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**U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY**

**LEVEL II BRIDGE SCOUR ANALYSIS FOR STRUCTURE 124090100200
ON ROUTE SC 901, CROSSING ROCKY CREEK IN CHESTER
COUNTY, SOUTH CAROLINA**

By Michael G. Zalants and J. Mike Sullivan

**Prepared in cooperation with the
SOUTH CAROLINA DEPARTMENT
OF TRANSPORTATION**



Columbia, South Carolina

1994

UNIT ABBREVIATIONS

cubic foot per second	ft ³ /s
feet per second	ft/s
foot	ft
mile	mi
millimeter	mm
square foot	ft ²
square mile	mi ²

OTHER ABBREVIATIONS

downstream	D/S
upstream	U/S
flood plain	f/p
median diameter of bed material	D ₅₀
Water-Surface Profile computation model	WSPRO
South Carolina Department of Transportation	SCDOT
section reference distance	SRD

In this report, the words “right” and “left” refer to directions that would be reported by an observer facing downstream.

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929-- a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.



United States Department of the Interior



GEOLOGICAL SURVEY
Water Resources Division
Stephenson Center, Suite 129
720 Gracern Road
Columbia, SC 29210-7651

October 11, 1994

William H. Hulbert, P.E.
Hydraulic Engineer
South Carolina Department of Transportation
955 Park Street
Columbia, South Carolina 29202

Dear Mr. Hulbert:

We are pleased to transmit to you another report of the Level II Bridge Scour Program titled, "Level II bridge scour analysis for structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina," by Michael G. Zalants and J. Mike Sullivan. The technical aspects of the report have been reviewed by the South Carolina District Bridge Scour Project Chief, and the report has been approved by the South Carolina District Reports Specialist.

If you have any questions concerning this report, please contact me (750-6159) or Mike Sullivan (750-6165), and we will be glad to assist you in any way possible.

Sincerely,

Michael G. Zalants
Hydrologist

Enclosure

**Level II bridge scour analysis
for structure 124090100200 on Route SC 901,
crossing Rocky Creek in Chester County, South Carolina**

by Michael G. Zalants and J. Mike Sullivan

This report provides the results of the detailed Level II analysis of scour potential at structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina (figure 1 in pocket; figures 4-7). The site is located in the Piedmont physiographic province near the community of Beckhamville in the southeastern part of Chester County. The drainage area for the site is 103 mi², and is a predominantly rural drainage basin with little development in recent years. In the vicinity of the study site, the land is covered by moderate woods consisting mainly of hardwoods underlain with moderately thick underbrush.

In the study area, Rocky Creek has a meandering channel with a slope of approximately 0.00094 ft/ft (5.0 ft/mi), an average channel top width of 82 ft and an average channel depth of 9.5 ft. The predominant channel bed material is medium sand (D_{50} is 1.0 mm) and the channel banks also consist of a well-graded sand (D_{50} is 0.45 mm). In general, the banks have thick woody vegetative cover with some instability observed at the time of the Level I and Level II site visits, July 19, 1990 and September 15, 1993, respectively.

The Route SC 901 crossing of Rocky River is a 330-ft-long, two-lane bridge consisting of ten 25-ft and one 80-ft concrete span, supported by eight timber-pile and two concrete-pile bents with spillthrough abutments. The right and left abutments are protected by riprap. In this report, the words "right" and "left" refer to directions that would be reported by an observer facing downstream. Additional details describing conditions at the site are included in the Scour Report Summary.

Scour depths were computed using engineering judgement and the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993) and the Transportation Research Board Draft Paper, "Evaluating scour at bridges using WSPRO" (Arneson and others, 1992). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution. The results of the scour analysis are presented in tables 1 through 4 and a graph of the scour depths is shown on figure 2.

Scour depth calculations indicate that the minimum remaining pile penetration for the 100-year discharge will be 2.9 ft. This occurs at bent 7. In addition, scour depth calculations indicate that pile tip exposure will occur at bent 7 during the 500-year discharge. Scour caused by the 500-year discharge will undermine bent 7 by 0.3 ft.

It should be noted that the SCDOT bridge plan borings (docket number 12.286) show subsurface rock that could affect the scour depths shown in this study. For more information, see the SCDOT bridge plans in the pocket at the back of the report.

Table 1. --Remaining pile/footing penetration at piers/bents for the 100-year discharge at structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina

Pier/bent number	Station from left end of bridge (feet)	Pile tip/ ³ footing elevation, SCDOT datum (feet)	Pile tip/ footing elevation, USGS datum (feet)	Ground elevation at pier/bent, USGS datum (feet)	Total ⁴ scour depth (feet)	Elevation of scour, USGS datum (feet)	Remaining pile/footing penetration (feet)
100-year discharge is 14,300 cubic feet per second							
2	25	333.0	74.2	82.9	2.6	80.3	6.1
3	50	328.8	70.0	79.0	2.7	76.3	6.3
4	75	326.5	67.7	77.6	2.7	74.9	7.2
5	100	325.2	66.4	77.4	2.7	74.7	8.3
6	125	319.9	61.1	70.2	6.2	64.0	2.9
7	205	318.5	59.7	74.4	10.8	63.6	3.9
8	230	319.6	60.8	77.2	7.0	70.2	9.4
9	255	320.6	61.8	75.8	7.1	68.7	6.9
10	280	321.0	62.2	77.7	7.0	70.7	8.5
11	305	328.1	69.3	83.4	6.8	76.6	7.3

¹ Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans.

² Stations are determined from left to right looking downstream.

³ Pile tip/footing elevations obtained from the SCDOT bridge plans. The maximum elevation at each pier/bent is used.

⁴ Total scour depth is the sum of the contraction and pier/bent scour depths.

NOTE: The SCDOT bridge plan borings (docket number 12.286) show subsurface rock that could reduce the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

Table 2. --Remaining pile/footing penetration at piers/bents for the 500-year discharge at structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina

Pier/bent number	Station from ² left end of bridge (feet)	Pile tip/ ³ footing elevation, SCDOT datum (feet)	Pile tip/ footing elevation, USGS datum (feet)	Ground elevation at pier/bent, USGS datum (feet)	Total ⁴ scour depth (feet)	Elevation of scour, USGS datum (feet)	Remaining ⁵ pile/footing penetration (feet)
500-year discharge is 20,900 cubic feet per second							
2	25	333.0	74.2	82.9	6.3	76.6	2.4
3	50	328.8	70.0	79.0	6.5	72.5	2.5
4	75	326.5	67.7	77.6	6.5	71.1	3.4
5	100	325.2	66.4	77.4	6.5	70.9	4.5
6	125	319.9	61.1	70.2	6.6	63.6	2.5
7	205	318.5	59.7	74.4	15.0	59.4	-0.3
8	230	319.6	60.8	77.2	11.3	65.9	5.1
9	255	320.6	61.8	75.8	11.3	64.5	2.7
10	280	321.0	62.2	77.7	11.3	66.4	4.2
11	305	328.1	69.3	83.4	11.1	72.3	3.0

¹ Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans.

² Stations are determined from left to right looking downstream.

³ Pile tip/footing elevations obtained from the SCDOT bridge plans. The maximum elevation at each pier/bent is used.

⁴ Total scour depth is the sum of the contraction and pier/bent scour depths.

⁵ A negative number signifies undermining of pile tip/footing.

NOTE: The SCDOT bridge plan borings (docket number 12.286) show subsurface rock that could reduce the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

Table 3. --Cumulative scour depths at piers/bents for the 100-year discharge at structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina

Pier/bent ¹ number	Station from ² left end of bridge (feet)	Contraction scour depth (feet)	Pier/bent scour depth without debris (feet)	Total ³ scour depth without debris (feet)
100-year discharge is 14,300 cubic feet per second				
2	25	0.5	2.1	2.6
3	50	0.5	2.2	2.7
4	75	0.5	2.2	2.7
5	100	0.5	2.2	2.7
6	125	0 ⁴	6.2	6.2
7	205	4.6	6.2	10.8
8	230	4.6	2.4	7.0
9	255	4.6	2.5	7.1
10	280	4.6	2.4	7.0
11	305	4.6	2.2	6.8

¹ Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans.

