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APEX

JOINT APPLICATION
PRE-CONSTRUCTION NOTIFICATION (PCN)
PHASE 2 – MODIFIED REMOVAL ACTION
SEDIMENT CAPPING PROJECT

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

September 2016

Prepared for:

SCANA Services, Inc.
220 Operation Way
Cayce, South Carolina 29033

Prepared by:

Apex Companies, LLC

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SCANA
POWER FOR LIVING

SCANA
Corporate Environmental Services
220 Operation Way
Cayce, SC 29033-3701

September 22, 2016

Mr. Brice McKoy
Northwest Regulatory Branch Chief

Mr. Chip Ridgeway
Project Manager
U.S. Army Corps of Engineers
Strom Thurmond Federal Building
1835 Assembly Street, Room 865 B-1
Columbia, South Carolina 29201

RE: Joint Application and Pre-Construction Notification (PCN) – Individual Permit
Phase 2 – Modified Removal Action (MRA) – Sediment Capping Project
SCE&G - Congaree River Sediments
Columbia, South Carolina
USACE Project Number: SAC-2011-01356-6NO

Dear Sirs:

On behalf of SCANA Services, Inc., (SCANA) and their primary subsidiary, South Carolina Electric & Gas Company Inc. (SCE&G), enclosed please find the following documents in support of an Individual Permit Application for the Congaree River Sediments Project:

- Joint Federal and State Application Form for Activities Affecting Waters of the United States or Critical Areas of the State of South Carolina (Joint Application);
- Pre-Construction Notification (PCN);
- Nation Wide Permit - 38 (NWP-38) Hazardous and Toxic Waste Removal checklist (provided for convenience, if required); and
- A letter from the South Carolina Department of Health and Environmental Control (SCDHEC) directing SCE&G to *"pursue Alternative 3 – Sediment Capping and Institutional Controls as provided in the Final EE/CA"*.

As you are aware, the Congaree River Sediment project is intended to address the presence of a tar-like material (TLM) that is comingled with sediment in Columbia, SC, in an area downstream of the Gervais Street Bridge, adjacent to the eastern shoreline. For implementation purposes and due to logistical issues, the project was to be completed in two phases that consisted of:

- Phase 1 – Field Demonstration Project (Phase 1 – FDP), as described in the June 12, 2015 Joint Application and Pre-Construction Notification (JA-PCN) ; and
- Phase 2 – Modified Removal Action (Phase 2 – MRA), (originally intended to address the removal of the TLM-impacted sediment via excavation, but will now involve the capping of the impacted sediment for reasons as explained herein).

The Phase 1 - Field Demonstration Project (FDP) was completed in the fall of 2015 and was conducted with coverage provided under the United States Army Corps of Engineers (USACE) NWP-38 - Hazardous and Toxic Waste Removal, General Permit. The "hazardous" condition was based on previously documented metal anomalies that exist in the project area that **may potentially be** unexploded ordnance (UXO) from the Civil War era. The FDP Documentation Report was submitted to the agencies on July 12, 2016 and provides the complete findings of Phase 1. Perhaps the most significant finding of the FDP was that for all of the metal anomalies positively identified (51), none (0) were found to be a UXO, material of explosive concern, or historical cultural resource.

For numerous reasons as detailed in the SCDHEC letter (dated August 16, 2016 - Attachment A), the excavation and removal approach has been abandoned and SCE&G has now been directed to pursue a capping approach. Therefore, the Phase 2 – MRA capping scope of work is described in the attached Joint Application and PCN and includes various plans, details and evaluations associated with the proposed capping alternative. Generally, the proposed Phase 2 – MRA Sediment Capping Project will consist of:

- Placement of an engineered cap (i.e., geotextile and articulated concrete blocks [ACB mats]) over the entire MRA area;
- Removal of the existing sandbar to facilitate capping and provide a more gradual transition to surrounding bottom surface contours; and
- Removal and replacement of existing rocks, boulders, tree stumps etc. to facilitate cap placement of the ACB mats.

For convenience, four previously-approved plans to address UXO management issues are incorporated by reference only. These plans are still relevant and applicable to the capping approach, but to a much lesser extent given the less intrusive nature of capping and the new layer of sediment that was deposited over the project area from the flooding that occurred in late 2015. The detailed plans, which have been developed, reviewed and approved by the appropriate USACE EOD/UXO specialists, will be generally adhered to for Phase 2 – MRA capping approach.

We would appreciate an opportunity to review the attached documents with you at your earliest convenience and sincerely appreciate your interest and assistance in this project. If you have any questions or require any additional information, please call Rusty Contrael at 412-829-9650 or me at 919-819-2748.

Sincerely,

Robert M. Apple
Remediation Project Manager

cc: L. Berresford – SCDHEC (w/ enclosure
M. Giffin – SCDHEC (w/o enclosure)
T. Effinger – SCANA (w/o enclosure)
R. Contrael, B. Zeli, T. Wolf – Apex (w/o enclosure)

JOINT FEDERAL AND STATE APPLICATION

Joint Federal and State Application Form **For Activities Affecting Waters of the United States** **Or Critical Areas of the State of South Carolina**	**This Space for Official Use Only** Application No.______ Date Received______ Project Manager______ Watershed # ______

Authorities: 33 USC 401, 33 USC 403, 33 USC 407, 33 USC 408, 33 USC 1341, 33 USC 1344, 33 USC 1413 and Section 48-39-10 et. Seq of the South Carolina Code of Laws. These laws require permits for activities in, or affecting, navigable waters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. The Corps of Engineers and the State of South Carolina have established a joint application process for activities requiring both Federal and State review or approval. Under this joint process, you may use this form, together with the required drawings and supporting information, to apply for both the Federal and/or State permit(s).

Drawings and Supplemental Information Requirements: In addition to the information on this form, you must submit a set of drawings and, in some cases, additional information. A completed application form together with all required drawings and supplemental information is required before an application can be considered complete. See the attached instruction sheets for details regarding these requirements. You may attach additional sheets if necessary to provide complete information.

1. Applicant Last Name: Harris	11. Agent Last Name (agent is not required): Contrael
2. Applicant First Name: Donald (Rusty)	12. Agent First Name: Andrew
3. Applicant Company Name: South Carolina Electric & Gas Co. (SCE&G)	13. Agent Company Name: Apex Companies, LLC
4. Applicant Mailing Address: 220 Operation Way	14. Agent Mailing Address: 1600 Commerce Circle
5. Applicant City: Cayce	15. Agent City: Trafford
6. Applicant State: SC / 7. Applicant Zip: 29033	16. Agent State: PA / 17. Agent Zip: 15085
8. Applicant Area Code and Phone No.: 803-217-7055	18. Agent Area Code and Phone No.: 412-829-9650
9. Applicant Fax No.: 704-810-3171	19. Agent Fax No.: 412-349-0350
10. Applicant E-mail: rharris@scana.com	20. Agent E-mail: rcontrael@apexcos.com

21. Project Name: Congaree River - Sediment Capping Project	22. Project Street Address: N/A - Congaree River (eastside) downstream of the Gervais Street Bridge.
23. Project City: Columbia / 24. Project County: Richland	25. Project Zip Code: 29201 / 26. Nearest Waterbody: Congaree River
27. Tax Parcel ID: R08911-01-14	28. Property Size (acres): Approximately 33 acres (landside), 2.13 acres (river)
29. Latitude: 33 59 40.59N	30. Longitude: 81 02 56.80W

31. Directions to Project Site (Include Street Numbers, Street Names, and Landmarks and attach additional sheet if necessary):

Travel east on the Gervais Street Bridge, turn right onto Gist Street, and turn right onto the Senate St. Ext. Project site located at the terminus of Senate St. Ext. and within the Congaree River directly downstream of the Gervais Street Bridge.

32. Description of the Overall Project and of Each Activity in or Affecting U.S. Waters or State Critical Areas (attach additional sheets if needed)

The Sediment Capping Project basically entails the placement of a physical barrier in the form of an engineered capping system (engineered cap) over top the newly deposited sediment (and the pre-existing, underlying TLM-impacted sediment) within the project area. Subsequent routine monitoring will also be a component of this project. Overall, the cap will consist of the new layer of sediment, which varies from 0 to 5 feet in thickness and the engineered cap placed in the near-shore area where human contact and erosion potential is greater. The engineered cap will consist of a geotextile fabric material overlaid by open-cell, articulated concrete blocks (ACBs) connected together to form a mat. Additional information is provided in the attachments.

33. Overall Project Purpose and the Basic Purpose of Each Activity In or Affecting U.S. Waters (attach additional sheets if needed):

Based on the multiple storm events and the associated flooding that occurred in the fall of 2015, a large volume of "new' sediment now exists within and immediately above the project area. This newly deposited sediment will greatly reduce the potential for human contact with the tar-like material (TLM) that exists below the new sediment. By installing the engineered cap, the impacted material will be isolated from human contact and will prevent or minimize re-suspension and downstream movement of the impacted sediment. Continued routine monitoring of the project area will provide a means for insuring long-term integrity of the cap. Additional information is provided in the attachments.

34. Type and quantity of Materials to Be Discharged

Material	Quantity	Unit
Dirt or Topsoil:		☐ cubic yards
Clean Sand:		☐ cubic yards
Mud:		☐ cubic yards
Clay:		☐ cubic yards
Gravel, Rock, or Stone:		☐ cubic yards
Concrete:	2,630	☒ cubic yards
Other (describe):		☐ cubic yards
TOTAL:	2,630	cubic yards

35. Type and Quantity of Impacts to U.S. Waters (including wetlands).

Impact	Quantity	Unit	Quantity	Unit
Filling:	2.30	☒ acres ☐ sq.ft.		☐ cubic yards
Backfill & Bedding:		☐ acres ☐ sq.ft.	330	☒ cubic yards
Landclearing:		☐ acres ☐ sq.ft.		☐ cubic yards
Dredging:		☐ acres ☐ sq.ft.	930	☒ cubic yards
Flooding:		☐ acres ☐ sq.ft.		☐ cubic yards
Draining/Excavation:		☐ acres ☐ sq.ft.		☐ cubic yards
Shading:		☐ acres ☐ sq.ft.		☐ cubic yards
TOTALS:	2.30 acres	sq.ft.	1,260	cubic yards

36. Individually list wetland impacts including mechanized clearing, fill, excavation, flooding, draining, shading, etc. and attach a site map with location of each impact (attach additional sheets if needed).

Impact No.	Wetland Type	Distance to Receiving Water body (LF)	Purpose of Impact (road crossing, impoundment, flooding, etc)	Impact Size (acres)
N/A				
			Total Wetland Impacts (acres)	N/A

37. Individually list all seasonal and perennial stream impacts and attach a site map with location of each impact (attach additional sheets)

Impact No.	Seasonal or Perennial Flow	Average Stream Width (LF)	Impact Type (road crossing, impoundment, flooding, etc)	Impact Length (LF)
001 - Congaree River	Perennial	~600	Placement of Engineered Cap	900
			Total Stream Impacts (Linear Feet)	900

38. Have you commenced work on the project site? ■ YES ☐ NO If yes, describe all work that has occurred and provide dates.

Completed sediment investigation from June 2010 to February 2011 and Phase 1 Field Demonstration Project to assess potential for unexploded ordnances (UXOs) in late 2015.

39. Describe measures taken to avoid and minimize impacts to Waters of the United States:

Prior to commencing work, measures will be taken to relocate freshwater mussels to outside of the project area. Erosion and sediment control BMPs will be installed, as needed, and total suspended solids monitoring will be conducted. Shoreline impacts will be minimized to the extent practical and disturbed portions of the shoreline will be reconstructed, as may be required.

40. Provide a brief description of the proposed mitigation plan to compensate for impacts to aquatic resources or provide justification as to why mitigation should not be required (Attach a copy of the proposed mitigation plan for review).

No mitigation plan is required since the proposed capping will not appreciably impact the project area's use or function. Placement of the cap will provide a benefit in the form of longer term protection from potential contact with the TLM by humans and other organisms, significant reduction of the potential for resuspension of the TLM and subsequent downstream movement and reduction of flux of dissolved phase constituents with the water column.

41. See the attached sheet to list the names and addresses of adjacent property owners.

42. List all Corps Permit Authorizations and other Federal, State, or Local Certifications, Approvals, Denials received for work described in this application.

The USACE approved Phase 1 - FDP under NWP-38 on September 1, 2015. SCDHEC Bureau of Land Management has recently directed SCE&G to pursue the implementation of the sediment capping alternative. No other authorizations, approvals or denials have been received for the work proposed in this application.

43. Authorization of Agent. I hereby authorize the agent whose name is given on page one of this application to act in my behalf in the processing of this application and to furnish supplemental information in support of this application.

[signature] 9/22/16

Applicant's Signature Date

44. Certification. Application is hereby made for a permit or permits to authorize the work and uses of the work as described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent for the applicant. [1]

[signature] 9/22/16 [signature] 9/19/16

Applicant's Signature Date Agent's Signature Date

[1]The application must be signed by the person who desires to undertake the proposed activity or it may be signed by a duly authorized agent if the authorization statement in blocks 11 and 43 have been completed and signed. 18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

JOINT FEDERAL AND STATE APPLICATION FORM FOR ACTIVITIES AFFECTING WATERS OF THE UNITED STATES OR CRITICAL AREAS OF THE STATE OF SOUTH CAROLINA (JOINT APPLICATION)

PHASE 2 – MODIFIED REMOVAL ACTION - SEDIMENT CAPPING PROJECT

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

September 2016

Prepared for:

SCANA Services, Inc.
220 Operation Way
Cayce, SC 29033

Prepared by:

Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

LIST OF ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
BMP	Best Management Practices
BTEX	Benzene, Toluene, Ethylbenzene, and total Xylenes
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act* (commonly known as Superfund)
CSM	Conceptual Site Model
CY	Cubic Yards
EE/CA	Engineering Evaluation/Cost Analyses
EOD	Explosive and Ordnance Demolition
FDP	Field Demonstration Project
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
MGP	Manufactured Gas Plant
MRA	Modified Removal Action
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NWP	Nationwide Permit
PAHs	Polynuclear Aromatic Hydrocarbons
PCN	Pre-Construction Notification
PDR	Project Delineation Report
RAWP	Remedial Action Work Plan
RD	Remedial Design
RSLs	Regional Screening Levels
RSSL	Rocky Shoal's Spider Lily
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCE&G	South Carolina Electric & Gas Company (primary subsidiary of SCANA Services, Inc.)
SCIAA	South Carolina Institute of Archeology and Anthropology
SHPO	South Carolina State Historic Preservation Office
SF	Square Feet
TLM	Tar-Like Material
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UXO	Unexploded Ordnance
VCC	Voluntary Cleanup Contract

TABLES

FIGURES

ATTACHMENTS

INTRODUCTION

This Joint Federal and State Application Form For Activities Affecting Waters Of The United States Or Critical Areas Of The State Of South Carolina (Joint Application) is being submitted on behalf of South Carolina Electric & Gas Company (SCE&G) to provide information pertaining to the proposed sediment remediation project located in a portion of the Congaree River in Columbia, South Carolina.

SCE&G is the respondent required to complete a remedial action for a tar-like material (TLM) that is commingled with sediment within the Congaree River. The actual project area is located along the eastern shoreline of the river, just south of the Gervais Street Bridge as shown on Figure 1.

Information regarding this project has been previously submitted under United States Army Corps of Engineers (USACE) Permit Number P/N 2011-01356-6NO. SCE&G had been working toward receiving authorization to complete a Modified Removal Action (MRA) to address impacted sediment, as directed by the South Carolina Department of Health and Environmental Control (SCDHEC). As originally envisioned, the MRA would have entailed constructing a temporary cofferdam to isolate the planned excavation area and physically removing the impacted sediment down to the underlying bedrock. Based on a recent letter from SCDHEC to SCE&G, dated August 16, 2016 (Attachment A), the excavation and removal approach has been abandoned [for reasons detailed in the letter] and SCE&G has been requested to pursue a capping alternative.

It is important to note that this project is further complicated by the potential presence of Civil War era unexploded ordinance (UXO) and/or historically significant items within the area impacted by the TLM. In order to gather additional information regarding the potential for UXO and to gain first-hand knowledge of the logistical and technical constraints associated with working in close proximity to the Congaree River, SCE&G submitted a permit application and received authorization to conduct a Field Demonstration Project (FDP) under the Nationwide Permit #38. This request was approved by the USACE on September 1, 2015 and the FDP Work Plan was approved by SCDHEC on September 2, 2015. The FDP work was referred to as Phase 1. The FDP Documentation Report was submitted to the agencies on July 12, 2016 and provides the details and findings of the completed field work.

In the correspondence dated August 16, 2016 (Attachment A), SCDHEC requested that SCE&G pursue the capping approach and begin the design and permitting process as soon as possible. This alternate approach would entail the installation of an engineered capping system over top of the sediment recently deposited during the October 2015 flooding event and the TLM impacted sediment. This capping approach will preserve and hold in place the newly deposited sediment and further isolate the TLM from potential human contact and downstream movement. The sediment capping approach (Alternative 3 – Sediment Capping and Institutional Controls) was identified as the second most effective option (other than physical removal) in the Engineering Evaluation/Cost Analysis (EE/CA) approved by SCDHEC on February 7, 2013.

Therefore, this Joint Application and the attached Preconstruction Notification is being submitted to obtain authorization from the USACE to complete Phase 2 of the MRA - the sediment capping alternative (Phase 2 – MRA Capping) as described herein.

JOINT FEDERAL AND STATE APPLICATION FORM FOR ACTIVITIES AFFECTING WATERS OF THE UNITED STATES OR CRITICAL AREAS OF THE STATE OF SOUTH CAROLINA (JOINT APPLICATION)

DRAWINGS AND SUPPLEMENTAL INFORMATION

Applicant and Project Information

Please refer to item numbers 1 thru 30 of the Joint Application form, which have been completed.

Item #31 - Directions to the Project Site

The project area is located along the eastern bank of the Congaree River and extends from approximately 200 feet south of the Gervais Street Bridge downriver (generally south) for approximately 1,000 feet. The nearest street intersection is Gist and Senate Streets. Figure 1 is a USGS 7½ minute quadrangle map that shows directions from Interstate I-126. Take interstate I-126 south and exit onto Huger Street. Stay on Huger Street for about one mile. Turn right onto Senate Street, which is located about 500 feet south of the Huger Street and Gervais Street intersection. Once on Senate Street, proceed about 1,000 feet west, where a steel gate exists across the access road and represents the entrance to the project site. The access road leads directly to the Congaree River and the Senate Street "alluvial fan", which is a term used to describe a prominent site feature where sediment has accumulated near the end of the deteriorated access road (i.e., tow of slope). The alluvial fan was the site of the FDP activities. See Figure 2 for specific site details.

Item #32 - Description of the Overall Project

Overview

This Sediment Capping Project basically entails the placement of a physical barrier in the form of an engineered capping system over the impacted sediment within the project area. Figure 2 provides the limits of the Modified Removal Action (MRA) area, which SCE&G is proposing to cap. Based on the outline of the MRA area as shown on Figure 2, approximately 100,000 square feet or approximately 2.3 acres of the river sediment will be capped. The actual location, orientation and manufacturer of the capping materials will be determined during the detailed design phase of the project and in consultation with the construction contractor. Subsequent, post-MRA, long-term monitoring and institutional controls (i.e., permanent fence and signage) will also be a component of the overall remedy for the site, and will be developed at a later date as directed by SCDHEC.

Additionally, please note that the capping materials will also be installed from the bottom of the existing access road (i.e., approximate end of the pavement at the boat ramp) westward, into the river and integrated with the actual sediment cap, as shown in Figure 2. This extra boat ramp area is:

- Approximately 60 feet wide and 100 feet long 6,000 square feet);
- Has been a long-term, chronically-susceptible area for erosion due to run-off; and
- Must be addressed to help prevent future erosion under the planned sediment cap.

Conceptual Design

A Conceptual Design of Sediment Capping Options was developed by Rizzo Associates, which is included in Attachment B. Based on the design criteria included in the evaluation, the selected capping approach will consist of a geotextile fabric material overlain by articulated concrete blocks (ACBs) connected together to form a mat. The individual concrete mats (ACBs) are approximately 20 feet long, 8 feet wide and 8 inches thick. A layout of the approximate area to be capped along with the conceptual orientation of the 8' x 20' concrete mats is shown on Figure 2. The 8-inch thickness of the blocks was determined by Rizzo to be acceptable to withstand the conservative maximum flow velocities, based on the stated assumptions included in the conceptual design. For the evaluation, Rizzo considered the ArmorFlex ACB's. Attachment C provides another readily available ACB mat product manufactured by SHORETEC®. The actual product and manufacture of the ACB's will be determined in the detailed design phase and/or in consultation with the construction contractor. At a minimum, the actual cap materials used for construction will meet or exceed the criteria used in the conceptual design evaluation.

Implementation - Capping

It is currently envisioned that the ACBs will be placed from approximately the 116' elevation line and they will extend westward, out into the river from approximately 50 to 200 feet, depending on the location. The precise location, orientation, placement techniques and construction/deployment sequence will be at the discretion of the construction contractor and will likely be dictated by actual field conditions encountered during construction. With an average river flow elevation for the general project area over the last five years of approximately 116.5', most of the ACBs will be placed below normal river flow elevations, except for the erosion prevention area on the boat ramp as described above. The openings in the ACBs, also referred to as cores or cells, will be visible through the water, at low water levels. Even with the underlying geotextile material, it is anticipated that the capping system will settle a few inches into the soft sediment. It is also anticipated that the open cells within the ACB mats will fill with clean sediment [from the top] over time and result in a more natural looking surface.

The exact placement method for the cap will depend on a variety of factors including the location and flow/depth and river characteristics at that particular section of the area to be capped. Mat deployment is anticipated to proceed generally from north to south. Based on preliminary discussions with a marine contractor, very experienced with this type of work, small platform barges will be brought onto the site. After the barges are assembled on dry land and fastened together, they will be pushed into position in the river with heavy machinery. Temporary timbers will likely be used to facilitate movement and leveling of the barges.

As currently envisioned, the ACB mat placement scenario will include a crane and/or excavator working from land and the secured barge platforms or "work pads". Temporary access roads constructed on top of the existing river bank will permit the equipment to access and place the cap material over the extent of the impacted area. The capping material will likely be staged on flat bed trailers and transferred down the ramp for deployment by the crane, as needed. Access roads will be constructed, as needed, along the shoreline to allow placement, relocation and eventual removal of the barge sections. For portions of the project area located near the shoreline, the ACB mats will likely be placed with the equipment based on the shoreline. The boat ramp area will likely be the primary access point during construction. Disturbing the actual river bank will be minimized.

Sediment containment during active construction will be a critical element of the project. Mitigation plans include deploying a floating silt curtain around the active work area in an attempt to contain sediment that may be liberated during the actual cap installation activities. Also, large sands bags, similar to those used during implementation of the FDP, will be deployed into the river (almost perpendicular to the flow direction) to collect and help prevent downward migration of sediment that may be liberated during construction activities. Real-time, total suspended solids (TSS) monitoring will also be conducted to ensure that construction activities do not significantly increase TSS concentrations down-river of the active construction zone and a permitted "mixing" zone. Generally, there will be four areas for the sediment monitoring program:

- An up-stream, (background) zone;
- The active construction work area;
- An entrained sediment reduction area (i.e., mixing zone); and
- A down-stream monitoring area.

The active construction work area and the down-stream monitoring area will be separated by sediment reduction items (e.g., silt curtains, sand bags, etc.) as described above. The ultimate goal of the monitoring program is to ensure that the down gradient TSS monitoring results do not exceed the up gradient measurements.

The general sequence of activities will include deployment of the silt curtain/ big sand bags surrounding a designated work area, construction of the work platforms and installation of the engineered cap system. The mats will be staged in the landside support area on flatbed trailers area and transported to the work area for deployment as needed. For the ACB mats that are deployed on the eastern, or landside edge of the cap, a small anchor trench approximately three feet deep will be excavated and the edge of the mats will be laid into the anchor trench. The anchor trench will help secure the mats on the slope and serve to prevent erosion under the mats from upslope run-off areas. The geotextile material will likely be pre-cut and affixed to the bottom of the concrete mats (with some additional material left on the edges for overlap) in the landside support zone to facilitate placement. This method of deployment will allow for the mat and geotextile to be lifted and placed as a unit in one motion and was successfully utilized by SCANA at another river capping project in South Carolina.

In areas where large boulders or severely uneven river bottom sections prevent the effective use of the mats, pieces of geotextiles and singular concrete blocks (i.e., singular ACBs or "blocks") will be hand placed. Additionally, some areas may require some limited grading of existing sediment to facilitate an even or smooth and continuous mat placement (e.g. the sandbar bar removal). Conversely, some small, irregularly shaped depressions in the river bottom may need to be filled to allow the mats to adequately cover the underlying sediment. To the extent practicable, clean, imported backfill will be used to fill low areas to minimize disturbance to the existing bottom sediment. These type of filling operations are anticipated to be minimal but may be required because the ACBs need to be in direct contact with the subgrade that it protects or it could lead to destabilizing processes (i.e., erosion or channeling under the mats, please refer to Appendix B for additional information).

Field implementation of this alternative will require limited land based construction support activities on the eastern shoreline to improve access to the project area for personnel, equipment and delivery of capping materials. These construction activities will include limited grading operations in the area of the Senate Street alluvial fan and the current asphalt access road (boat ramp). The access road and shoreline improvements will be necessary to allow delivery and staging of the capping materials and deployment equipment. The project support compound constructed for the FDP (e.g. office trailers, parking areas, laydown areas, etc.) will be re-established and secured with a temporary fence. Additional lay down or trailer parking areas within the total project area will be constructed as needed.

Once the cap is installed, the barges, work pads, and non-permanent road construction materials will be completely removed from the river and the disturbed river bank and shoreline will be restored to existing conditions, to the extent practicable. Additional requirements of the selected approach, but not necessarily covered under this permit application, is the need to erect permanent fencing and install signs in the project area. The details related to the fencing and signage will be discussed between SCDHEC, the property owner and SCE&G and addressed at a later date.

Implementation - UXOs / Artifacts

It is important to note that this project is further complicated by the potential presence of Civil War era unexploded ordinance (UXO) and/or historically significant items within the area impacted by the TLM. In order to gather additional information regarding the potential for UXO and to gain first-hand knowledge of the logistical and technical constraints associated with working in close proximity to the Congaree River, SCE&G submitted a permit application and received authorization to conduct a Field Demonstration Project (FDP) under the Nationwide Permit #38. This request was approved by the USACE on September 1, 2015 and the FDP Work Plan was approved by SCDHEC on September 2, 2015. The FDP work was referred to as Phase 1.

The field work associated with the FDP was initiated in the fall of 2015. Completion of the FDP was hampered by significant rainfall events within the Congaree River drainage basin and subsequent severe increases in the river level elevations. The storm and flooding of early October 2015 and the related breach of the Columbia Canal resulted in the deposition of thousands of tons of "new" sediment in the river and shoreline of the project area. However, several key findings into the potential UXO component of the project were identified and are applicable to the proposed future capping options. The findings include:

1. No potential UXO or historically significant items were identified;
2. Of the 51 previously identified Magnetic Anomalies investigated – Zero (0) were UXOs;
3. 5 'negative finds' – meaning nothing was found at the previously identified metal anomaly location (i.e., no object found at approximately 10% of the locations);
4. There was a relatively large amount of "cultural debris" (i.e., metallic junk) unearthed; and
5. Evaluating the metal anomalies was a time consuming and meticulous process due to the volume of subsurface metallic debris that existed within the study area.

The FDP Documentation Report was submitted to the agencies on July 12, 2016 and provides the complete details and findings of the completed field work.

With respect to the potential UXOs and/or historical items in the project area, SCE&G believes that any artifact and/or UXO that may have been present in the area to be capped is now covered by an additional layer of sediment (of varying thickness) deposited during the flood of 2015. Placement of the engineered capping materials on top of the project area is intended to NOT disturb any potential UXO or historical item and once installed, the engineered cap will provide an added layer of protection or isolation with respect to potential human contact.

The detailed plans developed to address potential UXO management issues for the FDP are still relevant and will be adhered to for implementation of the capping alternative, with only a very minor modification as to when the plans get implemented as discussed below. The four "UXO" plans were included within the PCN for the FDP and are included in this application by reference:

- Draft Final Work Plan for Munitions Response Removal Action and Construction Support;
- Explosives Safety Submission, Munitions and Explosives of Concern, Removal Action and Construction Support;
- Diving Operations Plan; and
- Diving Safe Practices Manual.

Regarding the historical artifacts, Attachment D provides a copy of the Cultural Resource Identification Survey (CRIS), Archaeological Data Recovery Plan and the Memorandum of Agreement (MOA) between the parties. These detailed plans have been previously developed and reviewed in consultation with the appropriate entities (i.e., South Carolina Institute of Archeology and Anthropology (SCIAA), State Historic Preservation Office (SHPO).

All work will be completed in accordance with the approved plans as listed above with the following exception: SCE&G plans to have one member of the UXO team and one member of the archeologist's staff present on-site during intrusive activities (e.g. anchor trench excavation, sandbar removal etc.). Should either the UXO team member or the archeologist's representative observe any UXO and or artifact or other item or issue of concern (or historically significance, the capping/construction work will immediately stop and the plans described above will be implemented to the maximum extent practicable. Work will not be restarted until all parties are satisfied that the intent of the plans have been fulfilled.

<u>Schedule</u>

As with the prior removal approach, it is anticipated that the permitted construction season will be limited to May 1st through October 31st as previously approved by the National Marine Fisheries (NMFS), United States Fish and Wildlife Service (USFWS) and SC Department of Natural Resources (SCDNR). This six-month in-the-river construction schedule should provide ample time to enter the river, complete the work and withdraw from the river, assuming normal river elevations weather conditions are encountered while completing the work. As currently envisioned, site preparatory activities will be completed during the first and early second quarters of next year. The required mussel relocation plan will likely be implemented in mid-April, or immediately prior to the May 1st date. Barring any unforeseen extreme weather conditions, the work should be completed within four to five months.

Item #33 - Overall Project Purpose and the Basic Purpose of Each Activity

Placement of the sediment cap will greatly reduce the potential for human health exposure by serving to prevent direct contact with the TLM material in the near shore areas. From an environmental perspective, the impacted material will be further isolated and the cap will prevent re-suspension and potential downstream migration of impacted sediment. Typical marine construction activities are required to install the engineered capping system.

Item #34 - Type and Quantity of Materials to be Discharged

As currently planned, the engineered cap will consist of geotextile overlain by 8-inch thick articulating concrete blocks connected together into mat. Example pictures, drawings and specifications are provided in Attachments B & C. The current outline of the MRA area is shown on Figure 2 and SCE&G currently envisions utilizing mats approximately 8' wide x 20' long. Singular concrete blocks will be utilized in areas where large boulders, pipe obstructions, or severely uneven river bottom sections prevent the effective use of the full-size mats. These singular blocks will be hand placed, by divers if required. A total of approximately 106,000 square feet of capping materials are planned for placement (river cap – 100,000 SF and boat ramp erosion protection – 6,000 SF). The total quantity of material to be "discharged" or placed is approximately 2,630 CY (106,000 SF x 0.67 SF [mat thickness] / 27). Additionally, it is assumed that 10 truckloads of imported sand will be used to level low or non-uniform areas under the cap, or approximately 330 CY of fill. Therefore, a total a total quantity of material to be discharged is approximately 3,000 CY (say 2,650 CY of concrete mats and 350 CY of sand fill).

Item #35 - Type and Quantity of Impacts to U.S. Waterways (including wetlands)

Installation of the cap will conservatively raise the riverbed elevation in the project area by approximately 8-inches based on the thickness of the capping material (ACB mats). However, it is anticipated that the capping system may settle a few inches into the soft sediment, in some areas. Removal of the sand mound, approximately 930 cubic yards of material, will also alter the flow characteristics near shore, in that localized area. Installation of the cap will alter the current benthic habitat and bathymetric characteristics of the project area. These impacts will be mitigated somewhat since the concrete mats are expected to settle and/or compress the sediment directly below the mat, which will lessen the effect on the increase in river bottom elevation. In addition, the concrete mats, as shown in Attachment C, contain cells or voids which are expected to fill with depositional sediment and that will result in a more natural river bottom within the capped area. There are still large amounts of sediment abundantly present upstream of the project area. As stated above, a total of approximately 100,000 SF (approximately 2.3 acres) of riverbed will be impacted by the cap.

Clearing and grading along the river bank in order to provide access to the work area and install the anchor trench will be minimized to the extent practical and will be limited to the approximately 900 linear feet of the eastern shore directly adjacent to the project area. These construction related impacts are temporary and will be mitigated by removing the work pad/road components at the end of the project and restoring vegetation to all disturbed areas.

Item #36 - Individually List Wetland Impacts

Figure 4 provides the project area and the nearby Waters of the State. The Congaree River within the project area will be the only wetland impacted by the activity. As shown on Figure 3, two unnamed tributaries (#1 and #2) lie to the north and south of the project area. No activities are proposed that will impact these tributaries. A relatively large palustrine wetland is also located to the south of Unnamed Tributary #2 and will not be disturbed or impacted by these activities. Placement of the engineered capping system will cover the river bottom in the project area with geotextile and the 8-inch thick articulated concrete mat.

Road and work pad construction as well as clearing and grading along the river bank will also temporary impact approximately 900 linear feet of the eastern shore of the river. Once the project is completed, these impacts will be mitigated by removing the work pad/road components and revegetating the disturbed areas.

Item #37 - Individually List Seasonal and Perennial Stream Impacts

The Congaree River is the main perennial water body located within the project area. Placement of the capping material and completion of the project will impact approximately 100,000 square feet of the river bottom and approximately 900 linear feet of the riverbank. There are two perennial streams located adjacent to the project area, as shown on Figure 3. The planned construction activities covered under this permit request will have no impact on these streams.

Item #38 - Have You Completed Work on the Project Site?

Yes, the TLM delineation activities were completed from June 2010 through February 2011. The sampling methods and findings of the sediment investigation activities were provided in the Project Delineation Report (PDR) [MTR, March 2012], which was submitted to SCDHEC for review and approval. The PDR was approved by SCDHEC on April 23, 2012. A brief summary of the PDR and a copy of the approval letter were provided in previous submittals.

The first phase of the overall sediment MRA project was the Field Demonstration Project (FDP), which was completed in the fall of 2015 under a NWP-38 permit. A summary of the findings of the FDP are provided in the Introduction section of this application and more detailed information is included in the FDP Documentation Report, submitted in July 2016.

Previously, the USACE approved an NWP-14 permit for linear construction projects to construct the "Southern Access Route" to allow major truck traffic to enter and exit on Blossom Street. The PCN for this permit request was submitted on July 8, 2014 and was approved on October 20, 2014 (SAC-2014-728-6NO). However, no work was completed under this permit. Since the remedial approach has changed from cofferdam/exaction to capping, the "Southern Access Route" is no longer required and will not be installed.

Item #39 - Describe Measures Taken to Avoid and Minimize Impacts to Waters of the United States

Placement of the capping material and construction of the temporary work pads will impact benthic organisms such as freshwater mussels. As shown in Table 1, a number of higher value mussel species are potentially located in the project area. As currently planned, a freshwater mussel relocation contractor will be employed to scan the area to be capped for mussels and perform relocation activities prior to commencement of construction activities. This will greatly lessen the impact of the cap placement on the mussels. With the relocation of the mussels, it is anticipated that the capping material will not necessarily be detrimental to the overall habitat quality of the project area since the mats will likely settle somewhat and the voids will fill with sediment to create a more natural river bottom.

Erosion and sediment control measures and best management practices (BMPs) such as deployment of the silt curtain and big bags will be employed during construction as well as the TSS monitoring discussed above. Standard E&S controls will also be installed on the upland areas of the project, as required. These activities will allow for construction activities to be completed without an increase in sediment generation/movement form the overall project area.

Item #40 - Justification as to Why Mitigation Should not be Required

No mitigation plan should be required since the proposed capping will not appreciably impact the project areas use or functions. Placement of the cap will provide a benefit in the form of protection from contact with the TLM by humans and other organisms, significant reduction of the potential for resuspension of the TLM and subsequent downstream movement and reduction of flux of dissolved phase constituents with the water column.

Item #41 - Adjacent Property Owners

Tax Map Number: R08911-01-01
Owner: City of Columbia, 1737 Main St., Columbia, SC 29201
Property Location: 1105 Gist St.

Tax Map Number: R08911-01-17
Owner: The Guignard Partnership, PO Box 8509, Columbia, SC 29202
Property Location: Senate St.

Tax Map Number: R08911-01-14
Owner: The Guignard Partnership, PO Box 8509, Columbia, SC 29202
Property Location: Senate St.

Attachment E provides a map depicting the locations of these properties.

Item #42 - List All Corps Permit Authorizations ... and Other State ... Approvals

Information regarding this project has been previously submitted under United States Army Corps of Engineers (USACE) Permit Number P/N 2011-01356-6NO. SCE&G had been working toward receiving authorization to complete a Modified Removal Action (MRA) to address impacted sediment, as directed by the South Carolina Department of Health and Environmental Control (SCDHEC). As originally envisioned, the MRA would have entailed constructing a temporary cofferdam to isolate the planned excavation area and physically removing the impacted sediment down to the underlying bedrock. Based on a recent letter from SCDHEC to SCE&G, dated August 16, 2016 (Attachment A), the excavation and removal approach has been abandoned [for reasons detailed in the letter] and SCE&G has been requested to pursue a capping alternative. The SCDHEC and SCE&G have executed a Voluntary Cleanup Contract (VCC) for the former Huger Street MGP site which has been extended to cover the Congaree River Sediment Project.

The recently completed Field Demonstration Project (FDP) described above was implemented under the Nationwide Permit #38.

Previously, the USACE approved an NWP-14 permit for linear construction projects to construct the "Southern Access Route" to allow major truck traffic to enter and exit on Blossom Street. The PCN for this permit request was submitted on July 8, 2014 and was approved on October 20, 2014 (SAC-2014-728-6NO). The need for this alternate route was predicated on an anticipated large number of truck movements associated with the removal action. At this time, completion of the sediment capping alternative will result in significantly reducing the number of overall truck movements associated with the project and will not require construction of the southern access route.

Additional Permit and Approval Requirements

In addition to the requested USACE permit, the following permits and/or approvals [have been] or will be obtained prior to implementation:

- SCDHEC 401 Water Quality Certification;
- SCDHEC approval of the Sediment Capping Work Plan;
- SCIAA/SHPO - Data Recovery License;
- SCIAA/SHPO Intensive Survey License; and
- City of Columbia approvals.

These licenses and approvals [have been] or will be obtained in accordance with their applicable requirements and copies will be included in the Final Documentation Report for the project, which will be submitted to the USACE.

This completes the additional responses and attachments for the Joint Application.

CHECKLIST – PCN CONTENTS

Required Preconstruction Notification Contents

SAC #:
NWP: ______
Date Application Complete:

Determination of completeness must be made within 30 days of the date of receipt. If all required information is not provided, the prospective permittee will be notified that the preconstruction notification (PCN) is still incomplete and the review will not commence until all requested information has been received. If the applicant has not received written notice from the DE within ***45 days*** of the date of receipt of a complete PCN, ***the verification is issued by default.*** However, if the permittee was required to notify the Corps pursuant to GC #17 (the activity may have an effect on listed species or critical habitat) or GC #18 (the activity may have the potential to cause effect to historic properties), then the activity cannot proceed until written notification from the Corps. Also, for NWPs 21, 49, or 50, work cannot proceed until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, work cannot begin until the district engineer issues the waiver.

All PCNs must be in writing, clearly indicate the document is a PCN, and include the following information:

ITEM#

#1 ☑ Name, address and telephone numbers of prospective permittee.

#2 ☑ Location of proposed project. This should include the following:
- ☑ Latitude and Longitude (use center of project site)
- ☑ County and nearest municipality
- ☑ Street address, if available and directions to the site

#3 ☑ Brief description of the proposed action to include:
- 3A ☑ Project purpose
- 3B ☑ Direct and indirect adverse environmental effects the project would cause.
- 3C ☑ List any other Corps of Engineers (Corps) permits or verifications used or intended to be used to authorize any part of the proposed project or any related activity. Sketches of the proposed activities should be provided when necessary to show that the activity complies with the terms of the NWP.

#4 ☑ Description of the aquatic resources that will be adversely impacted by the activity

#5 ☑ Location of each proposed impact See attached Figures

#6 ☑ For activities involving discharges of dredged or fill material into waters of the United States, the application must include a statement describing how impacts to waters of the United States are to be avoided and minimized.

#7 ☑ The application must also include either a statement describing how impacts to waters of the United States are to be compensated for or a statement explaining why compensatory mitigation should not be required for the proposed impacts.

#8 ☑ For non-Federal applicants, if listed species or critical habitat might be affected or is in the vicinity of the project, the PCN must include the names(s) of those listed species that might be affected or utilize critical habitat. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act.

#9 ☑ For non-Federal applicants, if any activity may affect a historic property, the PCN must state the name of the historic property. Federal applicants are required to provide documentation demonstrating compliance with Section 106.

☐ A delineation of affected special aquatic sites and other waters of the United States is **required** if the project requires notification under General Condition 27. **NOTE**: *The 45-day default time clock does not start until the wetland delineation has been completed and submitted to the Corps.*

☐ For **NWP 3,** where maintenance dredging is proposed, the pre-construction notification must include information regarding the original design capacities and configurations of the outfalls, intakes, small impoundments, and canals.

☐ For **NWP 3,** paragraph a activities. The permittee must notify the DE in accordance with GC 27, if the discharge of dredged or fill material causes the loss of greater than 1/10 acre of waters of the U.S or there is a discharge in a special aquatic site, including wetlands and riffle pool complexes.

☐ For **NWP 12**, where the proposed utility line is constructed or installed in navigable waters of the United States (i.e. section 10 waters), copies of the pre-construction notification and NWP verification will be sent by the Corps to the National Oceanic and atmospheric Administration (NOAA), National Ocean service (NOS), for charting the utility line to protect navigation.

☐ **For NWP 12**, construction techniques to prevent draining, such as anti-seep collars, will be required for utility lines buried in wetlands, when necessary. If no construction techniques to prevent draining are proposed, the applicant must provide appropriate documentation that such techniques are not required to prevent wetland drainage.

☐ **For NWP 12**, all notifications must include:

- ☐ Specifications of how pre-construction contours will be re-established and verified after construction;
- ☐ A justification for the required width of all maintained utility crossings impacting waters of the U.S.;
- ☐ A justification for the loss of waters of the U.S. impacted by utility line sub-stations.
- ☐ The acreage of impacts to waters of the U.S indefinitely converted from a forested wetland to a herbaceous wetland and a compensatory mitigation proposal.

☐ **For NWP's 14, 29, 39 and 46**, all notifications must include appropriately sized and located culverts for crossings of waters of the U.S. that meet the requirements of General Conditions 2, 9 and 10.

☐ **For NWP 27,** notifications for aquatic habitat *restoration*, establishment, and enhancement activities will require coordination with appropriate Federal, State, and local agencies. The coordination activity will be conducted by the Corps of Engineers. Agencies will generally be granted 15 days to review and provide comments unless the District Engineer determines that an extension of the coordination period is reasonable and prudent.

☐ **For NWP 31**:

- ☐ Prospective permittee must notify the District Engineer with a PCN prior to conducting any maintenance activity. The PCN may be for activity-specific maintenance or for maintenance of the entire flood control facility by submitting a five-year (or less) maintenance plan.
- ☐ The PCN must include sufficient baseline information to identify the approved channel depths and configuration of existing facilities.
- ☐ The PCN must specify the location of the dredged material disposal site.

☐ **For NWP 33**, the preconstruction notification must include a restoration plan showing how all temporary fills and structures will be removed and the area restored to pre-project conditions.

☑ **For NWP 38**, notifications require the following information:

- ☑ Documentation that the specific activities are required to effect the containment, stabilization, or removal of hazardous or toxic waste materials as performed, ordered, or sponsored by a government agency with established legal or regulatory authority; See Attachment
- ☑ A narrative description indicating the size and location of the areas to be restored, the work involved and a description of the anticipated results from the restoration; See attached text

☑ A plan for the monitoring, operation, or maintenance of the restored area. See attached PCN text

☐ **For NWP 41**, notification must be submitted for projects that require mechanized land clearing in waters of the U.S., including wetlands, in order to access or perform reshaping activities.

☐ **For NWP 44**, if reclamation is required by other statutes, then a copy of the reclamation plan must be submitted with the pre-construction notification.

☐ **For NWP 45**, the permittee must submit a pre-construction notification within 12 months of the date of damage to uplands. The PCN should include documentation, such as a recent topographic survey or photographs, to justify the extent of the proposed restoration.

PRE-CONSTRUCTION NOTIFICATION (PCN)
SEDIMENT CAPPING PROJECT

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

September 2016

Prepared for:

SCANA Services, Inc.
220 Operation Way
Cayce, SC 29033

Prepared by:

Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15385

DOCUMENT FORMAT

See the attached Joint Federal and State Application Form for Activities Affecting Waters of The United States or Critical Areas of The State of South Carolina (Joint Application) for information on the project background, and the proposed project details. The Joint Application will be referenced in this brief Pre-Construction Notification (PCN) in order expedite review of the project. Information required for the PCN and not included in the Joint Application will be summarized in this document.

REQUIRED PRE-CONSTRUCTION NOTIFICATION (PCN) CONTENTS

The following information is provided as supplemental information based on the "Required Pre-Construction Notification (PCN) Contents" checklist. For convenience, "Item Numbers" were assigned to each box on the PCN Application.

Item #1 - Name, Permittee

See Items 1 – 10 of the attached Joint Application.

Item #2 - Location of Proposed Project

See item #31 of the attached Joint Application.

Item #3 - Brief Description of Proposed Action

See Item #32 of the attached Joint Application.

Item #3A - Project Purpose

See Item #33 of the attached Joint Application.

Item #3B - Direct and Indirect Adverse Environmental Effects

Installation of the cap would raise the riverbed elevation by approximately 8-inches based on the thickness of the capping material. As a result, the project area benthic habitat and bathymetric characteristics would be directly altered. These impacts will be mitigated somewhat since the concrete mats are expected to sink and/or compress the sediment directly below the mat, which will lessen the effect on the increase in river bottom elevation. In addition, the concrete mats, as shown in Attachments B and C, contain voids which are expected to quickly fill with depositional sediment that will result in a more natural river bottom within the capped area.

Placement of the capping material and construction of the temporary work pads will impact benthic organisms such as freshwater mussels. As shown in Table 1, a number of imperiled or vulnerable mussel species are located in the project area. As currently planned, a freshwater mussel relocation contractor will be employed to scan the area to be capped for mussels and relocate them to a suitable area prior to commencement of construction activities. This will greatly lessen the impact of the cap placement on the mussels. With the relocation of the mussels it is anticipated that the capping material will not necessarily be detrimental to the overall habitat quality of the project area since the mats will likely sink somewhat with time and the voids will fill with sediment to create a more natural river bottom.

Clearing and grading along the river bank in order to provide access to the work area will be minimized to the extent practical and will be limited to the approximately 900 linear feet of the eastern shore directly adjacent to the project area. Once the project is completed these impacts will be mitigated by removing the work pad/road components at the end of the project and reconstruction of the bank area, as required.

In addition, some of the capping materials in some portions of the project area may be visible during low water conditions. This will change the visual aesthetic of a portion of the project area. It is currently envisioned that the ACBs will be placed along the approximate 116' elevation line and they will extend out into the river from approximately 50' to 200' depending on the location, as seen on Figure 2. With an average river flow elevation for the project area over the last five years of approximately 116.5', the ACBs will be placed below normal river flow elevations. As a result, the majority of the cap will be well below the water level for most days of the year, which will reduce its visibility. The voids in the mat are also expected to fill with sediment, which will also aid in reducing its visibility.

Erosion and sediment control measures and best management practices (BMPs) such as deployment of the silt curtain will be employed during construction as will total suspended solids (TSS) monitoring. These activities will allow for construction activities to be completed without an increase in sediment movement outside of the project area.

Item #3C - List Any Other Corps Permits to Be Used

See Item #42 of the attached Joint Application.

Item #4 - Description of the Aquatic Resources that will be Adversely Impacted by the Activity

See Item #36 of the attached Joint Application

Item #5 - Location of Each Proposed Impact

The location of each proposed impact is provided in the attached figures.

Item #6 - How Impacts to Waters of the United States are to be Avoided and Minimized

See Item #39 of the attached Joint Application

Item #7 - Compensatory Mitigation Not Required

See Item #40 of the attached Joint Application.

Item #8 - Endangered Species Act - Animals

A number of sources were used to assess the potential presence of endangered or threatened species in the project area and include:

- U.S. Fish and Wildlife Service (FWS);
- U.S. National Marine Fisheries Service (NMFS);
- South Carolina Department of Natural Resources (SCDNR); and
- The Rare, Threatened and Endangered Species Assessment developed by Kleinschmidt (March, 2008) prepared for the Saluda Hydroelectric Relicensing Project (FERC project no. 516).

The Kleinschmidt report was primarily focused on Lake Murray and the Lower Saluda River and the downriver extent was generally terminated at the confluence with the Broad River or the headwaters of the Congaree River (Figure 1). However, the shortnose sturgeon study and the freshwater mussels study conducted as part of the assessment activities extended into the upper Congaree River including the area adjacent to the FDP area. Review of these assessments and the available information from the FWS and SCDNR identified a number of federal and state threatened and endangered species, federal candidate species and other species of concern. Table 1 provides a summary of these species.

Of specific interest to this general project area, are the Rafinesque's big-eared bat, shortnose sturgeon and several species of freshwater mussels. The Rafinesque's big-eared bat and shortnose sturgeon are listed as state endangered species and state and federal endangered species, respectively. The five species of freshwater mussels range from "vulnerable" to "imperiled" at either the national or state level in the NatureServe database. The shortnose sturgeon have been documented to be present in the vicinity of the project area during spawning runs. Based on prior submittals and correspondence with the USFW and others, the planned project, if completed between months of June through December, will have no impact on potential sturgeon migration. Mussel relocation operations will significantly reduce the potential for negative impacts.

The Rafinesque's big-eared bat's range includes the sandhills region and it is known to roost under I-beam and T-beam bridges. The Gervais Street Bridge may provide a roosting site for this bat. However, project activities will occur downstream of the bridge and should not impact potential roosting sites within the structure.

Item #8 - Endangered Species Act - Plants

Potential habitat exists within the project area for the occurrence of one federal endangered species (smooth coneflower) and one federal candidate species (Georgia Aster). The potential habitat for the smooth coneflower and Georgia Aster would be along the power line corridor located directly east of the river based project area. Current plans include the use of a limited portion of the power line corridor for land based support activities (Figure 2) including staging of capping material. Due to the relatively small footprint of the support zone that will be located in the powerline corridor any potential impact is expected to be extremely limited.

Item #9 - Historic Property

A Cultural Resources Identification Survey (CRIS) was conducted by TRC (Attachment D) that covered the overall planned project area and the general vicinity. In addition, potential historical sites were researched using ArchSite, which is a geographic information system (GIS) maintained by SHPO and SCIAA.

Two separate sites are located in the general vicinity of the project area that are designated as historically significant. The sites consist of the Gervais Street Bridge and the Columbia Canal. Both properties are listed in the National Register of Historic Places and are shown on Figure 5 and listed on Table 2. The Gervais Street Bridge is located directly upstream of the project area. Implementation of the capping project is not expected to adversely impact the Gervais Street Bridge. Figure 5 shows that the approximate extent of the Columbia Canal area (as defined by the National Historic Register. Although the activities described in this PCN are located within the historical designation area as defined by the National Register (Figure 5), project related activities are not expected to adversely impact this historic property.

The cultural resources survey identified a number of archeological sites located in the vicinity of the area to be capped. These areas are shown on Figure 5 with their applicable descriptions and site ID numbers. Possible ruins from a saw mill (site ID: 38RD224) and a former structure foundation (site ID: 38RD234) are located directly adjacent to the FDP area. The archeologist will locate these sites in the field and they will be avoided during completion of sediment capping project. An underwater deposit of historic items (site ID: 38RD278) is located within the planned capping area. This area will be impacted by sediment cap installation operations and an archeologist will be on-site to properly document and secure any potential historical items. The items will be transferred to SCIAA/SHPO, as needed.

The Civil War era dump site (site ID: 38RD286) located in the river is of primary concern for the overall sediment remediation project. The FDP was conducted in order to potentially identify historical items or UXO in the alluvial fan area and none were found. Fifty one previously identified metallic anomaly locations were investigated and only cultural debris and trash was uncovered. As a result, it is expected that a minimal amount of historically significant items and/or UXO is still present within the planned project area. As currently envisioned, the cap will be placed on top of the undisturbed sediment and will not have the potential to uncover historical items. SCE&G currently plans to minimize sediment disturbance as much as possible and should not impact any remaining historical items. In the unlikely event that historical items are identified during completion of the project an archeologist will document the finding and secure the item for transmittal to SCIAA/SHPO. SCIAA/SHPO require two licenses that will be obtained prior to implementing the removal action. The licenses include an Intensive Survey License and a Data Recovery License. These were obtained for Phase 1 and will cover Phase 2.

REFERENCES

Kleinschmidt, 2007. Status of the Shortnose Sturgeon in the Lower Saluda and Upper Congaree Rivers, 2007 Final Summary Report.

Kleinschmidt, 2008. Rare, Threatened and Endangered Species Assessment.

MTR, March 2012. Project Delineation Report – Congaree River Sediments Investigation.

MTR, May 2012. Draft Engineering Evaluation/Cost Analyses (EE/CA) – Congaree River Sediments.

South Carolina Department of Natural Resources, Inc. (SCDNR) Rare, Threatened and Endangered Species Inventory.

U.S. EPA, 1993. Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA.

U.S. Fish and Wildlife Service (USFWS), Endangered Species Program; Species Reports.

CHECKLIST – NWP-38

U.S. Army Corps of Engineers - Charleston District
Checklist for 2007 Nationwide Permit Review
Nationwide Permit 38

Cleanup of Hazardous and Toxic Waste
(10/404)

SAC #: 2011-01356-6NO

Applicant Name: South Carolina Electric & Gas Company

Waterway/Location: Congaree River

Project Name: Congaree River - Phase 2 - Modified Removal Action Sediment Capping Approach

1. Is the discharge in association with specific activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials?

   ☑ Yes* ☐ No

2. Are the activities performed, ordered, or sponsored by a governmental agency with established legal or regulatory authority?

   ☑ Yes* ☐ No

3. Are the activities the result of a court ordered remedial action plan or related settlement?

   ☐ Yes* ☑ No

4. Are the activities proposed in designated critical resource waters or their adjacent wetlands?

   ☐ Yes* ☑ No

5. Are the activities proposed for the establishment of new disposal sites or the expansion of existing sites used for the disposal of hazardous or toxic waste?

   ☐ Yes ☑ No

6. Are the activities undertaken entirely on a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site by authority of CERCLA as approved or required by EPA?

   ☐ Yes[1] ☑ No

7. Are all of the applicable NWP General and Regional Conditions satisfied, including, endangered species, and cultural resources, and if any Federally listed species and/or designated critical habitat occurs in the action area, have you made an effect determination and properly documented it in the administrative record?

   ☑ Yes ☐ No

8. Does the discharge cause the loss of greater than 300 linear feet of streambed?

☐ Yes ☑ No

TO QUALIFY FOR THE NWP, UNLESS OTHERWISE NOTED, EVERY NUMBERED ITEM MUST HAVE A CHECKED BOX.

* - REQUIRES A PRE-CONSTRUCTION NOTIFICATION (PCN) TO THE DISTRICT ENGINEER. **SEE THE SEPARATE PCN CHECKLIST TO ENSURE THE PROSPECTIVE PERMITTEE SUBMITS THE REQUISITE INFORMATION.**

NOTE: THE PCN MUST INCLUDE A DELINEATION OF SPECIAL AQUATIC SITES AND OTHER WATERS OF THE UNITED STATES. WETLAND DELINEATIONS MUST BE PREPARED IN ACCORDANCE WITH THE CURRENT METHOD REQUIRED BY THE CORPS.

Remember, determination of completeness must be made within 30 days of the date of receipt. If all required information is not provided, the prospective permittee will be notified that the preconstruction notification (PCN) is still incomplete and the review will not commence until all requested information has been received. If the applicant has not received any written notice from the DE within ***45 days*** of the date of receipt of the PCN, ***the verification is issued by default.***

IN ADDITION, The PCN MUST INCLUDE THE FOLLOWING:

- **Documentation that the specific activities are required to effect the containment, stabilization, or removal of hazardous or toxic waste materials as performed, ordered, or sponsored by a government agency with established legal or regulatory authority;**
- **A narrative description indicating the size and location of the areas to be restored, the work involved and a description of the anticipated results from the restoration;**
- **A plan for the monitoring, operation, or maintenance of the restored area.**

[1] - Activities undertaken entirely on a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site by authority of CERCLA as approved or required by EPA, do not require permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.

Reviewed by:
Date:

TABLES

TABLE 1

SUMMARY OF FEDERAL AND STATE THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN

Congaree River Sediments
Columbia, South Carolina

Common Name	Scientific Name	Federal Listed and Status(2)	State Protection and Status(3)	Potential Occurrence
Mammals				
Rafinesque's Big-Eared Bat	*Corynorhinus Rafinesquii / Plecotus Rafinesquii*	No	Yes - Endangered	Potential for occurrence in project vicinity under the Gervais and Blossom Street bridges.
Red-Cockaded Woodpecker	*Picoides Borealis*	Yes - Endangered	Yes - Endangered	No - habitat not suitable.
Wood stork	*Mycteria Americana*	Yes - Threatened	Yes - Endangered	No - habitat not suitable, extremely rare and if present likely from dispersion or migration.
Bald Eagle	*Haliaeetus Leucocephalus*	No	Yes - Threatened	No - habitat not suitable.
Fish/Amphibians				
Pine Barrens Treefrog	*Hyla Andersonii*	No	Yes - Threatened	No - found in the sandhills region located northeast of the project area.
Shortnose Sturgeon	*Acipenser Brevirostrum*	Yes - Endangered	Yes - Endangered	Yes - though if present numbers likely limited
Robust Redhorse Sucker	*Moxostoma Robustum*	N1 - Critically Imperiled	SNR - Not Ranked	Yes - stocked by SCDNR below Parr Shoals dam.
Freshwater Mussels				
Carolina Heelsplitter	*Lasmigona Decorata*	Yes - Endangered	Yes - Endangered	No - found in rivers and tributaries other than the Congaree River.
Roanoke Slabshell	*Elliptio Roanokensis*	N3 - Vulnerable	S2 - Imperiled	Yes - potential for occurrence in project vicinity
Yellow Lampmussel	*Lampsilis Cariosa*	N3N4 - Vulnerable, Apparentley Secure	S2 - Imperiled	Yes - potential for occurrence in project vicinity
Carolina Slabshell	*Elliptio Congaraea*	N3 - Vulnerable	S3 - Vulnerable	Yes - potential for occurrence in project vicinity
Carolina Lance	*Elliptio Angustata*	N4 - Apparently Secure	S3 - Vulnerable	Yes - potential for occurrence in project vicinity
Fatmucket	*Lampsilis Splendida*	N3 - Vulnerable	S2 - Imperiled	Yes - potential for occurrence in project vicinity
Plants				
Canby's Dropwort	*Oxypolis Canbyi*	Yes - Endangered	S2 - Imperiled	No - habitat not suitable
Georgia Aster	*Symphyotrichum Georgianum*	Yes - Candidate	SNR - Not Ranked	Yes - but only if area near power line is used for general support activities.
Rough-Leaved Loosestrife	*Lysimachia Asperulaefolia*	Yes - Endangered	S1 - Critically Impaired	No - habitat is not suitable.
Smooth Coneflower	*Echnincea Laevigata*	Yes - Endangered	S3 - Vulnerable	Yes - but only if area near power line is used for general support activities.

Notes:
(1) Kleinschmidt, March 2008.
(2) If species was not listed in the USFWS Endangered Species Database the NaturServe National Status is shown.
(3) If species was not listed in the SCDNR SC Rare, Threatened & Endangered Species Inventory the NatureServe State or Subnational Status is shown.

TABLE 2

LISTING OF NATIONAL REGISTER OF HISTORIC PLACES

Congaree River Sediments
Columbia, South Carolina

Historic Place	Location	Level of Significance	Area of Significance
Gervais Street Bridge	Spans Congaree River in West Columbia, SC	State	Architecture
Columbia Canal	East bank of the Broad and Congaree Rivers from the diversion dam to the southern railroad bridge in Columbia, SC	National	Industry

Notes:

1. Table includes properties near to or coinciding with the Congaree River removal actions and included on the National Register of Historic Properties.
2. Source: South Carolina Institute of Archeology and Anthropology & South Carolina Department of Archives and History.

