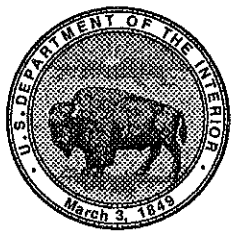
U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

LEVEL II BRIDGE SCOUR ANALYSIS FOR STRUCTURE 194023000500 ON ROUTE SC 230, CROSSING HORNE CREEK IN EDGEFIELD COUNTY, SOUTH CAROLINA

By Toby D. Feaster and Whitney J. Stringfield

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

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 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina

by Toby D. Feaster and Whitney J. Stringfield

This report provides the results of the detailed Level II analysis of scour potential at structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina (figure 1 in pocket; figures 4-6). The site is located in the southwestern part of Edgefield County and is a predominantly rural drainage basin with little development in recent years. The drainage area for the site is 73.2 mi^2 and is predominantly located in the Piedmont physiographic province with approximately 6 percent of the drainage area in the upper Coastal Plain physiographic region. In the vicinity of the study site, the land is covered by moderately thick hardwoods with moderate undergrowth.

In the study area, Horne Creek has a meandering channel with a slope of approximately 0.00067 ft/ft (3.5 ft/mi), an average channel top width of 62 ft and an average channel depth of 7.8 ft. The predominant channel bed material is sand (D_{50} is 1.2 mm) and the channel banks consist of a silty clayey sand (D_{50} is 0.26 mm). In general, the banks have moderate woody vegetative cover and were noted to be relatively stable at the time of the Level I and Level II site visits, January 22, 1991 and October 12, 1993, respectively.

The Route SC 230 crossing of Horne Creek is a 201-ft-long, two-lane bridge consisting of eight 25-ft concrete spans, supported by timber pile bents with spillthrough abutments. The abutments are protected by 8- to 16-inch granite. 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.

Pile penetration depths were obtained from SCDOT bridge plans. Scour depth calculations indicate that pile tip exposure will occur at bent 3 during the 100-year discharge and at bents 3, 5, 6, 7, and 8 during the 500-year discharge. Scour caused by the 100- and 500-year discharges will undermine bent 3 by 4.2 and 5.2 ft, respectively. Scour caused by the 500-year discharge will undermine bents 5, 6, 7, and 8 by 5.3, 3.7, 3.2 and 0.4 ft, respectively. Additionally, the SCDOT bridge plans indicate that bents 2 and 3 have footings. However, no special consideration was given to the possible contraction scour caused by the footings because the bridge plans indicate they were placed on rock.

It should be noted that the SCDOT bridge plan borings (file number 19.263) 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 this report.

Table 1. *--Remaining pile/footing penetration at piers/bents for the 100-year discharge at structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina*

Pier/bent [1] 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)
100-year discharge is 6,800 cubic feet per second							
2	25	199.8	199.8	210.0	2.7	207.3	7.5
3	50	191.2	191.2	196.0	9.0	187.0	-4.2
4	75	187.8	187.8	198.8	5.8	193.0	5.2
5	100	187.0	187.0	204.4	17.4	187.0	0.0
6	125	184.8	184.8	203.5	16.9	186.6	1.8
7	150	185.5	185.5	204.6	16.9	187.7	2.2
8	175	184.2	184.2	205.7	16.5	189.2	5.0

[1] Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans (file number 19.263).

[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 (file number 19.263) show subsurface rock that could affect 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 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina*

Pier/bent [1] 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 8,830 cubic feet per second							
2	25	199.8	199.8	210.0	3.0	207.0	7.2
3	50	191.2	191.2	196.0	10.0	186.0	-5.2
4	75	187.8	187.8	198.8	6.7	192.1	4.3
5	100	187.0	187.0	204.4	22.7	181.7	-5.3
6	125	184.8	184.8	203.5	22.4	181.1	-3.7
7	150	185.5	185.5	204.6	22.3	182.3	-3.2
8	175	184.2	184.2	205.7	21.9	183.8	-0.4

[1] Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans (file number 19.263)

[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 (file number 19.263) show subsurface rock that could affect 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 194023000500 on Route SC 230, crossing Horne Creek in Edgefield 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 6,800 cubic feet per second				
2	25	0.0	2.7	2.7
3	50	1.1	7.9	9.0
4	75	1.1	4.7	5.8
5	100	12.7	4.7	17.4
6	125	12.7	4.2	16.9
7	150	12.7	4.2	16.9
8	175	12.7	3.8	16.5

[1] Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans (file number 19.263).

[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.

NOTE: The SCDOT bridge plan borings (file number 19.263) show subsurface rock that could affect 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 194023000500 on Route SC 230, crossing Horne Creek in Edgefield 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 8,830 cubic feet per second				
2	25	0.0	3.0	3.0
3	50	1.8	8.2	10.0
4	75	1.8	4.9	6.7
5	100	17.8	4.9	22.7
6	125	17.8	4.6	22.4
7	150	17.8	4.5	22.3
8	175	17.8	4.1	21.9

[1] Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans (file number 19.263).

[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.

NOTE: The SCDOT bridge plan borings (file number 19.263) show subsurface rock that could affect 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.

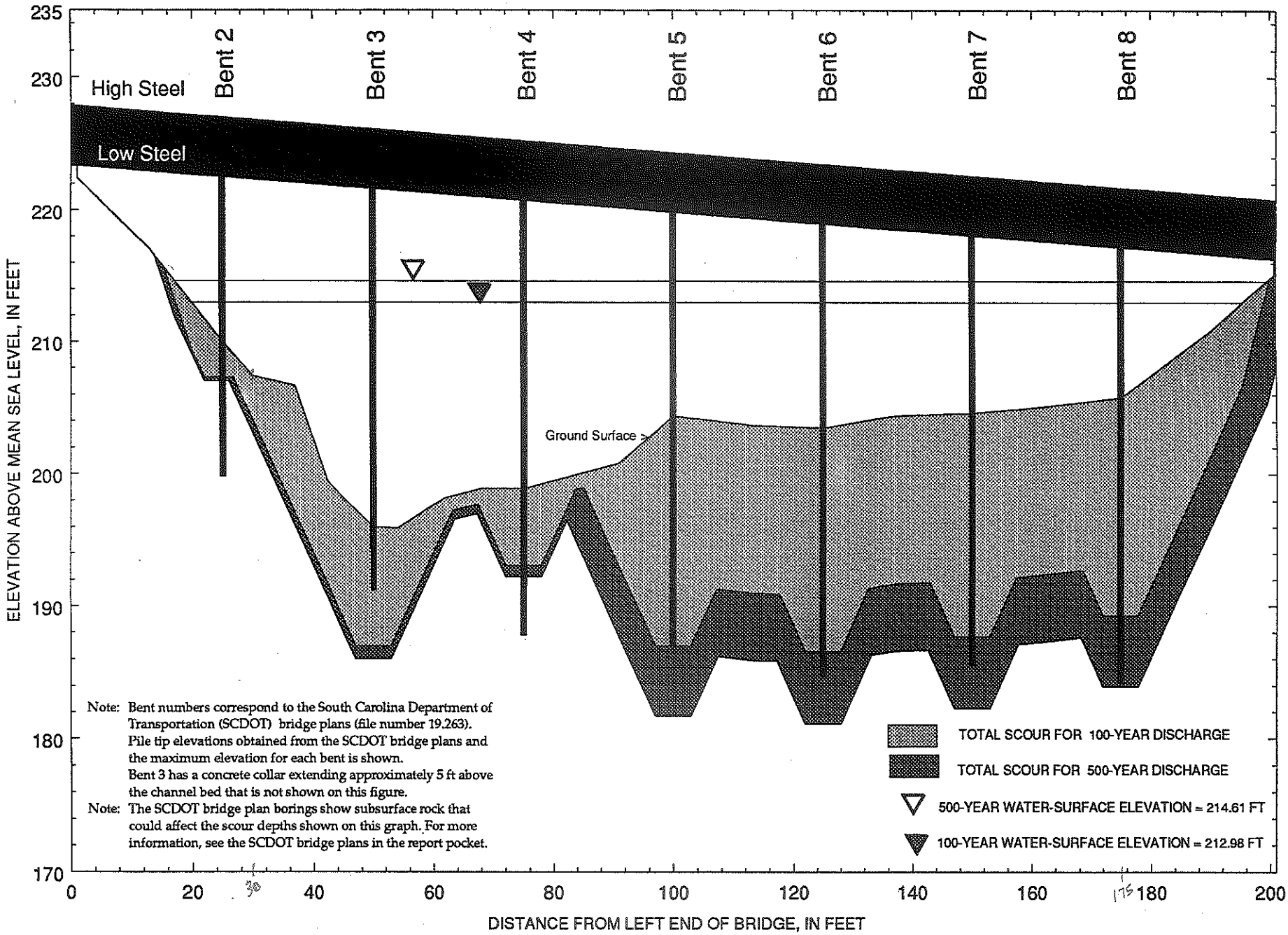


Figure 2.--Total scour depths for the 100- and 500-year discharges on the upstream bridge face at structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina.

