

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

**U.S. GEOLOGICAL SURVEY**

**LEVEL II BRIDGE SCOUR ANALYSIS FOR STRUCTURE 134014500200  
ON ROUTE SC 145, CROSSING BIG BLACK CREEK IN  
CHESTERFIELD COUNTY, SOUTH CAROLINA**

**By Whitney Stringfield and Toby D. Feaster**

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



**Columbia, South Carolina**

**1994**



## UNIT ABBREVIATIONS

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

## OTHER ABBREVIATIONS

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

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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.



**Level II bridge scour analysis  
for structure 134014500200 on Route SC 145,  
crossing Big Black Creek in Chesterfield County, South Carolina**

**by Whitney J. Stringfield and Toby D. Feaster**

This report provides the results of the detailed Level II analysis of scour potential at structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina (figure 1 in pocket; figures 4-7). The site is located in the upper Coastal Plain physiographic province near the town of Chesterfield in the central part of Chesterfield County. The drainage area for the site is 57.1 mi<sup>2</sup>, 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 to dense woods consisting of hardwoods and pines with heavy undergrowth.

In the study area, Big Black Creek has a meandering channel with a slope of approximately 0.0011 ft/ft (5.81 ft/mi), an average channel top width of 41 ft and an average channel depth of 6.8 ft. The predominant channel bed material is medium sand ( $D_{50}$  is 0.49 mm) and the channel banks consist of a fine sand ( $D_{50}$  is 0.17 mm). In general, the banks are covered with woody vegetation and moderately thick undergrowth and were noted to be relatively stable at the time of the Level I and Level II site visits, February 12, 1991, and July 28 and August 3, 1993, respectively.

The Route SC 145 crossing of Big Black Creek is a 250-ft-long, two-lane bridge consisting of ten 25-ft concrete spans, supported by timber pile bents with spillthrough abutments. Both abutments are adequately 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.

File penetration depths were obtained from the SCDOT bridge plans (file number 410-B). The minimum remaining pile penetration depths for the 100- and 500-year discharges are 8.5 and 7.9 ft, respectively. This occurs at bent 5.

**Table 1. --Remaining pile/footing penetration at piers/bents for the 100-year discharge at structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina**

Pier/bent number	Station from left end of bridge (feet)	Pier tip/ footing elevation, SCDOT datum (feet)	Pier tip/ footing elevation, USGS datum (feet)	Ground elevation at pier/bent, USGS datum (feet)	Total <sup>4</sup> scour depth (feet)	Elevation of scour, USGS datum (feet)	Remaining pile/footing penetration (feet)
100-year discharge is 1,890 cubic feet per second							
10	25	591.0	73.2	89.5	3.8	85.7	12.5
9	50	593.0	75.2	88.7	3.9	84.8	9.6
8	75	591.1	73.3	89.2	3.8	85.4	12.1
7	100	592.7	74.9	88.9	3.8	85.1	10.2
6	125	591.3	73.5	88.8	1.9	86.9	13.4
5	150	590.9	73.1	83.5	1.9	81.6	8.5
4	175	592.0	74.2	88.7	2.8	85.9	11.7
3	200	592.2	74.4	89.0	2.7	86.3	11.9
2	225	592.1	74.3	89.3	2.7	86.6	12.3

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

<sup>2</sup> Stations are determined from left to right looking downstream.

<sup>3</sup> Pier tip/footing elevations obtained from the SCDOT bridge plans (file number 410-B). The maximum elevation at each pier/bent is used.

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

Table 2. --Remaining pile/footing penetration at piers/bents for the 500-year discharge at structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina

Pier/bent number	Station from left end of bridge (feet)	Pile tip/ <sup>3</sup> footing elevation, SCDOT datum (feet)	Pile tip/ footing elevation, USGS datum (feet)	Ground elevation at pier/bent, USGS datum (feet)	Total <sup>4</sup> scour depth (feet)	Elevation of scour, USGS datum (feet)	Remaining pile/footing penetration (feet)
500-year discharge is 2,600 cubic feet per second							
10	25	591.0	73.2	89.5	5.4	84.1	10.9
9	50	593.0	75.2	88.7	5.4	83.3	8.1
8	75	591.1	73.3	89.2	5.4	83.8	10.5
7	100	592.7	74.9	88.9	5.4	83.5	8.6
6	125	591.3	73.5	88.8	2.5	86.3	12.8
5	150	590.9	73.1	83.5	2.5	81.0	7.9
4	175	592.0	74.2	88.7	4.1	84.6	10.4
3	200	592.2	74.4	89.0	4.1	84.9	10.5
2	225	592.1	74.3	89.3	4.1	85.2	10.9

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

<sup>2</sup> Stations are determined from left to right looking downstream.

<sup>3</sup> Pile tip/footing elevations obtained from the SCDOT bridge plans (file number 410-B). The maximum elevation at each pier/bent is used.

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



**Table 3. --Cumulative scour depths at piers/bents for the 100-year discharge at structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina**

Pier/bent <sup>1</sup> number	Station from <sup>2</sup> left end of bridge (feet)	Contraction scour depth (feet)	Pier/bent scour depth without debris (feet)	Total <sup>3</sup> scour depth without debris (feet)
100-year discharge is 1,890 cubic feet per second				
10	25	2.3	1.5	3.8
9	50	2.3	1.6	3.9
8	75	2.3	1.5	3.8
7	100	2.3	1.5	3.8
6	125	0 <sup>4</sup>	1.9	1.9
5	150	0 <sup>4</sup>	1.9	1.9
4	175	1.2	1.6	2.8
3	200	1.2	1.5	2.7
2	225	1.2	1.5	2.7

<sup>1</sup> Pier/bent number corresponds to the South Carolina Department of Transportation bridge plans.

<sup>2</sup> Stations are determined from left to right looking downstream.

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

<sup>4</sup> 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 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 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina**

Pier/bent <sup>1</sup> number	Station from <sup>2</sup> left end of bridge (feet)	Contraction scour depth (feet)	Pier/bent scour depth without debris (feet)	Total <sup>3</sup> scour depth without debris (feet)
500-year discharge is 2,600 cubic feet per second				
10	25	3.7	1.7	5.4
9	50	3.7	1.7	5.4
8	75	3.7	1.7	5.4
7	100	3.7	1.7	5.4
6	125	0.4	2.1	2.5
5	150	0.4	2.1	2.5
4	175	2.4	1.7	4.1
3	200	2.4	1.7	4.1
2	225	2.4	1.7	4.1

<sup>1</sup> Pier/bent number corresponds to the South Carolina Department of Transportation bridge plans.

<sup>2</sup> Stations are determined from left to right looking downstream.

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

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.