² Stations are determined from left to right looking downstream.

³ Total scour depth is the sum of the contraction and pier/bent scour depths.

⁴ The calculated contraction scour is a negative value, but was set equal to zero to reflect a more reasonable estimate of scour during peak flood conditions.

NOTE: The SCDOT bridge plan borings (docket number 12.286) show subsurface rock that could reduce the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

NOTE: The pier and contraction scour equations used in this scour analysis were those recommended in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution.

Table 4. --Cumulative scour depths at piers/bents for the 500-year discharge at structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina

Pier/bent ¹ number	Station from ² left end of bridge (feet)	Contraction scour depth (feet)	Pier/bent scour depth without debris (feet)	Total ³ scour depth without debris (feet)
500-year discharge is 20,900 cubic feet per second				
2	25	3.9	2.4	6.3
3	50	3.9	2.6	6.5
4	75	3.9	2.6	6.5
5	100	3.9	2.6	6.5
6	125	0 ⁴	6.6	6.6
7	205	8.4	6.6	15.0
8	230	8.4	2.9	11.3
9	255	8.4	2.9	11.3
10	280	8.4	2.9	11.3
11	305	8.4	2.7	11.1

¹ Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans.

² Stations are determined from left to right looking downstream.

³ Total scour depth is the sum of the contraction and pier/bent scour depths.

⁴ The calculated contraction scour is a negative value, but was set equal to zero to reflect a more reasonable estimate of scour during peak flood conditions.

NOTE: The SCDOT bridge plan borings (docket number 12.286) show subsurface rock that could reduce the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

NOTE: The pier and contraction scour equations used in this scour analysis were those recommended in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution.

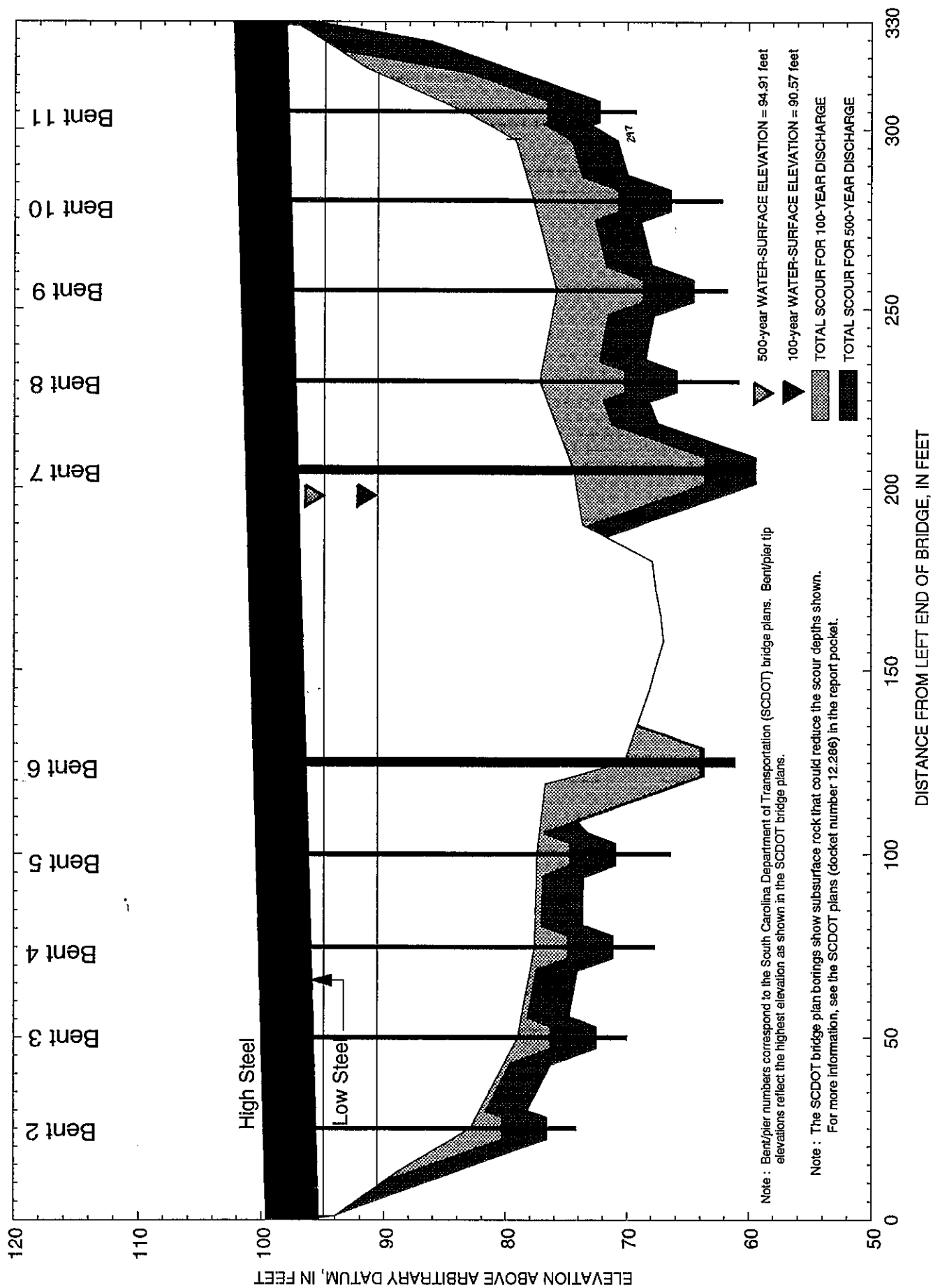


Figure 2.--Total scour depths for the 100- and 500-year discharges at the upstream face of structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina.