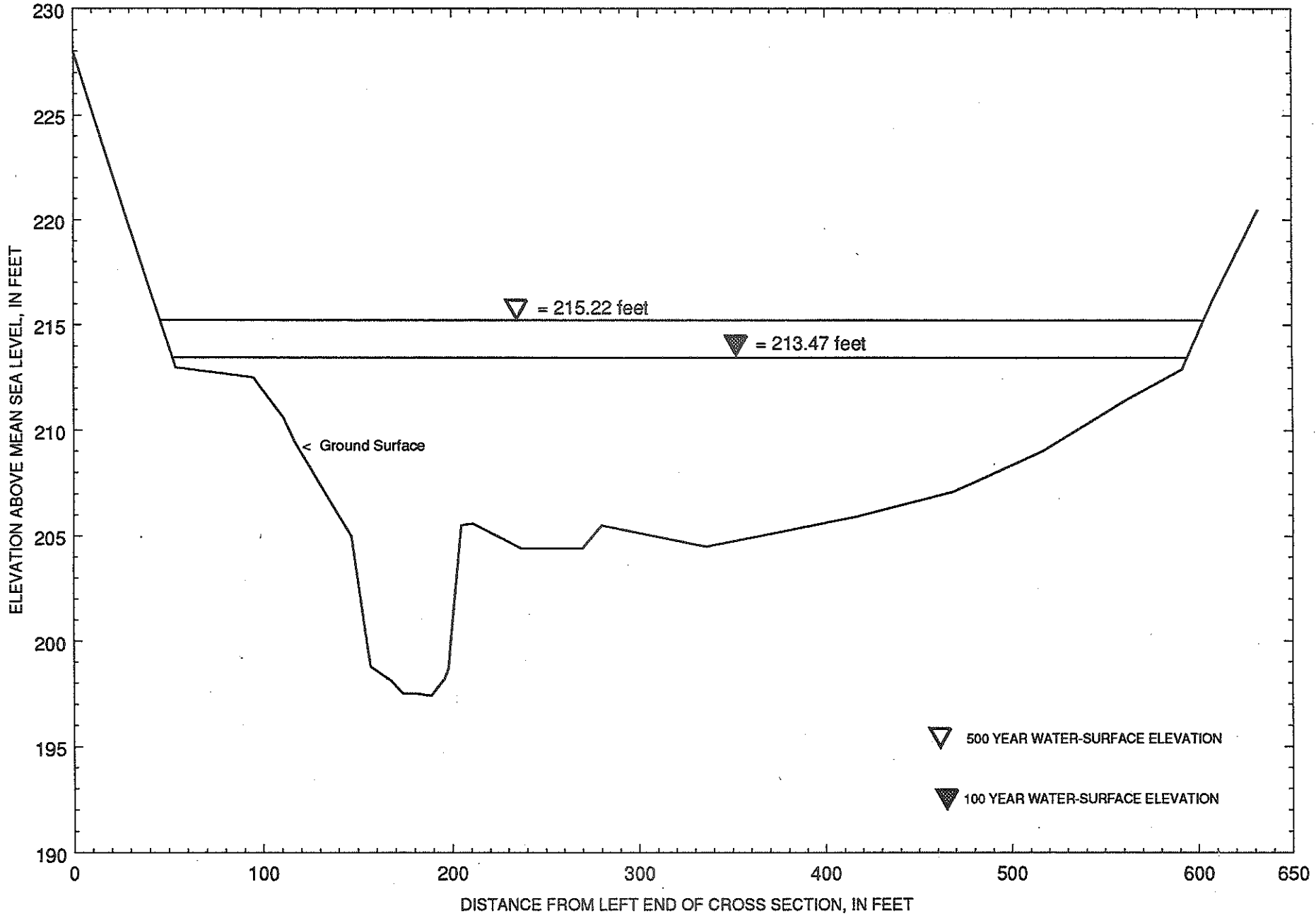


Figure 3.--Approach cross section at structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina.

Figure 4.--Structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina as viewed from the downstream left bank (January 22, 1991).

Figure 5.--Downstream channel as viewed from structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina (January 22, 1991).

Figure 6.--Upstream channel as viewed from structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina (January 22, 1991).

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U.S. Geological Survey, Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency, Bulletin 17B of the Hydrology Subcommittee, 190 p.

SCOUR REPORT SUMMARY

Structure Number 194023000500 *Stream* Horne Creek

County Edgefield *Road* SC 230 *District* 2

Description of Bridge

Bridge length 201 *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* 10-12-1993

Description of riprap Eight- to 16-inch granite in good condition.

Brief description of piers/pile bents Seven interior bents consisting of four 0.9-ft timber piles. The piles at bent 3 each have 3-ft diameter concrete collars that extend approximately 5 ft above the channel bed.

Is bridge skewed to flood plain according to USGS topo map? Yes *Angle* 31

Is bridge located on a bend in channel? Yes *If so, describe (mild, moderate, severe)* There is a fairly severe channel bend at the bridge (approximately 45 degrees).

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	1-22-1991	5	5
Level II	10-12-1993	80	20

Potential for debris Moderate; stable banks but fallen trees were noted in the upstream channel during the Level I site visit.

Describe any features near or at the bridge that may affect flow (include observation date). None observed.

Description of Flood Plain

General topography Typical Piedmont topography consisting of rolling hills.

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

Date of inspection 10-12-1993

D/S left: Moderately thick hardwoods with moderate undergrowth

D/S right: Moderately thick hardwoods with moderate undergrowth

U/S left: Moderately thick hardwoods with moderate undergrowth

U/S right: Moderately thick hardwoods with moderate undergrowth

Description of Channel

Average top width 62 *ft* *Average depth* 7.8 *ft*

Predominant bed material Sand *Bank material* Silty clayey sand

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

Vegetative cover on channel banks near bridge: Date of inspection 10-12-1993

D/S left: Moderate woody vegetative cover

D/S right: Moderate woody vegetative cover

U/S left: Moderate woody vegetative cover

U/S right: Moderate woody vegetative cover

Do banks appear stable? Yes *If not, describe location and type of instability and date of observation.* Overall, the banks appear stable. However, there is some bank failure occurring on the left bank at the bridge due to high flow impact.

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

Hydrology

Drainage area 73.2 mi^2

Percentage of drainage area in physiographic provinces:

Physiographic province	*Percent of drainage area*
Piedmont	93.9
Upper Coastal Plain	6.1

Is drainage area considered rural or urban? Rural *Describe any significant urbanization and potential for development.* Low potential for development due to rural location with little to no development in recent years.

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

USGS gage description Horn Creek near Colliers, SC

USGS gage number 02196250

Gage drainage area 13.9 mi^2

Is there a lake/pond that will significantly affect hydrology/hydraulics? No

If so, describe

Calculated Discharges

Q100 6,800 ft^3/s *Q500* 8,830 ft^3/s

Method used to determine discharges The 100- and 500-year discharges were estimated using the USGS regional regression equations, found on page 15 of "Techniques for estimating magnitude and frequency of floods in South Carolina, 1988" (WRIR 91-4157), by W. B. Guimaraes and L. R. Bohman. Data from station 02196250 was not used because the drainage area at the study site exceeds the drainage area of the gaging station by more than 50 percent.

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

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

Datum tie between USGS survey and SCDOT plans Both the USGS survey and the SCDOT plans are on the mean sea level datum.

Description of reference marks used to determine USGS datum. SC Geodetic Survey benchmark on the U/S right abutment, elevation = 218.17 ft. RM 2 is a chiseled square on the D/S left headwall with a surveyed elevation of 225.30 ft.

Cross Sections Used in WSPRO Analysis

**Cross section ID*	*Section Reference Distance (SRD) in feet*	***How cross section was developed*	*Comments*
EXIT	-201	2	Exit cross section
FULV	0	2	Full valley cross section
BRDG	0	1	U/S bridge face
APPR	226	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.

Horne Creek has a relatively uniform flood plain width in the study area, with no downstream natural or man-made contractions of flow that cause significant backwater at the Route SC 230 crossing. Therefore, it was assumed that slope-conveyance methodology would be adequate for estimating the starting water-surface elevation for the water-surface profile computations.

For this study, the WSPRO model requires, as a minimum, an exit section one bridge width downstream of the bridge, a full-valley section at the downstream face of the bridge, the bridge section, and an approach section one bridge width upstream of the 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 section reference distance (SRD) at the downstream face of the bridge was set to zero. Surveys of the exit and approach channels (located 145 ft downstream of the downstream bridge face and 200 ft upstream of the upstream bridge face, respectively) were superimposed on the flood plain survey taken along the upstream toe-of-fill of Route SC 230. Additionally, the U/S toe-of-fill stations were multiplied by the cosine of 31 degrees in order to orient the cross section perpendicular to the flood plain. 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 221.8 *ft*

Average low steel elevation 219.8 *ft*

100-year discharge 6,800 ft^3/s

Water-surface elevation at D/S bridge face 212.98 *ft*

Area of flow at D/S bridge face 1,413 ft^2

Average velocity in bridge opening 4.81 *ft/s*

Maximum WSPRO tube velocity at bridge 6.54 *ft/s*

Water-surface elevation at Approach section with bridge 213.47 *ft*

Water-surface elevation at Approach section without bridge 213.22 *ft*

Amount of backwater caused by bridge 0.25 *ft*

500-year discharge 8,830 ft^3/s

Water-surface elevation at D/S bridge face 214.61 *ft*

Area of flow at D/S bridge face 1,663 ft^2

Average velocity in bridge opening 5.31 *ft/s*

Maximum WSPRO tube velocity at bridge 6.96 *ft/s*

Water-surface elevation at Approach section with bridge 215.22 *ft*

Water-surface elevation at Approach section without bridge 214.88 *ft*

Amount of backwater caused by bridge 0.34 *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). Bent 2 is located on the left abutment and was analyzed using the maximum left overbank WSPRO tube velocity and the depth of flow at the bent. Bents 6 through 8 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 5 is located at 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 event. Bents 3 and 4 are located in the channel. Bents 3 through 5 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 event.

The timber piles at bent 3 have 3-ft diameter concrete collars to approximately 5 ft above the channel bed. In order to make a reasonable estimate of the pier scour at bent 3, a pile width of 2.0 ft was used in the pier scour analysis. The 2.0 ft width was obtained by taking an average of the 0.9-ft diameter timber pile and the 3.0-ft diameter concrete collar. Additionally, the SCDOT bridge plans (file number 19.263) indicate that bents 2 and 3 have footings. However, no special consideration was given to the possible contraction scour caused by the footings because the bridge plans indicate they were placed on rock.

The USGS topographic map indicates that the bridge is skewed to the flood plain by approximately 31 degrees. However, it seemed reasonable to assume that during extreme flows some ponding will occur upstream of the bridge and consequently, the average velocity vectors will approach the bridge at a smaller angle. Therefore, a high-flow approach angle of 16 degrees was estimated by taking half of the bridge skew angle and was used in determining the pier scour at each bent.

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).

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

It should be noted that the SCDOT bridge plan borings (file number 19.263) 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