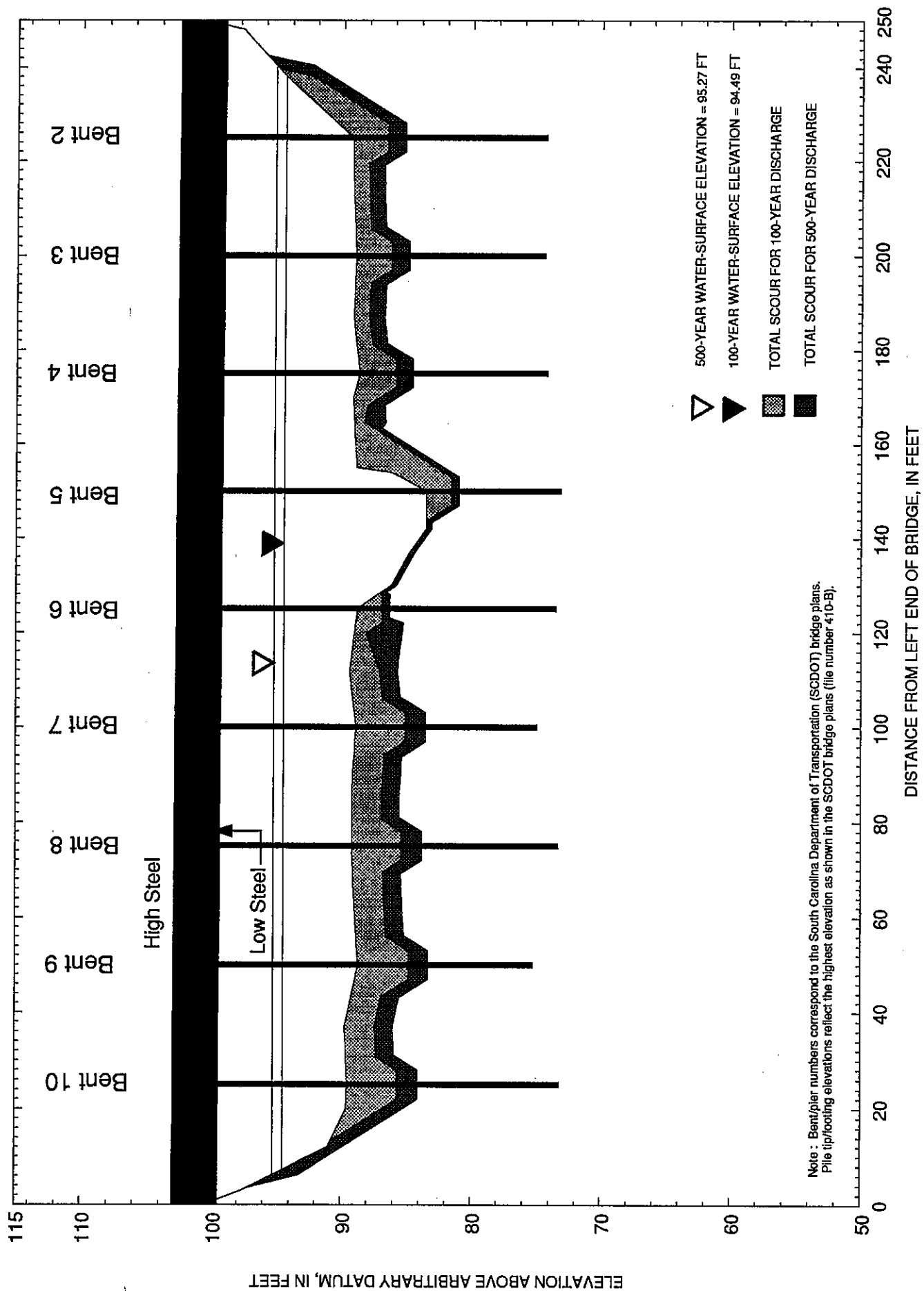


Figure 2.--Total scour depths for the 100- and 500-year discharges at structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina..



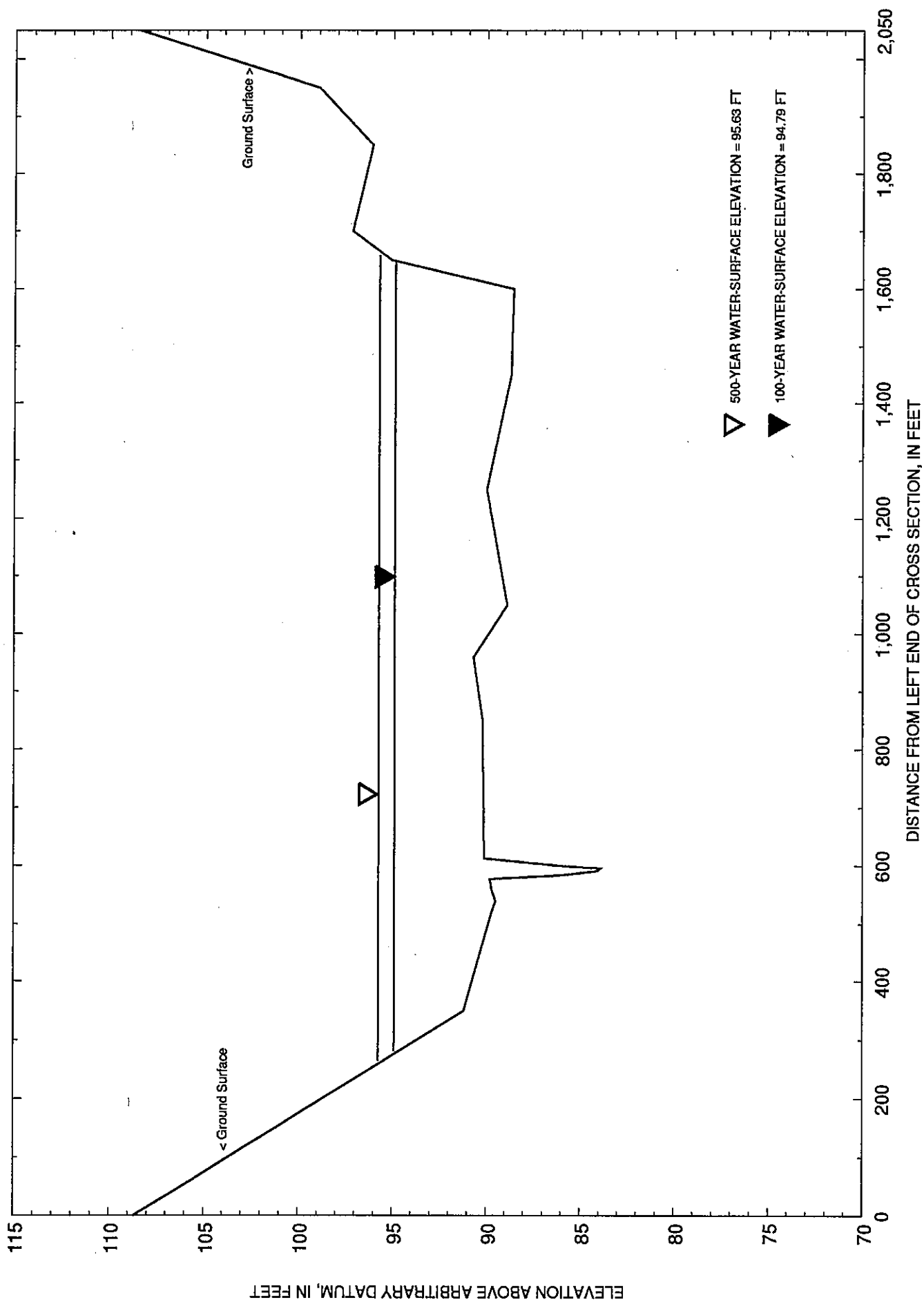
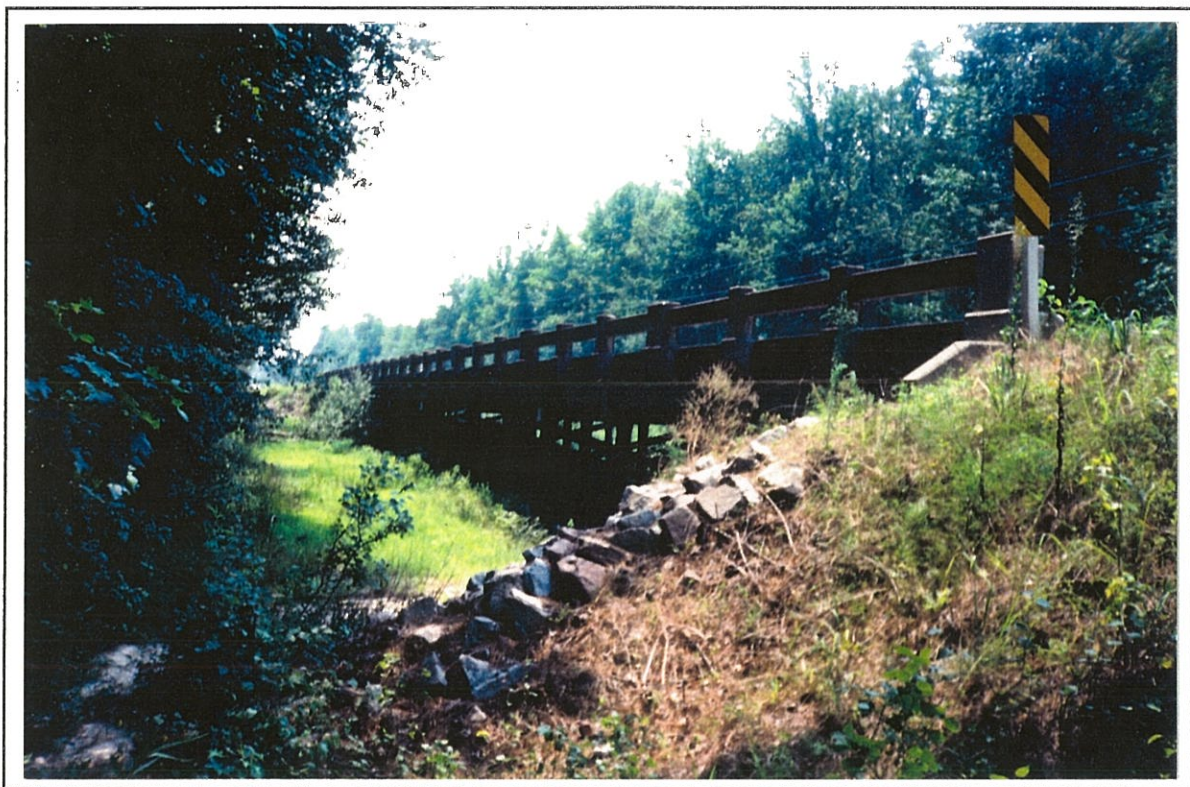