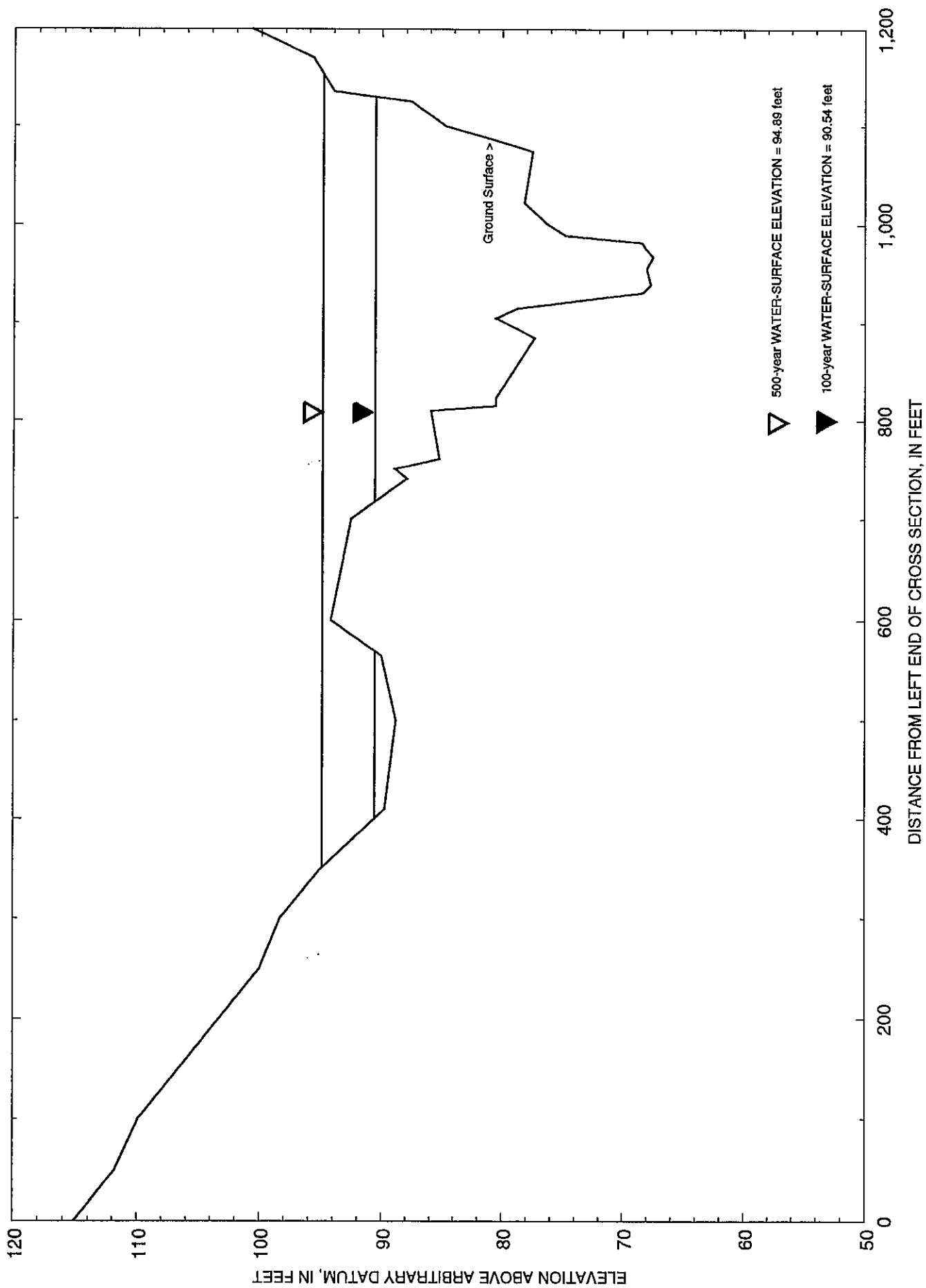


Figure 3.—Approach cross section of structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina.





Figure 4.--Structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina as viewed from the downstream channel (September 15, 1993).



Figure 5.--Downstream channel as viewed from structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina (July 19, 1990).





Figure 6.--Upstream channel as viewed from structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina (July 19, 1990).



Figure 7.--Abandoned pier from old bridge upstream of structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina (September 15, 1993).



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SCOUR REPORT SUMMARY

Structure Number 124090100200 **Stream** Rocky Creek
County Chester **Road** SC 901 **District** 4

Description of Bridge

Bridge length 330 ft **Bridge width** 26 ft **Max span length** 80 ft

Alignment of bridge to road (on curve or straight) straight

Abutment type spillthrough **Embankment type** sloping

Riprap on abutment? Yes **Date of inspection** 9-15-1993

Description of riprap Nearly full coverage of 12-inch granite on both abutments.

Vegetation is covering some of the riprap on the left abutment.

Brief description of piers/pile bents SCDOT bents 2 through 5 and 8 through 11 consist of four 1.0-ft diameter timber piles. SCDOT bents 6 and 7 consist of two 2.5- ft square concrete piles.

Is bridge skewed to flood plain according to USGS topo map? No **Angle** 0

Is bridge located on a bend in channel? No *If so, describe (mild, moderate, severe)*

Debris accumulation on bridge at time of Level I or Level II site visit:

	<i>Date of inspection</i>	<i>Percent of channel blocked horizontally</i>	<i>Percent of channel blocked vertically</i>
Level I	<u>7-19-1990</u>	<u>40</u>	<u>20</u>
Level II	<u>9-15-1993</u>	<u>----</u>	<u>----</u>

Potential for debris Moderate to high: High flow velocities could transport debris, and Level I inspection indicates undercutting of the upstream banks.

Describe any features near or at the bridge that may affect flow (include observation date).

Two abandoned concrete piers from the old bridge are present approximately 25 ft U/S of the SC 901 crossing. Each pier is located approximately 10 ft beyond each stream bank.

The dimensions are 16.5 ft long by 12.3 ft high by 2.8 ft wide. (See figure 7.)

Description of Flood Plain

General topography Gently rolling Piedmont topography. The left flood plain widens significantly from approximately 300 ft to 2500 ft downstream of the bridge.

Flood-plain conditions at bridge site: downstream (D/S), upstream (U/S)

Date of inspection 9-15-1993

D/S left: Moderate hardwood cover with moderate underbrush

D/S right: Moderate hardwood cover with moderate underbrush

U/S left: Moderate hardwood cover with moderate underbrush

U/S right: Moderate hardwood cover with moderate underbrush

Description of Channel

Average top width 82 ft *Average depth* 9.5 ft

Predominant bed material sand *Bank material* sand

Stream type (straight, meandering, braided, swampy, channelized) meandering

Vegetative cover on channel banks near bridge: Date of inspection 7-19-1990

D/S left: Moderate coverage of woody and herbaceous vegetation

D/S right: Thick coverage of woody and herbaceous vegetation

U/S left: Moderate coverage of woody and herbaceous vegetation

U/S right: Thick coverage of woody and herbaceous vegetation

Do banks appear stable? No *If not, describe location and type of instability and date of observation.* Areas of bank failure were observed on the upstream and downstream right bank during the Level I inspection on 7-19-1990. Additionally, several areas of undercutting were observed on both upstream banks during the Level I inspection.

Describe any obstructions in channel and date of observation. An old wooden dam, extending approximately 6 inches above the channel bed, was observed across the channel, approximately 80 ft downstream of the SC 901 bridge, during the Level II site visit on 9-15-1993. It is too low to affect flood flows.

Brief Description of the Water-Surface Profile Model (WSPRO) Analysis

Datum for WSPRO analysis (USGS survey, sea level, SCDOT plans) USGS survey

Datum tie between USGS survey and SCDOT plans Add 258.8 ft to the USGS survey datum to obtain the SCDOT plans' datum (docket number 12.286).

Description of reference marks used to determine USGS datum. R.M. 1 is a chiseled square on the downstream right abutment headwall of the Route SC 901 bridge with an assumed elevation of 100.00 ft. R.M. 2 is chiseled square on the upstream left abutment headwall of the Route SC 901 bridge with a surveyed elevation of 97.11 ft.

Cross Sections Used in WSPRO Analysis

<i>*Cross section ID</i>	<i>Section Reference Distance (SRD) in feet</i>	<i>**How cross section was developed</i>	<i>Comments</i>
SYN1	-3200	4	Synthesized cross section
SYN2	-2500	4	SYN1 shifted to SRD
SYN3	-1300	4	Synthesized cross section
EXIT	-330	2	Exit cross section
FULV	0	2	Full valley template
BRIDG	0	1	Upstream bridge face
APPR	356	2	Approach cross section

* For location of cross sections see topographic map included with report (figure 1).

For more detail on how cross sections were developed see WSPRO input file.

** Cross section development: 1) survey at SRD 2) shift of survey data to SRD 3) modification of survey data based on topographic map 4) synthesized by combining channel survey data and topographic contours 5) other

Description of data and assumptions used in developing WSPRO model.

The left flood plain at Rocky Creek at Route SC 901 begins to widen significantly beginning approximately 300 ft downstream of the bridge crossing and constricts again approximately 2500 ft downstream of the bridge. In order to model the change in width of the downstream left flood plain, two cross sections were synthesized and used to estimate the starting-water-surface elevation for the water-surface profile computations. These two cross sections were synthesized using the USGS survey of the exit channel (located 377 ft downstream of the downstream bridge face) in conjunction with the topographic contours. A transitional cross section was included between the widened flood plain and the constricted flood plain.

In addition, as required by WSPRO, an exit cross section one bridge width downstream of the bridge, a full-valley cross section at the downstream face of the bridge, the bridge cross section, and an approach cross section one bridge width upstream of the bridge were included in the model. Cross sections at the upstream and downstream faces of the bridge were directly surveyed and the more constricted (upstream) bridge face was used in the WSPRO model. The SRD at the downstream face of the bridge was set to zero. The flood plain survey made by the SCDOT at the location of the present Route SC 901 highway prior to construction of the highway was superimposed on the USGS surveys of the exit and approach channels (located at 377 ft downstream of the downstream bridge face and 257 ft upstream of the upstream bridge face, respectively). These cross sections were shifted by the channel slope to the appropriate SRD to represent the exit, full-valley, and approach cross sections required by the WSPRO model.