FIGURES

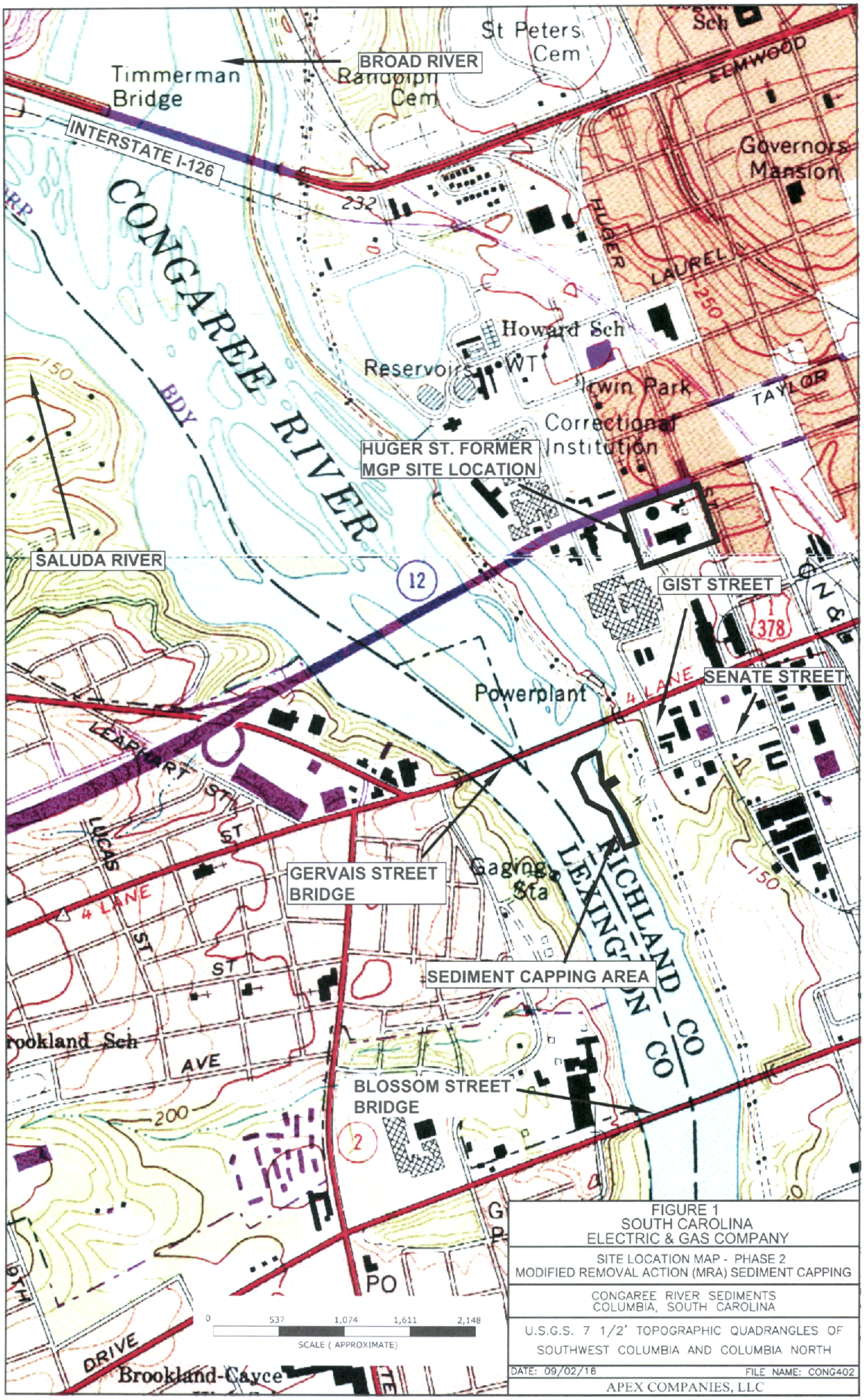


FIGURE 1
SOUTH CAROLINA
ELECTRIC & GAS COMPANY

SITE LOCATION MAP - PHASE 2
MODIFIED REMOVAL ACTION (MRA) SEDIMENT CAPPING

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

U.S.G.S. 7 1/2' TOPOGRAPHIC QUADRANGLES OF
SOUTHWEST COLUMBIA AND COLUMBIA NORTH

DATE: 09/02/16 FILE NAME: CONG402

APEX COMPANIES, LLC

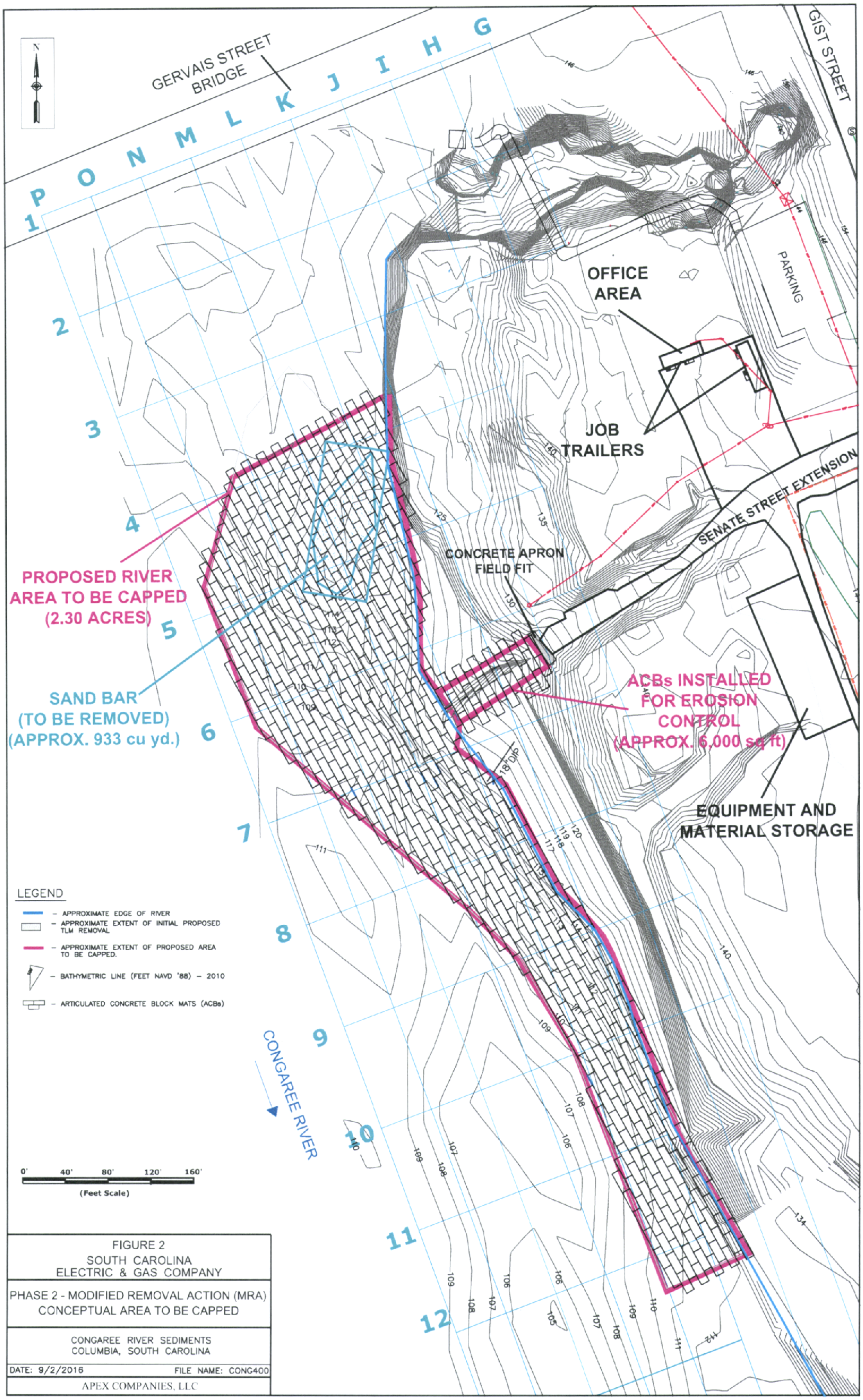


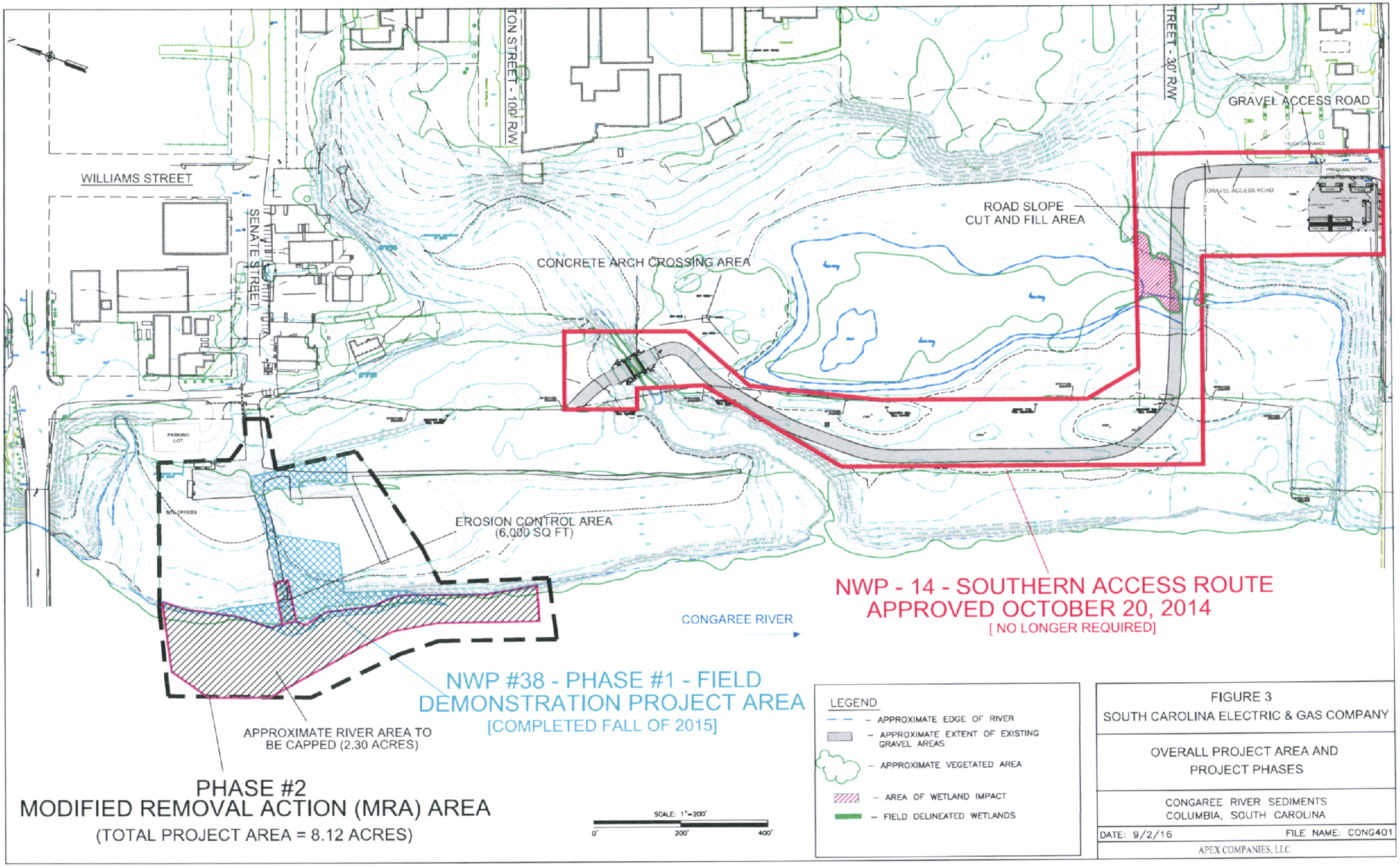
FIGURE 2
SOUTH CAROLINA ELECTRIC & GAS COMPANY

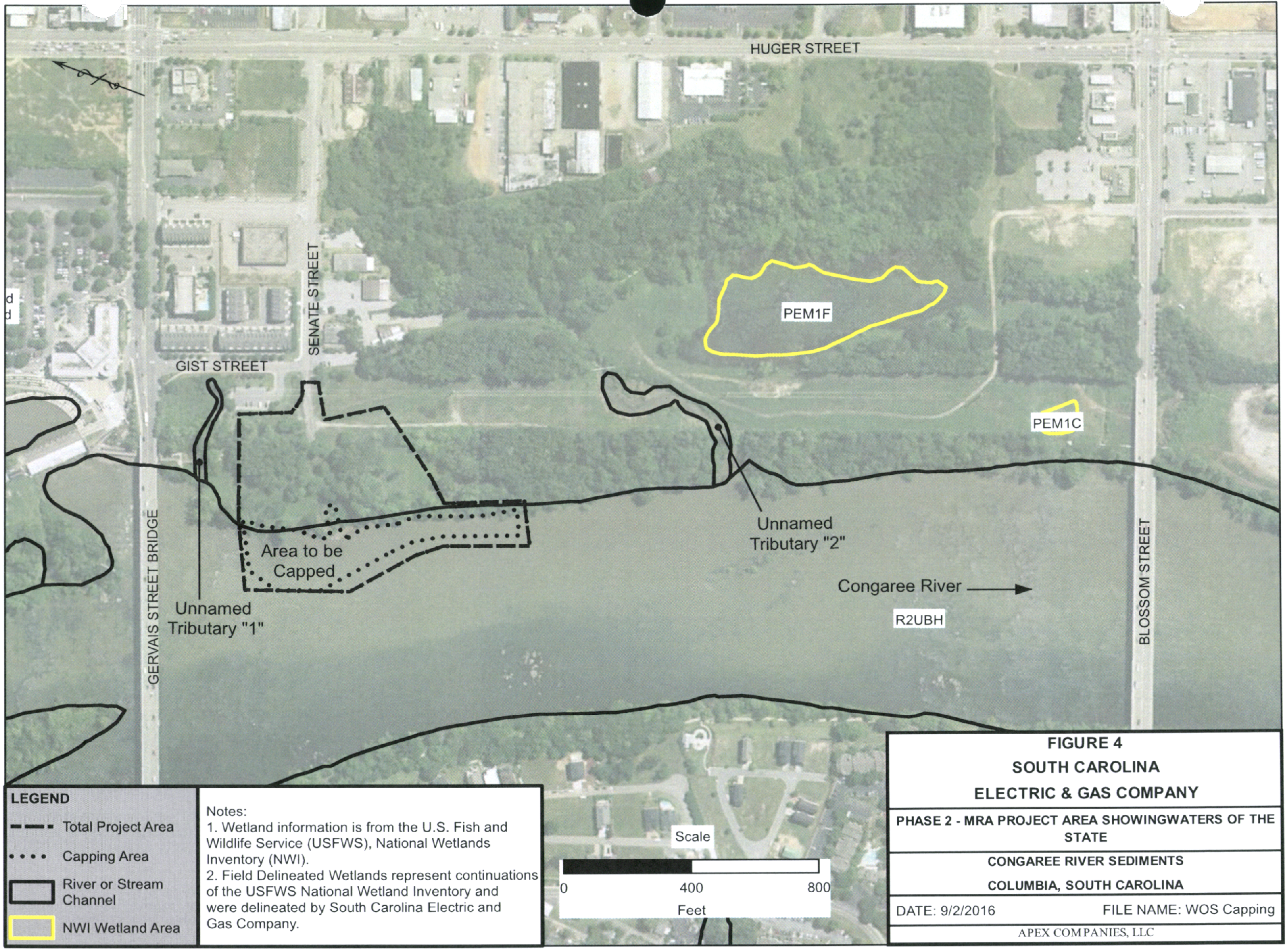
PHASE 2 - MODIFIED REMOVAL ACTION (MRA)
CONCEPTUAL AREA TO BE CAPPED

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 9/2/2016 FILE NAME: CONG400

APEX COMPANIES, LLC


GRAVEL ACCESS ROAD
TRUCK ENTRANCE
GRAVEL ACCESS ROAD
STREET - 30' R/W
TON STREET - 100' R/W
WILLIAMS STREET
SENATE STREET
ROAD SLOPE
CUT AND FILL AREA
CONCRETE ARCH CROSSING AREA
PARKING LOT
SITE OFFICES
EROSION CONTROL AREA
(6,000 SQ FT)
NWP - 14 - SOUTHERN ACCESS ROUTE
APPROVED OCTOBER 20, 2014
[NO LONGER REQUIRED]
CONGAREE RIVER
NWP #38 - PHASE #1 - FIELD
DEMONSTRATION PROJECT AREA
[COMPLETED FALL OF 2015]
APPROXIMATE RIVER AREA TO
BE CAPPED (2.30 ACRES)
PHASE #2
MODIFIED REMOVAL ACTION (MRA) AREA
(TOTAL PROJECT AREA = 8.12 ACRES)
SCALE: 1"=200'
0'
200'
400'
LEGEND
– APPROXIMATE EDGE OF RIVER
– APPROXIMATE EXTENT OF EXISTING GRAVEL AREAS
– APPROXIMATE VEGETATED AREA
– AREA OF WETLAND IMPACT
– FIELD DELINEATED WETLANDS
FIGURE 3
SOUTH CAROLINA ELECTRIC & GAS COMPANY
OVERALL PROJECT AREA AND
PROJECT PHASES
CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA
DATE: 9/2/16
FILE NAME: CONG401
APEX COMPANIES, LLC



Notes:
1. Wetland information is from the U.S. Fish and Wildlife Service (USFWS), National Wetlands Inventory (NWI).
2. Field Delineated Wetlands represent continuations of the USFWS National Wetland Inventory and were delineated by South Carolina Electric and Gas Company.

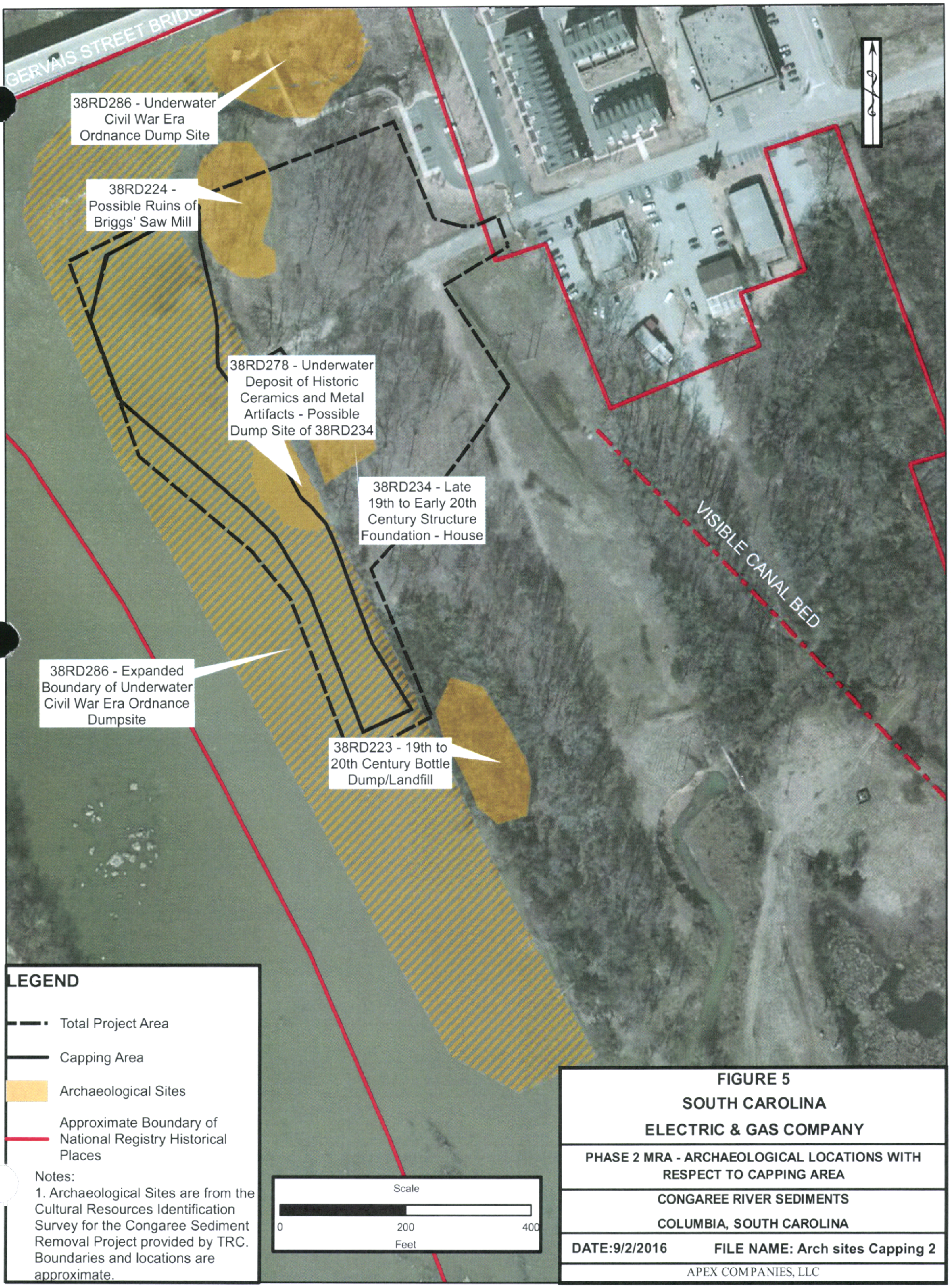
FIGURE 4
SOUTH CAROLINA
ELECTRIC & GAS COMPANY

PHASE 2 - MRA PROJECT AREA SHOWINGWATERS OF THE STATE

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

DATE: 9/2/2016 FILE NAME: WOS Capping

APEX COMPANIES, LLC


GERVAIS STREET BRIDGE
38RD286 - Underwater Civil War Era Ordnance Dump Site
38RD224 - Possible Ruins of Briggs' Saw Mill
38RD278 - Underwater Deposit of Historic Ceramics and Metal Artifacts - Possible Dump Site of 38RD234
38RD234 - Late 19th to Early 20th Century Structure Foundation - House
VISIBLE CANAL BED
38RD286 - Expanded Boundary of Underwater Civil War Era Ordnance Dumpsite
38RD223 - 19th to 20th Century Bottle Dump/Landfill
LEGEND
Total Project Area
Capping Area
Archaeological Sites
Approximate Boundary of National Registry Historical Places
Notes:
1. Archaeological Sites are from the Cultural Resources Identification Survey for the Congaree Sediment Removal Project provided by TRC. Boundaries and locations are approximate.
Scale
0
200
400
Feet
FIGURE 5
SOUTH CAROLINA
ELECTRIC & GAS COMPANY
PHASE 2 MRA - ARCHAEOLOGICAL LOCATIONS WITH RESPECT TO CAPPING AREA
CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA
DATE:9/2/2016
FILE NAME: Arch sites Capping 2
APEX COMPANIES, LLC

ATTACHMENT A

LETTER FROM L. BERRESFORD (SCDHEC) TO R. APPLE (SCANA) DATED AUGUST 16, 2016 REQUESTING SCE&G PURSUE A SEDIMENT CAPPING ALTERNATIVE

Healthy People. Healthy Communities

August 16, 2016

Mr. Robert Apple
SCANA Environmental Division
South Carolina Electric and Gas Company
4077 Haywood Road
Mills River NC 28759

RE: SCE&G Congaree River Sediments, Columbia SC
Removal Action Alternative
File # 52561, VCC# 02-4295-RP

Dear Mr. Apple,

In light of the 2015 flooding event and its impacts to the Congaree River, as well as the constraints with excavation of sediment from the Congaree River, the Department of Health and Environmental Control (Department) has reevaluated the alternatives from the 2013 Engineering Evaluation / Cost Analysis (EE/CA) for cleanup of the tar like material (TLM) in the Congaree River. Based on the current conditions, and the ability to obtain proper permits and safely conduct a removal action without adverse impacts to human health and the environment, the Department is requesting SCE&G pursue EE/CA Alternative 3 – Sediment Capping and Institutional controls instead of the removal alternative previously envisioned.

SUMMARY OF THE ADMININSTRATIVE RECORD

The following presents a summary of the administrative record maintained by SCDHEC:

- In June 2010, the occurrence of a tar-like material (TLM) within the Congaree River was reported to the Department. Three sediment samples were collected and analyzed by the Department and SCE&G. It was determined that that the TLM may be attributable to the Huger Street former Manufactured Gas Plant (MGP) that was located approximately 1,000 feet to the northeast of an outfall to the Congaree River. The MGP was operated by predecessor companies of SCE&G beginning in the early 1900s and ending in the 1950s.

- The Huger St. Former MGP Site is currently being administered by the Department via a Voluntary Cleanup Contract (VCC# 02-4295-RP). This VCC has been extended to include the impacted Congaree River sediment.

- After the initial discovery of TLM in June of 2010, SCE&G in conjunction with the Department conducted investigation activities within in the Congaree River to delineate the extent of TLM-impacted sediments. The delineation work was completed in five separate phases over approximately 18 months. The results of the delineation activities were submitted to the Department on March 23, 2012 in the Project Delineation Report (PDR) [MTR, March 2012]. Overall, the delineation activities extended from near the Gervais Street Bridge downriver approximately 9,050 feet to the area near the abandoned lock and dam. The PDR was approved by the Department on April 23, 2012.

- Next, SCE&G submitted an Engineering Evaluation/Cost Analysis (EE/CA) that evaluated potential options to address the TLM within the river. The EE/CA evaluated potential remedial approaches with respect to implementability, effectiveness and cost. In all, four remedial approaches were identified and analyzed in the final EE/CA approved by the Department in a letter dated February 7, 2013:

    - Alternative 1 - No Action – The TLM-impacted sediments would be left in their current state with no removal or mitigation activity;

    - Alternative 2 - Monitoring and Institutional Controls – Routine monitoring and evaluation of sediment conditions from within the impacted area would be conducted on a regular basis. Institutional controls in the form of a shoreline fence and signage would be put in place to limit access to the area.

    - Alternative 3 - Sediment Capping and Institutional Controls – This remedy would place a physical barrier in the form of an engineered capping system over the impacted sediment within the project area.

    - Alternative 4 - Removal and Off-Site Disposal – TLM and impacted sediment (and debris) would be excavated and transportation off-site to an approved disposal facility. This approach would include constructing a temporary cofferdam within the river to isolate the area to be excavated.

- The Department conducted a public meeting on March 21, 2013 to discuss the nature and extent of impacts and potential cleanup alternatives. All of the public comments received supported Alternative 4 - Removal and Off-Site Disposal. Therefore, in a letter dated May 8, 2013, the Department requested SCANA begin the design and permit process for Alternative 4 – Removal and Off-Site Disposal of the impacted sediments.

- Based on the EE/CA, the removal action alternative provided the best overall protection of human health and the environment, when compared to the other alternatives. The purpose of this remedy was to remove the most risk from exposure to contaminated material.

- A critical element of the removal alternative was the construction of a cofferdam to isolate the impacted area. The cofferdam had to be of sufficient size, height, and magnitude to withstand the fluctuating river while not adversely affecting the environment.

- While working through the design and permitting process, significant concerns were identified related directly to the construction of the cofferdam. These concerns included:
  - Risk in the form of potentially increasing shoreline erosion on the west bank;
  - Risk in the form of creating flooding on the west bank;
  - Risk in the form of an overtopping event or events;
  - Risk in the form of a catastrophic overtopping event where the cofferdam material and exposed TLM would be washed downriver; and
  - Risk associated with constructability leakage and removal of the proposed cofferdam.

- Based on these risks and concerns, the full-scale removal approach was abandoned and a Modified Removal Action was considered. This newly proposed Removal Action would consist of removing TLM-impacted material from a "focused" or "targeted" area of the site. The area would primarily consist of the thicker deposits of impacted material that are generally located closer to the existing eastern shoreline, where potential exposure due to activities such as swimming or wading is greater. Conceptually, implementation of the Modified Removal Action, would be completed using large sand bags or some other temporary means to sequentially isolate water from small subsections of riverbed within the "targeted" area to facilitate removal of TLM.

- On March 2, 2015, SCE&G in conjunction with the Department moved forward with the design and permitting of the Modified Removal Action and

SCE&G began revising all previously submitted plans to incorporate the approved modifications.

- A Field Demonstration Project (FDP) Work Plan was designed to primarily evaluate procedures for handling and managing metal anomalies that exist through-out the project area. These metal anomalies were considered potential unexploded ordnance (UXO). Implementation of the FDP allowed for the USACE-approved UXO management plans to be implemented on "dryland", before expanding the work into the full-scale river area.

- On September 1, 2015, the USACE approved the Pre-Construction Notification (PCN) for Implementing the FDP Work Plan;

- On September 2, 2015, the Department approved the FDP Work Plan.

NEW INFORMATION CONSIDERED

FDP implementation activities were conducted from September 8, 2015 through December 2015. Important findings include:

1. No potential UXO or historically significant items were identified;
2. Of the 51 previously identified Magnetic Anomalies investigated – Zero (0) were UXOs;
3. 5 'negative finds' – meaning nothing was found at the previously identified metal anomaly location (i.e., no object found at approximately 10% of the locations);
4. There was a relatively large amount of "cultural debris" (i.e. metallic junk) unearthed;
5. Evaluating the metal anomalies was a time consuming and meticulous process due to the volume of subsurface metallic debris that existed within the study area;
6. The project area is located adjacent within a very dynamic river environment. Due to the unpredictable nature of the river, isolating a work area with large sand bags proved to be ineffective during implementation of the FDP.
7. Based on multiple high–water events observed during the FDP, sandbags were not an effective way to allow for excavation of contaminated material from the river. In order to complete removal activities a "full-scale" cofferdam must be constructed.
8. The storm and flooding of early October 2015 and the related breach of the Columbia Canal resulted in the deposition of thousands of tons of "new" sediment in the river and shoreline of the project area. Much of the impacted sediment has been covered with a layer of new sediment, at varying thicknesses.

CONCLUSION

The Department has reevaluated the available options presented in the EE/CA and has determined that based on the construction and permitting limitations, it is not feasible to conduct a removal of TLM / impacted sediment in the Congaree River. Therefore, it is the Department's determination that the best remedy for the site is capping of a modified removal area. The primary objective of the capping approach is to limit or prevent human exposure to impacted sediments within the Modified Removal Area. The Department requests SCE&G pursue Alternative 3 – Sediment Capping and Institutional Controls as provided in the final EE/CA (approved by the Department in February 2013). SCE&G should begin the design and permit process for the capping alternative as soon as possible.

If you have any questions or comments please contact me at (803) 898-0747 or by email at berresjl@dhec.sc.gov.

Sincerely,

Lucas Berresford
State Remediation Section
Bureau of Land and Waste Management

cc: Harry L Mathis, P.G., Midlands Region EQC Director, via email
R. Gary Stewart, P.E., Manager State Remediation Section, via email
Mark Giffin, BOW
File 52561

ATTACHMENT B

CONCEPTUAL DESIGN OF SEDIMENT CAPPING OPTIONS DEVELOPED BY RIZZO AND ASSOCIATES

RIZZO ASSOCIATES

500 Penn Center Boulevard
Pittsburgh, PA 15235, USA
Phone: (412) 856-9700
Fax: (412) 856-9749
www.rizzoassoc.com

March 23, 2016
Project No. 11-4708

Mr. William Zeli
Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

via email: WZeli@apexcos.com

LETTER REPORT
CONCEPTUAL DESIGN OF SEDIMENT CAPPING OPTIONS
CONGAREE RIVER REMEDIATION
COLUMBIA, SOUTH CAROLINA

Dear Mr. Zeli:

This Letter Report presents the results of RIZZO Associates (RIZZO) engineering evaluation and conceptual design of sediment capping options for the Congaree River Remediation Project. Our services for this Project were performed in accordance with our January 22, 2016 proposal submitted to Apex Companies, LLC (Apex).

1.0 PROJECT UNDERSTANDING

Apex is currently working with South Carolina Electric & Gas (SCE&G) on a sediment remediation project in Columbia, South Carolina. The area to be remediated is located on the left bank of the Congaree River immediately downstream of the Gervais Street Bridge. A test program for evaluating the presence of metal anomalies was performed during fall 2015 and Apex is currently evaluating options for capping contaminated sediment in-place. Challenges with the Project include an uneven river bottom with boulders and rock outcrops, variable water levels, and swift currents in the Project area.

If any of the Project information described in this Letter Report is incorrect or has changed, please contact RIZZO immediately so that we can revise or amend the recommendations provided within, if appropriate.

2.0 DESIGN CRITERIA

Design Criteria were established for the conceptual design in RIZZO's February 5, 2016 (RIZZO Letter L38) letter to Apex. The following design criteria were considered during the development of the conceptual design options:

1. Flow Velocity: Previous HEC-RAS one-dimensional modeling of the existing river channel performed by RIZZO was reviewed to estimate the maximum water velocity in the area of remediation. Previous analysis considered the 100-year, 50-year, and 10-year floods, as well as several lower flow conditions. ***Table 2-1*** shows the maximum velocity in the area of interest for different flow conditions analyzed. The maximum velocity in the remediation area is 15.2 feet per second (ft/s) with a water surface of 128 feet (ft), National Geodetic Vertical Datum 1929 (NGVD29). To ensure the cap can withstand expected velocities, an approximately 20 percent increase was considered for the conceptual design. The capping options were evaluated assuming a maximum water velocity of 18 ft/s.

TABLE 2-1
MAXIMUM WATER VELOCITY IN PROJECT AREA

FLOW CONDITIONS	MAX VELOCITY (FT/S)
100-year Flood	10.5
50-year Flood	9.6
10-year Flood	8.1
128-ft Water Elev.	15.2
123-ft Water Elev.	8.4
120-ft Water Elev.	5.4
116.6-ft Water Elev.	2.7

2. Design Life: The capping needs to be a permanent (50 years or more) installation with little or no maintenance required. Only remediation options that met this requirement were considered.

3. Area to Cap: The capped area is expected to be the area shown on the Apex drawing titled "Targeted Removal Area to Be Capped" dated December 30, 2015. The cap is intended for containment of contaminated sediment and not for erosion control; therefore it is not required to extend the cap up the embankment beyond the normal water surface. A top elevation of 116.0 ft has been selected for the limits of remediation. The conceptual design includes extending the cap beyond the 116.0 ft limit in the area of the boat ramp for added erosion protection.

4. Appearance and Functionality: The area being capped has been a popular fishing and boating area, and includes an existing boat launch. The cap needs to be aesthetically pleasing, including the portion of the cap that is exposed above water during normal flow conditions.

The following factors are not part of the design criteria for the Project but were evaluated as part of the conceptual design:

1. Ease of Installation: Installation methods and restrictions are considered in the conceptual design, including the amount of equipment and time that would be required in the river and the ability of the option to accommodate the hard, uneven river bottom. To satisfy U.S. Army Corps of Engineers (USACE) requirements, the length of time working in the river should be less than six months to be considered a temporary encroachment on the river.

2. Anchoring: The cap needs to be secured in place. Feasibility and cost of different anchoring methods were taken into consideration, as well as the variable river bottom conditions that may be encountered during installation.

3. Cost: Cost was considered in development of the conceptual design alternatives. Installation methods and associated cost were considered in addition to material cost. A budgetary cost estimate has been developed for each option.

3.0 EVALUATION OF CAPPING OPTIONS

3.1 CAPPING ALTERNATIVES

Two alternatives were considered for the conceptual design of the cap. They included capping the contaminated area with articulated concrete blocks (ACBs) or with an erosion control mat.

ACBs, such as Contech ArmorFlex, are a flexible matrix of concrete blocks of uniform size, shape, and weight. Though they can be hand placed, they are typically interconnected with steel or synthetic cables to provide ease of installation and allow for them to conform to variations in the surface where they are being applied. An open-cell design for ACBs allows for placement of soil and seeding, allowing for vegetative growth; or for filling with rockfill or gravel to promote underwater habitats. ACBs provide hard armor erosion control and are well suited for shoreline protection, channel lining, and boat ramps (***Photograph 3-1***).

PHOTOGRAPH 3-1
INSTALLATION OF ACBs ALONG SHORELINE

Source: Project Profile, "Lake Wabamum Shoreline Protection," Nilex Civil Environmental Group, February 2012.

Erosion protection mats are a flexible turf reinforcement mat (TRM) for scour and erosion protection and slope stabilization. ArmorMax, by Propex Operating Company, is a two-part system. It combines PyraMat, a woven three-dimensional high performance turf reinforcement mat (HPTRM), and Type B1 percussion driven earth anchors (PDEAs). The mat is flexible and has high tensile strength. The mat surface is specially designed to interlock with the soil substrate and promote vegetative growth. These systems are well suited for shoreline protection, channel lining, and surficial slope stabilization (***Photograph 3-2***).

PHOTOGRAPH 3-2
INSTALLATION OF EROSION PROTECTION MAT
ALONG CHANNEL SLOPE

Source: Propex Operating Co., LLC, <http://propexglobal.com/Geo-Solutions/Product-Tour/ArmorMax>, Date accessed: February 4, 2016.

3.2 ANALYSIS AND FINDINGS

3.2.1 ACB Evaluation

RIZZO performed an analysis, following guidelines established by the Federal Highway Administration (FHWA), to determine an appropriate size and style of ArmorFlex block. Failure condition for ACBs is described in the guidelines as the local loss of intimate contact between the revetment and the subgrade it protects. The loss of contact can result from one or more of the following destabilizing processes:

- Ingress of flow beneath the armor layer
- Loss of subgrade soil through gradual piping
- Enhanced potential for rapid saturation and liquefaction of subgrade soil
- Loss of block or group of blocks from the revetment

The design guidelines are based around the ACB's hydraulic stability performance. They utilize a discrete particle approach to evaluate a single block within the overall matrix. The single block is evaluated for overturning, with the results being compared to a minimum factor of safety, which is based on the site conditions and intended application. A minimum factor of safety of 1.40 has been selected for the analysis. This value was selected based in part upon the low consequence of failure and the river conditions. Since HEC-RAS modeling has already been performed for the Site, a low degree of uncertainty in design values yields a lower recommended minimum factor of safety.

Two sizes of open-cell ArmorFlex block were evaluated based on the manufacturer's performance data: Class 50 (6-inch thick) and Class 70 (8.5-inch thick). Both blocks have a nominal area of 15.5-inch by 17.4-inch per block. The evaluation calculations are included in ***Attachment C***. It was determined from the analysis that the Class 50 block yielded a factor of safety of 1.34, which does not meet the minimum value. The Class 70 block yielded a factor of safety of 1.85, which does meet the minimum required value. Therefore, the conceptual design uses a Class 70 ArmorFlex block for the ACB mats.

3.2.2 Erosion Control Mat Evaluation

The initial selection of PyraMat and ArmorMax systems was determined using the Erosion Control Product Selection Guide from Contech engineering Solutions (Contech, 2012). The chosen option is based on the selection guide, a maximum velocity of 18 ft/sec, and a minimum design life of 50 years. From review of the manufacturer's data (Propex, 2015), the PyraMat system on its own is capable handling velocities up to 25 ft/sec and shear stress of 16 lb/ft^2 when in a fully vegetated state and there is good bonding with the substrate. Typical installation includes trenching and backfilling around the perimeter and the installation of 12-to-24 inch steel pins placed on 12-inch center over the entire area. When combined with the Type B1 percussion driven earth anchors to form the ArmorMax system, there are structural application benefits. Anchors are embedded up to 5 ft, and provide additional surficial slope stabilization. They do not, however, provide any performance improvement related to the maximum velocity.

According to manufacturer's data for PyraMat and ArmorMax systems, the channel surface should be uniform and smooth, having all rocks, clods, vegetation or other objects removed so that ArmorMax comes in direct, intimate contact with the channel surface. Based on manufacturer's data, the PyraMat and ArmorMax systems provide sufficient performance against design velocities, but they are not suited for the irregular and rocky conditions in portions of the Project area.

RIZZO has determined that the erosion control mats are not suited for capping the contaminated sediment along the river bed due to anchoring and bonding requirements. Neither the sediment layer nor the rocky bottom is sufficient for anchoring. There are also concerns with achieving the proper interlocking with the substrate to allow the erosion control mats to perform under the design velocities. Therefore, the conceptual design of the erosion control mats has not been developed further.

The erosion control mats could be installed above the normal water surface, in conjunction with the ACBs, if erosion protection of the river bank above the normal water surface elevation is required.

4.0 CONCEPTUAL DESIGN

A conceptual design has been developed for capping the contaminated sediment with ACBs. This design includes the placement of Class 70, open-cell, ArmorFlex ACB mats within the river channel to the extents of the proposed sediment capping area, provided in Apex's Drawing "Targeted Removal Area to be Capped" (CONG354, dated December 30, 2015). The ACB mats will cover the river bottom below elevation 116.0 ft. The ACB mats will also extend up the bank of the river to approximately elevation (EL) 124.0 ft in the area of the boat access ramp for protection in areas of prior erosion. ***Figure 1*** in ***Attachment A*** shows the limits of capping for the conceptual design.

The river bottom in the Project area includes rocky outcrops, boulders, and sediment. For proper placement of the ACB mats, rockfill will be used to fill in large holes or low spots within the remediation area as required, and geotextile fabric will be attached to the underside of the mats prior to placement. Large rocks or boulders may be temporarily moved to allow placement of the mats. In the event it is not practical to move or cover a rock outcrop or boulder, the feature will be left exposed and the ACB mat will be modified to fit around the feature. This may include the hand placement of ACBs, as needed. ***Figure 2*** in ***Attachment A*** shows a profile of the ACB mat installed along the embankment slope and river channel bottom. The design includes placement of rock in a portion of the capped area, following installation, to help promote sturgeon habitat.

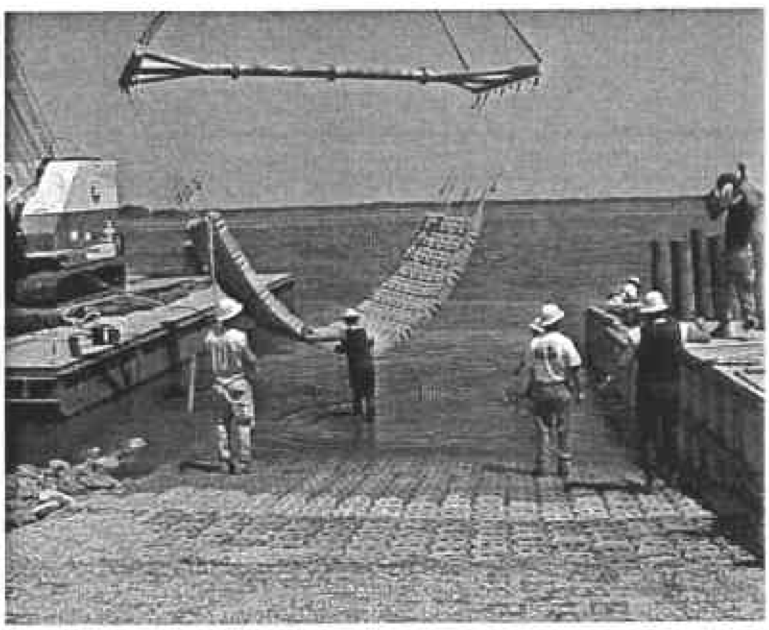
4.1 ANCHORING

The ACB mats will be anchored at the shoreline edge with an anchor trench. A minimum of two blocks will be turned down in the trench and covered with soil. See ***Figure 3*** in ***Attachment A*** for a detail of the anchor trench installation. Soil is recommended for the trench backfill based on the relatively shallow slopes at the Site. The backfilled soil will be seeded for a clean and aesthetically pleasing transition between the ACB mats and the embankment. Blocks above and around the normal water level will also be filled in with soil and seeded.

The edges of the mat located upstream, downstream, and parallel to the river flow will not have any additional treatment or anchoring. The perimeter blocks do not require any anchoring based on the results of the ACB stability calculation.

4.2 INSTALLATION

It is expected that the ACB mats will be installed using a spreader bar as shown in ***Photograph 4-1***. The span for the spreader bars span can range from 16 feet to up to 40 feet and can be sized for the site specific conditions. A crane or excavator can be used to lift the spreader bar and ACB mats.



PHOTOGRAPH 4-1
INSTALLATION OF ACBs BY CRANE

Source: Contech Engineering Solutions, Project Profile, "Sunny Point Marina," Sunny Point, North Carolina, Installed June 2003.

For the Congaree site, a crane or excavator will likely install the mats near the shoreline and in shallow water while operating from the shore or from shallow water near the bank. The area to be capped extends a maximum of approximately 200 feet into the Congaree River, with depths up to 11 feet under normal conditions. Therefore, some of the installation will be performed using an excavator or crane operating from a portable platform or a temporary access road in the water.

We estimate that it would take approximately 12 to 16 weeks to complete the installation. This estimate is dependent on the contractor, the number of crews they operate, and favorable weather and river conditions.

5.0 QUANTITY AND BUDGETARY LEVEL COST ESTIMATES

A material quantity and cost estimate has been developed for the ACB mat option and is included in ***Attachment B***. We estimate the cost of an ACB mat capping system will be approximately $3.57 million with the estimate influenced by the type of placement as described below.

For the cost estimate we have estimated that approximately 50 percent of the installation will be done by land and/or in relatively shallow water and that approximately 50 percent will be done by portable platform or a temporary access road in the water. The cost for land placement was estimated at 1.25 the cost of the ACB product. The cost of placement from the water was estimated at 2 to 2.5 times as much as the cost of the ACB product, so this ratio has a significant impact on the overall cost of the Project.

6.0 REFERENCES

1. Propex, 2015, Propex, "Product Data, ArmorMax for Erosion Control," Propex Operating Company, LLC, 2015.

2. Contech, 2012, Contech, "Erosion Control Product Selection Guide," Contech Engineered Solutions LLC, 2012.

7.0 SUMMARY

An evaluation of two proposed capping options for the Congaree River Remediation was conducted and a conceptual design was developed. We recommend that the articulated concrete block mats be considered for the capping of the Congaree River sediment.

If you have any questions or require any additional information, please contact me at 412-825-2015 or email me at kevin.cass@rizzoassoc.com.

Respectfully submitted,
RIZZO Associates

Kevin R. Cass, Senior Engineer,
RIZZO Associates

Kevin Cass, P.E.
Senior Project Engineer

Attachments

KRC/JDD/sdr

ATTACHMENT A

FIGURES

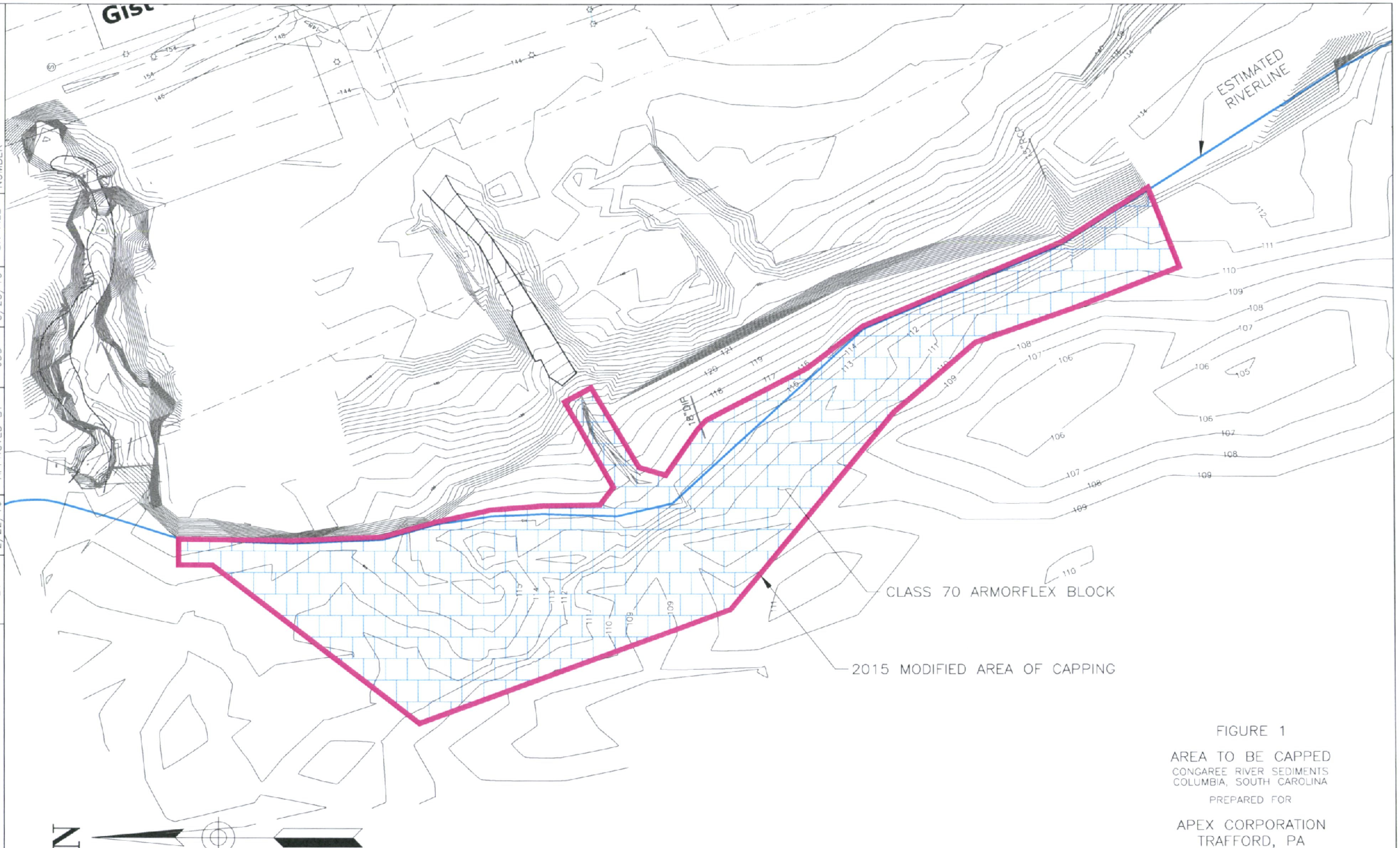


FIGURE 1

AREA TO BE CAPPED

CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA

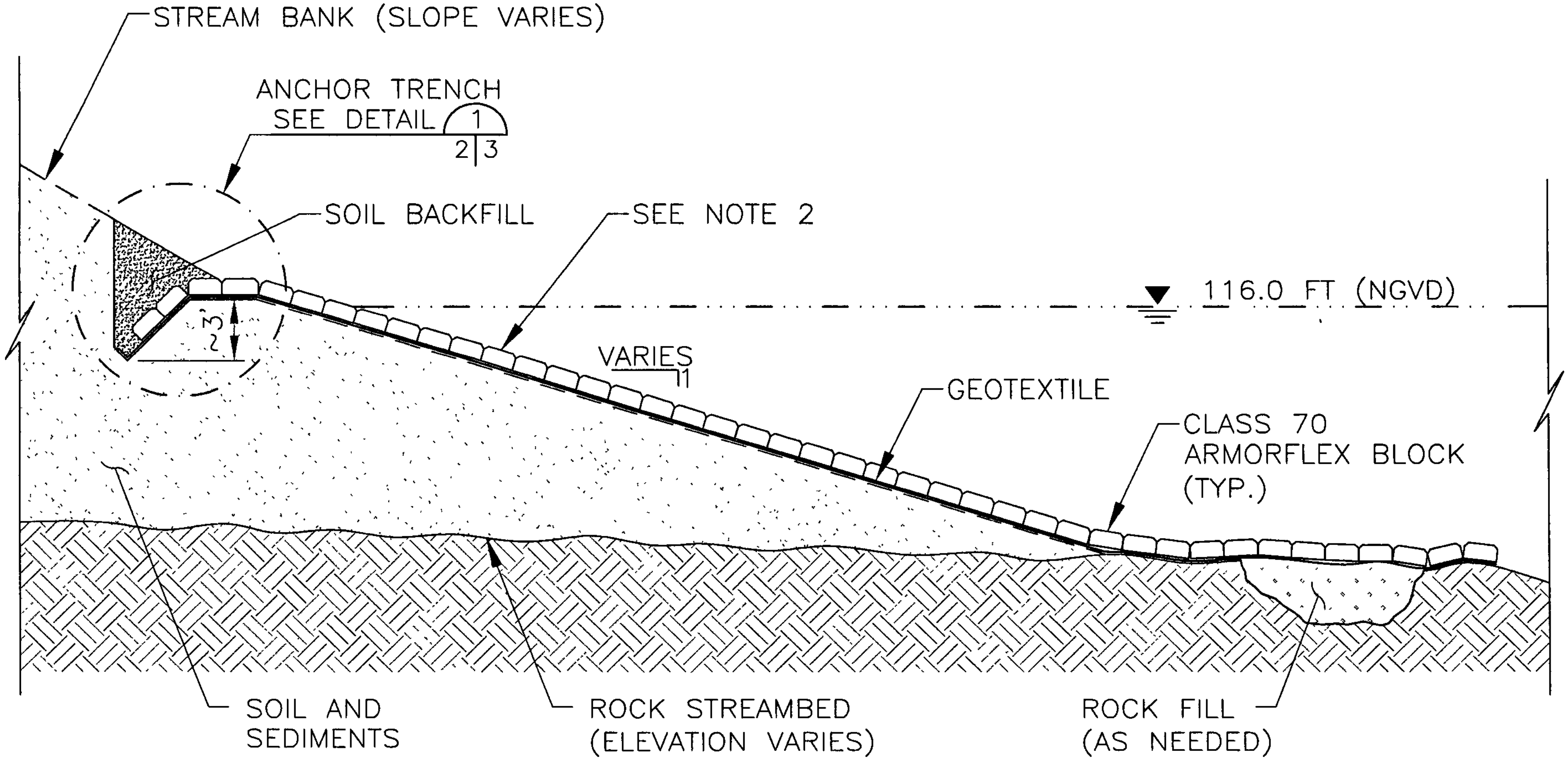
PREPARED FOR

APEX CORPORATION
TRAFFORD, PA

RIZZO ASSOCIATES

REFERENCE:
APEX DRAWING, "OPTION 2, TARGETED REMOVAL OF AREA TO BE CAPPED, "CONG354, PREPARED FOR SOUTH CAROLINA ELECTRIC & GAS COMPANY, APEX COMPANIES, LLC, 12/30/15.

DRAWN BY	TRD	2/22/16	CHECKED BY	KRC	3/23/16	SIGNATURES	CAD FILE	11-4708-B4
			APPROVED BY	JDD	3/23/16	ON FILE	NUMBER	



NOTE:

1. ARTICULATED CONCRETE BLOCKS (ACBs) WILL BE AN ARMORFLEX, CLASS 70, OPEN-CELL BLOCK WITH A NOMINAL HEIGHT OF 8.5-INCHES OR APPROVED ALTERNATE.

2. ROCK TO BE PLACED IN A PORTION OF THE CAPPED AREA VOIDS (HOLES IN BLOCKS), FOLLOWING INSTALLATION OF THE ACB MAT. BLOCKS ABOVE OR NEAR THE WATER LINE SHALL BE FILLED WITH SOIL AND SEEDED. OTHER BLOCKS TO REMAIN AS INSTALLED.

(NOT TO SCALE)

FIGURE 2

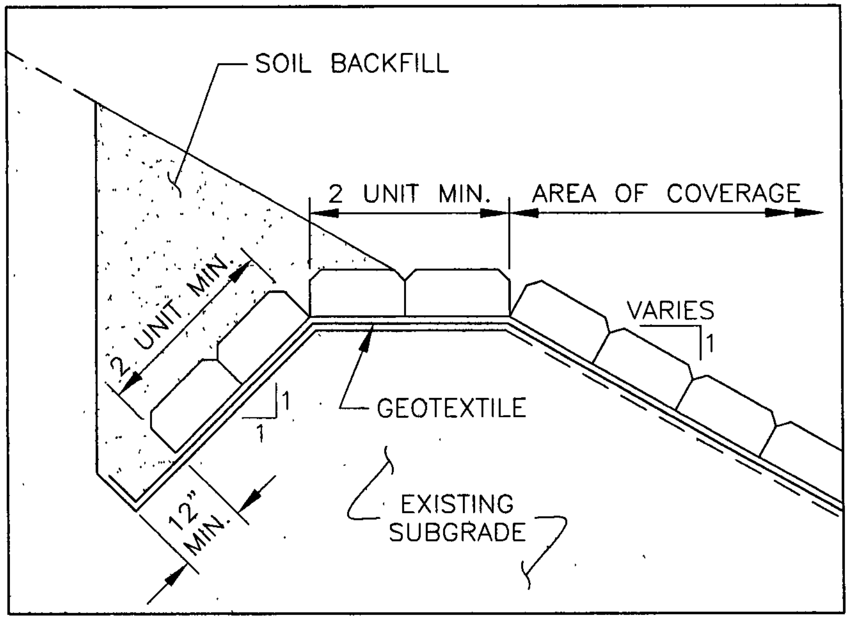
ACB MAT PROFILE

PREPARED FOR

SOUTH CAROLINA ELECTRIC & GAS
CONGAREE RIVER REMEDIATION
COLUMBIA, SOUTH CAROLINA

RIZZO ASSOCIATES

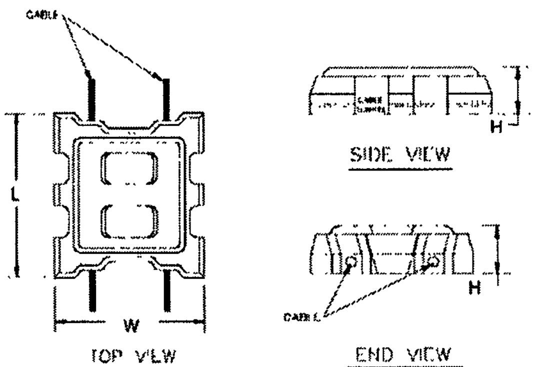
PLOT	DRAWN BY	TRD	CHECKED BY	KRC	3-23-16	CAD FILE NUMBER	114708A23
1:1	DATE	2-22-16	APPROVED BY	JDD	3-23-16		



DETAIL 1 2|3

ANCHOR TRENCH DETAIL

(NTS)



TYPICAL OPEN CELL BLOCK DETAIL

(NTS)

GENERAL NOTES:

1. ARTICULATED CONCRETE BLOCKS (ACBs) WILL BE AN ARMORFLEX, CLASS 70, OPEN-CELL BLOCK WITH A NOMINAL HEIGHT OF 8.5-INCHES OR APPROVED ALTERNATE.
2. PREPARE SUBGRADE PRIOR TO PLACEMENT OF THE ACB MAT. THIS INCLUDES CLEARING DEBRIS AND LARGER ROCKS AS REQUIRED AND FILLING LARGE HOLES WITH RIPRAP OR GRAVEL. FOR IMMOVABLE OBSTRUCTIONS THE MAT SHALL BE PLACED AROUND IT, WHILE MAXIMIZING COVERAGE.
3. A MINIMUM OF 2 UNITS SHALL BE ENTRENCHED FOR SECURING THE TOP EDGE OF THE ACB MAT. OTHER EDGES SHALL LAY FLAT, AS PLACED, WITH NO ADDITIONAL TREATMENT.

REFERENCE:
"ARMORTEC PRODUCT DETAILS", CONTECH ENGINEERING SOLUTIONS LLC, 2012.

(NOT TO SCALE)

FIGURE 3

ANCHOR TRENCH AND BLOCK DETAILS

PREPARED FOR

SOUTH CAROLINA ELECTRIC & GAS
CONGAREE RIVER REMEDIATION
COLUMBIA, SOUTH CAROLINA

RIZZO ASSOCIATES

PLOT	DRAWN BY	TRD	CHECKED BY	KRC	3-23-16	CAD FILE NUMBER	114708A24
1:1	DATE	2-23-16	APPROVED BY	JDD	3-23-16		

ATTACHMENT B

COST ESTIMATE

DCR ENGINEERS & CONSULTANTS

Congaree River Remediation
Conceptual Cost Estimate
Capping with ACB Mats

Item	Description	Estimated Quantity	Unit of Measure	Unit Cost	Total Estimated Cost (COMBO)
1.0	**Mobilization/Demobilization**				
1.1	Mobilization/Demobilization (10% of cost)	1	Lump Sum	$300,000.00	$300,000
	Sub Total 1.0				**$300,000**
2.0	**ACB Mat Installation**				
2.3	ACB Mat including Geotextile	104,400	SQ-ft	$8.60	$897,840
2.4A	50% Installation from Land (1.25 of product cost)	1.25	LS	$448,920.00	$561,150
2.4B	50% Installation from Water (2.5 of product cost)	2.50	LS	$448,920.00	$1,122,300
2.5	Rock Fill Placement (for low spots)	400	CY	$100.00	$40,000
2.6	Earthwork (Trench) and refill	389	CY	$40.00	$15,560
2.7	Soil Backfill and seeding	40	CY	$42.00	$1,680
2.8	Rock for habitat (based on 2-inch gravel in 50% of holes)	750	CY	$45.00	$33,750
	Sub Total 2.0				**$2,672,280**
				Sub Total	**$2,972,280**
				Contingency (20%)	**$594,456**
				Total	**$3,566,736**

ATTACHMENT C

CALCULATION

PCR ENGINEERS/CONSULTANTS/CM	**Calculation Title:** Congaree Sediment Capping		**Date:**	3-21-2016
	Calculation No.: 11-4708-F7	**Revision No.:** 0	**Page:**	1 of 28

Part I – Completed by Originator:

Project Name: Congaree River

1. If this is a revision, explain reason for revision: N/A
2. Have superseded versions been VOIDED, or destroyed as required? ☒N/A ☐No ☐Yes
3. Has design or analysis software been used for this Calculation? ☒No ☐Yes
   - 3.1. If Yes, provide the following information:
   - 3.2. Software Name: ________ Version Number: ________
   - 3.3. Computer Serial Number of computer used for this Calculation: ________
   - 3.4. Confirm that software is listed on Form QP-7-13. ☐No ☐Yes
   - 3.5. Confirm that Software Usage Log has been updated to include this calculation. ☐No ☐Yes
4. Has a thorough Self-Check of this Calculation been completed and accurate? ☐No ☒Yes
5. Is this calculation nuclear safety related? ☒No ☐Yes
   - 5.1. Has In-Use Test been performed on the computer used for this calculation? ☒N/A ☐No ☐Yes
   - 5.2. If "No" or "N/A," explain Non-nuclear safety related project

Part II – Completed by Verifier(s)–The Independent Reviewer shall address the following:

1. Calculation inputs were correctly selected. ☐N/A ☐No ☒Yes
2. Significant assumptions are adequately identified, described, justified, reasonable? ☐N/A ☐No ☒Yes
3. Any assumptions identified for re-verification are completed? ☐N/A ☐No ☒Yes
4. Calculation inputs were correctly incorporated into the design? ☐N/A ☐No ☒Yes
5. Numerical calculations correct, and documented? ☐N/A ☐No ☒Yes
6. Calculation outputs were reasonable compared to inputs ☐N/A ☐No ☒Yes
7. Calculation input and verification requirements for interfaces are identified (e.g., specified in the Work Plan, supporting procedures, or instructions) ☐N/A ☐No ☒Yes
8. Suitable materials, parts, processes, inspection and testing criteria specified? (e.g., may be applicable to design calculations, field activities, etc..) ☐N/A ☐No ☒Yes
9. Hand-annotated changes are made correctly (single line strike through, initialed, dated)? ☒N/A ☐No ☐Yes
10. All pages are legible, references identified and appropriate; document identifier and revision assigned; and acceptable with respect to grammar, spelling and punctuation ☐N/A ☐No ☒Yes
11. Each calculation input, Information and equations from external sources referenced? ☐N/A ☐No ☒Yes
12. Calculation Report contains the required information? ☐N/A ☐No ☒Yes

REVIEW COMMENTS:

Part III – Approval for Calculations:

Originator(s) Print Name	Signature/Date	
Kevin R. Cass	[signature]	Kevin R. Cass, Senior Engineer, RIZZO Associates
Verifier(s)	**Signature/Date**	**Verification: Independent Design Review**
Jennifer Mead	[signature]	Jennifer M. Mead, Engineering Associate, RIZZO Associates
Project Manager	**Signature/Date**	
Jared Deible	[signature]	Jared Deible, Senior Director, Dams & Water Resources, RIZZO Associates

Approval of the Project Manager signifies that the document and all required reviews are complete, and the document is released for use.

TABLE OF CONTENTS

PAGE

1.0 STATEMENT OF PURPOSE

The purpose of this calculation is to evaluate two different options for the capping of contaminated sediment in the Congaree River, just downstream of the Gervais Street Bridge, in Columbia, SC. From previously determined design criteria, articulated concrete block systems (ACBs) and erosion control mats have been chosen for evaluation. The ACBs are evaluated based on manufacturer's data and design guidelines in the Federal Highway Administration's (FHWA) Hydraulic Engineering Circular (HEC) No. 23 (***FHWA, 2009***). For conceptual design purposes, the erosion control mats are evaluated based on manufacturer's performance data only.

2.0 DESCRIPTION OF METHODOLOGY USED

The total contaminated sediment area runs approximately 1,650 feet along the east bank, starting downstream of the Gervais Street Bridge, and terminating at the inlet of a small unnamed tributary (referred to as Tributary No. 2). The area of interest for this evaluation is between river station 267750 (Section N) and river station 265610 (Section EX-5) of the previous HEC-RAS model (***RIZZO, 2014***). Several design criteria influence the selection of capping solutions, including maximum velocity and service life.

Previous HEC-RAS one-dimensional modeling of the existing river channel performed by RIZZO was reviewed to estimate the maximum water velocity in the area of remediation. Previous analyses considered the 100-year, 50-year, and 10-year floods (***RIZZO, 2014***), as well as several other lower flow conditions (***RIZZO, 2015***). The maximum velocity in the remediation area was determined to be 15.2 feet per second (ft/sec) for a water surface elevation of 128 feet, National Geodetic Vertical Datum 1929 (NGVD29). To ensure that the cap can withstand the expected velocities, an approximate 20% increase in velocity is applied to the design. Therefore, the cap is designed to withstand a maximum water velocity of 18 ft/sec.

The capping is required to be a permanent (50 years or more) installation with little or no maintenance required. Therefore, only capping solutions that meet this minimum requirement have been considered. For the evaluation of the ACBs, ArmorFlex by Armortec Erosion Control Solutions has been selected. Two sizes of ACBs were selected for initial evaluation. The ACBs are evaluated using design equations from HEC No. 23 (***FHWA, 2009***). For the evaluation of the erosion control mats, ArmorMax by Propex Operating Company has been selected. Erosion control mats are evaluated based on the manufacturer's data.

2.1 EVALUATION OF ARMORFLEX ACB

2.1.1 Initial Block Selection

ACBs are a flexible matrix of concrete blocks of uniform size, shape, and weight. Though ACBs can be hand placed, they are typically interconnected with steel or synthetic cables to provide ease of installation and to allow for the matrix of blocks to conform to variations in the application surface. The initial selection of ArmorFlex block is determined using the Erosion Control Product Selection Guide from Contech engineered Solutions (***Contech, 2012b***). Based on the selection guide and a maximum velocity of 18 ft/sec, the Class 50 (6-inch thick) and Class 70 (8.5-inch thick) ArmorFlex blocks are evaluated. The open-cell variation has a smaller mass and is therefore conservatively considered for evaluation.

