

The logo for the South Carolina Department of Transportation (SCDOT) is displayed in a bold, blue, sans-serif font. The letters 'S', 'C', 'D', and 'O' are connected, and the 'T' is a simple vertical bar. The background of the entire image is a photograph of a cable-stayed bridge with a diver in the foreground, all in a blue color scheme.

SCDOT

ACEC

AMERICAN COUNCIL OF ENGINEERING COMPANIES
of South Carolina

UNDERWATER BRIDGE INSPECTIONS

Protecting the Public from Below

1950s and 1960s

- Interstate construction boom
- No national inventory or inspection programs
- Some local inspection programs

Until...

December 15, 1967

Silver Bridge Collapsed Ohio River at Point Pleasant, West Virginia



46 people killed

Congress Took Action

Federal Aid Highway Act—April 27, 1971

- National Bridge Inspection Standards (NBIS)
 - All states must perform routine inspections of bridges (maximum interval 24 months)
 - Inspector qualifications defined
 - Inspector training program developed
 - Manuals and Report formats developed
 - Inspection and rating procedures defined (AASHTO)
- National Bridge Inventory (NBI)

Collapse of U.S. Route 43 Bridge

- Occurred in April 1985
- Over Chickasawbogue Creek in Mobile, Alabama
- Led to FHWA issuance of memo stressing
 - Importance of underwater inspections
 - Ordering steps to ensure each state has a well-founded underwater inspection program



New York's Schoharie Creek Bridge Collapse—1987

- Center pier scour failure
- Collapse of main span carrying I-90 in New York
- 10 fatalities
- Disruption of traffic



Response to Schoharie Creek Bridge Collapse

- New focus on “Bridges Over Waterways” (approx. 86% of bridges on the NBI)
- Technical advisory—*Scour at Bridges* (FHWA 1988)
- “Scour Critical” bridge inspections required
- Analytical procedures to predict bridge scour—*Hydraulic Engineering Circular No. 18* (FHWA)



October 1988 Modifications to NBIS

- FHWA mandated development of “Master List” of all bridges that require “Underwater Inspections”
- Underwater inspection frequency a maximum interval of 60 months
- Mandated development of “Master List” of all bridges that require “Fracture-Critical Inspections”
- NICET Level III and Level IV certifications allowed for bridge inspection team leaders



October 1988 Modifications to NBIS

U/W Inspection Frequency

60 month maximum interval

- Sound condition
- No channel instability
- Not deleterious environment

FHWA Guidance Revisions to NBIS

- Underwater members must be inspected to the extent necessary to determine structural safety with certainty
- Underwater inspection must include the streambed
- Types of inspections
 - Wadeable water—Visual and tactile from above
 - Deep water—Diving or other techniques

FHWA Guidance Revisions to NBIS (cont.)

Levels of Inspection

- Level I Visual and tactile, minimal cleaning
- Level II Limited cleaning and measurement
- Level III Highly detailed, non-destructive testing
- Scour
- In-depth underwater inspection, if routine inspection is not conclusive

