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AND
CITY OF PEORIA

BELL ROAD
NEW RIVER BRIDGE

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PEORIA, ARIZONA

BRIDGE SELECTION REPORT

FLOOD CONTROL
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BURGESS & NIPLE, INC.
5025 East Washington Street
Phoenix, Arizona 85034

February 1989

Registered Professional Engineer (Civil)
CERTIFICATE NO. 27236
FLOYD L.
OLIVER JR.
Signed 2/2/89
ARIZONA, U.S.A.

GENERAL

Introduction

This report is presented to aid in the selection of construction for widening and rehabilitating the existing Bell Road Bridge over New River. As is currently understood, most of the existing bridge structure is to be utilized. Costs presented in this report reflect construction in the 1989 construction season with inflation of 6 percent annually, contractor mobilization of 5 percent of the total cost, bid contingency of 10 percent, and a construction inspection allowance of 15 percent. Figures and computations are included in the Appendix.

Purpose of Project

The purpose of this project is to provide for a wider bridge to carry a widened and improved Bell Road over New River, improvements to the existing bridge structure, and scour protection to the existing piers and abutments. At present, Bell Road Bridge is a four-lane bridge with a center concrete median barrier. The widened bridge will accommodate six lanes of traffic, two left turn lanes, sidewalks, and a concrete median.

History

The original bridge was built in 1964 as a 37-foot-wide bridge to carry Bell Road over New River. Bell Road bridge was widened and reconstructed in 1977 to provide for a 74-foot-wide bridge to accommodate four lanes of traffic. The current bridge width matches the existing roadway width. The bridge currently has a standard concrete half barrier for traffic railing and a concrete median barrier.

Previous inspections in 1983 and 1985 have noted scouring problems at the piers in the channel. At this time, a new dam has been constructed upstream of the bridge which will reduce the peak discharge of water flowing through this location. However, the dam will also reduce the sediment available for

deposit at the site. Increasing urbanization will also reduce the sediment deposited at the site. The result of lower peak discharge and reduced sediment may be no significant change in the aggradation/degradation state of the river bed. Current indications are that the river bed is aggrading as suggested by the adverse grade to the south and accumulation of silt in the abandoned USGS gaging station at the bridge. Therefore, scour protection is still necessary at this bridge.

Geotechnical

Geotechical information presented in the Contract Plans for the existing bridges indicated that the native material is a gravel and sandy soil mixture with some lime of 7 feet to 15 feet deep overlaying a clay bed. The clay has a slight lime content and is well consolidated. Soil borings taken for this widening indicate the top 5 to 14 feet of the subsurface material consists of light brown medium dense sand, gravel and cobbles. Below this layer is an orangish-brown dense clayey sand and gravel mixture with varying percentages of cobbles.

CONSTRUCTION ALTERNATIVES

Bridge Widening

The current bridge is a five-span continuous concrete voided slab structure. The scope of this project requires the widened structure to be a five-span structure similar to the existing. The widened structure is to accommodate six traffic lanes, two left turn lanes, a 4-foot median, and 5-foot sidewalks on each side for a total structure width varying from 113 feet to 121 feet.

To make sidewalks truly accessible to bicycles, widths of 8-10 feet would be necessary. Rather than expend additional money to create wide sidewalks, we suggest that the scour protection can be used to serve as a bikeway through the river bed on the north side.

The substructure will consist of piers and abutments similar to the existing structure. The piers will consist of wall type piers on spread footings. The abutments will be a wall type on spread footings.

Since the widening will be done on both sides, the wingwalls will need to be replaced also. Existing walls are turned back type. New wingwalls will be constructed in the same manner.

Due to the narrow width of the existing piers, only a continuous structure will be acceptable as an alternate. Structure depth and similar expansion characteristics dictate that a voided continuous concrete slab comparable to the existing be used for the widening.

Bridge Rehabilitation

Upon inspecting the existing New River bridge, diagonal cracks were noted emanating from the reentrant corner of the daped voided slab at the hinges. Photographs taken by ADOT inspectors in 1983 indicated the presence of these cracks. The cracks had not been noted on prior inspections.

Our evaluation of these hinges indicate that they will not meet current AASHTO bridge code and using the 1996 average daily traffic (ADT) of 18,000 as shown on the plans. We recommend that 1-1/8 inch diameter bolts be installed in holes drilled through the deck at a location where these bolts will transfer the shear on the daped hinge to the full voided slab section (See Figure 3). This should be done for both hinges.

Scour Protection

Several methods were evaluated for scour protection. Alternate No.1 is to use a 12-inch mat of of rock filled gabions at the current river bed level. Upstream and downstream scour protection consists of 6-inch mats of rock filled gabions at the angle of repose of the soil down to a depth of 20 feet. Embankment protection is provided by a 6-inch mat of rock filled gabions at a 2:1 embankment slope. As asphaltic cement mixture (mastic) is placed on the gabions to prevent the cobbles from cutting the wires and negating the effects of the gabions. A geotextile fabric must also be installed to prevent the soils underneath the gabions from leaching out. This method has the advantages of the lowest cost ($221,000) and provides an articulating protection system. It's disadvantages include the less than aesthetic asphaltic cement topping and the need for a varying thickness concrete surface for the east-west bikeways and restrictions on the size of equipment used for maintenance of the channel.

Alternate No. 2 consists of 10-inch thick jointed reinforced concrete plating under the bridge and 6-inch thick jointed reinforced concrete slope plating protection for the 10-inch plating at the angle of repose of the soil. Six-inch thick jointed concrete slope plating is used on the 2:1 sloping embankments. It has the advantages of providing for the maintenance equipment normally used by the City of Peoria, the second lowest cost ($237,000) and a constant thickness bike path. It's disadvantages are its cost and it is not an articulating system.