Figure 3.-- Approach cross section of structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina.







**Figure 4.**--Structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina as viewed from the downstream left bank (July 28, 1993).



**Figure 5.**--Downstream channel as viewed from structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina (February 12, 1991).







**Figure 6.**--Upstream channel as viewed from structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina (February 12, 1991).



**Figure 7.**--Structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina as viewed from the upstream left floodplain (February 12, 1991).



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## SCOUR REPORT SUMMARY

Structure Number 134014500200 Stream Big Black Creek  
County Chesterfield Road SC 145 District 4

### Description of Bridge

Bridge length 250 ft Bridge width 25 ft Max span length 25 ft

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

Abutment type Spillthrough Embankment type Sloping

Riprap on abutment? Yes Date of inspection 7-28-1993

Description of riprap Both abutments are fully covered by 12- to 18-inch granite.  
Broken pieces of cinder blocks are on the right abutment.

Brief description of piers/pile bents Nine interior bents, each consisting of five 1.0 ft  
diameter timber 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:

	Date of inspection	Percent of channel blocked horizontally	Percent of channel blocked vertically
Level I	<u>2-21-1991</u>	<u>0</u>	<u>0</u>
Level II	<u>7-28-1993</u>	<u>0</u>	<u>0</u>

Potential for debris Moderate to high: fallen trees in the channel, upstream of the  
bridge.

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

None observed

## Description of Flood Plain

*General topography* Typical upper Coastal Plain topography

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

*Date of inspection* 7-28-1993

*D/S left:* Moderately thick hardwoods with heavy undergrowth of small trees

*D/S right:* Moderately thick hardwoods with heavy undergrowth of small trees

*U/S left:* Moderately thick hardwoods with heavy undergrowth of small trees

*U/S right:* Moderately thick hardwoods with heavy undergrowth of small trees

## Description of Channel

*Average top width* 41 *ft* *Average depth* 6.8 *ft*

*Predominant bed material* Medium sand *Bank material* Fine sand

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

*Vegetative cover on channel banks near bridge:* *Date of inspection* 7-28-1993

*D/S left:* Moderately thick hardwoods with heavy undergrowth of small trees

*D/S right:* Moderately thick hardwoods with heavy undergrowth of small trees

*U/S left:* Moderately thick hardwoods with heavy undergrowth of small trees

*U/S right:* Moderately thick hardwoods with heavy undergrowth of small trees

*Do banks appear stable?* Yes *If not, describe location and type of instability and date of observation.*

*Describe any obstructions in channel and date of observation.* None observed

## Hydrology

Drainage area 57.1  $mi^2$

*Percentage of drainage area in physiographic provinces:*

<i>Physiographic province</i>	<i>Percent of drainage area</i>
upper Coastal Plain	100

Is drainage area considered rural or urban? Rural Describe any significant urbanization and potential for development. The drainage area encompasses a predominantly rural area with little development in recent years.

Is there a USGS gage on the stream of interest? Yes

USGS gage description Big Black Creek near McBeeUSGS gage number 02130900

Gage drainage area 108  $mi^2$

Is there a lake/pond that will significantly affect hydrology/hydraulics? No  
If so, describe \_\_\_\_\_

### Calculated Discharges

$$Q_{100} = \frac{1,890}{\text{min}} \text{ ft}^3/\text{s}$$
$$Q_{500} = \underline{2,600} \text{ ft}^3/\text{s}$$

*Method used to determine discharges* A weighted 100- and 500-year discharge at station 02130900 was determined by weighting the log Pearson Type III and regression equation discharges. This weighted discharge at the gage was then transferred to Route SC 145 and weighted by the regression equation discharges at Route SC 145. For a description of the methods, see WRIR 91-4157, "Techniques for estimating magnitude and frequency of floods in South Carolina," by W. B. Guimares and L. R. Bohman.

## **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 517.8 ft to USGS survey datum to obtain the SCDOT plans' datum (file number 410-B).

*Description of reference marks used to determine USGS datum.* RM 1 is a chiseled square on the D/S left abutment headwall (assumed elevation = 100.00 ft) RM 2 is a chiseled square on the U/S right abutment headwall (surveyed elevation = 99.69 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>
EXIT1	-290	2	Natural ground section
DSRD	-280	2	Old road bed section
USRD	-260	2	Old road bed section
EXIT	-250	1	Exit section
FULV	0	2	Full valley section
BRDG	0	1	U/S face of bridge
APPR	275	4	Approach 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 SCDOT road plans, file number 410-B.



*Description of data and assumptions used in developing WSPRO model.*

The hydraulics at Route SC 145 are influenced by an old road embankment located approximately 250 ft downstream of the downstream bridge face. Therefore, a cross section was surveyed along the toe and at the top of the old embankment. The toe survey was shifted downstream of the old embankment and used as the starting cross section (EXIT1) for the WSPRO model. The top of embankment survey was used to model the upstream (USRD) and downstream (DSRD) face of the old embankment. Additionally, the toe of embankment survey was used to model the exit and full-valley cross sections for the Route SC 145 bridge. 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 approach cross section was determined by superimposing a channel cross section, which was surveyed approximately 90 ft upstream of the upstream bridge face, onto a cross section obtained from the SCDOT road plans (file number 410-B). This cross section was shifted by the channel slope to the appropriate section reference distance (SRD) to represent the approach section required by WSPRO. The SRD at the downstream face of the bridge was set to zero.

Because the flood plain is relatively uniform downstream of the old road embankment, it was assumed that slope-conveyance methodology would be adequate for estimating the starting water-surface elevation for the water-surface profile computations.