2.1.2 Evaluation using HEC No. 23

The FHWA has established guidelines and equations for the design of articulated concrete block systems (***FHWA, 2009***). The design guidelines are based around the ACBs hydraulic stability performance. Failure condition for ACBs is described in the guidelines as, *"the local loss of intimate contact between the revetment and the subgrade it protects."* The loss of contact can result in one or more of the following destabilizing processes:

- Ingress of flow beneath the armor layer
- Loss of subgrade soil through gradual piping
- Enhanced potential for rapid saturation and liquefaction of subgrade soil
- Loss of block or group of blocks from the revetment

FHWA (2009) provides design guidance and equations for two types of applications: bank revetment (or bed armor) and pier scour. The procedures for bank revetment are followed for this evaluation. The design guidelines utilize a discrete particle approach to evaluate a single block within the overall matrix. The single block is evaluated for overturning and compared to a minimum Factor of safety (SF), which is determined based on the application. A minimum SF of 1.40 has been selected for this evaluation for channel bed or bank protection. Armortec has published design guidance (***Armortec, 2002***) that is based on HEC No. 23 (***FHWA, 2009***) and was reviewed during the evaluation.

The evaluation of ACBs can be outlined in the following steps from ***FHWA, 2009***:

1. Determine a Target Factor of Safety
2. Calculate Design Shear Stress
3. Obtain ACB Properties
4. Calculate Drag and Lift force due to protrusion
5. Calculate Stability Number for Block on a Horizontal Surface
6. Calculate Angle between Side Slope projection of Submerged Block Weight and the Vertical

7. Calculate projection of Submerged Block Weight
8. Calculate Angle between Block Motion and the Vertical
9. Calculate Angle between Drag Force and Block Motion
10. Calculate Stability number for a Block on a Sloped Surface
11. Calculate the Submerged Weight of each Block
12. Calculate the Factor of Safety for each Block

Design inputs are summarized in ***Section 4.0*** and the equations are presented in ***Appendix A***. The numerical calculations were performed using Microsoft Excel. The Excel worksheets and detailed numerical calculations are presented in ***Appendix A***.

2.2 Evaluation of Erosion Control Mats

Erosion control mats provide scour and erosion protection and slope stabilization. ArmorMax, by Propex Operating Company, is a two-part system comprised of PyraMat, a woven three-dimensional High Performance Turf Reinforcement Mat (HPTRM), and Type B1 percussion driven earth anchors (PDEAs). The mat is flexible and has high tensile strength. The mat surface is specially designed to interlock with the soil substrate and promote vegetative growth.

The initial selection was determined using the Erosion Control Product Selection Guide from Contech engineering Solutions (***Contech, 2012b***). The chosen option is based on the selection guide, a maximum velocity of 18 ft/sec, and a minimum design life of 50 years. This evaluation will also consider the PyraMat on its own, without anchors.

3.0 ASSUMPTIONS AND JUSTIFICATION

1. All elevations are referenced to the National geodetic Vertical Datum of 1929 (NVGD29).
2. The design life of the capping solution should be permanent (minimum 50 years).
3. Maximum velocity is determined based on existing hydraulic analysis of the reach with an applied 20% increase to ensure that the cap can withstand the expected velocities.
4. A channel bed slope of 0.05 ft/ft is assumed for the area of evaluation for the Congaree River.
5. A value of 0.5-inch is assumed for the height of block protrusion above the ACB mat. This is based of design examples from the HEC No. 23 guidelines (***FWHA, 2009***).

6. The channel side slopes and maximum depth are estimated issuing cross-section data from previous HEC-RAS analyses, and are determined assuming capping will be applied up to an elevation of 116.0 ft.

4.0 CALCULATION INPUT

The evaluation of ACBs will consider ArmorFlex open-cell Class 50 (6-inch height) and Class 70 (8.5-inch height) blocks. ***Table 4-1*** summarizes the design inputs used for this evaluation and the reference sources.

TABLE 4-1: DESIGN INPUTS

Input	Value	Reference Source
Design Velocity	18 ft/sec	***RIZZO, 2015***
Maximum Depth	26.4 ft	***RIZZO, 2015***
Side Slope	3.8H:1V	***RIZZO, 2014***
Channel Bed Slope	0.05 ft/ft	***Assumption 4***
Slope of Energy Grade Line	0.0007624	***RIZZO, 2015***
Channel Top Width	1062.58 ft	***RIZZO, 2015***
ACB Dimensions	*see Appendix A*	***Contech, 2012a***
Critical Shear Stress on Horizontal	*see Appendix A*	***Contech, 2012b***
Submerged Weight of each Block	*see Appendix A*	***Contech, 2012b***
Height of Block protrusion above ACB Mat	*0.5 in*	***FHWA, 2009***

<u>Design Velocity</u> – based on a maximum velocity of 15.2 ft/sec with an approximate 20% increase.

<u>Maximum Depth</u> – the maximum channel depth within the area of analysis from the existing conditions cross-sections.

<u>Side Slope</u> – the maximum side slope within the area of analysis from the existing conditions cross-sections.

<u>Channel Bed Slope</u> – the slope of the channel bed along the area of analysis.

<u>Slope of Energy Grade Line</u> – the energy grade line slope at the cross-section where the maximum velocity was determined.

<u>Channel Top Width</u> – the average channel top width from within the area of analysis from the existing conditions cross-sections.

<u>ACB Dimensions</u> – The length, width and height of the ArmorFlex blocks.

<u>Critical Shear Stress on Horizontal</u> – the critical shear stress for a given ACB on a horizontal surface, provided by Armortec.

<u>Submerged Weight</u> – the submerged weight of a given ACB, provided by Armortec.

Height of Block Protrusion above ACB Mat – the height that a single block may protrude from the ACB mat. Used for the calculation of additional drag force. Estimated from FHWA guidelines.

5.0 NUMERICAL CALCULATIONS

See ***Appendix A*** for the ACB evaluation Excel worksheets.

6.0 CALCULATION OUTPUT

Not Applicable

7.0 RESULTS

7.1 ACB RESULTS

Table 7-1 summarizes the results of the ACB evaluation.

7-1: ARMORFLEX ACB EVALUATION RESULTS

Input	Value
Target Factor of Safety	1.40
Factor of Safety for Class 50 Block (6-inch)	1.34
Factor of Safety for Class 70 Block (8.5-inch)	1.85

7.2 EROSION CONTROL MAT FINDINGS

From review of the manufacturer's data (***Propex, 2015***), the PyraMat system on its own is capable handling velocities up to 25 ft/sec and shear stress of 16 lb/ft^2, when in a fully vegetated state and there is good bonding with the substrate. When combined with the Type B1 percussion driven earth anchors to form the ArmorMax system, there are structural application benefits. Anchors are embedded up to 5 feet, and provide surficial slope stabilization. They do not provide any improvement to the maximum velocity.

PyraMat has a design life of up to 50 years. The ArmorMax system has a design life of up to 50 years or greater. These erosion control mats are intended for application on soil substrates and are not suited for installation on rocky surfaces.

8.0 CONCLUSION/SUMMARY

The results in ***Table 7-1*** show the Class 70 block meets and exceeds the target factor of safety of 1.40. The Class 50 block does not meet the target factor of safety under the design conditions. According to manufacturer's data for PyraMat and ArmorMax systems, the channel surface should be uniform and smooth, having all rocks, clods, vegetation or other objects removed so that Armormax comes in direct, intimate contact with the channel surface. Based on manufacturer's data, the PyraMat and ArmorMax systems provide sufficient performance against design velocities, but they are not suited for the irregular or rocky conditions of the Congaree River.

Therefore, the initial conceptual design should be performed using the Class 70, open-cell ArmorFlex ACB mats. Erosion control mats, such as PyraMat or ArmorMax, may still be suited for the river bank, above the waterline, where sufficient soil may exist for proper anchoring and bonding.

9.0 REFERENCES

1. ***FHWA, 2009***: FHWA, "Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition," Hydraulic Engineering Circular No. 23, Publication No. FHWA-NHI-09-112 Volume 2, National Highway Institute, U.S. Department of Transportation, Federal Highway Administration, September 2009.
2. ***RIZZO, 2014***: RIZZO, "Congaree Backwater Analysis," Calculation No. 114708-F2, Rev. 1, Paul C. Rizzo Associates, 4/15/2014.
3. ***RIZZO, 2015***: RIZZO, "Cofferdam Berm Height Evaluation," Letter No. 35 to William Zeli, Apex Companies, Rizzo Associates, 7/1/2015.
4. ***Armortec, 2002***: Armortec, "ArmorFlex Design Manual, Abridged Version 2002, Design Manual for ArmorFlex Articulating Concrete Blocks," Armortec Erosion Control Solutions, 2002.
5. ***Propex, 2015***: Propex, "Product Data, Armormax for Erosion Control," Propex Operating Company, LLC, 2015.
6. ***Contech, 2012a***: Contech, "Armortec Product Details," Contech Engineered Solutions LLC, 2012.
7. ***Contech, 2012b***: Contech, "Erosion Control Product Selection Guide," Contech Engineered Solutions LLC, 2012.

APPENDIX A

ARMORFLEX ACB EVALUATION EXCEL WORKSHEETS

Inputs and Known Design Conditions		
Channel discharge, Q (cfs)	148000	*Not used, for information only*
Cross section average velocity, V_{ave} (ft/s)	8.7	*Not used, for information only*
Maximum velocity, V_{des} (ft/s)	18.0	
Maximum depth, y (ft)	26.4	
Side slope, H:V	3.8	
deg	14.74	
Bed slope, S_o (ft/ft)	0.05	*assumed channel slope for area of evaluation*
deg	2.86	
Slope of energy grade line, S_f (ft/ft)	0.0007624	
[average] Channel top width, T (ft)	1062.58	
Radius of curvature, R_c (ft)	N/A	*Section of reach is fairly straight*
density of concrete, γ_c (pcf)	140	*Not used, for information only*
mass density of water, ρ (slug/ft^3)	1.94	
density of water, γ_w (pcf)	62.4	

1. Target Factor of Safety		
Base Factor of Safety, SF_B	1.4	*assumed based on high velocities (figure 8.2, **FHWA, 2009**)*
multiplier based on consequence of failure, X_C	1	*assumed based on low risk from failure (figure 8.2, **FHWA, 2009**)*
multiplier based on model uncertainty, X_M	1	*assumed based on model geometry (figure 8.2, **FHWA, 2009**)*
$SF_T = (SF_B)(X_C)(X_M)$	1.4	

2. Calculate Design Shear Stress		
R_c/T	>>10	*Section of reach is fairly straight, therefore radius is assumed to greatly exceed the top width of the channel*
for $R_c/T \geq 10$ $K_b = 1.05$	1.05	
$\tau_{des} = K_b(\gamma)(y)(S_f)$ (psf)	1.32	

3. Obtain ACB Properties		
ArmorFlex Open Cell Block	Class 50	Class 70
length, l (in)	17.4	17.4
width, w (in)	15.5	15.5
height, h (in)	6.0	8.5
submerged weight, W(lb)	47.8	75.3
[1/2 block height] moment arm, ℓ_1 (in)	3.0	4.3
[distance center to corner] moment arm, ℓ_2 (in)	11.7	11.7
[8/10 block height] moment arm, ℓ_3 (in)	4.8	6.8
[distance center to corner] moment arm, ℓ_4 (in)	11.7	11.7
Critical shear stress for block on horiz surface, τ_c (psf)	26.6	35.5

4. Calculate Drag and Lift force due to protrusion, F_L' and F_D'		
height of block protusion above ACB mat, Δz (in)	0.5	0.5
block width normal to flow, b (in)	23.3	23.3
$F_L' = F_D' = 0.5\rho b(\Delta z)(V_{des})^2$ (lb)	25.43	25.43

5. Calculate Stability Number for Block on a Horizontal Surface, η_0		
$\eta_0 = \frac{\tau_{des}}{\tau_C}$	0.049520528	0.0371055

6. Calculate Angle between Side Slope projection of Submerged Block Weight and the Vertical, θ		
$\theta = \arctan\left(\frac{\tan\theta_0}{\tan\theta_1}\right)$	10.76	10.76

7. Calculate projection of Submerged Block Weight, a_θ		
$a_\theta = \sqrt{(\cos\theta_1)^2 - (\sin\theta_0)^2}$	0.97	0.97

8. Calculate Angle between Block Motion and the Vertical, β		
$\beta = \arctan\left(\frac{\cos(\theta_0+\theta)}{\left(\frac{\ell_4}{\ell_3}+1\right)\left(\frac{\sqrt{1-a_\theta^2}}{\eta_0(\ell_2/\ell_1)}\right)+\sin(\theta_0+\theta)}\right)$	11.31	7.74

9. Calculate Angle between Drag Force and Block Motion, δ		
$\delta = 90^\circ - \beta - \theta$	67.93	71.51

10. Calculate Stability number for a Block on a Sloped Surface, η_1		
$\eta_1 = \eta_0\left(\frac{(\ell_4/\ell_3)+\sin(\theta_0+\theta+\beta)}{(\ell_4/\ell_3)+1}\right)$	0.04	0.03

11. Calculate the Submerged Weight of each Block, W_s			
$W_s = W\left(\frac{\gamma_c - \gamma_w}{\gamma_c}\right)$	47.80	75.30	*previously provided by* ***Armortec, 2002***

12. Calculate the Factor of Safety for each Block		
$SF = \frac{(\ell_2/\ell_1)a_\theta}{\cos\beta\sqrt{1-a_\theta^2}+\eta_1(\ell_2/\ell_1)+\frac{(\ell_3 F'_D\cos\delta+\ell_4 F'_L)}{\ell_1 W_S}}$		
SF=	**1.34**	**1.85**

APPENDIX B

REFERENCES

FHWA, 2009

ASTM Standard D-6684 also specifies minimum strength properties of geotextiles according to the severity of the conditions during installation. Harsh installation conditions (vehicular traffic, repeated lifting, realignment, and replacement of mattress sections, etc.) require stronger geotextiles.

8.3 APPLICATION 1: HYDRAULIC DESIGN PROCEDURE FOR ACB SYSTEMS FOR BANK REVETMENT OR BED ARMOR

8.3.1 Hydraulic Stability Design Procedure

The hydraulic stability of ACB systems is analyzed using a "discrete particle" approach. The design approach is similar to that introduced by Stevens and Simons (1971) as modified by Julien (1995) in the derivation of the "Factor of Safety" method for sizing rock riprap. In that method, a calculated factor of safety of 1.0 or greater indicates that the particles will be stable under the given hydraulic conditions and site geometry (e.g., side slope and bed slope). For ACBs, the Factor of Safety force balance has been recomputed considering the weight and geometry of the blocks, and the Shields relationship for estimating the particle's critical shear stress is replaced with actual test results (Clopper 1992).

Considerations are also incorporated into the design procedure to account for the additional forces generated on a block that protrudes above the surrounding matrix due to subgrade irregularities or imprecise placement. The analysis methodology purposely omits any restraining forces due to cables, because any possible benefit that cables might provide are reflected in the performance testing of the block. Cables may prevent blocks from being lost entirely, but they do not prevent a block system from failing through loss of intimate contact with the subgrade. Similarly, the additional stability afforded by vegetative root anchorage or mechanical anchoring devices, while recognized as potentially significant, is ignored in the stability analysis procedure for the sake of conservatism in block selection and design.

A drainage layer may be used in conjunction with an ACB system. A drainage layer lies between the blocks and the geotextile and/or granular filter. This layer allows "free" flow of water beneath the block system while still holding the filter material to the subsoil surface under the force of the block weight. This free flow of water can relieve sub-block pressure and has appeared to significantly increase the hydraulic stability of ACB systems based on full-scale performance testing conducted since the mid 1990s.

Drainage layers can be comprised of coarse, uniformly sized granular material, or can be synthetic mats that are specifically manufactured to permit flow within the plane of the mat. Granular drainage layers are typically comprised of 1- to 2-inch crushed rock in a layer 4 inches or more in thickness. The uniformity of the rock provides significant void space for flow of water. Synthetic drainage nets typically range in thickness from 0.25 to 0.75 inches and are manufactured using stiff nylon fibers or high density polyethylene (HDPE) material. The stiffness of the fibers supports the weight of the blocks, thus providing large hydraulic conductivity within the plane of the drainage net.

Many full-scale laboratory performance tests have been conducted with a drainage layer in place. When evaluating a block system, for which performance testing was conducted with a drainage layer, a drainage layer must also be used in the design. This recommendation is based on the improvement in the hydraulic stability of systems that have incorporated a drainage layer in the performance testing.

8.3.2 Selecting a Target Factor of Safety

The designer must determine what factor of safety should be used for a particular application. Typically, a minimum allowable factor of safety of 1.2 is used for revetment (bank protection) when the project hydraulic conditions are well known and the installation can be conducted under well-controlled conditions. Higher factors of safety are typically used for protection at bridge piers, abutments, and at channel bends due to the complexity in computing hydraulic conditions at these locations.

The Harris County Flood Control District, Texas (HCFCD 2001) has developed a simple flowchart approach that considers the type of application, uncertainty in the hydraulic and hydrologic models used to calculate design conditions, and consequences of failure to select an appropriate target factor of safety to use when designing an ACB installation. In this approach, the minimum allowable factor of safety is recommended based on the type of application (e.g., bank protection, bridge scour protection, dam overtopping, etc). This base value is then multiplied by two factors, each greater than 1.0, to account for risk and uncertainty. Figure 8.2 shows the Harris County flow chart method for determining the target factor of safety.

8.3.3 Design Method

<u>Factor of Safety Method</u>: The stability of a single block is a function of the applied hydraulic conditions (velocity and shear stress), the angle of the inclined surface on which it rests, and the weight and geometry of the block. Considering flow along a channel bank as shown in Figure 8.3, the forces acting on a concrete block are the lift force F_L, the drag force F_D, and the components of the submerged weight of the block, W_S, both into and along the plane of the slope. Block stability is determined by evaluating the moments about the point O about which rotation can take place. The components of these forces are shown in Figure 8.3.

The safety factor (SF) for a single block in an ACB matrix is defined as the ratio of restraining moments to overturning moments:

$$SF = \frac{\ell_2 W_S a_\theta}{\ell_1 W_S \sqrt{1-a_\theta^2}\cos\beta + \ell_3 F_D \cos\delta + \ell_4 F_L + \ell_3 F'_D \cos\delta + \ell_4 F'_L} \quad (8.1)$$

Note that additional lift and drag forces F'_L and F'_D are included to account for protruding blocks that incur larger forces due to impact. The design implications regarding a protruding block are discussed in detail later in this section.

The moment arms ℓ_1, ℓ_2, ℓ_3, and ℓ_4 are determined from the block dimensions shown in Figure 8.4. In the general case, the pivot point of overturning will be at the downstream corner of the block; therefore, the distance from the center of the block to the corner should be used for both ℓ_2 and ℓ_4. Since the weight vector acts through the center of gravity, one half the block height should be used for ℓ_1. The drag force acts both on the top surface of the block (shear drag) and on the body of the block (form drag). Considering both elements of drag, eight-tenths the height of the block is considered a reasonable estimate of ℓ_3.

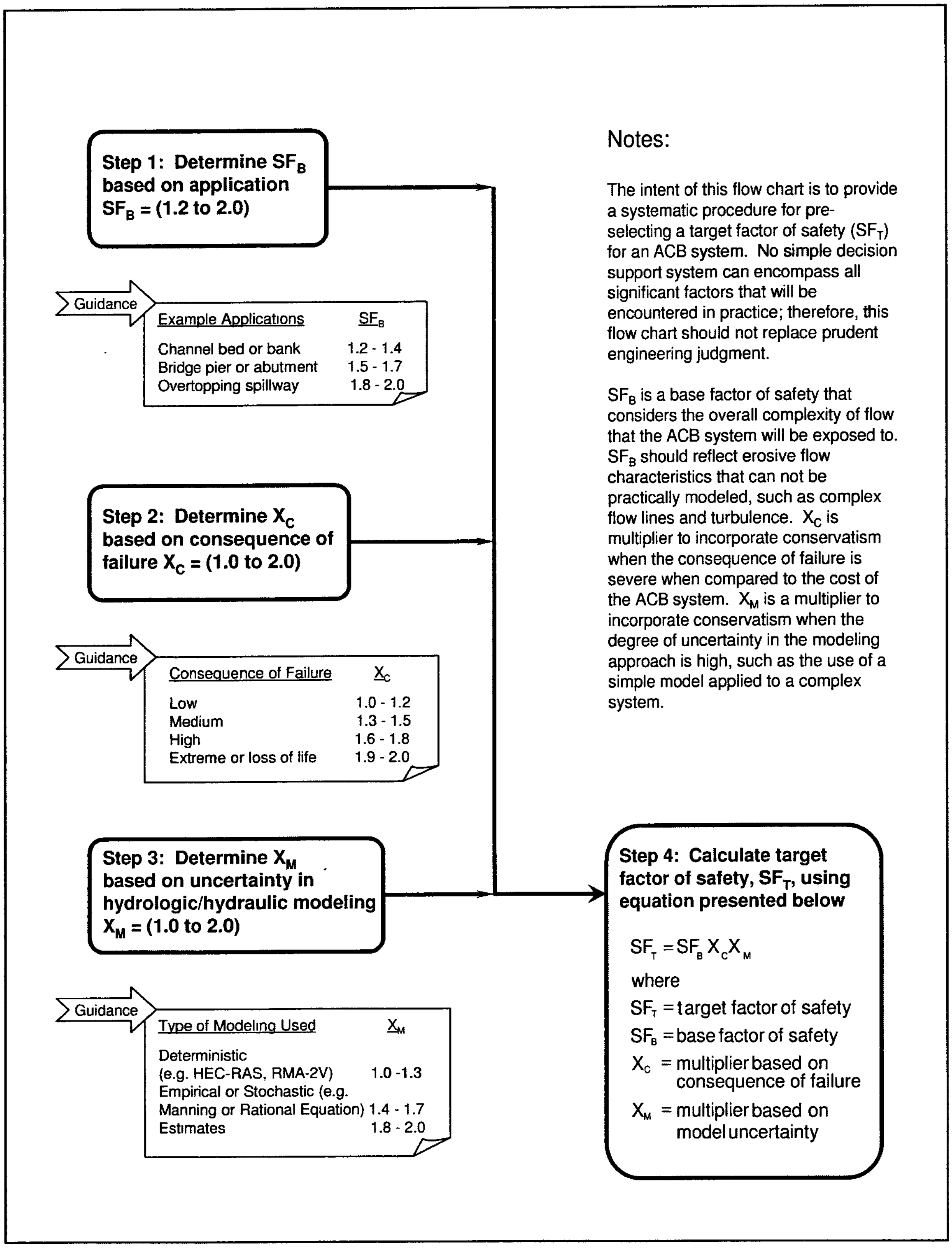


Figure 8.2. Selecting a target factor of safety (HCFCD 2001).

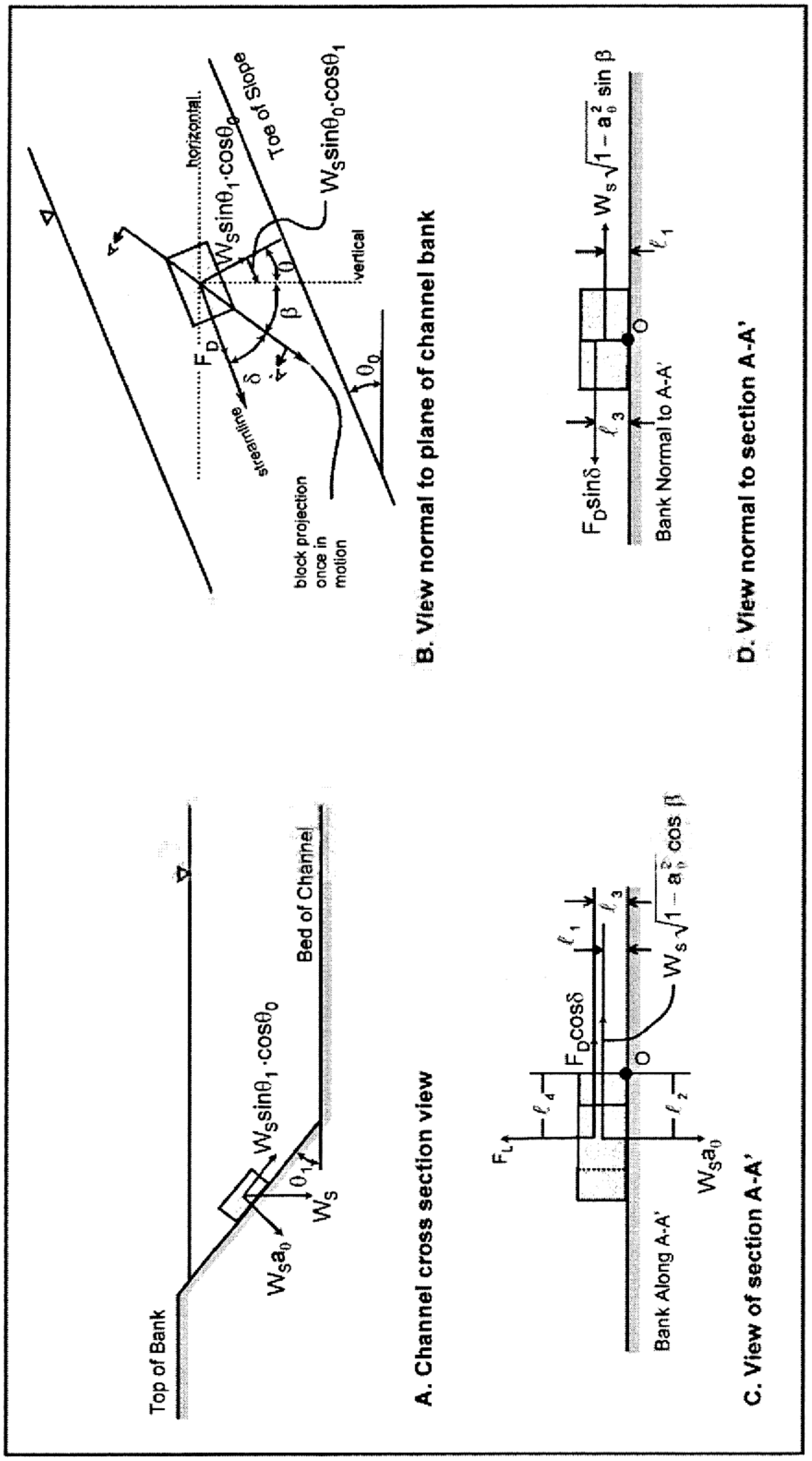
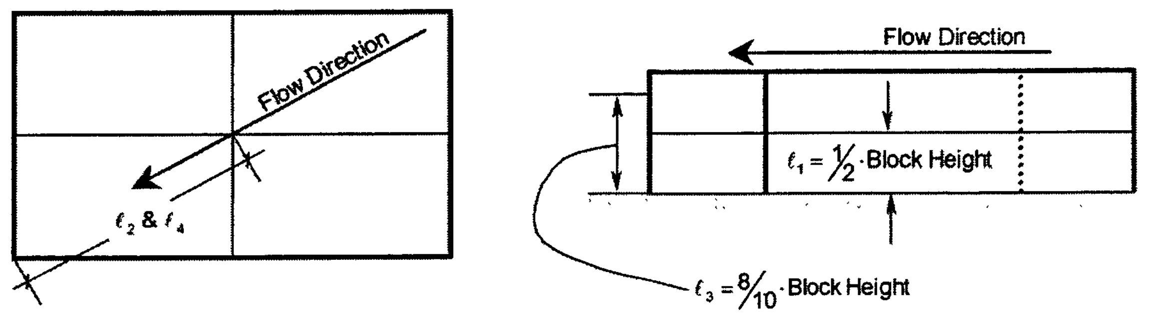


Figure 8.3. Single block on a channel side slope with factor of safety variables defined.



A. Plan view of block with design moment arms shown

B. Profile view of block with design moment arms shown

Figure 8.4. Schematic diagram of a block showing moment arms ℓ_1, ℓ_2, ℓ_3, and ℓ_4.

The shear stress on the block is calculated as follows:

$$\tau_{des} = K_b \gamma y S_f \tag{8.2}$$

where:

τ_{des}	=	Design shear stress, lb/ft^2
K_b	=	Bend coefficient (dimensionless)
γ	=	Unit weight of water, lb/ft^3
y	=	Maximum depth of flow on revetment, ft
S_f	=	Slope of the energy grade line, ft/ft

The bend coefficient K_b is used to calculate the increased shear stress on the outside of a bend. This coefficient ranges from 1.05 to 2.0, depending on the severity of the bend. The bend coefficient is a function of the radius of curvature R_c divided by the top width of the channel T, as follows:

$$K_b = 2.0 \qquad \text{for } 2 \geq R_c/T$$

$$K_b = 2.38 - 0.206\left(\frac{R_c}{T}\right) + 0.0073\left(\frac{R_c}{T}\right)^2 \qquad \text{for } 10 > R_c/T > 2 \tag{8.3}$$

$$K_b = 1.05 \qquad \text{for } R_c/T \geq 10$$

Protruding Blocks: While some manufacturers developed design charts to aid in the design of ACB systems, those charts generally are based on the assumption of a "perfect" installation (i.e., no individual blocks protrude into the flow). In reality, some placement tolerance must be anticipated and the factor of safety equation modified to account for protruding blocks, illustrated in Figure 8.5. Because poor installation, or differential settlement over time, can cause blocks to exceed the design placement tolerance, the actual factor of safety can be greatly reduced and may lead to failure. Therefore, subgrade preparation and construction inspection become critical to successful performance of ACB systems. Blocks must not be placed directly on an irregular surface such as cobbles or rubble. A suitably smooth subgrade can often be achieved by removing the largest blocky materials and placing imported sand or road base material prior to placing the geotextile.

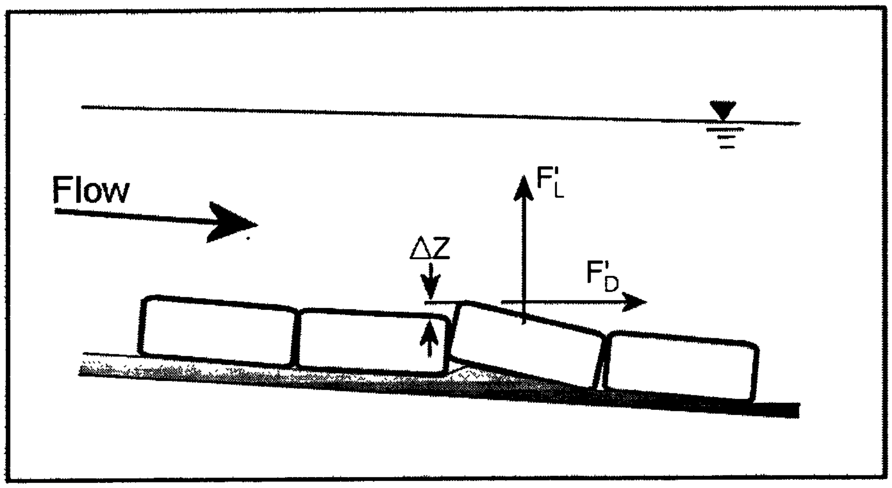


Figure 8.5. Sketch showing additional lift and drag forces on a protruding block.

The additional drag force on the block created by the protrusion is calculated as follows:

$$F'_D = \frac{1}{2} C \left[(\Delta z) b \rho \left(V_{des}^{2}\right)\right] \quad (8.4)$$

where:

F'_D = Drag force due to protrusion, lb
C = Drag coefficient assumed equal to 1.0
Δz = Protrusion height, ft
b = Projected block width, ft *(Note: This width is typically taken as 2 times the moment arm L_2; see Figure 8.4)*
ρ = Mass density of water, slugs/ft^3
V_{des} = Design velocity, ft/s

For typical revetment applications, the design velocity V_{des} is taken as the cross sectional average velocity. If a detailed hydraulic analysis has been performed, a more representative local velocity can be used for V_{des}.

Lastly, the additional lift force due to the protrusion F'_L is assumed equal to the drag force F'_D. Both of these forces create additional destabilizing moments associated with a protruding block.

Dividing Equation 8.1 by $\ell_1 W_S$ and substituting terms yields the final form of the factor of safety equations as summarized in Table 8.1. The equations can be used with any consistent set of units; however, variables are indicated here in U.S. customary (English) units.

8.3.4 Layout Details for ACB Bank Revetment and Bed Armor

Longitudinal Extent: The revetment armor should be continuous for a distance which extends both upstream and downstream of the region which experiences hydraulic forces severe enough to cause dislodging and/or transport of bed or bank material. The minimum distances recommended are an upstream distance of 1.0 channel width and a downstream distance of 1.5 channel widths. The channel reach which experiences severe hydraulic forces is usually identified by site inspection, examination of aerial photography, hydraulic modeling, or a combination of these methods.

Many site-specific factors have an influence on the actual length of channel that should be protected. Factors that control local channel width (such as bridge abutments) may produce local areas of relatively high velocity and shear stress due to channel constriction, but may also create areas of ineffective flow further upstream and downstream in "shadow zone" areas of slack water. In straight reaches, field reconnaissance may reveal erosion scars on the channel banks that will assist in determining the protection length required.

In meandering reaches, since the natural progression of bank erosion is in the downstream direction, the present limit of erosion may not necessarily define the ultimate downstream limit. FHWA's Hydraulic Engineering Circular No. 20, "Stream Stability at Highway Structures" (Lagasse et al. 2001) provides guidance for the assessment of lateral migration. The design engineer is encouraged to review this reference for proper implementation.

Vertical Extent. The vertical extent of the revetment should provide freeboard above the design water surface. A minimum freeboard of 1 to 2 ft should be used for unconstricted reaches and 2 to 3 ft for constricted reaches. If the flow is supercritical, the freeboard should be based on height above the energy grade line rather than the water surface. **The revetment system should either cover the entire channel bottom or, in the case of unlined channel beds, extend below the bed far enough so that the revetment is not undermined by the maximum scour which for this application is considered to be toe scour, contraction scour, and long-term degradation (Figure 8.7).**

Recommended revetment termination at the top and toe of the bank slope are provided in Figures 8.6 and 8.7 for armored-bed and soft-bottom channel applications, respectively. Similar termination trenches are recommended for the upstream and downstream limits of the ACB revetment.

Table 8.1. Factor of Safety Design Equations for ACB Systems.

Equation	No.
$F_L' = F_D' = 0.5\rho b(\Delta z)(V_{des})^2$	(8.5)
$\eta_0 = \frac{\tau_{des}}{\tau_c}$	(8.6)
$\theta = \arctan\left(\frac{\tan\theta_0}{\tan\theta_1}\right)$	(8.7)
$a_\theta = \sqrt{(\cos\theta_1)^2 - (\sin\theta_0)^2}$	(8.8)
$\beta = \arctan\left(\frac{\cos(\theta_0+\theta)}{\left(\frac{\ell_4}{\ell_3}+1\right)\left(\frac{\sqrt{1-a_\theta^2}}{\eta_0(\ell_2/\ell_1)}\right)+\sin(\theta_0+\theta)}\right)$	(8.9)
$\delta = 90^\circ - \beta - \theta$	(8.10)
$\eta_1 = \eta_0\left(\frac{(\ell_4/\ell_3)+\sin(\theta_0+\theta+\beta)}{(\ell_4/\ell_3)+1}\right)$	(8.11)
$W_s = W\left(\frac{\gamma_c - \gamma_w}{\gamma_c}\right)$	(8.12)
$SF = \frac{(\ell_2/\ell_1)a_\theta}{\cos\beta\sqrt{(1-a_\theta)^2} + \eta_1(\ell_2/\ell_1) + \frac{(\ell_3 F'_D \cos\delta + \ell_4 F'_L)}{\ell_1 W_s}}$	(8.13)

a_θ = Projection of W_S into plane of subgrade
b = Block width normal to flow (ft)
F'_D, F'_L = added drag and lift forces due to protruding block (lb)
ℓ_x = Block moment arms (ft)
γ_c = Concrete density, lb/ft^3
γ_w = Density of water, lb/ft^3
V_{des} = Design velocity (ft/s)
W = Weight of block in air (lb)
W_S = Submerged block weight (lb)
Δz = Height of block protrusion above ACB matrix (ft)
β = Angle between block motion and the vertical
δ = Angle between drag force and block motion
η_0 = Stability number for a block on a horizontal surface
η_1 = Stability number for a block on a sloped surface
θ = Angle between side slope projection of W_S and the vertical
θ_0 = Channel bed slope (degrees)
θ_1 = Side slope of block installation (degrees)
ρ = Mass density of water (slugs/ft^3)
τ_c = Critical shear stress for block on a horizontal surface (lb/ft^2)
τ_{des} = Design shear stress (lb/ft^2)
SF = Calculated factor of safety

Note: The equations cannot be solved for $\theta_1 = 0$ (i.e., division by 0 in Equation 8.7); therefore, a very small but non-zero side slope must be entered for the case of $\theta_1 = 0$.

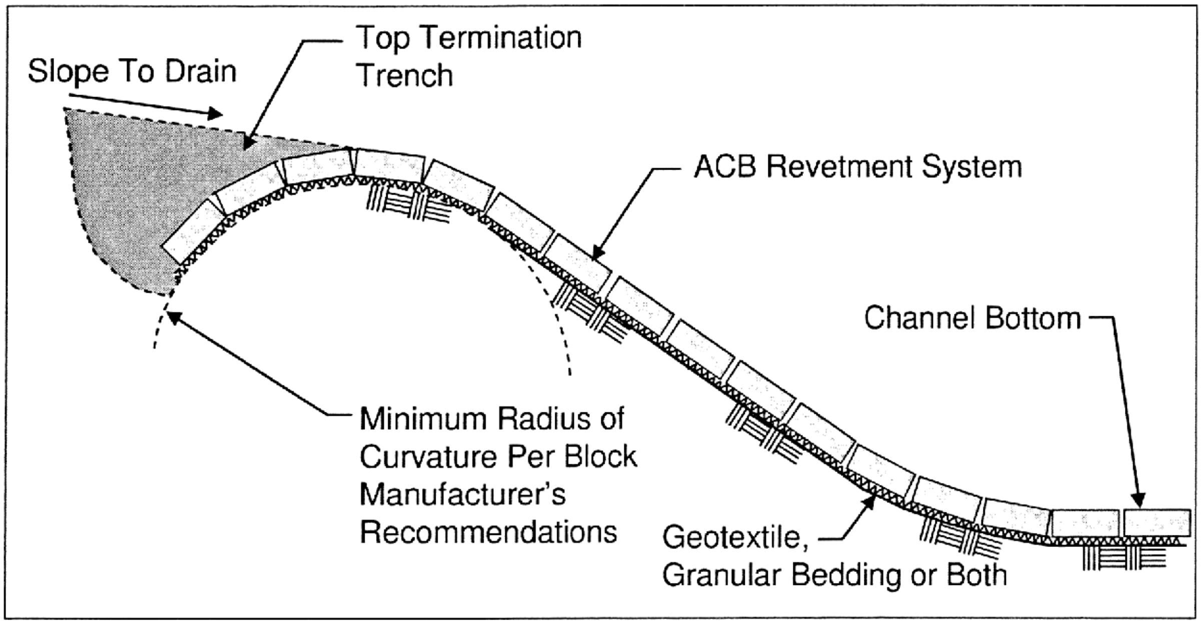


Figure 8.6. Recommended layout detail for bank and bed armor.

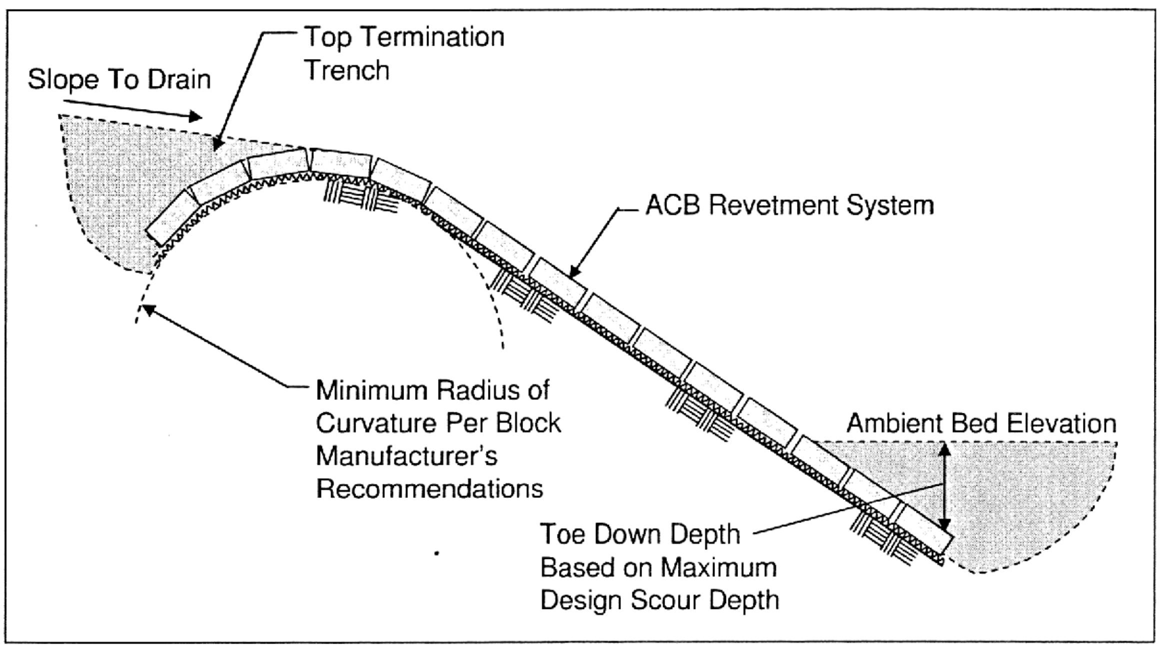


Figure 8.7. Recommended layout detail for bank revetment where no bed armor is required.

8.3.5 Filter Requirements

The importance of the filter component of an articulating concrete block installation should not be underestimated. Geotextile filters are most commonly used with ACBs, although coarse granular filters may be used where native soils are coarse and the particle size of the filter is large enough to prevent winnowing through the cells and joints of the ACB system. When using a granular stone filter, the layer should have a minimum thickness of 4 times the d_{50} of the filter stone or 6 inches, whichever is greater. The d_{50} size of the granular filter should be greater than one half the smallest dimension of the open cells of the system. When placing a granular filter under water, its thickness should be increased by 50%.

The filter must retain the coarser particles of the subgrade while remaining permeable enough to allow infiltration and exfiltration to occur freely. It is not necessary to retain all the particle sizes in the subgrade; in fact, it is beneficial to allow the smaller particles to pass through the filter, leaving a coarser substrate behind. Detailed aspects of filter design are presented in Design Guide 16 of this document.

Some situations call for a composite filter consisting of both a granular layer and a geotextile. The specific characteristics of the base soil determine the need for, and design considerations of the filter layer. ***In cases where dune-type bedforms may be present at the toe of a bank slope protected with an ACB system, it is strongly recommended that only a geotextile filter be considered.***

8.3.6 ACB Design Example

The following example illustrates the ACB design procedure using the Factor of Safety equations presented in Table 8.1. The example is presented in a series of steps that can be followed by the designer in order to select the appropriate ACB system based on a pre-selected target factor of safety. The primary criterion for product selection is if the computed factor of safety for the ACB system meets or exceeds the pre-selected target value. The example assumes that hydraulic testing has been performed to quantify a critical shear stress for that particular system. This problem is presented in English units only because ACB systems in the U.S. are manufactured and specified in units of inches and pounds.

Problem Statement:

Meandering River has a history of channel instability, both vertically and laterally. A quantitative assessment of channel stability has been conducted using the multi-level analysis from Hydraulic Engineering Circular No. 20, "Stream Stability at Highway Structures" (Lagasse et al. 2001). A drop structure has been designed at the downstream end of a bendway reach to control bed elevation changes. However, there is concern that lateral channel migration will threaten the integrity of the drop structure. An ACB system is proposed to arrest lateral migration. Figure 8.8 presents a definition sketch for this example problem.

The design procedure assumes that appropriate assessment of hydraulic and geomorphic conditions has been made prior to the design process. The US Army Corps of Engineers' HEC-RAS model has been used to determine the design hydraulic conditions for the project reach. A velocity distribution across the cross section was calculated at River Mile 23.4 using HEC-RAS. Figure 8.9 presents the velocity distribution as determined using 9 flow subsections across the main channel. The velocity distribution indicates that the maximum velocity expected at the outside of the bend is 11.0 ft/s, which will be used as the design value in the factor of safety calculations. The corresponding depth at this location, which is the channel thalweg depth at the toe of the bank slope, is 8.4 feet.

ARMORTECH, 2002

Table 2.3. Factor of Safety Equation Variables.

Block Class	Submerged Weight (Lbs)	ℓ_1 (ft)	ℓ_2 & ℓ_4 (ft)	ℓ_3 (ft)	τ_c @ 0 degrees (psf)
30-S	19.80	0.198	0.726	0.317	14.40
50-S	28.60	0.250	0.726	0.400	19.00
45-S	24.50	0.198	0.726	0.317	17.90
55-S	33.30	0.250	0.726	0.400	22.10
40	37.30	0.198	0.971	0.317	22.40
50	47.80	0.250	0.971	0.400	26.60
60	60.60	0.313	0.971	0.500	31.00
70	75.30	0.375	0.971	0.600	35.50
45	45.50	0.198	0.971	0.317	27.30
55	58.30	0.250	0.971	0.400	32.80
75	74.60	0.313	0.971	0.500	38.20
85	91.00	0.375	0.971	0.600	43.00
40-L	46.80	0.198	1.222	0.317	25.80
50-L	60.30	0.250	1.222	0.400	30.50
60-L	74.90	0.313	1.222	0.500	35.60
70-L	90.00	0.375	1.222	0.600	40.80
45-L	56.20	0.198	1.222	0.317	31.00
55-L	72.30	0.250	1.222	0.400	37.20
75-L	90.00	0.313	1.222	0.500	43.20
85-L	108.70	0.375	1.222	0.600	48.70
40-T	35.50	0.198	0.971	0.317	31.80
50-T	44.80	0.250	0.971	0.400	36.90
60-T	56.00	0.313	0.971	0.500	42.10
70-T	67.20	0.375	0.971	0.600	46.50

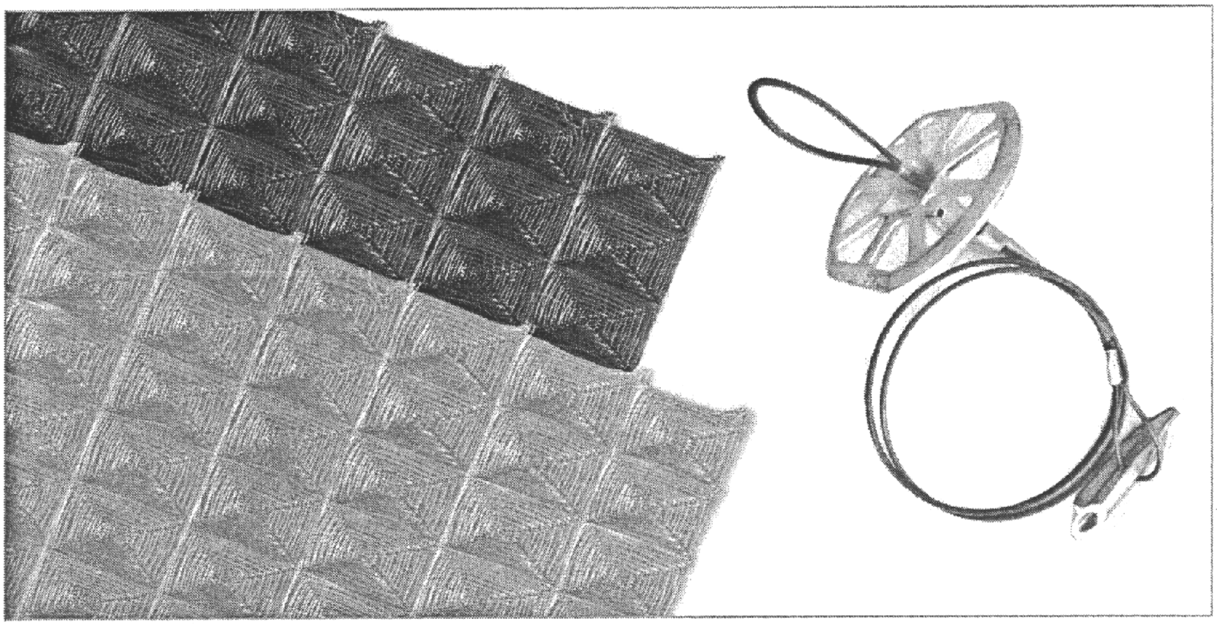
NOTE: Moment arms and critical shear stresses assume block orientation of the block with the long axis parallel to flow.

ARMORMAX® BY PROPEX

Product Data

ARMORMAX® FOR EROSION CONTROL

The ARMORMAX® Anchor Reinforced Vegetation System (ARVS) for Erosion Control is an engineered solution used for permanent erosion protection in vegetated and unvegetated applications. It is composed of two components: PYRAMAT® High Performance Turf Reinforcement Mat (HPTRM) and Type B1 Percussion Driven Earth Anchors (PDEAs). ArmorMax is available in green or tan to provide for an aesthetically pleasing solution with proven performance. The PDEA component is specifically designed and tested for compatibility and performance with PYRAMAT® to provide a system solution. Propex offers several PDEA options to provide the ARMORMAX® system designed for specific challenges and needs. The expected design life of ARMORMAX® is 50 years because of its superior UV resistance, resistance to corrosion, strength, and durability in the most demanding environments.



The PYRAMAT® component of ARMORMAX® has been tested and conforms to the property values listed below[1] while manufactured at a Propex facility having achieved ISO 9001:2000 certification. Propex also performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

The Type B1 Anchor model is used for permanent erosion protection applications and has a working load of up to 800 lbs. The Type B1 Anchor consists a die cast aluminum anchor head, zinc-aluminum coated carbon steel cable, a die cast zinc load-locking mechanism with a ceramic roller, and two aluminum ferrules. The bullet nose design of the anchor head allows the anchor to penetrate PYRAMAT® resulting in minimal installation damage. The Type B1 Anchor is also designed with a recessed cavity so the top of the cable can be cut below the surface being protected.

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ARMORMAX® BY PROPEX

Product Data

ARMORMAX® FOR EROSION CONTROL

PYRAMAT® PROPERTIES

PROPERTY	TEST METHOD	ENGLISH	METRIC
ORIGIN OF MATERIALS			
% U.S. Manufactured Inputs		100%	100%
% U.S. Manufactured		100%	100%
PHYSICAL			
Thickness [2]	ASTM D-6525	0.40 in	10.2 mm
Light Penetration (% Passing) [3]	ASTM D-6567	10%	10%
Color	Visual	Green or Tan	
MECHANICAL			
Tensile Strength [2]	ASTM D-6818	4000 x 3000 lbs/ft	58.4 x 43.8 kN/m
Elongation [2]	ASTM D-6818	40 x 35 %	40 x 35 %
Resiliency [2]	ASTM D-6524	80%	80%
Flexibility [4]	ASTM D-6575	0.534 in-lb	616,154 mg-cm
ENDURANCE			
UV Resistance % Retained at 6,000 hrs [4]	ASTM D-4355	90%	90%
UV Resistance % Retained at 10,000 hrs [4]	ASTM D-4355	85%	85%
PERFORMANCE			
Velocity (Vegetated) [4, 5]	Large Scale	25 ft/sec	7.6 m/sec
Shear Stress (Vegetated) [4, 5]	Large Scale	16 lb/ft²	766 Pa
Manning's n (Unvegetated) [4, 6]	Calculated	0.028	0.028
Seedling Emergence [4]	ASTM D-7322	296%	296%
ROLL SIZES		8.5 ft x 90 ft 15.0 ft x MR	2.6 m x 27.4 m 4.6 m x MR

TYPE B1 ANCHOR PROPERTIES

PHYSICAL		ENDURANCE/ COMPONENT MATERIALS	
Anchor Head Length	3.4 in	Anchor Head	Die cast aluminum
Anchor Head Width	1.0 in	Cable Tendon	Zinc-aluminum carbon steel
Anchor Head Bearing Area	2.5 in²	Load Bearing Plate	Die cast zinc
Anchor Head Weight	0.1 lbs	Load-Lock Mechanism	Die cast zinc w/ceramic roller
PERFORMANCE		Crimped Ferrule	Aluminum
		MECHANICAL	
Load Range (Cohesive through Non Cohesive Soils)	Up to 500 lbs	Ultimate Strength	1,100 lbs
Embedment Depth	Up to 5 ft	Working Load	800 lbs

NOTES:
1. The property values listed above are effective 07/13/2015 and are subject to change without notice.
2. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.
3. Maximum Average Roll Value (MaxARV), calculated as the typical plus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will meet to the value reported
4. Typical Value.
5. Maximum permissible velocity and shear stress has been obtained through vegetated testing programs featuring specific soil types, vegetation classes, flow conditions, and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information.
6. Calculated as typical values from large-scale flexible channel lining test programs with a flow depth of 6 to 12 inches

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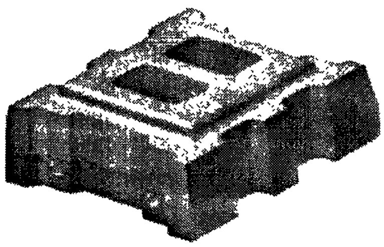
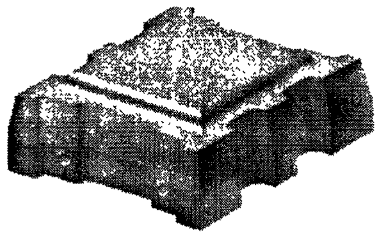
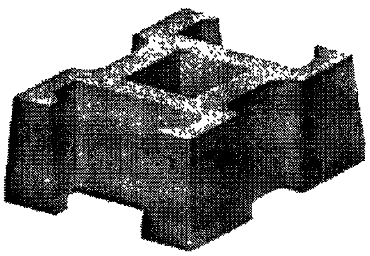
ARMORTEC® Product Details



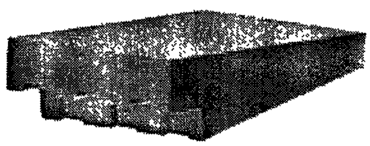
ArmorFlex® - Open Cell



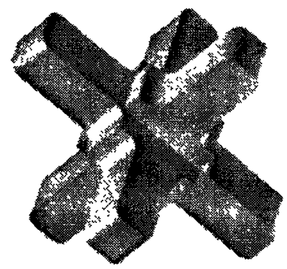
ArmorFlex® - Close Cell



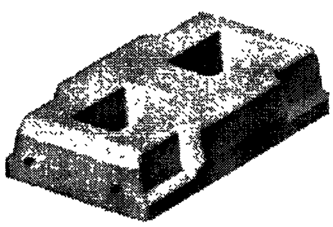
ArmorLoc®



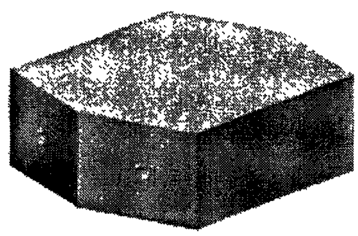
ArmorWedge®



A-Jacks®



ArmorStone®

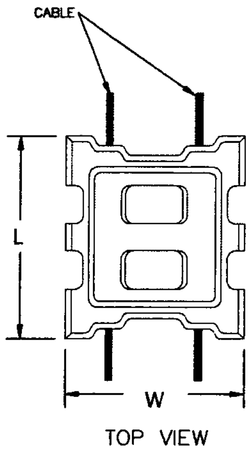


ArmorRoad®

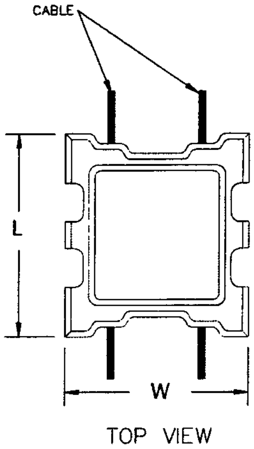
MANUFACTURING SPECIFICATION
ASTM D6684-04

ARMORTEC

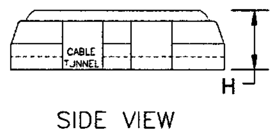
ArmorFlex® (not to scale)

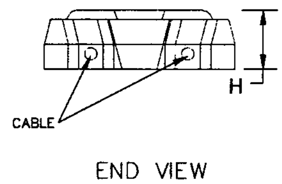


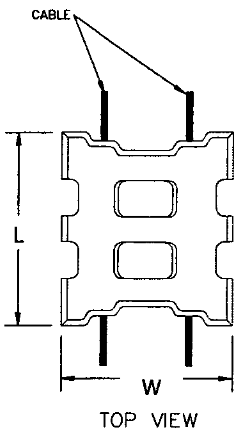
Open Cell Block



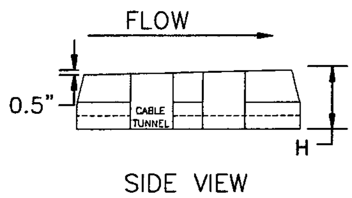
Close Cell Block

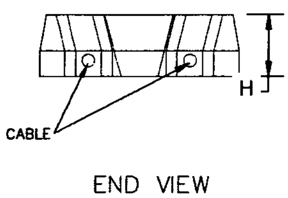


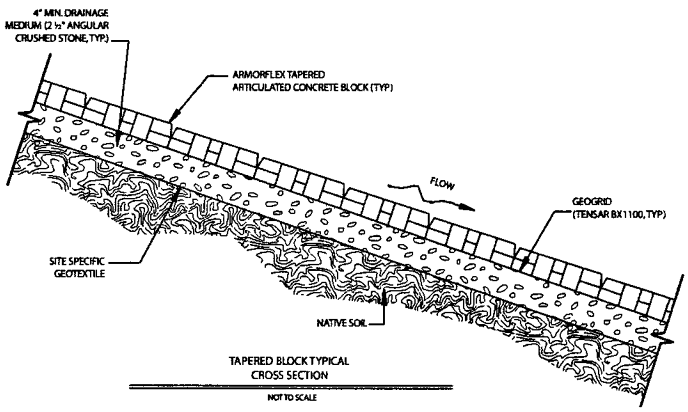




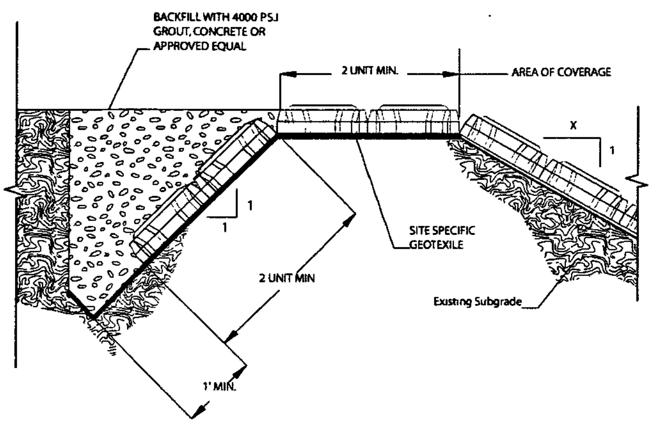
Tapered Series







Tapered Series - Cross Section



Top of Slope - Standard Detail

ArmorFlex Unit Specification

Concrete Block Class	Open/Closed Cell	Nominal Dimensions			Gross Area/ (sq ft.)	Block Weight		Open Area %
		L	W	H		lbs	lbs/sq. ft.	
30s	Open	13.0	11.6	4.75	0.98	33-35	34-36	20
50s	Open	13.0	11.6	6.00	0.98	42-45	43-46	20
40	Open	17.4	15.5	4.75	1.77	59-64	33-36	20
50	Open	17.4	15.5	6.00	1.77	76-82	43-46	20
70	Open	17.4	15.5	8.50	1.77	108-117	61-66	20
40L	Open	17.4	23.6	4.75	2.58	97-105	38-41	20
70L	Open	17.4	23.6	8.50	2.58	174-188	68-73	20
45s	Closed	13.0	11.6	4.75	0.98	39-42	38-43	10
55s	Closed	13.0	11.6	6.00	0.98	50-54	49-55	10
45	Closed	17.4	15.5	4.75	1.77	71-77	40-43	10
55	Closed	17.4	15.5	6.00	1.77	91-98	52-56	10
85	Closed	17.4	15.5	8.50	1.77	136-146	77-83	10
45L	Closed	17.4	23.6	4.75	2.58	109-118	42-46	10
85L	Closed	17.4	23.6	8.50	2.58	207-223	80-87	10
High Velocity Application Block Classes								
40-T	Open	17.4	15.5	4.75	1.77	58-63	33-35	20
50-T	Open	17.4	15.5	6.00	1.77	75-81	43-46	20
70-T	Open	17.4	15.5	8.50	1.77	116-124	65-70	20

CONTECH, 2012b

CONTECH ENGINEERED SOLUTIONS

EROSION CONTROL PRODUCT SELECTION GUIDE [1]

	PRODUCT	Functional Longevity	Slopes			Channels		Bank/Shoreline Stabilization		Culvert Outlets	Installed Costs[2] ($/SY)
			≤1:1[3]	≤2:1	≤3:1	Typical Velocity (ft/s)	Typical Shear Stress (lb/ft²)	Wave Potential	No Wave Potential		
TEMPORARY BLANKETS	Landlok (S1)	12 months			✔	5-6	2.0				1.00 to 1.75
TEMPORARY BLANKETS	Landlok (S2)	18 months			✔	5-6	1.5				1.25 to 1.75
TEMPORARY BLANKETS	Landlok (CS2)	24 months		✔		5-6	2.0				1.75 to 2.25
TEMPORARY BLANKETS	Landlok (C2)	36 months		✔ (≤1.5:1)		5-6	2.3				2.00 to 2.75
PERMANENT TURF REINFORCEMENT MATS	Landlok 450	Permanent	✔			8 to 18	2 to 10				6.00 to 8.00
PERMANENT TURF REINFORCEMENT MATS	Landlok 300	Permanent	✔			6 to 20	2 to 12		✔	✔	10.00 to 15.00
PERMANENT TURF REINFORCEMENT MATS	Pyramat	Permanent (up to 50 years)	✔			6 to 25	2 to 15		✔	✔	15.00 to 20.00
PERMANENT TURF REINFORCEMENT MATS	ArmorMax Anchored Reinforced System	Permanent (up to 50 years)	✔			6 to 25	2 to 18		✔	✔	20.00 to 25.00
HARD ARMOR	Armorflex ACB Revetment System	Permanent	✔			4" - 11 - 15 6" - 13 - 29 9" - 17 - 37	4" - 14 - 31 6" - 19 - 37 9" - 22 - 48	✔		✔	82.50 to 112.50 90.00 to 127.50 97.50 to 135.00
HARD ARMOR	Armorloc Hand Placed ACB Revetment System	Permanent	✔			4" - 10 6" - 12	4" - 8 6" - 11	✔		✔	52.50 to 82.50 75.00 to 97.50
HARD ARMOR	A-Jacks	Permanent	✔			24" - 22.0 48" - 31.1 72" - 38.1 96" - 44.0	24" - 38 48" - 76 72" - 114 96" - 152	✔		✔	30 to 45/ea. 375 to 525/ea. 900 to 1350/ea. 1650 to 2250/ea.
HARD ARMOR	Gabions	Permanent	✔			16	20	✔		✔	Basket:: 100 to 125/cy. Mattress:: 30 to 60/cy.