Hatchie River Bridge Collapse

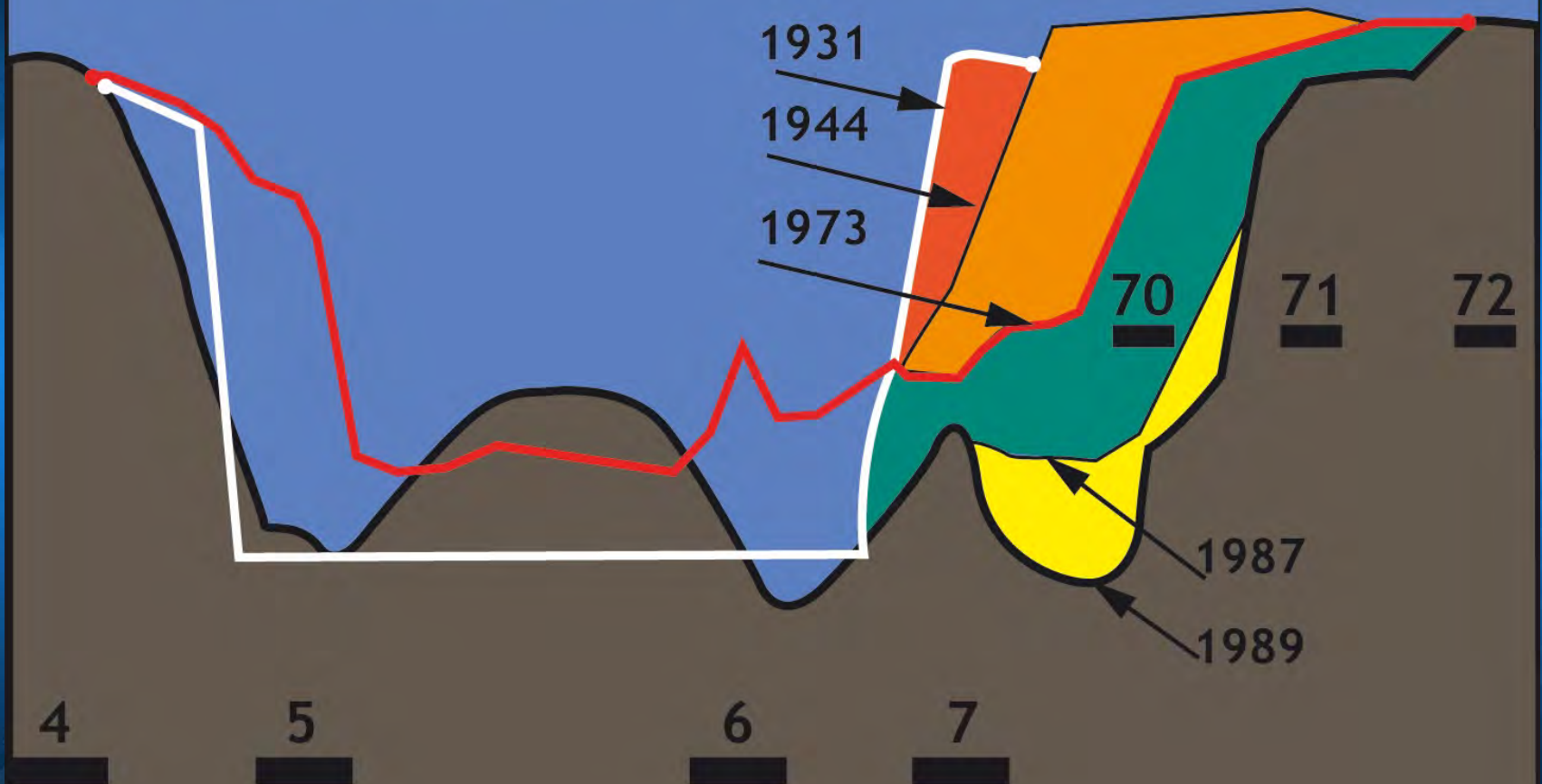
- April 1989-Covington, Tennessee
- Eight fatalities
- Disruption of traffic

Response

- Illustrated critical importance for underwater bridge inspections
- Focused attention on taking appropriate corrective action when deficiencies are discovered



HATCHIE CHANNEL MIGRATION



FHWA Minimum Guidelines for Diving Inspection Intensity Levels

- Routine underwater inspection
 - 100% Level I
 - 10% Level II
 - Scour inspection
- In-depth underwater inspection
 - If routine not conclusive
 - More extensive Level II and Level III effort
 - May be bridge owner requirement

Level I Underwater Inspection

- Visual and tactile techniques
- Large sweeping hand motions where visibility is limited
- Referred to as a “swim-by” inspection
- Minimal marine/aquatic growth cleaning
- Limited probing of substructure and surrounding channel bottom



Level I Inspection Results

- Detect obvious major damage, deterioration or over-stress
- Confirm continuity of construction
- Detect undermining or exposure of normally buried components
- Verification of as-built drawings
- Aid in selecting extent and location of Level II and Level III inspections



Level II Underwater Inspection

- Up-close and detailed techniques
- Marine/aquatic growth removal from portions of substructure to identify damage and deterioration
- Cleanings at low waterline, mudline and midway between
- Locate at more critical or susceptible areas of substructure
- 10 in. wide bands



Level III Underwater Inspection

- Highly detailed techniques
- Extensive cleaning and measurement
- Non and partially-destructive testing
 - Ultrasonics
 - Sample coring or boring
 - Physical material sampling
 - In-situ hardness testing
- Locate at key structural areas, suspect areas or representative areas
- Detect hidden or interior damage and/or section loss and evaluate material homogeneity

Level III Underwater Inspection (cont.)

