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Raleigh, NC 27609

Memo

Project: SCDOT CLRB Package 21

Subject: Preliminary Hydraulics Analysis

Route: Little Choestoea Rd. (S-37-168) Bridge over Choestoea Creek

Date: March 11, 2025

To: SCDOT

HNTB is providing a preliminary hydrologic and hydraulic assessment of the Bridge Replacement along (S-37-168) Little Choestoea Rd. in Oconee County, South Carolina. Little Choestoea Rd. is designated as a Secondary Route and provides access to residential and rural areas. The Flood Insurance Study (FIS) for Oconee County and Flood Insurance Rate Map (FIRM) Panel No. 45073C0405C (attached) indicates the project is located in Special Flood Hazard Zone AE.

Model Setup:

There was no existing model flow file for the 2-Yr, 10-Yr, 25-Yr, 50-Yr, and 500 Yr. events for Choestoea Creek therefore one was created based off the USGS Streamstats and used for the existing and proposed plans. USGS flows were compared to SCS hydrograph method, Streamstats (USGS) flows were more conservative and used for the study. The comparison of flows between the SCS Method and the USGS flows that were used for this analysis are shown below.

Design Even (% AEP)	SCS Unit Hydrograph (CFS)	FEMA Effective Model RS 13726	Streamstats USGS Flows (CFS)
2 YR (50% AEP)	441		487
10 YR (10% AEP)	1139		1130
25 YR (4% AEP)	1490		1510
50 YR (2% AEP)	1621		1850
100 YR (1% AEP)	1923	1648	2180
500 YR (0.2% AEP)	2676		2970

HEC-RAS V. (Version) 6.3.1 was used in the process of converting the effective model into the corrected effective model. Existing structure dimensions in the effective model were adjusted from site visits, publicly available LiDAR, and project surveys provided by SCDOT. The model extends approximately 4,140 feet upstream to the start of channel definition across from Mount Pleasant Rd. and approximately 11,000 feet downstream adjacent of Oconee Ave. The Manning's roughness values for the channel and floodplain areas in the vicinity of the bridge were unchanged after being reviewed based on aerial photography, and the procedure outlined in the SCDOT Requirements for Hydraulic Design Studies. RS 13052 and 13204 were updated based off existing survey & lidar. RS 13052 was adjusted and re-georeferenced so that it would not be impeding the proposed construction limits.