## Bridge Hydraulics

*Average embankment elevation*      99.6    ft

*Average low steel elevation*      99.5    ft

*100-year discharge*      1,890    ft<sup>3</sup>/s

*Water-surface elevation at D/S bridge face*      94.49    ft

*Area of flow at D/S bridge face*      1,295    ft<sup>2</sup>

*Average velocity in bridge opening*      1.46    ft/s

*Maximum WSPRO tube velocity at bridge*      2.19    ft/s

*Water-surface elevation at Approach section with bridge*      94.79    ft

*Water-surface elevation at Approach section without bridge*      94.56    ft

*Amount of backwater caused by bridge*      0.23    ft

*500-year discharge*      2,600    ft<sup>3</sup>/s

*Water-surface elevation at D/S bridge face*      95.27    ft

*Area of flow at D/S bridge face*      1,477    ft<sup>2</sup>

*Average velocity in bridge opening*      1.76    ft/s

*Maximum WSPRO tube velocity at bridge*      2.58    ft/s

*Water-surface elevation at Approach section with bridge*      95.63    ft

*Water-surface elevation at Approach section without bridge*      95.34    ft

*Amount of backwater caused by bridge*      0.29    ft

## 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 7 through 10 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 2 through 4 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 6 is located near the top of the 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 5 is located in the channel. Bents 5 and 6 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.

This site is located in the upper Coastal Plain physiographic province where sandy soils and heavily vegetated flood plains will minimize sediment transport during floods. Additionally, a comparison of the velocities in the approach channel with the critical velocity at incipient motion indicates that clear-water scour conditions will dominate. Therefore, it was decided that clear-water scour would best represent the contraction scour processes at the bridge, and the potential contraction scour was determined using Larsen's clear-water contraction scour equation (Richardson and other, 1993).

The clear-water contraction scour equation indicates the deposition of sediment in the channel at the bridge during the 100-year flood. (See negative scour values determined in scour calculations included at the end of the report). However, it seems unreasonable to expect sediment deposition at the bridge during peak flood conditions. Therefore, the negative scour value were set equal to zero as reflected in table 3 and figure 2.

Channel surveys taken by USGS personnel 90 ft upstream of the upstream bridge face and at the upstream and downstream bridge faces on July 28, 1993 were compared with the channel shown on the SCDOT road plans (file number 410-B) dated July 1935. From this comparison, it appears that the channel bed has degraded approximately 2 ft. This should be taken into consideration when evaluating the scour potential at this site. However, in order to verify the long-term channel degradation, further investigation would be necessary.

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

# WSPRO INPUT FILE

T1 Structure 134014500200, (250 ft bridge)  
T2 Big Black Creek at SC 145, Chesterfield County  
T3 WJS 9-26-1994, file: wspro.black

\*  
\* Weighted regression relations used to determine discharges  
\*

\* Q100 Q500  
Q 1890 2600  
\*

\* SK 0.0011 0.0011  
\*

\*  
\* SURV was surveyed at the EXIT section of SC 145 by the USGS.  
\* The EXIT section survey is along the toe of an old road bed  
\* downstream. Right flood plain cross section was extended by  
\* data from topographic map.  
\*

XT SURV -250 .0011  
GR 0 101.7 22 100.8 72 99.2 136 96.8 193 94.8 220 93.6 285 91.5  
GR 372 91.1 378 85.4 389 82.3 396 82.2 405 82.7 414 85.6 419 90.1  
GR 522 92.5 1200 92.5 1220 102.0  
\*

\* XS EXIT1 -290  
GT  
N 0.14 0.08 0.20  
SA 372 419  
\*

\* DSRD was surveyed at the EXIT section of SC 145. This section  
\* is along the top of an old road bed downstream.  
\*

XS DSRD -280 .0011  
GR 0 101.7 22 100.8 72 99.2 136 98.1 193 96.2 220 95.5 285 94.2  
GR 372 91.1 378 85.4 389 82.3 396 82.2 405 82.7 414 85.6 419 92.5  
GR 522 92.9 658 92.7 768 93.3 915 94.1 1003 96.0 1035 98.1  
N 0.12 0.08 0.04  
SA 372 419  
\*

\* XS USRD -260  
\*

\* XS EXIT -250  
GT  
N 0.14 0.08 0.20  
SA 372 419  
\*

XS FULV 0  
GT  
\*

# WSPRO INPUT FILE --Continued

```

*           U/S bridge face more constricted
*
BR  BRDG      0  99.5
GR      0 99.5   1.1 99.5   3 97.6  12 91.0  20 89.6  25 89.5
GR      37 89.7  50   88.7  62 89.0  75 89.2  87 89.2 100 88.9
GR     112 89.4 125   88.8 130 86.2 137 84.8 142 83.5 150 83.5
GR     154 86.2 155   88.9 170 89.2 175 88.7 187 89.2 200 89.0
GR     212 89.2 225   89.3 237 94.1 248 97.8 249 99.1 250 99.1
GR      0 99.5
N      0.045  0.045  0.045
SA      125   155
CD      3  25  1.5  99.6
PW 1    83.5 1 88.7 1 88.7 2 88.7 2 88.7 3 88.8 3 88.8 4 88.9 4
PW      88.9 5 89.0 5 89.0 6 89.2 6 89.2 7 89.3 7 89.3 8 89.5 8
PW      89.5 9 99.5 9 99.5 0
*
*           The KD card was used to shift the KQ section to include the main
*           channel of the cross-section
*
KD      * * *   458  697
*
*
XT  SURV2     12 .0011
GR      0 108.7 350 91.2 520 89.7 539 89.5 559 89.7 577 89.8 583 86.2
GR     585  85.7 591 84.1 595 83.9 600 86.1 612 90.1 850 90.2
GR     950  90.7 1050 88.9 1250 90.0 1450 88.7 1600 88.6 1650 95.1
GR    1700  97.2 1850 96.1 1950 99.0 2050 108.5
*
*
*           SRD OF APPROACH( 250 FT + 25 FT )= 275 FT
*
AS  APPR     275
GT
*           (ltb of appr) 577 - (ltb of bridge) 125 = BP
*
BP      452
N      0.18   0.08   0.18
SA      577   612
*
*
HP 1 BRDG 94.49 0 94.49  1890
HP 2 BRDG 94.50 0 94.50  1890
HP 1 APPR 94.79 0 94.79  1890
HP 2 APPR 94.79 0 94.79  1890
*
*
HP 1 BRDG 95.27 0 95.27  2600
HP 2 BRDG 95.28 0 95.28  2600
HP 1 APPR 95.63 0 95.63  2600
HP 2 APPR 95.63 0 95.63  2600
*
EX
ER

```

# WSPRO OUTPUT

WSPRO  
V042094

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

Structure 134014500200, (250 ft bridge)  
Big Black Creek at SC 145, Chesterfield County  
WJS 9-26-1994, file: wspro.black

\*\*\* RUN DATE & TIME: 10-06-94 10:27

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

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	600	58396	118	119				7687
	2	283	38755	30	34				4932
	3	412	39378	83	84				5211
94.49		1295	136529	231	237	1.08	7	238	16748

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

	WSEL	LEW	REW	AREA	K	Q	VEL
	94.50	7.2	238.2	1297.7	136906.	1890.	1.46
X STA.	7.2	28.7	43.6	55.4	67.9	80.4	
A(I)	85.0	74.0	66.4	68.7	67.1		
V(I)	1.11	1.28	1.42	1.38	1.41		
X STA.	80.4	93.2	105.3	118.3	129.3	135.0	
A(I)	68.2	66.5	68.1	66.2	50.0		
V(I)	1.39	1.42	1.39	1.43	1.89		
X STA.	135.0	139.8	143.8	147.8	152.4	164.3	
A(I)	47.3	43.2	44.0	48.9	72.3		
V(I)	2.00	2.19	2.15	1.93	1.31		
X STA.	164.3	176.7	189.0	201.4	214.8	238.2	
A(I)	68.0	67.0	67.5	72.0	87.2		
V(I)	1.39	1.41	1.40	1.31	1.08		

# WSPRO OUTPUT --Continued

WSPRO  
V042094

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

Structure 134014500200, (250 ft bridge)  
Big Black Creek at SC 145, Chesterfield County  
WJS 9-26-1994, file: wspro.black

\*\*\* RUN DATE & TIME: 10-06-94 10:27

CROSS-SECTION PROPERTIES: ISEQ = 7; SECID = APPR ; SRD = 275.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1074	21137	293	293				11671
	2	280	19966	35	37				4495
	3	4962	116890	1033	1034				61707
94.79		6317	157993	1361	1364	1.77	284	1645	58101

VELOCITY DISTRIBUTION: ISEQ = 7; SECID = APPR ; SRD = 275.