Alternate No. 3 consists of a 3.75-foot thick of rock rip rap placed on the river bed for the width of the bridge and then down the angle of repose of the soil to a point 20 feet below the river bed. Embankment protection will be a 3.75-foot thick layer of rip rap placed on the 2:1 embankment slope.

It's advantage is the need for very little maintenance. It's disadvantage includes a cost of $382,000 and much hand labor to place the rock. It would also require additional concrete for the bikeways.

Alternate No. 4 is a soil cement protection consisting of a 1-foot thick river bed layer and an 8-foot wide bench of 8-inch steps built on the angle of repose of the soil below the river bed. Embankment protection will consist of an 8-foot bench in 8-inch high steps at the 2:1 slope of the embankment. It's disadvantages include the second highest cost of $253,000 and it would need additional concrete for the bikeways.

We recommend using Alternate No. 2 due to a combination of cost, aesthetics and ease of maintenance. It is also the standard stream bed lining used by ADOT.

Maintenance of Traffic

Due to the width of the bridge, the bridge may be built in staged construction since the widening will be done on both sides of the existing structure. Judicious planning and traffic control should allow minimal impact on the traffic and construction time. Following completion of the new portion, traffic may be detoured off existing portions of the bridge to allow strengthening of the hinges.

UTILITIES

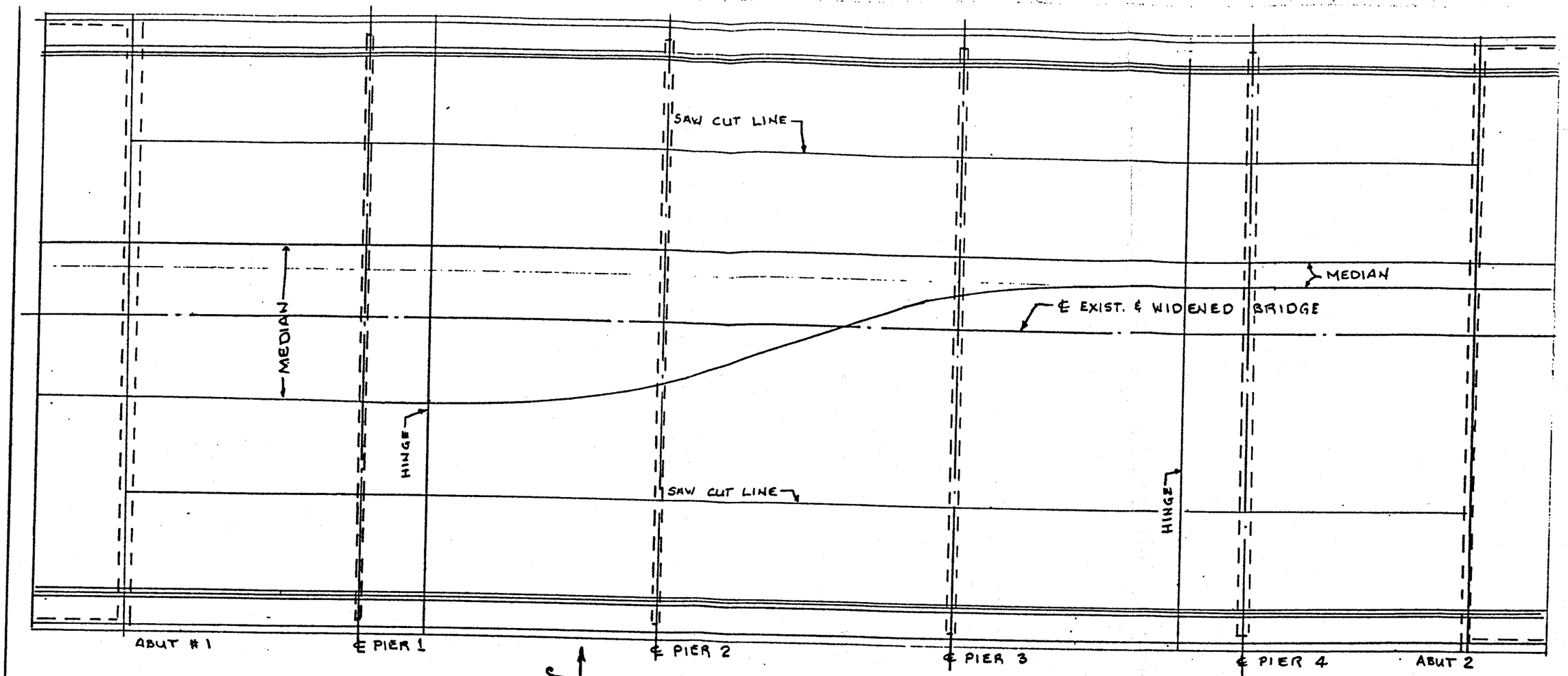
Only one 2-inch water line is currently attached to the bridge. No other utilities are in the right-of-way which may effect the bridge widening. The 2-inch water line will be relocated and attached to the widened bridge with little impact.

A gaging station is currently attached to the south side of the bridge. This gaging station is abandoned and will be removed the USGS prior to construction.

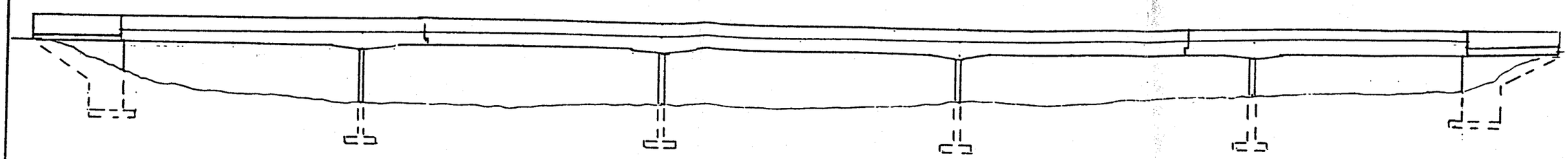
A new 16-inch waterline will be routed to the north of the widened bridge 4 feet beneath the new scour protection.