NOTES: 1. The above design recommendations should only be used as a "quick" reference tool for general project situations. Final selection of an appropriate product should be done by an experienced engineer and should consider site-specific parameters such as climate, soil, geometry, vegetation selection, irrigation, and installation conditions.
2. Installed cost estimates range from large to small projects according to material quantity. The estimates include E.C. material, seed, labor and equipment.
3. For slopes steeper than 2H:1V, mechanical anchoring should be investigated

ATTACHMENT C

ENGINEERED CAPPING SYSTEM – SHORETEC® EXAMPLE SPECIFICATIONS

SHORETEC®

SHORETEC, LLC
510 O' Neal Lane
Baton Rouge, LA 70819

225-408-1444 (phone)
225-408-1445 (fax)
shoretec.com (web)

Distributed By:

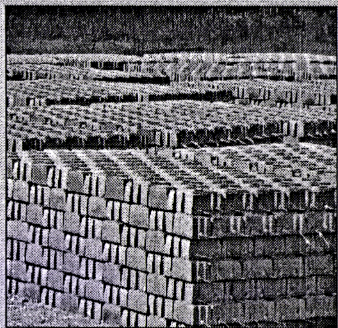
SHORETEC®

SHOREBLOCK®

SD SERIES

Concrete Revetment Block

PROTECTING OUR NATURAL RESOURCES



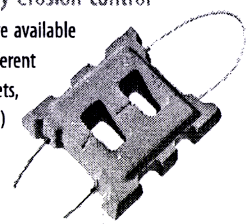
SHOREBLOCK® SD blocks of different heights and weights can be assembled to provide a castellated cover layer for a higher coefficient of hydraulic friction or improved wave energy absorption and retention.

SHOREBLOCK® SD is a flexible, interlocking matrix of concrete blocks of uniform size, shape and weight connected by a series of cables which pass longitudinally through preformed ducts in each block. SHOREBLOCK® SD revetment systems combine the favorable aspects of lightweight blankets and meshes, such as porosity, flexibility, vegetation encouragement and habitat enhancement with non-erodible, self-weight and high tractive force resistance of a rigid lining.

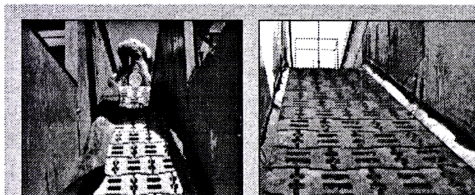
SHOREBLOCK® SD has proven to be an aesthetic and functional alternative to rip-rap, poured in place concrete and other heavy-duty, erosion protection systems. SHOREBLOCK® SD is easy to install, therefore, can dramatically reduce overall project costs. More specifically, when compared to other systems, life-cycle costs have been reduced because SHOREBLOCK® SD is a permanent system and saves on subsequent maintenance expenses.

Research and Design

SHOREBLOCK® SD is the most durable, effective and environmentally-friendly erosion control revetment method of fighting severe erosion problems. SHOREBLOCK® SD mats are available in eight foot widths in lengths up to 40 feet. Mats can be joined to achieve greater lengths. Different sizes of SHOREBLOCK® SD are available depending on the severity of the application. In most markets, Articulated Concrete Blocks (ACBs) are competitive in cost to 12" diameter (or greater) rock (or rip-rap) placed in an 18" or greater blanket thickness, are competitive with gabion mattresses and ACBs are typically more economical than poured in place concrete.



ACBs were successfully tested by the U.S. Bureau of Reclamation and U.S. Federal Highway Administration (FHWA-RD-89-199). The Corps of Engineers has used ACBs on numerous designs for both channel and shoreline stability. Comprehensive wave tank testing was evaluated in 1983 at Oregon State University. ACB installations have been performing successfully since 1980.



SHOREBLOCK® SD has been successfully tested by Colorado State University, in accordance with the hydraulic performance testing protocol established by the U.S. Federal Highway Administration. (FHWA-RD-89-199).

COLORADO STATE UNIVERSITY · EDUCATION · SERVICE · RESEARCH · EXTENSION · 1870

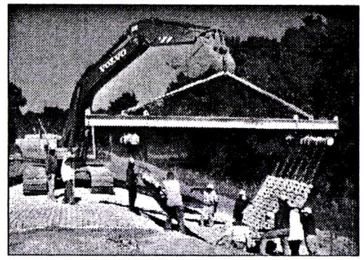
SHOREBLOCK® SD DESIGN ADVANTAGES

- Each block has an open area of up to 20% to allow for superior hydrostatic pressure relief and ecologically pleasing vegetative cover.
- Interlocking cabling allow greater flexibility through the axes of articulation — conforms better to ground contours and settlement.
- Prefabricated mats offer quick installation, even underwater.
- Tests have shown that the force needed to remove a block from a revegetated cover layer may be equal to 20 times the weight of the block.

MIN. DENSITY (IN AIR) (Lbs./Ft.^{3})		MIN. COMPRESSIVE STRENGTH (PSI)		MAX. WATER ABSORPTION (Lbs./Ft.^{3})	
AVE. OF 3 UNITS	INDIVIDUAL UNIT	AVE. OF 3 UNITS	INDIVIDUAL UNIT	AVE. OF 3 UNITS	INDIVIDUAL UNIT
130	125	4,000	3,500	9.1	11.7

* Unit weight and density values may vary due to availability of local materials.

Specifications



Fabrication of a SHOREBLOCK® SD mat is accomplished by threading corrosive resistant steel or special synthetic cable in one direction through a series of blocks. Cables are then secured to the mattress with corrosive resistant hardware. Cables are sized to provide a 5 to 1 cable strength to mat weight ratio to ensure safe handling while providing extraordinary strength in the system. Longitudinal cables are looped together at the ends of each row of blocks in the mat assembly for easy handling and anchoring. The open cells of SHOREBLOCK® SD comprise about 20% of the mat area.

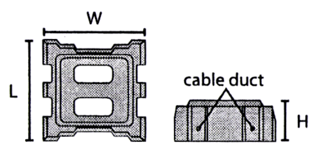
OPEN CELL

BLOCK CLASS	DIMENSIONS IN.			BLOCK		UNIT COVERAGE Sq. Ft.	OPEN AREA
	H	W	L	Unit Weight Lbs.	System Weight Lbs./Sq. Ft.		
SD-400 OC	4.00	15.50	17.40	50-57	28-32	1.78	20%
SD-475 OC	4.75	15.50	17.40	62-71	35-40	1.78	20%
SD-600 OC	6.00	15.50	17.40	81-94	46-53	1.78	20%
SD-800 OC	8.00	15.50	17.40	108-118	61-67	1.78	20%
SD-900 OC	9.00	15.50	17.40	120-138	68-78	1.78	20%

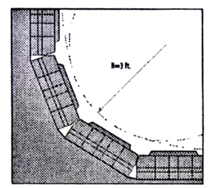
CLOSED CELL

BLOCK CLASS	DIMENSIONS IN.			BLOCK		UNIT COVERAGE Sq. Ft.	OPEN AREA
	H	W	L	Unit Weight Lbs.	System Weight Lbs./Sq. Ft.		
SD-400 CC	4.00	15.50	17.40	66-73	37-41	1.78	10%
SD-475 CC	4.75	15.50	17.40	78-89	43-50	1.78	10%
SD-600 CC	6.00	15.50	17.40	94-108	53-61	1.78	10%
SD-800 OC	8.00	15.50	17.40	125-135	71-76	1.78	10%
SD-900 CC	9.00	15.50	17.40	145-167	82-98	1.78	10%

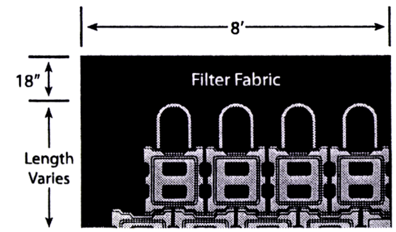
*The SD Series denotes Single Directional Cable System. Note: Additional block styles may be available in some areas. Check with your local SHORETEC® representative for product availability.



SHOREBLOCK® SD units are manufactured in accordance with ASTM C90, C140 and D6684-04.

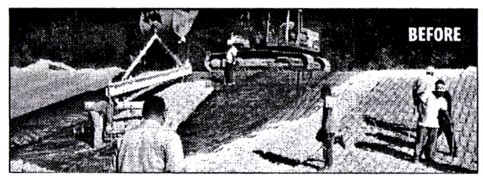


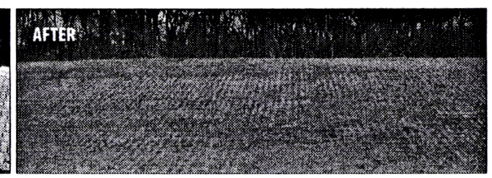
Each block is interconnected by flexible cables, providing articulation between adjacent blocks.



Woven monofiliments are preferred over nonwoven geotextiles. The soil's particle size (among other factors) will ultimately determine the fabric selection.

Features & Benefits





DURABILITY
SHOREBLOCK® SD will not suffer loss of function due to chemical degradation, UV degradation, biological degradation, vandalism or aging throughout its design life.

STABILITY
SHOREBLOCK® SD has the necessary strength characteristics to resist displacement due to imposed tractive forces and wave loads and the necessary strength to resist both lateral displacement and vertical uplift.

ACCEPTABILITY
SHOREBLOCK® SD becomes part of the landscape and the local ecosystem. Its construction is free of hazardous projections thus offering opportunities for recreation as native grasses are quick to germinate in the soil-filled cells.

AFFORDABILITY
The SHOREBLOCK® SD System is engineered to ensure comprehensive project design, and high quality components at 20-50% lower than alternative erosion control methods.

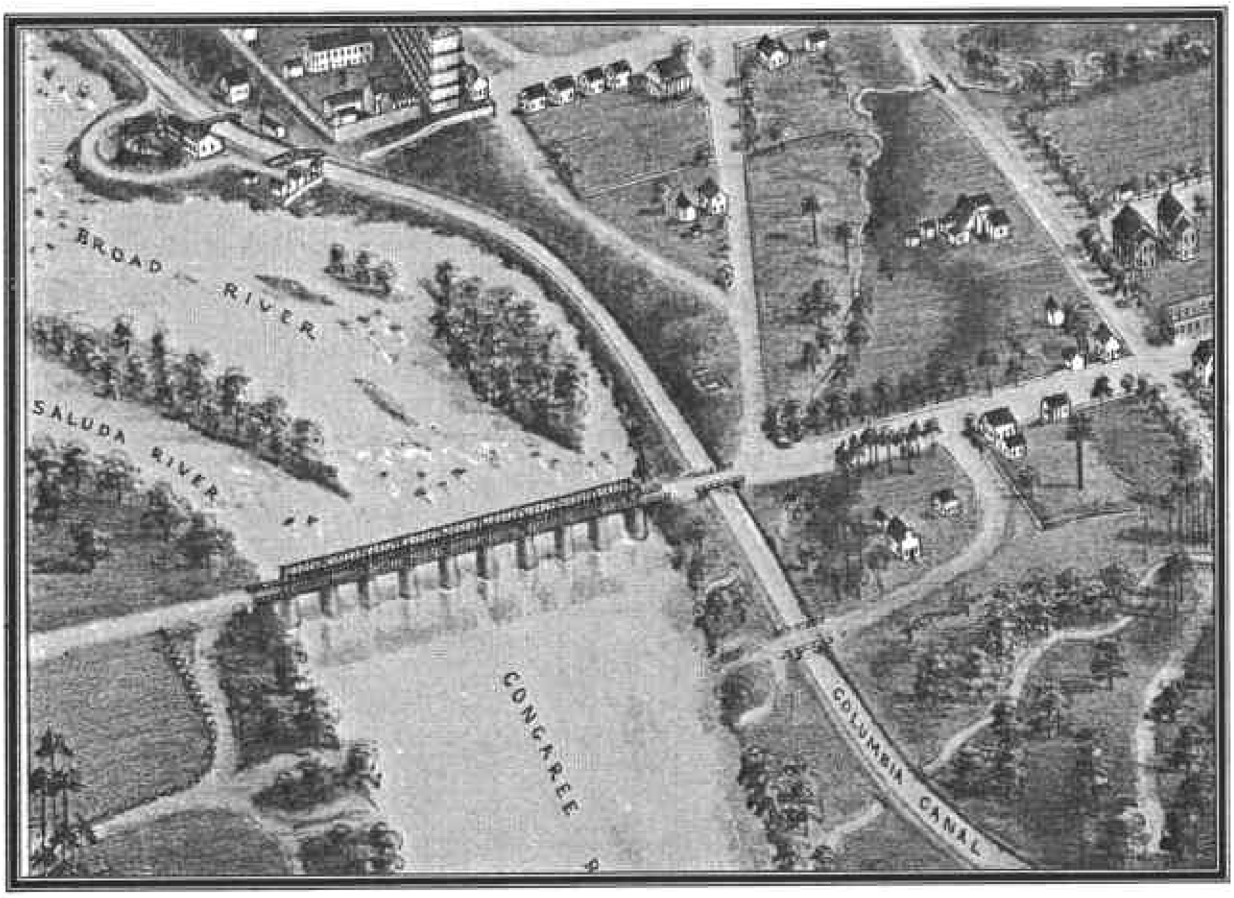
ATTACHMENT D

CULTURAL RESOURCE IDENTIFICATION SURVEY (CRIS), ARCHAEOLOGICAL DATA RECOVERY PLAN AND MEMORANDUM OF AGREEMENT (MOA)

CULTURAL RESOURCE IDENTIFICATION SURVEY FOR THE CONGAREE RIVER SEDIMENT REMOVAL PROJECT

RICHLAND COUNTY, SOUTH CAROLINA

Draft Report



September 2014

CULTURAL RESOURCE IDENTIFICATION SURVEY FOR THE CONGAREE RIVER SEDIMENT REMOVAL PROJECT RICHLAND COUNTY, SOUTH CAROLINA

DRAFT REPORT

Submitted to:
SCANA
COLUMBIA, SOUTH CAROLINA

Submitted by:
TRC
621 CHATHAM AVENUE
COLUMBIA, SOUTH CAROLINA 29205

Sean Norris, Principal Investigator, Author

September 2014

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FIGURES

TABLES

I. INTRODUCTION

TRC conducted a cultural resource identification survey in anticipation of federal permits required for the Congaree River Remediation Project. The project area is in the City of Columbia within and on the eastern bank of the Congaree River (Figure 1). In June 2010, tarlike material (TLM) was reported near the eastern bank of the Congaree River directly downstream of the Gervais Street Bridge. The South Carolina Department of Health and Environmental Control (SCDHEC) began sampling material from the river and concluded that the source of the TLM was a manufactured gas plant (MGP) that operated on Huger Street in downtown Columbia from 1906 to the mid-1950s. During its period of operation the MGP had allowed coat tar runoff to empty into the Congaree River.

This MGP, after a series of mergers and acquisitions, became one of South Carolina Electric and Gas's (SCE&G) predecessor companies. As a result SCE&G owned the land the former MGP occupied. In 2002 SCE&G had entered into a Voluntary Cleanup Contract with SCDHEC to mitigate the former MGP site. Beginning in 2008 SCE&G removed over 125,000 tons of MGP impacted soil and debris from the Huger Street location. Since the discovery of tar in the river SCE&G has worked with SCDHEC in order to define the extent of the TLM contamination, and has conducted a series of surveys to establish the vertical and horizontal distribution of the TLM. The project area begins directly south of the Gervais Street Bridge and extends downstream for approximately 2,000 feet; it extends approximately 300 feet into the river from the eastern bank (Figure 1).

In 2013 SCDHEC approved the Project Delineation Report and tasked SCE&G to develop an appropriate plan for the removal and mitigation of the contaminated soil. In 2013 a report detailing four "removal action" options was submitted to SCDHEC. The four options were:

1. No Action – Leave the TLM in place.

2. Monitoring and Institutional Controls – Leave the TLM in place; restrict access to the area, and conduct annual monitoring.

3. Sediment Capping and Institutional Controls – Place a physical barrier on top of the contaminated sediment effectively burying the TLM and conduct annual monitoring.

4. Removal – Physically remove the TLM and contaminated sediment.

SCDHEC approved option four as the preferred method of dealing with the TLM. This method was deemed to the most protective of human health and the environment because it would permanently remove the contaminated sediment. An average of two feet of sediment will need to be removed over the entire project area. This is equal to approximately 40,000 tons of sediment requiring removal and off-site treatment or disposal. The remediation and removal of the TLM and contaminated sediments will involve the following activities:

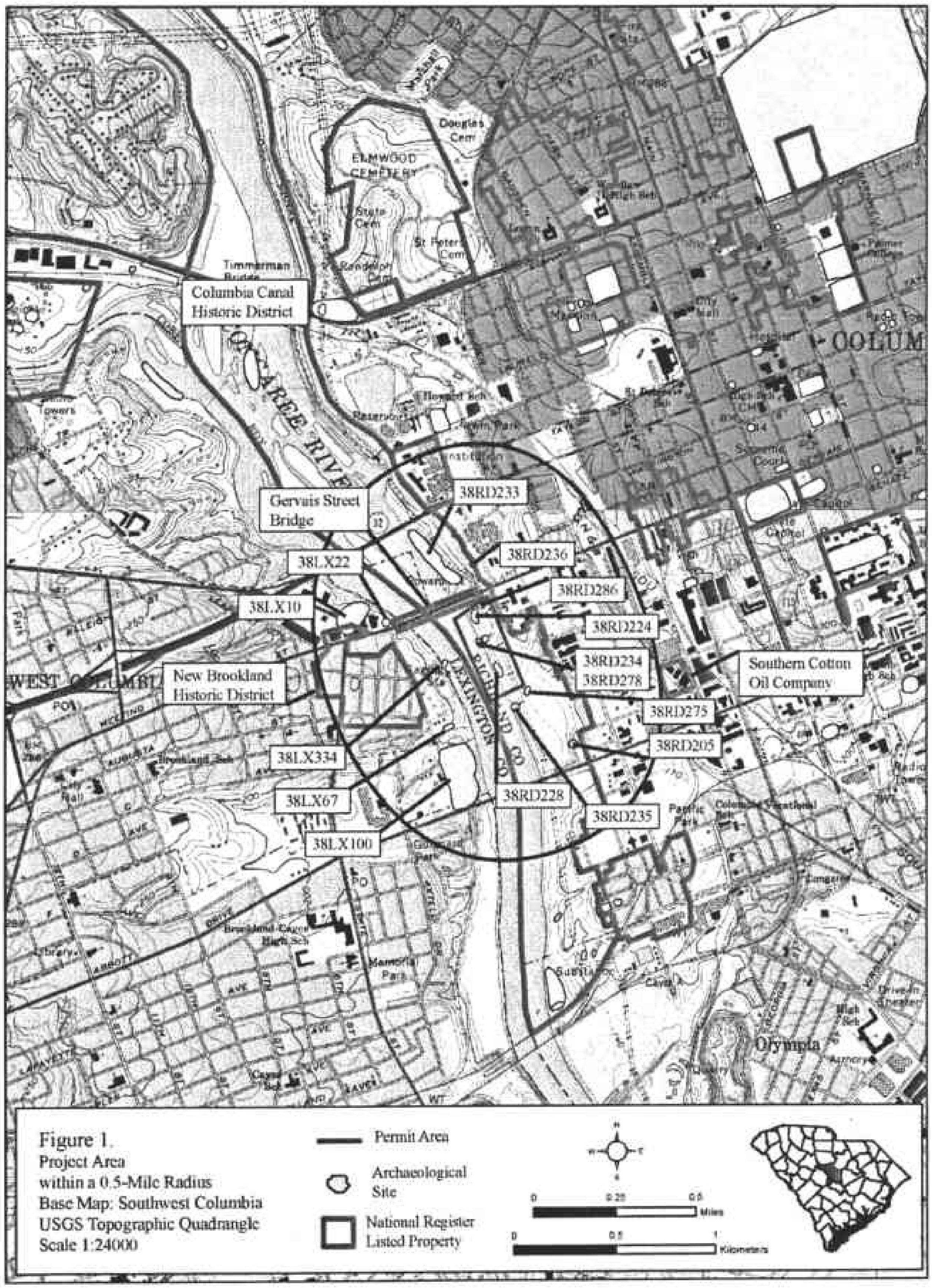

Figure 1.
Project Area within a 0.5-Mile Radius
Base Map: Southwest Columbia USGS Topographic Quadrangle
Scale 1:24000

- Conducting landside site setup activities;
- Installing a cofferdam of sufficient height to restrict river flow;
- Dewatering of the area to be excavated;
- Physically removing TLM-impacted sediment and debris using conventional equipment;
- Conditioning the sediment material for transportation to the landfill;
- Backfill as necessary; and
- Off-site disposal.

Prior to activities in the river, construction on the eastern shoreline to improve access to the project area for personnel, equipment and material transportation trucks will be conducted. These construction activities would include clearing and grading operations in the area of the Senate Street alluvial fan and along the eastern shoreline as well as improving and/or creating access roads (Figure 2). Access road improvements will raise the existing Senate Street Extension by adding a layer of fill (depth will vary pending on-site conditions) over the existing ground surface to level and widen the access road. Next a geotextile pad will be place over the fill. Geotextile is a high tensile strength fabric that stabilizes the ground surface and prevents ruts and the intermixing of gravel with the existing ground surface. Geotextiles are commonly used on construction sites to prevent damage caused by heavy equipment. The fabric used will meet or exceed the South Carolina Department of Transportation's standards for geotextiles. This protective layer will be topped by eight to ten inches of compact gravel effectively raising the existing access road by approximately 12 inches (Figure 3). New access roads will be raised above the current grade using the same procedure. Portions of the riverbank may be excavated in order to create access to the dewatered area.

Site setup activities will also include the construction of a project compound with office trailers, support structures and associated electrical power and utilities. These facilities would be located within the existing utility line corridor. These structures will be temporary. An agreement with the current landowner dictates that no subsurface ground disturbance will be caused by the project compound. Consequently, all temporary structures will be raised above the current grade using layers of fill, geotextile and gravel. Protective fencing would also be installed to restrict access to the work areas by unauthorized personnel.

The first component of the sediment removal will be the construction of a cofferdam around the planned removal areas. The purpose of the coffer dam is to isolate and dewater the areas prior to initiating the removal operations. The coffer dam will be designed to be over-topped during high water events. At average water levels the dam will rise approximately eight feet above the waterline. The temporary dam will be constructed with an impermeable barrier covered by stone or rip rap. Figure 4 is a conceptual rendering showing the approximate height and attributes of the coffer dam.

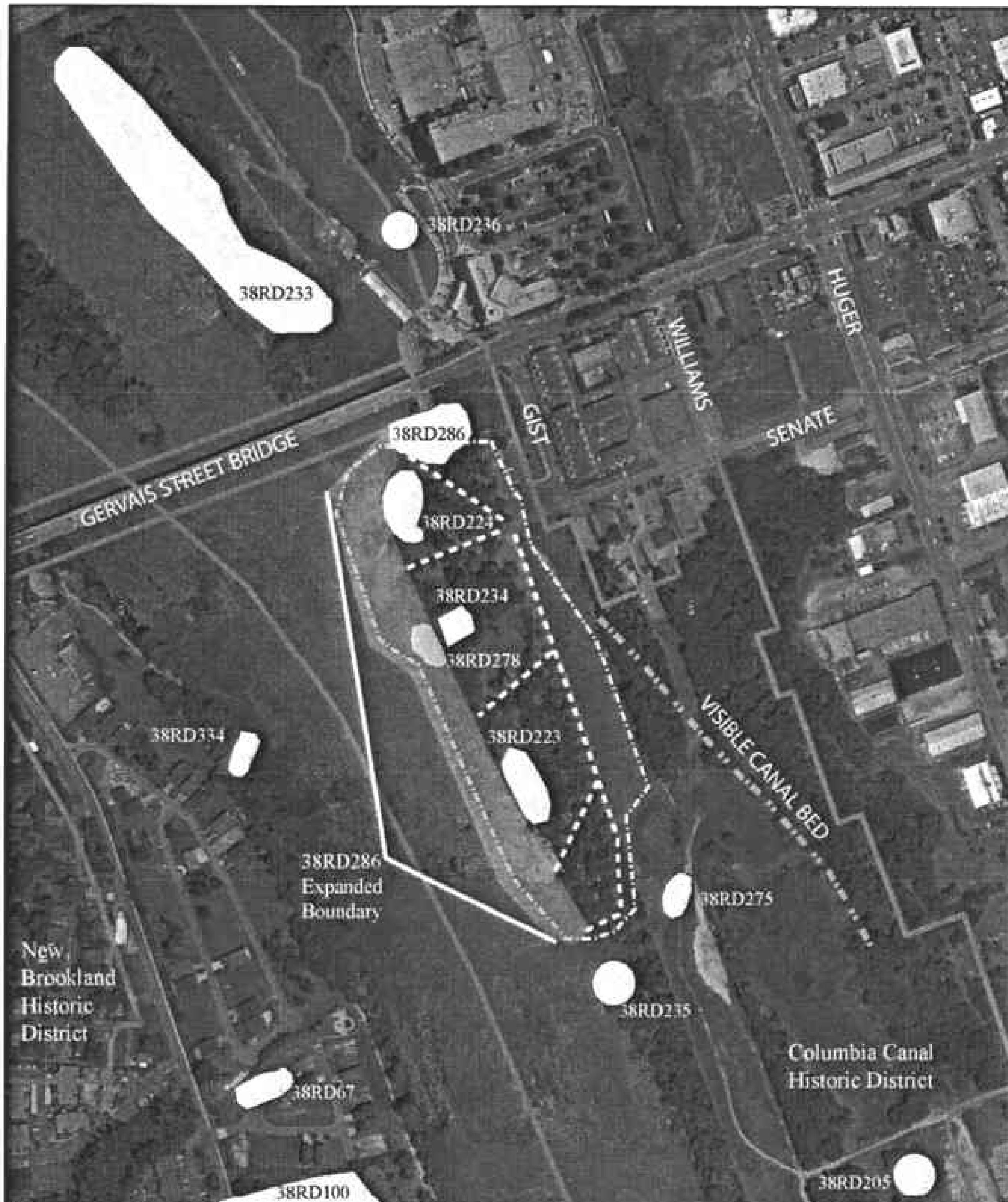

Figure 2.
Aerial view of the project area.
Scale: 1:5000
Base Map:
2014 Aerial Photograph

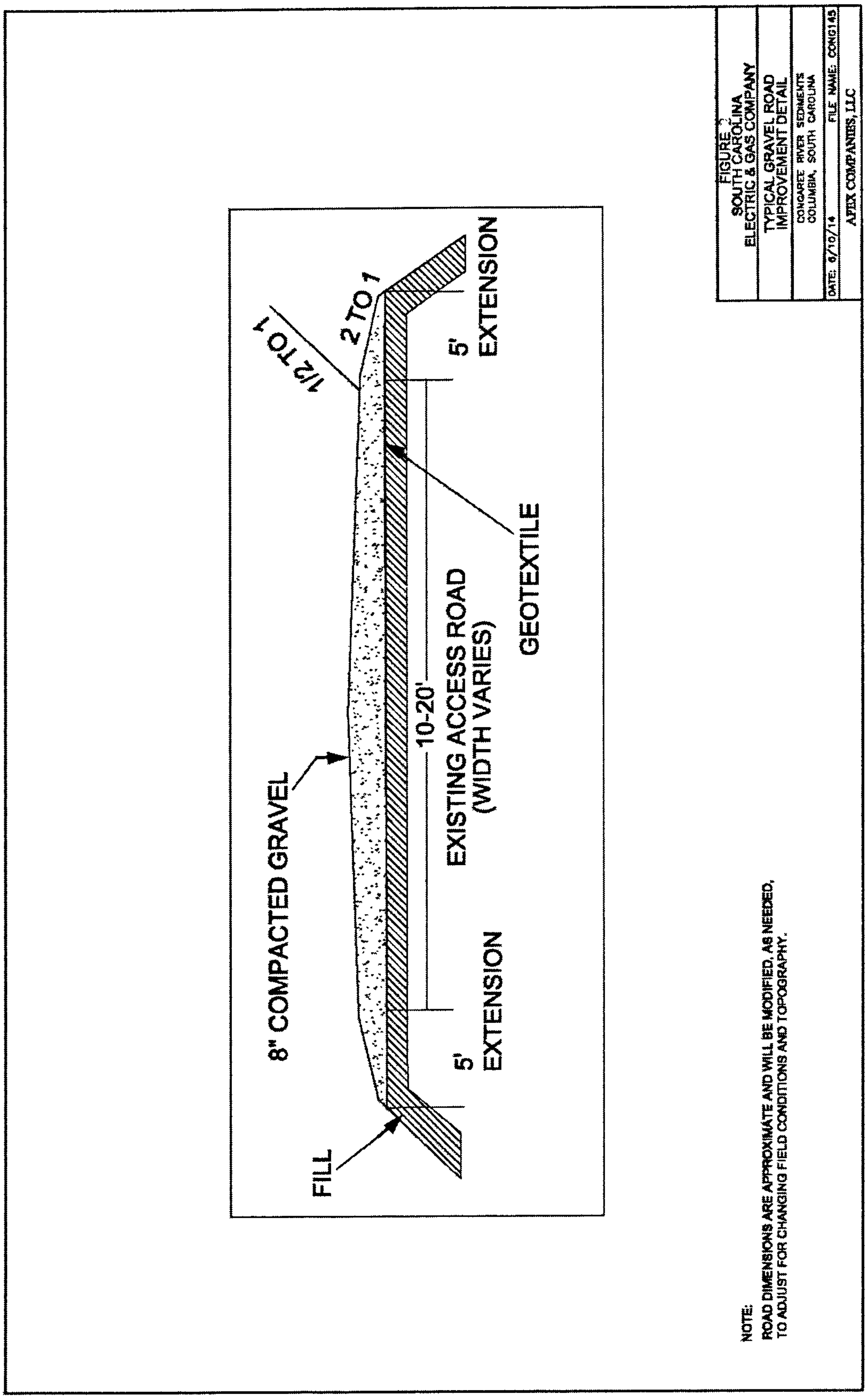

Figure 3. Conceptual construction plan for proposed access roads and improvements.

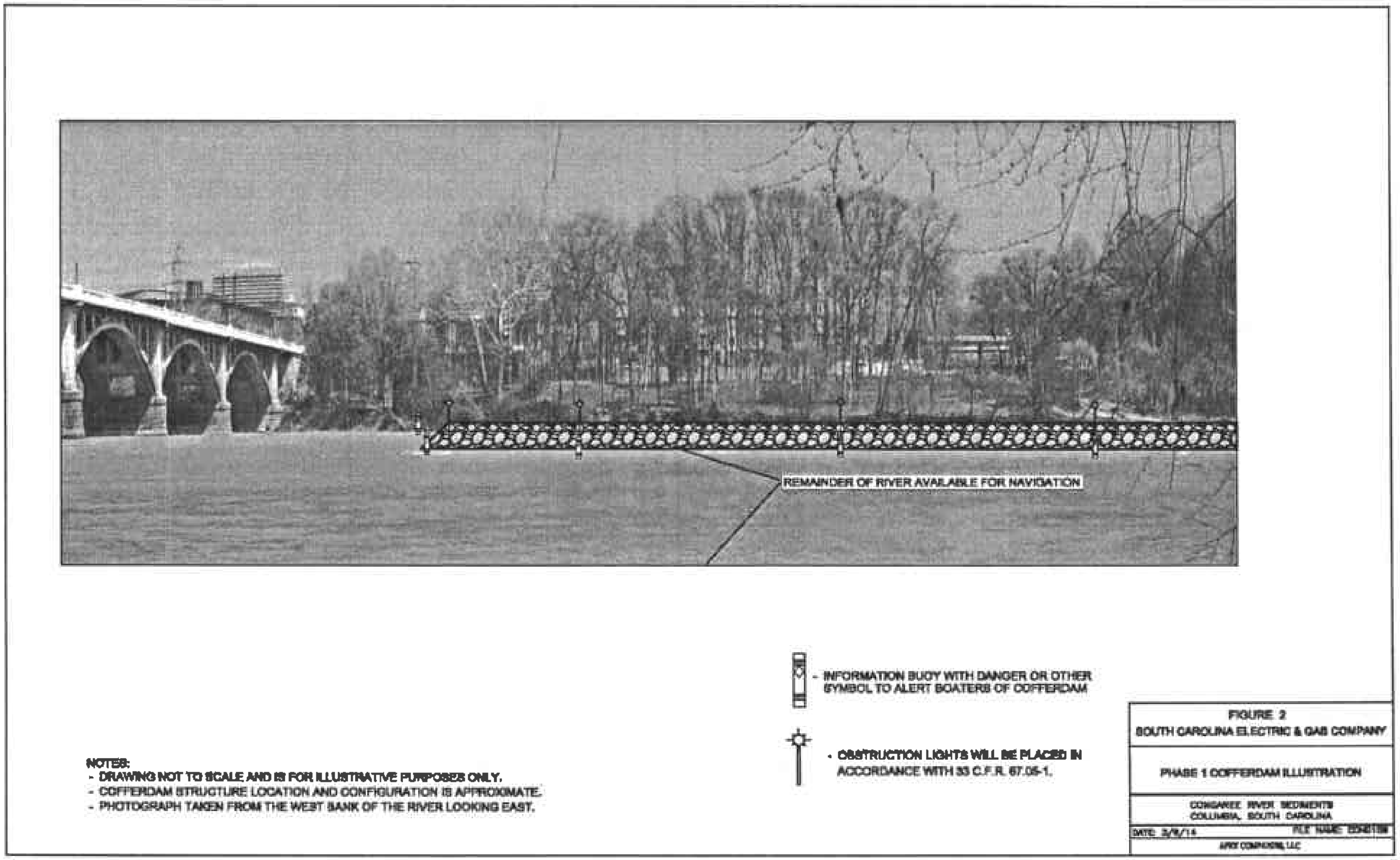

Figure 4. Conceptual drawing showing approximate height and style of proposed coffer dam.

Once the dam is in place there will be a period of dewatering and draining. After the area is dewatered sediment removal will begin. Due to the varying thickness of sediment, the uneven nature of the riverbed and changing conditions within the project area a number of different methodologies and equipment will be employed to complete the project. Generally speaking, heavy equipment/machine excavators coupled with vacuum removal or other techniques will be employed to remove the sediment to bedrock. The sediment will be removed in 50 × 50 foot grid squares.

Once removed, the sediment would likely require drying or solidification prior to transporting. Depending on the amount of TLM in the sediment the material will either be sent to an on-site sorting facility for screening or to an off-site facility for visual examination prior to disposal in a landfill. In order to minimize potential impacts on spawning migrations for threatened and/or endangered species a construction phase (for actual work in the river) would begin no earlier than May and need to end by October of each year. Because of this, and the amount of material to be removed, it is projected that multiple construction seasons or phases will be required. Once each construction phase is completed the river bottom would be restored to its approximate original conditions by the placement of imported fill sand or rock as may be required and the cofferdam would be removed, potentially to be reused as fill or erosion protection.

Due to the limited amount of ground disturbance proposed for this project the Area of Potential Effects (APE) for archaeology is considered to be the portion of the new access roads that will cut into the existing river bank. Due to the low visual profile and temporary nature of the coffer dam a 0.5-mile radius has been used as the APE for above ground resources.

The cultural resource investigations were performed under the direction of TRC Program Manager-Archaeologist Sean Norris, M.A., RPA. Fieldwork was conducted on August 5 and 26, 2014 by Mr. Norris and TRC archaeologist Ramona Grunden.

This report has been prepared in compliance with the National Historic Preservation Act of 1966 (as amended); the Archaeological and Historic Preservation Act of 1979; and procedures for the Protection of Historic Properties (36 CFR Part 800); 36 CFR Parts 60 through 79, as appropriate. Field investigations and the technical report meet or exceed the qualifications specified in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (FR 48:44716–44742) and the South *Carolina Standards and Guidelines for Archaeological Investigations* (SHPO et al. revised 2013). All supervisory personnel meet or exceed the Secretary of the Interior's Professional Qualifications Standards set forth in 36 CFR Part 61.

II. ENVIRONMENTAL SETTING

PROJECT SETTING

The project area is in the Fall Line region of South Carolina. It is characterized by a natural levy overlooking the Congaree River to the west. The project corridor is generally flat and, as stated above, a cleared access, maintenance and utility easement corridor that has been disturbed by underground sewer and gas lines characterizes the project area. It begins at the intersection of Gist and Senate Streets and continues south for approximately 1500 feet. The eastern portion of the project area is in an existing power line and gas line utility easement (Figure 5). The western part of the project area is wooded and undeveloped. Surrounding this is the City of Columbia.

Figure 5. General condtions in the project area.

PALEOENVIRONMENT

The contemporary climate and vegetation of the study area are products of a long and complex process of natural and man-induced change. The average winter temperatures in the study area were obviously considerably colder during the last glacial period, which lasted from ca. 25,000 to 15,000 B.P. At that time, the study area was covered by a boreal forest in which pines and spruce were dominant (Delcourt and Delcourt 1983; Whitehead 1973). The climate warmed and precipitation increased during the Late Glacial Period (ca. 15,000 to 10,000 B.P.), the period during which the first humans arrived in the region. During the late Pleistocene, coniferous forests were replaced by northern hardwoods as dominant canopy species (Bryson et al. 1970; Watts 1975, 1980; Whitehead 1973). The period ca. 10,000–5000 B.P., referred to as the Altithermal or Hypsithermal, was a period of continued warming but decreased precipitation (Bryson et al. 1970; Watts 1975). The dominant vegetation that survived was the oak-hickory forest (Watts 1975; Whitehead 1973). The climate since ca. 5000 B.P. has cooled slightly, with a possible increase in precipitation. The oak-hickory forests of earlier times decreased in size and became increasingly intermixed with pines (Wharton 1977). Although the earliest settlers reported large stands of yellow pine in the oak-hickory forests of the Piedmont, it is not known whether those stands were products of natural forces or of Native American hunting methods, which used fire to drive and concentrate game.

HISTORIC ENVIRONMENT

The project area is in the Oak-Pine Forest zone characteristic of the Piedmont and Fall Line (Braun 1950). Oaks and hickories are prevalent in this forest, with white oak the predominant species. Pines are also widespread in this zone (Braun 1950). However, the vegetation of the project area has been greatly modified in the past through climatic change, agricultural and silvicultural practices, and development.

Several sources suggest significant changes in the forest composition of the project region during historic times. Lowland vegetation in this area of the state has increased since European settlement. Valley sedimentation led to river and stream aggradation and a general rise of groundwater tables in the valleys. Formerly well-drained valleys with clear streams became swampy, and the streams themselves became muddy and sluggish.

The upland hardwoods probably exhibit the most change since European settlement. These forests, formerly dominant over most of South Carolina, were severely impacted by agricultural clearing in the 1700s and 1800s (Trimble 1974), and again by extensive timbering in the late 1800s and 1900s. In the past, the project area has been subjected to extensive land clearing that has severely altered the natural landscape and environment. Mixed hardwoods, situated along drainages, and loblolly pines mixed with deciduous secondary growth in the uplands, are found in areas that have suffered the least impact from these activities.

CLIMATE

The regional climate is characterized by long, hot, humid summers. The maximum daily temperature is usually near or above 90 degrees Fahrenheit with the minimum in the 65 to 70 degree range. The winter season is short, mild, and relatively dry. The average daily temperatures range from 40 to 45 degrees Fahrenheit. Precipitation is fairly heavy throughout the year and sustained droughts are uncommon. Rainfall is adequate for most crops during the peak-growing season of April–September. Because of the mild winters, precipitation in the form of snowfall is light, averaging about 10–13 inches annually (Kovacik and Winberry 1987).

PHYSIOGRAPHY AND HYDROLOGY

Relief in the project area is generally flat. Immediately west of the corridor the land slopes quickly to the Congaree River. Elevations at the site range from 140 feet Above Mean Sea Level

(AMSL) along the top of the levy to 130 feet AMSL along the tributary bottom and at the jurisdictional wetlands found near the southern terminus of the corridor.

SOILS

The project area contains two soil types:

Chastain Silty Clay Loam is poorly drained and found on floodplain associated with the unnamed tributary that will be spanned and the wetlands near the southern end of the corridor.

Toccoa Loam is found along the natural levy along which the corridor runs. It is deep, moderately well-drained soil found on floodplains and natural levees.

III. CULTURAL OVERVIEW

PRECONTACT AND CONTACT PERIOD OVERVIEWS

Paleoindian Period (ca. 12,500–10,000 B.P.)

The earliest definitive evidence of human occupation in the Southeastern United States has been dated to between 13,500 and 10,000 years before present (B.P.) (Anderson et al. 1996; Goodyear 1999). This time frame, known as the Paleoindian Period, is characterized by a social structure of small, highly mobile groups. Subsistence strategies relied on the hunting of large mammals (e.g., deer, elk, horse, wild pig) combined with the opportunistic hunting of smaller game and the collecting of wild plants and nuts. Megafauna such as mammoth, mastodon, and giant sloth, also would have been obtained, but the extent to which these animals were part of the Paleoindian diet is unknown. The only direct evidence for the exploitation of megafauna in South Carolina is a mammoth rib with cut marks that was found on Edisto Beach near Charleston (Anderson et al. 1992).

The artifacts left by these earliest inhabitants are comprised mostly of diagnostic projectile points, scrapers, gravers, denticulates, specialized hafted unifacial knives, large bifacial knives and burins. The most common and widely recognized artifact associated with the Paleoindian period is the fluted point. One of the most recent inventories of Paleoindian artifacts indicated that approximately 350 fluted points have been reported in South Carolina (Anderson et al. 1996). Unfortunately, almost all of these points were recovered by amateur collectors or from surface contexts, making archaeological interpretation difficult. Within the last twenty years only a small amount of Paleoindian material has been recovered from intact contexts in South Carolina and surrounding areas (Anderson and Schuldenrein 1985; Elliott and Doyon 1981; Michie 1996; O'Steen 1994).

Regional variation in projectile point morphology began to emerge in portions of the Southeast by about 11,000 B.P., probably due to restricted movement and the formation of loosely defined social networks and habitual use areas (Anderson 1995). The common point types that have been found throughout South Carolina include Clovis, Cumberland, Suwannee, Quad and Dalton (Anderson et al. 1990; Justice 1987; Milanich and Fairbanks 1980). Some have suggested dividing the Paleoindian into Early, Middle and Late sub-periods based on differences in projectile point morphology (Anderson et al. 1990; O'Steen et al. 1986).

The arrival of new environmental conditions influenced how Paleoindians organized their society. Paleoindians were required to cope with environmental changes and the consequent social pressures that came about during the period of climatic transition associated with the onset of the Archaic Period.

Archaic Period (ca. 10,000–3000 B.P.)

The transition from Paleoindian to Archaic is loosely defined, and in the Southeast the chronological interface ranges from ca. 10,000 to 8500 B.P. In addition to changes in environmental conditions, changes in technology, settlement patterns, and social organization were developed to cope with this climatic shift. The Archaic period is typically divided into Early, Middle, and Late subperiods based on changes in technology and subsistence through time. It should be emphasized, however, that these subdivisions are artificial constructs and the rate of change across the Southeast varied through time and from place to place.

The Early Archaic (10,000–8000 B.P.) is typically separated from the Paleoindian period by a warming climate and the emergence of seasonal occupation sites. Projectile points are similar to the previous period, but exhibit an increased sophistication through rejuvenation strategies. The typical forms are smaller than those of the Paleoindian period, and include Hardaway, Palmer, and Kirk, Big Sandy, and several bifurcate styles such as MacCorkle, St. Albans, Kanawha, and LeCroy. Wear patterns suggest that these tools were utilized for activities such as killing, butchering, skinning game, and woodworking.

Based on the increased number and size of Early Archaic sites, a population increase appears to have occurred during this period. Consequently, the social landscape became much more complex and settlement models for the Early Archaic period currently are under debate (e.g., Anderson 1992; Daniel 1996, 1998; Ward 1983).

The Middle Archaic (8000–5000 B.P.) marks the introduction of dart points, atlatl weights, and groundstone implements to the lithic tool assemblage. Diagnostic hafted biface types of this period include Stanly, Morrow Mountain, and Guilford points, followed by transitional Middle and Late Archaic Brier Creek and Allendale types. Also included in the Middle Archaic tool kits are groundstone artifacts such as metates and nutting stones, and there is a decrease in the diversity of chipped stone artifacts.

Middle Archaic sites in the Sandhills have been described as small, randomly distributed occupations exhibiting very little intersite technological variability. Local raw materials were used almost exclusively, and the vast majority of tools were technologically expedient (Blanton and Sassaman 1989; Sassaman 1993a).

The Late Archaic (ca. 5000–3000 B.P.) is transitional between the horticultural-based economies of the Woodland period and the previous hunter-gatherer cultures of the Early and Middle Archaic. Population was relatively dense, with large sites documented near major river systems along the fall line and in the Coastal Plain. A variety of imported materials such as copper and steatite, have been recovered from Late Archaic sites. This suggests an increasing complexity in trade relations.

The tool most commonly associated with the Late Archaic period in South Carolina is the Savannah River point. These bifaces, known by various names from Florida all the way into Canada, are often very large (12+ cm in length is not uncommon) and exhibit a straight stem, straight base, and triangular blade. These "points" were likely multifunctional tools used as both spear points and as knives for cutting and skinning.

Other Late Archaic varieties found in the project region include Appalachian Stemmed, small Savannah River Stemmed and Otarre Stemmed, (Sassaman 1985). Like Savannah River hafted bifaces, they are characterized by triangular blades, straight or slightly contracting stems, and straight bases. The primary difference is size; Savannah River points tend to be longer and wider than the other types. For the most part these type names are more a product of parochial terminology than of actual morphological differences.

Fiber-tempered wares, known as Stallings Island, are found almost entirely along the Savannah River and on the southern South Carolina and northern Georgia coasts during this sub-period (Sassaman 1993b; Stoltman 1974). Inland and along the northern South Carolina coast, a coeval sand-tempered ware known as Thom's Creek is more common. In the Piedmont, pottery is not commonly found on Late Archaic sites, where soapstone vessels were utilized well after they were abandoned on the coast (Sassaman et al.1990; Sassaman 1993b).

Woodland Period (ca. 3000–900 B.P.)

Whereas the stylistic typologies of projectile points are used to differentiate the Archaic subperiods, changes in ceramic types are used to define the divisions of the Woodland period. The Early Woodland begins at approximately 3000 B.P. with the adoption of pottery across most of the eastern United States. The progression from the Late Archaic to the Early Woodland was gradual, with an increase in the reliance on seeds and planting, and the development of a "big-man" social structure. Reflective of this development in social structure are the use of conical burial mounds and the elaboration of a widespread exchange network that occurs during this period. In the project area, ceramic artifacts dating to this period include the Yadkin and Deptford series (Anderson 1985, Blanton et al. 1986).

Mississippian Period (ca. A.D. 900–1670)

Social, economic, and technological manifestations that are associated with the Mississippian period became established by approximately A.D. 900. Unlike the transitions between the sub-phases of the Woodland period, these changes were dramatic, and some have argued that they occurred when the loosely integrated Late Woodland populations in the region were colonized and acculturated by the chiefdom-level societies that had emerged in the Etowah and Oconee River valleys (Anderson et al. 1996).

This time period represents cultures that were present at the time of initial European contact. The period is marked by a rise of ceremonialism, large public constructions such as pyramidal mounds, and a heavy reliance on the production of domesticated imports such as maize, beans and squash (Smith 1983).

A highly organized village structure developed during this period. Associated with the village lifestyle were rigid social, political and religious systems. Society was stratified and a ruling class exerted ascribed and achieved power over the general population. Central villages were typically located along terraces or levees of major rivers. Smaller villages, hamlets, and isolated family settlements are also characteristic of this period (Ferguson 1971). The increase in population put a strain on the amount of available resources and warfare became endemic. Central towns and villages were fortified with palisades, while small villages and farmsteads were located around the periphery, presumably to facilitate a safe retreat within the palisade in the event of an attack. Smaller villages and farmsteads also would have contributed resources and labor to the main towns.

Ceramic styles have allowed for the differentiation of this period into subdivisions and at least two possible cultural areas. Trinkley (1983) has presented a discussion of the ceramic variability for this period in the South Carolina Coastal Plain and coast, while Anderson and Joseph (1988) have presented one applicable to the South Carolina Piedmont. There is increasing evidence that territorial boundaries between chiefdoms were closely maintained during the Mississippian period.

Evidence of Mississippian chiefdoms has been identified in Georgia, North Carolina, South Carolina, and across much of the southeast. Current research identifies a number of major Mississippian centers along the Fall Line including Hollywood and Lawton near Augusta, Santee Indian Mound on the Santee River, Mulberry and Adamson near Camden, and Town Creek along the Pee Dee River in North Carolina. In addition, one or more small chiefdoms, dating from A.D. 1225–1375, may have been present in the Broad River Valley of the South Carolina Piedmont, not far from the current study area (Green and Bates 2003). In terms of settlement organization, these mound centers formed the center of political power. The ruling elite and a resident population permanently occupied these villages. As political control waxed and waned among elite factions in this politically turbulent era, mound centers were periodically constructed, maintained, and abandoned (Anderson 1990). Many mound centers were abandoned and then reoccupied several times.

HISTORICAL OVERVIEW OF THE PROJECT VICINITY

Early Settlement in the South Carolina Midlands

The South Carolina Midlands, for the purposes of this section, are defined as the City of Columbia and the surrounding counties of Richland, Newberry, Saluda, and Lexington.

In the early eighteenth century, the majority of European settlements remained in the state's Lowcountry. A trading post/fort was erected at "Congaree" in the vicinity of present-day Cayce in the first quarter of the eighteenth century, but there was no large-scale civilian settlement until the 1730s. To protect coastal interests from Spanish and Indian incursion, and to attract European immigrants in the hopes of balancing the ever-growing African slave population, Governor Robert Johnson created 11 townships across the state's northern frontier in the 1730s (Figure 6). The townships were located along rivers in the northern portion of the colony. Saxe-Gothe Township was established on the west side of the Congaree River south of the confluence of the Saluda River. The promise of new land and opportunities brought a large influx of immigrants to South Carolina (Edgar 1998).

The land along the Congaree River became an inviting location for settlement. The area was very appealing to the settlers for the richness of its landscape, which consisted of forests with little undergrowth and large hickory, oak, and pine trees. Most of the new settlers took up farming, along with cattle-grazing, milling, and commercial endeavors including operating ferries and Indian Trade (Salley 1898).

In an effort to attract settlers those arriving in Saxe-Gotha were eligible for a town lot and 50 acres of land per family member (Kovacik and Winberry 1987). Colonists in the Midlands created settlements that were largely independent of the Lowcountry. Coastal settlements were strongly Anglican, whereas the Midlands people were for the most part dissenters who were often seeking sanctuary to practice their faith unmolested. The coastal citizens were often several generations past the rigors of colonization, unlike the newcomers to the interior. Language, religion, economics, and geography created a barrier of sorts that was not breached until the late eighteenth century and the Revolution.

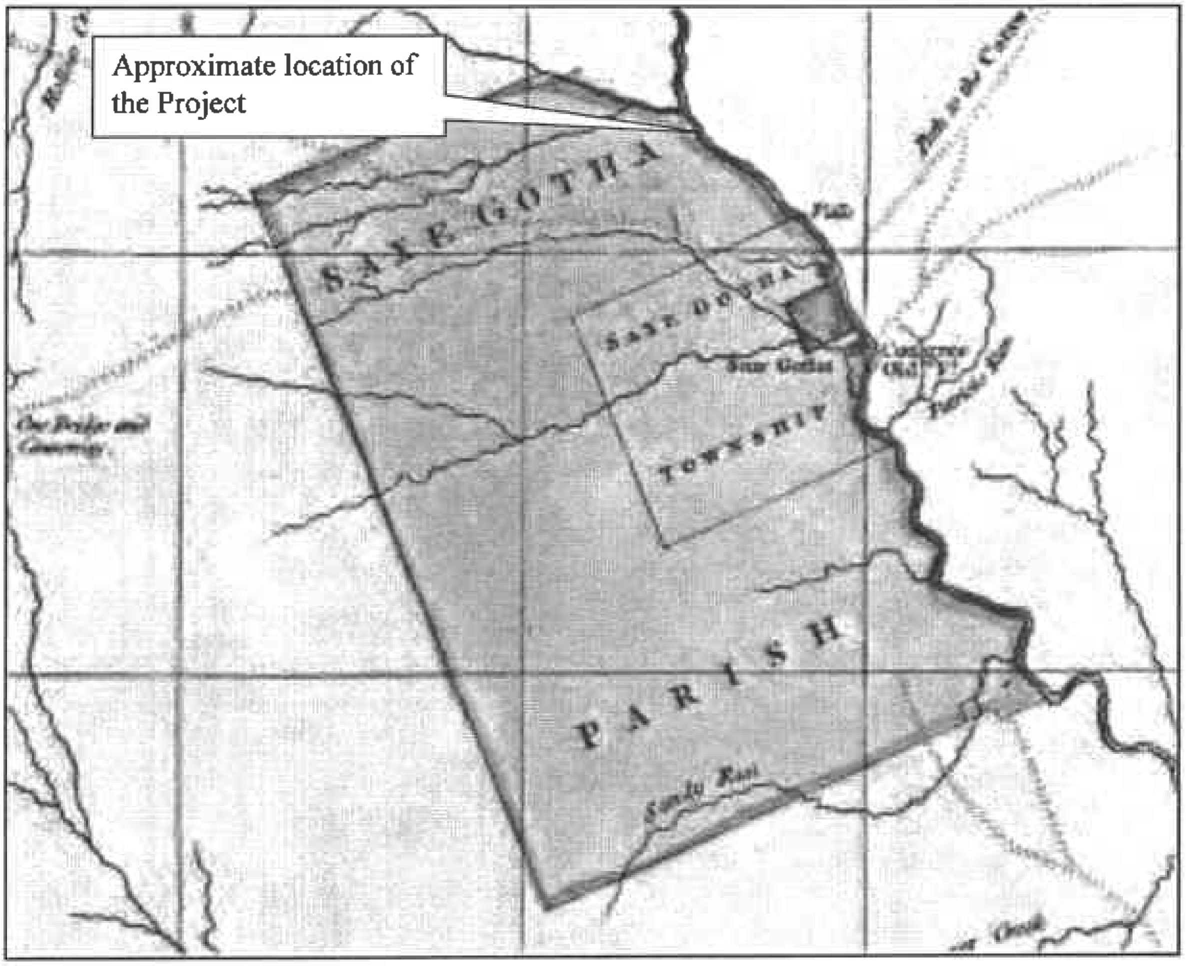

Figure 6. Saxe-Gotha in 1757 (DeBrahms 1757).

The American Revolution

Poor soils and lack of transportation improvements slowed the growth of the Saxe-Gotha Township until after the Revolutionary War. Prior to the start of the war, the township was virtually abandoned. A small trading center called Granby on the west bank of the Congaree River below the shoals at Columbia was established prior to 1774, and the fort constructed there during the Revolution was active in supplying the military. Located at the head of navigation of the Congaree River, the town became an important shipping point for goods produced on the surrounding agricultural lands, including cotton, indigo, hemp ropes, corn, and beeswax. Likewise, manufactured goods such as fabrics and household wares, and staples such as salt and coffee were shipped upriver and distributed throughout the Upcountry (Central Midlands Regional Planning Council [CMRPC] 1982).

As the Revolution neared, the dissatisfaction felt by the colonists toward their British leaders was largely concentrated in the coastal areas. Residents of the Midlands and Upcountry became a source of concern for the delegates, however, since they were more disillusioned with the government in Charleston than that of the Royal government. In an attempt to win support from the backcountry settlers, a group of representatives from the Provincial Congress were sent to talk with the area's inhabitants. The first of three meetings took place in the Dutch Fork at McLaurin's Store in present-day Newberry County. William Drayton, leader of the group, later noted in his journal that the meeting went poorly. In the end, the two parties reached an accord; representatives from the South Carolina Midlands and Upcountry regions would sign an agreement stating that they would remain neutral in exchange for the promise that they would no longer be bothered with talk of revolution (Edgar 1998).

At the war's conclusion, South Carolina slowly began the process of reestablishing its government. After the Revolution, Ninety-Six, Orangeburg, Cheraw, and Camden Districts, created in 1769, had become too large to effectively govern. In 1783 the state government decided to divide the existing districts into smaller counties of no more than 40 square miles. Richland County was formed from that part of Camden District located between the Congaree and Wateree rivers. In 1786 vote by the legislature to move the state's capital from Charleston to a new town that would be constructed in a centralized location along the banks of the Congaree River in Richland County. After a great deal of debate, it was decided that the new town would be named Columbia, a name that symbolized the new nation (Edgar 1998).

The site for the capital was chosen because it was centrally located between the upcountry regions and the former capital of Charleston. The location proved to be well situated for the promotion of trade as well. Although it lay beyond the head of navigation by about two miles, the presence of the state and county governments, banks, law offices, and South Carolina College (established in 1801), encouraged growth of the capital. The Columbia Canal, completed in 1824, brought boats into the city, and a series of canals on the Broad, Wateree, and Saluda rivers was constructed to further facilitate trade. For the most part, the use of these canals did not justify the enormous cost to the state for their construction, since they were often inoperable because of a lack of water, damage caused by freshets, or structural and mechanical problems. Nevertheless, they were important in attracting business and industry to the Columbia area. By 1830 the town had a population of 3,310 and could boast of a thriving state college, a State House, town hall and marketplace, numerous churches, a Masonic Hall, two public libraries and a third at the college, a series of bridges spanning its three rivers, and a modest but active spirit of commerce and industry (Moore 1993).

Antebellum Agriculture in the Midlands

The introduction of the cotton gin in the late 1790s transformed the Midlands' economy. Short staple cotton and the cotton gin allowed Midlands farmers access to the wealth and opportunities that had been previously reserved for coastal planters. The possibility of making a large profit from the sale of their cotton crop was a driving reason behind the shift in interest. As a result, Midlands planters began to invest in infrastructure, educational institutions, and commercial enterprises.

Accompanying the cotton boom during the first portion of the nineteenth century was a statewide effort supporting internal improvements, including new roads and canals to connect the upper and lower parts of the state that had been separated for years both physically and economically. In 1818, the General Assembly established a Board of Internal Improvements to oversee a $1 million program of roads and canals to improve the state's transportation network (Edgar 1998). Construction started on a system of canals was begun on the Saluda, Broad, Congaree, Catawba, and Wateree rivers.

The state's canal system was largely a disappointment. The plan proposed by the Board of Internal Improvements called for eight canals. Four were to be located on the Catawba and Wateree Rivers above Camden. The Lockwood and Columbia Canals along the Broad River were intended to open up traffic 110 miles north of Columbia, and the Saluda and Dreher Canals along the Saluda River were meant to open up river traffic to Laurens and Abbeville west of Columbia (Edgar 1998). All eight canals were completed and totaled 25 miles of canals and 59 locks that connected every district in the state except Greenville.

The entire canal system was plagued with problems from the outset. Shoddy construction and damage from flooding resulted in the poor operation of the locks. Public disinterest added to operational problems. Lack of use by the public resulted in a failure to generate enough revenue to pay the lock keepers' salaries (Ford 1988). The Saluda River Canals were infrequently used, and their operation was often plagued by either too much or too little water from upstream. No tolls had been collected at the Dreher Canal by 1824, and it was not until 1827 that any evidence has been found of revenues from the canal. Twenty-one boats used the canal that year, carrying 578 bales of cotton. The Columbia Canal can be seen on Mills' 1825 Atlas of Richland District on the east side of the Congaree River (Figure 7).

Despite these setbacks, the area managed to prosper during the first quarter of the nineteenth century, as a result of the cotton boom. Besides the business generated by the state government, Columbia supported a large, but dispersed agricultural community in surrounding Richland and Lexington districts. Merchants, bankers, plantation owners, and real estate speculators capitalized on the flow of goods through Columbia, where cotton from the countryside was loaded onto barges for shipment to Charleston, and manufactured goods from New England and abroad was sold to farmers, peddlers, and storeowners. The new money from the trade encouraged investment, and some of the leading businessmen began to invest in manufacturing enterprises, in hopes of decreasing the state's dependency on imports and improving the return on their money (Lansdell 2003). With a ready supply of cotton available, and a slave labor force to work in the factories, many felt that the South could become the next great textile center.

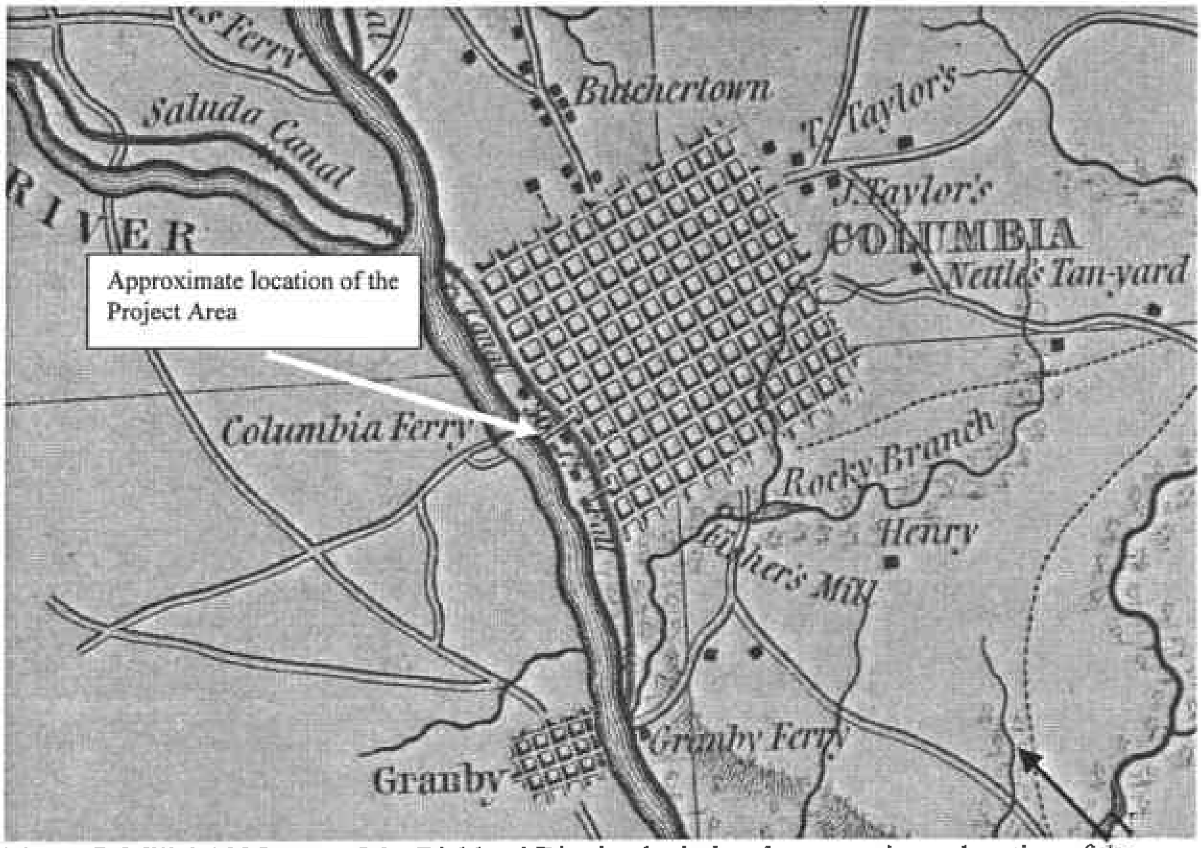

Figure 7. Mills' 1825 map of the Richland District depicting the approximate location of the project area.

Civil War

South Carolinians worried that Abraham Lincoln's victory in the 1860 election would lead to freedom for the black population and the end to wealth that relied heavily on slave labor. Upon hearing of Lincoln's victory, communities across South Carolina convened to discuss what action would be taken in retaliation. On 17 December 1860 delegates from communities across the state unanimously voted to draft an Ordinance of Secession. Following an outbreak of smallpox in Columbia, the convention reconvened in Charleston where the Ordinance was signed on 20 December 1860, and Francis W. Pickens of Edgefield District was elected governor (Pope 1992; Moore 1993).