	WSEL	LEW	REW	AREA	K	Q	VEL
	94.79	284.0	1645.4	6316.6	157993.	1890.	0.30
X STA.	284.0	447.7	528.1	583.7	593.7	606.2	
A(I)		473.5	363.1	282.4	97.0	106.8	
V(I)		0.20	0.26	0.33	0.97	0.89	
X STA.	606.2	677.1	760.0	843.0	933.9	1019.2	
A(I)		317.2	360.8	358.8	373.1	368.1	
V(I)		0.30	0.26	0.26	0.25	0.26	
X STA.	1019.2	1076.4	1137.4	1203.7	1278.7	1346.5	
A(I)		310.2	322.2	327.4	346.2	332.5	
V(I)		0.30	0.29	0.29	0.27	0.28	
X STA.	1346.5	1405.3	1458.5	1509.2	1562.2	1645.4	
A(I)		312.8	302.1	295.4	310.6	356.3	
V(I)		0.30	0.31	0.32	0.30	0.27	



# WSPRO OUTPUT --Continued

WSPRO  
V042094

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

Structure 134014500200, (250 ft bridge)  
Big Black Creek at SC 145, Chesterfield County  
WJS 9-26-1994, file: wspro.black

\*\*\* RUN DATE & TIME: 10-06-94 10:27

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

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	692	73573	119	120				9483
	2	306	44242	30	34				5556
	3	478	49440	85	87				6417
95.27		1477	167255	234	241	1.06	6	240	20400

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

	WSEL	LEW	REW	AREA	K	Q	VEL
	95.28	6.2	240.5	1479.2	167666.	2600.	1.76
X STA.	6.2		28.1	42.2	54.0		65.9
A(I)		99.0		80.1	75.3	75.2	76.6
V(I)		1.31		1.62	1.73	1.73	1.70
X STA.	78.4		91.0	102.7	115.4		127.3
A(I)		76.8		73.9	76.7	76.3	60.2
V(I)		1.69		1.76	1.70	1.70	2.16
X STA.	134.0		139.2	143.7	148.0		153.4
A(I)		54.9		52.0	50.4	59.6	81.4
V(I)		2.37		2.50	2.58	2.18	1.60
X STA.	165.9		177.9	190.2	202.5		215.5
A(I)		75.7		76.5	76.5	80.1	101.9
V(I)		1.72		1.70	1.70	1.62	1.28

# WSPRO OUTPUT --Continued

WSPRO  
V042094

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

Structure 134014500200, (250 ft bridge)  
Big Black Creek at SC 145, Chesterfield County  
WJS 9-26-1994, file: wspro.black

\*\*\* RUN DATE & TIME: 10-06-94 10:27

CROSS-SECTION PROPERTIES: ISEQ = 7; SECID = APPR ; SRD = 275.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1327	28978	310	310				15591
	2	309	23581	35	37				5221
	3	5834	152041	1044	1044				78260
95.63		7470	204600	1389	1391	1.66	267	1656	76425

VELOCITY DISTRIBUTION: ISEQ = 7; SECID = APPR ; SRD = 275.

	WSEL	LEW	REW	AREA	K	Q	VEL
	95.63	267.2	1655.7	7470.5	204600.	2600.	0.35
X STA.	267.2	435.2	518.2	581.4	593.5	607.3	
A(I)	556.4	436.0	365.2	123.7	127.2		
V(I)	0.23	0.30	0.36	1.05	1.02		
X STA.	607.3	679.5	759.3	839.2	925.4	1008.9	
A(I)	380.9	414.5	412.8	428.8	420.3		
V(I)	0.34	0.31	0.31	0.30	0.31		
X STA.	1008.9	1069.3	1129.6	1195.1	1267.9	1337.2	
A(I)	372.5	372.3	381.1	398.4	393.4		
V(I)	0.35	0.35	0.34	0.33	0.33		
X STA.	1337.2	1397.9	1453.5	1505.9	1559.7	1655.7	
A(I)	371.1	360.2	349.1	360.2	446.2		
V(I)	0.35	0.36	0.37	0.36	0.29		

# WSPRO OUTPUT --Continued

WSPRO  
V042094

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

Structure 134014500200, (250 ft bridge)  
Big Black Creek at SC 145, Chesterfield County  
WJS 9-26-1994, file: wspro.black  
\*\*\* RUN DATE & TIME: 10-06-94 10:27

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
EXIT1:XS	*****	209	2168	0.07	*****	94.11	87.67	1890	94.04
-289	*****	1203	56950	5.87	*****	*****	0.25	0.87	
DSRD :XS	10	289	1045	0.08	0.01	94.13	*****	1890	94.05
-279	10	905	53722	1.59	0.01	0.00	0.31	1.81	
USRD :XS	20	289	1048	0.08	0.02	94.15	*****	1890	94.07
-259	20	906	53859	1.59	0.00	0.00	0.31	1.80	
EXIT :XS	10	209	2176	0.07	0.01	94.17	*****	1890	94.10
-249	10	1203	57151	5.87	0.00	0.00	0.25	0.87	
FULV :FV	250	209	2181	0.07	0.27	94.45	*****	1890	94.38
0	250	1203	57281	5.87	0.00	0.01	0.25	0.87	

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

==135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.  
"APPR " KRATIO = 2.55

APPR :AS	275	289	6008	0.00	0.12	94.57	*****	1890	94.56
275	275	1644	146179	1.81	0.00	0.00	0.04	0.31	

<<<<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	
BRDG :BR	250	7	1295	0.06	0.38	94.54	90.33	1890	94.49
0	250	238	136403	1.76	0.00	0.00	0.14	1.46	

TYPE	PPCD	FLOW	C	P/A	LSEL	BLEN	XLAB	XRAB
3.	1.	1.	0.754	0.042	99.50	*****	*****	*****

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
APPR :AS	250	284	6314	0.00	0.24	94.79	90.38	1890	94.79
275	437	1645	157907	1.77	0.01	-0.01	0.03	0.30	
M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL				
0.830	0.740	41183.	458.	697.	94.75				

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

# WSPRO OUTPUT --Continued

WSPRO  
V042094

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

Structure 134014500200, (250 ft bridge)  
Big Black Creek at SC 145, Chesterfield County  
WJS 9-26-1994, file: wspro.black  
\*\*\* RUN DATE & TIME: 10-06-94 10:27

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
EXIT1:XS	*****	191	2957	0.06	*****	94.90	88.69	2600	94.83
-289	*****	1205	78345	5.39	*****	*****	0.21	0.88	
DSRD :XS	10	253	1571	0.06	0.01	94.90	*****	2600	94.85
-279	10	950	89042	1.34	0.00	0.00	0.23	1.66	
USRD :XS	20	253	1567	0.06	0.02	94.92	*****	2600	94.86
-259	20	949	88793	1.34	0.00	0.00	0.23	1.66	
EXIT :XS	10	191	2952	0.07	0.01	94.93	*****	2600	94.87
-249	10	1205	78185	5.39	0.00	0.00	0.21	0.88	
FULV :FV	250	191	2960	0.06	0.28	95.22	*****	2600	95.15
0	250	1205	78412	5.39	0.00	0.01	0.21	0.88	

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

===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.