COST ESTIMATE

The bridge as configured in SK-1, 2 and 3 is estimated to cost $982,900. These costs include scour protection. This total estimated cost includes 6 percent for inflation to 1989, 5 percent for contractor mobilization, 10 percent contingency and 15 percent for construction inspection.



PLAN VIEW



ELEVATION

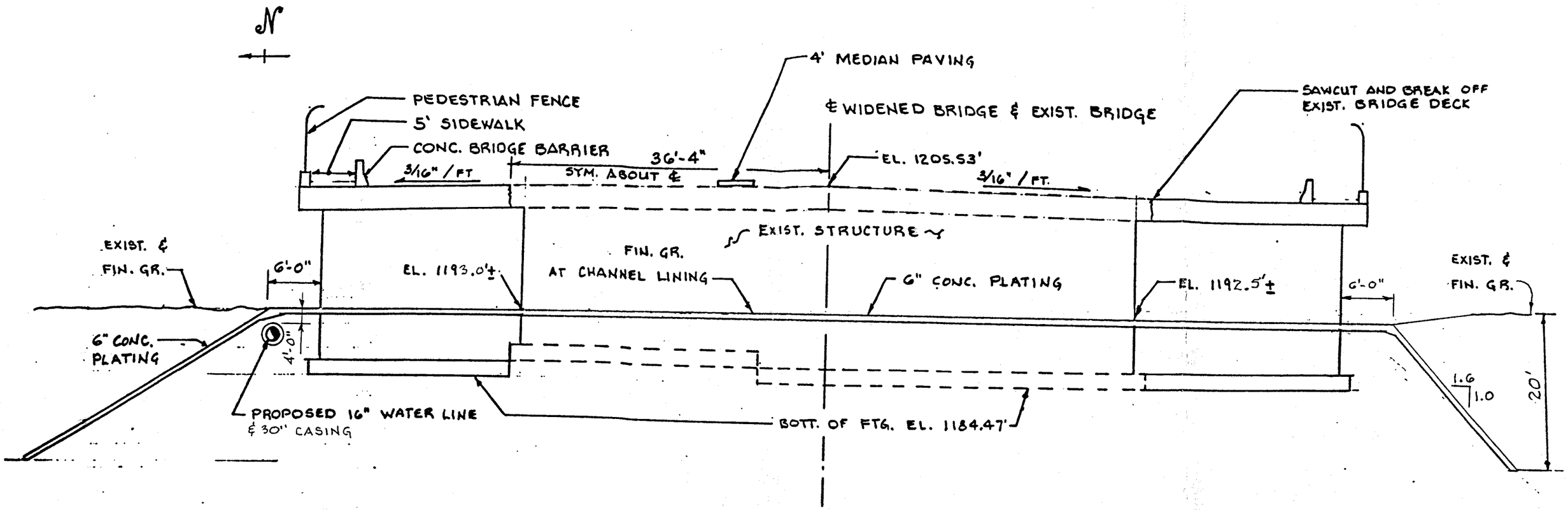
SK-1

BURGESS & NIPLE, INC. - COMPUTATION SHEET

JOB NO. _____ JOB NAME _____ SHEET ___ OF _____ SHEETS

SUBJECT _____ PREPARED BY _____ DATE _____

_____ CHECKED BY _____ DATE _____



SECTION AT PIER NO. 3

LOOKING EAST

(OTHER PIERS SIMILAR)

