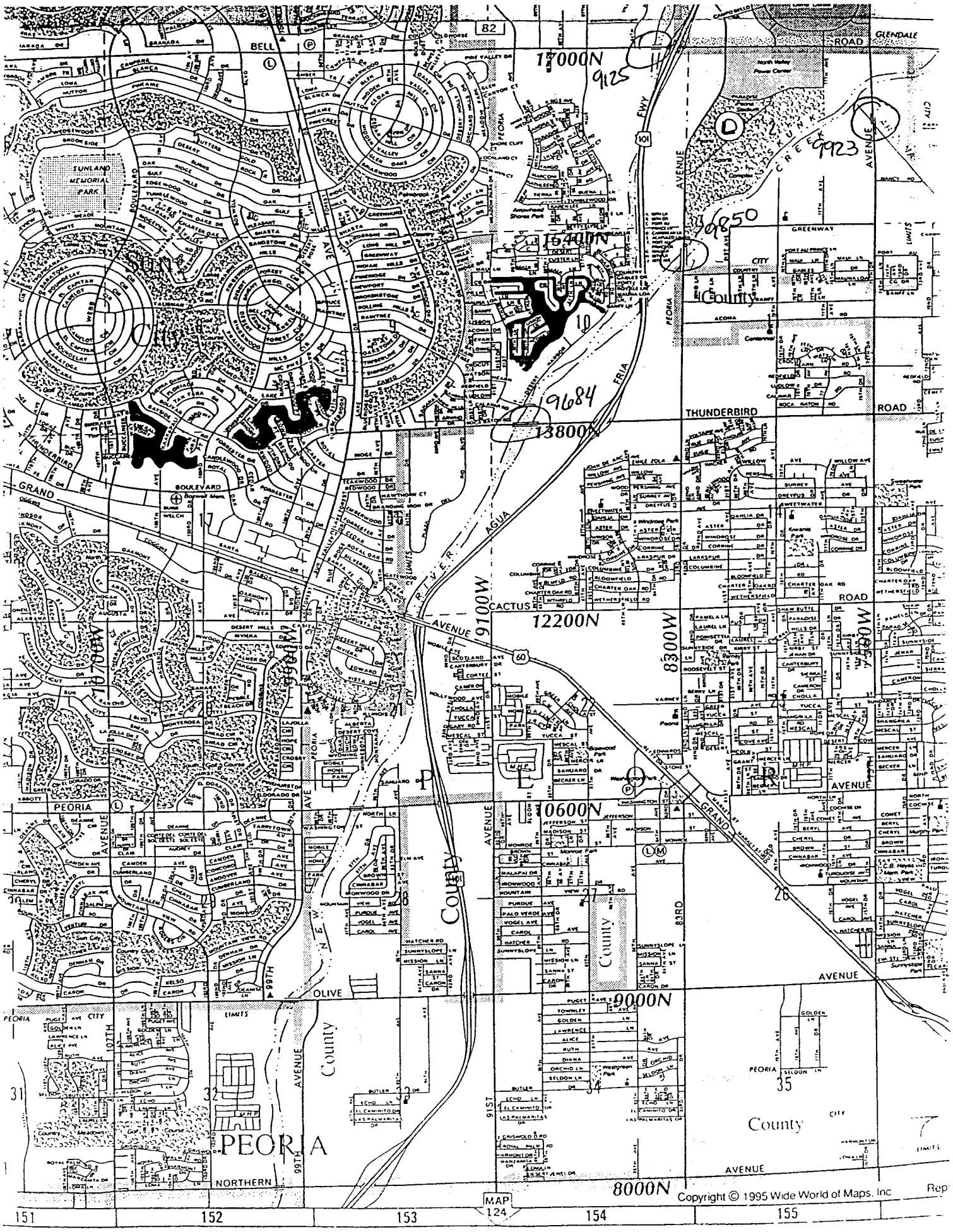

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APPENDIX A

Structure Evaluations

S.O. No.	21693 - APA				
Subject:	Bridge Scour Evaluation Study				
Structural Bridge Evaluation				**Sheet No.**	
				Drawing No.	
Computed By	JGK	**Checked By**	AN/MMP	**Date**	Feb-97

Baker

Bridge # ***09684***

Summary:

Bridge structure number 09684 is *not* considered scour critical. This conclusion was reached by loading the bridge under scoured conditions. The loading was done in accordance with the 1996 version of AASHTO specifications. Additionally "The Final Scour Evaluation Report" provided the scoured conditions.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
28174
MARK
PILWALLIS
Date Signed 2/25/97
ARIZONA, U.S.A.

Bridge # *09684*

Based on the initial hydraulic and geotechnical assessments a structural analysis of this bridge is required to determine the stability of the structure under scour conditions. Foundation capacities will be evaluated for three load cases using load factor design.