The Midlands of South Carolina did not witness any military action until the waning months of the war, but the effects of the hostilities were keenly felt. Nearly every man of fighting age was pressed into service, leaving the farms to be run by old men, wives, children, and slaves. Many of the men who served never returned, or were permanently disabled.

Late in 1864, as Union troops moved into Georgia from the north, Confederate authorities began to move prisoners of war from Andersonville and other stockades to what was perceived as more secure territory. The ultimate destinations included Florence, South Carolina for enlisted men and Columbia for officers. It is a sign of the stress war had placed on the Confederate infrastructure that housing, feeding, and guarding the prisoners was left to the state. In both Florence and Columbia the guards were for the most part too young or too old for active military service. In Columbia the prisoners were first kept at "Camp Sorghum", so named for the sorghum molasses that made up the bulk of the food supply. Camp Sorghum was located on the west side of the Saluda River in a field near the Saluda Factory. The camp was not fortified and escapes were common, becoming so prevalent that the prisoners were moved in December 1864 to the grounds of the South Carolina Lunatic Asylum.

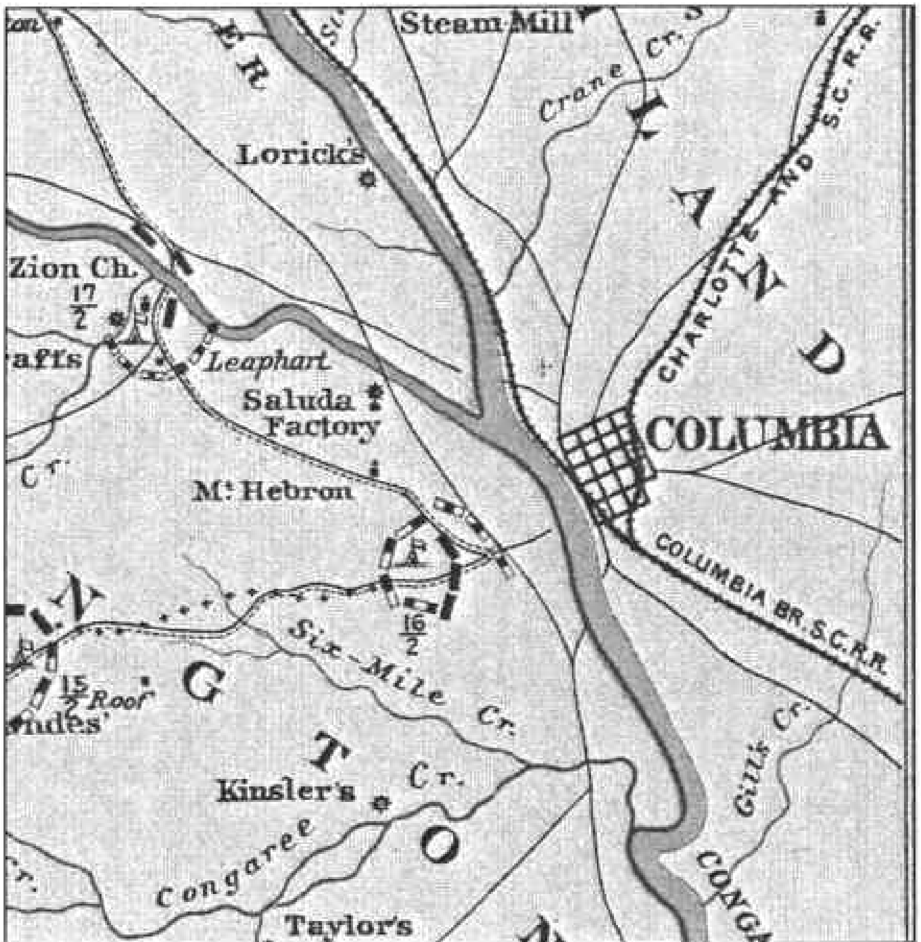

Figure 8. Union Troop locations February 15, 16 and 17, 1865

The infamous "March to the Sea" made by Union troops under the command of General William T. Sherman concluded with the surrender of Savannah in late December, 1864. Some troops remained in coastal Georgia while others were transported to Beaufort and its environs. In mid-January, 1865 the troops were again on the move, this time heading north in what became known as the "Campaign of the Carolinas". The left wing of Sherman's army (that is, those furthest west) crossed the Savannah River at several points, the bulk regrouping at Robertsville (in present day Jasper County) at the end of January, 1865. Heavy rains during the winter caused swollen streams and creeks and often bridges had been burned before the Union forces arrived, slowing the pace of the advance. Nonetheless, the troops averaged approximately 15 miles per day, skirmishing with Confederate troops before them and destroying railroads along the way.

By February 16, 1865 the First, Second and Third Divisions as well as Kirkpatrick's Cavalry were camped on the west bank of the Congaree River directly across from Columbia (Figure 8). Meanwhile, Columbia's citizens were trying to evacuate the city, and bales of cotton were dragged into the street to be carried off and burned to keep them from falling into enemy hands.

Wade Hampton, hastily promoted to lieutenant general, was left to defend the city with General Joseph Wheeler's cavalry. Sensing the futility of the defense, Wheeler's men began looting the city, ostensibly to prevent capture by the Union army.

On the night of the 16th, Hampton announced that he planned to evacuate on the following morning, leaving behind the cotton, which he was unable to transport. Sherman's troops began shelling the city, which surrendered the following day. That evening, fueled by spirits dispensed without restriction, Union troops created more mischief through the city. When the cotton in the streets caught fire, they were unable or unwilling to contain the blazes, in some cases probably fanning the flames. The result was the near complete destruction of Columbia (Moore 1993). Having the run of the countryside for several days, Union troops burned many homes and farms in region.

Postbellum Agricultural Practices

Lee's surrender at Appomattox in April 1865 sealed the fate of the Confederacy and launched the South on a difficult course to remodel its social structure around free labor. Soldiers returned home to the Midlands to find desolation. Farmland was barren and plantation houses stood overgrown and decaying. Production and livestock holdings were still below 1860 levels by the time of the 1870 census; widespread corruption in state and local government during Reconstruction further hampered recovery. By 1880, however, cotton production had reached antebellum levels (Kennedy 1990).

The rapid increase in cotton production in the post-war years led to the abandonment of food crops and eventually to a statewide agricultural crisis. Prior to the introduction of cotton, farms had been small and self-sufficient, producing their own food. Eager to make a profit, most farmers reclaimed fields that had previously been reserved for food crops to grow more cotton. When prices began to fall, farmers became desperate to pay off overdue bank loans and in turn over-planted fields, used substandard land for planting, and heavily fertilized their crops in the hopes that increased production would lead to increased profits. In 1860, South Carolina produced 353,412 bales of cotton; by 1890 the figure had reached 747,190 bales. Eventually, the market became flooded with cotton resulting in a drop in the price per pound. Prices fell gradually, but consistently from 1881 through 1886 (Edgar 1998).

African-American farmers faced even greater hurdles in the postbellum period than did their white counterparts. Blocked from owning land by discriminatory banking and real estate practices, blacks generally took up as sharecroppers, sometimes on their old plantations, sometimes in a new location. The sharecropping system proved fundamentally detrimental to both tenants and landlords because of the opportunity for abuse by the landlords in the distribution of the proceeds and the lack of incentives for tenants to make improvements to the land. As lands became exhausted, tenants sought new arrangements, moving from farm to farm, but seeing no improvement in their situation.

A worldwide agricultural depression and the arrival of the boll weevil during the 1920s further eroded the established agricultural regime of the region. By 1930, tenancy levels in South Carolina had begun to stabilize, but the number of farms decreased as tenants left farming for other employment (Edgar 1998).

Although the tenant system led to widespread poverty in the region over the long run, cotton farming and the associated textile industry formed the basis of the region's economy from the end of the Civil War until the beginning of World War II.

Industrialization and Expansion in the Postbellum Era

While agriculture was the mainstay of the Midlands' economy until the mid-twentieth century, the late nineteenth and early twentieth centuries saw rapid changes in transportation and manufacturing. The post-Civil War years saw the continuing development of the state's railway system. By 1880, cities such as Columbia began to once again grow and prosper as the cotton market continued to expand. Many of these towns became major cotton markets as trains running through the area allowed the easy shipment of cotton and other agricultural products.

The opening of the improved Columbia Canal in 1891 resulted in new mills and factories being constructed, and between 1880 and 1900 the population of Columbia doubled to 21,108. The South Carolina textile industry saw a dramatic increase with 61 mills either built or expanded between 1895 and 1907, becoming the largest textile producing state in the South. Columbia Mills, on the east side of the Congaree River at Columbia, became the first mill in the state to operate solely on hydroelectric power generated from the Columbia Canal, and a host of other mills soon followed suit.

An Agricultural Depression and a National Depression

An economic depression hit South Carolina in 1921, almost a decade before it was felt throughout the rest of the country. The collapse of cotton and tobacco prices, overseas competition, and the advance of the boll weevil took a heavy toll on the local economy. The boll weevil arrived in South Carolina in 1917, but it was not until 1922 that short staple cotton crops were affected (Edgar 1998). The price would rebound slightly, but remained low until World War II.

The arrival of the 1930s saw an agricultural system on the brink of collapse. Farmland and associated buildings stood at half of their original value and many farms across the state were mortgaged with owners surviving on borrowed money. Over-planted and over-fertilized land caused major erosion problems (most notably in the upstate) and by 1934, eight million of the state's farming acreage had been declared useless (Edgar 1998). The agricultural crisis of the 1920s and 1930s triggered a mass exodus of residents from the state. Because of the growth of Columbia, Richland County did not see a large decline in population, but residents were moving from the rural areas to the more urbanized areas close to the capital (Moore 1993).

It took some time for the effects of the nationwide Depression that came on the heels of the 1929 Stock Market Crash to be felt in the South Carolina Midlands. The construction of Lake Murray and the active cotton mills kept employment high until the end of 1930. New Deal work programs such as the Civilian Conservation Corps, Works Progress Administration, and Public Works Agency helped bridge the gap until the material and personnel demands of World War II pulled the country out of economic collapse (Moore 1993).

A New Era in a Diversified Economy

World War II finally brought an end to the Depression in the region. The war years saw an increase in agricultural production and manufactured products, as many South Carolina businesses became government contractors. Fort Jackson, established in Richland County during World War I, but virtually abandoned since the end of that war, was revived during World War II for infantry training. In 1940, a site between Six Mile Creek and Congaree Creek in Lexington County was chosen by the U.S. Army for an airfield, which was completed that same year. After World War II, the facility was turned over to the local governments for a regional airport to serve the Columbia area. At the war's close, veterans came home with renewed ambition and many quickly stepped forward as leaders of their communities. Soldiers took advantage of the G.I. Bill, obtaining an education and utilizing their newly developed skills throughout the community. In the years immediately following World War II, veterans opened businesses throughout the area, some of which are still in operation today (Pope 1992; Moore 1993).

Previous Investigations in the Project Area

An examination of materials on file at the SCDAH and SCIAA revealed one project that has a bearing on the current survey. In 1981 the South Carolina Institute of Archaeology and Anthropology (SCIAA) conducted a preliminary archaeological assessment of the Riverfront Park area and adjacent portions of the Historic Columbia Canal (Canouts and Harmon, 1981). The work consisted of a background literature review and a field reconnaissance survey with limited subsurface testing. The goal of the work was to document specifics of the canal and its features that were not well defined in the National Register Nomination Form. Recommendations for further archaeological studies were provided.

The report found that the area south of Gervais Street "has been drastically altered by the construction of a transmission line and other activities" (Canouts and Harmon, 1981). Despite the disturbance a number of archaeological resources were identified. These resources will be discussed in Chapter IV. Interestingly, the report notes that the National Register nomination form for the Columbia Canal Historic District states that portions of the canal are visible from Gervais Street south to Green Street, however they were unable to locate the canal bed itself and state that the canal route disappears in the area of Bicentennial Park. The report recommended further study.

IV. METHODS AND RESULTS

METHODS

The APE for archaeology for this project is considered to be the areas to be impacted by the proposed project. This includes the dewatered portion of the Congaree River and the upland locations of access roads and project compound. Repeated requests to shovel test the APE were denied by the property owner. Consequently no subsurface testing was conducted during the course of the project. A pedestrian survey was carried out along the existing dirt and gravel access road and the wooded area adjacent to the project compound. The entire road was walked on two separate occasions. The road surface was visually inspected for cultural material. Transects spaced approximately 15 meters apart were walked within the wooded portion of the project boundary. Photographs were taken at the locations of previously recorded sites.

RESULTS

Background and Literature Search

Prior to fieldwork, TRC conducted background research at the site files of the South Carolina Office of State Archaeology housed at SCIAA. This research included examination of archaeological sites, structures, and National Register of Historic Places (NRHP) files. The background research gathered information concerning the presence of known archaeological sites, historic structures or cemeteries, or potential sites on or in close proximity to the project area. Previous Recorded Archaeological Sites

Background research established that there are five previously recorded sites within the permit area. Site 38RD223 is a large nineteenth to twentieth century dump/sanitary landfill site located on a bluff overlooking the Congaree River (Canouts and Harmon, 1981). It is noted that the site has been disturbed by pot hunters although portions of it may be in good condition. This site was not assessed as to its National Register eligibility.

Site 38RD224 is interpreted as the possible ruins of Briggs' sawmill. Canouts and Harmon (1981) note a building foundation adjacent to a small tributary of the Congaree River. This site has not been assessed for the National Register.

Site 38RD278 is an underwater discovery of historic ceramics and metal artifacts. It is adjacent to site 38RD234 and may be a dump site from that structure

38RD286 is Civil War era ordnance dump site. Its boundaries are currently defined as being localized to a small unnamed tributary of the Congaree River just south of the Gervais Street Bridge. Historic documentation indicates that the site extends beyond its currently defined boundaries. Recent side scan sonar magnetometer surveys conducted in advance of the Congaree River Cleanup project support this notion. Currently the site has not been formally investigated by professional archaeologists. The South Carolina State Underwater Archaeologist has issued salvage licenses in the past to recreational divers to conduct recovery work at this site. Log reports associated with these salvages confirm the presence of Civil War ordnance.

Site 38RD234 was recorded as the ruins of a late nineteenth to early twentieth century house with a visible brick porch house footings and a "square brick enclosure that could be a house well" (SCIAA Site Form 1982). No evaluation of this site was made at the time it was recorded.

Table 1. Archaeological Sites within a 0.5-Mile Radius of the Project Tract.

Site No.	Description	NRHP Status
38LX10	Paleoindian through Late Archaic Campsite	Not Assessed
38LX22	Woodland Period Lithic and Ceramic Scatter	Not Assessed
38LX67	Lithic Scatter	Not Eligible
38LX100	Guignard Brick Works	Listed
38LX334	Underwater Shipwreck Site	Not Assessed
38RD205	Middle-Late Archaic Lithic Scatter, destroyed	Not Eligible
38RD223	19^{th}-20^{th} Century bottle dump, land fill	Not Assessed
38RD224	Briggs Saw Mill	Not Assessed
38RD233	19^{th} – 20^{th} Century Artifact Scatter	Not Eligible
38RD234	Late 19^{th} Early 20^{th} Century structure foundation	Not Assessed
38RD235	V-shaped wooden object eroding out of river bank	Not Assessed
38RD236	Historic Period Dugout Canoe in Riverbank	Not Assessed
38RD275	Unknown Prehistoric lithic scatter, 20^{th} century	Not Eligible
38RD278	Underwater deposit of historic ceramics	Not Assessed
38RD286	Underwater Ordnance Dump Site	Not Assessed

Including the five sites mentioned above there are 15 previously recorded archaeological sites located within a 0.5-mile radius of the project area (Figure 1, Table 1). On the project side of the Congaree River,

Site 38RD205 is just north of Blossom Street in what is currently a parking lot. It was recorded in 1979 as a surface scatter of quartz thinning flakes and two quartz bifaces. The bifaces were dated to the Middle and Late Archaic Period. The South Carolina Site Form indicates that the artifacts were recovered from an active construction site and no further work was recommended for the site.

38RD233 is late nineteenth to early twentieth century dump site on an island across from the Columbia Canal Power House and the Gervais Street Bridge. It is not eligible for the National Register.

Canouts and Harmon (1981) initially identified site 38RD235 as an isolated find, it was later assigned an official site number. It is described as "V-shaped wooden object" measuring approximately 3.5 meters in length and 60 cm in width. They interpret this as being either a fragment from a boat or an industrial trough of some sort that was dumped in the river.

Site 38RD236 is on the same island as 38RD233. It is an historic period dugout canoe that was observed by Canouts and Harmon (1981) eroding out of the canal side of the island.

Site 38RD275 is a small surface scatter consisting of two prehistoric lithic flakes and a scatter of twentieth century brick fragments. It was noted as being disturbed and not recommended for additional work (SCIAA site form 1982).

On the opposite side of the river from the project area site 38LX10 is a large site investigated in the late 1930's by Robert Wauchope (SCIAA site form). It was recorded as containing a Clovis Point and net weights and a pipe carved out of steatite. The exact location of the site is unknown. 38LX22 and 38LX67 are prehistoric artifacts recovered by amateur collectors in the 1970's. They have not been formally assessed and their locations are approximate. 38LX100 is the Guignard Brick Works. This site is on the National Register of Historic Places. It is located on the west side of the Blossom Street Bridge. The brick works were active for the first half of the twentieth century. Structures associated with the brick works including "beehive" or circular kilns, and a one-story, brick office building are still standing. The brick works are approximately 0.28 mile southwest of the project area. A large, modern apartment complex and a tall trees lie between this site and the project area. The project will have no effect on this NRHP listed site.

38LX334 is an underwater resources identified by Canouts and Harmon (1981). It is the wreck of the City of Columbia, a steamship that sank in the early twentieth century. This wreck has not been evaluated. Underwater investigation and special conservation methods would be necessary to fully assess this site.

A review of Archsite website (online GIS database of recorded South Carolina cultural resources) indicates that the project area is within the Columbia Canal Historic District. The Columbia Canal Historic District encompasses an approximately 4.1 mile long area along the eastern bank of the Broad and Congaree Rivers. The northern boundary of the district is defined as the dam of the Columbia Reservoir approximately 0.5-mile upstream from the Broad River Road Bridge. The southern boundary is effectively at the railroad trestles and quarry on the south side of Granby Park. The National Register Nomination form defines this area as the "minimum acreage necessary to protect the historic integrity of the canal". The Nomination form indicates that the nominated area of the canal follows the area outlined in the *Columbia Canal Study* (Wilbur Smith and Associates 1979). The western boundary line of the district was delineated as the western bank of the Broad River until it meets the Saluda River and becomes the Congaree. From there south, the western boundary is defined as the Richland/Lexington County Line. The eastern boundary of the district was determined by using the property lines as they existed in 1979. Property lines were used to define the district since a complete appraisal of the area by archaeologists and a surveyor was not feasible. In the project area the district boundary follows the property lines of land belonging to Guignard Estates

There are four other National Register listed districts or structures, including the previously mentioned Guignard Brick Works (38LX100), within a 0.5-mile radius of the project area.

Table 2. National Register Listed Resources within a 0.5-Mile Radius of the Project Tract.

Resource	Description	NRHP Status
Columbia Canal	1824 and 1891 Canal and Associated Recouces	Listed
Gervais Street Bridge	Circa 1928 Bridge	Listed
Guignard Brick Works	20th Century Brick Kilns and facility	Listed
New Brookland Historic District	Early 20th Century Mill Village	Listed
Southern Cotton Oil Company	Early 20th Century Cotton Oil Mill	Listed

The Gervais Street Bridge overlooks the project area from the north. This is an open spandrel arch bridge constructed between 1926 and 1928. Ferry crossings and bridges have historically been present in this approximate location since the 1790's. During the Union invasion of Columbia in 1865 the wooden bridge that was at this location was burned in an attempt to slow Sherman's troop advancement into the city.

The New Brookland Historic District is approximately 0.2 miles west of the project area. This is a mill village constructed for the employees of the Columbia Duck Mill, the mill that was hydroelectrically powered by the Columbia Canal. A large number of commercial buildings and residences associated with the various growth phases of the mill are still present and in good condition.

The Southern Cotton Oil Company is approximately 0.50 miles east of the project corridor. This was one of the first and one of the largest cottonseed and cotton oil mills in the country. Similar to olive oil, cottonseed oil saw a boom period in the early 1900's thanks to aggressive promoters of the cotton oil industry. In 1994 there were seven extant structures associated with the Southern Cotton Oil Company. Subsequent to its listing on the National Register all seven buildings were demolished and removed.

Field Survey

Previously Recorded Resources

38RD223 – According to Canouts and Harmon (1981) this is a relatively large site measuring approximately 3000 square meters. This late nineteenth to early twentieth century bottle dump was located in a stand of hardwoods and dense undergrowth (Figure 9). They note that approximately 25% of the site was disturbed by pot hunters. A visit to the site identified an area relatively clear of undergrowth. The site has continued to be a dumping ground for the past 30 years. Plastic glass and metal containers, articles of clothing and modern refuse has been spread over and mixed with the bottle dump. It appears that the vegetation in the area is regularly mowed to minimize the undergrowth. It is unknown how much this grounds keeping has disturbed the site. No shovel tests were excavated at the site. It is believed that historic bottles may still be present. The plans for the Congaree River Sediment Removal Project call for the avoidance of this site. As seen in Figure 2 access roads are proposed to the north and south of this site. Monitoring during construction of the access roads is recommended to ensure that no significant artifact deposits are disturbed during the undertaking. The site remains unevaluated for the National Register. Further work in the form of subsurface shovel testing and artifact identification is necessary to determine the NRHP eligibility of this site.

38RD224 – In 1981 Canouts and Harmon located a building foundation approximately 60 meters downstream of a small unnamed tributary of the Congaree River (Figure 10). The ruins were noted as being in good condition and were assumed to be the remains of Briggs sawmill, a mill utilized by the Confederate government and burned by Union Troops in 1865. The site was considered significant and recommended for additional work.

This site was visited and an attempt to locate the foundation and any historic artifacts visible on the ground surface. A picture of the foundation shows stacked, large granite blocks. Transects

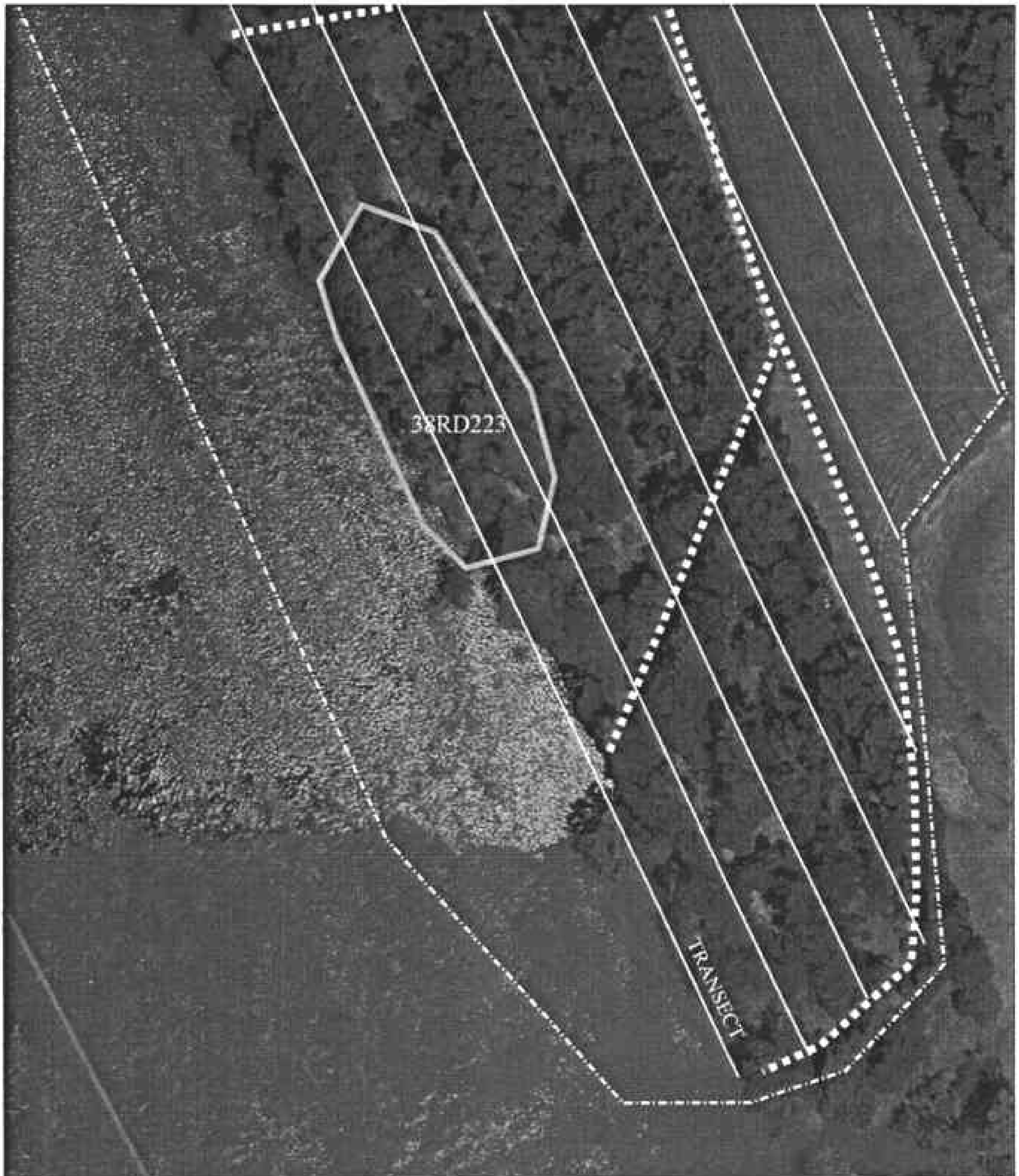

Figure 9.
Aerial view of sites
38RD223.
Scale: 1:1000
Base Map:
2014 Aerial Photograph

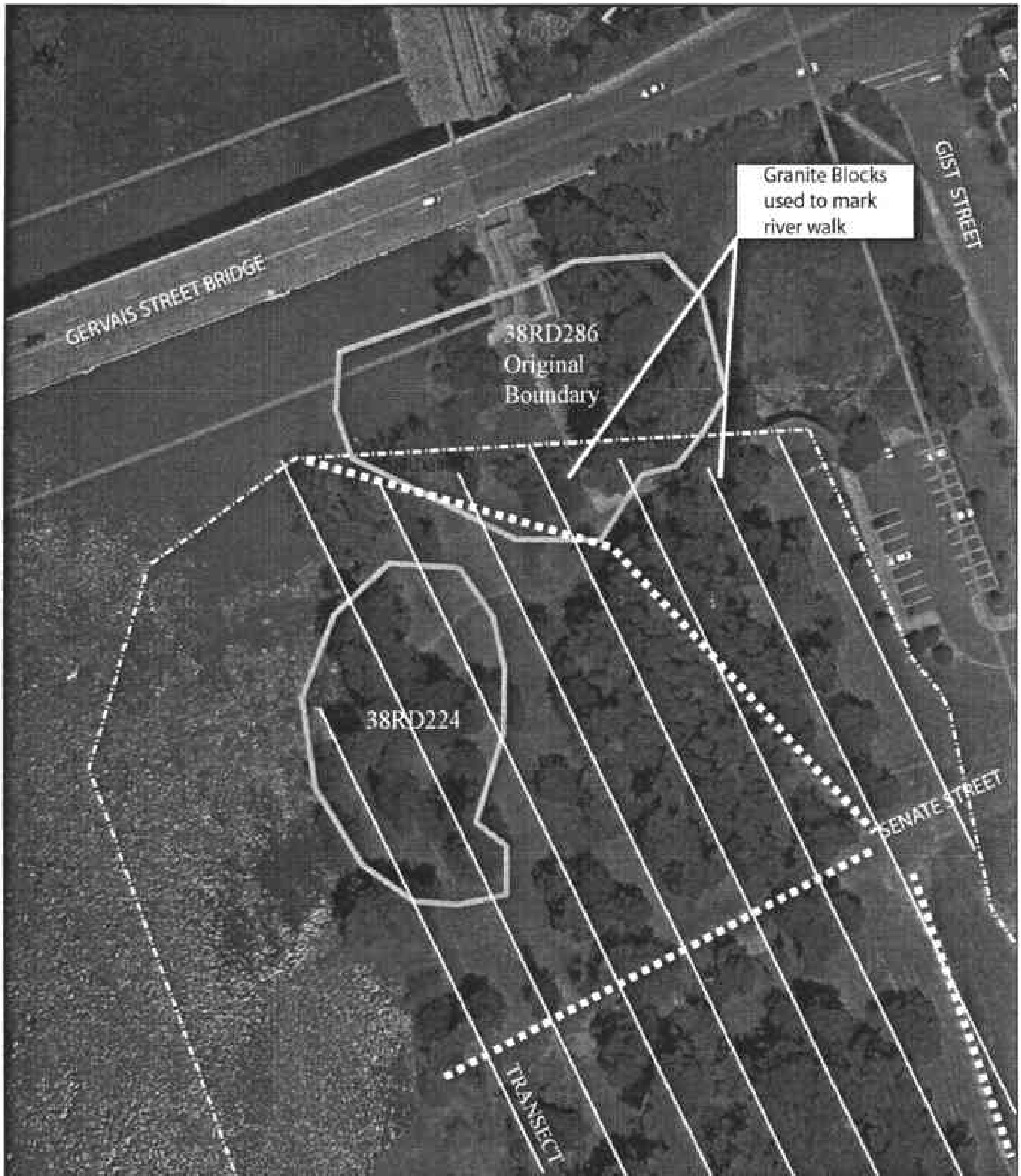

Figure 10.
Aerial view of sites
38RD224 and 38RD286.
Scale: 1:1000
Base Map:
2014 Aerial Photograph

Permit Area
Proposed Road Improvements
Archaeological Site
National Register Listed Property

Figure 11. Conditions at 38RD224.

Figure 12. Historic granite blocks used as river walk border.

separated by a 15 meter interval were walked in the mapped location of the site. Vegetation consisted of manicured grass in the upland portion of the site and shin high grasses and undergrowth closer to the river's edge (Figure 11). No trace of an intact granite foundation was found. While accessing the site via the City of Columbia River Walk large granite blocks were noted lining the pathway and marking drainage areas (Figure 12). These blocks are presumed to be the foundation stones identified in 1981 now repurposed as decorative elements to the river walk.

The foundation of the possible sawmill has been disturbed. However, it is possible that intact, subsurface features related to the mill are present. Currently the Congaree River Sediment Removal Project plans to avoid this area. An access road to facilitate dam construction is proposed just north of this site (see Figure 10). It is recommended that monitoring during construction of this road take place to ensure that no significant resources be impacted. Orange construction fencing may be needed to ensure that no activities take place within the boundaries of this site.

38RD234 – Was identified during a reconnaissance survey of the proposed Bicentennial Park. There is no official report of this survey however the SCIAA site form indicates that the site was recorded by SCIAA/Harmon in 1981. The site is recorded as nineteenth century architectural remains that include house footings, a partially intact brick porch and a square brick enclosure which was interpreted as a well house. Woodland Period pottery was also recovered. The site is located approximately 100 feet south of the Senate Street Landing (Figure 13). Similar to Site 38RD224 the area around this site has been periodically cleared over the last 30 years. Pedestrian transects within the boundaries of the site were unable to relocate the well house, brick porch or house footings. The site remains unassessed as to its National Register eligibility. Plans call for the avoidance of this site during the proposed undertaking. It is recommended that monitoring occur during any road construction in the vicinity of this site.

38RD278 -- This site is an underwater resource located immediately west of 38RD234 (see Figure 13). The site was examined in the early 1980s by Cleveland Huey under South Carolina Underwater Salvage License 26. Historic ceramics, a pewter spoon and prehistoric ceramics were reportedly recovered. It is likely that this site represents a dumping area for the structure associated with 38RD334. This site has not been evaluated for the National Reregister and due to it being underwater was not revisited. The site is in the permit area and will be impacted by the Congaree River Sediment Removal Project. The boundaries of this site will be encompassed within the newly expanded boundary of site 38RD286 (see below). Recovery and evaluation of artifacts associated with this site should occur concurrently with the mitigation of 38RD286.

38RD286 The Ordnance Dump Site – This site was originally recorded as being within an unnamed tributary of the Congaree River, immediately south of the Gervais Street Bridge (Figure 14). It is the recorded location of where munitions captured by the Union during the invasion of Columbia were dumped.

On February 17, 1865 General Sherman's troops captured Columbia. During the two day occupation, live munitions and other weapons of war housed at the Palmetto Armory were

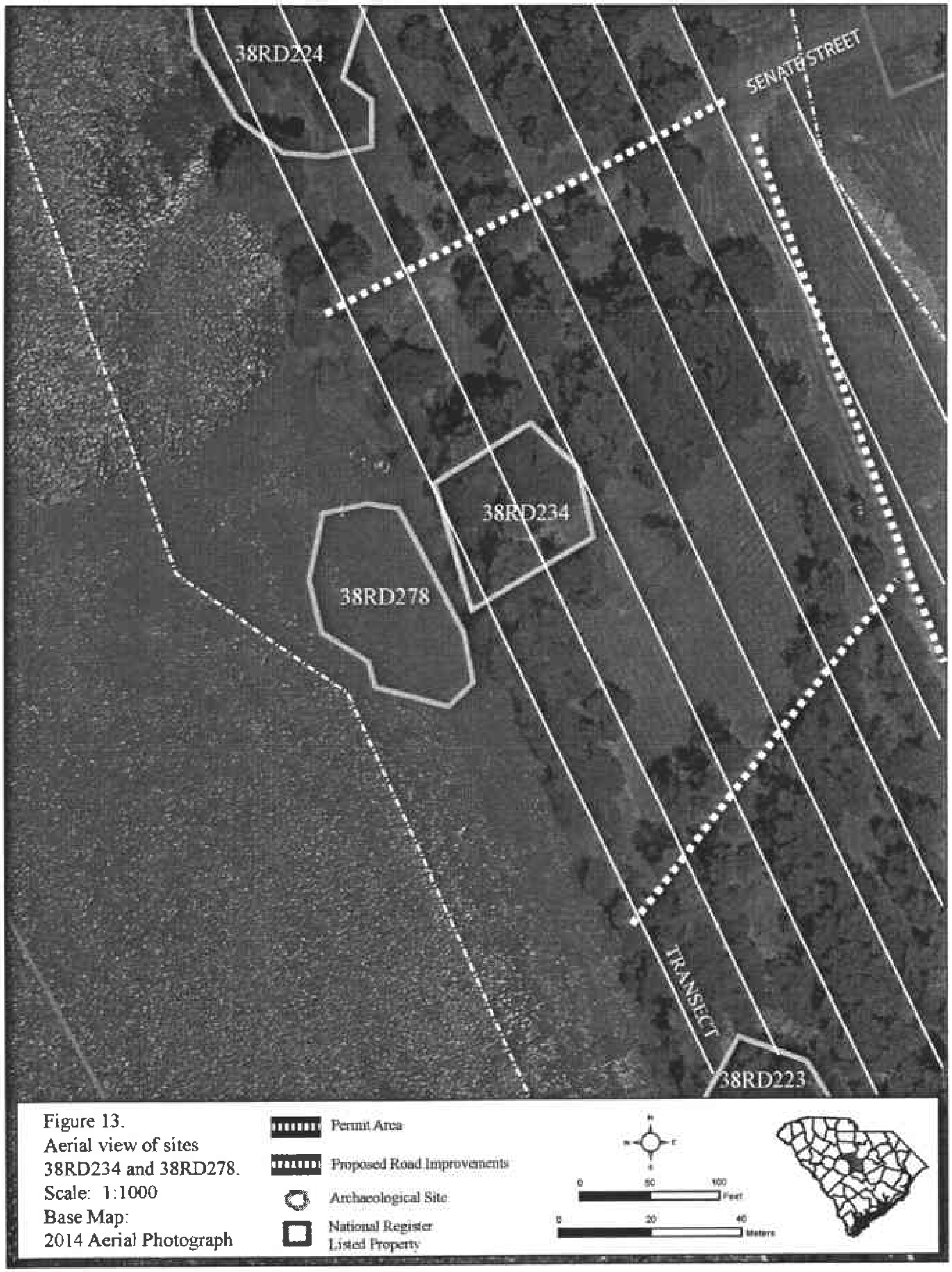

Figure 13.
Aerial view of sites
38RD234 and 38RD278.
Scale: 1:1000
Base Map:
2014 Aerial Photograph

dumped into the Congaree River near the Gervais Street Bridge. According to Civil War Records:

> *A detail of 500 men each from the First and Second Brigades, properly officered for fatigue duty, together with the pioneer corps and fifty wagons, reported to Captain Buel, chief ordnance officer, to destroy public works, machinery, ordnance, ordnance stores, and ammunition, of which there were large quantities.*
>
> *General John. E. Smith*

According to General Smith it took 1200 men and 50 wagons from 1 P.M. February 18 to 6 P.M. February 19 to destroy the machinery, ordnance, ordnance stores and ammunition. Figure 15 provides a list of the ordnance captured.

Soon after Union troops departed Columbia ordnance recovery began. The accounts of J. F. Williams indicated that industrious citizens of Columbia were quick to salvage powder from the boxes of paper cartridges that had been left on the bank and for years after the war people would dive into the river and recover cannon balls and shells (Williams 1929).

Newspaper articles dating to the 1930s and more formal recovery attempts conducted in the 1970s and 1980s provide supporting evidence that Civil War ordnance is still present in the river. In June 1930, *The State* reported that two fishermen recovered ammunition from the area of a small tributary near the base of the Gervais Street Bridge. The discovery motivated New Brookland Mayor L. Hall and Councilman D. A. Spigner to organize a project to recover the artifacts. Their recovery was extensive and labor intensive. A coffer dam was erected approximately where Senate Street terminates at the river. After digging through the mud and silt the project collected six 10-inch cannonballs, 1,010 round rifle balls, 767 pointed rifle balls, a number of cast-iron copper fused explosive cannon shells; and cast iron lead butt explosive shells; three cast-iron cannon balls; one brass cap explosive, 11 3½-inch round cannon balls, 51 2-inch cannon balls; 2 6-inch cannon balls; 3 3½-inch time fuse explosive bombs; and an artillery axe (*The State* 1930). According to the article Hall and Spigner believed they had recovered practically all the ammunition that was deposited in the river. Based on the inventory presented in Figure 3, however, the 1930s recovery accounts for only a fraction of what may be present.

Eight years after the Hall and Spigner conducted their recovery, the *Spartanburg Herald* reported that two New Brookland high school boys found an artillery projectile in the Congaree River. The boys, Luther J. Morris and Knowiton Jeffcoat, apparently attempted to melt lead out of the round causing a minor explosion that brought the find to the attention of New Brookland authorities (*The Spartanburg Herald* 1938).

Beginning in the 1970s a number of formal recovery and salvage projects have been conducted at the sites. A majority of these projects have been conducted with licenses provided by the South Carolina Institute of Archaeology and Anthropology (SCIAA) under the Underwater Antiquities Act, providing a precedent for conducting the currently proposed project under a similar Salvage License. In the winter of 1976 an acoustic survey in the Congaree River below the Gervais Street Bridge was conducted to identify concentrations of ordnance and artifacts. Although conditions were not ideally suited for an acoustic survey the project identified a concentration of ferrous material below the Gervais Street Bridge (Finkelstein 1976).

Inventory of ordnance and ordnance stores captured in Columbia, S. C., February 17, 1865.

Ball cartridges (no caps)		1,200,000
Percussion caps		100,000
Powder	pounds	26,150
12-pounder gun ammunition, fixed	rounds	1,007
6-pounder gun ammunition, fixed	do	3,852
24-pounder gun ammunition, fixed	do	546
8-inch shot and shell	do	2,364
10-inch shot and shell	do	1,320
Stands of arms		10,410
Unfinished arms		6,000
6-pounder guns		14
James guns		2
12-pounder mountain howitzers		5
Blakely guns		4
18-pounder rifled guns		3
Wiard gun		1
3-inch rifle		1
10-pounder guns		2
4-inch gun		1
4-inch mortars		2
6-inch Coehorn		1
Bronze guns, caliber 1½ and 2 inches		4
4-inch gun, smooth-bore		1
10 pounder Parrotts		2
Repeating battery		1
Gun carriages		9
Gun caissons		14
Gun (mountain howitzer) caissons		3
Forges		2
Anvils		4
Blacksmiths' vises		20
Sponges and rammers		1,125
Sabers, cavalry, artillery, and naval		3,100
Saber knots		700
Pairs cavalry pistol holsters		300
Saber belts		800
Bayonet scabbards		4,000
Cartridge-boxes (infantry)		5,150
Cartridge-box plates		3,500
Cartridge-box belts and plates		2,500
Waist-belts		2,900
Waist-belt plates		3,000
Ball screws		2,000
Pistol cartridge-boxes		550
Gunners' shot-pouches		600
Knapsacks		1,100
Haversacks		900
Slow match	yards	500
10-inch fuses		900
Tents		58

PHILIP MacCAHILL,
Lieut. and Actg. Ordnance Officer, First Div., Fifteenth Army Corps.

Figure 15. Inventory of ordnance caputured during the occupation of of Columbia.

Under a salvage license issued in 1980, diver Gerald Mahle discovered a cache of 10-inch cannon balls at the site. Mahle and his team estimated that 50 to 100 additional shot lay in the river. However, by the time they were able to return to the river divers associated with the Savannah River Dive Club in Hampton, South Carolina had removed the ordnance (Salvage License No. 26 file SCIAA).

Mahle continued work under the SCIAA permit from February through September 1981. Using a dragline, a backhoe and a gold dredge, Mahle and his team removed and screened sediment from the river bed and apparently the alluvial fan near the foot of Senate Street. Fieldwork resumed in August 1981 using the backhoe for excavation. The project recovered numerous Civil War artifacts including a 3.5-inch shell, a 24-pound cannonball, two 10-inch shells and a post-Civil War projectile. Apparently the work did not produce sufficient material to justify continuation of the project (Salvage License No. 27 file SCIAA).

In 1983 a SCIAA Salvage License was issued for a metal detecting survey in the Congaree immediately south of the Gervais Street Bridge. Recovered artifacts associated with the Armory consist of 12 explosive shot for a 6-pounder cannon and one explosive shot for a 4-pounder (Salvage License No. 30 file SCIAA).Since the 1980s there are anecdotal reports of Civil War related artifacts being discovered in the river and on the alluvial fan at the terminus of Senate Street but there have been no additional formal recoveries.

Based on this information, there is sufficient documentary and formal survey evidence to establish the continuing presence of ordnance in this section of the river. With this in mind a series of magnetometer and side scan sonar surveys were conducted in advance of the Congaree River Sediment Clean-up project to determine the possible extent of ordnance within the contaminated area.

Over a period of 18 months, from 2010 to 2012, Tidewater Atlantic Research, Inc. conducted remote sensing surveys within the course of the river and on the eastern bank (Tidewater Atlantic Research 2010, 2011a, 2011b, 2012). The first phase of this work focused on the area from the Gervais Street to approximately 1500 feet downstream. The magnetometer survey identified 218 anomalies that were consistent with unexploded ordnance (UXO). Phase II of the survey began where Phase I ended and extended another 400 feet downstream. Ten anomalies that could be could represent UXO were identified in this phase. Phase III of the survey focused on the area from Unnamed Tributary 2 to just south of the Blossom Street Bridge. One hundred and twenty-two hits consistent with potential ordnance were recorded in this phase. Phase IV was the continuation of a terrestrial metal detector survey along the river bank and alluvial fan at the end of Senate Street. An additional 67 potential instances of UXO were recorded along the shoreline. Figure 16 is a map of the location of the magnetic anomalies. Attachment A provides a summary of magnetic anomaly survey along with a map detailing the precise locations of the possible UXO.

Based on the underwater survey work the boundaries of Site 38RD286 have expanded. The site now measures 90 meters east to west by 500 meters north to south. Historic documentation clearly indicates that disposal of the ordnance was a significant event associated with the capture and burning of Columbia. Historic accounts are clear and consistent as to the location of this site. Previous underwater salvage operations have confirmed the presence of Civil War ordnance and the underwater survey has confirmed the likelihood of additional artifacts. This site is recommended Eligible for the National Register of Historic Places under Criterion A based on its association with significant events related to the Civil War and Criterion D based on its potential to yield information important to history. This site will be adversely affected by the proposed undertaking. Mitigation will be required.

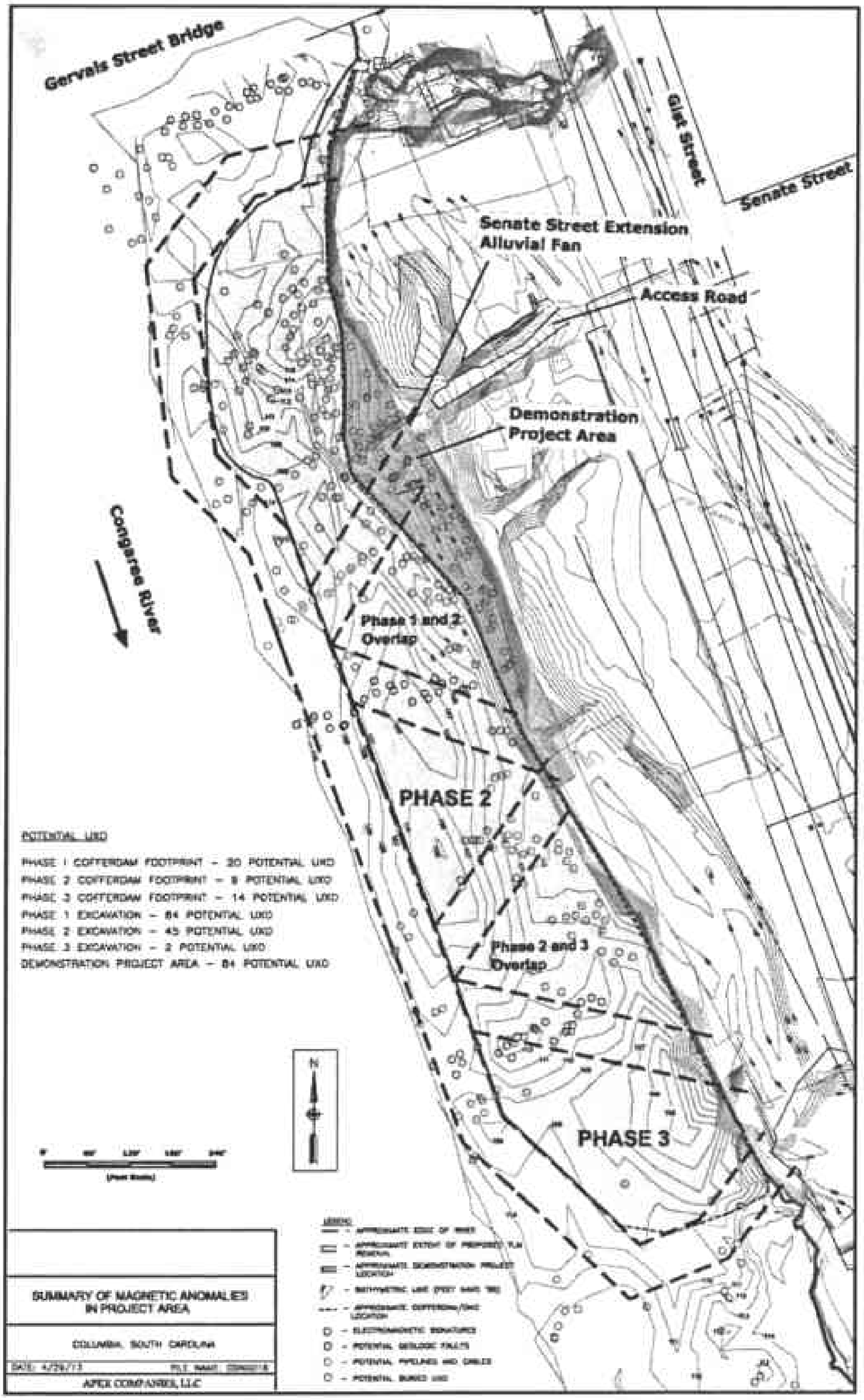

Figure 16. Locations of potential ordnance base on side magenetic anomolies.

National Register Listed Resources

New Brookland Historic District – The New Brookland District is approximately 0.25 miles west of the project area. This is a mill village constructed for the employees of the Columbia Duck Mill, the mill that was hydroelectrically powered by the Columbia Canal. A large number of commercial buildings and residences associated with the various growth phases of the mill are still present and in good condition. The mill district is screened by large trees that line the western bank of the Congaree River. The district cannot be seen from the project area (Figure 17) and will not be affected by the proposed undertaking.

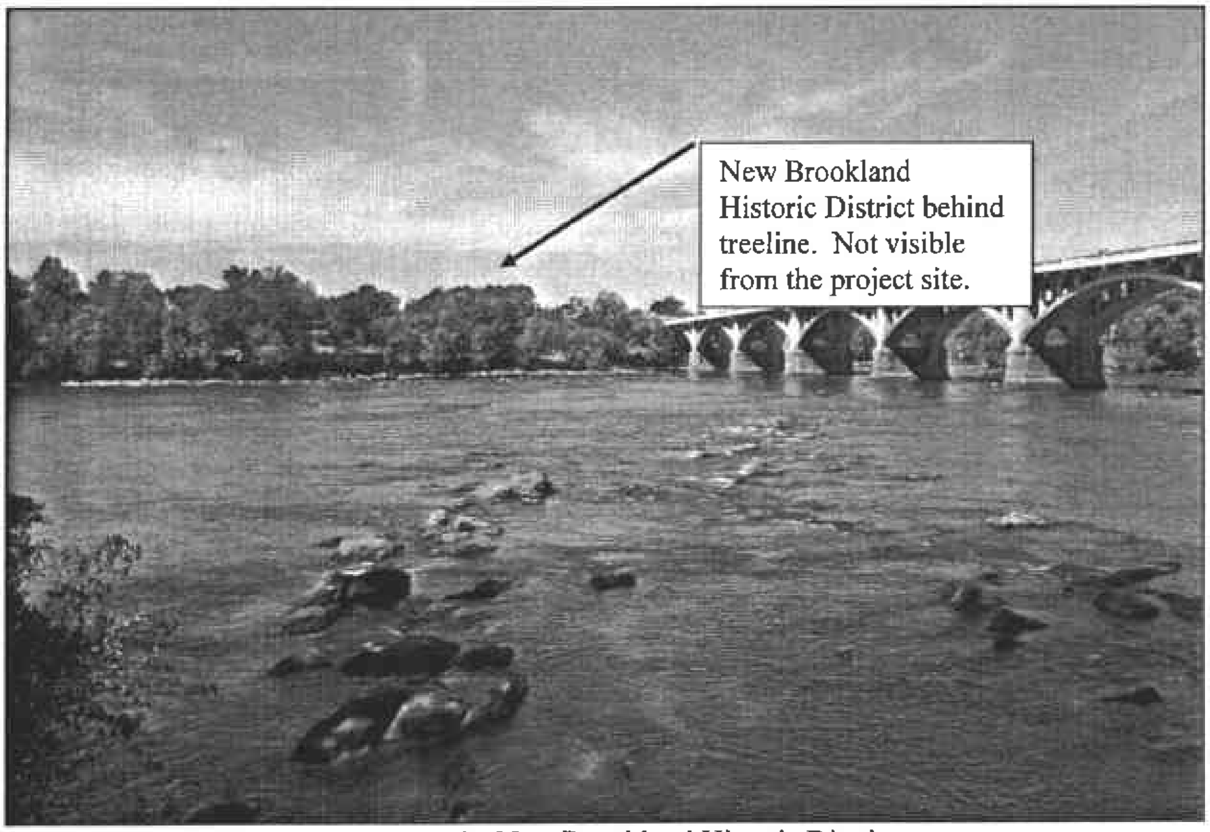

Figure 17. From the project area to the New Brookland Historic District.

Gervais Street Bridge – The Gervais Street Bridge is adjacent to the north side of the project area. Ferry crossings and bridges have historically been present in this approximate location since the 1790's. During the Union invasion of Columbia in 1865 the wooden bridge that was at this location was burned in an attempt to slow Sherman's troop advancement into the city. Another bridge was built at the same location and was owned privately until 1912 when it was purchased by Richland County (Figure 18). This bridge was demolished with completion of the current Gervais Street Bridge. Construction began on the current bridge 1926 and was completed in 1928. The 1415 foot bridge has nine open spandrel arch segments with closed arch spandrels at each end. Other than removal and repaving activities there have been no alterations to the bridge.

The bridge is one of four open spandrel arch bridges in South Carolina. It is significant for its design and its association with transportation and the growth of Columbia. It was listed on the National Register in 1978 as part of the Columbia Multiple Resource Area (National Register of Historic Places Nomination Form 1978).

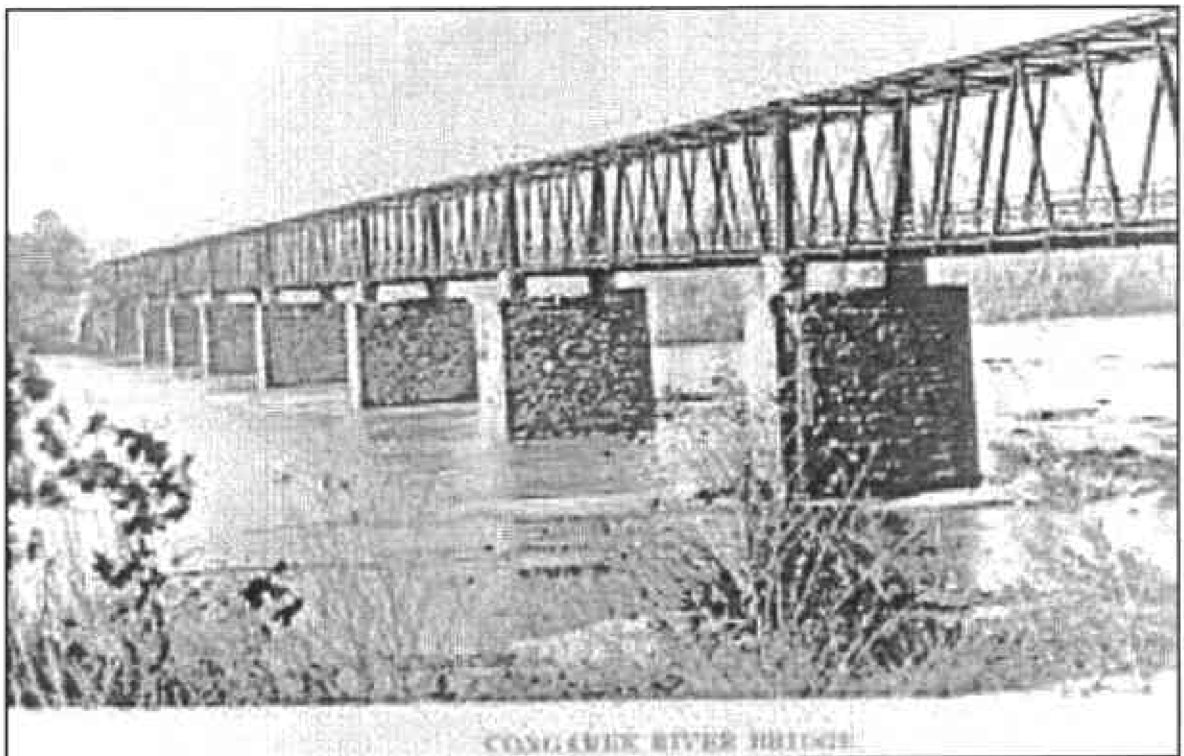

Figure 18. Previous Gervais Street Bridge circa 1900 (photo curteusy of the Carolina Library).

The Congaree River Sediment Removal project proposes a temporary coffer dam immediately downstream of the the bridge. As stated previously the coffer dam will be constructed of rock/rip rap and will stand between 0 and 10 feet above the water line depending on river fluctuations. The coffer dam and the remediation project will have no effect on the design of the bridge nor will affect the bridge's significant role in transportation. There is little remaining of any historic viewshed that may have been associated with the bridge. Billboads are present at both ends of the bridge and a large modern apartemtent building is located on its western side (Figure 19). Develoment and the skyline of downtown Columbia are also clearly visible from the bridge. The coffer dam will be a temporary construction and will provide no significant visual impact to an already compromised historic viewshed.

Columbia Canal – The Columbia Canal Historic District was listed on the National Register in 1979 under a number of areas of significance. It is considered archaeologically/historically significant based on the likelihood that excavation around intact portions of the canal could obtain detailed information on the construction of the canal bed and associated features. This information could, in turn, be compared to work done on other canals of the period. Excavation of the canal beds could also recover artifacts that would help interpret how the canal was utilized when it was active. The engineering techniques utilized in the construction of both the original 1824 canal and 1891 improvement are considered significant.

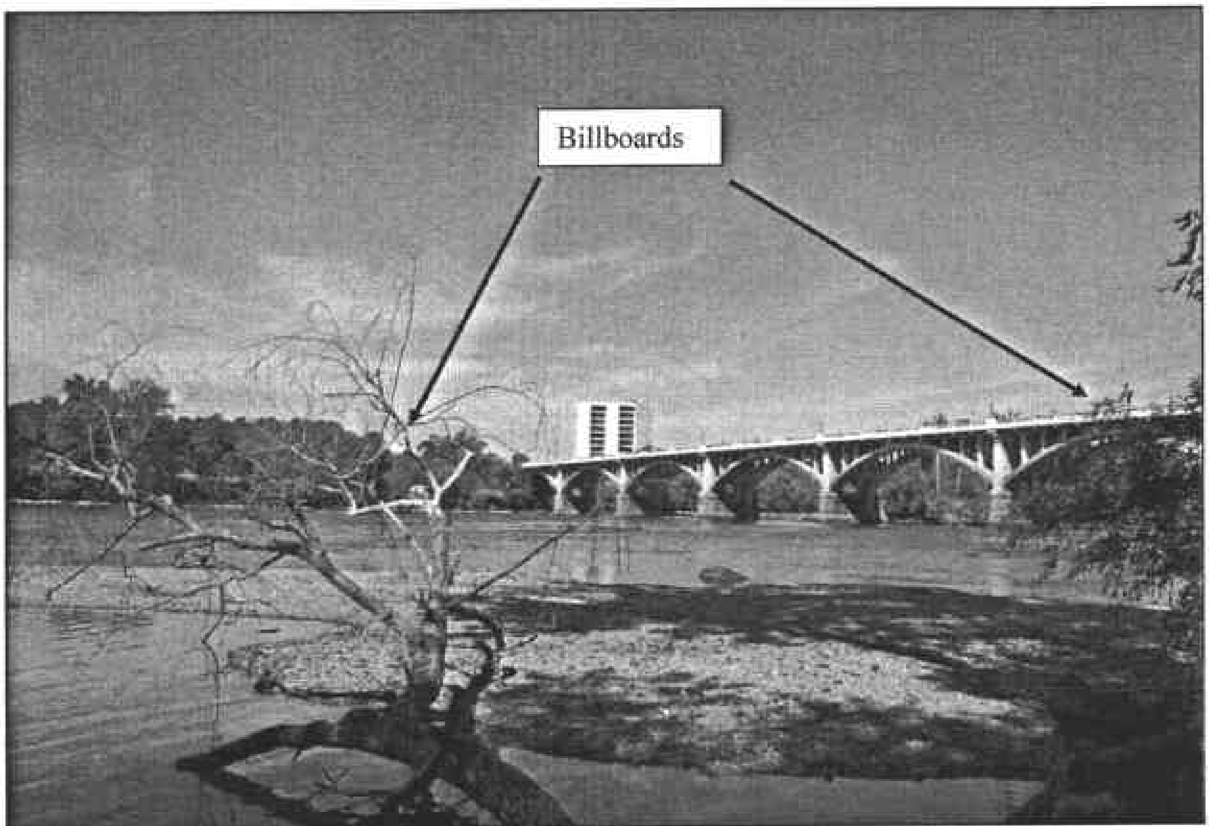

Figure 19. From project area to Gervais Street Bridge. Note modern apartment building.

The canal is also considered significant for the role it played in transportation and commerce. Because it was integral to the largest cotton shipping center in the state, the canal played a crucial role in the development of South Carolina's railroad system and the growth of Columbia. Expanding on the canal's role in commerce it was significant for its role in advancing industry in the state. From supporting ancillary small industries such as saw and grist mills to eventually becoming a valuable power source to larger mills the canal supported industry in Columbia. Finally the canal is considered significant under the category of "invention". In 1894 a large textile mill became the first in the country to use electrically generated power directly from a canal over a distance rather than an on-site power system like a waterwheel.

The original canal was constructed between 1820 and 1824. It was initially intended as a means of circumventing the unnavigable confluence of the Broad and Saluda rivers. This canal was over three miles long. It began above Richland Street on the Broad River and ended at Granby Ferry south of the project area. It had five turning basins with the largest being at the south end of Senate Street just north of the project tract. North of the Senate Street Turning Basin the canal was 12 feet wide and contained two and half feet of water. South of Senate Street, in the vicinity of the project area, the canal was 18 feet, contained four feet of water and was flanked by eight foot wide tow paths (Nomination Form 1978). With the increasing reliance on the railroad for shipping the 1824 canal was gradually allowed to deteriorate and by 1842 was used primarily to power waterwheels for mill sites rather than transport goods. Its route is visible on Russell's 1850 map of Columbia (Figure 20) and the 1870 Tingle map of the Columbia Canal (Figure 21).

In 1888 the Board of Trustees for the Columbia Canal approved a plan to develop the portion of the canal north of Gervais Street into a new power source for the city. This project involved widening the canal to 150 feet across and dredging it to a depth of 10 feet (Wilbur Smith and Associates 1979). The expanded canal was completed on November 21, 1891. Power houses and the associated Hydro Plant used for generating electricity for the Duck Mill opened up north of Gervais Street. South of Gervais the canal was abandoned.

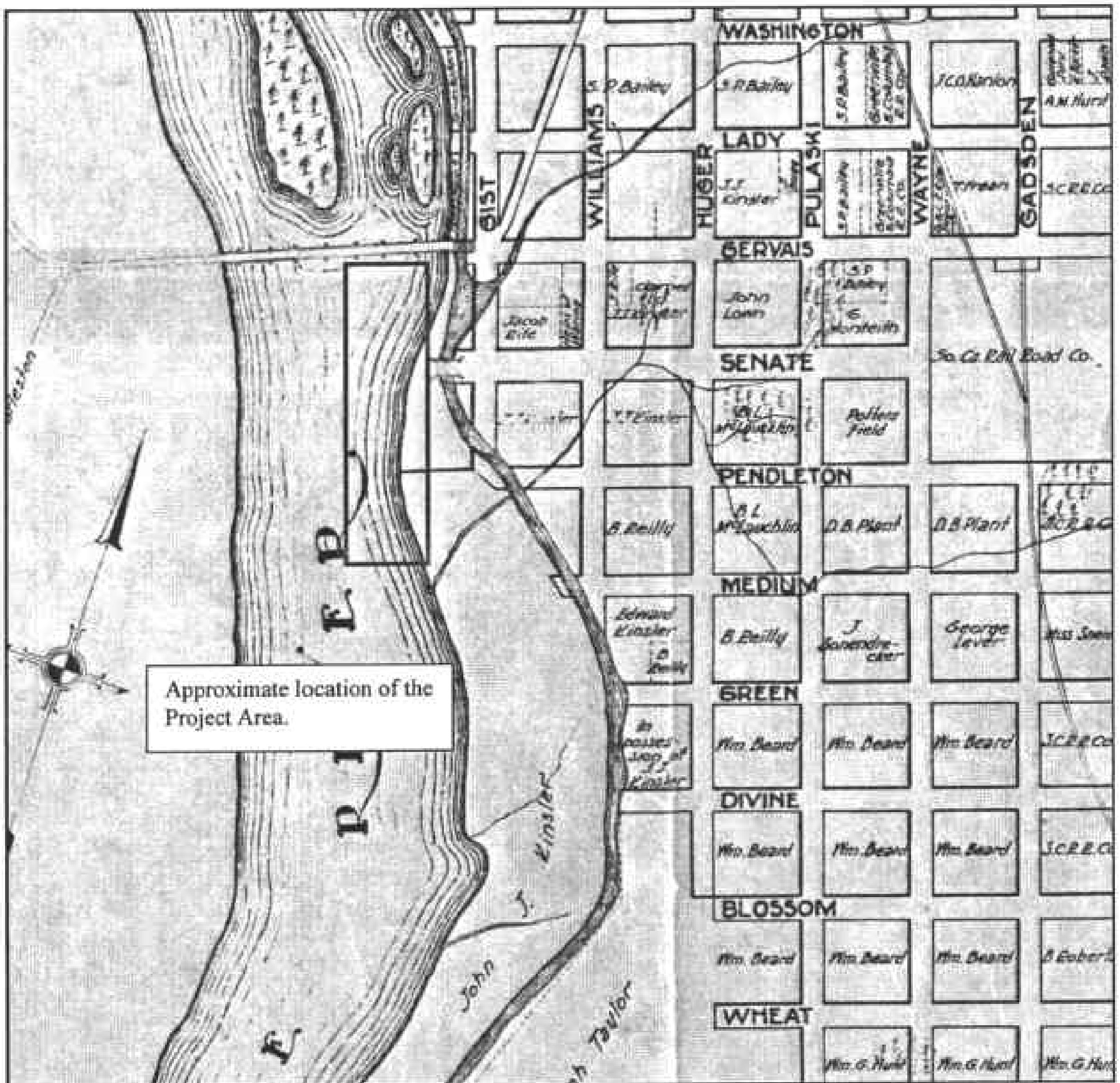

Figure 20. Location of the Canal bed in relation to the project area in 1850.