"APPR " KRATIO = 2.40

APPR :AS	275	273	7071	0.00	0.13	95.34	*****	2600	95.34
275	275	1650	188212	1.69	0.00	0.00	0.04	0.37	

<<<<<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	
BRDG :BR	250	6	1477	0.08	0.42	95.35	90.73	2600	95.27
0	250	240	167230	1.76	0.00	0.00	0.16	1.76	

TYPE	PPCD	FLOW	C	P/A	LSEL	BLEN	XLAB	XRAB
3.	1.	1.	0.754	0.042	99.50	*****	*****	*****

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
APPR :AS	250	267	7474	0.00	0.27	95.64	90.87	2600	95.63
275	431	1656	204758	1.66	0.01	-0.01	0.03	0.35	

M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
0.830	0.748	51771.	458.	697.	95.59

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

PIER SCOUR COMPUTATIONS  
FOR  
BIG BLACK CREEK AT SC 145 STRUCTURE # 134014500200  
100-YEAR SCOUR, WJS, scour.1, 10-6-1994

---

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	10	9	8	7
PIER STATION (FT)	25	50	75	100
LOCATION OF PIER	lfp	lfp	lfp	lfp
Y1: DEPTH (FT)	5.0	5.8	5.3	5.6
V1: VEL. (FPS)	1.5	1.5	1.5	1.5
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0
L: PIER LENGTH (FT)	5.0	5.0	5.0	5.0
PIER SHAPE	3	3	3	3
ATTACK ANGLE	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00
FROUDE NO.	0.11	0.11	0.11	0.11

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	1.38	1.41	1.39	1.40
MAX SCOUR DEPTH (FT)	1.52	1.55	1.53	1.54

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HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	6	5	4	3	2
PIER STATION (FT)	125	150	175	200	225
LOCATION OF PIER	ltb	mcm	rfp	rfp	rfp
Y1: DEPTH (FT)	11.0	11.0	5.8	5.4	5.2
V1: VEL. (FPS)	2.0	2.0	1.5	1.5	1.5
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	1.0
L: PIER LENGTH (FT)	5.0	5.0	5.0	5.0	5.0
PIER SHAPE	3	3	3	3	3
ATTACK ANGLE	0	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00	1.00
FROUDE NO.	0.10	0.10	0.11	0.11	0.11

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	1.75	1.75	1.41	1.40	1.39
MAX SCOUR DEPTH (FT)	1.92	1.92	1.55	1.54	1.53

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

CONTRACTION SCOUR COMPUTATIONS

CONTRACTION SCOUR COMPUTATIONS  
FOR  
BIG BLACK CREEK AT SC 145 STRUCTURE # 134014500200  
100-YEAR SCOUR, WJS, scour.1, 10-6-1994

---

LEFT OVERBANK IN BRIDGE OPENING  
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	808.
WIDTH OF CONTRACTED SECTION (FT)	=	105.0
MEDIAN GRAIN SIZE (FT)	=	0.0007
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	5.9
AVERAGE FLOOD PLAIN DEPTH (FT)	=	3.7
DEPTH OF CONTRACTION SCOUR (FT)	=	2.3

RIGHT OVERBANK IN BRIDGE OPENING  
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	545.
WIDTH OF CONTRACTED SECTION (FT)	=	70.0
MEDIAN GRAIN SIZE (FT)	=	0.0007
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	6.0
AVERAGE FLOOD PLAIN DEPTH (FT)	=	4.8
DEPTH OF CONTRACTION SCOUR (FT)	=	1.2

MAIN CHANNEL BRIDGE OPENING  
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	537.
WIDTH OF CONTRACTED SECTION (FT)	=	29.0
MEDIAN GRAIN SIZE (FT)	=	0.0020
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	9.3
AVERAGE FLOOD PLAIN DEPTH (FT)	=	10.2
DEPTH OF CONTRACTION SCOUR (FT)	=	-0.9

PIER SCOUR COMPUTATIONS  
FOR  
BIG BLACK CREEK AT SC 145 STRUCTURE # 134014500200  
500-YEAR SCOUR, WJS, scour.5, 10-6-1994

---

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	10	9	8	7
PIER STATION (FT)	25	50	75	100
LOCATION OF PIER	lfp	lfp	lfp	lfp
Y1: DEPTH (FT)	5.7	6.5	6.1	6.4
V1: VEL. (FPS)	1.8	1.8	1.8	1.8
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0
L: PIER LENGTH (FT)	5.0	5.0	5.0	5.0
PIER SHAPE	3	3	3	3
ATTACK ANGLE	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00
FROUDE NO.	0.13	0.12	0.13	0.12

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	1.53	1.56	1.54	1.55
MAX SCOUR DEPTH (FT)	1.68	1.71	1.70	1.71

---

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	6	5	4	3	2
PIER STATION (FT)	125	150	175	200	225
LOCATION OF PIER	ltb	mcm	rfp	rfp	rfp
Y1: DEPTH (FT)	11.8	11.8	6.6	6.2	5.9
V1: VEL. (FPS)	2.3	2.3	1.7	1.7	1.7
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	1.0
L: PIER LENGTH (FT)	5.0	5.0	5.0	5.0	5.0
PIER SHAPE	3	3	3	3	3
ATTACK ANGLE	0	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.00
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00	1.00
FROUDE NO.	0.12	0.12	0.12	0.12	0.12

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	1.89	1.89	1.54	1.53	1.52
MAX SCOUR DEPTH (FT)	2.08	2.08	1.70	1.69	1.68

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

1

CONTRACTION SCOUR COMPUTATIONS  
FOR  
BIG BLACK CREEK AT SC 145 STRUCTURE # 134014500200  
500-YEAR SCOUR, WJS, scour.5, 10-6-1994

---

LEFT OVERBANK IN BRIDGE OPENING  
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS) = 1144.  
WIDTH OF CONTRACTED SECTION (FT) = 105.0  
MEDIAN GRAIN SIZE (FT) = 0.0007  
  
COMPUTED DEPTH OF CONTRACTED SECTION (FT) = 8.0  
AVERAGE FLOOD PLAIN DEPTH (FT) = 4.3  
DEPTH OF CONTRACTION SCOUR (FT) = 3.7

RIGHT OVERBANK IN BRIDGE OPENING  
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS) = 769.  
WIDTH OF CONTRACTED SECTION (FT) = 70.0  
MEDIAN GRAIN SIZE (FT) = 0.0007  
  
COMPUTED DEPTH OF CONTRACTED SECTION (FT) = 8.0  
AVERAGE FLOOD PLAIN DEPTH (FT) = 5.6  
DEPTH OF CONTRACTION SCOUR (FT) = 2.4

MAIN CHANNEL BRIDGE OPENING  
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS) = 688.  
WIDTH OF CONTRACTED SECTION (FT) = 29.0  
MEDIAN GRAIN SIZE (FT) = 0.0020  
  
COMPUTED DEPTH OF CONTRACTED SECTION (FT) = 11.4  
AVERAGE FLOOD PLAIN DEPTH (FT) = 11.0  
DEPTH OF CONTRACTION SCOUR (FT) = 0.4









# United States Department of the Interior



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

October 6, 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 another report of the Level II Bridge Scour Program titled, "Level II bridge scour analysis for structure 134014500200 on Route SC 145, crossing Big Black Creek in Chesterfield County, South Carolina", by Whitney J. Stringfield and Toby D. Feaster. The technical aspects of the report have been reviewed by the South Carolina District Surface-Water Specialist, and the report has been approved by the South Carolina District Reports Specialist.

If you have any questions concerning this report, please contact me (750-6131) or Toby Feaster (750-6103) and we will be glad to assist you in any way possible.