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T1          Structure 194023000500    (201 ft Bridge)
T2          Horne Creek at SC 230     File name: wspro.sc230
T3          Edgefield County, South Carolina   31 October 1994  TDF
*
*
*           Q100       Q500
Q           6800       8830
SK          .00067      .00067
*
*           SURV section was obtained by superimposing an exit channel surveyed
*           approximately 145 ft D/S of the D/S bridge face onto the toe-of-fill
*           section surveyed along the toe of the U/S embankment approximately
*           50 ft U/S of the U/S bridge face. The toe survey data has been
*           multiplied by the cosine 31 degrees in order to orient the survey
*           perpendicular to the flood plain. The distances were obtained from
*           the field notes.
*
XT    SURV  75  0.00065
GR            0  228.0   54  213.0   95  212.5  111  210.6  117  209.4
GR          147  205.7  154  197.8  160  197.5  162  197.8  176  198.8
GR          186  197.7  192  197.1  204  197.8  212  205.8  226  204.1
GR          276  204.4  294  203.6  343  204.5  423  205.9  475  207.1
GR          523  209.0  567  211.4  598  212.9  615  216.2  639  220.5
*
*
XS    EXIT  -201
GT
N            0.15      0.045      0.15
SA                147        212
*
*
XS    FULV   0
GT
*
*
*           U/S Face of Bridge on SC 230 (more constricted face).
*
*
BR    BRDG   0   219.8  31
GR            0   223.4    1  223.4    1.1  222.4   13   216.6   25   210.0
GR           30   207.4   37  206.7   42.4  199.4   45   198.2   50   196.0
GR           54   195.9   59  197.4   62    198.2   68   198.9   75   198.8
GR           91   200.8  100  204.4  113    203.7  125   203.5  137   204.4
GR          150   204.6  162  205.1  175    205.7  190   210.7  200.7 215.0
GR          200.8 216.3 201  216.3    0    223.4
N            0.045     0.045     0.045
SA                 37        100
PW 1          196.0  3.0  198.8  3.0  198.8  3.9  200.7  3.9  200.7  1.8
PW            203.5  1.8  203.5  2.7  204.4  2.7  204.4  3.6  204.6  3.6
PW            204.6  4.5  205.7  4.5  205.7  5.4  210.0  5.4  210.0  6.3
PW            219.8  6.3  219.8  0.0
CD           3   25   1.5   221.8
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*          The channel for SURV2 was surveyed approximately 200 ft U/S of the
*          U/S bridge face of SC 230. The channel was superimposed on the
*          U/S toe-of-fill survey taken approximately 50 ft U/S of the U/S
*          bridge face. The toe survey stations have been multiplied by the
*          cosine of 31 degrees in order to orient the section perpendicular
*          to the flood plain.
*
XT    SURV2  75  0.00065
GR            0  228.0   54  213.0   95  212.5  111  210.6  117  209.4
GR          147  205.0  157  198.8  168  198.1  174  197.5  181  197.5
GR          189  197.4  196  198.2  198  198.7  205  205.5  211  205.6
GR          237  204.4  270  204.4  280  205.5  336  204.5  416  205.9
GR          468  207.1  516  209.0  560  211.4  591  212.9  608  216.2
GR          632  220.5
*
*
AS    APPR   226
GT
N             0.15      0.045       0.15
SA                 147        205
*
*         The reference point for the BP card was determined from the
*         survey data. (LTB at approach - LTB at bridge)
*         147 - 37 = 110
*
BP        110
*
*
PX    EXIT
PX    FULV
PX    BRDG
PX    APPR
*
HP 1 BRDG   212.98 0 212.98
HP 2 BRDG   213.02 0 213.02  6800
*
HP 1 APPR   213.47 0 213.47
HP 2 APPR   213.47 0 213.47  6800
*
HP 1 BRDG   214.61 0 214.61
HP 2 BRDG   214.65 0 214.65  8830
*
HP 1 APPR   215.22 0 215.22
HP 2 APPR   215.22 0 215.22  8830
*
EX
ER
```

WSPRO OUTPUT

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 194023000500    (201 ft Bridge)
        Horne Creek at SC 230     File name: wspro.sc230
        Edgefield County, South Carolina    31 October 1994  TDF
           *** RUN DATE & TIME: 10-31-94  14:12
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRDG ;  SRD =        0.

     WSEL  SA#      AREA          K   TOPW   WETP  ALPH     LEW     REW      QCR
           1          61       4795     15     17                              697
           2         733     128387     54     60                            15320
           3         618      77781     82     84                             9638
   212.98           1412     210962    151    160  1.10      20     196     23322


    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRDG ;  SRD =        0.

         WSEL      LEW      REW     AREA          K         Q      VEL
       213.02     19.5    195.8   1418.2   212289.    6800.     4.79

X STA.        19.5        43.2        48.3        52.2        55.8        59.8
  A(I)           117.0        66.1        56.3        52.0        54.8
  V(I)            2.90        5.15        6.03        6.54        6.21

X STA.        59.8        64.1        68.6        73.1        77.7        82.7
  A(I)            55.0        55.4        54.9        56.2        57.5
  V(I)            6.18        6.14        6.19        6.05        5.91

X STA.        82.7        88.0        94.3       104.0       113.6       122.7
  A(I)            59.4        64.3        77.2        75.4        73.1
  V(I)            5.72        5.29        4.41        4.51        4.65

X STA.       122.7       132.2       143.0       154.2       167.1       195.8
  A(I)            75.6        80.6        80.7        87.8       118.8
  V(I)            4.50        4.22        4.22        3.87        2.86
```

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 194023000500    (201 ft Bridge)
        Horne Creek at SC 230     File name: wspro.sc230
        Edgefield County, South Carolina   31 October 1994  TDF
           *** RUN DATE & TIME: 10-31-94  14:12
    CROSS-SECTION PROPERTIES:  ISEQ =  4;  SECID = APPR ;  SRD =     226.

     WSEL  SA#      AREA         K   TOPW   WETP  ALPH     LEW     REW       QCR
           1         260      5064     94     95                              2453
           2         829    153356     58     63                             17769
           3        2558     89241    388    389                             37255
   213.47           3647    247661    541    546  4.70      53     593      24798


    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = APPR ;  SRD =     226.

         WSEL      LEW      REW     AREA         K         Q      VEL
       213.47     52.7    593.4   3647.1   247661.    6800.     1.86

X STA.        52.7      152.4      157.9      162.4      166.5      170.6
  A(I)           314.5       73.9       65.7       62.3       62.2
  V(I)            1.08       4.60       5.17       5.45       5.47

X STA.       170.6      174.4      178.2      182.0      185.8      189.6
  A(I)           60.7       60.1       60.6       60.0       60.1
  V(I)           5.60       5.66       5.61       5.67       5.65

X STA.       189.6      193.6      197.9      213.5      248.6      284.0
  A(I)           63.3       65.1      147.1      301.6      307.9
  V(I)           5.37       5.23       2.31       1.13       1.10

X STA.       284.0      322.3      359.5      400.8      454.6      593.4
  A(I)          318.0      323.3      334.1      387.1      519.6
  V(I)           1.07       1.05       1.02       0.88       0.65
```

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 194023000500    (201 ft Bridge)
        Horne Creek at SC 230     File name: wspro.sc230
        Edgefield County, South Carolina    31 October 1994  TDF
           *** RUN DATE & TIME: 10-31-94  14:12
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRDG ;  SRD =        0.

     WSEL  SA#      AREA         K   TOPW   WETP  ALPH     LEW     REW      QCR
           1          87      7821     17     20                              1106
           2         821    155103     54     60                             18162
           3         755    105250     85     87                             12731
   214.61           1663    268174    157    167  1.10      17     200      29337


    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRDG ;  SRD =        0.

         WSEL      LEW      REW     AREA         K         Q      VEL
       214.65     16.5    199.8   1669.4   269659.    8830.     5.29

X STA.        16.5        42.2        47.9        52.1        56.1        60.4
  A(I)           139.3       80.2        66.4        63.4        64.3
  V(I)            3.17        5.51        6.65        6.96        6.86

X STA.        60.4        65.0        69.8        74.7        79.7        85.0
  A(I)            65.0        65.9        65.8        66.6        68.0
  V(I)            6.80        6.70        6.71        6.63        6.49

X STA.        85.0        90.8        98.4       108.2       117.3       126.2
  A(I)            70.4        81.5        88.1        84.9        84.1
  V(I)            6.27        5.42        5.01        5.20        5.25

X STA.       126.2       135.7       146.2       157.2       169.8       199.8
  A(I)            87.2        91.9        93.9       102.2       140.2
  V(I)            5.06        4.80        4.70        4.32        3.15
```

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 194023000500    (201 ft Bridge)
        Horne Creek at SC 230     File name: wspro.sc230
        Edgefield County, South Carolina    31 October 1994  TDF
           *** RUN DATE & TIME: 10-31-94  14:12
    CROSS-SECTION PROPERTIES:  ISEQ =  4;  SECID = APPR ;  SRD =      226.
```

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	431	11223	101	101				5059
	2	930	185930	58	63				21132
	3	3246	130654	397	398				52637
215.22		4607	327807	556	562	4.61	46	602	35046