Figure 21. Location of the canal bed in relation to the project area in 1870.

The Hydro Plant was built in 1896. It furnished electricity for lights in the city of Columbia, as well as supplied current for public and private manufacturing and the Street Railway System. The plant is still operational and provides a large portion of power for the city. While the internal workings of the Hydro Plant have been updated and modified to meet today's demand for electricity the building itself remains much as it was when it was first built. It is a brick structure with symmetrical arches that allow the canal to flow back into the river. The plant can be seen from the northern edge of the project area (Figure 22).

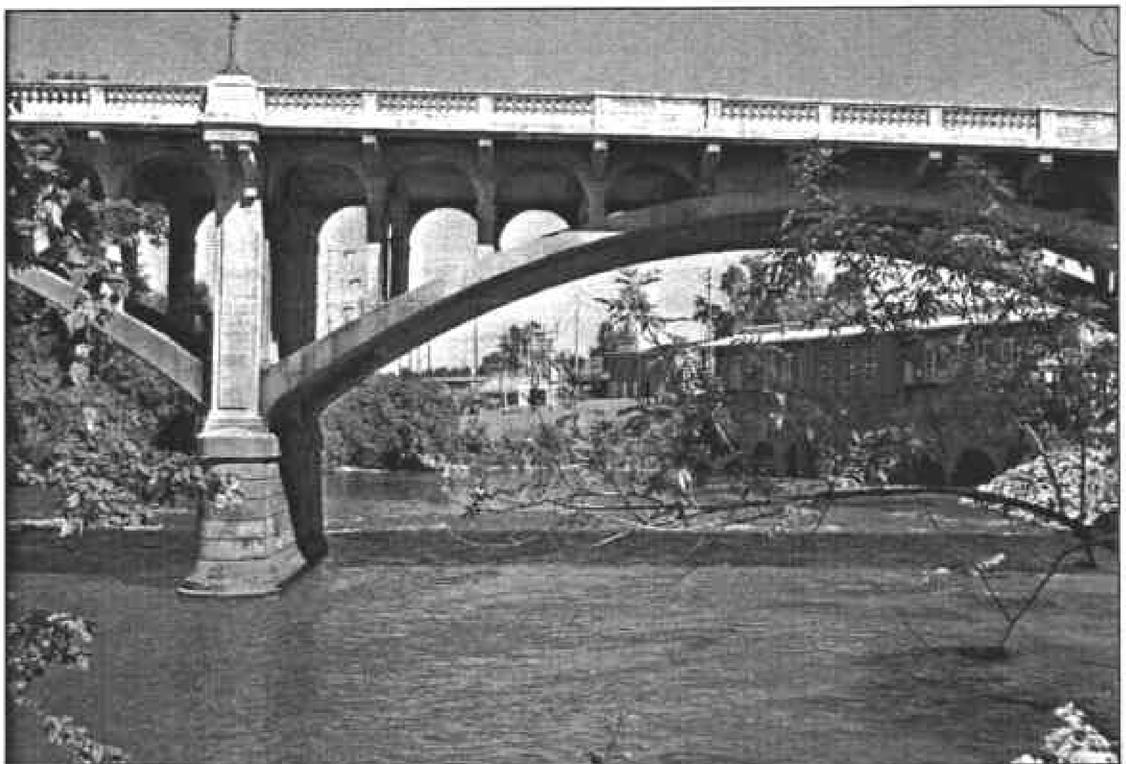

Figure 22. View from project location to Canal Hydro Plant, facing north.

The plant is part of the Columbia Canal Historic District and adds to the district's significant contribution to Industry and Invention. The proposed coffer dam will not affect those areas of significance. The historic nature viewshed of the Hydro Plant will also not be affected by the proposed undertaking.

The temporary coffer dam will be similar in appearance to the existing rip rap and stone embankment that currently abuts the Hydro Plant (Figure 23). The coffer dam will in fact be similar in construction to the canal itself. Canouts and Harmon (1981) note that an 1867 profile drawing shows the canal banks as rip rap along the river's edge. They also indicate that the 1891 canal had rip rap placed along erosional areas. Additionally there are numerous modern intrusions to the Hydro Plant's viewshed. The Edventure Children's Museum with its modern three story glass façade is adjacent to the plant compromising the historic integrity of Canal District (Figure 24). The proposed project will have no impact on the visual landscape of the Columbia Canal Historic District.

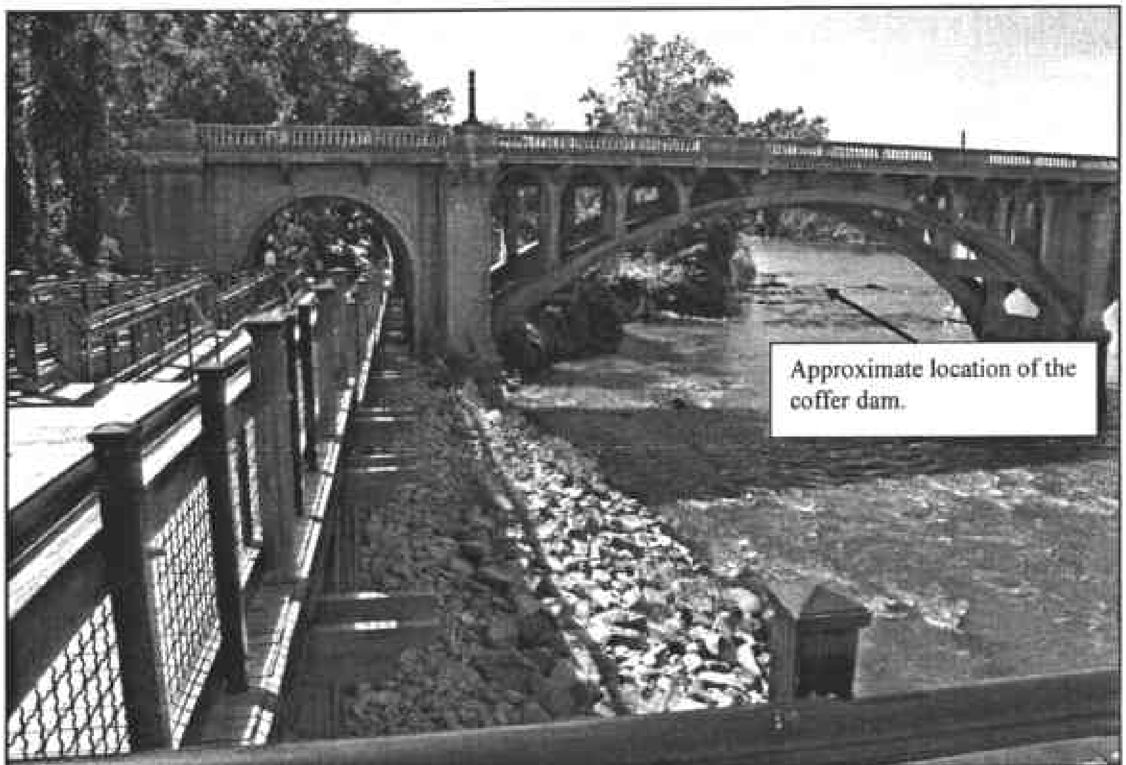

Figure 23. View from Columbia Canal Hydro Plant to project area. Note rip rap.

Figure 24. Example of modern buildings adjacent to the Canal Hydro Plant.

V. SUMMARY AND RECOMMENDATIONS

Five archaeological sites and two National Register Listed properties/districts were identified within or adjacent to the permit area. A background study and pedestrian survey were employed to determine if the proposed project would have any effect on significant cultural resources.

Project plans have been designed to avoid impacts to archaeological sites 38RD223, 38RD224 and 38RD234. These are upland, terrestrial sites that fall within the permit area. These sites were identified 33 years ago during a reconnaissance survey. At the time they were recorded all three sites had clearly visible, above ground components. In the intervening years periodic land clearing and maintenance appear to have displaced and removed the structural ruins associated with 38RD224 and 38RD234. Modern dumping has obscured the historic nature of the late nineteenth to early twentieth century bottle dump at 38RD223. These three site potentially have intact subsurface deposits. Avoidance of these sites is recommended as they have not been evaluated for the NRHP. Monitoring is recommended during construction activities in the vicinity of these sites to ensure that no significant cultural deposits be impacted.

There are two underwater archaeological sites that were previously recorded in the project area. 38RD278 is a small scatter of historic and prehistoric artifacts. The historic artifacts may be associated with the historic structure recorded as site 38RD234. This site was not evaluated for the NRHP. It will be adversely impacted by the proposed undertaking. Site 38RD286 is the location where Union troops dumped ordnance from the Palmetto Armory during the capture and burning of Columbia. Recent magnetometer and side-scan SONAR surveys have led to an expansion of the boundary of this site. The site now measures 90 by 500 meters and encompasses site 38RD278. 38RD278 is effectively a component of the ordnance dump site. Historic accounts, past salvage operations and recent underwater survey work have led to the recommendation that this site is eligible for the NRHP. If this site cannot be avoided additional archaeological work will be required to mitigate the adverse effects of the Congaree Sediment Removal Project.

The project area is within the Columbia Canal Historic District. The project will not affect the integrity or National Register significance of the district nor will affect any individual components of the district such as the extant canal bed and the Columbia Canal Hydro Plant.

The Gervais Street Bridge is adjacent to the project area. The bridge is significant for its contribution to transportation and for its design. The project will cause no alteration to the bridge's design nor affect its role in transportation. The bridge is flanked by the City of Columbia to the east and Cayce to the west. The modern skyline associated with this metropolitan area is clearly visible from the bridge. The proposed project will have no effect on the viewshed of the bridge.

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ATTACHEMENT 1 – ANOMALY SUMMARY

DRAFT

Congaree River Anomaly Summary
Congaree River Project
Columbia, SC

Site Location

The report summarizes the results of the magnetometer surveying activities conducted in support of the South Carolina Electric and Gas (SCE&G) Company Congaree River Project located in Columbia, SC. The Congaree River begins at the confluence of the Saluda River and the Broad River in Columbia, SC. The portion of the Congaree relevant to this project is the approximate eastern third of the river beginning directly south of the Gervais Street Bridge and extending for approximately 3,700 feet downstream to approximately 500 feet below the Blossom Street Bridge. Figure 1 provides the location of the area in question.

Background Information

In June 2010, the South Carolina Department of Health and Environmental Control (SCDHEC) noted tar-like material (TLM) near the eastern shoreline of the Congaree River directly downstream of the Gervais Street Bridge. SCDHEC collected samples of this material and the analytical results indicated that the source of the TLM might be attributable to the former manufactured gas plants (MGP) that operated in Columbia starting in the mid-1800s and ending in the late 1940's to early 1950's. Predecessor companies of SCE&G operated the Huger Street manufactured gas plant (Huger Street MGP). Its location is provided on Figure 1. SCE&G has recently completed a removal action at the Huger Street site where over 125,000 tons of MGP impacted soil and debris was excavated and removed with oversight provided by SCDHEC.

SCE&G submitted a Project Delineation Report (PDR) [MTR, March 2012] to SCDHEC on March 23, 2012. SCDHEC approved the PDR on April 23, 2012. The PDR presented the results of delineation activities completed to determine the extent of the TLM within the river. The delineation work was completed in five separate phases over approximately 18 months. The magnetometer surveying operations described in this summary report were a component of the investigative activities and were necessary due to the potential presence of Civil War era explosive ordnance within the project area. Details pertaining to the ordnance are provided below.

Potential Presence of Historical Items and Unexploded Ordnance (UXO)

It has been confirmed that in 1865, during the Civil War, live munitions and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman's occupation and subsequent destruction of Columbia. A list of munitions and other Confederate items captured by the Union forces is provided in Attachment A. The Union Army kept some of these items for its own use and the remainder was destroyed. One of the methods for destruction was dumping the items into the river.

Archeological investigations, conducted as late as 1980, recovered some live and unstable munitions or unexploded ordinance (UXO) from the area as well as some other potentially historically significant artifacts. Specifically this work was focused in and adjacent to the unnamed tributary that enters the river just south of the Gervais Street Bridge. Figure 2 shows this location and a daily activity log documenting some of the archeological work is provided in the initial Tidewater Atlantic Research Inc. report (Attachment B). Several live cannonballs were identified during this operation and properly disposed of by trained explosive ordinance disposal (EOD) personnel located at nearby Fort Jackson.

Due to the potential presence of live munitions within the project area, an additional reconnaissance and screening of the area in question was conducted as part of the investigative activities. Acoustic (side scan sonar) and magnetic (magnetometer) remote sensing surveying activities were completed in order to determine if potential munitions were present prior to conducting the sediment sampling activities. A description of these activities and their subsequent results are provided below.

Surveying Activities

Magnetometer surveying of the project area was conducted over four separate phases. The first phase was focused on the area directly downstream of the Gervais Street Bridge (grid lines 1 through 16 on Figure 2) and included some limited shoreline surveying near the Senate Street Extension Alluvial Fan (Figure 2). A sidescan sonar survey was also performed during Phase I. The purpose of the side scan sonar was to complement the magnetometer survey by potentially visually identifying objects (e.g., ordnance) that may be lying on the Congaree River bottom. The sidescan sonar survey results were inconclusive and it was not utilized in the subsequent phases.

Magnetometer surveying progressed downstream in conjunction with the continuing investigation activities with Phase II extending the survey area from grid line 16 to grid line 20. Survey of the unnamed tributary that is located south of the Gervais Street Bridge was also conducted during Phase II. Phase III encompassed the portions of the project area between grid lines 20 and 37 and Phase IV completed the shoreline surveying in the vicinity of the Senate Street Extension Alluvial Fan that was not conducted during the other phases due to access constraints.

The specific details pertaining to the surveying equipment and methodology are provided in the phase specific reports produced by Tidewater Atlantic Research Inc. provided in Attachment B. In general, depending on the area to be surveyed and the presence of rock outcrops and water level conditions, either a small boat with an outboard motor or an inflatable boat was utilized to carry the surveying equipment. The inflatable boat was pushed through areas where water levels and the presence of rocks precluded the use of the motorboat. Terrestrial surveying was done on foot with handheld and backpack mounted equipment.

The magnetometer surveys were generally run on north-south trending lines and were controlled via a differential global positioning system (DGPS) using a Trimble AgCPS 132 navigation system. HYPACK navigation software was used to translate the DGPS data into real-time data that was used to direct the survey along a predetermined grid or transects. In general, the magnetometer transects lines were located approximately 20 feet apart. In some areas of the river where obstructions were encountered and navigation had to be altered, the distance between the transect lines varied and could be decreased to less than 10 feet.

The magnetometer survey was performed with an EG&G Geometrics G-858 cesium magnetometer that is capable of +/- 0.001 gamma resolution. The magnetic data was collected at a frequency of six samples per second. The locations of the magnetic readings were determined from the DGPS.

The side scan sonar survey was performed from approximately the 4 to 16 Lines and boulders and shallow water prevented performing the survey above the 4 Line. A 445/900 kHz Klein System 3900 digital side scan sonar was employed. The side scan sonar data was horizontally tied to the DGPS and reconciled with the HYPACK survey software. Where navigation was possible, a total of five side scan sonar survey passes were made on a 50-foot transect spacing.

The magnetometer detects changes in earth's magnetic field that may be attributed to buried anthropogenic influences (e.g., UXOs, electrical cables, etc.) or naturally occurring geologic features (e.g., remnant thermal magnetism, ore bodies, etc.). Once the magnetometer data was collected it was systematically analyzed to identify potential targets. A variety of characteristics of the targets including configuration, areal extent, intensity and contrast with background were analyzed and compared to signature characteristics previously found to be reliable indicators of historic ordnance. The results are discussed below.

Results

Following each phase of fieldwork the accumulated data was analyzed and the potential UXO locations were identified. Table 1 provides the results of the magnetometer surveying activities by investigation phase and Figure 3 provides the anomaly locations for the project area. Each phase is also described in more detail in the phase specific reports provided in Attachment B. Table 2 provides a summary of the anomaly locations and interpretation and Table 3 provides a summary of the anomalies located within the planned project area and located in the planned cofferdam footprint.

As the historical and anecdotal evidence suggested, the majority of anomalies were located in the Phase I survey area nearest the Gervais Street Bridge and the boat apron. A total of 323 anomalies were detected in the Phase I area with 218 of those locations exhibiting signature characteristics that could be associated with ordnance. Some of the non-ordnance anomalies included discarded debris and appliances, an electrical cable crossing and a geologic feature.

Phase II produced 10 potential UXOs in grid lines 16 through 20 and an additional 8 in the unnamed tributary. For Phase III the number of anomalies continued to be relatively low from grid line 20 to 31 but increased directly downstream of the Blossom Street Bridge. This increase can be potentially attributable to more recent objects being thrown from the bridge and not necessarily historical UXO. The total number of targets for Phase III was 145 with 121 exhibiting signature characteristics that could be associated with ordnance.

Finally, Phase IV was conducted to obtain information in the area directly downstream of the boat apron, which was not completed during Phase I due to access constraints. A total of 84 anomalies were detected with 67 exhibiting signature characteristics that could be associated with ordnance. The total for all four phases of magnetometer surveying is 570 anomalies located within the investigated area with 425 or 75 percent of those potentially being ordnance.

Due to the nature of the potential historical objects and UXO deposited within the study area and their real or perceived value and/or potential hazard to public safety, the information contained in this summary report must remain confidential. This information was compiled by SCANA for use during completion of the investigative and subsequent remedial activities associated with the Congaree River Project. Any use or dissemination of the information for other purposes is not permitted and may be subject to legal action.

TABLE 1

MAGNETOMETER STUDY RESULTS SUMMARY

Congaree River Sediments
Columbia, South Carolina

Study	Dates	Study Area	Total Magnetic Anomalies	Potential Ordnance (UXO)	Other Anomalies
Phase I	Aug. 25-26, 2010	Congaree River - Grid Lines: 1 thru 16	323	**218**	105
Phase II	Jan. 4-5, 2011	Congaree River - Grid Lines. 16 thru 20	10	**10**	0
		Unnamed Tributary #1 - Outfall to River	8	**8**	0
Phase III	June 30, 2011	Congaree River - Grid Lines: 20 thru 37	145	**122**	23
Phase IV	January 31 - February 2, 2012	Senate Street Extension / Alluvial Fan Area	84	**67**	17
		Total Anomalies	570	**425**	145
		Percentage with UXO Potential		**75%**	

Notes:
1. All magnetometer work was completed by Tidewater Atlantic Research, Inc of Washington, North Carolina.
2. Magnetic Anomalies - As determined by Tidewater by the magnetic, remote-sensing survey.
3. UXO - Unexploded Ordnance
4. UXO Potential - Refering to Magnetic Anomalies that "have signature characteristics that could be associated with ordnance" and "those anomalies should be considered potentially hazardous until material generating the signatures can be identified".
5. Other - Other magnetic anomalies include pipelines, geologic features, modern debris etc.

TABLE 2

MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
1	078-1-nm262g175f	Geological Feature
2	078-2-dp280g49f	Pipeline
3	078-3-mc48g59f	Possible Ordnance
4	078-5-mc1854g71f	Possible Ordnance
5	077-1-nm758g34f	Possible Ordnance
6	077-2-mc40g45f	Possible Ordnance
7	077-3-mc52g76f	Possible Ordnance
8	077-4-pm203g68f	Pipeline
9	077-5-pm320g176f	Geological Feature
10	077-6-30g18f	Possible Ordnance
11	077-7-dp57g58f	Possible Ordnance
12	077-8-dp63g83f	Geological Feature
13	077-9-mc149g71f	Possible Ordnance
14	076-1-pm130g44f	Possible Ordnance
15	076-2-pm137g288f	Possible Ordnance
16	076-3-nm31g37f	Possible Ordnance
17	076-4-nm34g49f	Possible Ordnance
18	076-5-pm307g190f	Geological Feature
19	076-6-pm510g66f	Pipeline
20	076-7-mc76g69f	Possible Ordnance
21	076-8-mc627g66f	Possible Ordnance
22	075-1-dp116g50f	Possible Ordnance
23	075-2nm18g40f	Possible Ordnance
24	075-3-dp52g65f	Possible Ordnance
25	075-4-dp70g65f	Possible Ordnance
26	075-5-pm301g60f	Pipeline
27	075-5-pm289g178f	Geological Feature
28	075-7-dp36g30f	Possible Ordnance
29	075-8-nm59g80f	Possible Ordnance
30	075-9-pm48g35f	Geological Feature
31	075-10-pm125g70f	Possible Ordnance
32	074-1-dp207g40f	Possible Ordnance
33	074-2-dp121g40f	Geological Feature
34	074-3-pm32g20f	Possible Ordnance
35	074-4-pm288g215f	Geological Feature
36	074-5-nm861g50f	Pipeline
37	074-6-pm27g20f	Possible Ordnance
38	074-7-dp42g40f	Possible Ordnance
39	074-8-dp71g65f	Possible Ordnance
40	074-9-nm58g90f	Possible Ordnance
41	073-1-nm36g22f	Possible Ordnance
42	073-2-nm21g30f	Possible Ordnance
43	073-3-dp21g40f	Possible Ordnance
44	073-4-dp149g65f	Possible Ordnance
45	073-5-dp527g60f	Pipeline
46	073-6-pm302g199f	Geological Feature
47	073-7-pm41g18f	Possible Ordnance
48	073-8-nm60g70f	Possible Ordnance
49	073-9-dp64g31f	Geological Feature
50	073-10-dp42g17f	Possible Ordnance
51	072-1-pm46g11f	Possible Ordnance
52	072-2-pm88g23f	Geological Feature
53	072-3-pm310g167f	Geological Feature
54	072-4-pm2310g36f	Pipeline

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
55	072-5-dp62g49'	Possible Ordnance
56	071-1-nm28g10f	Possible Ordnance
57	071-2-pm46g62f	Possible Ordnance
58	071-3-pm170g55f	Possible Ordnance
59	071-4-dp494g96f	Pipeline
60	071-5-pm324g202f	Geological Feature
61	071-6-pm117g97f	Geological Feature
62	071-7-pm70g33f	Possible Ordnance
63	070-1-pm66g25f	Possible Ordnance
64	070-2-pm251g132f	Geological Feature
65	070-3-dp235g21f	Possible Ordnance
66	070-4-nm549g33f	Pipeline
67	070-5-pm159g46f	Possible Ordnance
68	070-6-nm36g18f	Possible Ordnance
69	070-7-dp48g55f	Possible Ordnance
70	070-8-nm44g15f	Possible Ordnance
71	069-1-dp23g10f	Possible Ordnance
72	069-2-dp78g44f	Possible Ordnance
73	069-3-nm1841g50f	Pipeline
74	069-4-dp252g53f	Possible Ordnance
75	069-5-pm214g155f	Geological Feature
76	069-6-pm63g17f	Geological Feature
77	068-1-pm72g94f	Geological Feature
78	068-2-dp238g167f	Possible Ordnance
79	068-3-nm402g55f	Pipeline
80	068-4-dp38g40f	Possible Ordnance
81	067-1-dp32g38f	Possible Ordnance
82	067-2-mc181g93f	Pipeline
83	067-3-pm221g300f	Geological Feature
84	067-5-mc68g90f	Geological Feature
85	067-6-dp22g30f	Possible Ordnance
86	066-1-dp61g40f	Geological Feature
87	066-2-pm182g193f	Geological Feature
88	066-3-nm190g95f	Pipeline
89	066-4-dp127g77f	Possible Ordnance
90	066-5-dp48g18f	Possible Ordnance
91	066-6-nm43g42f	Possible Ordnance
92	066-7-pm27g10f	Possible Ordnance
93	066-8-dp9g10f	Possible Ordnance
94	065-1-dp143g31f	Possible Ordnance
95	065-2-nm19g10f	Possible Ordnance
96	065-3-pm11g7f	Possible Ordnance
97	065-4-dp32g60f	Possible Ordnance
98	065-5-dp127g20f	Possible Ordnance
99	065-6-nm363g52f	Pipeline
100	065-7-pm176g186f	Geological Feature
101	065-8-pm24g38f	Possible Ordnance
102	065-9-pm44g37f	Possible Ordnance
103	065-10-mc69g110f	Geological Feature
104	064-1-pm108g121f	Geological Feature
105	064-2-mc67g61f	Possible Ordnance
106	064-3-pm27g21f	Possible Ordnance
107	064-4-pm193g210f	Geological Feature
108	064-5-nm363g63f	Pipeline

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
109	064-6-pm63g16f	Possible Ordnance
110	064-7-dp415g60f	Possible Ordnance
111	063-1-dp395g68f	Possible Ordnance
112	063-2-pm67g14f	Possible Ordnance
113	063-3-nm188g73f	Possible Ordnance
114	063-4-nm334g26f	Pipeline
115	063-5-pm224g187f	Geological Feature
116	063-6-pm111g143f	Geological Feature
117	062-1-pm99g136f	Geological Feature
118	062-2-pm203g163f	Geological Feature
119	062-3-nm257g48f	Pipeline
120	062-4-dp373g110f	Possible Ordnance
121	062-5-mc68g107f	Possible Ordnance
122	062-6-pm59g55f	Possible Ordnance
123	061-1-pm127g57f	Possible Ordnance
124	061-2-pm182g43f	Possible Ordnance
125	061-3-pm113g52f	Possible Ordnance
126	061-4-nm198g67f	Pipeline
127	061-5-pm225g210f	Geological Feature
128	061-6-pm112g147f	Geological Feature
129	060-1-pm109g18f	Geological Feature
130	060-2-pm66g46f	Possible Ordnance
131	060-3-pm246g205f	Geological Feature
132	060-4-nm107g38f	Pipeline
133	060-5-dp288g93f	Possible Ordnance
134	059-1-nm124g99f	Possible Ordnance
135	059-2-dp73g64f	Possible Ordnance
136	059-3-pm240g200f	Geological Feature
137	059-4-dp76g55f	Possible Ordnance
138	059-5-dp140g102f	Possible Ordnance
139	059-6-dp241g37f	Geological Feature
140	058-1-dp114g101f	Geological Feature
141	058-2-nm65g51f	Possible Ordnance
142	058-3-pm87g33f	Possible Ordnance
143	058-4-mc248g200f	Geological Feature
144	058-5-nm44g15f	Possible Ordnance
145	058-6-dp137g91f	Possible Ordnance
146	057-1-pm144g94f	Pipeline
147	057-2-pm67g62f	Possible Ordnance
148	057-3-dp54g14f	Possible Ordnance
149	o57-4-mc231g180f	Geological Feature
150	057-5-pm55g57f	Possible Ordnance
151	057-6-nm30g36f	Possible Ordnance
152	057-7-dp138g78f	Possible Ordnance
153	057-8-dp135g41f	Geological Feature
154	056-1-pm144g157f	Geological Feature
155	056-2-nm36g22f	Possible Ordnance
156	056-3-pm129g33f	Possible Ordnance
157	056-4-dp34g15f	Possible Ordnance
158	056-5-dp83g70f	Possible Ordnance
159	056-6-mc210g153f	Geological Feature
160	056-7-dp53g21f	Possible Ordnance
161	056-8-dp103g46f	Possible Ordnance
162	056-9-mc178g110f	Pipeline

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
163	055-1-pm277g110f	Pipeline
164	055-2-nm75g32f	Possible Ordnance
165	055-3-dp54g15f	Possible Ordnance
166	055-4-pm127g62f	Possible Ordnance
167	055-5-pm195g58f	Geological Feature
168	055-6-dp221g64f	Possible Ordnance
169	055-7-dp28g10f	Possible Ordnance
170	055-8-pm146g36f	Possible Ordnance
171	055-9-dp18g20f	Possible Ordnance
172	055-10-pm136g123f	Geological Feature
173	054-1-dp65g44f	Possible Ordnance
174	054-2-dp66g30f	Possible Ordnance
175	054-3-dp62g38f	Possible Ordnance
176	054-4-pm196g90f	Geological Feature
177	054-5-dp100g48f	Possible Ordnance
178	054-6-dp106g20f	Possible Ordnance
179	054-7-dp47g15f	Possible Ordnance
180	054-8-pm479g50f	Pipeline
181	053-1-nm71g18f	Possible Ordnance
182	053-2-nm21g26f	Possible Ordnance
183	053-3-mn90g46f	Possible Ordnance
184	053-4-dp26g17f	Possible Ordnance
185	053-5-nm32g15f	Possible Ordnance
186	053-6-pm71g56f	Possible Ordnance
187	053-7-pm199g57f	Geological Feature
188	053-8-nm111g38f	Iron Pipe
189	053-9-nm51g20f	Possible Ordnance
190	0543-10-dp43g40f	Possible Ordnance
191	053-11-nm70g66f	Possible Ordnance
192	053-12-pm115g105f	Geological Feature
193	052-1-pm129g142f	Geological Feature
194	052-2-dp99g63f	Possible Ordnance
195	052-3-mc292g160f	Iron Pipe
196	052-4-dp60g42f	Possible Ordnance
197	052-5-pm63g30f	Possible Ordnance
198	052-6-dp47g12f	Possible Ordnance
199	052-7-dp251g53f	Possible Ordnance
200	051-1-mc601g117f	Iron Pipe
201	051-2-nm97g26f	Possible Ordnance
202	050-1-nm94g33f	Possible Ordnance
203	050-2-dp102g45f	Possible Ordnance
204	050-3-pm50g17f	Possible Ordnance
205	050-4-pm818g20fEOL	Possible Ordnance
206	049-1-pm112g64f	Possible Ordnance
207	049-2-pm111g78f	Possible Ordnance
208	049-3-dp74g66f	Possible Ordnance
209	049-4-dp75g70f	Possible Ordnance
210	048-1-nm74g38f	Possible Ordnance
211	048-2-dp13g14f	Possible Ordnance
212	049-3-nm104g28f	Possible Ordnance
213	048-4-pm127g53f	Possible Ordnance
214	048-5-pm22g28f	Possible Ordnance
215	047-1-nm119g46fEOL	Possible Ordnance
216	047-2-dp13g15f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
217	047-3-nm89g33f	Possible Ordnance
218	046-1-nm223g37f	Possible Ordnance
219	078-1-pm1949g7f	Possible Ordnance
220	068-1-dp311g7f	Possible Ordnance
221	045-1-mc6548g8f	Electromagnetic Anomaly
222	062L-1-pm150g5f	Possible Ordnance
223	062L-2-nm109g11f	Possible Ordnance
224	061L-1-nm135g4f	Possible Ordnance
225	061L-2-pm95g6f	Possible Ordnance
226	061L-3-dp105g20f	Possible Ordnance
227	060L-1-pm113g3f	Possible Ordnance
228	060L-2dp93g27f	Possible Ordnance
229	059L-1-nm150g25f	Possible Ordnance
230	058L-1-pm302g11f	Possible Ordnance
231	058L-2-pm79g16f	Possible Ordnance
232	057L-1-dp257g7f	Possible Ordnance
233	056L-dp150g11f	Possible Ordnance
234	056L-2-pm43g10f	Possible Ordnance
235	055L-1-dp201g11f	Possible Ordnance
236	054L-1-nm166g9f	Possible Ordnance
237	001SL-1-pm4902g20	Boiler
238	001SL-2-pm4554g4f	Possible Ordnance
239	001SL-3-mc8907g11f	Electromagnetic Anomaly
240	002SL-1-dp8978g9f	Possible Ordnance
241	002SL-2-dp3987g7f	Possible Ordnance
242	002SL-3-mc7345g7f	Possible Ordnance
243	003SL-1-pm269g10f	Possible Ordnance
244	003Sl-2-pm515g7f	Possible Ordnance
245	003SL-3-nm80g5f	Possible Ordnance
246	003SL-4-dp168g19f	Boiler
247	003SL-5-pm129g6f	Washing Machine
248	060L-1-nm105g20f	Possible Ordnance
249	059L-1-nm279g5f	Possible Ordnance
250	059L-2-pm423g34f	Possible Ordnance
251	058L-1-dp209g6f	Possible Ordnance
252	058L-2-pm35g11f	Possible Ordnance
253	057L-1-nm17g11f	Possible Ordnance
254	057L-2-pm98g8f	Possible Ordnance
255	057L-3-pm37g9f	Possible Ordnance
256	057L-4-pm38g11f	Possible Ordnance
257	057L-5-dp75g10f	Sign
258	056L-1-mc8186g11f	Possible Ordnance
259	055L-1-mc5360g20f	Possible Ordnance
260	055L-2-nm357g19f	Possible Ordnance
261	054L-1-261g11f	Possible Ordnance
262	054L-2-pm3122g8f	Possible Ordnance
263	053L-1-nm110g9f	Possible Ordnance
264	053L2-dp109g16f	Possible Ordnance
265	052L-1-dp286g3f	Manhole
266	052L-2-pm327g9f	Possible Ordnance
267	052L-3-nm248g21f	Possible Ordnance
268	052L-4-dp259g26f	Possible Ordnance
269	051L-1-nm109g13f	Possible Ordnance
270	067-1-dp48g33f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
271	067-2-dp142g44f	Possible Ordnance
272	0701-dp480g13f	Possible Ordnance
273	070-2-pm49g11f	Possible Ordnance
274	072-1-pm89g13f	Possible Ordnance
275	073-1-nm80g5f	Possible Ordnance
276	073-2-nm356g23f	Possible Ordnance
277	075-1-nm364g11f	Possible Ordnance
278	075-2-dp1039g39f	Possible Ordnance
279	077-1-dp123g14f	Possible Ordnance
280	077-2-dp776g30f	Possible Ordnance
281	078R-3mc8302g20f	Electromagnetic Anomaly
282	068-1-dp320g7f	Possible Ordnance
283	068R-2-mc9213g15f	Electromagnetic Anomaly
284	066R-1-mc8334g15f	Electromagnetic Anomaly
285	065R-1-mc8486g18f	Electromagnetic Anomaly
286	064R-1-mc9633g18f	Electromagnetic Anomaly
287	063R-1-mc9404g19f	Electromagnetic Anomaly
288	062R-2-mc9746g18f	Electromagnetic Anomaly
289	061R-1-mc7773g16f	Electromagnetic Anomaly
290	060R-1-mc8127g8f	Electromagnetic Anomaly
291	059R-1-mc5961g11f	Electromagnetic Anomaly
292	058R-1-mc6758g17f	Electromagnetic Anomaly
293	057R-1-mc7119g24f	Electromagnetic Anomaly
294	056R-1-mc7891g16f	Electromagnetic Anomaly
295	055R-1-mc6461g17f	Electromagnetic Anomaly
296	054R-1-mc9645g16f	Electromagnetic Anomaly
297	053R-1-mc6680g13f	Electromagnetic Anomaly
298	052R-1-mc9795g10f	Electromagnetic Anomaly
299	051R-1-mc6531g15f	Electromagnetic Anomaly
300	050R-1-mc6531g14f	Electromagnetic Anomaly
301	049R-1-mc9574g7f	Electromagnetic Anomaly
302	048R-1-mc6550g12f	Electromagnetic Anomaly
303	047BR-1-mc6477g7f	Electromagnetic Anomaly
304	045R-1mc6548g8f	Electromagnetic Anomaly
305	003-4-dp103g12f	Possible Ordnance
306	004-1-pm93g10f	Possible Ordnance
307	003-3-pm58g16f	Possible Ordnance
308	002-1-dp38g9f	Possible Ordnance
309	003-2-pm96g11f	Possible Ordnance
310	004-3-pm95g12f	Possible Ordnance
311	001-1-pm54g6f	Possible Ordnance
312	006-2-nm207g12f	Possible Ordnance
313	004-2-pm81g9f	Possible Ordnance
314	003-1-pm19g4f	Possible Ordnance
315	004-4-pm78g8f	Possible Ordnance
316	006-1-dp191g16f	Possible Ordnance
317	002-2-dp53g11f	Possible Ordnance
318	004-5-pm85g11f	Possible Ordnance
319	004-6-pm71g10f	Possible Ordnance
320	004-7-pm82g12f	Possible Ordnance
321	004-8-dp156g19f	Possible Ordnance
322	002-3-nm32g8f	Possible Ordnance
323	053L-4-dp437g70f	Iron Pipe
324	022-1-pm100g25f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
325	021-2-nm400g25f	Possible Ordnance
326	021-2-pm70g20f	Possible Ordnance
327	012-1-pm270g23f	Possible Ordnance
328	011-1-dp225g75f	Possible Ordnance
329	010-1-nm50g15f	Possible Ordnance
330	020-1-dp22g15f	Possible Ordnance
331	016-1-pm38g37f	Possible Ordnance
332	020-2-dp23g13f	Possible Ordnance
333	020-3-dp18g16f	Possible Ordnance
334	A	Possible Ordnance
335	B	Possible Ordnance
336	C	Possible Ordnance
337	D	Possible Ordnance
338	E	Possible Ordnance
339	F	Possible Ordnance
340	G	Possible Ordnance
341	H	Possible Ordnance
342	1-1-mc806g44f	Possible Ordnance
343	1-2-pm100g9f	Possible Ordnance
344	1-3-dp533g47f	Possible Ordnance
345	1-4-dp233g24f	Possible Ordnance
346	1-5-pm73g13f	Possible Ordnance
347	1-6-dp210g33f	Possible Ordnance
348	22-1-dp544g65f	Pipeline
349	21-1-pm323g42f	Possible Ordnance
350	21-2-dp1330g64f	Pipeline
351	20-1-dp94g25f	Possible Ordnance
352	20-2-dp2601g102f	Pipeline
353	19-1-pm79g8f	Possible Ordnance
354	19-2-pm113g18f	Possible Ordnance
355	19-3-dp154g31f	Possible Ordnance
356	19-3-dp1419g86f	Pipeline
357	18-1-dp333g16f	Possible Ordnance
358	18-2-dp40g17f	Possible Ordnance
359	18-3-dp105g24f	Possible Ordnance
360	18-4-dp196g34f	Possible Ordnance
361	18-5-pm13g8f	Possible Ordnance
362	18-6-dp2092g60f	Pipeline
363	18-6-dp83g22f	Possible Ordnance
364	18-7-dp?1687+g18+f	Pipeline
365	17-1-dp1497g47f	Pipeline
366	17-2-dp47g44f	Possible Ordnance
367	17-3-pm29g16f	Possible Ordnance
368	17-4-mc53g35f	Possible Ordnance
369	16-1-nm61g10f	Possible Ordnance
370	16-2-dp136g17f	Possible Ordnance
371	16-3-pm50g27f	Possible Ordnance
372	16-5-dp10g6f	Possible Ordnance
373	16-6-pm47g26f	Possible Ordnance
374	15-1-dp59g30f	Possible Ordnance
375	15-2-pm43g16f	Possible Ordnance
376	15-3-dp304g29f	Possible Ordnance
377	14-1-dp136g21f	Possible Ordnance
378	14-2-dp185g32f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
379	14-4-pm95g31f	Possible Ordnance
380	10-1-nm29g25f	Possible Ordnance
381	10-2-dp31g260f	Possible Ordnance
382	10-2-nm57g13f	Possible Ordnance
383	13-1-dp66g23f	Possible Ordnance
384	13-2-pm40g21f	Possible Ordnance
385	13-3-pm27g17f	Possible Ordnance
386	13-4-dp46g10f	Possible Ordnance
387	12-1-dp40g30f	Possible Ordnance
388	12-2-pm46g33f	Possible Ordnance
389	11-1-pm22g39f	Possible Ordnance
390	11-2-pm39g31f	Possible Ordnance
391	10-1-dp95g21f	Possible Ordnance
392	9-1-dp78g23f	Possible Ordnance
393	8-1-dp247g13f	Possible Ordnance
394	7-1-dp180g23f	Possible Ordnance
395	7-2-dp145g20f	Possible Ordnance
396	6-1-dp138g15f	Possible Ordnance
397	6-2-dp235g26f	Possible Ordnance
398	5-1-pm103g31f	Possible Ordnance
399	5-2-dp53g57f	Possible Ordnance
400	4-1-pm103g15f	Possible Ordnance
401	4-2-dp49g12f	Possible Ordnance
402	2-1-pm110g13f	Possible Ordnance
403	15-1-mc16g4f	Possible Ordnance
404	14-1-dp68g16f	Possible Ordnance
405	13-1-dp53g7f	Possible Ordnance
406	13-2-dp188g28f	Possible Ordnance
407	12-1-pm11g29f	Possible Ordnance
408	11-1-dp528g20f	Possible Ordnance
409	9-1-dp342g22f	Possible Ordnance
410	8-1-dp135g24f	Possible Ordnance
411	8-2-dp72g23f	Possible Ordnance
412	8-1-dp34g16f	Possible Ordnance
413	6-1-pm32g5f	Possible Ordnance
414	5-1-dp47g21f	Possible Ordnance
415	4-1-dp218g25f	Possible Ordnance
416	4-2-dp80g21f	Possible Ordnance
417	3-1-dp146g27f	Possible Ordnance
418	3-2-pm123g17f	Possible Ordnance
419	3-3-dp85g22f	Possible Ordnance
420	1-1-dp112g18f	Possible Ordnance
421	22-1-dp122g37f	Possible Ordnance
422	22-3-nm28g10f	Possible Ordnance
423	22-2-pm17g10f	Possible Ordnance
424	1-1-pm73g12f	Possible Ordnance
425	1-2-pm215g23f	Possible Ordnance
426	2-1-dp185g16f	Possible Ordnance
427	2-2-mc287g46f	Possible Ordnance
428	2-3-dp107g24f	Possible Ordnance
429	1-1-dp55g16f	Possible Ordnance
430	1-2-dp223g45f	Possible Ordnance
431	1-3-dp700g35f	Possible Ordnance
432	1-4-dp97g25f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
433	5-1-dp89g22f	Possible Ordnance
434	13-1-dp44g15f	Possible Ordnance
435	13-2-dp37g24f	Possible Ordnance
436	14-1-dp28g14f	Possible Ordnance
437	11-1-dp52g44f	Possible Ordnance
438	11-2-dp72g43f	Possible Ordnance
439	10-1-pm41g18f	Possible Ordnance
440	10-2-pm20g11f	Possible Ordnance
441	10-3-dp72g35f	Possible Ordnance
442	10-4-pm74g23f	Possible Ordnance
443	9-1-dp281g31f	Possible Ordnance
444	7-1-dp208g20f	Possible Ordnance
445	7-2-dp125g23f	Possible Ordnance
446	7-3-pm115g10f	Possible Ordnance
447	6-1-dp152g34f	Possible Ordnance
448	6-2-mc175g49f	Possible Ordnance
449	5-1-pm60g11f	Possible Ordnance
450	5-2-pm32g6f	Possible Ordnance
451	5-3-pm63g12f	Possible Ordnance
452	5-4-pm50g7f	Possible Ordnance
453	5-5-dp65g4f	Possible Ordnance
454	5-6-mc6558g70f	Possible Ordnance
455	4-1-dp164g41f	Possible Ordnance
456	4-2-pm177g20f	Possible Ordnance
457	4-3-nm220g17f	Possible Ordnance
458	11-1-dp208g48f	Possible Ordnance
459	11-2-dp28g17f	Possible Ordnance
460	14-1-pm293g50f	Possible Ordnance
461	14-1-pm153g18f	Possible Ordnance
462	15-1-pm136g14f	Possible Ordnance
463	001-1-mc30093g25f	Possible Ordnance
464	022-1-mc31539g13f	Possible Ordnance
465	021-1-mc28767g12f	Possible Ordnance
466	020-1-mc31683g35f	Possible Ordnance
467	018-1-mc31942g23f	Possible Ordnance
468	018-1-mc31657g24f	Possible Ordnance
469	017-1-mc26003g23f	Possible Ordnance
470	017-1-dp67g14f	Possible Ordnance
471	014-1-mc26324g17f	Electromagnetic Anomaly
472	013-1-mc31252g8f	Electromagnetic Anomaly
473	013-2-mc16747g7f	Electromagnetic Anomaly
474	012-1-mc27653g21f	Electromagnetic Anomaly
475	011-1-mc34257g22f	Electromagnetic Anomaly
476	010-1-mc26761g24f	Electromagnetic Anomaly
477	009-1-mc29279g28f	Electromagnetic Anomaly
478	008-1-mc30182g22f	Electromagnetic Anomaly
479	07-1-mc21762g7f	Electromagnetic Anomaly
480	006-1-mc27687g21f	Electromagnetic Anomaly
481	005-1-mc30284g22f	Electromagnetic Anomaly
482	004-1-mc26874g21f	Electromagnetic Anomaly
483	003-1-mc28428g18f	Electromagnetic Anomaly
484	002-1-mc30321g12f	Electromagnetic Anomaly
485	007-1-pm6g10f	Tire
486	010-1-pm38g15f	Lamp

TABLE 2

MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
487	01-1-nm77g7f	Possible Ordnance
488	01-2-mc187g13f	Pipeline Associated
489	02-1-dp662gEOL	Pipeline Associated
490	03-1-mc795g52f	Pipeline Associated
491	03-2-nm47g6f	Pipeline Associated
492	03-3-nm321g45f	Possible Ordnance
493	03-4-pm190g2f	Possible Ordnance
494	03-5-dp2178gEOL	Possible Ordnance
495	03-6-dp156g18f	Possible Ordnance
496	04-1-dp2770g35f	Pipeline Associated
497	04-2-dp44891g35f	Electromagnetic Anomaly
498	04-3-mc44891g7f	Electromagnetic Anomaly
499	05-1-pm2582g30f	Possible Ordnance
500	05-2-pm705g21f	Pipeline Associated
501	05-3-pm139g13f	Possible Ordnance
502	05-4-nm169g17f	Possible Ordnance
503	06-1-pm1537g21f	Possible Ordnance
504	06-2-dp216g15f	Possible Ordnance
505	06-3-dp2658g33f	Pipeline Associated
506	06-4-pm96g13f	Possible Ordnance
507	06-5-pm90g10f	Possible Ordnance
508	06-6-dp109g12f	Possible Ordnance
509	06-7-pm36g4f	Possible Ordnance
510	07-1-dp1681g38f	Possible Ordnance
511	07-2-pm70g6f	Possible Ordnance
512	07-3-mc3436g43f	Pipeline Associated
513	07-4-dp608g39f	Possible Ordnance
514	08-1-nm61g14f	Possible Ordnance
515	08-2-mc138g24f	Possible Ordnance
516	08-3-dp2380g51f	Pipeline Associated
517	08-4-pm1479g40f	Possible Ordnance
518	08-5-nm20g2f	Possible Ordnance
519	08-6-mc244gEOL	Possible Ordnance
520	09-1-nm157g9f	Possible Ordnance
521	09-2-pm2592g48f	Possible Ordnance
522	09-3-dp129g6f	Possible Ordnance
523	09-4-dp4790g50f	Pipeline Associated
524	09-5-pm23864g4f	Electromagnetic Anomaly
525	09-6-pm34g13f	Possible Ordnance
526	10-1-pm37g24f	Possible Ordnance
527	10-2-dp6063g73f	Pipeline Associated
528	10-3-mc34109g1f	Electromagnetic Anomaly
529	10-4-pm2385g43f	Possible Ordnance
530	10-5-mc92g2f	Possible Ordnance
531	11-1-pm1474g41f	Possible Ordnance
532	11-2-dp2385g29f	Pipeline Associated
533	11-3-mc207g22f	Possible Ordnance
534	11-4-dp52g19f	Possible Ordnance
535	12-1-pm52g7f	Possible Ordnance
536	12-2-nm398g18f	Possible Ordnance
537	12-3-pm75g7f	Possible Ordnance
538	12-4-nm29g4f	Possible Ordnance
539	12-5-nm24g3f	Possible Ordnance
540	12-6-nm115g3f	Possible Ordnance

TABLE 2

MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
541	12-7-nm23g8f	Possible Ordnance
542	12-8-mc457g25f	Possible Ordnance
543	12-9-mc613g30f	Possible Ordnance
544	12-10-nm642g43f	Possible Ordnance
545	13-1-dp244g28f	Possible Ordnance
546	13-2-nm213g24f	Possible Ordnance
547	13-3-nm224g18f	Possible Ordnance
548	13-4-nm156g14f	Possible Ordnance
549	13-5-dp25g9f	Possible Ordnance
550	14-1-nm61g15f	Possible Ordnance
551	14-2-nm234g18f	Possible Ordnance
552	14-3-dp193g23f	Possible Ordnance
553	14-4-dp462g36f	Possible Ordnance
554	14-5-nm19g6f	Possible Ordnance
555	14-6-dp646g26f	Possible Ordnance
556	14-7-dp1357g24f	Possible Ordnance
557	16-1-dp400g18f	Possible Ordnance
558	16-2-pm160g17f	Possible Ordnance
559	16-3-dp368g20f	Possible Ordnance
560	16-4-mc403g30f	Possible Ordnance
561	16-5-pm36g11f	Possible Ordnance
562	16-6-pm12g4f	Possible Ordnance
563	16-7-pm35g13f	Possible Ordnance
564	17-1-dp273g42f	Possible Ordnance
565	18-1-dp527g12f	Possible Ordnance
566	18-2-pm91g8f	Possible Ordnance
567	19-1-dp528g38f	Possible Ordnance
568	19-2-pm166g7f	Possible Ordnance
569	19-3-dp1000g33f	Possible Ordnance
570	20-1-mc48849g8f	Electromagnetic Anomaly

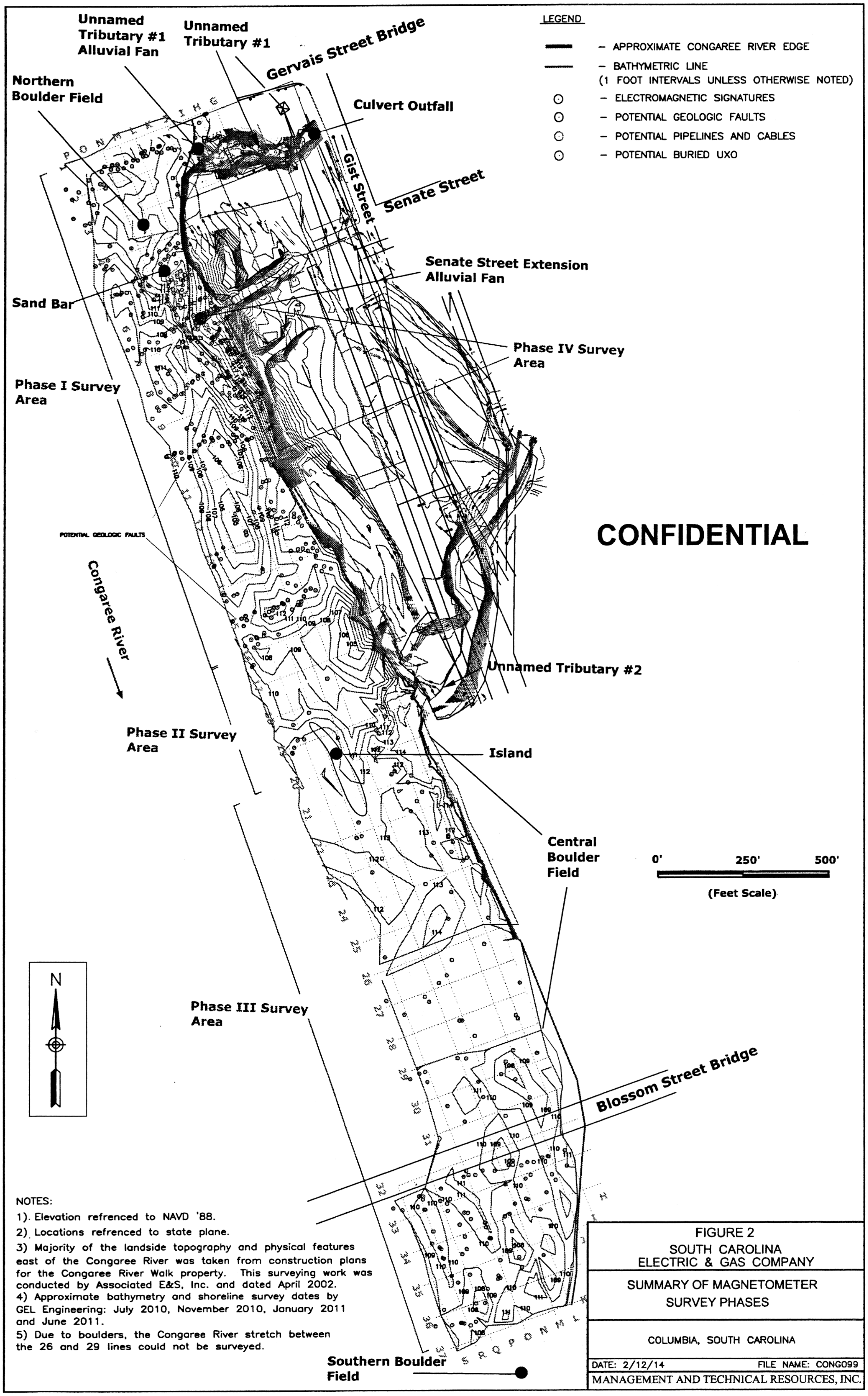
TABLE 3

ANOMALIES BY PLANNED PROJECT AREA

Congaree River Sediments
Columbia, South Carolina

Construction Phase	Potential Ordnance (UXO)	Potential UXO Under the Footprint of the Cofferdam	Other Anomalies	Total Magnetic Anomalies
Field Demonstration Project Area	84	0	17	101
Phase I	84	20	14	118
Phase II	45	9	16	70
Phase III	2	14	17	33
Outside of Project Area	210	0	38	248
Total Anomalies	**425**	**43**	**102**	**570**

Notes:
Please refer to Figures 2 and 3.
1. All magnetometer work was completed by Tidewater Atlantic Research, Inc of Washington, North Carolina.
2. Magnetic Anomalies - As determined by Tidewater by the magnetic, remote-sensing survey.
3. UXO - Unexploded Ordnance
4. UXO Potential - Refering to Magnetic Anomalies that "*have signature characteristics that could be associated with ordnance*" and "*those anomalies should be considered potentially hazardous until material generating the signatures can be identified*".
5. Other - Other magnetic anomalies include pipelines, geologic features, modern debris etc.



NOTES:

1). Elevation refrenced to NAVD '88.

2). Locations refrenced to state plane.

3) Majority of the landside topography and physical features east of the Congaree River was taken from construction plans for the Congaree River Walk property. This surveying work was conducted by Associated E&S, Inc. and dated April 2002.

4) Approximate bathymetry and shoreline survey dates by GEL Engineering: July 2010, November 2010, January 2011 and June 2011.

5) Due to boulders, the Congaree River stretch between the 26 and 29 lines could not be surveyed.

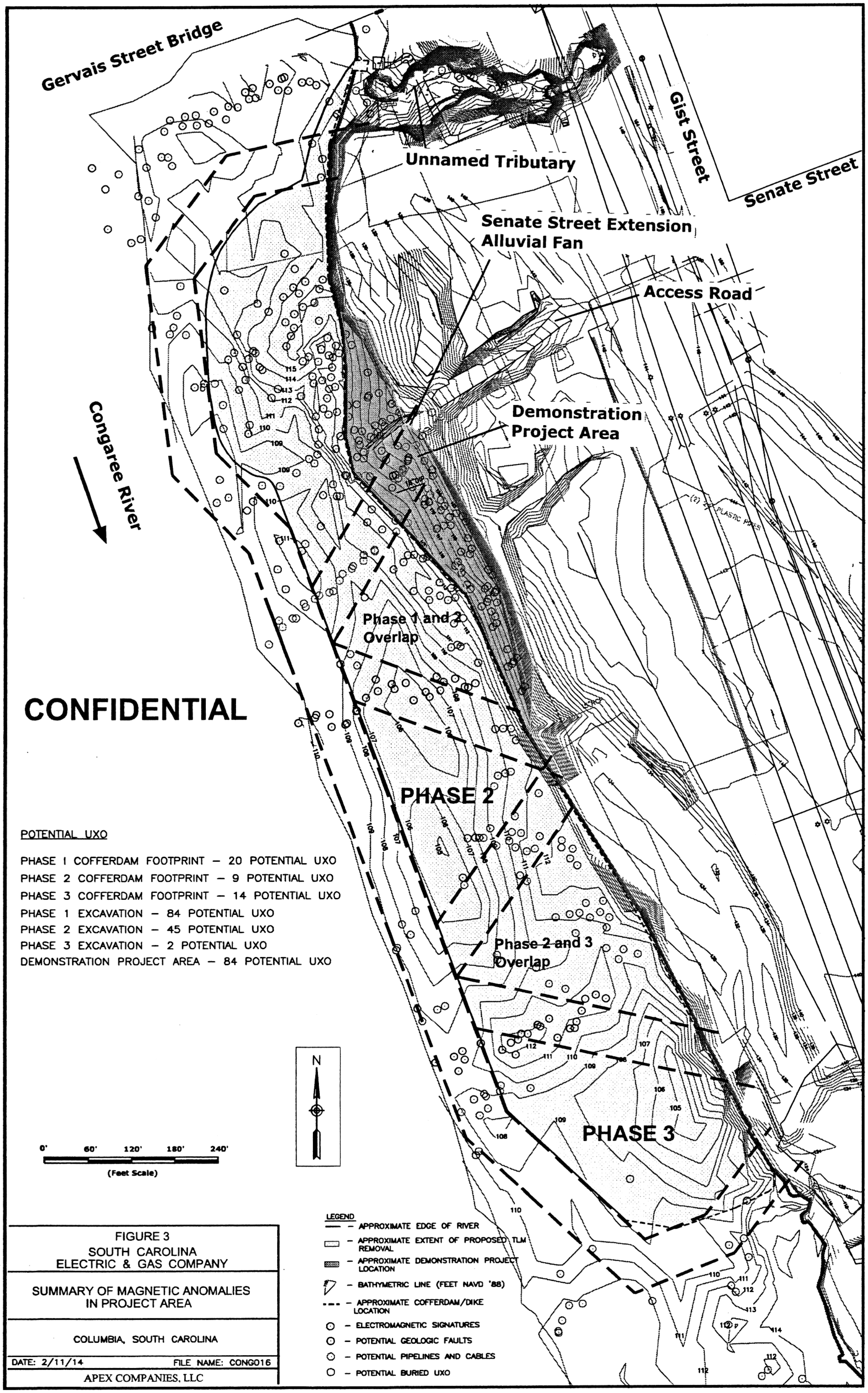
FIGURE 2
SOUTH CAROLINA
ELECTRIC & GAS COMPANY

SUMMARY OF MAGNETOMETER
SURVEY PHASES

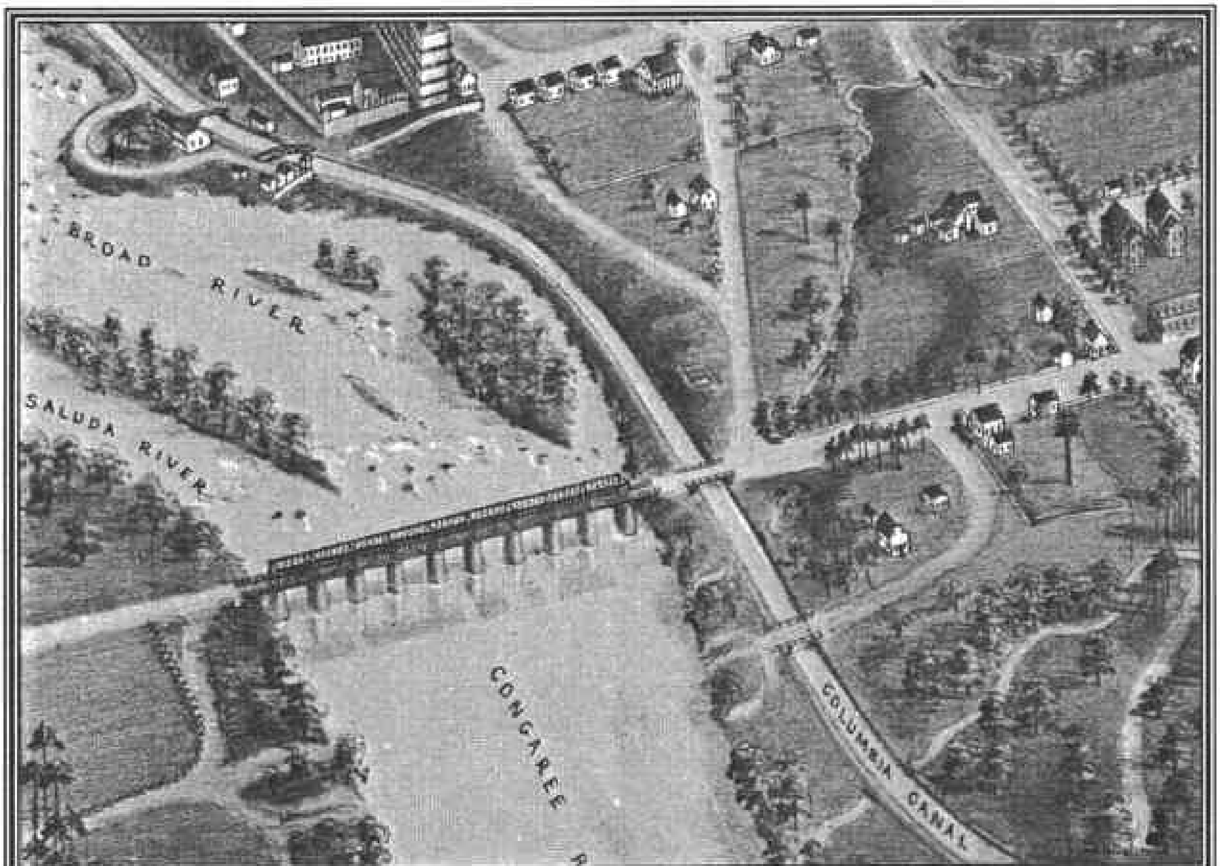
COLUMBIA, SOUTH CAROLINA

DATE: 2/12/14 FILE NAME: CONG099

MANAGEMENT AND TECHNICAL RESOURCES, INC.