Bridge Hydraulics

Average embankment elevation 98.9 ft

Average low steel elevation 96.7 ft

100-year discharge 14,300 ft³/s

Water-surface elevation at D/S bridge face 90.57 ft

Area of flow at D/S bridge face 4,361 ft²

Average velocity in bridge opening 3.28 ft/s

Maximum WSPRO tube velocity at bridge 5.21 ft/s

Water-surface elevation at Approach section with bridge 90.54 ft

Water-surface elevation at Approach section without bridge 90.56 ft

Amount of backwater caused by bridge 0 * ft

500-year discharge 20,900 ft³/s

Water-surface elevation at D/S bridge face 94.91 ft

Area of flow at D/S bridge face 5,728 ft²

Average velocity in bridge opening 3.65 ft/s

Maximum WSPRO tube velocity at bridge 5.77 ft/s

Water-surface elevation at Approach section with bridge 94.89 ft

Water-surface elevation at Approach section without bridge 94.88 ft

Amount of backwater caused by bridge 0.01 ft

* Backwater for the 100-year discharge is -0.02 ft. Because negative backwater is unlikely, it was set to zero.

Scour

Describe any special assumptions or considerations made in bridge scour analysis.

Scour depths were computed using engineering judgement and the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993) and the Transportation Research Board Draft Paper, "Evaluating scour at bridges using WSPRO" (Arneson and others, 1992). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution. The results of the scour analysis are presented in tables 1 through 4 and a graph of the scour depths is shown on figure 2.

The local pier scour was determined using the Colorado State University pier scour equation (Richardson and others, 1993). Bents 2 through 5 are located on the left overbank and were analyzed using the maximum left overbank WSPRO tube velocity and the depth of flow at each bent. Bents 8 through 11 are located on the right overbank and were analyzed using the maximum right overbank WSPRO tube velocity and the depth of flow at each bent. Bent 7 is located near the top of the right bank and was analyzed as if it was in the channel to account for the possibility of a shift in the channel during a flood. Bent 6 is located in the channel. Bents 6 and 7 were analyzed using 90 percent of the maximum WSPRO tube velocity and the maximum depth within the channel at the bridge. The maximum depth within the channel was used to account for possible changes in the thalweg during a flood.

The left and right overbanks at the bridge were analyzed for contraction scour using Laursen's clear-water contraction scour equation (Richardson and others, 1993). The channel contraction scour was analyzed using Laursen's modified live-bed contraction scour equation (Richardson and others, 1993). Because the footings of bents 6 and 7 are not exposed by the live-bed contraction scour caused by the 100- and 500-year discharges, no scour analysis for the footings was made.

The live-bed contraction scour equation indicates the deposition of sediment in the channel at the bridge during the 100- and 500-year floods. (See negative scour values determined in scour calculations included at the end of the report). However, it seems unlikely for sediment deposition to occur at the bridge during peak flood conditions. Therefore, the negative scour values were set equal to zero as reflected in tables 1 through 4 and figure 2.

No abutment scour computations were made because the abutments are protected by riprap.

It should be noted that the SCDOT bridge plan borings (docket number 12.286) show subsurface rock that could affect the scour depths shown in this study. For more information, see the SCDOT bridge plans in the pocket at the back of the report.

WSPRO INPUT FILE --Continued

XS EXIT -330

GT

*

N 0.15 0.05 0.15

SA 908 992

PX

*

XS FULV 0

GT

PX

*

*

*

Upstream Bridge Face

BR BRIDG 0 96.7 0

GR 0 95.3 1 95.3 1.1 94.0 13 88.9 25 82.9

GR 50 79.0 75 77.6 100 77.4 119 76.7 125 70.2

GR 145 68.1 151 67.6 158 67.0 165 67.2 172 67.6

GR 180 67.9 190 73.7 205 74.4 230 77.2 255 75.8

GR 280 77.7 297 79.2 305 83.4 317 91.5 328.9 97.0

GR 329 98.1 330 98.1 0 95.3

*

N 0.06 0.045 0.06

SA 119 190

CD 3 25.6 2.0 98.88

PW 1 70.2 2.5 74.4 2.5 74.4 5.0 75.8 5.0 75.8 6.0 77.4 6.0

PW 77.4 9.0 77.7 9.0 77.7 10.0 79.0 10.0 79.0 11.0 82.9 11.0

PW 82.9 12.0 83.4 12.0 83.4 13.0 96.7 13.0 96.7 0

PX

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*

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The approach template (SURV2) was developed using the SCDOT pre-construction survey at the location of the present highway and the USGS-surveyed approach channel surveyed approximately 257 ft upstream of the upstream bridge face.

XT SURV2 283 0.00094

GR 0 115.0 50 111.7 100 109.8 250 99.9 300 98.2

GR 350 94.9 410 89.6 500 88.7 565 89.9 600 94.1

GR 700 92.4 740 87.8 750 88.8 760 85.1 810 85.8

GR 815 80.4 823 80.4 885 77.2 905 80.4 915 78.6

GR 931 68.2 939 67.6 955 67.9 967 67.4 976 68.0

GR 982 68.3 989 74.7 1001 76.2 1022 78.1 1074 77.4

GR 1080 78.9 1100 84.6 1125 87.5 1135 93.9 1170 95.6

GR 1200 100.6

*

AS APPR 356

GT

*

N 0.15 0.05 0.15

SA 915 989

*

BP 796

PX

*

WSPRO INPUT FILE --Continued

HP 1	BRIDG	90.57	0	90.57	
HP 2	BRIDG	90.59	0	90.59	14300
HP 1	APPR	90.54	0	90.54	
HP 2	APPR	90.54	0	90.54	14300
HP 1	BRIDG	94.91	0	94.91	
HP 2	BRIDG	94.92	0	94.92	20900
HP 1	APPR	94.89	0	94.89	
HP 2	APPR	94.89	0	94.89	20900

EX

ER

WSPRO OUTPUT

WSPRO
V060188

FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS

Structure No. 124090100200

(330 ft. Bridge)

Rocky Creek at SC 901

File: rocky.wspro

Chester County, South Carolina

MGZ 9/94

*** RUN DATE & TIME: 10-05-94 10:56

CROSS-SECTION PROPERTIES: ISEQ = 6; SECID = BRIDG; SRD = 0.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1190.	142849.	110.	112.				22225.
	2	1537.	379183.	71.	76.				40583.
	3	1633.	219946.	126.	129.				33397.
90.57		4360.	741978.	307.	317.	1.36	9.	316.	80146.

VELOCITY DISTRIBUTION: ISEQ = 6; SECID = BRIDG; SRD = 0.

	WSEL	LEW	REW	AREA	K	Q	VEL
	90.59	9.1	315.7	4366.0	743483.	14300.	3.28
X STA.		9.1	60.6	82.0	102.7	122.8	131.0
A(I)		426.1	273.3	272.0	281.0	166.3	
V(I)		1.68	2.62	2.63	2.54	4.30	
X STA.		131.0	137.8	144.3	150.5	156.4	162.4
A(I)		146.8	143.8	140.5	137.1	139.0	
V(I)		4.87	4.97	5.09	5.21	5.14	
X STA.		162.4	168.2	174.3	180.6	189.2	202.7
A(I)		137.5	140.0	142.7	170.6	225.6	
V(I)		5.20	5.11	5.01	4.19	3.17	
X STA.		202.7	218.5	237.3	255.5	273.7	315.7
A(I)		245.7	259.6	260.2	256.9	401.2	
V(I)		2.91	2.75	2.75	2.78	1.78	

WSPRO OUTPUT --Continued

WSPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS

Structure No. 124090100200 (330 ft. Bridge)
Rocky Creek at SC 901 File: rocky.wspro
Chester County, South Carolina MGZ 9/94

*** RUN DATE & TIME: 10-05-94 10:56

CROSS-SECTION PROPERTIES: ISEQ = 7; SECID = APPR ; SRD = 356.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1724.	47628.	368.	372.				21177.
	2	1563.	338839.	74.	80.				40753.
	3	1487.	70445.	141.	143.				27445.
90.54		4774.	456912.	582.	594.	3.85	400.	1130.	39514.