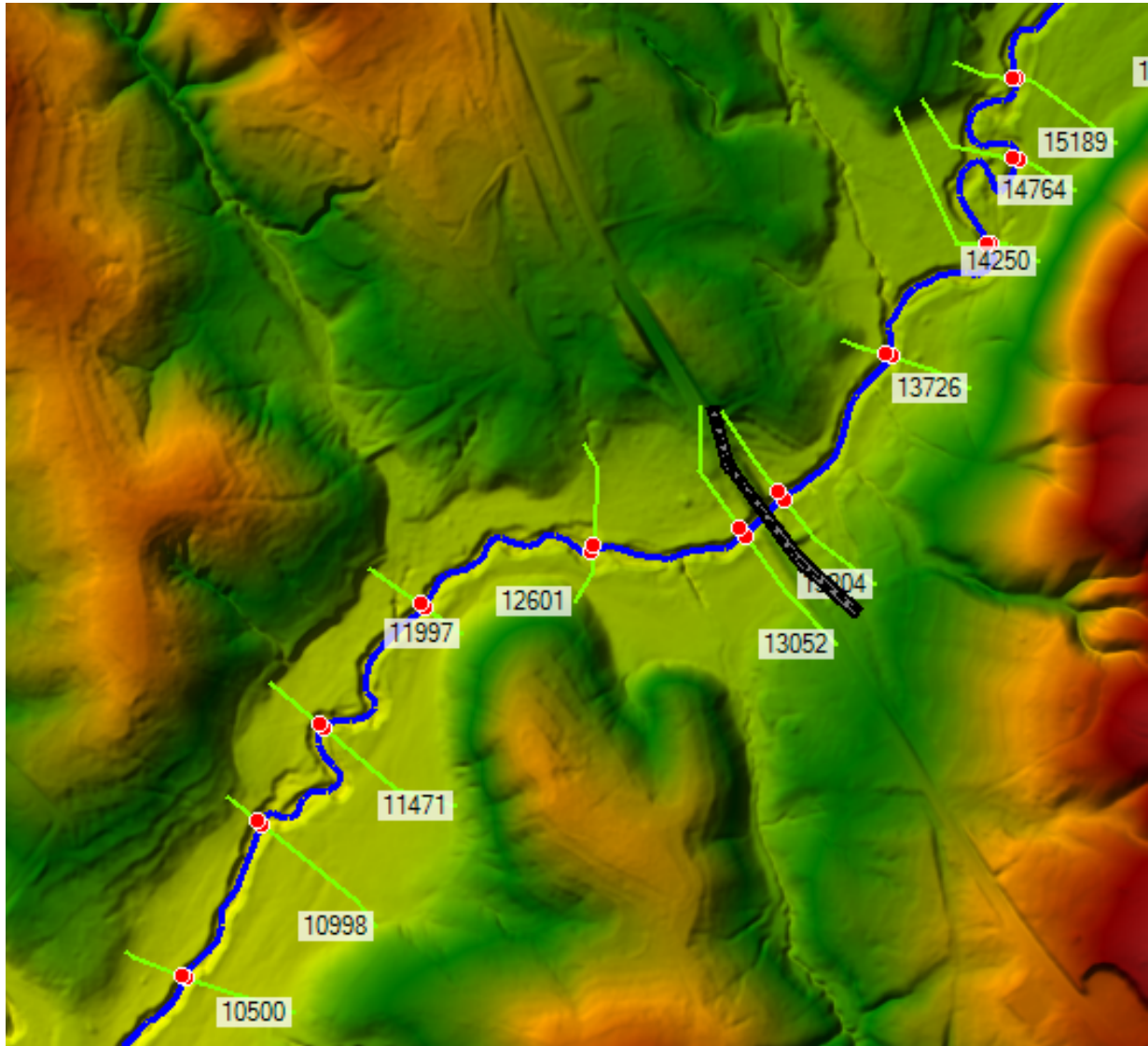


Figure 1: Choestoea Creek Model Layout (S-37-168)

A sensitivity analysis was completed on the existing conditions model to verify the extents of the model. The analysis was performed by revising the downstream boundary conditions +/- 3-ft and comparing the resulting water surface elevations near the bridge location. The results of the sensitivity analysis are shown below.

100-Year (1% AEP) Water Surface Elevations- Sensitivity Analysis			
RS	Natural WSE (ft)	+3 Sensitivity (ft)	-3 Sensitivity (ft)
Little Choestoea Rd. (BS 13134)			
7928	671.24	671.24	671.24
7419	664.76	665.36	664.76
6882	663.92	664.92	663.92
6300	663.85	664.90	663.84
5338	663.77	664.87	663.77
4600	663.58	664.81	663.57
3382	662.42	664.71	662.45
2155	661.69	664.69	658.69*

*WSE defaulted to Critical W.S.

The sensitivity analysis indicates that the model has sufficient downstream length to negate any negative effects of fluctuations in the downstream boundary condition at the bridge site (BS 13134). -3 and +3 Sensitivity ties into model at RS 7928.