Gervais Street Bridge
Gist Street
Senate Street
Unnamed Tributary
Senate Street Extension
Alluvial Fan
Access Road
Demonstration
Project Area
Congaree River
Phase 1 and 2
Overlap
CONFIDENTIAL
PHASE 2
Phase 2 and 3
Overlap
PHASE 3
N
POTENTIAL UXO
PHASE 1 COFFERDAM FOOTPRINT – 20 POTENTIAL UXO
PHASE 2 COFFERDAM FOOTPRINT – 9 POTENTIAL UXO
PHASE 3 COFFERDAM FOOTPRINT – 14 POTENTIAL UXO
PHASE 1 EXCAVATION – 84 POTENTIAL UXO
PHASE 2 EXCAVATION – 45 POTENTIAL UXO
PHASE 3 EXCAVATION – 2 POTENTIAL UXO
DEMONSTRATION PROJECT AREA – 84 POTENTIAL UXO
0' 60' 120' 180' 240'
(Feet Scale)
LEGEND
– APPROXIMATE EDGE OF RIVER
– APPROXIMATE EXTENT OF PROPOSED TLM REMOVAL
– APPROXIMATE DEMONSTRATION PROJECT LOCATION
– BATHYMETRIC LINE (FEET NAVD '88)
– APPROXIMATE COFFERDAM/DIKE LOCATION
– ELECTROMAGNETIC SIGNATURES
– POTENTIAL GEOLOGIC FAULTS
– POTENTIAL PIPELINES AND CABLES
– POTENTIAL BURIED UXO
FIGURE 3
SOUTH CAROLINA
ELECTRIC & GAS COMPANY
SUMMARY OF MAGNETIC ANOMALIES
IN PROJECT AREA
COLUMBIA, SOUTH CAROLINA
DATE: 2/11/14
FILE NAME: CONG016
APEX COMPANIES, LLC

ARCHAEOLOGICAL DATA RECOVERY PLAN FOR THE MITIGATION OF SITE 38RD286, THE ORDNANCE DUMP SITE, FOR THE CONGAREE RIVER SEDIMENT REMOVAL PROJECT,COLUMBIA, SOUTH CAROLINA



Birdseye View of the city of Columbia showing the Gervais Street Bridge (C. Drie, 1872).

September 2014

ARCHAEOLOGICAL DATA RECOVERY PLAN FOR THE MITIGATION OF SITE 38RD286, THE ORDNANCE DUMP SITE, FOR THE CONGAREE RIVER SEDIMENT REMOVAL PROJECT,COLUMBIA, SOUTH CAROLINA

Submitted to:

SCANA SERVICES, INC.
200 Operation Way
Cayce, South Carolina 29033

By:

TRC ENVIRONMENTAL CORPORATION
621 Chatham Avenue
Columbia, South Carolina 29205

Sean Norris, Program Manager Archaeology

March 2014

INTRODUCTION

TRC Environmental Corporation (TRC) is pleased to provide the following information for Artifact Recovery and Artifact Conservation for Site 38RD286 as related to the Congaree River Sediment Removal Project. This plan is being submitted as one the stipulations agreed upon in a Memorandum of Agreement between the U.S. Army Corps of Engineers, the State Historic Preservation Office and SCANA. It also serves as the application for an Exclusive Commercial Data Recovery Salvage License as pursuant to the Underwater Antiquities Act of 1991 (Article 5, Chapter 7, Title 54, Code of Laws of South Carolina, 1976). Due to the extensive nature of the undertaking a one year license is being requested with the expectation that up to three additional year-long extensions will be requested. Mr. Robert Apple, SCANA Project Manager, will be the license holder.

The excavation and recovery of submerged artifacts will be conducted in support of and concurrently with a large scale environmental remediation project. The project involves the removal of contaminated sediments in the Congaree River. In June 2010, tarlike material (TLM) was reported near the eastern shoreline of the Congaree River directly downstream of the Gervais Street Bridge. The South Carolina Department of Health and Environmental Control (SCDHEC) began sampling material from the river and concluded that the source of the TLM was a manufactured gas plant (MGP) that operated on Huger Street in downtown Columbia from 1906 to the mid-1950s. During its period of operation the MGP had allowed coat tar runoff to empty into the Congaree River.

This MGP, after a series of mergers and acquisitions, became one of South Carolina Electric and Gas's (SCE&G) predecessor companies. As a result SCE&G owned the land the former MGP occupied. In 2002 SCE&G had entered into a Voluntary Cleanup Contract with SCDHEC to mitigate the former MGP site. Beginning in 2008 SCE&G removed over 125,000 tons of MGP impacted soil and debris from the Huger Street location. Since the discovery of tar in the river SCE&G has worked with SCDHEC in order to define the extent of the TLM contamination, and has conducted a series of surveys to establish the vertical and horizontal distribution of the TLM. The project area begins directly south of the Gervais Street Bridge and extends downstream for approximately 2,000 feet; it extends approximately 300 feet into the river from the eastern bank (Figure 1).

In 2013 SCDHEC approved the Project Delineation Report and tasked SCE&G to develop an appropriate plan for the removal and mitigation of the contaminated soil. In 2013 a report detailing four "removal action" options was submitted to SCDHEC. The four options were:

1. No Action – Leave the TLM in place.

2. Monitoring and Institutional Controls – Leave the TLM in place, restrict access to the area, and conduct annual monitoring.

3. Sediment Capping and Institutional Controls – Place a physical barrier on top of the contaminated sediment effectively burying the TLM and conduct annual monitoring.

4. Removal – Physically remove the TLM and contaminated sediment.

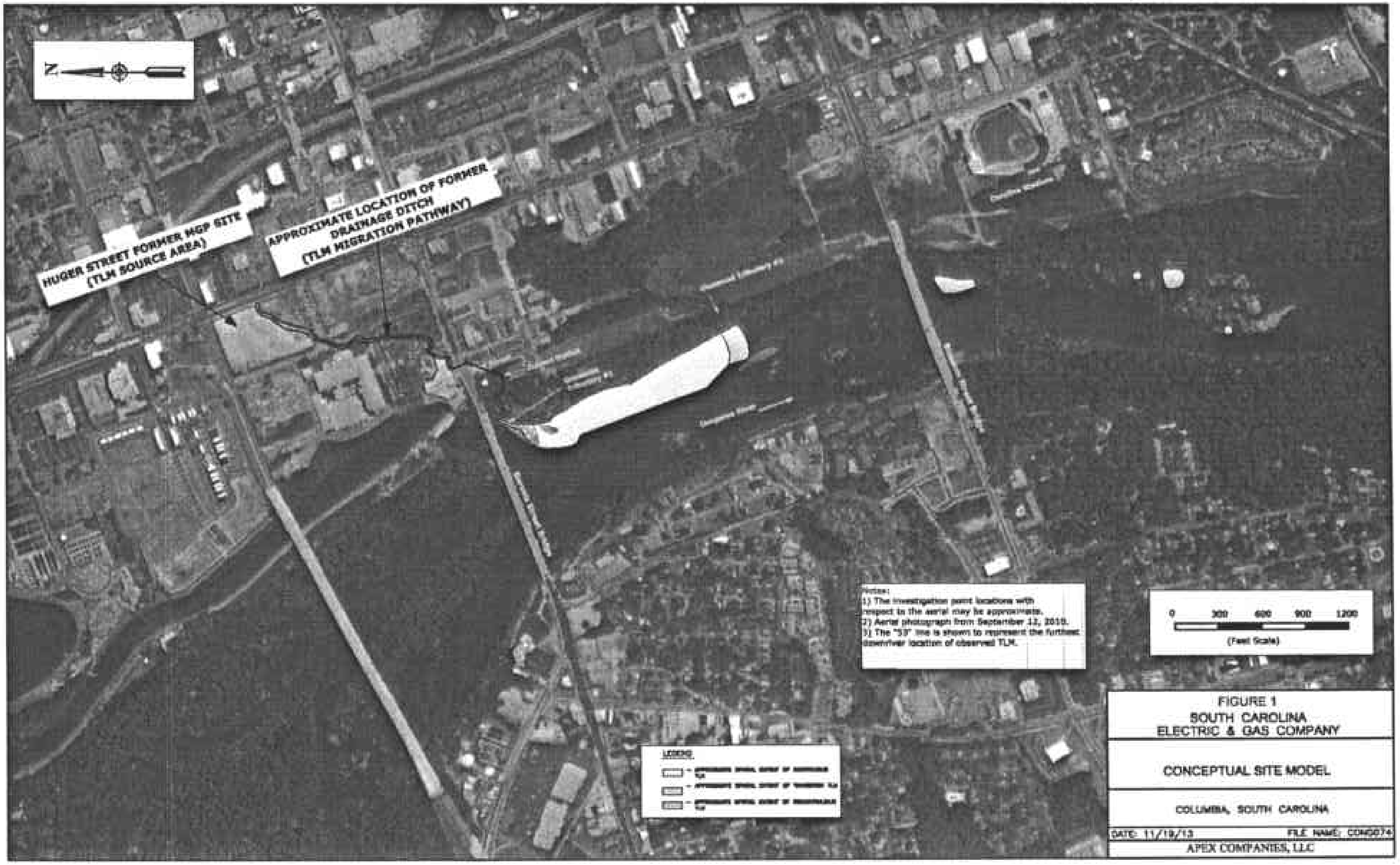


Figure 1. Project location map.

SCDHEC approved option four as the preferred method of dealing with the TLM. This method was deemed to the most protective of human health and the environment because it would permanently remove the contaminated sediment.

PROJECT DESCRIPTION

The recovery of archaeologically significant artifacts Site 38RD286 will take place concurrently with the proposed environmental remediation project. The remediation and removal of the TLM and contaminated sediments will involve the following activities:

- Conducting landside clearing, grading and site setup activities;
- Installing a cofferdam of sufficient height to restrict river flow;
- Dewatering of the area to be excavated;
- Physically removing TLM-impacted sediment and debris using conventional equipment;
- Conditioning the sediment material for transportation to the landfill;
- Backfill as necessary; and
- Off-site disposal.

An average of two feet of sediment will need to be removed over the entire project area. This is equal to approximately 40,000 tons of sediment requiring removal and off-site treatment or disposal. Prior to activities in the river, construction on the eastern shoreline to improve access to the project area for personnel, equipment and material transportation trucks will be conducted. These construction activities would include improving and/or creating access roads by using fill, gravel and geotextile over the existing landscape. A project compound with office trailers, support structures and associated electrical power and utilities would be required. Protective fencing would also be installed to restrict access to the work areas by unauthorized personnel.

The first component of the sediment removal will be the construction of a cofferdam around the planned removal areas. Figure 2 provides a potential sediment removal scenario with an assumed cofferdam configuration. The purpose of the coffer dam is to isolate and dewater the areas prior to initiating the removal operations. Due to the varying thickness of sediment, the uneven nature of the riverbed and changing conditions within the project area a number of different methodologies and equipment will be employed to complete the project. Generally speaking, heavy equipment/machine excavators coupled with vacuum removal or other techniques will be employed to remove the sediment to bedrock. The sediment will be removed in 50 × 50 foot grid squares.

Once removed, the sediment would likely require drying or solidification prior to transporting. Depending on the amount of TLM in the sediment the material will either be sent to an on-site sorting facility for screening or to an off-site facility for visual examination prior to disposal in a landfill. In order to minimize potential impacts on spawning migrations for threatened and/or endangered species a construction phase (for actual work in the river) would begin no earlier

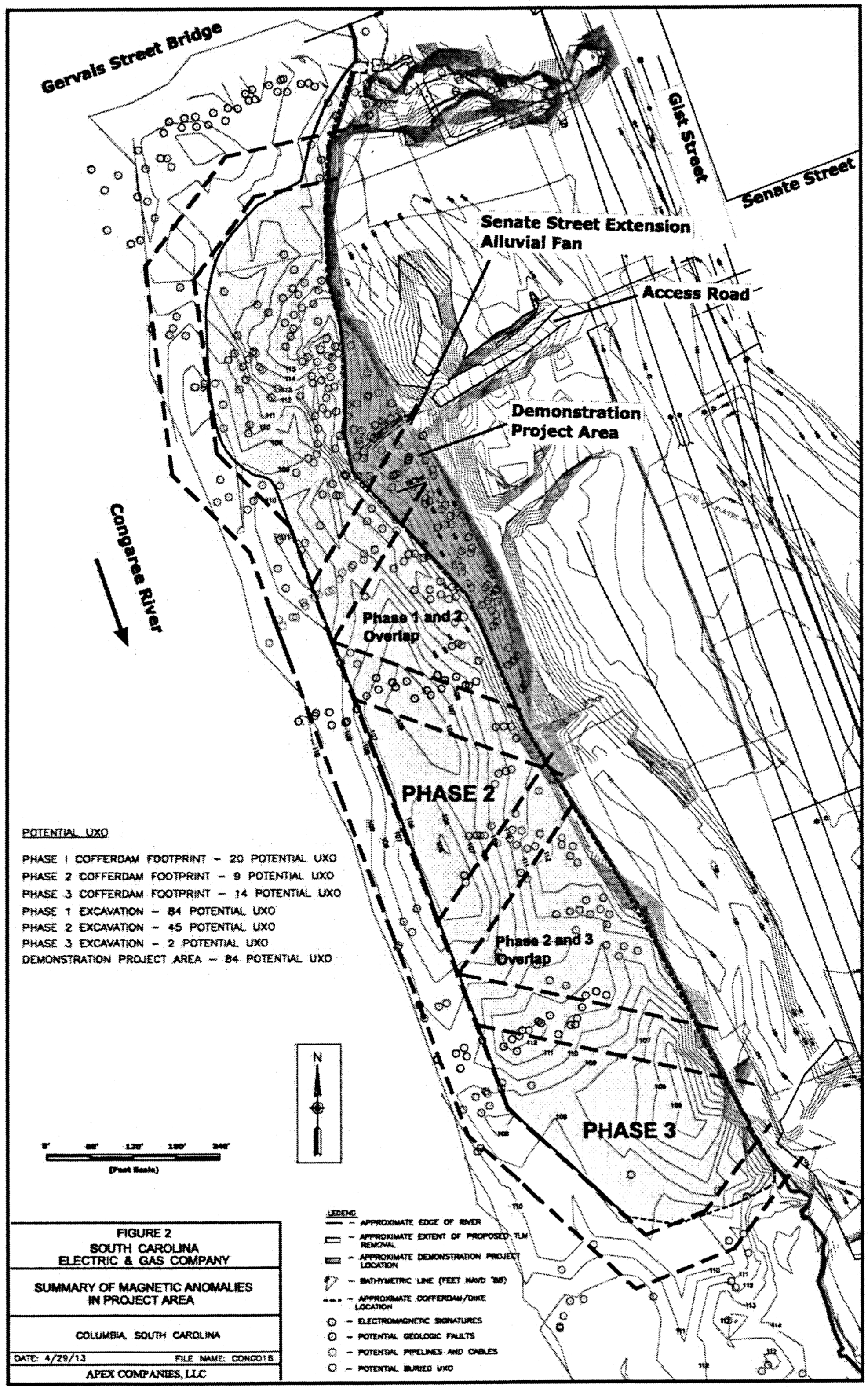


Figure 2. Recovery phase plan map.

than May and need to end by October of each year. Because of this, and the amount of material to be removed, it is projected that multiple construction seasons or phases will be required. Once each construction phase is completed the river bottom would be restored to its approximate original conditions by the placement of imported fill sand or rock as may be required and the cofferdam would be removed, potentially to be reused as fill or erosion protection.

ARCHAEOLOGICAL SIGNIFICANCE

On February 17, 1865 General Sherman's troops captured Columbia. During the two day occupation, live munitions and other weapons of war housed at the Palmetto Armory were dumped into the Congaree River near the Gervais Street Bridge. According to Civil War Records:

> *A detail of 500 men each from the First and Second Brigades, properly officered for fatigue duty, together with the pioneer corps and fifty wagons, reported to Captain Buel, chief ordnance officer, to destroy public works, machinery, ordnance, ordnance stores, and ammunition, of which there were large quantities.*
>
> *General John. E. Smith*

According to General Smith it took 1200 men and 50 wagons from 1 P.M. February 18 to 6 P.M. February 19 to destroy the machinery, ordnance, ordnance stores and ammunition. Figure 3 provides a list of the ordnance captured.

Soon after Union troops departed Columbia ordnance recovery began. The accounts of J. F. Williams indicated that industrious citizens of Columbia were quick to salvage powder from the boxes of paper cartridges that had been left on the bank and for years after the war people would dive into the river and recover cannon balls and shells (Williams 1929).

Newspaper articles dating to the 1930s and more formal recovery attempts conducted in the 1970s and 1980s provide supporting evidence that Civil War ordnance is still present in the river. In June 1930, *The State* reported that two fishermen recovered ammunition from the area of a small tributary near the base of the Gervais Street Bridge. The discovery motivated New Brookland Mayor L. Hall and Councilman D. A. Spigner to organize a project to recover the artifacts. Their recovery was extensive and labor intensive. A coffer dam was erected approximately where Senate Street terminates at the river. After digging through the mud and silt the project collected six 10-inch cannonballs, 1,010 round rifle balls, 767 pointed rifle balls, a number of cast-iron copper fused explosive cannon shells; and cast iron lead butt explosive shells; three cast-iron cannon balls; one brass cap explosive, 11 3½-inch round cannon balls, 51 2-inch cannon balls; 2 6-inch cannon balls; 3 3½-inch time fuse explosive bombs; and an artillery axe (*The State* 1930). According to the article Hall and Spigner believed they had recovered practically all the ammunition that was deposited in the river. Based on the inventory presented in Figure 3, however, the 1930s recovery accounts for only a fraction of what may be present.

Eight years after the Hall and Spigner conducted their recovery, the *Spartanburg Herald* reported that two New Brookland high school boys found an artillery projectile in the Congaree River. The boys, Luther J. Morris and Knowiton Jeffcoat, apparently attempted to melt lead out of the round causing a minor explosion that brought the find to the attention of New Brookland authorities (*The Spartanburg Herald* 1938).

Beginning in the 1970s a number of formal recovery and salvage projects have been conducted at the sites. A majority of these projects have been conducted with licenses provided by the South Carolina Institute of Archaeology and Anthropology (SCIAA) under the Underwater Antiquities Act, providing a precedent for conducting the currently proposed project under a similar Salvage License. In the winter of 1976 an acoustic survey in the Congaree River below the Gervais Street Bridge was conducted to identify concentrations of ordnance and artifacts. Although conditions were not ideally suited for an acoustic survey the project identified a concentration of ferrous material below the Gervais Street Bridge (Finkelstein 1976).

Inventory of ordnance and ordnance stores captured in Columbia, S. C., February 17, 1865.

Ball cartridges (no caps)		1,200,000
Percussion caps		100,000
Powder	pounds	26,150
12-pounder gun ammunition, fixed	rounds	1,007
6-pounder gun ammunition, fixed	do	3,852
24-pounder gun ammunition, fixed	do	546
8-inch shot and shell	do	2,364
10-inch shot and shell	do	1,320
Stands of arms		10,410
Unfinished arms		6,000
6-pounder guns		14
James guns		2
12-pounder mountain howitzers		6
Blakely guns		4
18-pounder rifled guns		3
Wiard gun		1
3-inch rifle		1
10-pounder guns		2
4-inch gun		1
4-inch mortars		2
6-inch Coehorn		1
Bronze guns, caliber 1¼ and 2 inches		4
4-inch gun, smooth-bore		1
10-pounder Parrotts		2
Repeating battery		1
Gun carriages		9
Gun caissons		14
Gun (mountain howitzer) caissons		3
Forges		2
Anvils		4
Blacksmiths' vises		20
Sponges and rammers		1,125
Sabers, cavalry, artillery, and naval		3,100
Saber knots		700
Pairs cavalry pistol holsters		300
Saber belts		800
Bayonet scabbards		4,000
Cartridge-boxes (infantry)		5,150
Cartridge-box plates		3,500
Cartridge-box belts and plates		2,500
Waist-belts		2,900
Waist-belt plates		3,000
Ball screws		2,000
Pistol cartridge-boxes		550
Gunners' shot-pouches		600
Knapsacks		1,100
Haversacks		900
Slow match	yards	500
10-inch fuses		900
Tents		58

PHILIP MacCAHILL,
Lieut. and Actg. Ordnance Officer, First Div., Fifteenth Army Corps.

Figure 3. Inventory of ordnance caputured during the occupation of of Columbia.

Under a salvage license issued in 1980, diver Gerald Mahle discovered a cache of 10-inch cannon balls at the site. Mahle and his team estimated that 50 to 100 additional shot lay in the river. However, by the time they were able to return to the river divers associated with the Savannah River Dive Club in Hampton, South Carolina had removed the ordnance (Salvage License No. 26 file SCIAA).

Mahle continued work under the SCIAA permit from February through September 1981. Using a dragline, a backhoe and a gold dredge, Mahle and his team removed and screened sediment from the river bed and apparently the alluvial fan near the foot of Senate Street. Fieldwork resumed in August 1981 using the backhoe for excavation. The project recovered numerous Civil War artifacts including a 3.5-inch shell, a 24-pound cannonball, two 10-inch shells and a post-Civil War projectile. Apparently the work did not produce sufficient material to justify continuation of the project (Salvage License No. 26 file SCIAA).

In 1983 a SCIAA Salvage License was issued for a metal detecting survey in the Congaree immediately south of the Gervais Street Bridge. Recovered artifacts associated with the Armory consist of 12 explosive shot for a 6-pounder cannon and one explosive shot for a 4-pounder (Salvage License No. 30 file SCIAA).Since the 1980s there are anecdotal reports of Civil War related artifacts being discovered in the river and on the alluvial fan at the terminus of Senate Street but there have been no additional formal recoveries. The site was designated 38RD286.

Based on this information, there is sufficient documentary and formal survey evidence to establish the continuing presence of ordnance in this section of the river. With this in mind a series of magnetometer and side scan sonar surveys were conducted in advance of the Congaree River Sediment Clean-up project to determine the possible extent of ordnance within the contaminated area.

Over a period of 18 months, from 2010 to 2012, Tidewater Atlantic Research, Inc. conducted remote sensing surveys within the course of the river and on the eastern bank (Tidewater Atlantic Research 2010, 2011a, 2011b, 2012). The first phase of this work focused on the area from the Gervais Street to approximately 1500 feet downstream. The magnetometer survey identified 218 anomalies that were consistent with unexploded ordnance (UXO). Phase II of the survey began where Phase I ended and extended another 400 feet downstream. Ten anomalies that could be could represent UXO were identified in this phase. Phase III of the survey focused on the area from Unnamed Tributary 2 (as seen in figure 1) to just south of the Blossom Street Bridge. One hundred and twenty-two hits consistent with potential ordnance were recorded in this phase. Phase IV was the continuation of a terrestrial metal detector survey along the river bank and alluvial fan at the end of Senate Street. An additional 67 potential instances of UXO were recorded along the shoreline. Attachment A provides a summary of magnetic anomaly survey along with a map detailing the precise locations of the possible UXO.

SCOPE OF WORK

The following Scope of Work outlines our approach to artifact recovery and conservation at the Congaree River Project. The design will outline the goals of the salvage project followed by a detailed methodology for three stages of artifact recovery. Laboratory and artifact conservation methods will be outlined and initial plans for project deliverables, public outreach and the final disposition of the artifacts will be discussed.

PROJECT GOALS

Historic documents, previous salvage projects and intensive remote sensing surveys have confirmed the presence of artifacts related to the burning of Columbia and destruction of the stores at the State Armory in 1865. This previous work has also established that ordnance in the river may not possess locational or depositional integrity. In other words, the location of the artifacts may not be able to provide any pertinent or useful information as allowing interpretation of intra and inter-site feature patterns or depositional positioning however, grid recovery and unexploded ordnance recovery will provide information on depositional positioning. The main goal and value of this project is the recovery of the artifacts and their final inventory and analysis. Secondary goals will be to document the TLM as a man-made artifact and address the events that led to its deposition in the river, and make a formal evaluation of Site 38RD278, an underwater resource that is also within the project boundaries. The Congaree River Sediment Removal Project is designed in such a way as to remove the sediment down to bed rock. That material will then be deposited in a landfill. Recognizing the presence of artifacts invaluable to the history of South Carolina and the nation, recovering them has become a priority to SCANA. Because of the lack of depositional integrity and the nature of the remediation project, the recovery of artifacts will focus on salvage and collection of as many artifacts as possible rather than the collection of traditional archaeological data.

In addition to satisfying salvage objectives and essential rescue of artifacts that would otherwise be confined to a landfill, it is expected that the cataloging of the ordnance will provide substantive contributions to the archaeology of the Civil War. Archaeological inquiry applied to this collection will not only corroborate or refute the historical record but ideally also provide what Smith (1994) describes as the relevant facts upon which to build the discipline of Civil War archaeology. This is vital in defining history because historical records are often confusing, disorganized, contradictory, incomplete, and biased (Smith 1994). For example in Sherman's memoirs he mentions that the ordnance from the Columbia Armory:

> *...were hauled in wagons to the Saluda River, under the supervision of Colonel Baylor, chief of ordnance, and emptied into deep water, causing a very serious accident by the bursting of a percussion-shell, as it struck another on the margin of the water. The flame followed back a train of powder which had sifted out, reached the wagons, still partially loaded, and exploded them, killing sixteen men and destroying several wagons and teams of mules.* (Sherman 2006: 443)

We know from other historic documents that it was the Congaree River and that one commissioned officer (Captain William Davis, whose tombstone stands in Florence National Cemetery, Florence, SC) and three enlisted men (Jesse Johnson, James Kilpatrick and Coleman Wright) were killed by the explosion. By drawing on both the historical record and archaeological evidence a more informed account of the past will established. Consequently, the data gathered during each phase of this project will be used as far as possible to address research questions specific to this site as well as pertinent to Civil War archaeology in general. These include the following topics:

- A comparison of the reported inventories and the collected material;
    - The 1930 salvage inventory lists an "artillery axe", which is presumably a pick axe or axe carried by a caisson. No axes are listed in the official Civil War inventories. Are there items in the river that were not identified in the historic inventories?
- Identification of different styles and types of ordnance and ammunition;
    - During the Civil War more varieties of artillery were used than in another conflict in history. Can it be determined if the ammunition present was created at the Columbia Armory?
    - Are there shells and munitions present that were shipped to Columbia during this latter stage of the war from other armories?

    - Can an evolution or time line of ordnance types be identified?
    - Are there shells from the beginning of the war as well as well as more technologically advanced material from later in the war?
- Identification of military rank or distinction between the quality of side arms, personal weaponry and miscellaneous items that may be deposited in the river;
    - At the start of the war high quality French and British arms and armaments were purchased and utilized by officers. Are examples of these weapons present?
    - Were higher quality items appropriated and distributed to Union troops during the initial destruction of the State Armory or were all items deposited in the river?
    - Reports indicate that muskets and sabers were destroyed at the site of the Armory itself. Might any of these destroyed weapons have made it to the wagons that were depositing material in the river?
    - A number of side arms and weapons were present at the Citadel Arsenal Academy and listed on some inventories of the captured and destroyed items from Columbia. Did any of these items make it into the river and can it be determined if they were cadet issued items?

FIELD METHODS

Based on previous archaeological work conducted at manufactured gas plants (e.g., Cherau and Bannister 2006; Stratton et al. 2004; Warren et al. 2002) and consultation with SCANA on the nature of the project the following recovery plan for this unique project is proposed. Artifact recovery will take place in three different locations pending the disposition of the material: *in situ*, within enclosed structures, and in an off-site location. The flow chart presented in Figure 4 provides a guide to how artifacts will be identified and recovered at various locations during the course of the project. Generally speaking 100% of the project area will be assessed by pedestrian survey and remote sensing equipment including, but not necessarily limited to, metal detectors and magnetometers during the *in situ* ordnance removal phase. All sediment removed from the project area will be evaluated as to its level of TLM contamination. Sediment determined to be lightly impacted or "clean" will be sent to a screening facility for sorting and artifact recovery. Sediment determined to be too viscous to effectively screen will be sent to an off-site location where it will be spread out in thin layers and subject to visual inspection and/or metal detecting to facilitate artifact recovery. It is expected that reviewers and monitors from SCIAA and SHPO will periodically visit the recovery operations and provide feedback on the recovery methods.

Details for artifact recovery for each of these stages follow.

In Situ Ordnance Removal/Geophysical Survey

During each phase of the sediment removal project the area to be removed will be divided into 50 foot by 50 foot grid squares. Removing the soil in units of this size accomplishes three goals. It provides an organized system that expedites the removal of contaminated soil. It also provides a system to easily identify the boundaries for UXO clearance, and provides additional provenience for use in assessing the distribution of the artifacts.

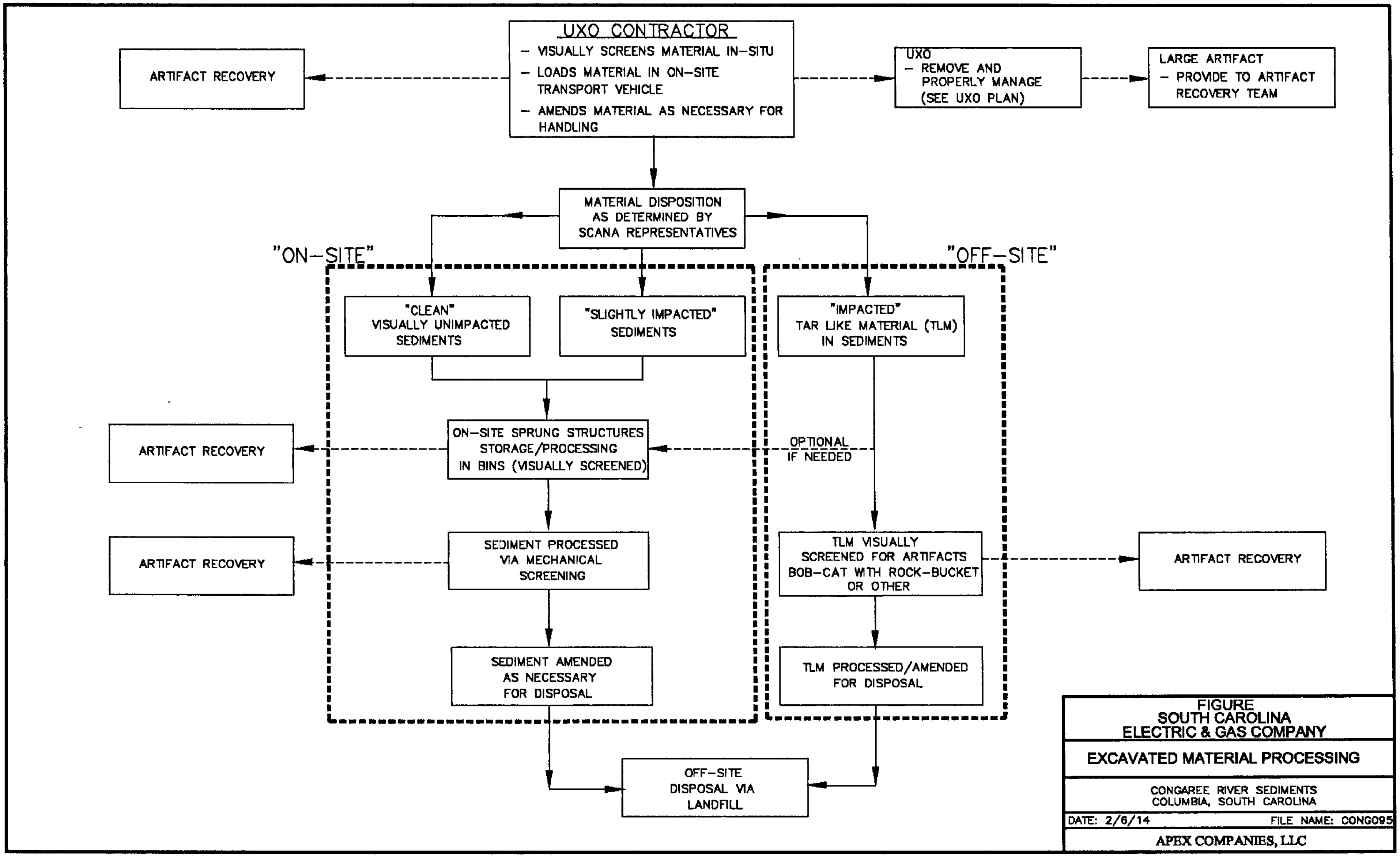


Figure 4. Process for recovering artifacts during sediment removal.

The overarching goal of the project is the timely removal of the contaminated soil rather than the recovery of the artifacts themselves. As stated earlier the material in the river possesses no depositional context. Locational information for the artifacts will not result in the identification of any patterns or organizational system that can be applied to any other Civil War site or archaeological context. Given these facts, the 50 foot by 50 foot system constitutes a practical grid size that will facilitate recovery and processing of the materials and artifacts, and is believed to be the minimum grid size possible for the time constraints required by the sediment removal. The grid size along with the locational data attained during the magnetometer survey will provide acceptable locational information of larger artifacts. Smaller artifacts will have been displaced by river currents, the actual disposal into the river and modern day activities.

The final plan for removal of UXO will be determined by the UXO contractor, in consultation with TRC and TRC's subcontractor James Legg. It is believed the plan will generally follow the guidelines and procedures outlined in *Handbook on the Management of Munitions Response Actions* (EPA 2005) and *EPA Munitions Response Guidelines OWSER Directive 9200.1-101* (EPA 2010) for UXO recovery in areas other than operational ranges. Site specific modifications to these guidelines will be generated due to the historic nature of the potential UXO and the conditions of the project area.

In the first step of the *in situ* recovery nonintrusive geophysical detection technologies will be deployed to locate surface and subsurface anomalies that may be UXO. Distinguishing the ordnance from modern material and other non-ordnance materials based solely on the geophysical signature will be a challenge and will likely require continual adjustments in equipment and procedures throughout the recovery. It is presumed that each 50 foot by 50 foot grid square will be subdivided into lanes in order to facilitate and coordinate the geophysical survey. It is likely that a combination of technologies will then be utilized to evaluate each lane. Magnetometers will be used to detect subsurface ferrous anomalies. The amount of river rock containing ferrous inclusions may cause false positives with this type of sensor. Electromagnetic Induction (EMI) sensors will use electric currents to identify both ferrous and non-ferrous ordnance. Ground Penetrating Radar (GPR) does not appear to be a viable option based on an initial evaluation of the conditions at the site, however, the option is available should the UXO contractor deem it appropriate.

A positioning system will likely be employed to map the location of anomalies based on the geophysical readings. This map will provide data on the anomalies that can be processed by the UXO contractor. They UXO contractor will determine if an anomaly meets the minimum threshold for potential ordnance. The map produced during this phase can be compared to and combined with the results of the underwater magnetometer survey to provide additional locational information of artifacts.

Once identified, the potential UXO will be recovered. A combination of mechanized, manual, and possibly remote control recovery techniques will be employed in order to recover the items. Excavators or front end loaders will be used to remove the surrounding soil matrix from large or deeply buried UXO. Shovels and other hand tools will be utilized for the final clearing of deeply buried UXO once a sufficient level is reached, and for surface or near surface finds. Once an item is uncovered it will be visually assessed to determine they type of ordnance, whether it is inert and can safely be removed for on-site processing, whether it is live (fused or unfused) and if so whether it can be safely removed for off-site detonation or whether on-site demolition will be

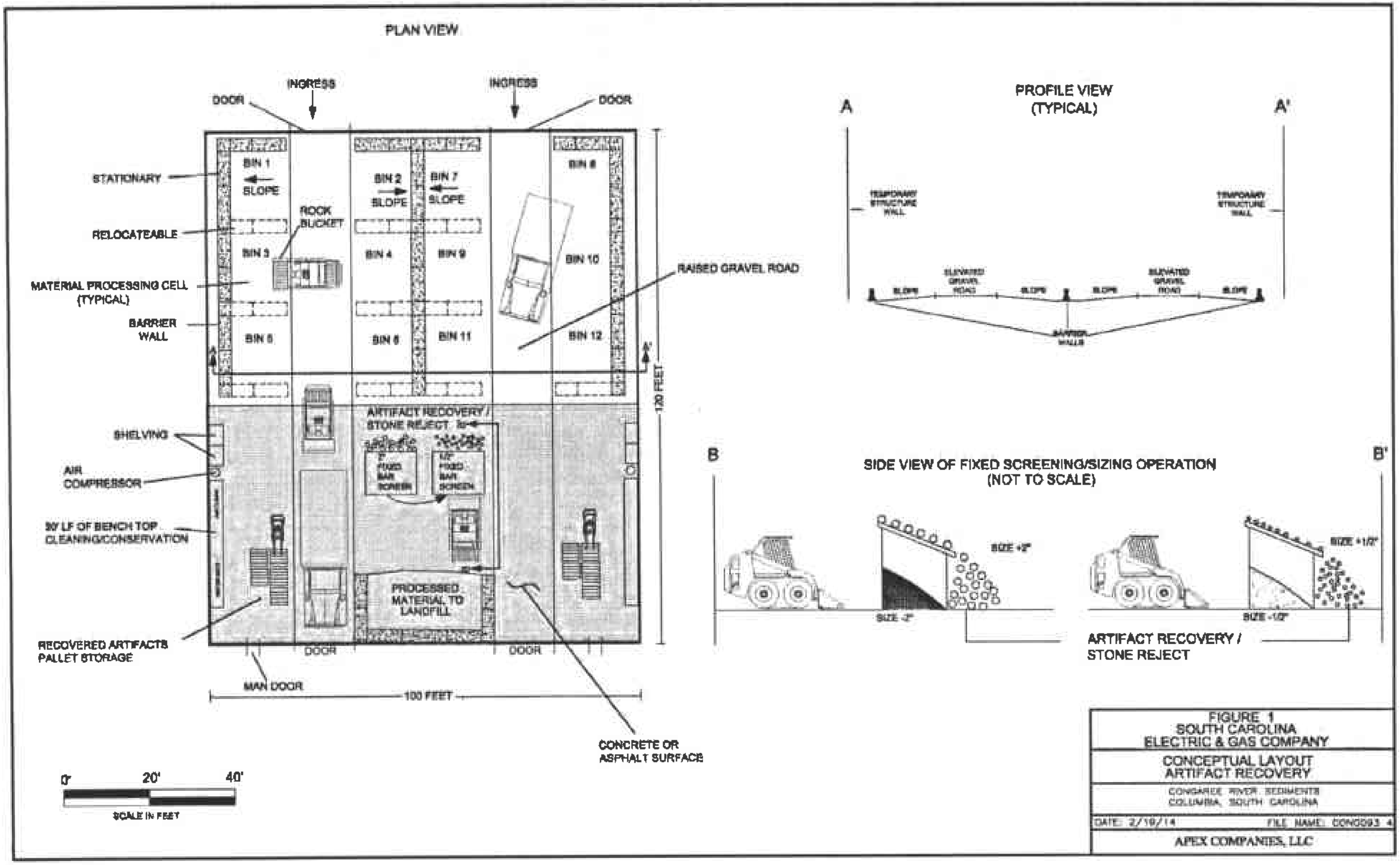


Figure 5. Artifact processing facility.

Material that falls through the tines of the rock bucket will be subject to a second sort through a narrower gauge 2-inch bar sorter (Figure 7) similar to those used to sort rock and gravel. Material that does not fall through the bars will be visually examined. This sort is designed to recover items smaller ordnance and items or fragments of items that may have been broken up prior to disposal in the river (sabers, rifles, side arms, tools, buckles). The castoff material will be place in roll-off containers for disposal.

Figure 7. Example of a bar sorter

The remaining material will be taken to a screening and sorting station. This final stage of on-site recovery will be designed to recover the smaller artifacts. The soil will be sifted through various methods depending on the nature of the material and amount of time available for recovery. Options include ½-inch or ¼-inch mesh screens set up on sawhorses where the sediment can be manually screened. Water screening stations over shop sinks and standard archaeological shaker screens are also options. Artifacts recovered at the on-site processing facility will be bagged and labeled according to grid square and any other pertinent provenience.

With this final station up to 100% of the soil capable of falling through a screen will be screened. Due to time constraints and the throughput requirements of the project, however, circumstances may arise where it may not be feasible to screen all the "clean" sediment from a particular grid square. Therefore it is proposed that a minimum of 50% of the "clean" sediment removed from each grid square will be screened. Every effort will be made to screen 100% of this material, but if that fails, it is believed that recovery from 50% of this soil along with the *in situ* recovery will provide a viable study sample.

Off-Site Recovery

The viscous nature of the TLM in the river requires a creative solution to artifact recovery. Above a certain threshold of TLM in the sediment screening will result in clogged mesh, soil consolidating into large tar balls and ineffectual artifact recovery. For this reason, sediment that is determined to contain too much TLM will be sent to an off-site location, tentatively identified as the landfill where the contaminated material will be disposed of, and examined. Examination will take place visually and through geophysical methods.

When it arrives at the off-site facility the soil will once again be stored according to grid location. An area measuring up to 50 feet by 50 feet (final dimensions will depend on the amount of open land available) will be covered with heavy, industrial plastic sheeting. A backhoe will be used to spread the sediment from a selected grid square in a thin layer, up to 2 inches thick, on the sheeting. Five foot wide lanes will be established across the examination area. A crew of archaeological field technicians will then walk the lanes and make a visual survey of the sediment collecting artifacts as they are encountered.

In the early stages of the recovery process a metal detector will be employed on every other lane. A comparison will be made of the amount and type of artifacts recovered from the metal detected lanes and the visually inspected lanes. If there is a large discrepancy the method found to recover the most artifacts will be employed throughout the remainder of the project. If there is no discernable difference the method found to be the most effective use of time and personnel will be the procedure of choice for the project.

Artifacts recovered from this facility will be more contaminated. They will be safely bagged, labeled and stored until they can be effectively cleaned and conserved.

Recovery Conclusions

The complex nature of this project must be recognized. Not only will conditions change during each proposed field session, but they have the potential to change on a weekly and daily basis. The characteristics of the coal-tar plume vary along the 2,000-foot length of the project area. The amount of TLM will vary from little to nearly 100% tar. It is because of this that different recovery strategies were developed.

The plan is designed to maximize the amount of sediment examined and minimize the time in which that examination takes place. If reported inventories are correct nearly 1.5 million items were potentially discarded into the river over a two day period. Official recovery projects account for around 2000 of those artifacts. Unofficial recoveries dating back to the Civil War have likely accounted for thousands if not tens of thousands more. That only accounts for a fraction of the potential material that may be present. The proposed recovery plan is focused heavily on recovering the larger artifacts that may be present. The Minié balls, round shot and percussion caps that account for much of the inventory will be collected to the extent possible. It is felt that if they are still present a fairly large representative sample of these smaller items will be recovered from ½-inch screening and visual examination. Similarly, artifacts not related to the Civil War and of a smaller size, including prehistoric tools and projectiles, prehistoric ceramics, and historic artifacts dating from the populating of Columbia to the early twentieth century, will be collected with the proposed strategy. While these artifacts are not the primary focus of the salvage every effort will be made to recover significant diagnostic material.

ARTIFACT ANALYSIS AND CONSERVATION

Civil War documents indicate that artifacts recovered during this project may include lead ammunition, rifle barrels and wood stocks, percussion caps, sabers and cutlasses, artillery shells, cannons, scabbards, and munitions containers. Other artifacts may be present in addition to the military artifacts. There are a number of sites adjacent to the project area, including a 19th century saw mill and a possible ferry crossing (Figure 8). Likewise, prehistoric Native American artifacts have been recorded as being present on the shoreline adjacent to the project area. Artifacts from these sites may have eroded or been deposited into the river and may be present in the project area as well; the condition of potential artifacts from these sites is unknown.

The Artifact Analysis and Conservation Plan has been designed to accommodate this broad range of materials. The laboratory operations from the time a specimen is delivered to its ultimate place of storage or exhibition can be separated into five basic stages:

1. Initial documentation.
2. Storage prior to conservation process.
3. Encrustation removal.
4. Analysis.
5. Curation.

Initial Documentation

As an artifact is recovered, it will be bagged, labeled and recorded on the site log sheet documenting its associated unique provenience number (grid square). In this manner the recovered material can be roughly tracked and artifact density information by proveniences can be monitored. Inert and defused materials recovered during the in situ/ordnance removal phase will be similarly bagged and labeled according to grid square and UXO identifiers. Blow-in-place ordnance and live ordnance transported off-site for detonation will be photographed and measured in place (as safety allows) and assigned a specific inventory number.

At this stage artifacts may be lightly washed or dry brushed to remove excess sediment and TLM. Based on information provided by SCANA, some artifacts may be entirely encased in TLM. The time and effort needed to clean and conserve these artifacts may be cost prohibitive. Depending on the information collected as the project goes on, it may be appropriate to propose sorting criteria based on the amount of tar affecting an artifact and the type of artifact as part of the conservation plan. For example if thousands of rounds of ammunition are recovered and found to be entirely encased in TLM an initial cleaning might remove as much material as possible, the lab crew would add the artifact type, quantities, and description to the field excavation forms and the items (or a percentage of the items) would be discarded. The details of a triage procedure such as this will be determined through consultation with SCANA and SCIAA personnel.

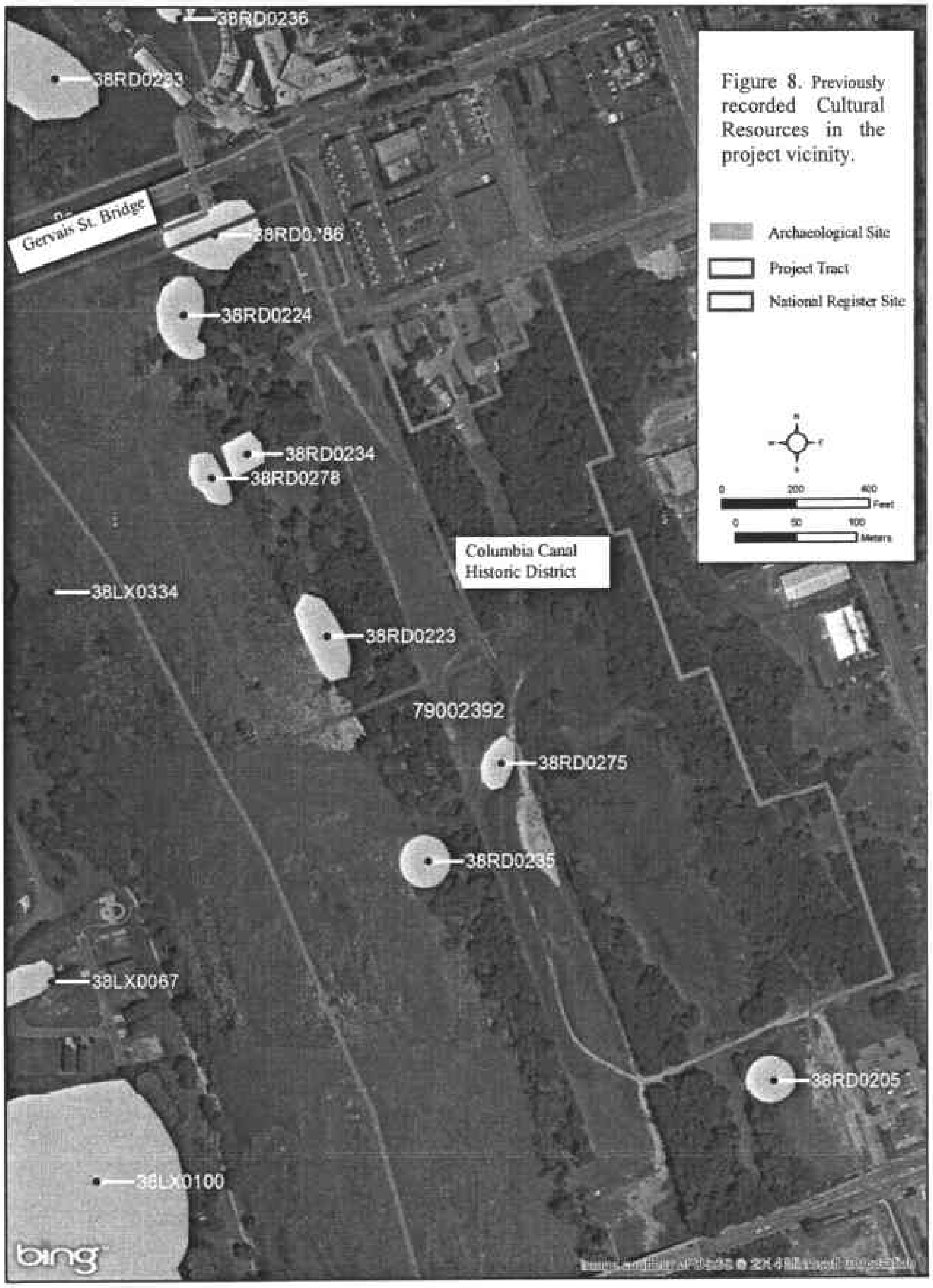


Figure 8. Previously recorded Cultural Resources in the project vicinity.

Storage Prior to Treatment

Removal of TLM will take place at this stage. In order to remove potentially hazardous contaminants artifacts will be lightly brushed and bathed in a solution of BioSolve. This is a water-based, biodegradable formulation of surfactants and performance additives. It is used in soil remediation projects and been found to be effective in cleaning oily residue and TLM from heavy equipment used in MGP remediation projects. This process will likely take place in TRC's Treatability Lab in Greenville, SC or in a designated area at the on-site processing facility where contaminants can be disposed of with the overburden.

Once the TLM has been removed the artifacts will be stored and conserved according to methods outlined in *Methods of Conserving Archaeological Material from Underwater Sites* (Hamilton 1999). Due to the potential volume of artifacts it is anticipated that some materials may need to be stored for a time before they can be properly cleaned and conserved. As part of this storage stage any adhering encrustation or corrosion layers will largely be left intact until the objects are treated, since they form a protective coating which retards further corrosion. Therefore all metal objects determined to be suitable for analysis will initially be kept in tap water with an inhibitor added to prevent further corrosion. For long-term storage, an oxidizing solution of potassium dichromate and sodium hydroxide or an alkaline inhibitive solution may be used (Hamilton 1999).

Encrustation Removal/Conservation

For most metal items, this will consist of thorough reduction in electrolysis, alternating with manual cleaning. After the rust has been removed, the artifact will be boiled in distilled water to remove salts, and then dried. The artifacts will finally be sealed with microcrystalline wax. Non-ferrous or fragile items may be treated by boiling in distilled water, drying, and sealing. Below are more details of possible cleaning and conservation methods based on expected material types.

<u>IRON/FERROUS OBJECTS</u>
Iron artifacts will be stored in an aqueous solution until they are subject to electrolysis. Electrolysis will take place in tanks specially equipped with a battery charger and a copper pipe; alligator clips are used to suspend the artifacts in a solution of tap water and sodium bicarbonate. A low voltage electric current is passed through the tank, removing the rust from the artifacts. Electrolysis is continued in the tap water electrolyte until the chloride level of the electrolyte approximates the level found in the tap water. The artifacts will remain in the tanks for as long as it takes to remove all rust.

The artifact is then rinsed thoroughly in several changes of alternate boiling and cold de-ionized water to remove any residuum. The artifact will be submerged in the last vat of rinse water for a minimum of 24 hours. After rinsing, the moisture absorbed by the artifact must be removed before any sealant is applied. The artifact may be baked or if exposure to air is found to cause too much oxidation the object may be submerged in water-free isopropanol to dehydrate for a minimum of 24 hours. It may also be expedient to eliminate the drying process altogether and simply towel off the artifacts before dipping them in microcrystalline wax (Hamilton 1999). If larger object such as cannons are recovered a wax sealant may not be feasible. In such a case coats of polyurethane or Rustoleum may be appropriate.

LEAD

A majority of the artifacts recovered will presumably be made of lead. Lead will initially be stored in a tap water and sodium sesquicarbonate solution. In the case of lead artifacts, use of electrolysis is minimal. The lead will be immersed in 10 percent hydrochloric acid, which will remove any adhering marine encrustation, along with lead carbonates, lead monoxide, lead sulfide, calcium carbonate, and ferric oxide. This will be followed by a rinsing and gentle removal of adhering materials. Lead objects will be allowed to dry and finally sealed with microcrystalline wax.

COPPER, BRONZE AND BRASS

Artifacts made of copper and its alloys will be subject to the same electrolysis procedures as described for iron. The main variations in treatment involve the fact that the duration of electrolysis for cupreous objects is significantly shorter than that for comparable iron objects. Small cupreous artifacts, such as coins, require only a couple of hours in electrolysis (Hamilton 1999). Following electrolytic cleaning, the artifacts will be put through a series of hot rinses in de-ionized water until the pH of the last rinse bath is neutral. Because copper tarnishes in water, a wet paste of sodium bicarbonate may be used as polish. After polishing, a coat of benzotriazole (BTA), commercially known as KrylonClear Acrylic Spray will be applied._

WOOD

Waterlogged wood artifacts in the form of gun stocks, pistol butts or wagon/caisson wheels or parts may be recovered. Wood artifacts will be assessed as to their preservation potential and either discarded after being documented or submerged to await conservation. If wood is to be conserved it will be done with the Polyethylene glycol (PEG) method. This process simultaneously removes water from the object while also strengthening and consolidating the wood. The procedure is simple but time consuming. The wood artifact is placed in a solution of PEG and water or alcohol where it is allowed to sit. Over a period of months or years (depending on the size of the artifact) the PEG level is gradually raised until the solution consists of at least 70% PEG. At this level wood will remain stable and no further treatment of the wood should be necessary.

CERAMICS, STONE AND GLASS

Ceramic artifacts, stone tools or projectiles and glass objects that have been submerged in water do not typically require special treatment. Glazed and hard fired historic ceramics such as stoneware and porcelain are impervious to water. Low fired earthenware and prehistoric ceramics may encounter some erosion but will remain structurally solid. Glass and lithic material may become discolored be will largely remain unaffected. Rinsing with tap water and light brushing to remove excess sediment is typically all that will be required. A mild detergent may be used in an attempt to remove deep stains. Care will be taken not to remove paint or surface treatments. The artifacts will then be allowed to air dry on rack. Reconstruction or re-fitting of vessel or container fragments may be attempted using proper fixatives. No sealant is required.

LEATHER

Leather conservation will follow the same procedures as detailed for ceramic items. Rinsing with tap water and light brushing to remove ingrained soil is typically all that will be required. If leather is waterlogged it can be subject to the same PEG treatment as wood. Treating leather with PEG will generally take less time than wood.

Analysis

Artifacts will be separated into functional groups that are then subdivided by use category and object type. The artifact pattern model, as devised by South (1977) and revised by Garrow (1982) is the basic formatting procedure for all artifacts. This model offers a rational approach for the organization of artifacts on a provenience to provenience level, or all the way up to total site contents. This system also allows for analytical modifications when collections of a specialized nature are recovered and was used to generate the functional categories outlined above for the Civil War artifacts.

This system will consolidate large quantities of like artifacts under descriptive headings and facilitate interpretation. A final and compelling reason to use the artifact pattern model is that it provides a good format within which to present the contents of the site, and can lead to cross-comparisons with other sites formatted in that manner. Functional groups, categories and sub-categories will consist of:

- Arms
    - Artillery
        - Cannons
        - Howitzer/Mortar
        - Ordnance - Fixed
            - Shot (24-pounder, 12-pounder, 6-pounder)
            - Case (24-pounder, 12-pounder, 6-pounder)
            - Fuse (24-pounder, 12-pounder, 6-pounder)
            - Grape (24-pounder, 12-pounder, 6-pounder)
            - Canister (24-pounder, 12-pounder, 6-pounder)
        - Ordnance – Not Fixed
            - Shot (10 inch, 8 inch)
            - Shell (10 inch, 8 inch)
        - Artillery Accoutrements
            - Carriages and parts
            - Caissons and parts
            - Tools
            - Fuses
    - Firearms
        - Small Arms (pistols, pistol parts)
            - Small Arms Ammunition (shot)
            - Small Arms Accoutrements (holsters, belts, cartridge boxes, tools)
        - Long Arms (muskets, rifles, parts)
            - Long Arms Ammunition (shot, Minié balls)
            - Long Arms Accoutrements
    - Edged Weapons
        - Sabers
            - Cavalry
            - Artillery
            - Naval
        - Bayonets

        - Cavalry
    - Edged Weapon Accoutrements
        - Saber knots
        - Saber scabbards
        - Bayonet scabbards

- Clothing
    - Button
    - Buckles
    - Insignias/Pins
    - Knapsacks
    - Haversacks
    - Other

- Tools
    - Anvil
    - Forge
    - Vise
    - Other

- Personal – Civil War
    - Jewelry
    - Writing
    - Food storage, preparation and consumption
    - Indulgence (alcohol and tobacco related items)
    - Medicine

Information recorded during the analysis of the Civil War related artifacts will vary depending on what objects are recovered. It is anticipated that a majority of artifacts recovered will be lead shot. These will be and measured, perpendicular to the ball's mold seam, for diameter (*not caliber*) to 1000ths of an inch. The catalog description will include a conclusion regarding each shot's function based on its diameter or former diameter as implied by weight. Shot and shell will similarly be measured and weighed. Distinguishing characteristics that denote armory or metalworks of origin, and when possible range of manufacture, will be noted and photographed. Guns and fire arm parts as well as saber parts will be identified, photographed and cataloged.

Clothing items will be weighed and measured. Photographs will be taken. Detailed photographs of insignias or devises apparent on the durable clothing items will be documented and attempts will be made to identify insignias by military unit. Since their presence in the river is not necessarily documented and their recovery is not anticipated we are collapsing some material culture categories outlined by Legg and Smith (1989) into the single category of Personal Items. These items are items that would be in the possession of an individual soldier.

Historic artifacts will be analyzed by functional groups according to the procedures outlined in South (1977). Historic ceramic artifacts will be classified according to recognized types (e.g., pearlware, ironstone), and by decorative technique (e.g., hand-painted, transfer print, decal) and vessel form. Bottles are described by type, color, size, and closure type. Where possible, standard references such as Miller (2000), Noel Hume (1970), Jones and Sullivan (1985) and South (1977), as well as more specific published and on-line references for particular artifact types will be used to obtain date ranges for historic ceramics and glass.

The prehistoric artifact analysis will focus on identifying assemblages and/or technological attributes diagnostic of particular temporal and geographical cultural trends. The artifacts will be identified according to established regional types or styles. In the case of projectile points, morphological attributes will be used as typological markers. Ceramics will be typed according to paste, temper, and surface decoration.

The following descriptions define the categories in the lithic artifact typology to be used in the lithic analysis. Lithics refer to stone tools and debris from producing stone tools. The following categories are derived in part from those developed by Blanton et al. (1986) and Garrow (1982), which have been used with excellent success on many projects in South Carolina.

The two major groups of lithics are debitage and functional artifacts. Debitage can be divided into the following categories:

> *Biface Thinning Flakes.* Biface thinning flakes are relatively thin and flat to slightly curved in cross section. Secondary flake scars are frequently present on the dorsal surface. The platform may be faceted and may exhibit a distinct lip, and the bulb of percussion is usually diffuse. These features are characteristic of soft hammer percussion, and the flakes of this type are most often the result of late stage biface reduction and maintenance.
>
> *Blades and Bladelike Flakes.* These flakes approach or exceed a length-to-width ratio of 2:1. Blades and bladelike flakes frequently have a ridge oriented along the dorsal surface. They are typically manufactured for a specific purpose, such as replacing edges in cutting or grating implements.
>
> *Bipolar Flakes.* Bipolar flakes exhibit a bulb of percussion on the ventral surface of both the distal and proximal ends. They are often curved in cross section. These flakes are manufactured by placing the raw material on a hard surface, such as an anvil stone, and striking its superior surface with a hard implement.
>
> *Unspecialized Flakes.* These flakes are relatively thick and wide with little or no indication of having a particular function or representing a specific stage of manufacture.
>
> *Flake Fragment.* This category includes those flakes that have only nondiagnostic medial or distal portions. Any flake lacking a proximal end will be placed in this category.
>
> *Shatter.* Shatter is debitage that is angular and blocky. Specimens in this category cannot be oriented in relation to their proximal or distal end.
>
> Chipping debris also will be subdivided based on the amount of cortex present on the dorsal surface. Classifications are assigned based on whether more than half (>50%), less than half (<50%), or no cortex was present on the dorsal surface. This measure should give an approximate indication of the stage of reduction represented in the assemblage. All lithic artifacts will be identified as to debitage class and raw material.

The second major lithic group is functional artifacts. The categories in this group are defined as follows:

> *Bifaces.* This category comprises artifacts that are bifacially flaked and do not have haft elements. They can be finished tools, projectile points, knives, scrapers, or preforms. Bifaces usually cannot be given an established type name.
>
> *Hafted Bifaces.* Hafted bifaces are bifacially worked artifacts that have a hafting element (i.e., stem and notches). They are often described as projectile points or knives and may conform to established type names.

Cobble Tools. Cobble tools are altered or unaltered cobbles used as hammerstones, nutting stones, anvils, and other similar tools.

Cores. Cores consist of parent raw material and are the remnants of flake manufacture. They can be blocky or discoidal in appearance and exhibit one or more flake scars.

Ground Stone. Artifacts in this category are manufactured by polishing or grinding stone into a desired shape—celts, axes, and manos, for example. These tools are often used in woodworking and food processing.

Manuports. Manuports are unaltered pieces of stone that are not indigenous to the area and obviously have been transported to the site by humans.

Retouched, Used, or Modified (RUM) Flakes The category of RUM flakes includes all flakes that have been retouched into a unifacial tool, exhibit use wear, or have been modified by undetermined means. This category includes scrapers and utilized flakes.

Soapstone. Soapstone is a very soft stone that is easily worked. Artifacts frequently constructed of soapstone include bowls, pipes, and beads.

Fire-Cracked Rock. Although fire-cracked rock is not a tool per se, these are rocks that exhibit evidence of having been in or near a fire due to human activity. Alteration in color and/or luster, angular fractures, and potlidded surfaces are diagnostic of fire-cracked rock.

The analysis of prehistoric sherds will begin with a basic characterization of the entire assemblage. Sherds smaller than 2 × 2 cm will be counted, weighed, and examined to determine the presence of surface treatments or vessel forms that could prove useful in the analysis. If not, they will receive no further analysis. All larger sherds will be classified by surface decoration and aplastic content. The aplastic content will be documented as the type (or raw material) and size of the major aplastics. Size will be determined through comparison with the Wentworth scale, used by most archaeologists to standardize aplastic descriptions. Aplastic size will be recorded as no apparent temper, fine, medium, coarse, and very coarse. Surface decoration will be recorded by type (e.g., incised), and major decorative mode characteristics will be recorded.

The preliminary analysis will allow a characterization of the sherd assemblage. During this initial analysis, sherds will be labeled and pulled for cross-mending, so the subsequent analyses can focus on the vessel assemblage. The surface decoration–aplastic content classes from the preliminary analysis will be compared to published type descriptions; type names will be applied where possible.

Surface decoration, aplastic content, thickness, and interior surface treatment will be considered in cross-mending the sherds. The analysis will seek to reconstruct as many vessels as possible to help determine vessel form and function. The following attributes will be recorded for each vessel to provide a detailed technological description of the wares. They will be examined to determine technological patterns within and between types.

- Type, size, shape, and density of major aplastics
- Type and size of minority aplastics
- Degree of carbon core retention
- Sherd core cross-section configuration
- Thickness 3 cm below rim
- Rim form
- Presence of coil breaks

- Dominant paste color
- Interior surface treatment

Curation

SCANA realizes a disposition agreement with SCIAA regarding the percentage of artifacts to be received is required as part of the application process. SCANA is committed to displaying and making the artifacts recovered from this site available to the public. At the conclusion of the analysis the artifacts will be prepared for curation following accepted guidelines. Copies of all records, including, but not limited to, field notes, maps, catalog sheets, and representative photographs shall be submitted for curation with the artifacts. After project clearance has been obtained, artifacts and relevant notes will be curated in accordance with the selected repository. It has not yet been determined where the material will be curated. It is possible that due to the volume of material expected multiple curation facilities may be needed..

DOCUMENTATION

Daily logs and records will be kept at each artifact processing area during the recovery phase. These logs will be available for review by COE, SHPO and SCIAA personnel during monitoring visits. Interim reports/management summaries will be provided documenting each phase of the remediation project. These management summaries will minimally include maps depicting the area cleared during the related field season, a description of the work completed to date, a preliminary inventory of the artifacts recovered and a status update that will provide detail of the next field season.