VELOCITY DISTRIBUTION: ISEQ = 7; SECID = APPR ; SRD = 356.

	WSEL	LEW	REW	AREA	K	Q	VEL
	90.54	400.1	1129.6	4774.0	456912.	14300.	3.00
X STA.		400.1	873.9	911.3	925.2	931.1	935.4
A(I)		1236.4	444.8	198.3	119.6	95.6	
V(I)		0.58	1.61	3.61	5.98	7.48	
X STA.		935.4	939.6	943.8	947.9	952.2	956.5
A(I)		95.7	96.4	94.6	96.5	96.2	
V(I)		7.47	7.41	7.56	7.41	7.43	
X STA.		956.5	960.7	964.9	969.1	973.3	977.6
A(I)		96.3	97.1	95.3	95.9	96.6	
V(I)		7.42	7.36	7.50	7.46	7.40	
X STA.		977.6	982.0	991.0	1019.6	1053.9	1129.6
A(I)		97.7	165.0	399.0	430.8	626.1	
V(I)		7.32	4.33	1.79	1.66	1.14	

WSPRO OUTPUT --Continued

WSPRO
V060188

FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS

Structure No. 124090100200 (330 ft. Bridge)
Rocky Creek at SC 901 File: rocky.wspro
Chester County, South Carolina MGZ 9/94

*** RUN DATE & TIME: 10-05-94 10:56

CROSS-SECTION PROPERTIES: ISEQ = 6; SECID = BRIDG; SRD = 0.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1688.	242120.	118.	122.				36238.
	2	1845.	514165.	71.	76.				53379.
	3	2196.	343293.	134.	139.				50364.
94.91		5729.	1099579.	323.	336.	1.32	1.	324.	119298.

VELOCITY DISTRIBUTION: ISEQ = 6; SECID = BRIDG; SRD = 0.

	WSEL	LEW	REW	AREA	K	Q	VEL
	94.92	1.0	324.4	5732.3	1100487.	20900.	3.65
X STA.		1.0	53.9	74.2		93.4	111.6
A(I)		560.9	338.9	334.4		322.0	311.8
V(I)		1.86	3.08	3.12		3.25	3.35
X STA.		127.0	134.7	142.0		148.9	155.5
A(I)		194.4	190.1	185.7		181.1	183.8
V(I)		5.38	5.50	5.63		5.77	5.68
X STA.		162.1	168.6	175.4		182.6	193.4
A(I)		181.6	185.0	193.6		243.9	294.9
V(I)		5.75	5.65	5.40		4.28	3.54
X STA.		207.6	223.5	241.5		258.4	276.2
A(I)		306.0	324.7	318.1		324.3	557.0
V(I)		3.41	3.22	3.29		3.22	1.88

WSPRO OUTPUT --Continued

WSPRO
V060188

FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS

Structure No. 124090100200

(330 ft. Bridge)

Rocky Creek at SC 901

File: rocky.wspro

Chester County, South Carolina

MGZ 9/94

*** RUN DATE & TIME: 10-05-94 10:56

CROSS-SECTION PROPERTIES: ISEQ = 7; SECID = APPR ; SRD = 356.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	3722.	129386.	564.	568.				54247.
	2	1885.	462977.	74.	80.				53972.
	3	2122.	114229.	165.	168.				43185.
94.89		7728.	706592.	803.	816.	4.81	351.	1154.	62014.

VELOCITY DISTRIBUTION: ISEQ = 7; SECID = APPR ; SRD = 356.

	WSEL	LEW	REW	AREA	K	Q	VEL
	94.89	350.9	1154.0	7728.5	706592.	20900.	2.70
X STA.		350.9	821.2	858.3	890.8	919.7	928.0
A(I)		2229.1	566.2	552.2	457.0	182.4	
V(I)		0.47	1.85	1.89	2.29	5.73	
X STA.		928.0	933.4	938.3	943.2	948.1	952.9
A(I)		142.4	131.4	133.4	131.4	131.0	
V(I)		7.34	7.95	7.83	7.95	7.98	
X STA.		952.9	957.8	962.7	967.5	972.4	977.4
A(I)		132.4	133.3	131.1	132.6	133.6	
V(I)		7.89	7.84	7.97	7.88	7.82	
X STA.		977.4	982.4	994.9	1023.6	1055.8	1154.0
A(I)		135.1	268.4	514.4	545.3	945.6	
V(I)		7.74	3.89	2.03	1.92	1.11	

WSPRO OUTPUT --Continued

WSPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS

Structure No. 124090100200 (330 ft. Bridge)
Rocky Creek at SC 901 File: rocky.wspro
Chester County, South Carolina MGZ 9/94
*** RUN DATE & TIME: 10-05-94 10:56

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
SYN1 :XS	*****	116.	3759.	0.59	*****	88.30	76.18	14300.	87.72
-3200.	*****	466.	466353.	2.61	*****	*****	0.33	3.80	
SYN2 :XS	700.	116.	3761.	0.59	0.66	88.97	*****	14300.	88.38
-2500.	700.	466.	466581.	2.62	0.00	0.01	0.33	3.80	

===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
"SYN3 " KRATIO = 1.46

SYN3 :XS	1200.	54.	8665.	0.20	0.77	89.74	*****	14300.	89.55
-1300.	1200.	947.	678920.	4.62	0.00	0.00	0.20	1.65	
EXIT :XS	970.	399.	5005.	0.45	0.58	90.45	*****	14300.	90.00
-330.	970.	1130.	499884.	3.57	0.13	0.00	0.33	2.86	

FULV :FV	330.	400.	4984.	0.46	0.27	90.73	*****	14300.	90.28
0.	330.	1130.	497973.	3.56	0.00	0.01	0.33	2.87	

<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>

APPR :AS	356.	400.	4783.	0.54	0.32	91.09	*****	14300.	90.56
356.	356.	1130.	457753.	3.86	0.04	0.00	0.36	2.99	

<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>

<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
BRIDG:BR	330.	9.	4361.	0.17	0.29	90.74	80.26	14300.	90.57
0.	330.	316.	742336.	1.00	0.00	0.01	0.15	3.28	

TYPE	PPCD	FLOW	C	P/A	LSEL	BLEN	XLAB	XRAB
3.	1.	1.	1.000	0.042	96.70	*****	*****	*****

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
APPR :AS	330.	400.	4777.	0.54	0.32	91.08	80.76	14300.	90.54
356.	340.	1130.	457142.	3.85	0.02	0.00	0.36	2.99	

M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
0.581	0.000	470009.	803.	1110.	90.22

<<<<END OF BRIDGE COMPUTATIONS>>>>

WSPRO OUTPUT --Continued

WSPRO FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188 MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS

Structure No. 124090100200 (330 ft. Bridge)
Rocky Creek at SC 901 File: rocky.wspro
Chester County, South Carolina MGZ 9/94
*** RUN DATE & TIME: 10-05-94 10:56

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
SYN1 :XS	*****	32.	5525.	0.71	*****	92.83	78.95	20900.	92.12
-3200.	*****	483.	681198.	3.18	*****	*****	0.34	3.78	
SYN2 :XS	700.	32.	5528.	0.71	0.66	93.49	*****	20900.	92.79
-2500.	700.	484.	681562.	3.18	0.00	0.01	0.34	3.78	