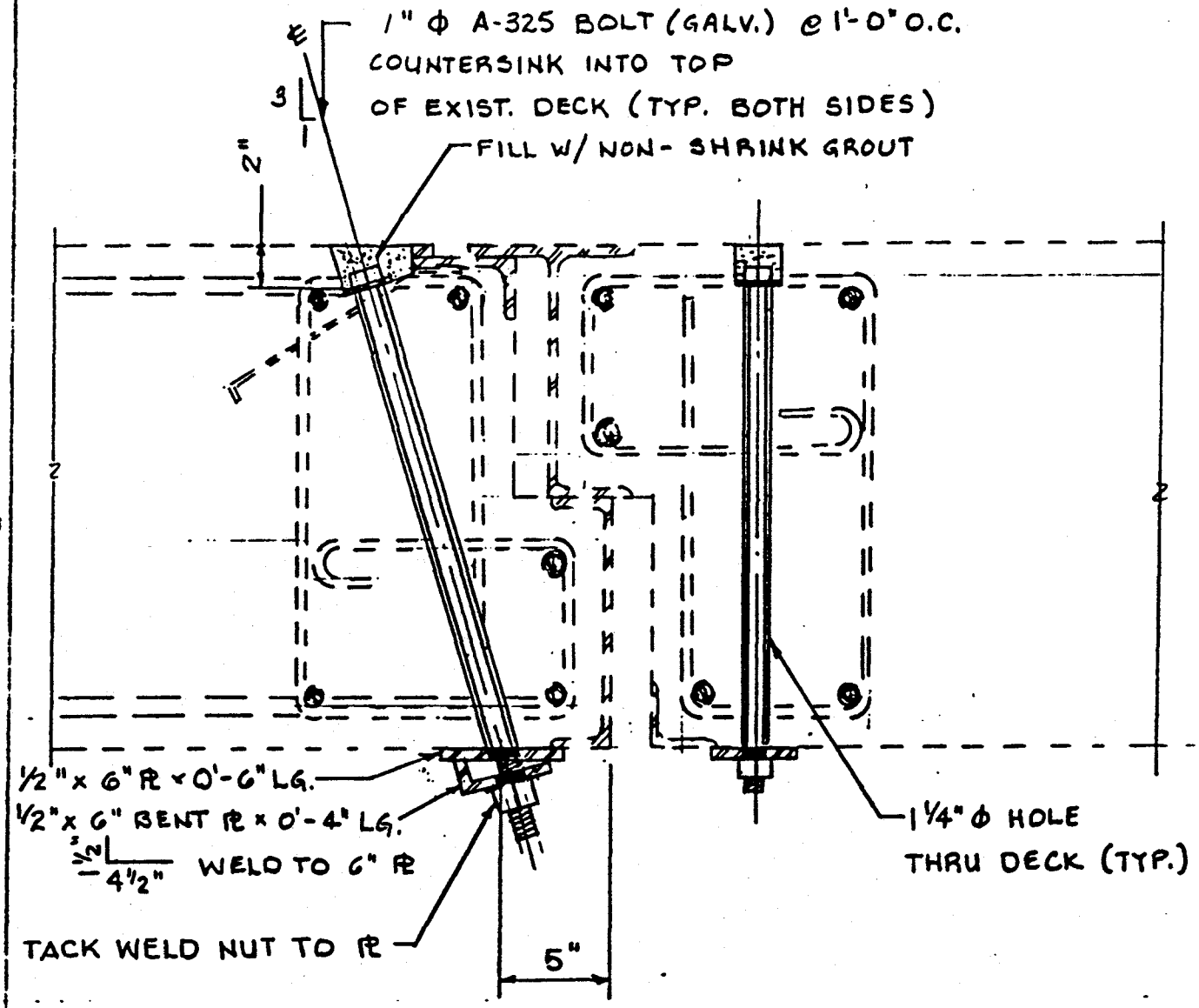
SK-2

BURGESS & NIPLE, INC. - COMPUTATION SHEET

JOB NO. 7069 JOB NAME BELL RD. BRIDGE SHEET ___ OF ___ SHEETS

SUBJECT ___ PREPARED BY ___ DATE ___

CHECKED BY ___ DATE ___



DETAIL

SK-3

BURGESS & NIPLE, INC. - COMPUTATION SHEET

JOB NO. 7069 JOB NAME BELL RD. BRIDGE SHEET 1 OF ____ SHEETS

SUBJECT SCOUR PROTECTION PREPARED BY F. OLIVER, JR DATE 11/15/88

CHECKED BY JJC DATE 1/5/89 REV. 11/18/88

RE: ENGR. ANALYSIS OF FLUVIAL SYSTEMS by SIMONS & LI REV. 1/26/89

11.6.2 ANALYSIS OF LOCAL SCOUR

NEILL'S EQ. $d_s/d_1 = 2.2 \left(\frac{b}{d_1}\right)^{0.65} F_{r_1}^{0.43}$ SQUARE NOSED

$d_s/d_1 = 2.0 \left(\frac{b}{d_1}\right)^{0.65} F_{r_1}^{0.43}$ CIRCULAR CYLINDERS

d_s = DEPTH OF SCOUR HOLE

b = PIER WIDTH NORMAL TO STREAM FLOW

d_1 = UPSTREAM DEPTH OF FLOW

F_r = UPSTREAM FROUDE NUMBER $= \frac{V_1}{\sqrt{g d_1}}$

V_1 = UPSTREAM VELOCITY

g = ACCELERATION OF GRAVITY

FOR b, ON SKEW

EQUIV. b = EQUIV. a = $l \sin\alpha + a \cos\alpha$

(b_e) l = LENGTH OF PIER

a = WIDTH OF PIER

α = ANGLE OF ATTACK

b_e = EQUIV. a = 120.17' (sin 10°) + 1.17' (cos 10°)

= 20.87' + 1.15' = 22.02'

FOR NEILL'S EQ., b = WIDTH OF PIER + BRUSH WIDTH

≈ 1.17' + 4' BRUSH = 5.17' V_1 = 8.86

(SEC. 9.96) d_1 = 7.00' FROM HEC-II RUN DTD 88-11-16.'

$$F_r = \frac{V_1}{\sqrt{g d_1}} = \frac{8.86 \times 1.50\ (SF)}{\sqrt{32.2 \times 7.00'}} = 0.88$$

$$d_s/d_1 = 2.2 \left(\frac{b}{d_1}\right)^{0.65} F_{r_1}^{0.43}$$

BURGESS & NIPLE, INC. - COMPUTATION SHEET

JOB NO. 7069 JOB NAME BELL RD. BRIDGE SHEET 2 OF ____ SHEETS

SUBJECT SCOUR PROTECTION PREPARED BY F. OLIVER, JR DATE 11/15/88

CHECKED BY JJC DATE 1/5/89

REV. 11/16/88
REV 1/26/89

$$\therefore d_s = d_1 \times 2.2 \left(\frac{b}{d_1}\right)^{.65} F_{r_1}^{0.43}$$

$$= 7.00' \times 2.2 \left(\frac{5.17'}{7.00'}\right)^{0.65} (0.88)^{0.43}$$

$$= 11.97'$$

SHEN'S EQ.

$$d_{sc} = 0.00073\ R^{0.619}$$

$$R = \frac{Vb}{\nu}$$

b = WIDTH PROJECTED ON A PLANE NORMAL TO UNDISTURBED FLOW

ν = KINEMATIC VISCOSITY = $.93 \times 10^{-5}$ @ 80°F

$$\therefore R = \frac{1.5\,(8.86) \times 5.17' \times 1.015}{.93 \times 10^{-5}} = 7{,}498{,}918$$

$$\therefore d_{sc} = 0.00073\ (7{,}498{,}918)^{0.619}$$

$$= 13.15'$$

$$\therefore \text{AVG. } d = \frac{11.97 + 13.15}{2} = 12.56'$$

ADJUST FOR SKEW ANGLE OF 10°

FROM SH. 1, b = 22.02'

$$l/a = \frac{120.17'}{22.02'} = 5.46 : 1$$

FROM "FINAL SEDIMENT TRANSPORT REPORT FOR THE NEW RIVER AND SKUNK CREEK" - 1985 FOR CORPS OF ENGINEERS, BY SIMONS, LI & ASSOC.