```
    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = APPR ;  SRD =      226.
```

WSEL	LEW	REW	AREA	K	Q	VEL
215.22	46.4	602.4	4606.8	327807.	8830.	1.92

X STA.	46.4	150.2	156.9	161.7	166.4	170.8
A(I)	466.6	95.0	79.1	79.5	75.2	
V(I)	0.95	4.65	5.58	5.56	5.87	
X STA.	170.8	175.2	179.3	183.5	187.8	192.0
A(I)	75.3	73.2	73.6	75.6	75.2	
V(I)	5.86	6.03	6.00	5.84	5.87	
X STA.	192.0	196.6	204.4	239.8	272.5	309.1
A(I)	77.4	108.7	357.3	350.3	362.7	
V(I)	5.70	4.06	1.24	1.26	1.22	
X STA.	309.1	345.0	382.1	423.7	475.8	602.4
A(I)	373.5	376.4	393.3	439.4	599.5	
V(I)	1.18	1.17	1.12	1.00	0.74	

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 194023000500    (201 ft Bridge)
        Horne Creek at SC 230     File name: wspro.sc230
        Edgefield County, South Carolina    31 October 1994   TDF
           *** RUN DATE & TIME: 10-31-94  14:12

 XSID:CODE    SRDL      LEW       AREA     VHD      HF       EGL      CRWS        Q      WSEL
       SRD    FLEN      REW          K    ALPH      HO       ERR       FR#      VEL

EXIT :XS    ******       54       3699    0.23   *****   213.16    206.15     6800   212.93
      -200  ******      599     262535    4.36   *****  *******      0.26     1.84

FULV :FV       201       54       3706    0.23    0.13   213.30   *******     6800   213.07
         0     201      599     263054    4.36    0.00     0.01      0.26     1.83
        <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

APPR :AS       226       54       3511    0.27    0.17   213.49   *******     6800   213.22
       226     226      592     237035    4.70    0.02     0.00      0.29     1.94
        <<<<<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       201       20       1413    0.50    0.18   213.48    207.48     6800   212.98
         0     201      196     211120    1.38    0.14    -0.01      0.33     4.81

     TYPE PPCD FLOW       C      P/A     LSEL    BLEN    XLAB    XRAB
       3.   1.   1.   0.852    0.050   219.80  ******  ******  ******

 XSID:CODE    SRDL      LEW       AREA     VHD      HF       EGL      CRWS        Q      WSEL
       SRD    FLEN      REW          K    ALPH      HO       ERR       FR#      VEL

APPR :AS       201       53       3649    0.25    0.21   213.73    207.36     6800   213.47
       226     216      593     247839    4.70    0.04     0.01      0.27     1.86

      M(G)    M(K)        KQ     XLKQ     XRKQ     OTEL
     0.672   0.223    192406.     126.     302.   213.32

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

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 194023000500    (201 ft Bridge)
        Horne Creek at SC 230     File name: wspro.sc230
        Edgefield County, South Carolina   31 October 1994  TDF
           *** RUN DATE & TIME: 10-31-94  14:12

 XSID:CODE    SRDL     LEW      AREA    VHD     HF      EGL     CRWS       Q     WSEL
       SRD    FLEN     REW         K   ALPH     HO      ERR      FR#     VEL

EXIT :XS    ******      48      4618   0.25  *****   214.84   207.29    8830   214.59
      -200  ******     608    341016   4.34  *****  *******     0.24    1.91

FULV :FV       201      48      4624   0.25   0.13   214.98  *******    8830   214.73
         0     201     608    341539   4.34   0.00     0.01     0.24    1.91
          <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

APPR :AS       226      48      4417   0.29   0.17   215.17  *******    8830   214.88
       226     226     601    311267   4.63   0.02     0.00     0.27    2.00
          <<<<<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       201      17      1663   0.62   0.19   215.23   208.44    8830   214.61
         0     201     200    268260   1.42   0.20    -0.01     0.34    5.31

     TYPE PPCD FLOW       C     P/A     LSEL    BLEN    XLAB    XRAB
       3.    1.    1.  0.841   0.049  219.80  ******  ******  ******

 XSID:CODE    SRDL     LEW      AREA    VHD     HF      EGL     CRWS       Q     WSEL
       SRD    FLEN     REW         K   ALPH     HO      ERR      FR#     VEL

APPR :AS       201      46      4607   0.26   0.22   215.48   208.36    8830   215.22
       226     219     602    327794   4.61   0.04     0.01     0.25    1.92

       M(G)    M(K)        KQ    XLKQ    XRKQ     OTEL
      0.668   0.260   242203.     123.    306.   215.07

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

PIER SCOUR COMPUTATIONS
FOR
HORNE CREEK @ SC 230 STR. 194023000500 EDGEFIELD, CO
CASE 1 (without debris) Q100 = 6800 cfs 2 NOVEMBER 1994 TDF

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	2	3	4	5	6	7	8
PIER STATION (FT)	25	50	75	100	125	150	175
LOCATION OF PIER	lfp	mcm	mcr	rtb	rfp	rfp	rfp
Y1: DEPTH (FT)	3.0	17.1	17.1	17.1	9.5	8.4	7.3
V1: VEL. (FPS)	2.9	5.9	5.9	5.9	4.7	4.7	4.7
a: PIER WIDTH (FT)	0.9	2.0	0.9	0.9	0.9	0.9	0.9