===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
"SYN3 " KRATIO = 1.61

SYN3 :XS	1200.	14.	12851.	0.18	0.70	94.19	*****	20900.	94.02
-1300.	1200.	994.	1097009.	4.33	0.00	0.00	0.16	1.63	

===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
"EXIT " KRATIO = 0.70

EXIT :XS	970.	350.	7994.	0.48	0.50	94.85	*****	20900.	94.37
-330.	970.	1156.	765195.	4.49	0.15	0.00	0.31	2.61	

FULV :FV	330.	350.	7946.	0.48	0.25	95.10	*****	20900.	94.62
0.	330.	1155.	760977.	4.47	0.00	0.00	0.31	2.63	

<<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

APPR :AS	356.	351.	7718.	0.55	0.29	95.43	*****	20900.	94.88
356.	356.	1154.	705760.	4.81	0.03	0.00	0.34	2.71	

<<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

<<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
BRIDG:BR	330.	1.	5728.	0.21	0.27	95.12	82.01	20900.	94.91
0.	330.	324.	1099307.	1.03	0.00	0.01	0.16	3.65	

TYPE	PPCD	FLOW	C	P/A	LSEL	BLEN	XLAB	XRAB
3.	1.	1.	0.985	0.042	96.70	*****	*****	*****

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
APPR :AS	330.	351.	7727.	0.55	0.30	95.44	83.11	20900.	94.89
356.	340.	1154.	706478.	4.81	0.01	0.00	0.34	2.70	

M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
0.598	0.019	692810.	792.	1115.	94.60

<<<<<END OF BRIDGE COMPUTATIONS>>>>>

PIER SCOUR COMPUTATIONS
FOR
Rocky Creek at SC 901; Chester Co.; Struc.# 124090100200; MGZ 10-5-94
Scour Analysis for Q100

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	2	3	4	5	6	7	8	9
PIER STATION (FT)	25	50	75	100	125	205	230	255
LOCATION OF PIER	lfp	lfp	lfp	lfp	mcl	rtb	rfp	rfp
Y1: DEPTH (FT)	7.7	11.6	13.0	13.2	23.6	23.6	13.4	14.8
V1: VEL. (FPS)	2.6	2.6	2.6	2.6	4.7	4.7	3.2	3.2
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	2.5	2.5	1.0	1.0
L: PIER LENGTH (FT)	4.0	4.0	4.0	4.0	5.0	5.0	4.0	4.0
PIER SHAPE	5	5	5	5	1	1	5	5
ATTACK ANGLE	0	0	0	0	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.10	1.10	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FROUDE NO.	0.17	0.14	0.13	0.13	0.17	0.17	0.15	0.15

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	1.89	2.00	2.03	2.04	5.63	5.63	2.21	2.24
MAX SCOUR DEPTH (FT)	2.08	2.20	2.23	2.24	6.20	6.20	2.43	2.46

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	10	11
PIER STATION (FT)	280	305
LOCATION OF PIER	rfp	rfp
Y1: DEPTH (FT)	12.9	7.2
V1: VEL. (FPS)	3.2	3.2
a: PIER WIDTH (FT)	1.0	1.0
L: PIER LENGTH (FT)	4.0	4.0
PIER SHAPE	5	5
ATTACK ANGLE	0	0
K1 (SHAPE COEF.)	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00
FROUDE NO.	0.16	0.21

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.20	2.03
MAX SCOUR DEPTH (FT)	2.42	2.24

"MAX SCOUR DEPTH" includes an additional 10 percent of the computed CSU scour depth as recommended in HEC 18

CONTRACTION SCOUR COMPUTATIONS
FOR
Rocky Creek at SC 901; Chester Co.; Struc.# 124090100200; MGZ 10-5-94
Scour Analysis for Q100

=====

LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	2750.
WIDTH OF CONTRACTED SECTION (FT)	=	94.0
MEDIAN GRAIN SIZE (FT)	=	0.0019
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	13.9
AVERAGE FLOOD PLAIN DEPTH (FT)	=	13.4
DEPTH OF CONTRACTION SCOUR (FT)	=	0.5

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	10600.	7310.
BOTTOM WIDTH (FT)	74.0	68.5
MANNINGS n	0.045	0.045
AVERAGE DEPTH (FT)	22.7	

ENERGY SLOPE	0.00100
D50 (FT)	0.0033
FALL VELOCITY (FPS)	0.50
K1 COEF.	0.64
K2 COEF.	0.21

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	17.3
DEPTH AT MAIN CHANNEL (FT)	=	22.7
DEPTH OF CONTRACTION SCOUR (FT)	=	-5.4

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	4240.
WIDTH OF CONTRACTED SECTION (FT)	=	107.0
MEDIAN GRAIN SIZE (FT)	=	0.0019
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	18.0
AVERAGE FLOOD PLAIN DEPTH (FT)	=	13.4
DEPTH OF CONTRACTION SCOUR (FT)	=	4.6

PIER SCOUR COMPUTATIONS
FOR
Rocky Creek at SC 901; Chester Co.; Struc.# 124090100200; MGZ 10-5-94
Scour Analysis for Q500

=====

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	2	3	4	5	6	7	8	9
PIER STATION (FT)	25	50	75	100	125	205	230	255
LOCATION OF PIER	lfp	lfp	lfp	lfp	mcl	rtb	rfp	rfp
Y1: DEPTH (FT)	12.0	15.9	17.3	17.5	27.9	27.9	17.7	19.1
V1: VEL. (FPS)	3.3	3.3	3.3	3.3	5.2	5.2	4.3	4.3
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	2.5	2.5	1.0	1.0
L: PIER LENGTH (FT)	4.0	4.0	4.0	4.0	5.0	5.0	4.0	4.0
PIER SHAPE	5	5	5	5	1	1	5	5
ATTACK ANGLE	0	0	0	0	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.10	1.10	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FROUDE NO.	0.17	0.15	0.14	0.14	0.17	0.17	0.18	0.17

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.23	2.32	2.34	2.35	6.02	6.02	2.61	2.64
MAX SCOUR DEPTH (FT)	2.45	2.55	2.58	2.58	6.62	6.62	2.87	2.90

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HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	10	11
PIER STATION (FT)	280	305
LOCATION OF PIER	rfp	rfp
Y1: DEPTH (FT)	17.2	11.5
V1: VEL. (FPS)	4.3	4.3
a: PIER WIDTH (FT)	1.0	1.0
L: PIER LENGTH (FT)	4.0	4.0
PIER SHAPE	5	5
ATTACK ANGLE	0	0
K1 (SHAPE COEF.)	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00
FROUDE NO.	0.18	0.22

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.60	2.46
MAX SCOUR DEPTH (FT)	2.86	2.71

"MAX SCOUR DEPTH" includes an additional 10 percent of the computed CSU scour depth as recommended in HEC 18

CONTRACTION SCOUR COMPUTATIONS
FOR
Rocky Creek at SC 901; Chester Co.; Struc.# 124090100200; MGZ 10-5-94
Scour Analysis for Q500

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LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	4600.
WIDTH OF CONTRACTED SECTION (FT)	=	94.0
MEDIAN GRAIN SIZE (FT)	=	0.0019
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	21.6
AVERAGE FLOOD PLAIN DEPTH (FT)	=	17.7
DEPTH OF CONTRACTION SCOUR (FT)	=	3.9

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	13700.	9770.
BOTTOM WIDTH (FT)	74.0	68.5
MANNINGS n	0.045	0.045
AVERAGE DEPTH (FT)	27.1	

ENERGY SLOPE	0.00094
D50 (FT)	0.0033
FALL VELOCITY (FPS)	0.50
K1 COEF.	0.64
K2 COEF.	0.21

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	21.3
DEPTH AT MAIN CHANNEL (FT)	=	27.1
DEPTH OF CONTRACTION SCOUR (FT)	=	-5.8

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	6520.
WIDTH OF CONTRACTED SECTION (FT)	=	107.0
MEDIAN GRAIN SIZE (FT)	=	0.0019
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	26.1
AVERAGE FLOOD PLAIN DEPTH (FT)	=	17.7
DEPTH OF CONTRACTION SCOUR (FT)	=	8.4





FED ROAD DIST NO.	STATE	COUNTY	DOCKET NO.	ROUTE NO.	SHEET NO.
12	S.C.	CHESTER	2286	901	18

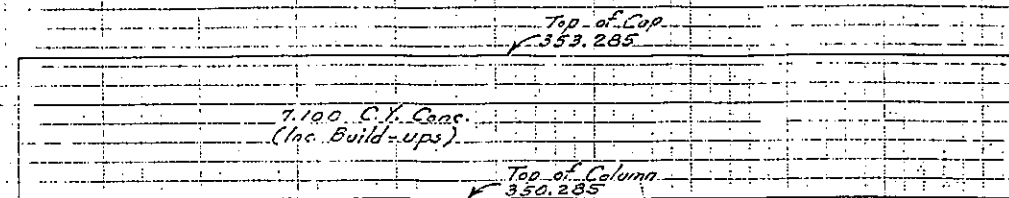
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CROSS SECTION

SCALE 1 INCH = 5 FEET

CHESTER 12.286 5.239 901.11.19

EXCAVATION
 DRY = 32,570 C.Y.
 WET = 96,313 C.Y.
 ROCK = 25,320 C.Y.