MULTIPLYING FACTOR FOR DEPTH OF SCOUR, PG. 630, TABLE 6.15

BURGESS & NIPLE, INC. - COMPUTATION SHEET

JOB NO. 7069 JOB NAME BELL RD. BRIDGE SHEET 3 OF ____ SHEETS

SUBJECT SCOUR PROTECTION PREPARED BY F. OLIVER DATE 11/15/88

CHECKED BY JJC DATE 1/5/89

REV. 11/16/88
REV 1/26/89

	LENGTH TO WIDTH OF PIER		
α	4	5.46	8
0°	1.0	1.0	1.0
15°	1.5	1.683	2.0

BY INTERPOLATION, MULT. = 1.46

∴ DEPTH OF SCOUR = 1.46 × 12.56' = 18.34', USE 19'-0" CONTROLS

CHECK FOR ARMORING POTENTIAL (CHAP. 11, SEC. 11.3 & 11.4)

$$\Delta Z = \frac{2 d_a}{P_c} \quad \text{(EQ. 11.13)} = \text{SCOUR DEPTH}$$

VEL. ≈ 8.86 × 1.5 = 13.29 FPS
(SF)

FOR MIN. PARTICLE SIZE AT INCIPIENT MOTION

$$V_c = \left(\frac{8 \tau_c}{f_p}\right)^{1/2} \simeq 18.4\, D_s^{1/2}$$

$\tau_c \approx 0.047 (\gamma_s - 8) D_s$

$$\tau_c \approx 4.84\, D_s \quad \text{(PG. 11.16)}$$

D_s = PARTICLE SIZE

τ_c = SHEAR STRESS

BY OBSERVATION, GEOTECHNICAL GRAIN DISTRIBUTION USED IN "FINAL SEDIMENT REPORT" BY SIMONS, LI IS MORE ACCURATE AND CONSERVATIVE THAN DATA IN REPORT BY ATL.

$$D_s = \left(\frac{V_c}{18.4}\right)^2 = \left(\frac{13.29}{18.4}\right)^2 = 0.52' \quad \text{SAY} \quad 6'' \text{ MAT'L}$$

D_s = DIAMETER OF MAT'L. = d_a

FROM GRAIN SIZE DIST. IN FIG. 5.2, PG. 5.21 OF "FINAL SED. REPORT"

P_c = PERCENT COARSER ≈ 1%

$$\Delta Z = \frac{2 \times 0.50}{.01} = 100' \quad \therefore \text{ WILL NOT ARMOR}$$

USE 20'-0" FOR SCOUR PROTECTION DEPTH

LATEST 1/26/89

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User: MISCHJ                                  at PHX

MFD2.3>U307.0>BELL>NRB.FINAL.OUT

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W W W   W    WWW  W     WWWWW    W
W   W   W       W W     W   W W  W
W   W   W   W   W W   W W   W W  W
W   W  WWW   WWW   WWW  W   W  WW


W   W WWWW  WWWW        WWWWW  WWW  W   W  WWW  W            WWW  W   W WWWWW
WW  W W   W W   W       W       W   WW  W W   W W           W   W W   W   W
W W W W   W W   W       W       W   W W W W   W W           W   W W   W   W
W W W WWWW  WWWW        WWWW    W   W W W WWWWW W           W   W W   W   W
W W W W W   W   W       W       W   W W W W   W W           W   W W   W   W
W  WW W  W  W   W   WW  W       W   W  WW W   W W       WW  W   W W   W   W
W   W W   W WWWW    WW  W      WWW  W   W W   W WWWWW   WW   WWW   WWW    W

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[Spooler rev 20.2.1 (c) Prime Computer, Inc., 1986]

Label: PRT024 -form

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File last modified: 89-01-26.15:44:24.Thu

Spooled:  89-01-26.15:46:12.Thu
Started:  89-01-26.15:46:32.Thu   on: AMLC      by: PHX
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H E C 2

B U R G E S S & N I P L E , L I M I T E D
E N G I N E E R S A N D A R C H I T E C T S
C O L U M B U S , O H I O

HEC2 MAY 1984 VERSION - INCLUDES ERROR CORRECTION 06 AND MODIFICATION 56.
ACQUIRED FROM THE HYDROLOGIC ENGINEERING CENTER IN MARCH 1988.
MADE OPERATIONAL ON THE PRIME COMPUTER SYSTEM IN OCTOBER 1988 BY G. GULBIS.