L: PIER LENGTH (FT)	3.6	8.0	3.6	3.6	4.5	4.5	3.6
PIER SHAPE	2	2	2	2	2	2	2
ATTACK ANGLE	16	16	16	16	16	16	16
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
K2 (ANGLE COEF.)	1.53	1.53	1.53	1.53	1.66	1.66	1.53
FROUDE NO.	0.30	0.25	0.25	0.25	0.27	0.28	0.30

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.49	7.17	4.27	4.27	3.85	3.79	3.44
MAX SCOUR DEPTH (FT)	2.74	7.89	4.70	4.70	4.24	4.17	3.78

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

CONTRACTION SCOUR COMPUTATIONS
FOR
HORNE CREEK @ SC 230 STR. 194023000500 EDGEFIELD, CO
CASE 1 (without debris) Q100 = 6800 cfs 2 NOVEMBER 1994 TDF

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	4210.	4140.
BOTTOM WIDTH (FT)	58.0	51.2
MANNINGS n	0.045	0.045
AVERAGE DEPTH (FT)	16.0	

ENERGY SLOPE	0.00120
D50 (FT)	0.0039
FALL VELOCITY (FPS)	0.57
K1 COEF.	0.64
K2 COEF.	0.21

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	17.1
DEPTH AT MAIN CHANNEL (FT)	=	16.0
DEPTH OF CONTRACTION SCOUR (FT)	=	1.1

LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	155.
WIDTH OF CONTRACTED SECTION (FT)	=	6.0
MEDIAN GRAIN SIZE (FT)	=	0.0010
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	14.8
AVERAGE FLOOD PLAIN DEPTH (FT)	=	6.0
DEPTH OF CONTRACTION SCOUR (FT)	=	8.8

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	2510.
WIDTH OF CONTRACTED SECTION (FT)	=	64.0
MEDIAN GRAIN SIZE (FT)	=	0.0010
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	21.2
AVERAGE FLOOD PLAIN DEPTH (FT)	=	8.5
DEPTH OF CONTRACTION SCOUR (FT)	=	12.7

PIER SCOUR COMPUTATIONS
FOR
HORNE CREEK @ SC 230 STR. 194023000500 EDGEFIELD, CO
CASE 1 (without debris) Q500 = 8830 cfs 2 NOVEMBER 1994 TDF

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	2	3	4	5	6	7	8
PIER STATION (FT)	25	50	75	100	125	150	175
LOCATION OF PIER	lfp	mcm	mcr	rtb	rfp	rfp	rfp
Y1: DEPTH (FT)	4.6	18.8	18.8	18.8	11.2	10.0	9.0
V1: VEL. (FPS)	3.2	6.3	6.3	6.3	5.3	5.3	5.3
a: PIER WIDTH (FT)	0.9	2.0	0.9	0.9	0.9	0.9	0.9
L: PIER LENGTH (FT)	3.6	8.0	3.6	3.6	4.5	4.5	3.6
PIER SHAPE	2	2	2	2	2	2	2
ATTACK ANGLE	16	16	16	16	16	16	16
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
K2 (ANGLE COEF.)	1.53	1.53	1.53	1.53	1.66	1.66	1.53
FROUDE NO.	0.26	0.25	0.25	0.25	0.28	0.29	0.31

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.74	7.46	4.44	4.44	4.15	4.09	3.73
MAX SCOUR DEPTH (FT)	3.01	8.20	4.88	4.88	4.57	4.50	4.10

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

CONTRACTION SCOUR COMPUTATIONS
FOR
HORNE CREEK @ SC 230 STR. 194023000500 EDGEFIELD, CO
CASE 1 (without debris) Q500 = 8830 cfs 2 NOVEMBER 1994 TDF

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	5010.	5110.
BOTTOM WIDTH (FT)	58.0	51.2
MANNINGS n	0.045	0.045
AVERAGE DEPTH (FT)	17.7	

ENERGY SLOPE	0.00110
D50 (FT)	0.0039
FALL VELOCITY (FPS)	0.57
K1 COEF.	0.64
K2 COEF.	0.21

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	19.5
DEPTH AT MAIN CHANNEL (FT)	=	17.7
DEPTH OF CONTRACTION SCOUR (FT)	=	1.8

LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	258.
WIDTH OF CONTRACTED SECTION (FT)	=	6.0
MEDIAN GRAIN SIZE (FT)	=	0.0010
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	22.9
AVERAGE FLOOD PLAIN DEPTH (FT)	=	7.6
DEPTH OF CONTRACTION SCOUR (FT)	=	15.3

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	3470.
WIDTH OF CONTRACTED SECTION (FT)	=	64.0
MEDIAN GRAIN SIZE (FT)	=	0.0010
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	28.0
AVERAGE FLOOD PLAIN DEPTH (FT)	=	10.2
DEPTH OF CONTRACTION SCOUR (FT)	=	17.8

United States Department of the Interior

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

November 4, 1994

William H. Hulbert, P.E.
Hydraulic Engineer
South Carolina Department of Transportation

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 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina", by Toby D. Feaster and Whitney J. Stringfield. 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 Hydraulics Section Chief.

If you have any questions concerning this report, please contact me or Whitney J. Stringfield and we will be glad to assist you in any way possible.

Sincerely,

Toby D. Feaster

Toby D. Feaster, E.I.T.
Hydraulic Engineer

Enclosure

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COLLIERS QUADRANGLE
SOUTH CAROLINA
7.5 MINUTE SERIES (TOPOGRAPHIC)

STUDY AREA

SUMTER NATIONAL FOREST

Mapped, edited, and published by the Geological Survey

Control by USGS, NOS/NOAA, and South Carolina Geodetic Survey

Topography by photogrammetric methods from aerial photographs taken 1962. Field checked 1964

Polyconic projection. 10,000-foot grid ticks based on South Carolina coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks, zone 17, shown in blue
1927 North American Datum
To place on the predicted North American Datum 1983 move the projection lines 12 meters south and 14 meters west as shown by dashed corner ticks