Design Criteria:

Based on the Flood Insurance Study (FIS) for Oconee County and Flood Insurance Rate Map (FIRM) Panel Number 45073C0405C the project is located in Special Flood Hazard Area AE. As such the bridge will be designed based on the following criteria:

1. The minimum low chord elevation shall be the 25-year (4.0% AEP) water surface elevation plus 2-ft of freeboard.
2. The 100-year (1% AEP) low chord should be set per other hydraulic requirements.
3. "No Impact" if there is no increase in the 1% AEP flood and floodway profiles and there is no increase in floodway width at the published and unpublished cross sections.
4. The backwater for the 100-year (1% AEP) design event is one (1) foot or less when compared to the unrestricted or natural conditions or that the proposed bridge does not create more backwater than the existing bridge.

Existing Bridge Analysis:

The existing bridge consists of a five (5) 15-ft. spans for a total length of approximately 75-ft and is a concrete slab bridge supported by 12-in (1-ft) timber piles over a sandy/gravel channel. The out-to-out width was taken from *SCDOT's Bridge Inspection Form* as 27.70-ft. Ineffective flows upstream and downstream of the proposed bridge were set based approximately on 1.5:1 expansion and 1:1 contraction ratio.

The existing bridge's lowest low chord was estimated at elevation 703.48' based on the project surveys and existing bridge plans.

Preliminary Bridge Analysis:

A single-span prestressed concrete box beam bridge with a total length of 100-ft and out-to-out width of 30' (12-ft lanes) was assumed for the preliminary design/analysis to span the stream. The bridge has no piers.

Ineffective flows upstream and downstream of the proposed bridge were set around 1.5:1 expansion and 1:1 contraction ratios and sloping abutments were added. The Little Choestoea Rd. crossing is located at BS 13134.

The table below shows the resulting water surface elevations in the project area for the existing and proposed preliminary bridge for the 25-year (4% AEP) event.

25- Year (4% AEP) Design Event			
RS	Corrected Effective 75' Bridge WSE (ft)	Revised 100' Bridge WSE (ft)	Difference (ft)
16206	702.32	702.32	0.00
15666	700.57	700.56	-0.01
15189	699.42	699.41	-0.01
14764	698.17	698.06	-0.11
14250	696.55	696.26	-0.29
13726	695.42	694.92	-0.50
13204	694.44	693.52	-0.92
<i>Little Choestoea Rd. (BS 13134)</i>			
13052	691.34	691.34	0.00
12601	689.34	689.34	0.00
11997	687.10	687.10	0.00
11471	685.73	685.73	0.00
10998	684.28	684.28	0.00
10500	682.91	682.91	0.00
9906	680.91	680.91	0.00
9429	679.09	679.09	0.00

The resulting water surface elevation upstream of the bridge was used to check the required minimum bridge low chord elevation for the preliminary bridge vs the existing low chord elevation.

Min. Low Chord (preliminary) = $693.52 + 2.0\text{-ft freeboard} = 695.52 \leq$ existing low chord of 703.48.

Based off the proposed roadway profile, a low chord of $\approx 703.48'$ was used for the design. The preliminary low chord was lowered from the existing low chord by approximately $0.01'$.

In addition to the freeboard requirement, the SCDOT Requirements for Hydraulic Design Studies, states that the proposed bridge must not be subject to pressurized flow for the 100-year design event and produce less than $1'$ of backwater over natural (unrestricted) conditions or that the proposed bridge does not create more backwater than the existing bridge. The resulting water surface elevations along the stream are presented below. Proposed improvements dropped backwater from $1.65'$ to $0.44'$ which meets SCDOT standard.

100- Year (1% AEP) Design Event			
RS	Natural WSE (ft)	Existing Conditions 75' Bridge WSE (ft)	Preliminary Proposed 100' Bridge WSE (ft)
16206	703.74	703.74	703.74
15666	701.85	701.84	701.85
15189	700.54	700.52	700.53
14764	699.73	699.69	699.71
14250	698.07	698.41	698.14
13726	696.36	697.20	696.55
13204	694.70	696.35	695.14
<i>Little Choestoea Rd. (BS 13134)</i>			
13052	692.74	692.97	692.97
12601	691.58	691.58	691.58
11997	689.17	689.17	689.17
11471	688.02	688.02	688.02
10998	686.47	686.47	686.47
10500	685.09	685.09	685.09
9906	682.88	682.88	682.88
9429	681.11	681.11	681.11

The 100-year (1.0% AEP) event was investigated to determine the viability of setting the proposed low chord below the existing water surface elevation. To maintain the existing roadway grades with the increased structure height, the preliminary minimum low chord elevation was higher than the 100-yr WSEL.