I N P U T F I L E: NRB.FINAL

RUN START DATE (MMDD) TIME (HHMM): 0126 1544

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*****************************************
*  WATER SURFACE PROFILES               *
*  VERSION OF NOVEMBER 1976             *
*  UPDATED MAY 1984                     *
*                                       *
*  RUN DATE       0126 TIME       1544  *
*****************************************
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  THE HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616          *
*  (916) 440-2105 (FTS) 448-2105    *
*************************************
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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
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*************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
*************************************************
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T1 BELL ROAD NEW RIVER BRIDGE, PHOENIX, ARIZONA, AUGUST 1988
T2 MARICOPA COUNTY
T3 100-YEAR FLOOD--SCOUR ANALYSIS

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	2.	0.	0.	0.000000	0.00	0.0	0.	1180.700	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1.000	0.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

1.000	4.000	8.000	14.000	26.000	38.000	43.000	0.000	150.000	0.000

NC	0.045	0.045	0.035	0.100	0.300	0.000	0.000	0.000	0.000	0.000
QT	1.000	16240.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X1	9.318	10.000	685.000	1360.000	0.000	0.000	0.000	0.000	0.000	0.000
GR	1184.000	685.000	1178.000	710.000	1178.000	865.000	1176.000	945.000	1174.000	985.000
GR	1173.200	1000.000	1174.000	1010.000	1181.500	1015.000	1181.300	1105.000	1182.000	1360.000
NC	0.045	0.045	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X1	9.492	15.000	490.400	1000.000	910.000	890.000	920.000	0.000	0.000	0.000
GR	1188.800	470.000	1189.100	490.400	1174.700	520.000	1173.100	538.000	1173.600	600.000
GR	1174.100	611.000	1174.100	700.000	1175.500	745.000	1175.600	800.000	1176.800	900.000
GR	1177.900	952.000	1180.900	990.000	1184.900	1000.000	1186.600	1010.000	1186.900	1020.000
X1	9.691	8.000	575.000	1000.000	1070.000	1090.000	1060.000	0.000	0.000	0.000
GR	1194.900	575.000	1194.700	594.000	1180.300	623.000	1181.800	627.500	1181.800	900.000
GR	1182.200	984.500	1195.000	1000.000	1195.000	1020.000	0.000	0.000	0.000	0.000
NC	0.045	0.045	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X1	9.892	12.000	738.000	1000.000	960.000	1055.000	1080.000	0.000	0.000	0.000
GR	1197.400	726.000	1201.500	738.000	1201.100	748.000	1195.900	797.000	1186.600	822.000
GR	1189.400	830.000	1188.800	882.000	1187.200	896.000	1189.400	900.000	1189.400	971.000
GR	1200.600	1000.000	1200.600	1010.000	0.000	0.000	0.000	0.000	0.000	0.000
X1	9.893	0.000	0.000	0.000	5.000	5.000	5.000	0.000	0.000	0.000

X1	9.894	0.000	0.000	0.000	5.000	5.000	5.000	0.000	0.000	0.000
X1	9.937	11.000	765.000	1000.000	260.000	255.000	260.000	0.000	0.000	0.000
GR	1198.200	745.000	1200.100	765.000	1190.900	806.000	1191.200	836.000	1190.200	858.000
GR	1190.900	883.000	1190.200	902.000	1191.000	928.000	1190.100	980.000	1202.600	1000.000
GR	1202.600	1010.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.000	0.000	0.000	0.300	0.500	0.000	0.000	0.000	0.000	0.000
X1	9.948	6.000	717.000	1000.000	55.000	55.000	55.000	0.000	0.000	0.000
GR	1200.100	716.000	1200.100	717.000	1192.500	732.000	1192.500	980.000	1202.600	1000.000
GR	1202.600	1010.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SB	0.900	1.620	2.600	0.000	248.000	4.700	2601.800	2.000	1193.000	1192.500
X1	9.956	6.000	712.000	1000.000	120.000	120.000	120.000	0.000	0.000	0.000
X2	0.000	0.000	1.000	1202.900	1207.600	0.000	0.000	1.330	0.000	15.000
X3	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BI	2.000	728.000	1207.700	1203.000	1000.000	1207.600	1202.900	0.000	0.000	0.000
GR	1201.700	707.000	1201.700	712.000	1192.500	730.000	1192.500	978.000	1203.300	1000.000
GR	1202.600	1020.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X1	9.975	9.000	726.000	1000.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	1201.700	707.000	1201.700	726.000	1191.600	760.000	1191.500	800.000	1192.000	905.000
GR	1194.300	916.000	1197.100	972.000	1203.300	1000.000	1202.600	1020.000	0.000	0.000
LJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

248'

NEO2

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

#PROF 1

CCHV=   0.100 CEHV=   0.300
*SECNO 9.318
3720 CRITICAL DEPTH ASSUMED
     9.32      8.79  1181.99  1181.99  1180.70  1183.41      1.42      0.00      0.00  1184.00
   16240.        0.   16240.        0.        0.    1699.        0.        0.        0.   1182.00
     0.00      0.00      9.56      0.00     0.000     0.035     0.000     0.000  1173.20   693.39
 0.014546        0.        0.        0.         0        10         0      0.00   661.99  1355.37

*SECNO 9.492

3301 HV CHANGED MORE THAN HVINS

     9.19     11.15  1184.25      0.00      0.00  1184.48      0.23      0.96      0.12  1189.10
   16240.        0.   16240.        0.        0.    4242.        0.       63.       12.   1184.90
     0.07      0.00      3.83      0.00     0.000     0.030     0.000     0.000  1173.10   500.36
 0.000346      910.      920.      890.         4         0         0      0.00   498.03   998.39

*SECNO 9.691

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     9.69      5.45  1185.75  1185.75      0.00  1187.69      1.94      1.02      0.51  1194.90
   16240.        0.   16240.        0.        0.    1453.        0.       132.      23.   1195.00
     0.09      0.00     11.18      0.00     0.000     0.030     0.000     0.000  1180.30   612.02
 0.008507     1070.     1060.     1090.        20        11         0      0.00   376.78   988.80