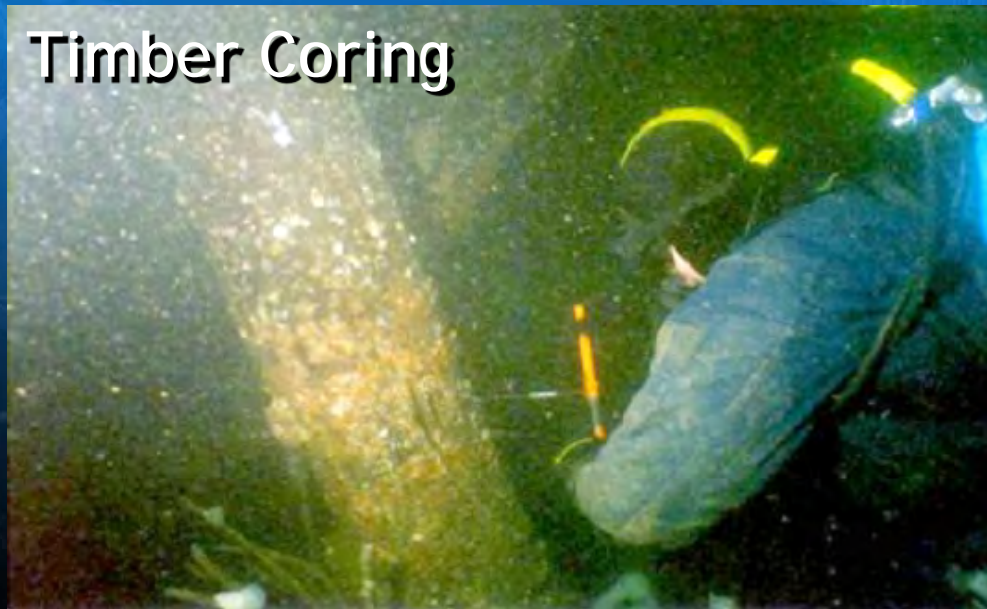
Ultrasonics



Cathodic Potential



Timber Coring



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SCDOT

The logo for the American Council of Engineering Companies of South Carolina (ACEC) is displayed in a blue, serif font. The letters 'A', 'C', 'E', and 'C' are of uniform size. A thin, curved line arches over the top of the letters.