The existing and proposed 100-year backwater along with the low chord criteria checks are summarized in the following table.

Design Criteria Summary (WSEs at RS 2894)							
Prelim. Bridge (4% AEP) WSE (ft)	Minimum Required Freeboard (ft)	Prelim. Bridge Min. Low Chord (ft)	Existing Low Chord Elevation (ft)	Prelim. Bridge (1% AEP) WSE (ft)	Prelim. (1% AEP) Backwater (ft)	Existing (1% AEP) Backwater (ft)	100-Year (1.0% AEP) WSE Check (ft)
693.52'	2	695.52'	703.48'	695.14'	0.44'	1.65'	695.14 < LC

The preliminary bridge configuration meets the SCDOT design criteria for backwater and is an improvement from the 1.65-ft backwater that the existing is currently showing. The proposed roadway profile grade is raised about 2' and the preliminary low chord meets the 2' of freeboard requirement from the 25-year event.

Design Considerations:

The preliminary bridge opening conveys the 100-year (1.0% AEP) event below the low chord of the bridge with approximately 8.34-ft of freeboard between the water surface and the proposed low chord. There is approximately 9.95-ft of freeboard between the water surface and proposed low chord for the 25-year (4% AEP). There is no skew with the bridge and the angle of the bridge is 90 degrees. Based off the proposed roadway grade, the proposed low chord for the bridge is around 703.49', with bench elevations of 697' no piers, and 5' abutment setbacks based off of the *"Supplemental Design Criteria For Low Volume Bridge Replacement Projects."* For the 100-year, existing velocities within the bridge section max at 10.31 fps and the proposed bridge produces a 100-year velocity of 9.06 fps. Rip rap abutment protection is recommended for the final design. Contraction scour would be limited based on observations from the field visit.

NOTES TO USERS

This map is for use in administration of the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or **Summary of Stillwater Elevations** tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was State Plane South Carolina FIPS 3600. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRM for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

Spatial Reference System Division National Geodetic Survey, NOAA Silver Spring Metro Center 1315 East-West Highway Silver Spring, Maryland 20910 (301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

Base map information shown on this FIRM was provided in digital format by Oconee County, South Carolina.