*SECNO 9.892

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     9.89      9.12  1195.72  1195.72      0.00  1198.78      3.07     10.01      0.34  1201.50
   16240.        0.   16240.        0.        0.    1155.        0.      164.      30.   1200.60
     0.11      0.00     14.06      0.00     0.000     0.035     0.000     0.000  1186.60   797.49
 0.010140      960.     1080.     1055.         3        14         0      0.00   189.86   987.36
```

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

*SECNO 9.893

3301 HV CHANGED MORE THAN HVINS

     9.89      9.85  1196.45      0.00      0.00  1198.89      2.44      0.04      0.06  1201.50
   16240.        0.  16240.        0.        0.     1296.        0.      164.       30.  1200.60
     0.11      0.00     12.53     0.00     0.000     0.035     0.000     0.000  1186.60   791.86
 0.007281        5.        5.        5.         5         0         0      0.00   197.38   989.24

*SECNO 9.894
     9.89     10.05  1196.65      0.00      0.00  1198.94      2.29      0.03      0.01  1201.50
   16240.        0.  16240.        0.        0.     1337.        0.      165.       30.  1200.60
     0.11      0.00     12.14     0.00     0.000     0.035     0.000     0.000  1186.60   789.90
 0.006669        5.        5.        5.         2         0         0      0.00   199.88   989.78

*SECNO 9.937

3265 DIVIDED FLOW

3280 CROSS SECTION      9.94 EXTENDED      0.58 FEET

3301 HV CHANGED MORE THAN HVINS

     9.94      8.68  1198.78      0.00      0.00  1200.35      1.58      1.34      0.07  1200.10
   16240.        2.  16238.        0.        2.     1611.        0.      173.       31.  1202.60
     0.12      0.87     10.08     0.00     0.045     0.035     0.000     0.000  1190.10   745.00
 0.004118      260.      260.      255.         2         0         0      0.00   229.11   993.89

CCHV=   0.300 CEHV=   0.500
*SECNO 9.948
     9.95      6.91  1199.41      0.00      0.00  1200.67      1.25      0.21      0.10  1200.10
   16240.        0.  16240.        0.        0.     1809.        0.      176.       32.  1202.60
     0.12      0.00      8.98     0.00     0.000     0.035     0.000     0.000  1192.50   718.35
 0.003690       55.       55.       55.         3         0         0      0.00   275.34   993.69
```

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

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	0.90	1.62	2.60	0.00	248.00	4.70	2601.80	2.00	1193.00	1192.50

#SECNO 9.956
CLASS A LOW FLOW

3420 BRIDGE W.S.= 1199.59 BRIDGE VELOCITY=, 9.24 CALCULATED CHANNEL AREA=, 1690.

LGPRS	LGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD
0.00	1200.72	0.09	0.	16240.	2602.	2605.	1202.90	1207.60

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 1201.70 ELREA= 1203.30

SEC, ...

9.96	7.00	1199.50	0.00	0.00	1200.72	1.22	0.05	0.00	1201.70
16240.	0.	16240.	0.	0.	1834.	0.	181.	32.	1203.30
0.13	0.00	8.86	0.00	0.000	0.035	0.000	0.000	1192.50	716.30
0.003538	120.	120.	120.	0	0	0	0.00	275.95	992.26

FLOW DISTRIBUTION FOR SECNO= 9.96 CWSEL= 1199.50

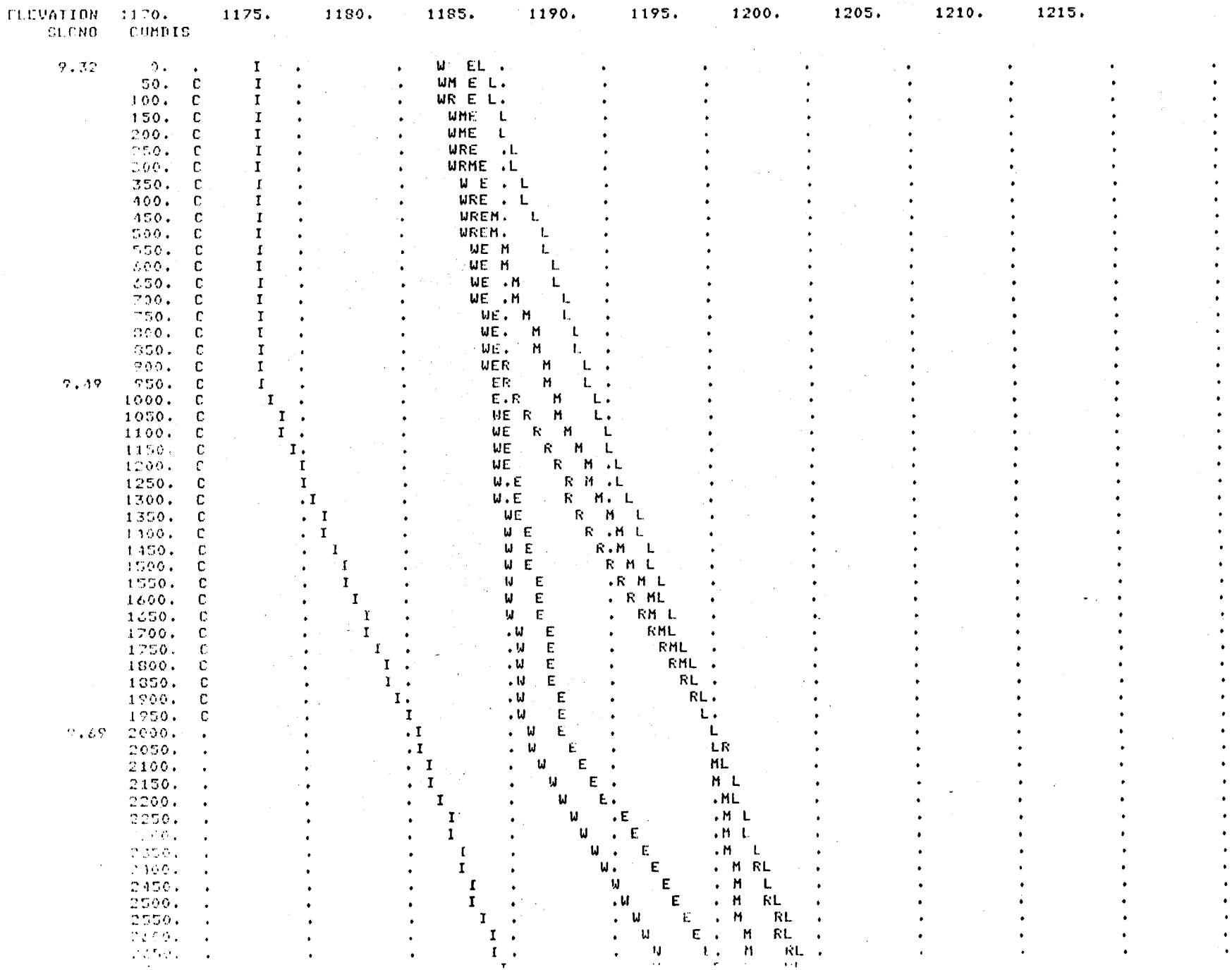
STA= 716. 1000.
PER Q= 100.0
AREA= 1833.7
VEL= 8.9