Sincerely,

Whitney J. Stringfield  
Hydrologist

Enclosure





# INDEX OF SHEETS

SHEET No. 1 TITLE PAGE  
2-2 PLAN & PROFILE  
4-251' COMBINATION BRIDGE - STA. 581+24.5 TO 583+75.5

## STATE OF SOUTH CAROLINA STATE HIGHWAY DEPARTMENT

# PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

STATE PROJECT

NO. 410

ROUTE NO. 95

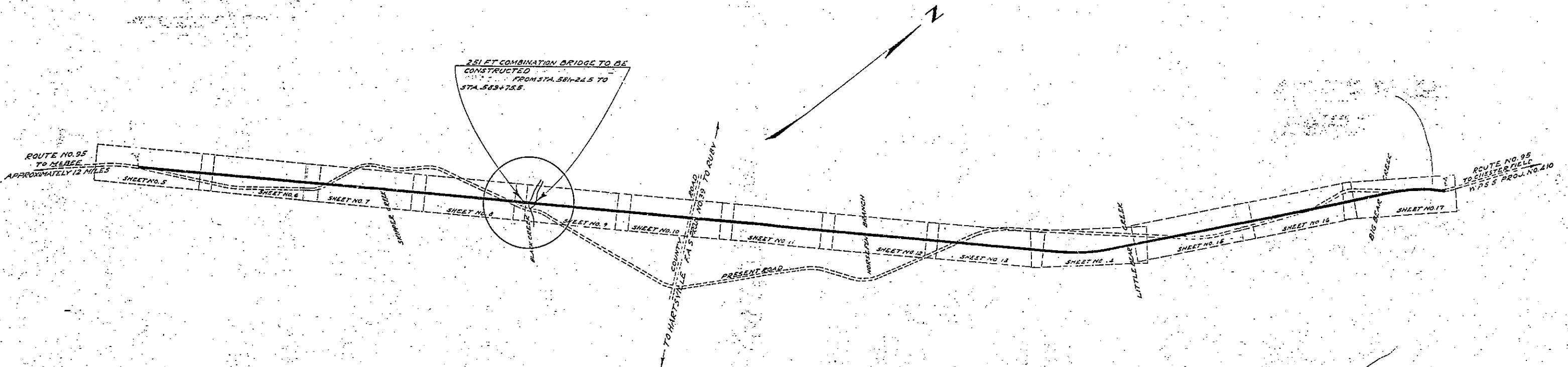
CHESTERFIELD COUNTY

BRIDGE OVER BLACK CREEK

SCALE: PLAN AND PROFILE 1 INCH=100 FEET HORIZONTAL; 1 INCH=10 FEET VERTICAL

FED. ROAD DIST. NO.	STATE	COUNTY	STATE PROJ. NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
14	S. C.	CHESTERFIELD	410-B	95	1	4

SUMMARY OF QUANTITIES FOR 251' COMBINATION BRIDGE					
CLASS "A" CONCRETE C.Y.	REINFORCING STEEL LBS.	STRUCT. STEEL LBS.	HARDWARE LBS.	TRTD. LUMBER M.B.M.	TRTD. PILES L.F.
172.45	38,827	63,936	1,090	3,409	1,600



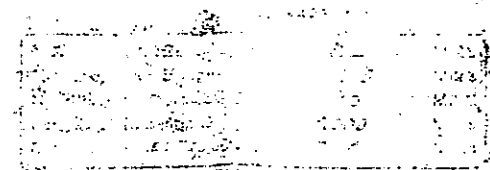
### CONVENTIONAL SIGNS

etc. Line	Trolley Poles	→ → →
County Line	Power Poles	→ → →
City or Town Limits	Telephone or Telegraph Poles	→ → →
Property Line	Marsh	→ → →
Gravel	Trees	→ → →
Retaining Wall	Brush	→ → →
Existing Road	Stumps	→ → →
and R.O.W. Lines of	Buildings	→ → →
Proposed Road	Bridge	→ → →
Highway	Concrete Box Culvert	→ → →
Gravel or Embankment	Pipe Culvert	→ → →
and Rail	Drop Inlet and Culvert	→ → →
Int. of Intersection (P. 1)	Hub on Center Line	→ → →

### LEGEND

PROPOSED PROJECT  
OTHER ROADS

### LAYOUT



Note: All workmanship and material on this project to conform with South Carolina

APPROVED	DATE
STATE HIGHWAY ENGINEER	
RECOMMENDED FOR APPROVAL	DATE
DISTRICT ENGINEER - BUREAU OF PUBLIC ROADS	
RECOMMENDED FOR APPROVAL	DATE
CHIEF ENGINEER - BUREAU OF PUBLIC ROADS	
APPROVED	DATE





PILE RECORD

2000 lb. Hammer 75 ft. Drop									
Bent	Pile	Length	Cut-off	Net	Elev. of Cut-off	Elev. of ground	Penetration	Pen. last 2 ft.	Time 5 ft. drive
1	1	32.0	13.2	18.8	666.32	667.3	11.2	11.2	12.6
	2	32.0	6.4	25.6			11.5	11.5	12.0
	3	32.0	13.1	18.9			11.8	11.8	12.1
	4	32.0	12.8	19.2			12.0	12.0	12.1
	5	32.0	10.9	21.1			14.0	14.0	12.2
2	1	32.0	9.6	22.4	615.275	617.2	15.7	15.7	12.1
	2	32.0	9.3	22.7			15.5	15.5	12.0
	3	32.0	9.3	22.7			15.2	15.2	11.9
	4	32.0	6.2	25.8			18.0	18.0	11.9
	5	32.0	9.4	22.6			15.3	15.3	11.8
3	1	32.0	9.5	22.5	615.512	615.5	15.5	15.5	11.8
	2	32.0	9.3	22.7			15.0	15.0	11.7
	3	32.0	9.3	22.7			15.6	15.6	11.7
	4	32.0	8.1	23.9			16.6	16.6	11.6
	5	32.0	9.1	22.9			15.6	15.6	11.6
4	1	32.0	8.2	23.8	614.500	614.0	16.2	16.2	11.6
	2	32.0	9.4	22.6			15.0	15.0	11.5
	3	32.0	8.3	23.7			16.1	16.1	11.5
	4	32.0	7.2	24.8			17.2	17.2	11.5
	5	32.0	9.5	22.5			14.9	14.9	11.4
5	1	32.0	5.0	27.0	615.487	615.4	17.5	17.5	11.4
	2	32.0	7.4	24.6			15.4	15.4	11.3
	3	32.0	8.3	23.7			14.5	14.5	11.2
	4	32.0	4.9	27.1			17.9	17.9	11.2
	5	32.0	7.8	24.2			15.4	15.4	11.2
6	1	32.0	7.4	24.6	614.325	614.0	15.8	15.8	11.1
	2	32.0	7.0	25.0			16.7	16.7	11.1
	3	32.0	3.1	28.9			20.0	20.0	11.0
	4	32.0	6.2	25.8			17.2	17.2	11.0
	5	32.0	8.0	24.0			15.4	15.4	10.9
7	1	32.0	10.8	21.2	614.262	614.0	16.0	16.0	10.9
	2	32.0	8.6	23.4			17.6	17.6	10.8
	3	32.0	8.0	24.0			14.0	14.0	10.8
	4	32.0	7.3	24.7			14.7	14.7	10.8
	5	32.0	5.1	26.9			16.9	16.9	10.7
8	1	32.0	5.5	26.5	614.200	614.0	16.5	16.5	10.7
	2	32.0	4.7	27.3			17.3	17.3	10.7
	3	32.0	5.0	27.0			17.0	17.0	10.6
	4	32.0	7.4	24.6			15.6	15.6	10.6
	5	32.0	7.8	24.2			15.6	15.6	10.6
9	1	25.0	7.2	17.8	614.799	614.0	16.0	16.0	10.5
	2	25.0	2.2	22.8			15.1	15.1	10.5
	3	25.0	2.6	22.4			15.1	15.1	10.5
	4	25.0	1.2	23.8			18.0	18.0	10.4
	5	25.0	2.3	22.7			13.9	13.9	10.4
10	1	25.0	0.9	24.1	614.75	614.0	16.1	16.1	10.4
	2	25.0	0.6	24.4			16.2	16.2	10.4
	3	25.0	0.8	24.2			16.4	16.4	10.4
	4	25.0	0.7	24.3			16.3	16.3	10.4
	5	25.0	1.2	23.8			15.8	15.8	10.3
11	1	25.0	2.7	22.3	614.712	614.0	14.2	14.2	10.3
	2	25.0	2.8	22.2			14.5	14.5	10.3
	3	25.0	1.8	23.2			15.1	15.1	10.3
	4	25.0	7.8	17.2			15.2	15.2	10.3
	5	25.0	7.1	17.9			15.8	15.8	10.3
TOTALS		1624.8V	532.0V	1290.0V					