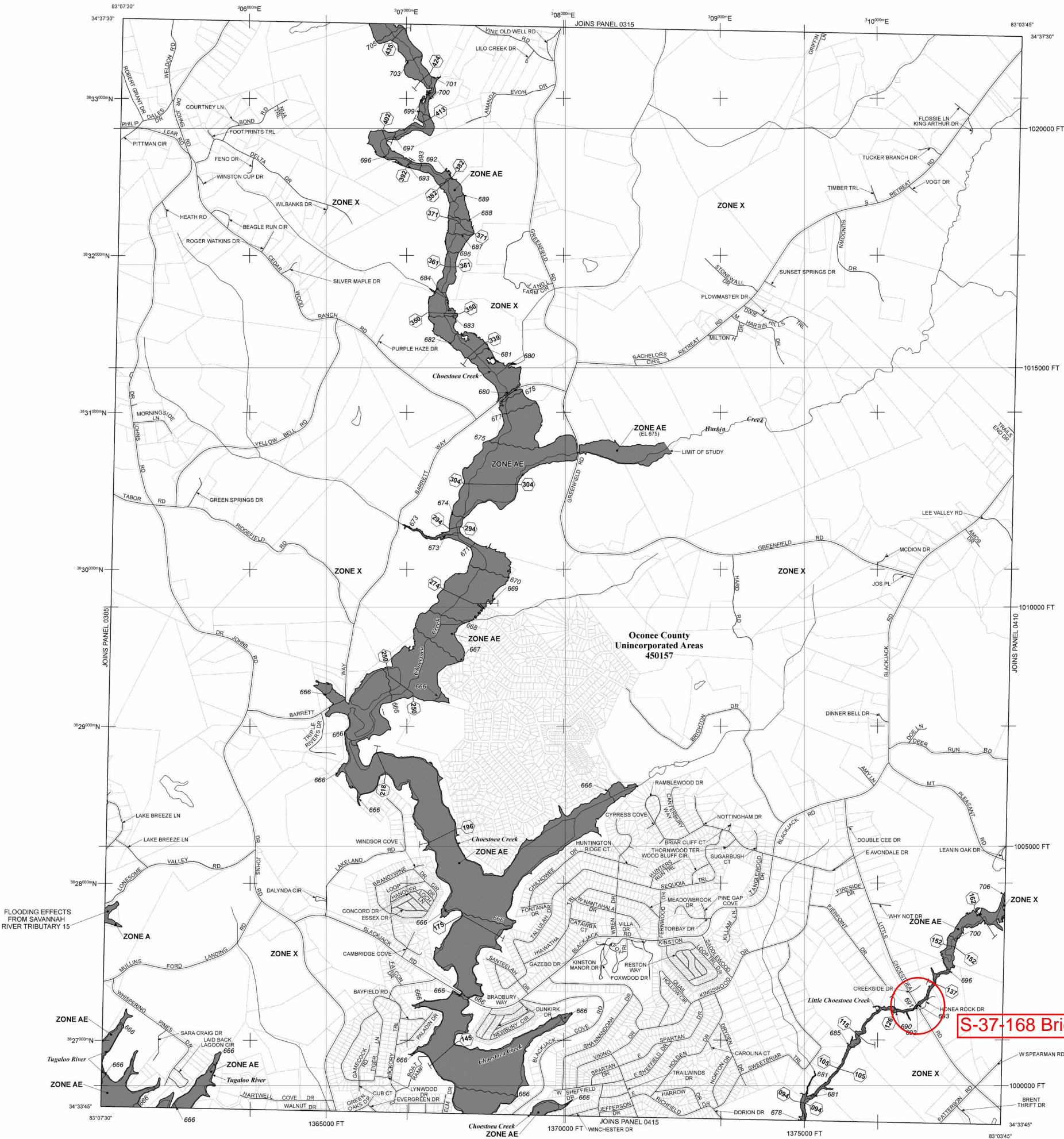
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at <http://www.msc.fema.gov/>.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/>.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
Base Flood Elevation line and value; elevation in feet*
Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
1000-meter Universal Transverse Mercator grid ticks, zone 17
5000-foot grid values: South Carolina State Plane coordinate system (FIPSZONE = 3900), Lambert projection
Bench mark (see explanation in Notes to Users section of this FIRM panel)
River Mile
MAP REPOSITORIES
Refer to Map Repositories list on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
SEPTEMBER 11, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

0 500 1,000 1,500 2,000 FEET
0 500 1,000 1,500 2,000 METERS

DNR

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of South Carolina and the Federal Emergency Management Agency (FEMA). The State of South Carolina has implemented a long term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map floodplain areas at the local level. As a part of this effort, the state of South Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

<http://www.dnr.state.sc.us/>

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0405C

FIRM

FLOOD INSURANCE RATE MAP

OCONEE COUNTY, SOUTH CAROLINA

AND INCORPORATED AREAS

PANEL 405 OF 505

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
OCONEE COUNTY	450157	0405	C

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER 45073C0405C

EFFECTIVE DATE SEPTEMBER 11, 2009

Federal Emergency Management Agency