#SECNO 9.975

9.98	8.21	1199.71	0.00	0.00	1201.34	1.63	0.42	0.21	1201.70
16240.	0.	16240.	0.	0.	1586.	0.	185.	33.	1203.30
0.13	0.00	10.24	0.00	0.000	0.035	0.000	0.000	1191.50	732.69
0.005030	100.	100.	100.	2	0	0	0.00	251.11	983.80

PROFILE FOR STREAM 100-YEAR FLOOD--SCOUR AN

PLOTTED POINTS BY PRIORITY)-E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA



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        2700.  .         .         .         .         I.        .         W         E M       RL        .         .         .         .         
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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

100-YEAR FLOOD--SCOUR AN

SUMMARY PRINTOUT

	CWSEL	TOPWID	DEPTH	QCH	VCH	SECNO	Q
*	1181.987	661.99	8.79	16240.00	9.56	9.32	16240.00
	1184.253	498.03	11.15	16240.00	3.83	9.49	16240.00
*	1185.752	376.78	5.45	16240.00	11.18	9.69	16240.00
*	1195.717	189.86	9.12	16240.00	14.06	9.89	16240.00
	1196.452	197.38	9.85	16240.00	12.53	9.89	16240.00
	1196.650	199.88	10.05	16240.00	12.14	9.89	16240.00
	1198.776	229.11	8.68	16238.46	10.08	9.94	16240.00
	1199.414	275.34	6.91	16240.00	8.98	9.95	16240.00
	1199.500	275.95	7.00	16240.00	8.86	9.9[illegible]	16240.00
	1199.713	251.11	8.21	16240.00	10.24	9.98	16240.00

100-YEAR FLOOD--SCOUR AN

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01F
*	9.318	0.00	0.00	0.00	1173.20	16240.00	1181.99	1181.99	1183.41	145.46	9.56	1699.39	1316.51
	9.492	920.00	0.00	0.00	1173.10	16240.00	1184.25	0.00	1184.48	3.46	3.83	4241.82	8727.50
*	9.691	1060.00	0.00	0.00	1180.30	16240.00	1185.75	1185.75	1187.69	85.07	11.18	1452.75	[illegible]
*	9.892	1080.00	0.00	0.00	1186.60	16240.00	1195.72	1195.72	1198.78	101.40	14.06	1155.34	1612.25
	9.893	5.00	0.00	0.00	1186.60	16240.00	1196.45	0.00	1198.89	72.81	12.53	1296.15	1903.28
	9.894	5.00	0.00	0.00	1186.60	16240.00	1196.65	0.00	1198.94	66.69	12.14	1337.43	1988.65
	9.937	260.00	0.00	0.00	1190.10	16240.00	1198.78	0.00	1200.35	41.18	10.08	1612.79	2530.62
	9.948	55.00	0.00	0.00	1192.50	16240.00	1199.41	0.00	1200.67	36.90	8.98	1809.11	2673.40
	9.956	120.00	1207.60	1202.90	1192.50	16240.00	1199.50	0.00	1200.72	35.38	8.86	1833.74	2730.21
	9.975	100.00	0.00	0.00	1191.50	16240.00	1199.71	0.00	1201.34	50.30	10.24	1585.83	2289.74

9.318	1173.2
9.492	1179
9.692	1184.1
9.889	1188
9.953	1188.6
→ 9.967	1188.6
10.036	1195.7
10.271	1198.2

100 YEAR FLOOD--SCOUR AN

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	9.318	16240.00	1181.99	0.00	0.00	1.29	661.99	0.00
	9.492	16240.00	1184.25	0.00	2.27	0.00	498.03	920.00
*	9.691	16240.00	1185.75	0.00	1.50	0.00	376.78	1060.00
*	9.892	16240.00	1195.72	0.00	9.96	0.00	189.86	1080.00
	9.893	16240.00	1196.45	0.00	0.74	0.00	197.38	5.00
	9.894	16240.00	1196.65	0.00	0.20	0.00	199.88	5.00
	9.937	16240.00	1198.78	0.00	2.13	0.00	229.11	260.00
	9.948	16240.00	1199.41	0.00	0.64	0.00	275.34	55.00
	9.956	16240.00	1199.50	0.00	0.09	0.00	275.95	120.00
	9.975	16240.00	1199.71	0.00	0.21	0.00	251.11	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

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CAUTION  SECNO=     9.318  PROFILE= 1  CRITICAL DEPTH ASSUMED

CAUTION  SECNO=     9.691  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     9.691  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     9.691  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=     9.892  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     9.892  PROFILE= 1  MINIMUM SPECIFIC ENERGY
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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
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