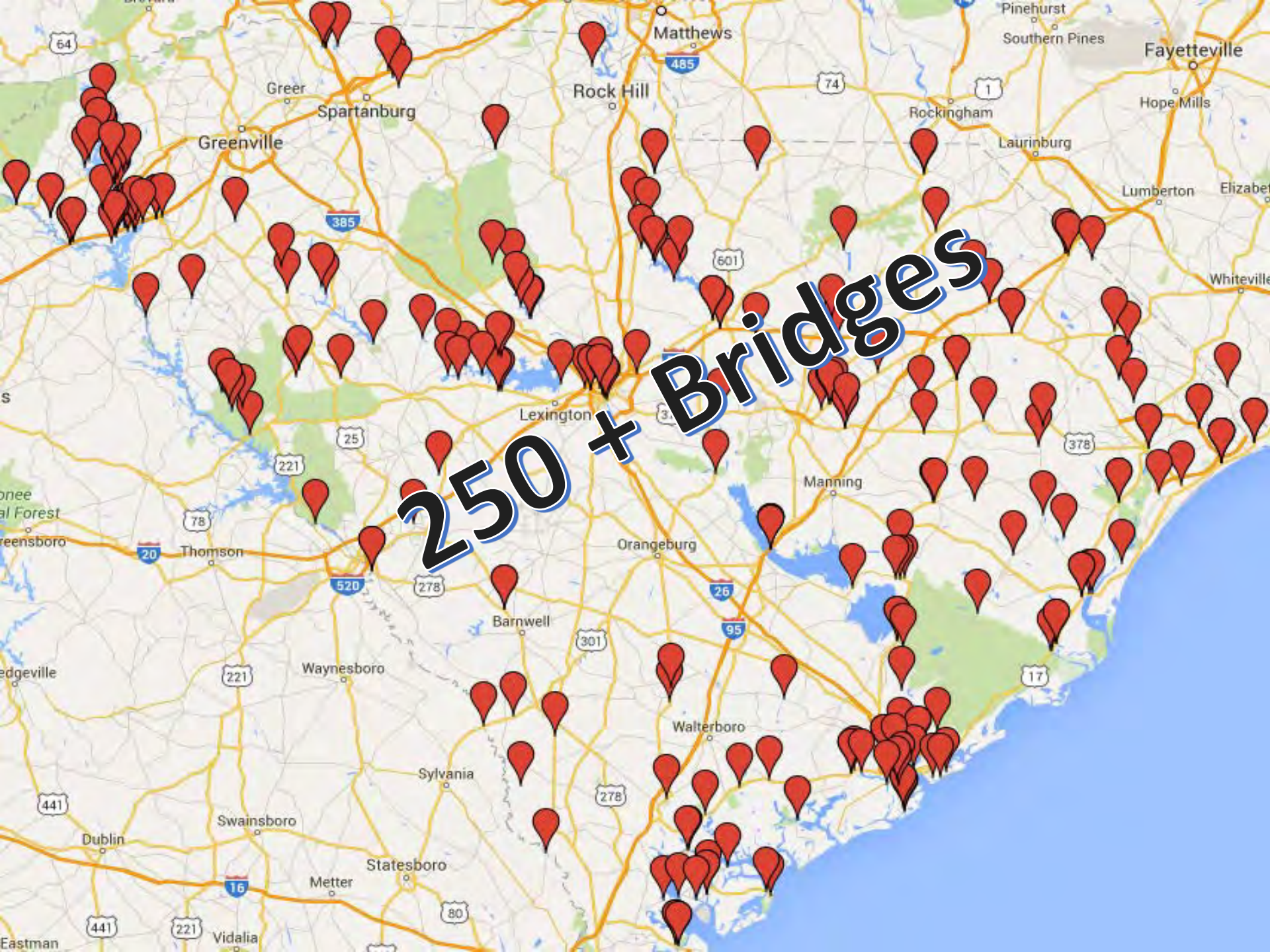
ACEC

AMERICAN COUNCIL OF ENGINEERING COMPANIES
of South Carolina



SC UNDERWATER BRIDGE INSPECTIONS

Protecting the SC Public from Below



250+ Bridges

SOUTH CAROLINA



Underwater Bridge Statistics

- Deepest Bridge: **SC 24 over Lake Hartwell – 140 ft.**
- Shallowest Bridge: **S-25 over Unnamed Ditch – 3 ft.**

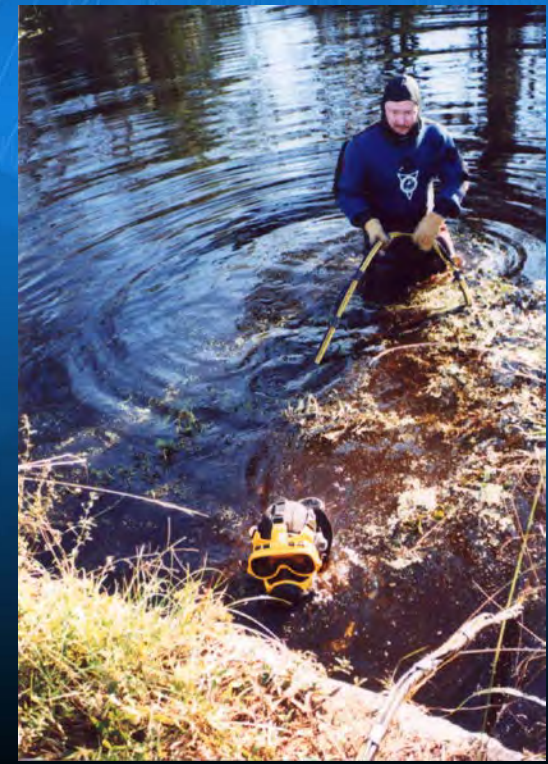


SOUTH CAROLINA

Underwater Bridge Statistics



- Largest Bridge: **I-95 over Lake Marion – 82 Piers**
- Shortest Bridge: **Small Submerged Culverts**