Load Cases,

I. D+SF+0.5W+B
II. D+L+SF
III. D+L+SF+.3*W+WL+LF+T

Bridge information:

Bridge Roadway Width =	68.00	ft.		
Span Lengths, L =	75.00	ft.		
Bridge Length =	300.00	ft.	# of 12' Lanes =	5
Pier Column Spacing =	21.35	ft.		
Bridge skew =	26.42	degrees		
Column Diameter 1,133.00 ft. =	3.00	ft.		
Shaft Diameter 1,089.00 ft. =	3.50	ft.		

Elevations:

Top of pier cap elev. =	1157.03	ft.
Bottom of pier cap elev. =	1153.28	ft.
Native ground elev. =	1136.10	ft.
Column/Shaft Diameter change =	1133.00	ft.
Shaft tip elev. =	1089.00	ft.
Length of 3.00 ft. dia. column =	20.28	ft. = 243.36 in.
Length of 3.50 ft. dia. shaft =	44.00	ft. = 528.00 in.

Scour Information:

High water elev. =	1156.00	ft.
Total scour depth =	17.10	ft.
Ground elev. after scour =	1119.00	ft.
Length of exposed column after scour =	34.28	ft. = 411.36 in.
Water Velocity, V_{avg} =	10.70	ft/s

Bridge # *09684*

Dead Load,

Dimensions:			Loading:		
Bridge deck width =	83.50	ft.	Deck =	8.35	kips/ft.
Slab Thickness =	0.67	ft.			
F.W.S =	0.04	kips/ft^2	F.W.S =	2.38	kips/ft.
Parapet weight =	1.09	kips/ft.	Parapet =	1.09	kips/ft.

Girders

# of Girders =	10	
Girder area =	853	in.^{2}
Girder weight =	8.89	kips/ft.

Girder Loading = 8.89 kips/ft.

Super Dead loading = 20.70 kips/ft.

Loading on pier line = 1.143*Span length*Super Dead loading = 1774.58 kips

Pier Cap

Width =	3.25	ft.
Height =	3.75	ft.
Length =	91.83	ft.

Pier cap taken care of in STAAD model.

Pier Diaphram

Length =	73.50	ft.
Thickness =	2.33	ft.
Height =	4.63	ft.
Diaphram weight =	100.18	kips

Pier Diaphram loading = 100.18 kips

Bridge # 09684

# of columns = 5

Total Dead Loading = 1874.75 kips

Pier Line Dead Load = 20.41 kips/ft.
Total Dead Loading/Column = 374.95 kips

Live Load,

HS20-44 truck will be used for the Live Loading. Modeling a four span section the controlling live load can be in looked in up the AISC Manual from Moments, Shears, and Reactions for continuous highway bridges.

Span Lengths, L = 75.00 ft.

Max. Reaction at piers = 84.70 kips/lane
# of 12' Lanes = 5
Reduction factor = 0.75

# of columns = 5

Pier Line Live loading = 317.63 kips

Pier Line Live loading = 3.46 kips/ft.

Total Live Load loading/column = 63.53 kips

Bridge # *09684*

Buoyancy,

Length of 3 ft. dia. column under water =	20.28	ft.
Column Vol. =	143.35	ft^3
Length of 3.5 ft. dia. column under water =	14.00	ft.
Shaft Vol. =	134.70	ft^3
Submerged pier cap vol. =	936.70	ft^3
Buoyant force =	0.0624	$kips/ft^3$

Force per column = 29.04 kips

Stream Flow Pressure,

Column Pressure

Water Velocity, V_{avg} = 10.70 ft./s

Reference section 3.18.1.1.1 of AASHTO,

Constant for circular piers, K =	0.70	
Average Pressure, $P_{avg} = KV_{avg}^2$ =	0.080	$kips/ft.^2$
Max. Pressure, $P_{max} = 2P_{avg}$ =	0.16	$kips/ft.^2$
Column Diameter =	3.00	ft.

Force at column top = 0.48 kips

Force on column at scour bottom = 0.00 kips

Since the stream water elevation is above the top of column, assume the maximum pressure is uniformly distributed over the exposed area.
Reference section 3.18.1.1.2 of AASHTO

Bridge # *09684*

Pier Cap Pressure

Pier Cap Width = 3.25 ft.
Exposed Area = 8.84 $ft.^2$

Water pressure parallel to pier cap = 1.42 kips

Wind Load,

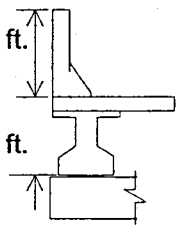
Superstructure wind,

Pressure		Direction
0.050	$kips/ft.^2$	Transverse to bridge
0.012	$kips/ft.^2$	Longitudinal to bridge

Reference section 3.15.2.1.3 of AASHTO,

All wind loads on structure apply simultaneously.

Superstructure depth exposed to wind = 7.96 ft.