POURING RECORD

SECTION	BAGS	WASTE	NET
SPAN 9-1	23.4	1.0	22.4
SPAN 7-9	22.0	1.0	21.0
SPAN 3-5	21.9	1.0	20.9
SPAN 5-7	22.1	1.0	21.1
SPAN 1-3	23.8	2.0	21.8
PAUL DILLON	1.0	0.5	0.5
PAUL DILLON	1.0	0.5	0.5
PAUL DILLON	1.0	0.5	0.5
PAUL DILLON	1.0	0.5	0.5
PAUL DILLON	1.0	0.5	0.5
TOTALS	118.0V	9.0V	109.0V

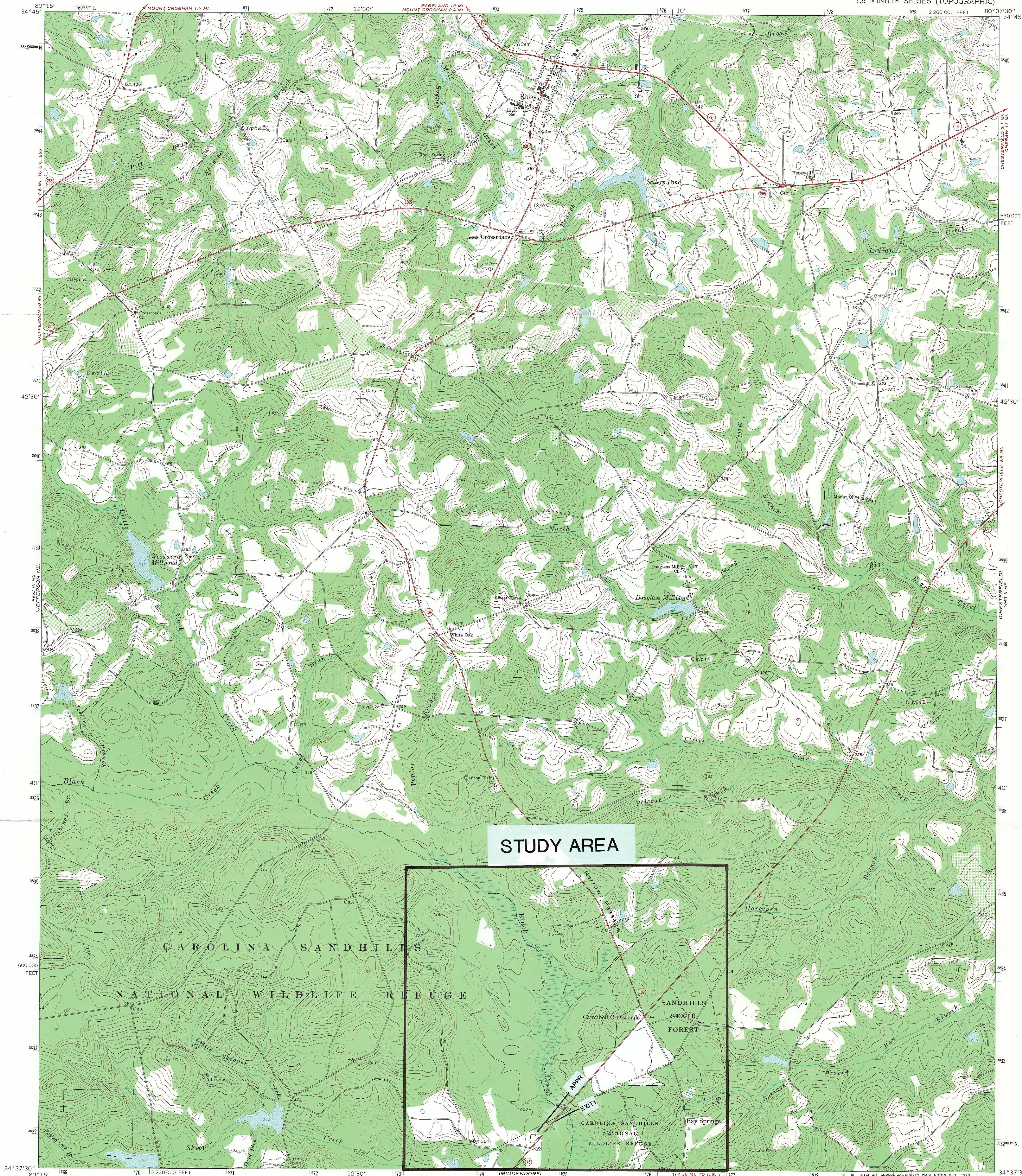
SUMMARY OF QUANTITIES

SECTION	CLASS A CONCRETE	REINFORCEMENT STEEL LBS.	CREOSOTED PILING LBS.	CREOSOTED STAKE TIMBER IN LBS.	HARDWARE LBS.	STRUCTURAL STEEL LBS.
BENT 1-11		1290.0	3409		636.7	184.2
SPAN 1-10	122.45	38.827	1229.0	3409	636.7	63.6518
TOTALS	122.45V	38.827V	1229.0V	3409V	1095.0V	64.4960V

FINAL QUANTITIES  
STATE PROJECT 410-  
10-SPAN BRIDGE ON  
BLACK CREEK, BETWEEN  
MCBEE AND CHESTER



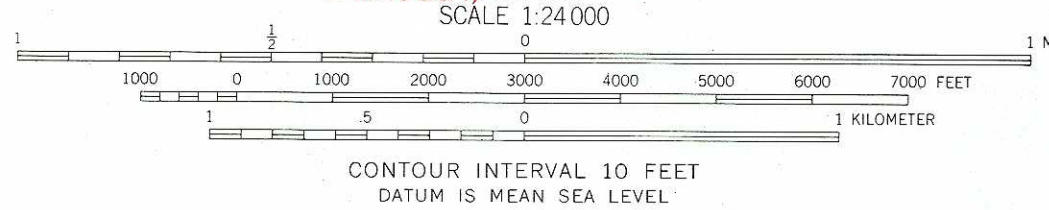




STUDY AREA

CAROLINA SANDHILLS  
NATIONAL WILDLIFE REFUGE

SANDHILLS  
STATE FOREST



**EXPLANATION**  
— EXIT cross section

**ROAD CLASSIFICATION**  
Primary highway, all weather, hard surface  
Secondary highway, all weather, hard surface  
Unimproved road, fair or dry weather  
State Route



Figure 1.—Topography of study area and location of cross sections used in WSPRO analysis for structure 134014500200 on Route SC 145, crossing the Big Black Creek in Chesterfield County, South Carolina.

RUBY, S. C.  
N3437.5—W8007.5/7.5  
1968  
AMS 4953 II NW—SERIES V846

Maped, edited, and published by the Geological Survey  
Control by USGS, USC&GS, and South Carolina Geodetic Survey  
Topography by photogrammetric methods from aerial  
photographs taken 1964. Field checked 1968  
Polyconic projection. 1927 North American datum  
10,000-foot grid based on South Carolina coordinate system, north zone  
1000-meter Universal Transverse Mercator grid ticks,  
zone 17, zone in blue  
Fine red dashed lines indicate selected fence and field lines where  
generally visible on aerial photographs. This information is unchecked