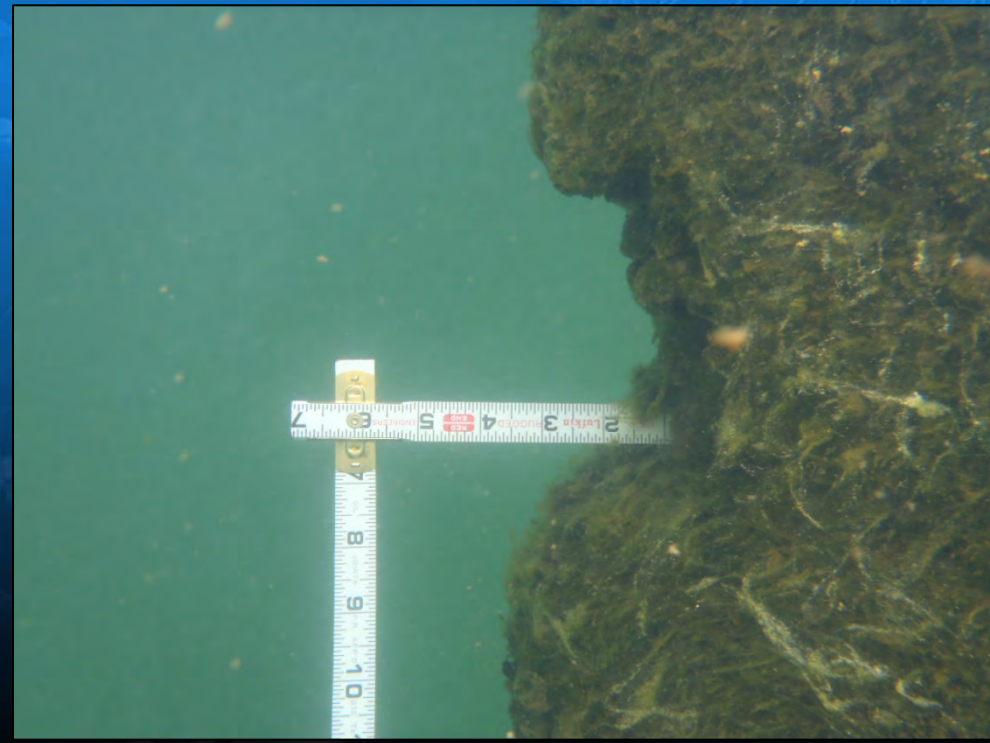


SOUTH CAROLINA



Underwater Bridge Statistics

- Clearest Water: **Lake Keowee**
- Murkiest Water: **The Black River ?**



SOUTH CAROLINA

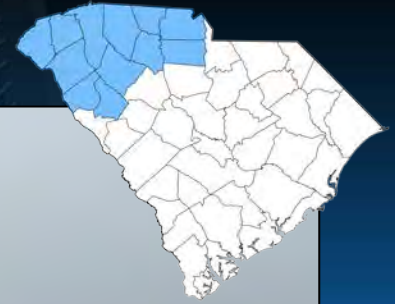


Underwater Bridge Statistics

- Warmest Water: **Catawba Nuclear – 85 F+**
- Coldest Water: **32 F**



Bridges in the Upstate



- Shallow River Bridges
- Deep Lake Bridges



Decompression Chamber

- Required to be on site if dive is over 100 ft
- Slowly bring a diver up from depth
- Mixed gas diving / O₂ Decompression