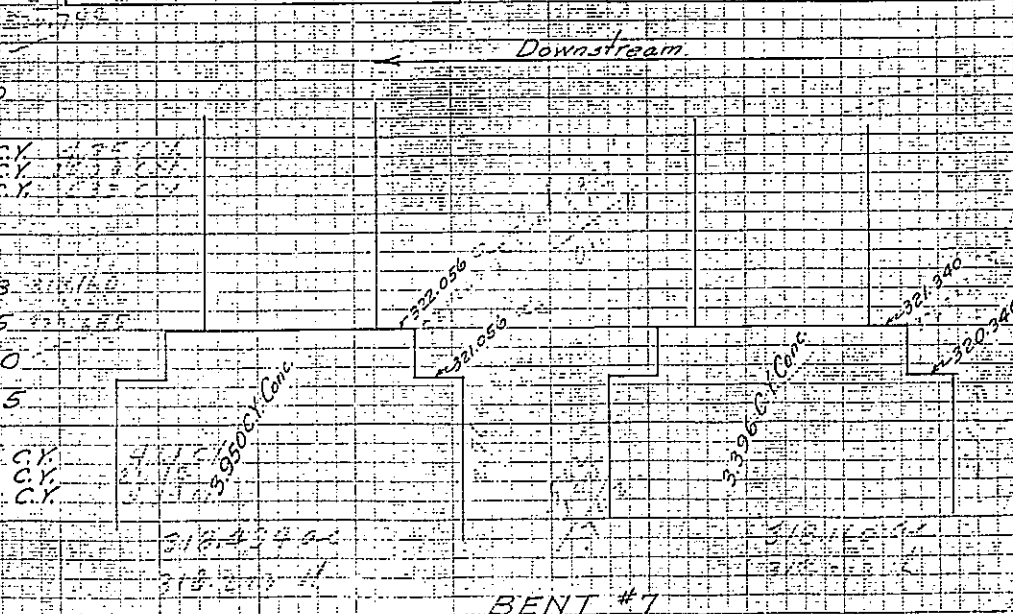
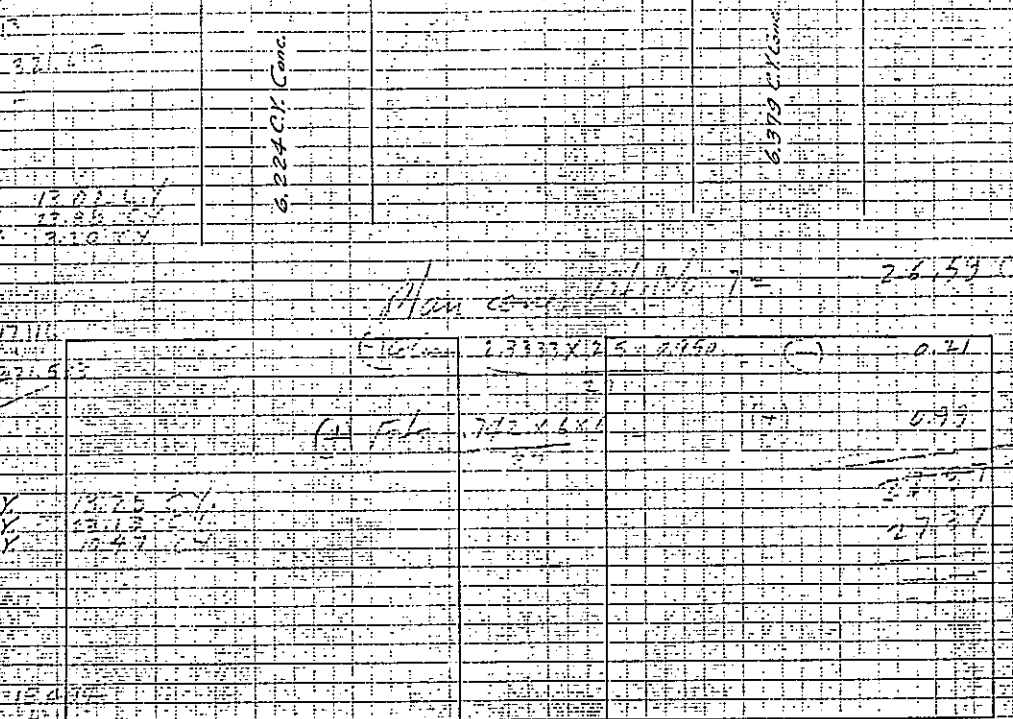
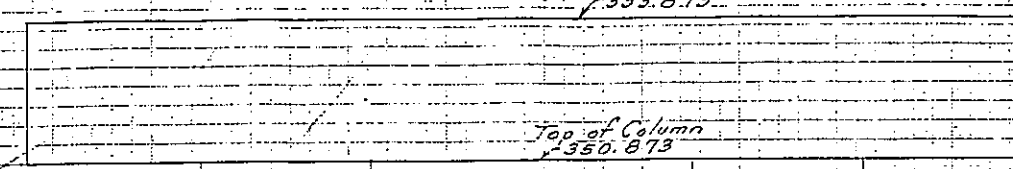
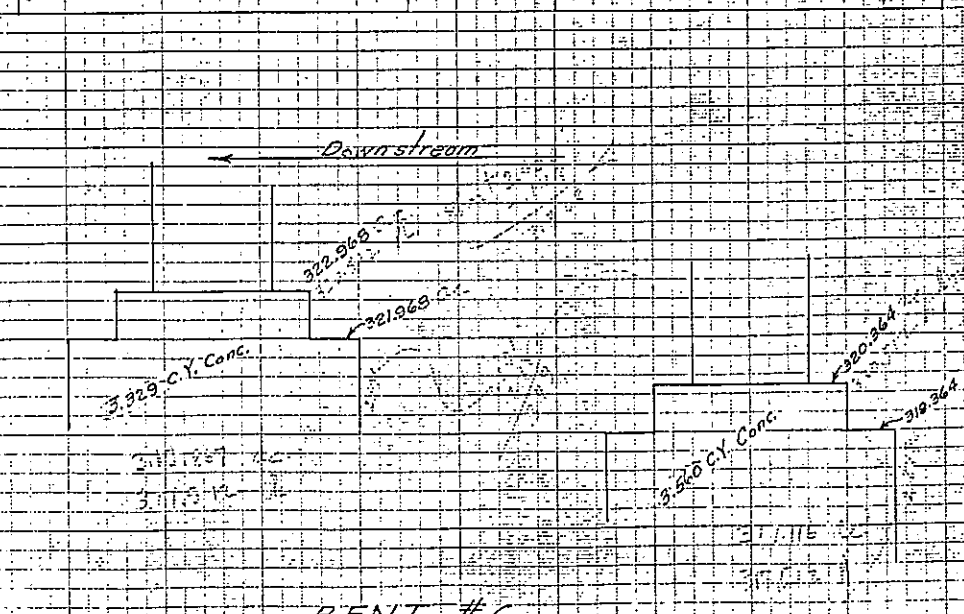
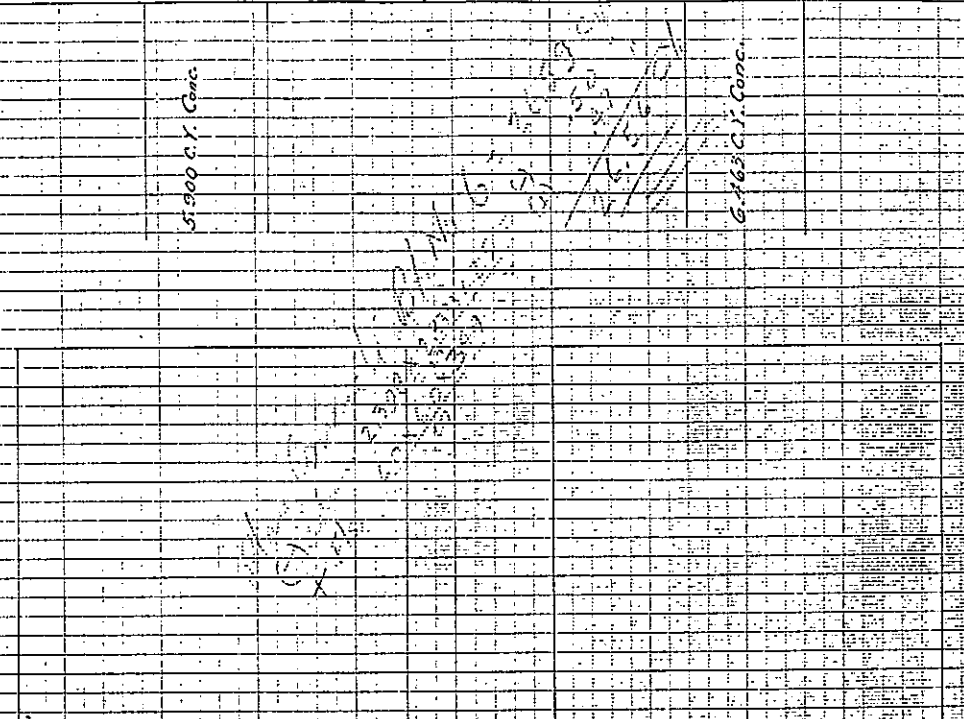