Longitudinal wind,

W = 0.012 * 7.96 * 300 / 3 = 9.55 kips/pier

Horizontal wind on column top = 1.91 kips

Horizontal loading on column top,

Loading parallel to pier line = 0.85 kips
Loading perpendicular to pier line = 1.71 kips

Bridge # *09684*

Transverse wind,

W = 0.05 * 7.96 * 75.00 = 29.84 kips/pier

Horizontal wind on column top = 5.97 kips/col.

Horizontal loading on column top,

Loading parallel to pier line = 5.35 kips

Loading perpendicular to pier line = 2.66 kips

Substructure wind,

Substructure wind apply pressure of .04 kips/ft.^{2} to each pier face.

Top of pier cap elev. = 1157.03 ft.
Water elevation = 1156.00 ft.
Long. pier cap length = 91.83 ft.
Exposed Pier cap height = 1.03 ft.

Perpendicular wind to pier line,

Longitudinal exposed pier cap area = 94.59 ft.^{2}

Pier cap wind loading = .04 * 94.59 / 5 = 0.76 kips/col.

Loading perpendicular to pier line = 0.76 kips

Parallel wind to pier line,

Wind loading on pier cap,

Projected pier length = 3.25 ft.
Exposed height = 1.03 ft.
Exposed Area = 3.35 ft.^{2}

Loading parallel to pier line = 0.04 * 3.35 / 5 = 0.03 kips

Bridge # *09684*

Wind on Live Load (WL),

The wind on live load is applied 6 feet above the deck.

Loading		Direction
0.10	kips/ft.	Transverse to bridge
0.04	kips/ft.	Longitudinal to bridge

Bridge Roadway Width = 68.00 ft.
# of contributing spans = 4
# of contributing piers = 3

Longitudinal force = 4.00 kips/pier
Transverse force = 10.00 kips/pier

WL_{perp} = 1.61 kips/col.
WL_{parll} = 2.15 kips/col.

Longitudinal Force,

Longitudinal force is 5% of Live Load. (AASHTO 3.9)

# of contributing piers = 3 Pier span lengths = 75.00 ft.
# of contributing spans = 4 # of columns = 5

Longitudinal force per pier, LF = 15.88 kips

Loading perpendicular to pier line = 14.22 kips => LF_{perp} = 2.84 kips/col.
Loading parallel to pier line = 7.07 kips => LF_{parll} = 1.41 kips/col.

Bridge # *09684*

Thermal Force,

Moderate climate temp. fall = 40 degree F
Coefficient of thermal expansion = 6.00E-06 / degree F

Displacement due to temp. change = 0.216 in.

Deflection perpendicular to pier line, Δ_{perp} = 0.193 in.

The equivalent horizontal forces produced from the thermal displacements are calculated in STAAD.

$Loading_{perp}$ = 3.90 kips

$Loading_{parll}$ = 1.94 kips

Bridge # ***09684***

Axial Loading Summary,

Dead Load = 374.95 kips

Live Load = 63.53 kips

Buoyancy = 29.04 kips

Horizontal Loading Summary,

Loading Type	Direction to pier line: Perpendicular		Parallel	
Stream Flow Pressure	0.00	kips	1.42	kips
		Top =	0.48	kips
		Bottom =	0.00	kips
Wind	5.12	kips	6.22	kips
Wind on Live Load	1.61	kips	2.15	kips
Longitudinal Force	2.84	kips	1.41	kips
Thermal Force	3.90	kips	1.94	kips

Bridge # *09684*

Design Loading:

Using the load factor design, the gamma value for case I, II and III is 1.25.

STAAD-III Output,

Parallel (to pier line) Loading,

Loading Combinations:	P (kips)	M (ft.-kips)	Lat Load (kips)
I. D+SF+0.5W+B	251.70	109.70	22.71
II. D+L+SF	855.24	0.00	23.74
III. D+L+SF+.3*W+WL+LF+T	797.17	423.62	31.54

Perpendicular (to pier line) Loading,

Loading Combinations:	P (kips)	M (ft.-kips)	Lat Load (kips)
I. D+SF+0.5W	251.70	361.27	3.20
II. D+L+SF	855.24	350.49	0.00
III. D+L+SF+.3*W+WL+LF+T	797.17	514.59	12.36

COM624P Input,

Loading Combinations:	P (lbs.)	M (in.-lbs.)	Lat Load (lbs.)
I. D+SF+0.5W	251700	4530697	22934
II. D+L+SF	855240	4205880	23740
III. D+L+SF+.3*W+WL+LF+T	797170	7998311	33875

Results:

The maximum axial service load is 633 kips.

The greatest calculated axial service load is 633 kips, and at the same time, the geotech report the allows a maximum of 600 kips. (Sergent, Hauskins & Beckwith) This produces an overstress of 5%. This temporary situation occurs concurrently when the maximum of both overloading and scour conditions occur. Because in fact this small overstress is temporary it passes the structural evaluation.

The results from PCACOL shows the column and shaft to be OK.