Bridges in the Midlands

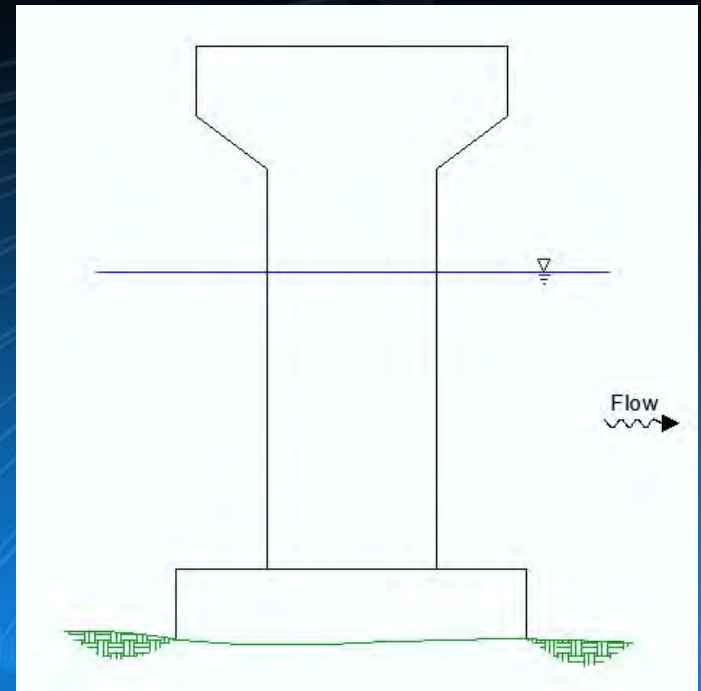


- More Lakes
- Fast Flowing Rivers



Fast Flowing Rivers

- Stabilization of the Diver
- Progressive Passes
- Focus on the Footings