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs. This information is unchecked

There may be private inholdings within the boundaries of the National or State reservations shown on this map

UTM GRID AND 1986 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Figure 1.--Topography of study area and location of cross sections used in WSPRO analysis for structure 194023000500 on Route SC 230, crossing Horne Creek in Edgefield County, South Carolina.

EXPLANATION

EXIT — cross section

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty — Light-duty

Medium-duty — Unimproved dirt

State Route

Revisions shown in purple and woodland compiled from aerial photographs taken 1981 and other sources. This information not field checked. Map edited 1986

COLLIERS, S. C.
33082-F1-TF-024

1964
PHOTOREVISED 1986
DMA 4551 II NE--SERIES V846

INDEX OF SHEETS

Sheet No. | Title Sheet

1-2 - Plan & Profile of Proposed Bridge over Horn Creek

3 - Detail Data over Horn Creek

SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT
COLUMBIA

PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

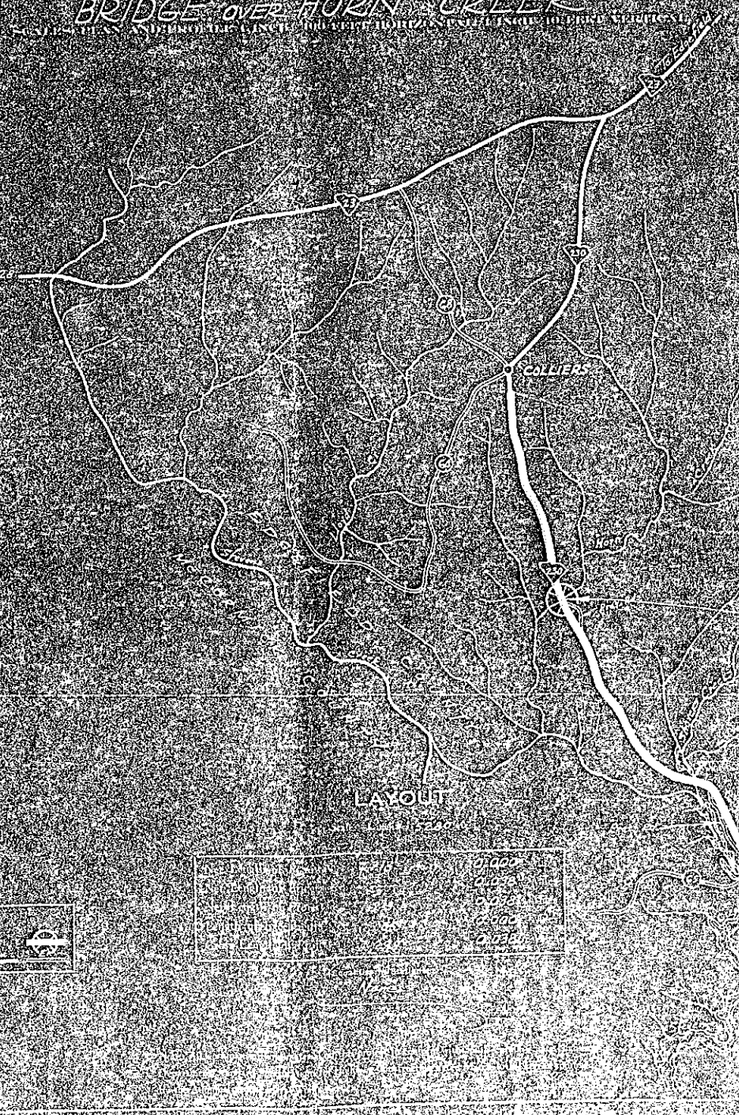
F.A.P. S111(5)

DKT. No. 19263

RT. 230

EDGEFIELD COUNTY

BRIDGE over HORN CREEK

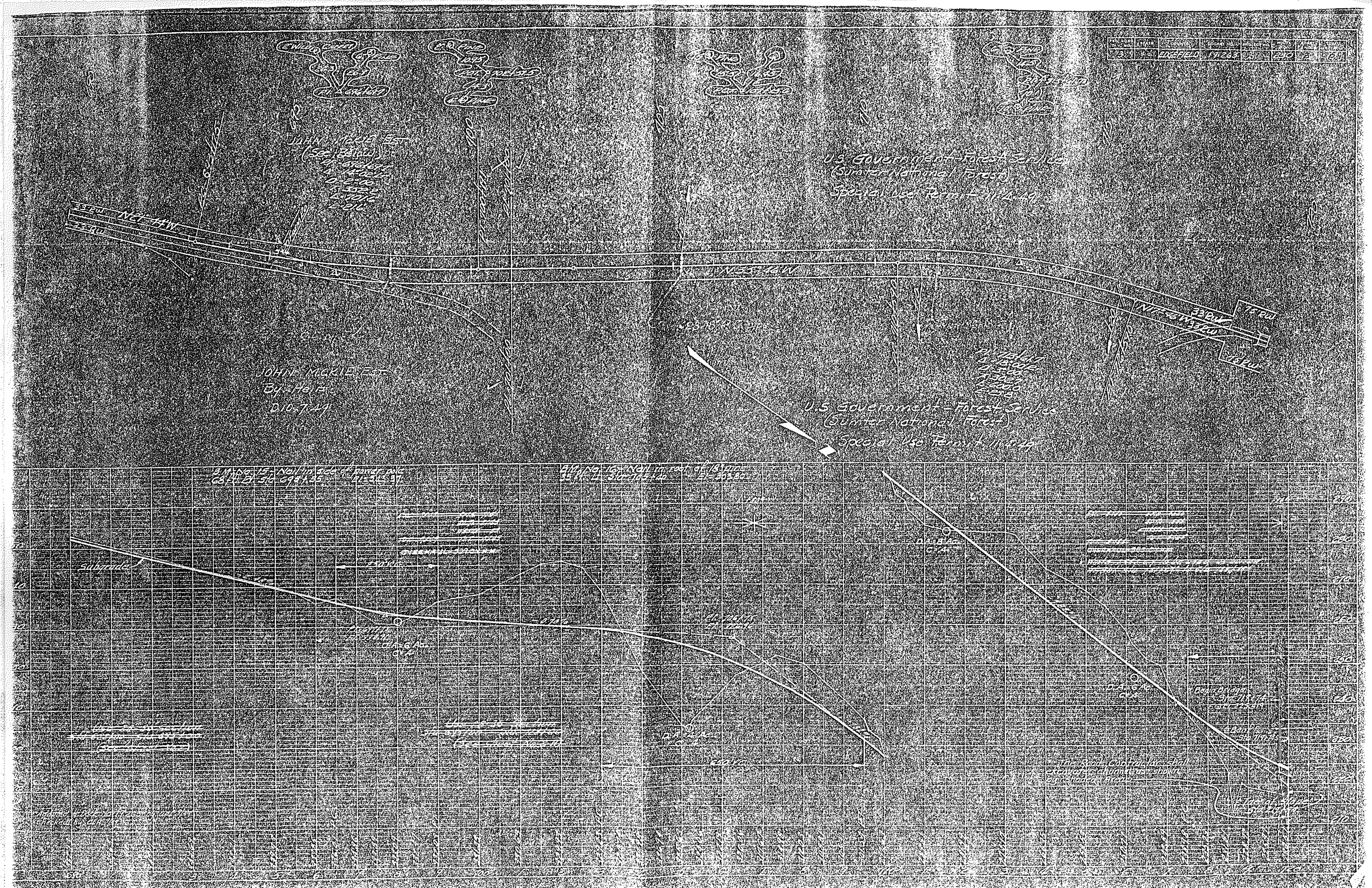


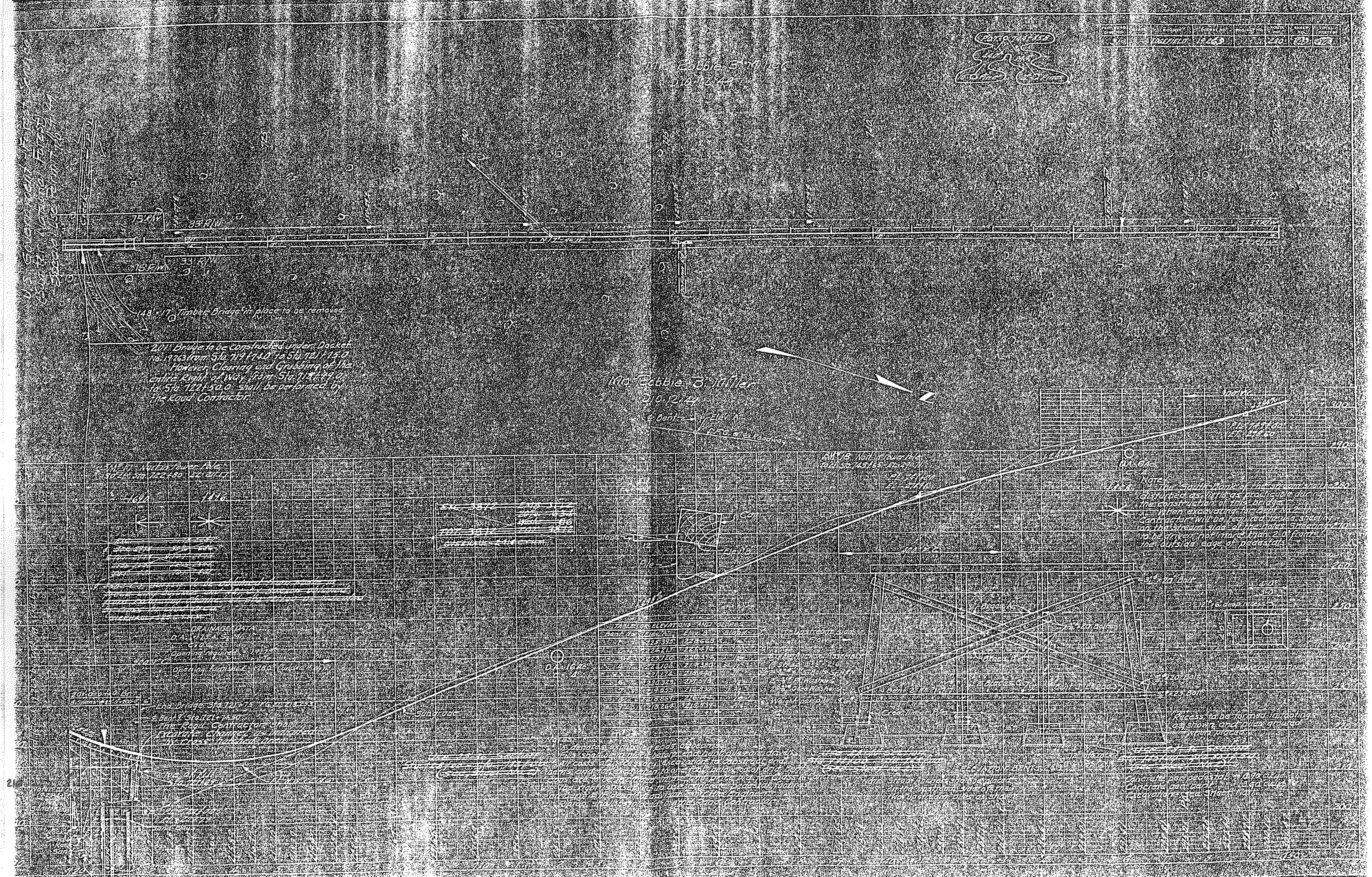
SUMMARY OF ESTIMATED QUANTITIES

EARTHWORK		
	DRY EXCAVATION	55 CY.
	WET EXCAVATION	5 CY.
	ROCK EXCAVATION	5 CY.
BASE COURSE		
SURFACING		
STRUCTURES		
	CLASS A CONCRETE	104.34 CY.
	REINFORCING STEEL	29,420 LB.
	CREOSOTED STRUCTURAL TIMBER	6,101 F.B.M.
	HARDWARE	1500 LB.
	STRUCTURAL STEEL	54.3 SQ. FT.
	CREOSOTED TIMBER PILING	720 L.F.
	METAL GUARDRAIL (NO. 10 GA)	102 L.F.
INCIDENTALS		

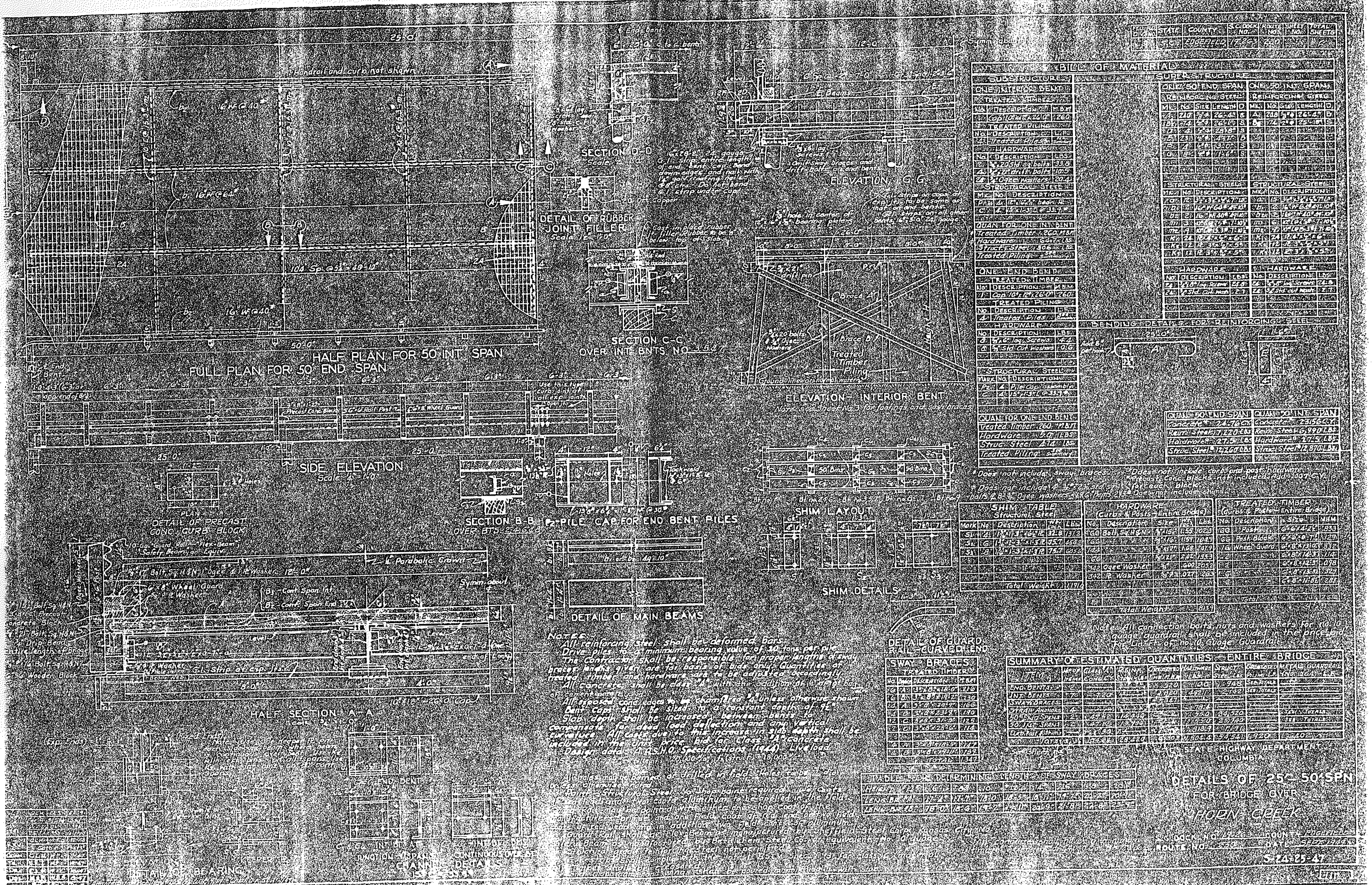
CONVENTIONAL SIGNS

LEGEND


JOHN MICKLE Est.
(See Below)
U.S. Government - Forest Service
(Sumter National Forest)
Special Use Permit 11-4-49
N 55°44' W
JOHN MICKLE Est.
By: Heirs
D.10-7-49
U.S. Government - Forest Service
(Sumter National Forest)
Special Use Permit 11-4-49
Subgrade



FAIRFIELD
19263
Mr. Robbie B. Miller
D.I.O. 12-44
75' R/W
33' R/W
75' R/W
33' R/W
148' x 17' Timber Bridge in place to be removed
201' Bridge to be constructed under Docket No. 19263 from Sta. 119+74.0 to Sta. 121+75.0
However, Clearing and Grubbing of the entire Right of Way from Sta. 118+49.0 to Sta. 122+50.0 shall be performed by the Road Contractor.
Mr. Robbie B. Miller
D.I.O. 12-44
Elev. A
F.R.G. @ ℄ Roadway
DRAINAGE DATA
Subgrade
Slope
Pile
TABLE OF ELEVATIONS AND SLOPES
Note
Recess to be formed in footings as shown and piles grouted when placed.
PLAN OF FOOTING
ELEVATION BENTS



Handrail and curb not shown
SECTION D-D
DETAIL OF RUBBER JOINT FILLER
SECTION C-C
OVER INT. BNTS. NO.
ELEVATION G-G
ELEVATION - INTERIOR BENT
HALF PLAN FOR 50' INT. SPAN
FULL PLAN FOR 50' END SPAN
50'-0"
25'-0"
SIDE ELEVATION
DETAIL OF PRECAST CONC. CURB BLOCK
SECTION B-B
PILE CAP FOR END BENT PILES
DETAIL OF MAIN BEAMS
SHIM LAYOUT
SHIM DETAILS
DETAIL OF GUARD RAIL - CURVED END
HALF SECTION A-A
BILL OF MATERIAL
SUBSTRUCTURE
SUPERSTRUCTURE
ONE INTERIOR BENT
ONE END BENT
ONE 50' END SPAN
ONE 50' INT. SPAN
TREATED TIMBER
TREATED PILING
HARDWARE
STRUCTURAL STEEL
REINFORCING STEEL
BENDING DETAILS FOR REINFORCING STEEL
SHIM TABLE
SWAY BRACES
SUMMARY OF ESTIMATED QUANTITIES - ENTIRE BRIDGE
NOTES:
All reinforcing steel shall be deformed bars.
S.C. STATE HIGHWAY DEPARTMENT
COLUMBIA
DETAILS OF 25'-50' SPN
FOR BRIDGE OVER
HORN CREEK
S.C. DOCK. NO.
COUNTY
ROUTE NO.
DATE
S-24-25-47

PILE RECORD ON DOCKET NO. 19263

FED ROAD DIST. NO.	STATE	COUNTY	DOCKET NO.	ROUTE NO	SHEET NO.	TOTAL SHEETS
14	S.C	Aiken	19263	S-114(5)	7	12

WEIGHT OF HAMMER 2232 Lbs FALL 15 FT TYPE GRAVITY

BENT NO.	FOOTING	PILE NO.	DATE DRIVEN	DIAMETER BUTT	DIAMETER TIP	PENETRATION	PEN. PER BLOW	BEARING	ELEVATION PILE TIP	ELEVATION CUT-OFF	LENGTH IN PLACE	ORIGINAL LENGTH	LENGTH CUT-OFF	PAY LENGTH	C.O. AT 0.40 OF UNIT PRICE	C.O. AT 0.25 OF UNIT PRICE
		1	1-6-50	12	8¼		.550	21.6	186.00	215.539	29.54	30.08	0.54	29.54		
		2	"	13	9		.450	23.1	186.23	"	29.31	30.46	1.15	29.31		
		3	"	12⅞	10		.670	20.0	185.42	"	30.12	30.25	0.13	30.12		
		4	"	13	12		.917	17.5	185.40	"	30.14	30.25	0.11	30.14		
		1	1-10-50	15	11		.325	25.3	183.72	216.144	32.42	35.42	3.00	32.42	1.00	-
		2	"	15	10½		.155	28.0	183.71	"	32.43	35.42	2.99	32.43	0.99	-
		3	"	14	11		.300	25.8	184.17	"	31.97	35.30	3.33	31.97	1.33	-
		4	"	14	10		.425	23.5	183.96	" "	32.18	35.30	3.12	32.18	1.12	-
		1	"	14	9½		.300	22.3	183.90	216.830	32.93	35.25	2.32	32.93	0.32	-
		2	"	14	11		.400	23.9	185.33	"	31.50	35.33	3.83	31.50	1.83	-
		3	"	14	11¼		.275	22.1	185.21	"	31.62	35.25	3.63	31.62	1.63	-
		4	"	13	9		.350	24.8	185.47	"	31.36	35.42	4.06	31.36	2.06	-
		1	1-11-50	12	7⅞		.450	23.1	184.58	216.60	32.02	35.09	3.07	32.02	1.07	-