Downstream - Bent #6
 Aver. Elev. Bot. of Footing = 319.976
 Aver. Elev. Top of Rock = 321.299
 Aver. Elev. Top of Wet Exc. = 331.290
 Aver. Elev. Top of Dry Exc. = 336.700
 Excavation Totals
 Dry Excavation = 12,824 C.Y.
 Wet Excavation = 23,682 C.Y.
 Rock Excavation = 3,278 C.Y.

Upstream - Bent #6
 Aver. Elev. Bot. of Footing = 317.154
 Aver. Elev. Top of Rock = 321.591
 Aver. Elev. Top of Wet Exc. = 331.290
 Aver. Elev. Top of Dry Exc. = 336.125
 Excavation Totals
 Dry Excavation = 11,461 C.Y.
 Wet Excavation = 22,976 C.Y.
 Rock Excavation = 10,532 C.Y.

Downstream - Bent #7
 Aver. Elev. Bot. of Footing = 318.538
 Aver. Elev. Top of Rock = 320.817
 Aver. Elev. Top of Wet Exc. = 331.290
 Aver. Elev. Top of Dry Exc. = 332.850
 Excavation Totals
 Dry Excavation = 3,698 C.Y.
 Wet Excavation = 24,825 C.Y.
 Rock Excavation = 5,402 C.Y.

Upstream - Bent #7
 Aver. Elev. Bot. of Footing = 318.238
 Aver. Elev. Top of Rock = 320.815
 Aver. Elev. Top of Wet Exc. = 331.290
 Aver. Elev. Top of Dry Exc. = 333.225
 Excavation Totals
 Dry Excavation = 4,587 C.Y.
 Wet Excavation = 24,830 C.Y.
 Rock Excavation = 6,108 C.Y.



BENT #7

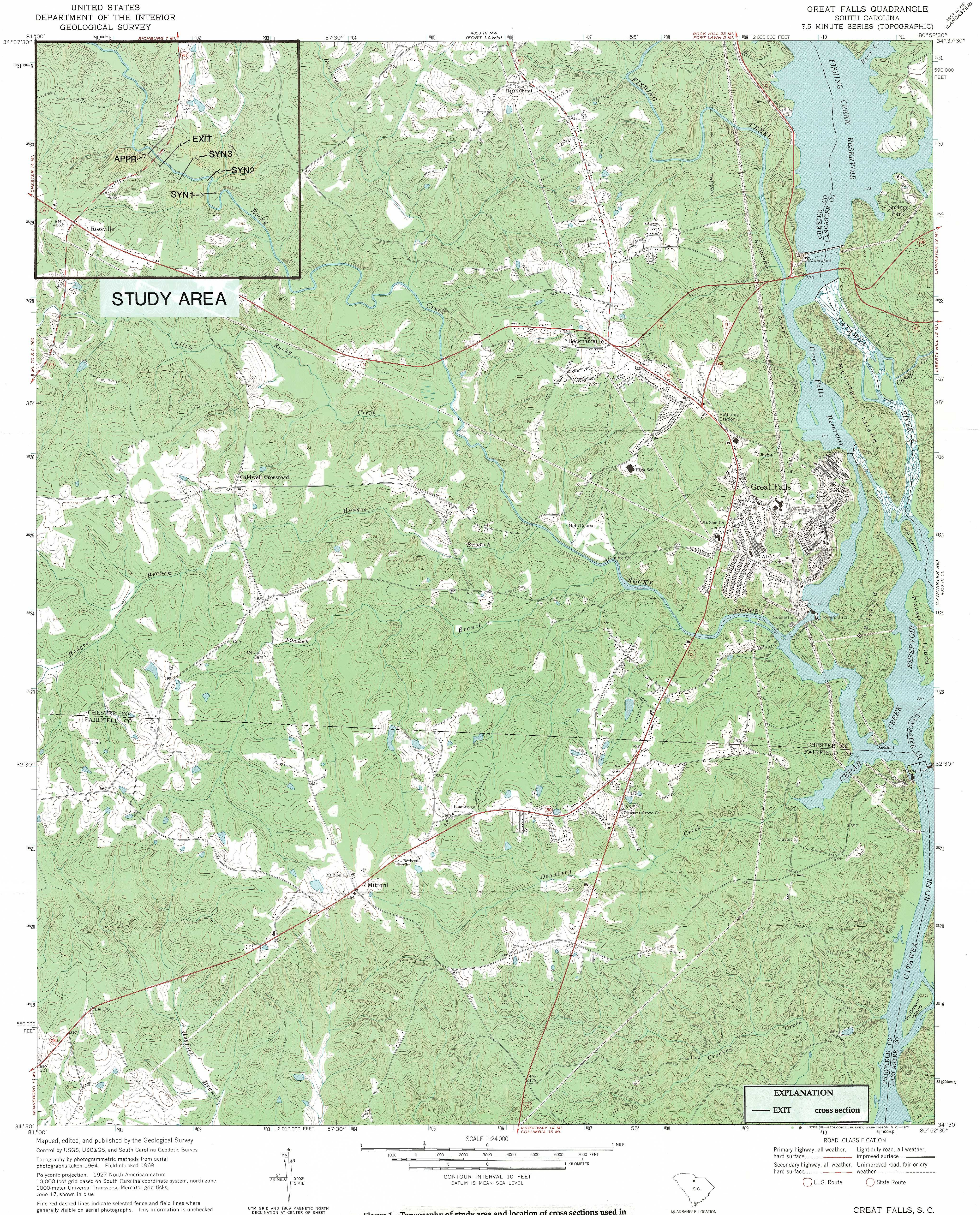


Figure 1--Topography of study area and location of cross sections used in WSPRO analysis for structure 124090100200 on Route SC 901, crossing Rocky Creek in Chester County, South Carolina.