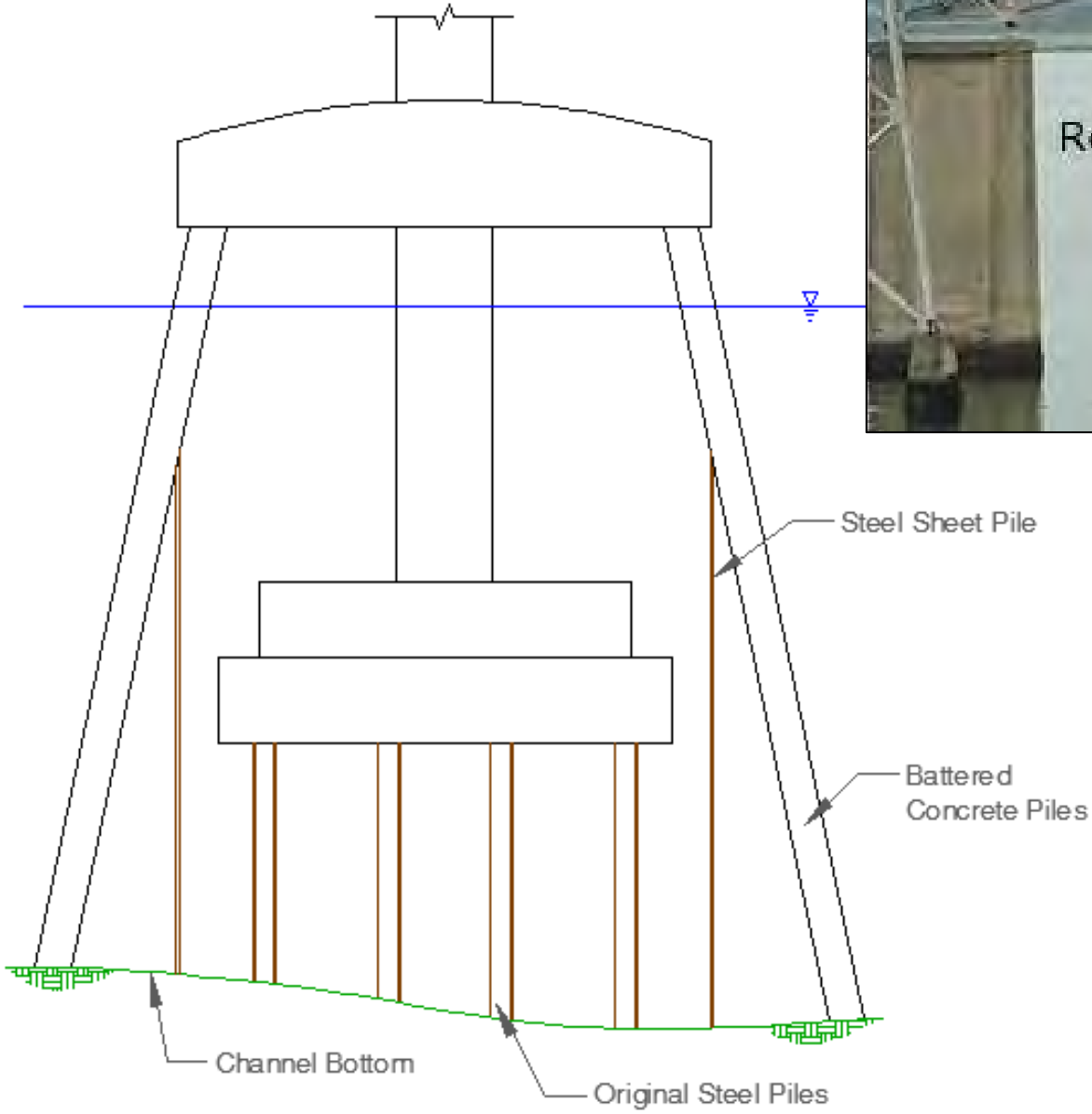
Bridges in the Lowcountry



- Tidal Rivers
- Movable Bridges
- Navigable Waterways



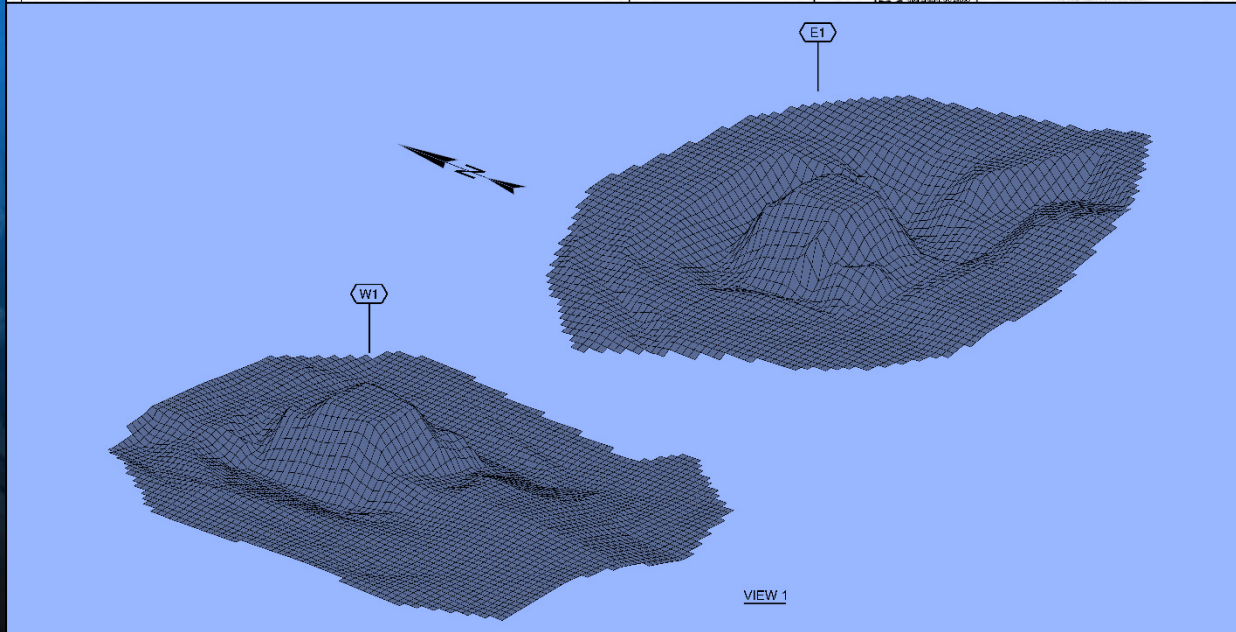
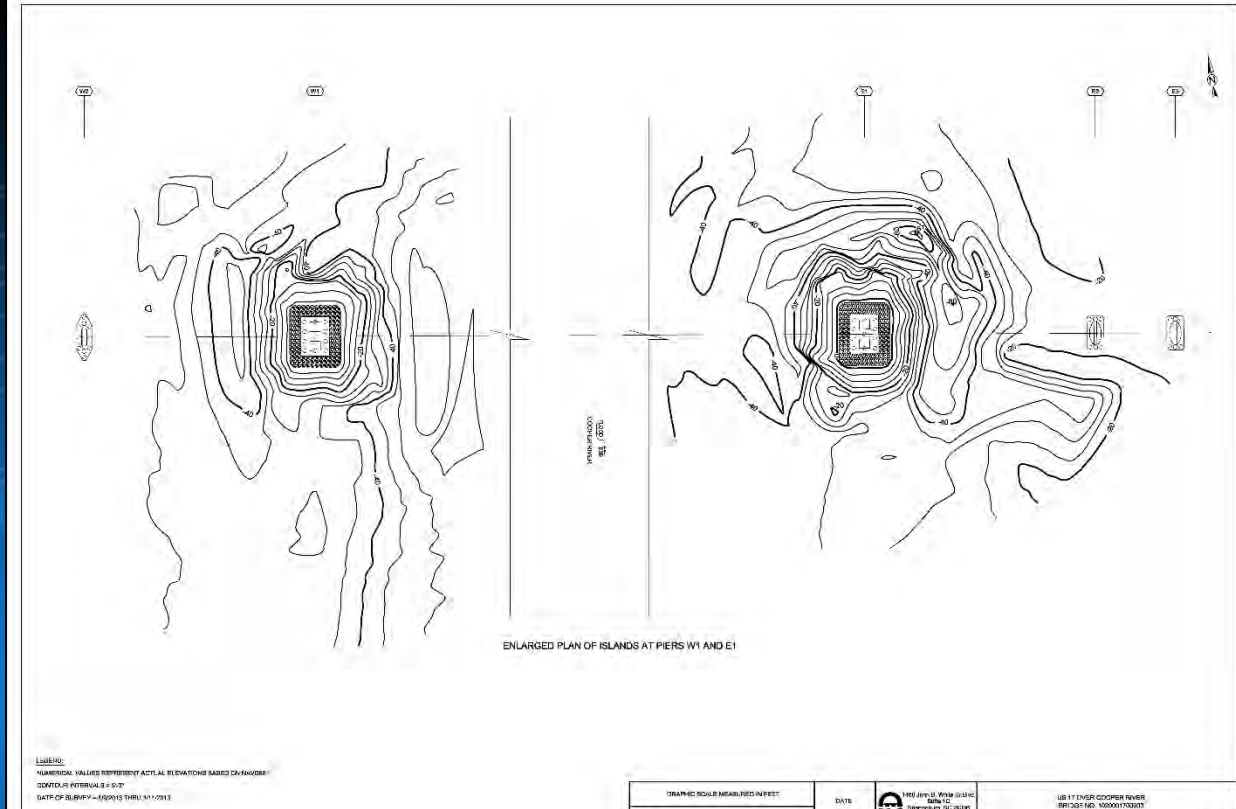
Old Cooper River Bridge - Grace