		2	"	12	9¼		.425	23.5	183.95	"	32.65	35.25	2.60	32.65	0.60	-
		3	"	12	9⅞		.575	21.3	182.09	"	34.51	35.33	0.82	34.51		
		4	"	12	8		.550	21.6	184.62	"	31.78	35.09	2.31	31.78	1.31	-
		1	"	14	11		.550	21.6	186.83	218.448	31.62	35.33	3.71	31.62	1.71	-
		2	"	18	13		.450	23.1	186.97	"	31.48	35.33	3.85	31.48	1.35	-
		3	"	14½	10		.350	24.8	186.95	"	31.50	35.50	4.00	31.50	2.00	-
		4	"	12	8		.475	22.7	188.56	"	31.89	35.09	3.20	31.89	1.20	-
		1	1-17-50	13	8		R	33.5	187.26	219.380	32.12	35.25	3.13	32.12	1.13	-
		2	"	13	7⅞		R	33.5	187.55	"	31.83	35.15	3.32	31.83	1.32	-
		3	"	12	8		R	33.5	187.40	"	31.98	35.25	3.27	31.98	1.27	-
		4	"	14	9⅛		R	33.5	187.83	"	31.55	35.25	3.70	31.55	1.70	-
		1	2-4-50	12	8		Planted in Solid Rock		187.01	220.394	32.98	39.92	6.94	32.98	4.94	-
		2	2-1-50	12	8		"	"	189.37	"	31.02	40.00	8.98	31.02	-	6.98
		3	1-30-50	12	8		"	"	191.15	"	29.24	30.33	1.09	29.24	-	-
		4	1-31-50	12	10		"	"	190.70	"	29.69	30.25	10.56	29.69	-	-
		1	2-6-50	15	11½	X	.300	25.8	198.63	221.490	22.86	30.25	7.39	22.86	5.39	-
		2	"	13⅞	10	X Ø	.025	21.8	199.84	"	21.65	30.30	8.65	21.65	-	6.65
		3	"	13	9⅛	X Ø	.025	21.8	198.93	"	22.56	30.25	7.69	22.56	5.69	-
		4	"	14	10½	X Ø	.025	21.8	198.75	"	22.74	30.33	7.59	22.74	5.59	-
		1	1-19-50	13	9		.425	23.5	207.18	222.668	15.49	30.17	14.68	15.49	-	12.68
		2	"	14	9¼		.450	23.1	206.20	"	16.47	30.15	13.68	16.47	-	11.68
		3	1-20-50	14	9		.425	23.5	205.49	"	17.18	30.15	12.97	17.18	-	10.97
		4	1-20-50	14	11		.450	23.1	206.63	"	16.04	30.10	14.06	16.04	-	12.06
Tals											1038.37	1208.84	170.47	1038.37	47.05	61.02
														4.0		
														1042.37		

X Metal Shoes Used on Piles Bt #2

Ø Bearing checked at 10' drop after pile had reached rock.

TOTAL

BENT NO.	FOOTING	PILE NO.	DATE DRIVEN	DIAMETER BUTT	DIAMETER TIP	PENETRATION	PEN. PER BLOW	BEARING	ELEVATION PILE TIP	ELEVATION CUT-OFF	LENGTH IN PLACE	ORIGINAL LENGTH	LENGTH CUT-OFF	PAY LENGTH	C.O. AT 0.40 OF UNIT PRICE	C.O. AT 0.25 OF UNIT PRICE

TOTAL

GRAND TOTAL

NOTES CONCERNING ANY UNUSUAL FOUNDATION CONDITION

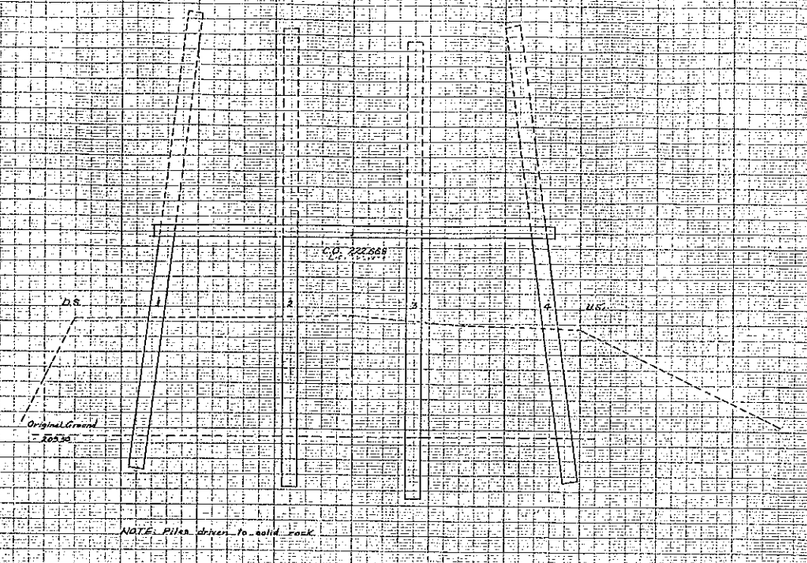
BENT NO.	FOOTING	PILE NO.	REMARKS

CROSS SECTION

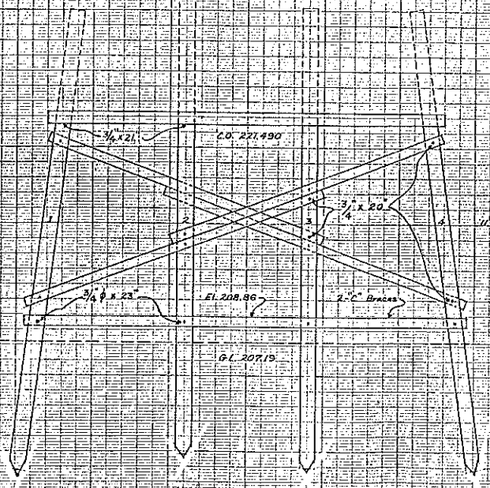
SCALE 1 INCH = 5 FEET

FED. ROAD DIST. NO.	STATE	COUNTY	FED. AID PROJ. NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
14	S. C.	Aiken	S-114(5)	230	9	12

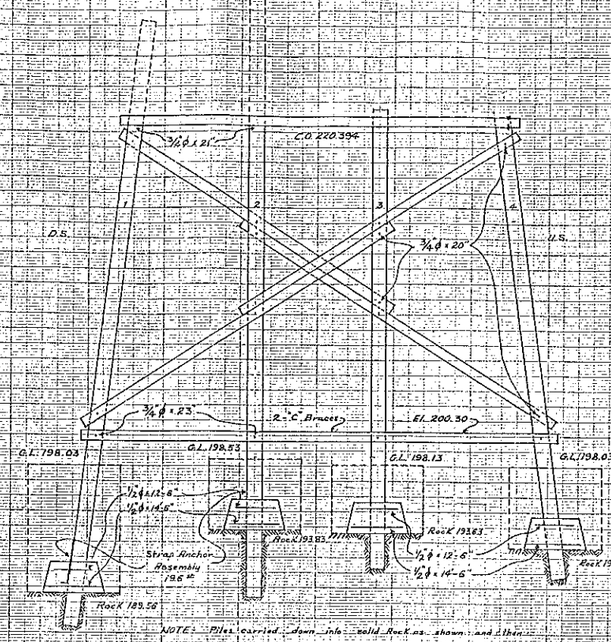
BENT NO. 1



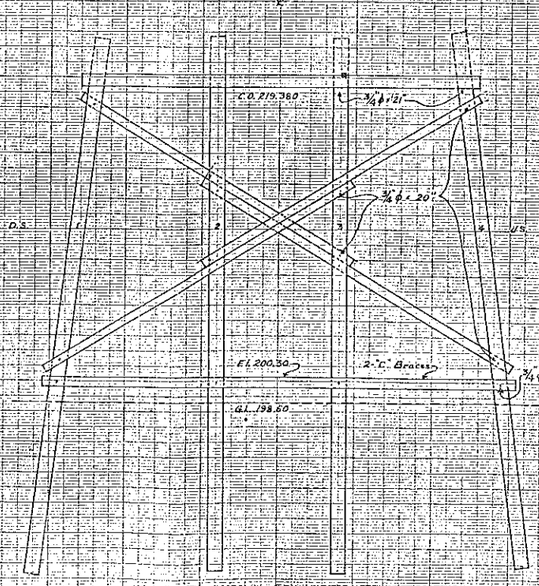
BENT NO. 2



BENT NO. 3



BENT NO. 4



PILE RECORD BENTS 1, 2, 3 AND 4

	DATE	BENT	PILE NO.	LENGTH	ELEV CUT-OFF	ELEV TOP PILE	LENGTH CUT-OFF	WET LENGTH	40% C.O.	25% C.O.	AVE PEN. PER BLOW	TOWN BEARING	SIZE PILE	ELEV PILE TIPS
	1-19-50	1	1	30.17	222.688	237.36	14.68	15.49		12.68	.425	23.5	13-9	207.18
	"		2	30.15	"	236.35	13.66	16.47		11.68	.450	23.1	14-9½	206.20
	1-20-50		3	30.15	"	235.64	12.97	17.18		10.97	.425	23.5	14-9	205.49
	"		4	30.10	"	236.73	14.06	16.04		12.06	.450	23.1	14-11	206.63
X	2-6-50	2	1	30.25	221.490	228.88	7.39	22.86	6.39		.800	25.8	15-11½	198.62
X	"		2	30.30	"	230.14	8.65	21.65		6.65	@ .025	21.8	13½-10	199.84
X	"		3	34.25	"	229.18	7.69	22.56	5.69		@ .025	21.8	13-9½	198.93
X	"		4	30.33	"	229.08	7.59	22.74	5.59		@ .025	21.8	14-10½	198.75
	2-4-50	3	1	39.92	220.394	227.53	6.64	32.98	4.94		R	33.5	12-8	187.91
	2-1-50		2	40.00	"	229.17	8.98	31.02		6.98	R	33.5	12-8	189.37
	1-30-50		3	30.33	"	221.48	1.69	29.24			R	33.5	12-8	191.15
	1-31-50		4	30.25	"	220.95	0.56	29.69			R	33.5	12-10	190.70
	1-17-50	4	1	35.25	219.380	232.51	3.13	32.12	1.13		R	33.5	13-8	197.26
	"		2	35.15	"	232.70	3.32	31.83	1.32		R	33.5	13-7½	197.55
	"		3	35.25	"	232.63	3.27	31.98	1.27		R	33.5	12-8	197.40
	"		4	35.25	"	223.68	3.90	31.55	1.70		R	33.5	14-9½	192.83
X	Metal Shoes Used on Piles Bent 2							4.00						
	TOTALS			523.10			117.70	403.40	27.03	61.02				

@ NOTE: Fall of hammer 10' when pile was checked.

QUANTITIES BENT NO. 3

WET EXCAVATION

PILE NO. 1 = (198.03 − 193.56) × 6.00 × 6.00 = 304.9200 C.F.

PILE NO. 2 = (198.53 − 193.83) × 6.00 × 6.00 = 169.2000 "

PILE NO. 3 = (198.13 − 193.63) × 6.00 × 6.00 = 162.0000 "

PILE NO. 4 = (198.03 − 192.74) × 6.00 × 6.00 = 190.4400 "

TOTAL 27 / 826.5600 = 30.61 CU. YDS.

ROCK EXCAVATION

PILE NO. 1 = (8)² × 0.7854 × (189.56 − 187.41) = 0.7503 C.F.

PILE NO. 2 = (8)² × 0.7854 × (193.83 − 189.37) = 1.5565 "

PILE NO. 3 = (8)² × 0.7854 × (193.63 − 191.15) = 0.8655 "

PILE NO. 4 = (10)² × 0.7854 × (192.74 − 190.70) = 1.1126 "

TOTAL 27 / 4.2849 = 0.16 CU. YDS.

CLASS A CONCRETE

PILE NO. 1 = 2.00 × 3.0 × 3.0 + 4 × 3.5 × 3.5 + 4.0 × 4.0 = 20 × (6)² × 0.7854 = 23.9686 C.F.
6

PILE NO. 2 = 2.00 × 3.0 × 3.0 + 4 × 3.5 × 3.5 + 4.0 × 4.0 = 20 × (6)² × 0.7854 = 23.9686 "
6

PILE NO. 3 = 2.00 × 3.0 × 3.0 + 4 × 3.5 × 3.5 + 4.0 × 4.0 = 20 × (6)² × 0.7854 = 23.9686 "
6

PILE NO. 4 = 2.00 × 3.0 × 3.0 + 4 × 3.5 × 3.5 + 4.0 × 4.0 = 20 × (6)² × 0.7854 = 23.5759 "
6

TOTAL 27 / 95.5817 = 3.54 CU. YDS.

REINFORCING STEEL

4 bars 1½ ϕ × 12'-6" @ 0.668# = 33.40 lbs.

4 bars 1½ ϕ × 14'-6" @ 0.668# = 38.74 "

TOTAL 72.14 lbs.

SUMMARY OF QUANTITIES

BENT	PILING	40% C.O.	25% C.O.	TR. LUMBER M.B.M.	HARDWARE	WET EXCAV.	ROCK EXCAV.	CONCRETE	REINFORCING	STRUCT. STEEL
1	66.14		4.23	.260	5.0					674.0
X 2	85.81	16.67	6.65	.532	84.3					306.0
3	122.93	4.94	6.98	.564	123.5	30.61	0.16	3.54	72.1	306.0
X 4	129.48	5.42		.564	84.3					306.0
TOTALS	409.40	27.03	61.02	1.920	297.1	30.61	0.16	3.54	72.1	1392.0

X 40 included for Metal Shoes

TREATED TIMBER

BENT 1
- CAP = 10" × 12" × 26.0' = 1 / 260 = 260
BENT 2
- CAP = 10" × 12" × 26.0' = 1 / 260
- A = 2 × 18" × 3" × 8" = 072
- B = 2 × 20" × 3" × 8" = 080
- C = 2 × 30" × 3" × 8" = 120 = 532
BENT 3
- CAP = 10" × 12" × 26' = 260
- A = 2 × 20" × 3" × 8" = 080
- B = 2 × 24" × 3" × 8" = 096
- C = 2 × 32" × 3" × 8" = 128 = 564
BENT 4
- CAP = 10" × 12" × 26' = 260
- A = 2 × 22" × 3" × 8" = 088
- B = 2 × 24" × 3" × 8" = 096
- C = 2 × 30" × 3" × 8" = 120 = 564

HARDWARE

BENT 1
- 8 - 5/8 × 6" LAG SCREWS = 4.4 lbs
- 8 - 5/8 Std. Cut Washers = 0.6 " = 5.0

BENT 2
- 4 - 3/4 × 21" Drifts = 10.5 lbs
- 12 - 3/4 × 20" Bolts = 33.8 "
- 4 - 3/4 × 23" Bolts = 12.8 "
- 32 - 3/4" Ogee Washers = 27.2 " = 84.3

BENT 3
- 4 - 3/4 × 21" Drifts = 10.5 "
- 12 - 3/4 × 20" Bolts = 33.8 "
- 4 - 3/4 × 23" Bolts = 12.8 "
- 32 - 3/4" Ogee Washers = 27.2 "
- 2 Strap Anchor Assemblies = 39.2 = 123.5

BENT 4
- 4 - 3/4 × 21" Drifts = 10.5 "
- 12 - 3/4 × 20" Bolts = 33.8 "
- 4 - 3/4 × 23" Bolts = 12.8 "
- 32 - 3/4" Ogee Washers = 27.2 = 84.3

DETAILS

BENTS 1, 2, 3 & 4

HORN CREEK BRIDGE

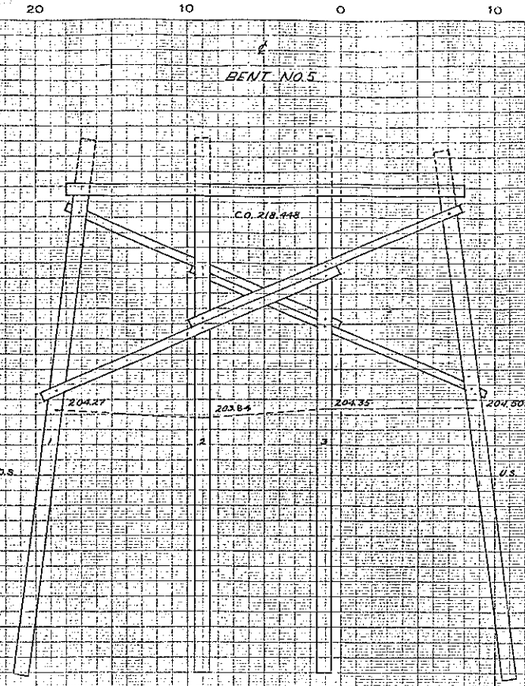
DOCKET 19263 - FAP S-114(5)

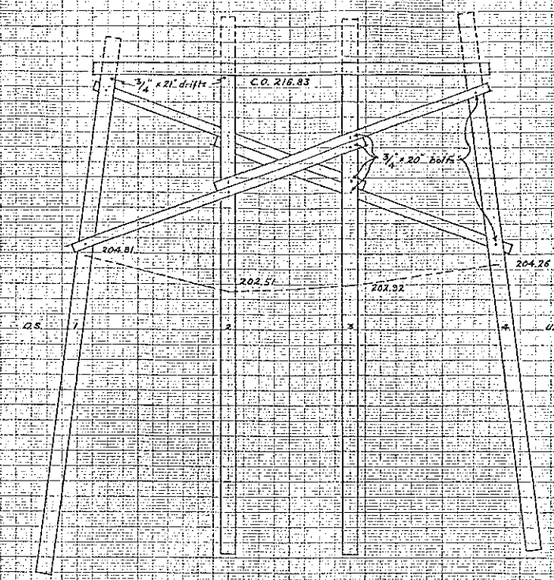
EDGEFIELD COUNTY - ROUTE 230

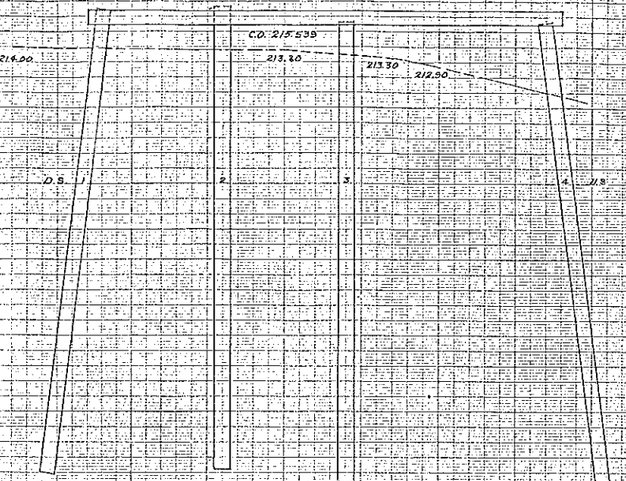
FED. ROAD DIST. NO.	STATE	COUNTY	FED. AID PROJ. NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
14	S. C.	Aiken / Edgefield	S-1145	230	10	12

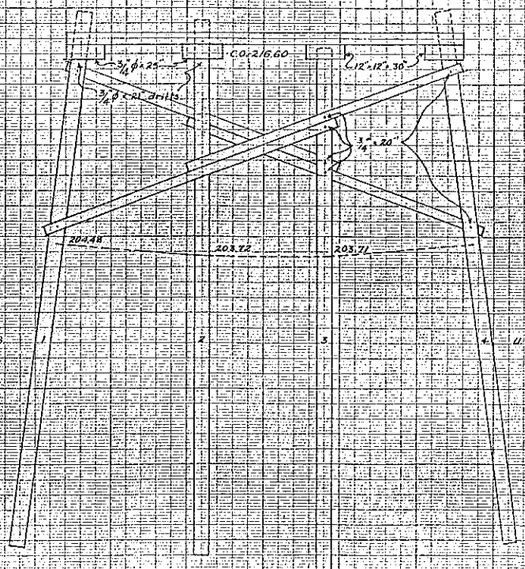
CROSS SECTION

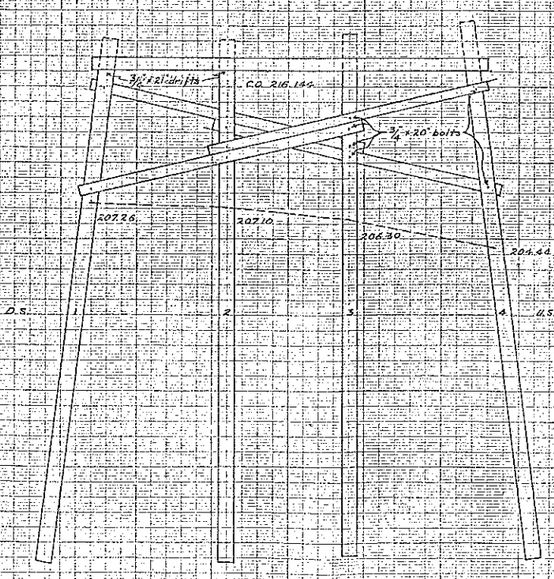
SCALE 1 INCH = 5 FEET











TREATED TIMBER

BENT 5	Cap	10"x12"x26'	=	0.260 MBM
	A	2"x8"x20'	=	0.080
	B	2"x8"x22'	=	0.088
BENT 6	Cap	10"x12"x26'	=	0.260
	A	2"x8"x20'	=	0.080
	B	2"x8"x20'	=	0.080
	Blocks	4"x12"x12"x2.5'	=	0.120
BENT 7	Cap	10"x12"x26'	=	0.260
	A	2"x8"x20'	=	0.080
	B	2"x8"x20'	=	0.080
BENT 8	Cap	10"x12"x26'	=	0.260
	A	2"x8"x18'	=	0.072
	B	2"x8"x18'	=	0.072
BENT 9	Cap	10"x12"x26'	=	0.260

HARDWARE

B#5	4 drifts	3/4"x21"	=	10.5#
	12 bolts	3/4"x20"	=	33.8
	24	3/4" Cpee Washers	=	20.4 64.70#
B#6	4 drifts	3/4"x21"	=	10.5#
	12 bolts	3/4"x20"	=	33.8
	8 bolts	7/8"x25"	=	27.4
	40	3/4" Cpee Washers	=	34.0 105.7#
B#7	4 drifts	3/4"x21"	=	10.5#
	12 bolts	3/4"x20"	=	33.8
	24	3/4" Cpee Washers	=	20.4 64.7#
B#8	4 drifts	3/4"x21"	=	10.5#
	12 bolts	3/4"x20"	=	33.8
	24	3/4" Cpee Washers	=	20.4 64.7#
B#9	8 bolts	7/8"x6"	=	4.8#
	8 Cut Washers	7/8" Sq.	=	0.6# 5.0#

DATE	BENT	PILE	LENGTH	ELEV CUT-OFF	ELEV PILE TOPS	LENGTH CUT-OFF	NET LENGTH	40% C.O.	25% C.O.	AVE HAM. FOR BLOW	TRUE BEARING	SIZE PILE	ELEV PILE TOPS
1-11-50	5	1	35.13	218.448	222.16	3.71	31.42	1.71		550	21.6	H-11	186.83
"		2	35.33	"	222.30	3.85	31.48	1.85		450	23.1	"	186.97
"		3	35.50	"	223.45	4.00	31.50	2.00		350	24.8	10"ϕ	188.95
"		4	34.09	"	221.65	3.20	31.89	1.20		475	22.7	12-8	186.56
"	6	1	35.09	218.600	219.67	3.07	32.02	1.07		650	23.1	12-7⅞	184.58
"		2	35.25	"	219.20	2.60	32.65	0.60		425	23.5	12-7⅞	183.35
"		3	35.33	"	217.42	0.82	34.51			575	21.3	12-7⅞	182.09
"		4	35.09	"	219.91	3.51	31.78	1.51		550	21.6	12-8	184.82
H10-50	7	1	35.25	216.830	219.15	2.32	32.93	0.32		500	22.3	14-9⅛	182.50
"		2	35.31	"	220.66	3.83	31.50	1.83		400	23.9	14-11	185.83
"		3	35.25	"	220.44	3.63	31.82	1.63		475	22.7	14-11⅛	185.21
"		4	35.42	"	220.89	4.06	31.36	2.06		350	24.8	13-9	185.47
"	8	1	35.42	216.144	219.14	3.00	32.42	1.00		325	25.8	15-11	183.72
"		2	35.42	"	219.13	2.99	32.43	0.99		455	23.0	15-10⅞	183.71
"		3	35.30	"	219.47	3.33	31.97	1.33		300	25.8	14-11	184.17
"		4	35.30	"	219.46	3.32	31.14	1.32		425	23.5	14-10	183.26
1-6-50	9	1	38.81	215.519	216.08	0.57	38.24			550	21.6	12-8⅞	186.00
"		2	39.46	"	216.68	1.16	38.21			450	23.1	13-9	186.23
"		3	38.25	"	215.67	0.15	38.12			670	20.9	12½-10	185.42
"		4	38.29	"	215.65	0.11	38.14			917	18.5	13-12	185.48
TOTALS			685.74			57.77	627.97	20.02					

SUMMARY OF QUANTITIES

BENT	PILING	40% C.O.	25% C.O.	TR LUMBER M.B.M.	HARDWARE	STRUCT. STEEL
5	126.49	6.78		0.428	64.7	306.0
6	130.96	2.98		0.548	105.7	306.0
7	127.41	5.84		0.428	64.7	306.0
8	129.00	4.44		0.404	64.7	306.0
9	118.11			0.260	5.0	434.0
TOTALS	632.91	20.02		2.068	304.8	1698.0

DETAILS

BENTS 5, 6, 7, 8 AND 9

HORN CREEK BRIDGE

DOCKET 19263 - FAP S-1145

EDGEFIELD CO. - ROUTE 230

by

CHARLES BRUNING CO., INC.
NEW YORK, N.Y.