The Cage Pier

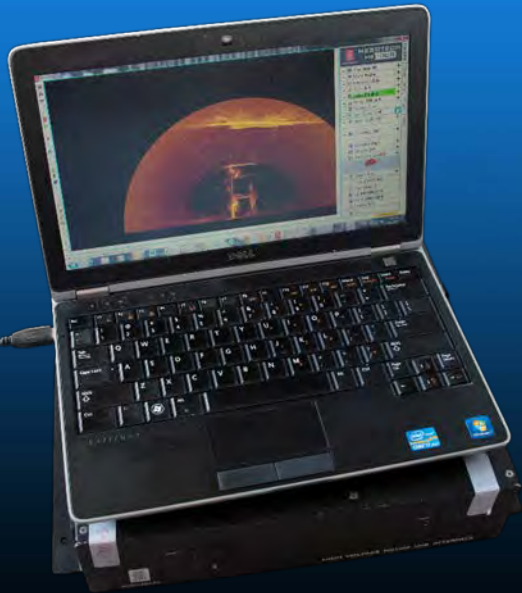


Hydrographic Survey



Acoustic Imaging

- Provides a “Visual” Image of What the Divers are Feeling
- Fast Flow
- Turbid Water
- Low Visibility



South Carolina Emergency Inspections

- Emergency Diving
- Acoustic Imaging
- Depth Soundings



- Tired of Sitting Behind a Desk
- Ready for Some Adventure
- Use Your Technical Skills in the Field

Are **YOU** Ready
to Become a
Diver?



Teammates?



Accommodating Environmental Conditions



Satisfaction of Protecting the South Carolina Public from Below