At the conclusion of the remediation project a draft technical report will be produced and delivered to review agencies. The report will follow the format and content specified in the *South Carolina Standards and Guidelines for Archaeological Investigations*, including a description of past archaeological research in the project vicinity, a discussion of local history, an explanation of the research design, the field methods employed, evaluation methods, findings, conclusions, and recommendations. TRC will promptly address all comments and revisions provided in writing by SCIAA in a final technical report.

All maps and drawings will be high quality and produced in a professional manner. Project maps will be produced in color using ArcGIS software, CAD or other appropriate mapping programs. These maps will depict each phase of the project and include grid square boundaries. Individual maps of grid squares may be used to identify the locations of ordnance removed during the UXO recovery stages of the project. Overlays of historic maps and plats may be used where appropriate. High quality color photographs or measured drawings, as appropriate, will be provided that show details of representative diagnostic or other interesting artifacts. The report will be bound in a durable cover (minimum 80 lbs cover stock), and contain an identifying label. The paper will be high quality laser printed paper, minimum 24 lbs stock, and will be acid free. Pages will be printed on both sides and project maps and photographs will be produced in color. Electronic copies of the final report in Adobe Portable Document File (PDF) format will be provided to SCIAA and outside reviews as appropriate. In addition a CD or DVD with photographs of the artifacts will be provided if desired.

At the discretion of SCANA a popular report suitable for public distribution may be produced. This report may also be reviewed and commented on by review agencies prior to publication. This report, if produced, will be part of the public outreach program that SCANA is committed to in order to inform and educate the public on this significant find.

PUBLIC INFORMATION

Salvage of the Civil War material deposited in the Congaree River offers an amazing opportunity to educate and involve the public about a historically significant site. The recovery of tangible evidence of the capture of Columbia will take place almost exactly 150 years from when it occurred. There will be multiple opportunities for the general public to benefit from this project. Initial plans call for an on-site structure dedicated to exhibiting the history of the site, the on-going work and the interpretation of the artifacts. This structure will be open to the public and will tentatively be staffed by SCANA personnel and an archaeological docent.

An electronic presentation or social media site suitable for hosting by SCANA or other appropriate website may be created to present the on-going recovery process. Museum quality artifact displays and/or traveling artifact shows at museums throughout the state can be generated. A book/booklet depicting the artifacts and history of the site suitable for presentation to the general public can be authored. Additional public outreach may involve professional papers and presentations at national and regional archaeological conferences, tours and talks for school age children as well as avocational groups is also an option. Some or all of these potential public outreach approaches will be completed as a result of this project.

QUALIFICATIONS

Company Profile

A pioneer in groundbreaking scientific and engineering developments since the 1960s, TRC is a national engineering and consulting firm providing integrated services to the energy, environmental, and infrastructure markets. We serve a broad range of clients in government and industry, implementing complex projects from initial concept to operations. TRC employs over 2,600 technical professionals and support personnel at more than 70 offices throughout the U.S.

TRC's cultural resource group in the Southeast originated as Garrow and Associates, an Atlanta-based small business that was founded in 1983 and acquired by TRC in 1997. We offer a complete range of cultural resource services in the Southeast from our offices in Atlanta, Georgia; Chapel Hill, North Carolina; Columbia, South Carolina; and Nashville, Tennessee; including archaeological investigations, historic structure surveys and evaluations, and cemetery studies. Our local office in Columbia is within a ten-minute drive of the Congaree River Project site. With the Principal Project Manager and Key Project Team members being local to Columbia, we will be able to respond quickly to all SCANA's needs. Our office provides us rapid access to SCIAA, SHPO, the South Carolina Department of Archives and History (SCDAH), the University of South Carolina at Columbia, and other regulatory offices and research facilities. Our organizational depth will allow us to draw on resources from our nearby offices to support this project as needed.

TRC's core cultural resources staff in the Southeast consists of approximately 55 professional archaeologists, crew chiefs, preservation planners, historians, and support personnel. Our archaeologists possess M.A. or Ph.D. degrees in Anthropology, meet the Secretary of the Interior's standards, and are Register of Professional Archaeologists (RPA) certified or eligible.

Our Columbia office contains 2,400 square feet of laboratory, office, and storage space. It possesses wet lab and dry lab capabilities and has ample room to conduct electrolysis and metal conservation operations. TRC's Atlanta facility includes 2,500 square feet of fully equipped laboratory space that includes tanks capable of conserving metal objects up to four feet in length, and the Chapel Hill office has similar lab and storage capabilities. Our Greenville office contains a wet lab and research/treatability laboratories complete with ventilation hoods and resources for preparing and storing solvents for use in cleaning coal tar from artifacts.

Key Personnel

TRC's proposed key staff for the Congaree River Sediment Removal Project includes highly experienced researchers with extensive experience managing and directing large scale projects that require consultation with multi-disciplinary teams as well as state and Federal agencies. Our team also has experience with both complex projects that involve creative approaches to archaeological issues and with Civil War era projects that involve recovery and conservation of artifacts similar to those anticipated for the Congaree River Project.

TRC Columbia Program Manager Sean Norris, M.A., RPA, will serve as Principal Project Manager for the project. Ms. Ramona Grunden, Senior Archaeologist in our Columbia office will serve as the Assistant Project Manager. Both Mr. Norris and Ms. Grunden will be available for rapid deployment to any meetings or consultations required by SCIAA.

Principal Project Manager

Mr. Sean Norris is the Program Manager for Archaeology at the Columbia Office of TRC. He handles administrative duties and manages all projects and contracts that originate in that office. Mr. Norris will serve as Principal Project Manager and will attend meetings with SCANA and other team members, lead the development of the Artifact Recovery/Salvage and Artifact Conservation and Stabilization plans, and act as TRC's point of contact for this project. Mr. Norris has over 15 years of experience in the eastern U.S. and is RPA certified. Mr. Norris has served as Principal Investigator on numerous projects in South Carolina and has experience in project planning, the development and implementation of research designs and field and laboratory methodologies, and technical and popular reporting. Mr. Norris is President of the Council of South Carolina Professional Archaeologists and routinely interacts and sits on committees with employees of SCIAA and the South Carolina SHPO. He has authored Memorandums of Agreement (MOAs) and Memorandums of Understanding (MOUs) as well as Protective Covenants for significant archaeological sites that have included the SHPO, SCDHEC, and the COE as signatories.

Assistant Project Manager

Ms. Ramona Grunden is a Senior Archaeologist and Laboratory Director in TRC's Columbia Office. She will serve as the Assistant Project Manager. Her duties for this phase of the project will include providing input on artifact recovery strategies related to Civil War sites, she will also be present to attend meetings should Mr. Norris be unavailable. Ms. Grunden has over 30 years of experience in South Carolina archaeology including seven years as an archaeologist at SCIAA. Ms. Grunden has conducted and managed numerous large-scale projects in the Southeast. She has extensive experience in all phases of historic sites investigations, and has worked on numerous Civil War projects and others involving military instillations and military components.

Senior Technical Advisor

Mr. Paul Webb is TRC's Cultural Resource Program Leader, and is stationed in the Chapel Hill office. He has over 25 years of experience in cultural resource management, including planning, implementing, and reporting all aspects of cultural resource studies. His qualifications include extensive experience with large and technically complex archaeological projects, and in assisting multidisciplinary teams in developing creative approaches to cultural resource issues. Mr. Webb will assist in the development of the artifact recovery/salvage and conservation and stabilization plans, and will also assist in agency negotiations as appropriate. Mr. Webb's background includes service to public, tribal, and private-sector clients, including the North Carolina Department of Transportation; Federal Highway Administration Eastern Federal Lands Highway Division (FHWA EFLHD); National Park Service (NPS); National Forests in North Carolina; Eastern Band of Cherokee Indians; U.S. Army Corps of Engineers; U.S. Army Construction Engineering Research Laboratory (USACERL); U.S. Army Environmental Center; Maryland State Highway Administration; Iroquois Gas Transmission System; Duke Energy; Piedmont Natural Gas; North Carolina Natural Gas; Spectra Energy; and Progress Energy; along with numerous engineering and environmental firms.

Safety Advisor/Technical Advisor

Dr. Larry McKee has over 25 years of experience and progressive responsibility in archaeological research and cultural resource management. His qualifications include extensive field investigation, artifact analysis, consultation at the tribal, state, and federal level, and large-scale project management. Mr. McKee came to TRC in 1999 following twenty years of academic and museum based archaeological research. He currently serves as a Senior Program Manager with the southeastern cultural resources division of TRC, with responsibility for the business functions and technical performance of the Nashville, TN office.

Laboratory Director

Mr. Thomas Garrow is the Laboratory Manager for TRC's Atlanta office, a position he has held since 1993. Mr. Garrow is responsible for artifact processing, analysis, conservation, and cataloging, as well as specialized recovery techniques such as flotation. Mr. Garrow has nearly 30 years of experience in cultural resource management, including field and laboratory work across the eastern United States. Mr. Garrow has participated in numerous archaeological investigations covering a wide range of site types, including those dating to the Civil War. Mr. Garrow has received training in artifact conservation techniques and curation standards, and few cultural resource practitioners in the region can match his depth of experience in metal conservation. Mr. Garrow will assist in development of the Artifact Recovery/Salvage and Conservation and Stabilization plans.

Senior Scientific Advisor

Dr. Karen Saucier has over 25 years of experience, and has worked extensively in the areas of CERCLA- and RCRA-mandated investigations, risk evaluations and remediations. Dr. Saucier will act as TRC's in-house technical advisor with experience on Manufactured Gas Plant sites. Her expertise includes providing strategic technical services, and assessing regulatory and business implications of environmental remediations and historic liabilities. Dr. Saucier supports client/agency negotiations with respect to risk-based decision making, sediment, soil and groundwater remediation approaches, and liability portfolio life-cycle costing and management. She routinely serves as Project Manager with responsibility for coordination and integration of multidisciplinary technical resources through the various stages of liability project life cycles. She advises on and leads project communications to corporate, regulatory and community stakeholders.

Additional Consultants/Staff

TRC will retain the services of Mr. James Legg as an archaeologist and consultant to assist in the General Consulting and planning tasks requested in this RFP. Mr. Legg currently works as a project archaeologist for SCIAA and has more than 40 years of experience in archaeological research involving battlefields and other military sites. He has worked with Ms. Grunden on a number of those sites. He has a particular interest in 18th and 19th century ordnance, including both small arms and artillery ammunition. He is a recognized expert who has handled all of the major types of Civil War ammunition and has disarmed and conserved many examples.

Mr. Legg has 32 years of experience in archaeological metal detecting, and has a regional reputation as an authority on the subject. Mr. Legg is also highly experienced in metal conservation. Over the last 35 years he has conserved several thousand metal artifacts from private collections as well as significant archaeological collections including those from 16th century Santa Elena, the Camden Battlefield, and a number of other projects conducted by SCIAA and other research entities.

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ATTACHMENT A – SUMMARY OF UNDERWATER ANOMALIES

DRAFT

Congaree River Anomaly Summary
Congaree River Project
Columbia, SC

Site Location

The report summarizes the results of the magnetometer surveying activities conducted in support of the South Carolina Electric and Gas (SCE&G) Company Congaree River Project located in Columbia, SC. The Congaree River begins at the confluence of the Saluda River and the Broad River in Columbia, SC. The portion of the Congaree relevant to this project is the approximate eastern third of the river beginning directly south of the Gervais Street Bridge and extending for approximately 3,700 feet downstream to approximately 500 feet below the Blossom Street Bridge. Figure 1 provides the location of the area in question.

Background Information

In June 2010, the South Carolina Department of Health and Environmental Control (SCDHEC) noted tar-like material (TLM) near the eastern shoreline of the Congaree River directly downstream of the Gervais Street Bridge. SCDHEC collected samples of this material and the analytical results indicated that the source of the TLM might be attributable to the former manufactured gas plants (MGP) that operated in Columbia starting in the mid-1800s and ending in the late 1940's to early 1950's. Predecessor companies of SCE&G operated the Huger Street manufactured gas plant (Huger Street MGP). Its location is provided on Figure 1. SCE&G has recently completed a removal action at the Huger Street site where over 125,000 tons of MGP impacted soil and debris was excavated and removed with oversight provided by SCDHEC.

SCE&G submitted a Project Delineation Report (PDR) [MTR, March 2012] to SCDHEC on March 23, 2012. SCDHEC approved the PDR on April 23, 2012. The PDR presented the results of delineation activities completed to determine the extent of the TLM within the river. The delineation work was completed in five separate phases over approximately 18 months. The magnetometer surveying operations described in this summary report were a component of the investigative activities and were necessary due to the potential presence of Civil War era explosive ordnance within the project area. Details pertaining to the ordnance are provided below.

Potential Presence of Historical Items and Unexploded Ordnance (UXO)

It has been confirmed that in 1865, during the Civil War, live munitions and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman's occupation and subsequent destruction of Columbia. A list of munitions and other Confederate items captured by the Union forces is provided in Attachment A. The Union Army kept some of these items for its own use and the remainder was destroyed. One of the methods for destruction was dumping the items into the river.

Archeological investigations, conducted as late as 1980, recovered some live and unstable munitions or unexploded ordinance (UXO) from the area as well as some other potentially historically significant artifacts. Specifically this work was focused in and adjacent to the unnamed tributary that enters the river just south of the Gervais Street Bridge. Figure 2 shows this location and a daily activity log documenting some of the archeological work is provided in the initial Tidewater Atlantic Research Inc. report (Attachment B). Several live cannonballs were identified during this operation and properly disposed of by trained explosive ordinance disposal (EOD) personnel located at nearby Fort Jackson.

Due to the potential presence of live munitions within the project area, an additional reconnaissance and screening of the area in question was conducted as part of the investigative activities. Acoustic (side scan sonar) and magnetic (magnetometer) remote sensing surveying activities were completed in order to determine if potential munitions were present prior to conducting the sediment sampling activities. A description of these activities and their subsequent results are provided below.

Surveying Activities

Magnetometer surveying of the project area was conducted over four separate phases. The first phase was focused on the area directly downstream of the Gervais Street Bridge (grid lines 1 through 16 on Figure 2) and included some limited shoreline surveying near the Senate Street Extension Alluvial Fan (Figure 2). A sidescan sonar survey was also performed during Phase I. The purpose of the side scan sonar was to complement the magnetometer survey by potentially visually identifying objects (e.g., ordnance) that may be lying on the Congaree River bottom. The sidescan sonar survey results were inconclusive and it was not utilized in the subsequent phases.

Magnetometer surveying progressed downstream in conjunction with the continuing investigation activities with Phase II extending the survey area from grid line 16 to grid line 20. Survey of the unnamed tributary that is located south of the Gervais Street Bridge was also conducted during Phase II. Phase III encompassed the portions of the project area between grid lines 20 and 37 and Phase IV completed the shoreline surveying in the vicinity of the Senate Street Extension Alluvial Fan that was not conducted during the other phases due to access constraints.

The specific details pertaining to the surveying equipment and methodology are provided in the phase specific reports produced by Tidewater Atlantic Research Inc. provided in Attachment B. In general, depending on the area to be surveyed and the presence of rock outcrops and water level conditions, either a small boat with an outboard motor or an inflatable boat was utilized to carry the surveying equipment. The inflatable boat was pushed through areas where water levels and the presence of rocks precluded the use of the motorboat. Terrestrial surveying was done on foot with handheld and backpack mounted equipment.

The magnetometer surveys were generally run on north-south trending lines and were controlled via a differential global positioning system (DGPS) using a Trimble AgCPS 132 navigation system. HYPACK navigation software was used to translate the DGPS data into real-time data that was used to direct the survey along a predetermined grid or transects. In general, the magnetometer transects lines were located approximately 20 feet apart. In some areas of the river where obstructions were encountered and navigation had to be altered, the distance between the transect lines varied and could be decreased to less than 10 feet.

The magnetometer survey was performed with an EG&G Geometrics G-858 cesium magnetometer that is capable of +/- 0.001 gamma resolution. The magnetic data was collected at a frequency of six samples per second. The locations of the magnetic readings were determined from the DGPS.

The side scan sonar survey was performed from approximately the 4 to 16 Lines and boulders and shallow water prevented performing the survey above the 4 Line. A 445/900 kHz Klein System 3900 digital side scan sonar was employed. The side scan sonar data was horizontally tied to the DGPS and reconciled with the HYPACK survey software. Where navigation was possible, a total of five side scan sonar survey passes were made on a 50-foot transect spacing.

The magnetometer detects changes in earth's magnetic field that may be attributed to buried anthropogenic influences (e.g., UXOs, electrical cables, etc.) or naturally occurring geologic features (e.g., remnant thermal magnetism, ore bodies, etc.). Once the magnetometer data was collected it was systematically analyzed to identify potential targets. A variety of characteristics of the targets including configuration, areal extent, intensity and contrast with background were analyzed and compared to signature characteristics previously found to be reliable indicators of historic ordnance. The results are discussed below.

Results

Following each phase of fieldwork the accumulated data was analyzed and the potential UXO locations were identified. Table 1 provides the results of the magnetometer surveying activities by investigation phase and Figure 3 provides the anomaly locations for the project area. Each phase is also described in more detail in the phase specific reports provided in Attachment B. Table 2 provides a summary of the anomaly locations and interpretation and Table 3 provides a summary of the anomalies located within the planned project area and located in the planned cofferdam footprint.

As the historical and anecdotal evidence suggested, the majority of anomalies were located in the Phase I survey area nearest the Gervais Street Bridge and the boat apron. A total of 323 anomalies were detected in the Phase I area with 218 of those locations exhibiting signature characteristics that could be associated with ordnance. Some of the non-ordnance anomalies included discarded debris and appliances, an electrical cable crossing and a geologic feature.

Phase II produced 10 potential UXOs in grid lines 16 through 20 and an additional 8 in the unnamed tributary. For Phase III the number of anomalies continued to be relatively low from grid line 20 to 31 but increased directly downstream of the Blossom Street Bridge. This increase can be potentially attributable to more recent objects being thrown from the bridge and not necessarily historical UXO. The total number of targets for Phase III was 145 with 121 exhibiting signature characteristics that could be associated with ordnance.

Finally, Phase IV was conducted to obtain information in the area directly downstream of the boat apron, which was not completed during Phase I due to access constraints. A total of 84 anomalies were detected with 67 exhibiting signature characteristics that could be associated with ordnance. The total for all four phases of magnetometer surveying is 570 anomalies located within the investigated area with 425 or 75 percent of those potentially being ordnance

Due to the nature of the potential historical objects and UXO deposited within the study area and their real or perceived value and/or potential hazard to public safety, the information contained in this summary report must remain confidential. This information was compiled by SCANA for use during completion of the investigative and subsequent remedial activities associated with the Congaree River Project. Any use or dissemination of the information for other purposes is not permitted and may be subject to legal action.

TABLE 1

MAGNETOMETER STUDY RESULTS SUMMARY

Congaree River Sediments
Columbia, South Carolina

Study	Dates	Study Area	Total Magnetic Anomalies	Potential Ordnance (UXO)	Other Anomalies
Phase I	Aug. 25-26, 2010	Congaree River - Grid Lines: 1 thru 16	323	**218**	105
Phase II	Jan. 4-5, 2011	Congaree River - Grid Lines: 16 thru 20	10	**10**	0
		Unnamed Tributary #1 - Outfall to River	8	**8**	0
Phase III	June 30, 2011	Congaree River - Grid Lines: 20 thru 37	145	**122**	23
Phase IV	January 31 - February 2, 2012	Senate Street Extension / Alluvial Fan Area	84	**67**	17
		Total Anomalies	570	**425**	145
		Percentage with UXO Potential		**75%**	

Notes:

1. All magnetometer work was completed by Tidewater Atlantic Research, Inc of Washington, North Carolina.
2. Magnetic Anomalies - As determined by Tidewater by the magnetic, remote-sensing survey.
3. UXO - Unexploded Ordnance
4. UXO Potential - Refering to Magnetic Anomalies that "have signature characteristics that could be associated with ordnance" and "those anomalies should be considered potentially hazardous until material generating the signatures can be identified".
5. Other - Other magnetic anomalies include pipelines, geologic features, modern debris etc.

TABLE 2

MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
1	078-1-nm262g175f	Geological Feature
2	078-2-dp280g49f	Pipeline
3	078-3-mc48g59f	Possible Ordnance
4	078-5-mc1854g71f	Possible Ordnance
5	077-1-nm758g34f	Possible Ordnance
6	077-2-mc40g45f	Possible Ordnance
7	077-3-mc52g76f	Possible Ordnance
8	077-4-pm203g68f	Pipeline
9	077-5-pm320g176f	Geological Feature
10	077-6-30g18f	Possible Ordnance
11	077-7-dp57g58f	Possible Ordnance
12	077-8-dp63g83f	Geological Feature
13	077-9-mc149g71f	Possible Ordnance
14	076-1-pm130g44f	Possible Ordnance
15	076-2-pm137g288f	Possible Ordnance
16	076-3-nm31g37f	Possible Ordnance
17	076-4-nm34g49f	Possible Ordnance
18	076-5-pm307g190f	Geological Feature
19	076-6-pm510g66f	Pipeline
20	076-7-mc76g69f	Possible Ordnance
21	076-8-mc627g66f	Possible Ordnance
22	075-1-dp116g50f	Possible Ordnance
23	075-2nm18g40f	Possible Ordnance
24	075-3-dp52g65f	Possible Ordnance
25	075-4-dp70g65f	Possible Ordnance
26	075-5-pm301g60f	Pipeline
27	075-5-pm289g178f	Geological Feature
28	075-7-dp36g30f	Possible Ordnance
29	075-8-nm59g80f	Possible Ordnance
30	075-9-pm48g35f	Geological Feature
31	075-10-pm125g70f	Possible Ordnance
32	074-1-dp207g40f	Possible Ordnance
33	074-2-dp121g40f	Geological Feature
34	074-3-pm32g20f	Possible Ordnance
35	074-4-pm288g215f	Geological Feature
36	074-5-nm861g50f	Pipeline
37	074-6-pm27g20f	Possible Ordnance
38	074-7-dp42g40f	Possible Ordnance
39	074-8-dp71g65f	Possible Ordnance
40	074-9-nm58g90f	Possible Ordnance
41	073-1-nm36g22f	Possible Ordnance
42	073-2-nm21g30f	Possible Ordnance
43	073-3-dp21g40f	Possible Ordnance
44	073-4-dp149g65f	Possible Ordnance
45	073-5-dp527g60f	Pipeline
46	073-6-pm302g199f	Geological Feature
47	073-7-pm41g18f	Possible Ordnance
48	073-8-nm60g70f	Possible Ordnance
49	073-9-dp64g31f	Geological Feature
50	073-10-dp42g17f	Possible Ordnance
51	072-1-pm46g11f	Possible Ordnance
52	072-2-pm88g23f	Geological Feature
53	072-3-pm310g167f	Geological Feature
54	072-4-pm2310g36f	Pipeline

TABLE 2

MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
55	072-5-dp62g49'	Possible Ordnance
56	071-1-nm28g10f	Possible Ordnance
57	071-2-pm46g62f	Possible Ordnance
58	071-3-pm170g55f	Possible Ordnance
59	071-4-dp494g96f	Pipeline
60	071-5-pm324g202f	Geological Feature
61	071-6-pm117g97f	Geological Feature
62	071-7-pm70g33f	Possible Ordnance
63	070-1-pm66g25f	Possible Ordnance
64	070-2-pm251g132f	Geological Feature
65	070-3-dp235g21f	Possible Ordnance
66	070-4-nm549g33f	Pipeline
67	070-5-pm159g46f	Possible Ordnance
68	070-6-nm36g18f	Possible Ordnance
69	070-7-dp48g55f	Possible Ordnance
70	070-8-nm44g15f	Possible Ordnance
71	069-1-dp23g10f	Possible Ordnance
72	069-2-dp78g44f	Possible Ordnance
73	069-3-nm1841g50f	Pipeline
74	069-4-dp252g53f	Possible Ordnance
75	069-5-pm214g155f	Geological Feature
76	069-6-pm63g17f	Geological Feature
77	068-1-pm72g94f	Geological Feature
78	068-2-dp238g167f	Possible Ordnance
79	068-3-nm402g55f	Pipeline
80	068-4-dp38g40f	Possible Ordnance
81	067-1-dp32g38f	Possible Ordnance
82	067-2-mc181g93f	Pipeline
83	067-3-pm221g300f	Geological Feature
84	067-5-mc68g90f	Geological Feature
85	067-6-dp22g30f	Possible Ordnance
86	066-1-dp61g40f	Geological Feature
87	066-2-pm182g193f	Geological Feature
88	066-3-nm190g95f	Pipeline
89	066-4-dp127g77f	Possible Ordnance
90	066-5-dp48g18f	Possible Ordnance
91	066-6-nm43g42f	Possible Ordnance
92	066-7-pm27g10f	Possible Ordnance
93	066-8-dp9g10f	Possible Ordnance
94	065-1-dp143g31f	Possible Ordnance
95	065-2-nm19g10f	Possible Ordnance
96	065-3-pm11g7f	Possible Ordnance
97	065-4-dp32g60f	Possible Ordnance
98	065-5-dp127g20f	Possible Ordnance
99	065-6-nm363g52f	Pipeline
100	065-7-pm176g186f	Geological Feature
101	065-8-pm24g38f	Possible Ordnance
102	065-9-pm44g37f	Possible Ordnance
103	065-10-mc69g110f	Geological Feature
104	064-1-pm108g121f	Geological Feature
105	064-2-mc67g61f	Possible Ordnance
106	064-3-pm27g21f	Possible Ordnance
107	064-4-pm193g210f	Geological Feature
108	064-5-nm363g63f	Pipeline

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
109	064-6-pm63g16f	Possible Ordnance
110	064-7-dp415g60f	Possible Ordnance
111	063-1-dp395g68f	Possible Ordnance
112	063-2-pm67g14f	Possible Ordnance
113	063-3-nm188g73f	Possible Ordnance
114	063-4-nm334g26f	Pipeline
115	063-5-pm224g187f	Geological Feature
116	063-6-pm111g143f	Geological Feature
117	062-1-pm99g136f	Geological Feature
118	062-2-pm203g163f	Geological Feature
119	062-3-nm257g48f	Pipeline
120	062-4-dp373g110f	Possible Ordnance
121	062-5-mc68g107f	Possible Ordnance
122	062-6-pm59g55f	Possible Ordnance
123	061-1-pm127g57f	Possible Ordnance
124	061-2-pm182g43f	Possible Ordnance
125	061-3-pm113g52f	Possible Ordnance
126	061-4-nm198g67f	Pipeline
127	061-5-pm225g210f	Geological Feature
128	061-6-pm112g147f	Geological Feature
129	060-1-pm109g18f	Geological Feature
130	060-2-pm66g46f	Possible Ordnance
131	060-3-pm246g205f	Geological Feature
132	060-4-nm107g38f	Pipeline
133	060-5-dp288g93f	Possible Ordnance
134	059-1-nm124g99f	Possible Ordnance
135	059-2-dp73g64f	Possible Ordnance
136	059-3-pm240g200f	Geological Feature
137	059-4-dp76g55f	Possible Ordnance
138	059-5-dp140g102f	Possible Ordnance
139	059-6-dp241g37f	Geological Feature
140	058-1-dp114g101f	Geological Feature
141	058-2-nm65g51f	Possible Ordnance
142	058-3-pm87g33f	Possible Ordnance
143	058-4-mc248g200f	Geological Feature
144	058-5-nm44g15f	Possible Ordnance
145	058-6-dp137g91f	Possible Ordnance
146	057-1-pm144g94f	Pipeline
147	057-2-pm67g62f	Possible Ordnance
148	057-3-dp54g14f	Possible Ordnance
149	o57-4-mc231g180f	Geological Feature
150	057-5-pm55g57f	Possible Ordnance
151	057-6-nm30g36f	Possible Ordnance
152	057-7-dp138g78f	Possible Ordnance
153	057-8-dp135g41f	Geological Feature
154	056-1-pm144g157f	Geological Feature
155	056-2-nm36g22f	Possible Ordnance
156	056-3-pm129g33f	Possible Ordnance
157	056-4-dp34g15f	Possible Ordnance
158	056-5-dp83g70f	Possible Ordnance
159	056-6-mc210g153f	Geological Feature
160	056-7-dp53g21f	Possible Ordnance
161	056-8-dp103g46f	Possible Ordnance
162	056-9-mc178g110f	Pipeline

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
163	055-1-pm277g110f	Pipeline
164	055-2-nm75g32f	Possible Ordnance
165	055-3-dp54g15f	Possible Ordnance
166	055-4-pm127g62f	Possible Ordnance
167	055-5-pm195g58f	Geological Feature
168	055-6-dp221g64f	Possible Ordnance
169	055-7-dp28g10f	Possible Ordnance
170	055-8-pm146g36f	Possible Ordnance
171	055-9-dp18g20f	Possible Ordnance
172	055-10-pm136g123f	Geological Feature
173	054-1-dp65g44f	Possible Ordnance
174	054-2-dp66g30f	Possible Ordnance
175	054-3-dp62g38f	Possible Ordnance
176	054-4-pm196g90f	Geological Feature
177	054-5-dp100g48f	Possible Ordnance
178	054-6-dp106g20f	Possible Ordnance
179	054-7-dp47g15f	Possible Ordnance
180	054-8-pm479g50f	Pipeline
181	053-1-nm71g18f	Possible Ordnance
182	053-2-nm21g26f	Possible Ordnance
183	053-3-mn90g46f	Possible Ordnance
184	053-4-dp26g17f	Possible Ordnance
185	053-5-nm32g15f	Possible Ordnance
186	053-6-pm71g56f	Possible Ordnance
187	053-7-pm199g57f	Geological Feature
188	053-8-nm111g38f	Iron Pipe
189	053-9-nm51g20f	Possible Ordnance
190	0543-10-dp43g40f	Possible Ordnance
191	053-11-nm70g66f	Possible Ordnance
192	053-12-pm115g105f	Geological Feature
193	052-1-pm129g142f	Geological Feature
194	052-2-dp99g63f	Possible Ordnance
195	052-3-mc292g160f	Iron Pipe
196	052-4-dp60g42f	Possible Ordnance
197	052-5-pm63g30f	Possible Ordnance
198	052-6-dp47g12f	Possible Ordnance
199	052-7-dp251g53f	Possible Ordnance
200	051-1-mc601g117f	Iron Pipe
201	051-2-nm97g26f	Possible Ordnance
202	050-1-nm94g33f	Possible Ordnance
203	050-2-dp102g45f	Possible Ordnance
204	050-3-pm50g17f	Possible Ordnance
205	050-4-pm818g20fEOL	Possible Ordnance
206	049-1-pm112g64f	Possible Ordnance
207	049-2-pm111g78f	Possible Ordnance
208	049-3-dp74g66f	Possible Ordnance
209	049-4-dp75g70f	Possible Ordnance
210	048-1-nm74g38f	Possible Ordnance
211	048-2-dp13g14f	Possible Ordnance
212	049-3-nm104g28f	Possible Ordnance
213	048-4-pm127g53f	Possible Ordnance
214	048-5-pm22g28f	Possible Ordnance
215	047-1-nm119g46fEOL	Possible Ordnance
216	047-2-dp13g15f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
217	047-3-nm89g33f	Possible Ordnance
218	046-1-nm223g37f	Possible Ordnance
219	078-1-pm1949g7f	Possible Ordnance
220	068-1-dp311g7f	Possible Ordnance
221	045-1-mc6548g8f	Electromagnetic Anomaly
222	062L-1-pm150g5f	Possible Ordnance
223	062L-2-nm109g11f	Possible Ordnance
224	061L-1-nm135g4f	Possible Ordnance
225	061L-2-pm95g6f	Possible Ordnance
226	061L-3-dp105g20f	Possible Ordnance
227	060L-1-pm113g3f	Possible Ordnance
228	060L-2dp93g27f	Possible Ordnance
229	059L-1-nm150g25f	Possible Ordnance
230	058L-1-pm302g11f	Possible Ordnance
231	058L-2-pm79g16f	Possible Ordnance
232	057L-1-dp257g7f	Possible Ordnance
233	056L-dp150g11f	Possible Ordnance
234	056L-2-pm43g10f	Possible Ordnance
235	055L-1-dp201g11f	Possible Ordnance
236	054L-1-nm166g9f	Possible Ordnance
237	001SL-1-pm4902g20	Boiler
238	001SL-2-pm4554g4f	Possible Ordnance
239	001SL-3-mc8907g11f	Electromagnetic Anomaly
240	002SL-1-dp8978g9f	Possible Ordnance
241	002SL-2-dp3987g7f	Possible Ordnance
242	002SL-3-mc7345g7f	Possible Ordnance
243	003SL-1-pm269g10f	Possible Ordnance
244	003Sl-2-pm515g7f	Possible Ordnance
245	003SL-3-nm80g5f	Possible Ordnance
246	003SL-4-dp168g19f	Boiler
247	003SL-5-pm129g6f	Washing Machine
248	060L-1-nm105g20f	Possible Ordnance
249	059L-1-nm279g5f	Possible Ordnance
250	059L-2-pm423g34f	Possible Ordnance
251	058L-1-dp209g6f	Possible Ordnance
252	058L-2-pm35g11f	Possible Ordnance
253	057L-1-nm17g11f	Possible Ordnance
254	057L-2-pm98g8f	Possible Ordnance
255	057L-3-pm37g9f	Possible Ordnance
256	057L-4-pm38g11f	Possible Ordnance
257	057L-5-dp75g10f	Sign
258	056L-1-mc8186g11f	Possible Ordnance
259	055L-1-mc5360g20f	Possible Ordnance
260	055L-2-nm357g19f	Possible Ordnance
261	054L-1-261g11f	Possible Ordnance
262	054L-2-pm3122g8f	Possible Ordnance
263	053L-1-nm110g9f	Possible Ordnance
264	053L2-dp109g16f	Possible Ordnance
265	052L-1-dp286g3f	Manhole
266	052L-2-pm327g9f	Possible Ordnance
267	052L-3-nm248g21f	Possible Ordnance
268	052L-4-dp259g26f	Possible Ordnance
269	051L-1-nm109g13f	Possible Ordnance
270	067-1-dp48g33f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
271	067-2-dp142g44f	Possible Ordnance
272	0701-dp480g13f	Possible Ordnance
273	070-2-pm49g11f	Possible Ordnance
274	072-1-pm89g13f	Possible Ordnance
275	073-1-nm80g5f	Possible Ordnance
276	073-2-nm356g23f	Possible Ordnance
277	075-1-nm364g11f	Possible Ordnance
278	075-2-dp1039g39f	Possible Ordnance
279	077-1-dp123g14f	Possible Ordnance
280	077-2-dp776g30f	Possible Ordnance
281	078R-3mc8302g20f	Electromagnetic Anomaly
282	068-1-dp320g7f	Possible Ordnance
283	068R-2-mc9213g15f	Electromagnetic Anomaly
284	066R-1-mc8334g15f	Electromagnetic Anomaly
285	065R-1-mc8486g18f	Electromagnetic Anomaly
286	064R-1-mc9633g18f	Electromagnetic Anomaly
287	063R-1-mc9404g19f	Electromagnetic Anomaly
288	062R-2-mc9746g18f	Electromagnetic Anomaly
289	061R-1-mc7773g16f	Electromagnetic Anomaly
290	060R-1-mc8127g8f	Electromagnetic Anomaly
291	059R-1-mc5961g11f	Electromagnetic Anomaly
292	058R-1-mc6758g17f	Electromagnetic Anomaly
293	057R-1-mc7119g24f	Electromagnetic Anomaly
294	056R-1-mc7891g16f	Electromagnetic Anomaly
295	055R-1-mc6461g17f	Electromagnetic Anomaly
296	054R-1-mc9645g16f	Electromagnetic Anomaly
297	053R-1-mc6680g13f	Electromagnetic Anomaly
298	052R-1-mc9795g10f	Electromagnetic Anomaly
299	051R-1-mc6531g15f	Electromagnetic Anomaly
300	050R-1-mc6531g14f	Electromagnetic Anomaly
301	049R-1-mc9574g7f	Electromagnetic Anomaly
302	048R-1-mc6550g12f	Electromagnetic Anomaly
303	047BR-1-mc6477g7f	Electromagnetic Anomaly
304	045R-1mc6548g8f	Electromagnetic Anomaly
305	003-4-dp103g12f	Possible Ordnance
306	004-1-pm93g10f	Possible Ordnance
307	003-3-pm58g16f	Possible Ordnance
308	002-1-dp38g9f	Possible Ordnance
309	003-2-pm96g11f	Possible Ordnance
310	004-3-pm95g12f	Possible Ordnance
311	001-1-pm54g6f	Possible Ordnance
312	006-2-nm207g12f	Possible Ordnance
313	004-2-pm81g9f	Possible Ordnance
314	003-1-pm19g4f	Possible Ordnance
315	004-4-pm78g8f	Possible Ordnance
316	006-1-dp191g16f	Possible Ordnance
317	002-2-dp53g11f	Possible Ordnance
318	004-5-pm85g11f	Possible Ordnance
319	004-6-pm71g10f	Possible Ordnance
320	004-7-pm82g12f	Possible Ordnance
321	004-8-dp156g19f	Possible Ordnance
322	002-3-nm32g8f	Possible Ordnance
323	053L-4-dp437g70f	Iron Pipe
324	022-1-pm100g25f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
325	021-2-nm400g25f	Possible Ordnance
326	021-2-pm70g20f	Possible Ordnance
327	012-1-pm270g23f	Possible Ordnance
328	011-1-dp225g75f	Possible Ordnance
329	010-1-nm50g15f	Possible Ordnance
330	020-1-dp22g15f	Possible Ordnance
331	016-1-pm38g37f	Possible Ordnance
332	020-2-dp23g13f	Possible Ordnance
333	020-3-dp18g16f	Possible Ordnance
334	A	Possible Ordnance
335	B	Possible Ordnance
336	C	Possible Ordnance
337	D	Possible Ordnance
338	E	Possible Ordnance
339	F	Possible Ordnance
340	G	Possible Ordnance
341	H	Possible Ordnance
342	1-1-mc806g44f	Possible Ordnance
343	1-2-pm100g9f	Possible Ordnance
344	1-3-dp533g47f	Possible Ordnance
345	1-4-dp233g24f	Possible Ordnance
346	1-5-pm73g13f	Possible Ordnance
347	1-6-dp210g33f	Possible Ordnance
348	22-1-dp544g65f	Pipeline
349	21-1-pm323g42f	Possible Ordnance
350	21-2-dp1330g64f	Pipeline
351	20-1-dp94g25f	Possible Ordnance
352	20-2-dp2601g102f	Pipeline
353	19-1-pm79g8f	Possible Ordnance
354	19-2-pm113g18f	Possible Ordnance
355	19-3-dp154g31f	Possible Ordnance
356	19-3-dp1419g86f	Pipeline
357	18-1-dp333g16f	Possible Ordnance
358	18-2-dp40g17f	Possible Ordnance
359	18-3-dp105g24f	Possible Ordnance
360	18-4-dp196g34f	Possible Ordnance
361	18-5-pm13g8f	Possible Ordnance
362	18-6-dp2092g60f	Pipeline
363	18-6-dp83g22f	Possible Ordnance
364	18-7-dp?1687+g18+f	Pipeline
365	17-1-dp1497g47f	Pipeline
366	17-2-dp47g44f	Possible Ordnance
367	17-3-pm29g16f	Possible Ordnance
368	17-4-mc53g35f	Possible Ordnance
369	16-1-nm61g10f	Possible Ordnance
370	16-2-dp136g17f	Possible Ordnance
371	16-3-pm50g27f	Possible Ordnance
372	16-5-dp10g6f	Possible Ordnance
373	16-6-pm47g26f	Possible Ordnance
374	15-1-dp59g30f	Possible Ordnance
375	15-2-pm43g16f	Possible Ordnance
376	15-3-dp304g29f	Possible Ordnance
377	14-1-dp136g21f	Possible Ordnance
378	14-2-dp185g32f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
379	14-4-pm95g31f	Possible Ordnance
380	10-1-nm29g25f	Possible Ordnance
381	10-2-dp31g260f	Possible Ordnance
382	10-2-nm57g13f	Possible Ordnance
383	13-1-dp66g23f	Possible Ordnance
384	13-2-pm40g21f	Possible Ordnance
385	13-3-pm27g17f	Possible Ordnance
386	13-4-dp46g10f	Possible Ordnance
387	12-1-dp40g30f	Possible Ordnance
388	12-2-pm46g33f	Possible Ordnance
389	11-1-pm22g39f	Possible Ordnance
390	11-2-pm39g31f	Possible Ordnance
391	10-1-dp95g21f	Possible Ordnance
392	9-1-dp78g23f	Possible Ordnance
393	8-1-dp247g13f	Possible Ordnance
394	7-1-dp180g23f	Possible Ordnance
395	7-2-dp145g20f	Possible Ordnance
396	6-1-dp138g15f	Possible Ordnance
397	6-2-dp235g26f	Possible Ordnance
398	5-1-pm103g31f	Possible Ordnance
399	5-2-dp53g57f	Possible Ordnance
400	4-1-pm103g15f	Possible Ordnance
401	4-2-dp49g12f	Possible Ordnance
402	2-1-pm110g13f	Possible Ordnance
403	15-1-mc16g4f	Possible Ordnance
404	14-1-dp68g16f	Possible Ordnance
405	13-1-dp53g7f	Possible Ordnance
406	13-2-dp188g28f	Possible Ordnance
407	12-1-pm11g29f	Possible Ordnance
408	11-1-dp528g20f	Possible Ordnance
409	9-1-dp342g22f	Possible Ordnance
410	8-1-dp135g24f	Possible Ordnance
411	8-2-dp72g23f	Possible Ordnance
412	8-1-dp34g16f	Possible Ordnance
413	6-1-pm32g5f	Possible Ordnance
414	5-1-dp47g21f	Possible Ordnance
415	4-1-dp218g25f	Possible Ordnance
416	4-2-dp80g21f	Possible Ordnance
417	3-1-dp146g27f	Possible Ordnance
418	3-2-pm123g17f	Possible Ordnance
419	3-3-dp85g22f	Possible Ordnance
420	1-1-dp112g18f	Possible Ordnance
421	22-1-dp122g37f	Possible Ordnance
422	22-3-nm28g10f	Possible Ordnance
423	22-2-pm17g10f	Possible Ordnance
424	1-1-pm73g12f	Possible Ordnance
425	1-2-pm215g23f	Possible Ordnance
426	2-1-dp185g16f	Possible Ordnance
427	2-2-mc287g46f	Possible Ordnance
428	2-3-dp107g24f	Possible Ordnance
429	1-1-dp55g16f	Possible Ordnance
430	1-2-dp223g45f	Possible Ordnance
431	1-3-dp700g35f	Possible Ordnance
432	1-4-dp97g25f	Possible Ordnance

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
433	5-1-dp89g22f	Possible Ordnance
434	13-1-dp44g15f	Possible Ordnance
435	13-2-dp37g24f	Possible Ordnance
436	14-1-dp28g14f	Possible Ordnance
437	11-1-dp52g44f	Possible Ordnance
438	11-2-dp72g43f	Possible Ordnance
439	10-1-pm41g18f	Possible Ordnance
440	10-2-pm20g11f	Possible Ordnance
441	10-3-dp72g35f	Possible Ordnance
442	10-4-pm74g23f	Possible Ordnance
443	9-1-dp281g31f	Possible Ordnance
444	7-1-dp208g20f	Possible Ordnance
445	7-2-dp125g23f	Possible Ordnance
446	7-3-pm115g10f	Possible Ordnance
447	6-1-dp152g34f	Possible Ordnance
448	6-2-mc175g49f	Possible Ordnance
449	5-1-pm60g11f	Possible Ordnance
450	5-2-pm32g6f	Possible Ordnance
451	5-3-pm63g12f	Possible Ordnance
452	5-4-pm50g7f	Possible Ordnance
453	5-5-dp65g4f	Possible Ordnance
454	5-6-mc6558g70f	Possible Ordnance
455	4-1-dp164g41f	Possible Ordnance
456	4-2-pm177g20f	Possible Ordnance
457	4-3-nm220g17f	Possible Ordnance
458	11-1-dp208g48f	Possible Ordnance
459	11-2-dp28g17f	Possible Ordnance
460	14-1-pm293g50f	Possible Ordnance
461	14-1-pm153g18f	Possible Ordnance
462	15-1-pm136g14f	Possible Ordnance
463	001-1-mc30093g25f	Possible Ordnance
464	022-1-mc31539g13f	Possible Ordnance
465	021-1-mc28767g12f	Possible Ordnance
466	020-1-mc31683g35f	Possible Ordnance
467	018-1-mc31942g23f	Possible Ordnance
468	018-1-mc31657g24f	Possible Ordnance
469	017-1-mc26003g23f	Possible Ordnance
470	017-1-dp67g14f	Possible Ordnance
471	014-1-mc26324g17f	Electromagnetic Anomaly
472	013-1-mc31252g8f	Electromagnetic Anomaly
473	013-2-mc16747g7f	Electromagnetic Anomaly
474	012-1-mc27653g21f	Electromagnetic Anomaly
475	011-1-mc34257g22f	Electromagnetic Anomaly
476	010-1-mc26761g24f	Electromagnetic Anomaly
477	009-1-mc29279g28f	Electromagnetic Anomaly
478	008-1-mc30182g22f	Electromagnetic Anomaly
479	07-1-mc21762g7f	Electromagnetic Anomaly
480	006-1-mc27687g21f	Electromagnetic Anomaly
481	005-1-mc30284g22f	Electromagnetic Anomaly
482	004-1-mc26874g21f	Electromagnetic Anomaly
483	003-1-mc28428g18f	Electromagnetic Anomaly
484	002-1-mc30321g12f	Electromagnetic Anomaly
485	007-1-pm6g10f	Tire
486	010-1-pm38g15f	Lamp

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MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
487	01-1-nm77g7f	Possible Ordnance
488	01-2-mc187g13f	Pipeline Associated
489	02-1-dp662gEOL	Pipeline Associated
490	03-1-mc795g52f	Pipeline Associated
491	03-2-nm47g6f	Pipeline Associated
492	03-3-nm321g45f	Possible Ordnance
493	03-4-pm190g2f	Possible Ordnance
494	03-5-dp2178gEOL	Possible Ordnance
495	03-6-dp156g18f	Possible Ordnance
496	04-1-dp2770g35f	Pipeline Associated
497	04-2-dp44891g35f	Electromagnetic Anomaly
498	04-3-mc44891g7f	Electromagnetic Anomaly
499	05-1-pm2582g30f	Possible Ordnance
500	05-2-pm705g21f	Pipeline Associated
501	05-3-pm139g13f	Possible Ordnance
502	05-4-nm169g17f	Possible Ordnance
503	06-1-pm1537g21f	Possible Ordnance
504	06-2-dp216g15f	Possible Ordnance
505	06-3-dp2658g33f	Pipeline Associated
506	06-4-pm96g13f	Possible Ordnance
507	06-5-pm90g10f	Possible Ordnance
508	06-6-dp109g12f	Possible Ordnance
509	06-7-pm36g4f	Possible Ordnance
510	07-1-dp1681g38f	Possible Ordnance
511	07-2-pm70g6f	Possible Ordnance
512	07-3-mc3436g43f	Pipeline Associated
513	07-4-dp608g39f	Possible Ordnance
514	08-1-nm61g14f	Possible Ordnance
515	08-2-mc138g24f	Possible Ordnance
516	08-3-dp2380g51f	Pipeline Associated
517	08-4-pm1479g40f	Possible Ordnance
518	08-5-nm20g2f	Possible Ordnance
519	08-6-mc244gEOL	Possible Ordnance
520	09-1-nm157g9f	Possible Ordnance
521	09-2-pm2592g48f	Possible Ordnance
522	09-3-dp129g6f	Possible Ordnance
523	09-4-dp4790g50f	Pipeline Associated
524	09-5-pm23864g4f	Electromagnetic Anomaly
525	09-6-pm34g13f	Possible Ordnance
526	10-1-pm37g24f	Possible Ordnance
527	10-2-dp6063g73f	Pipeline Associated
528	10-3-mc34109g1f	Electromagnetic Anomaly
529	10-4-pm2385g43f	Possible Ordnance
530	10-5-mc92g2f	Possible Ordnance
531	11-1-pm1474g41f	Possible Ordnance
532	11-2-dp2385g29f	Pipeline Associated
533	11-3-mc207g22f	Possible Ordnance
534	11-4-dp52g19f	Possible Ordnance
535	12-1-pm52g7f	Possible Ordnance
536	12-2-nm398g18f	Possible Ordnance
537	12-3-pm75g7f	Possible Ordnance
538	12-4-nm29g4f	Possible Ordnance
539	12-5-nm24g3f	Possible Ordnance
540	12-6-nm115g3f	Possible Ordnance

TABLE 2

MAGNETIC ANOMALY LOCATION AND INTERPRETATION

Congaree River Sediments
Columbia, South Carolina

Designation	Characteristics	Potential Interpretation
541	12-7-nm23g8f	Possible Ordnance
542	12-8-mc457g25f	Possible Ordnance
543	12-9-mc613g30f	Possible Ordnance
544	12-10-nm642g43f	Possible Ordnance
545	13-1-dp244g28f	Possible Ordnance
546	13-2-nm213g24f	Possible Ordnance
547	13-3-nm224g18f	Possible Ordnance
548	13-4-nm156g14f	Possible Ordnance
549	13-5-dp25g9f	Possible Ordnance
550	14-1-nm61g15f	Possible Ordnance
551	14-2-nm234g18f	Possible Ordnance
552	14-3-dp193g23f	Possible Ordnance
553	14-4-dp462g36f	Possible Ordnance
554	14-5-nm19g6f	Possible Ordnance
555	14-6-dp646g26f	Possible Ordnance
556	14-7-dp1357g24f	Possible Ordnance
557	16-1-dp400g18f	Possible Ordnance
558	16-2-pm160g17f	Possible Ordnance
559	16-3-dp368g20f	Possible Ordnance
560	16-4-mc403g30f	Possible Ordnance
561	16-5-pm36g11f	Possible Ordnance
562	16-6-pm12g4f	Possible Ordnance
563	16-7-pm35g13f	Possible Ordnance
564	17-1-dp273g42f	Possible Ordnance
565	18-1-dp527g12f	Possible Ordnance
566	18-2-pm91g8f	Possible Ordnance
567	19-1-dp528g38f	Possible Ordnance
568	19-2-pm166g7f	Possible Ordnance
569	19-3-dp1000g33f	Possible Ordnance
570	20-1-mc48849g8f	Electromagnetic Anomaly

TABLE 3

ANOMALIES BY PLANNED PROJECT AREA

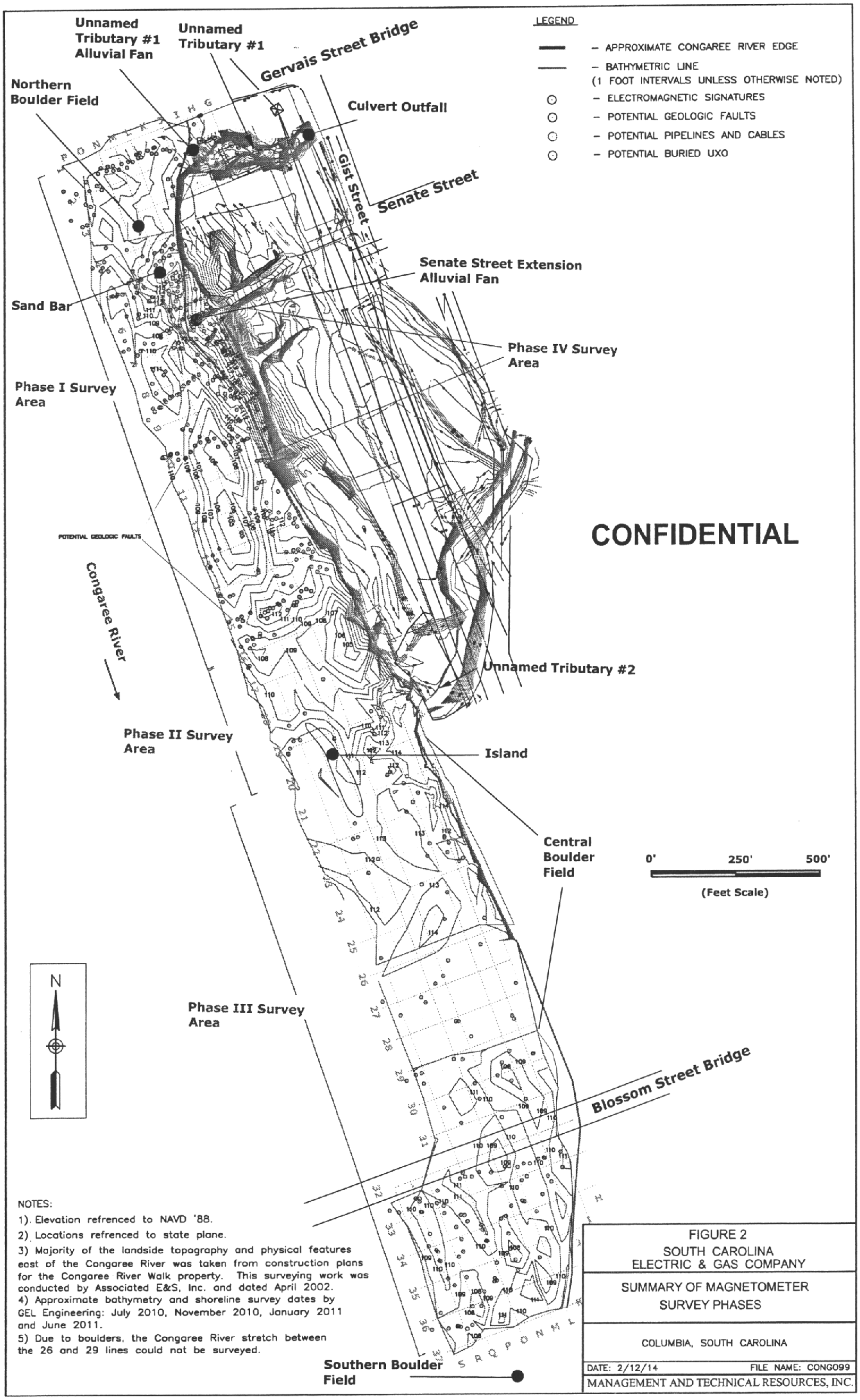
Congaree River Sediments
Columbia, South Carolina

Construction Phase	Potential Ordnance (UXO)	Potential UXO Under the Footprint of the Cofferdam	Other Anomalies	Total Magnetic Anomalies
Field Demonstration Project Area	84	0	17	101
Phase I	84	20	14	118
Phase II	45	9	16	70
Phase III	2	14	17	33
Outside of Project Area	210	0	38	248
Total Anomalies	**425**	**43**	**102**	**570**

Notes:

Please refer to Figures 2 and 3.

1. All magnetometer work was completed by Tidewater Atlantic Research, Inc of Washington, North Carolina.
2. Magnetic Anomalies - As determined by Tidewater by the magnetic, remote-sensing survey.
3. UXO - Unexploded Ordnance
4. UXO Potential - Refering to Magnetic Anomalies that "*have signature characteristics that could be associated with ordnance*" and "*those anomalies should be considered potentially hazardous until material generating the signatures can be identified*".
5. Other - Other magnetic anomalies include pipelines, geologic features, modern debris etc.



CONFIDENTIAL

NOTES:

1). Elevation refrenced to NAVD '88.

2). Locations refrenced to state plane.

3) Majority of the landside topography and physical features east of the Congaree River was taken from construction plans for the Congaree River Walk property. This surveying work was conducted by Associated E&S, Inc. and dated April 2002.

4) Approximate bathymetry and shoreline survey dates by GEL Engineering: July 2010, November 2010, January 2011 and June 2011.

5) Due to boulders, the Congaree River stretch between the 26 and 29 lines could not be surveyed.

FIGURE 2
SOUTH CAROLINA ELECTRIC & GAS COMPANY

SUMMARY OF MAGNETOMETER SURVEY PHASES

COLUMBIA, SOUTH CAROLINA

DATE: 2/12/14 FILE NAME: CONG099

MANAGEMENT AND TECHNICAL RESOURCES, INC.

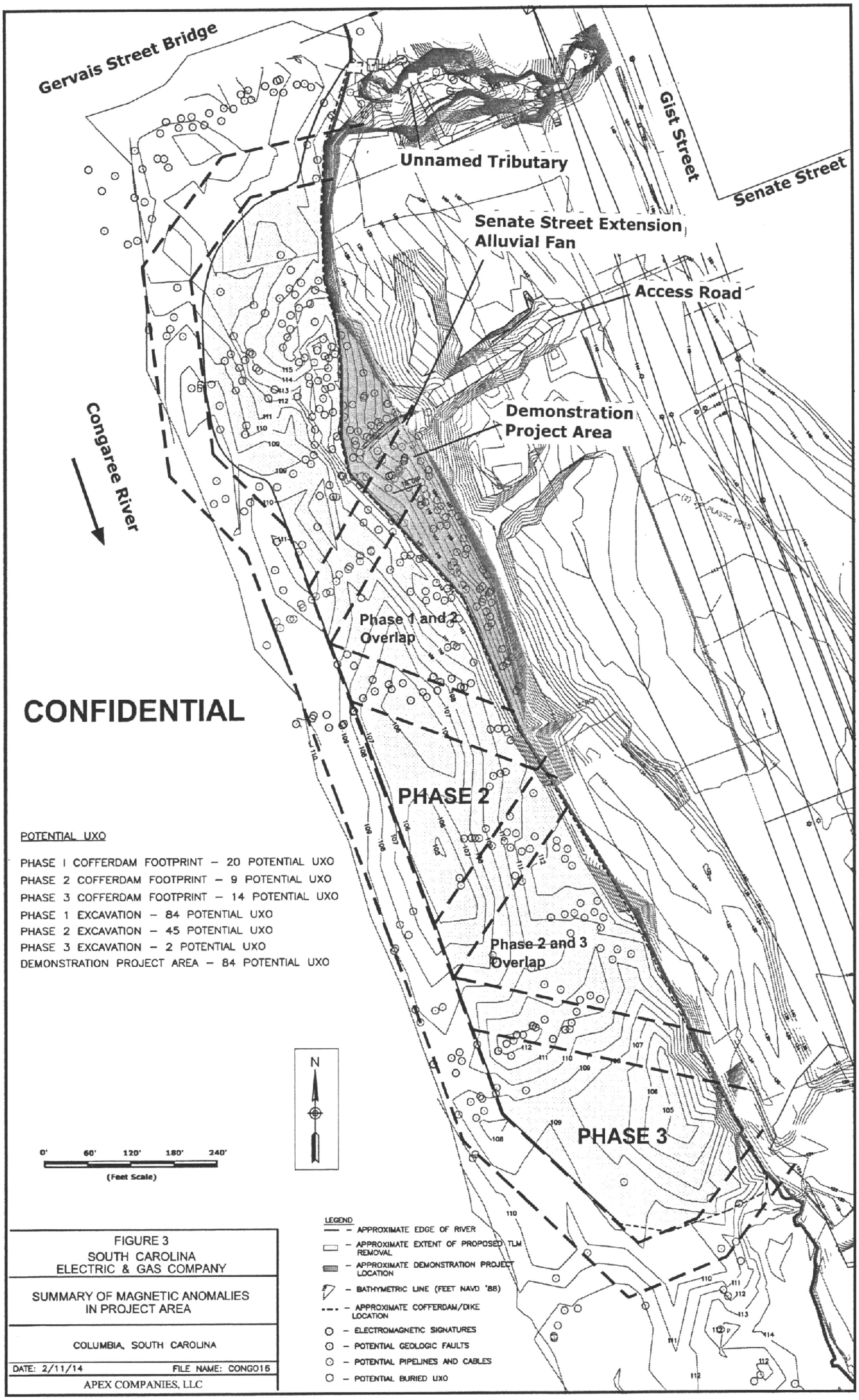


FIGURE 3
SOUTH CAROLINA
ELECTRIC & GAS COMPANY

SUMMARY OF MAGNETIC ANOMALIES
IN PROJECT AREA

COLUMBIA, SOUTH CAROLINA

DATE: 2/11/14 FILE NAME: CONG016

APEX COMPANIES, LLC

MEMORANDUM OF AGREEMENT

AMONG THE U.S. ARMY CORPS OF ENGINEERS; THE SOUTH CAROLINA STATE HISTORIC PRESERVATION OFFICE; AND SCANA

REGARDING THE CONGAREE RIVER REMEDIATION PROJECT

WHEREAS, Pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Sections 401 and 404 of the Clean Water Act (33 U.S.C. 1344), an application (P/N # 2011-1356-6IO) has been submitted to the U. S. Army Corps of Engineers, Charleston District (Corps) by SCANA for a permit to construct a cofferdam and remove a Tar-Like Material that is comingled with sediment in the Congaree River, Richland County, South Carolina, and

WHEREAS, the Corps has determined that the undertaking may adversely affect Archaeological Site 38RD286/38RD278 (the Ordnance Dump Site/historic underwater site), which is eligible for listing in the National Register of Historic Places and Archaeological Sites 38RD223, 38RD224, and 38RD234 which are considered Geographic Areas of Potential Concern (GPAC), and has consulted with the South Carolina State Historic Preservation Officer (SHPO) pursuant to 36 CFR part 800, the regulations implementing Section 106 of the National Historic Preservation Act (16 USC Part 470f); and

WHEREAS, the Corps has consulted with SCANA regarding the effects of the undertaking on sites 38RD286/38RD273, 38RD223, 38RD224, and 38RD234 and has invited SCANA to sign this Memorandum of Agreement (MOA) as an invited signatory; and

WHEREAS, in accordance with 33 CFR Part 325, Appendix C, 36 CFR Part 800.6(a)(1), and 36 CFR Part 800.6(b)(1)(iv) the Corps has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination with specified documentation and the ACHP has chosen not to participate in the consultation pursuant to 36 CFR Part 800.6(a)(1)(iii);

NOW, THEREFORE, the Corps, the SHPO and SCANA agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic artifacts.

STIPULATIONS

Failure to comply with this MOA may result in the modification, suspension, or revocation of the above-referenced Corps authorizations as described in the special conditions and pursuant to 33 CFR 325.7.

The Corps shall ensure that the following measures are carried out:

1. SCANA and any successors or assigns engaged in the removal of the contaminated sediment shall allow representatives from the Corps and the SHPO to inspect the authorized activity at any time that is deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of this MOA. During

any inspection the Corps and the SHPO will follow all safety protocols established at the work site.

2. All plans and reports developed for the salvage of historic artifacts shall incorporate guidance provided by the Secretary of Interior's *Standards and Guidelines for Archaeological Documentation* (48 FR 44734-37) and the President's Advisory Council on Historic Preservation publication, *Treatment of Archaeological Properties* (ACHP 1980). Additionally, all plans and reports will be consistent with *South Carolina Standards and Guidelines for Archaeological Investigations* (Council of South Carolina Professional Archaeologists, et al. 2005).

3. SCANA's archaeological consultant will develop a recovery plan (Plan) for the portions of Archaeological Site 38RD286/38RD278 contained within the project area and identified in Attachement A. The recovery plan will include a description of the undertaking's research design and methodology for artifact recovery. The recovery plan will be submitted to the Corps and the SHPO for review and approval prior to any fieldwork. The Corps and the SHPO will be afforded thirty (30) days to review the recovery plan and provide comments.

4. SCANA will protect and preserve the areas labeled as Archaeological Sites 38RD223, 38RD224 and 38RD234 as shown in Exhibit A by completing the requirements stated in Stipulation 5 below until such time as sites are determined not eligible for the NRHP or potential adverse effects to those Sites determined eligible are mitigated with data recovery in accordance with this MOA and the Plan.

5. No less than ten (10) days prior to any land disturbing activities SCANA shall ensure that:

   a. Archaeological Sites 38RD223, 38RD224 and 38RD234 are marked on construction and maintenance plans with treatment notes and this MOA referenced.

   b. All newly constructed roads in the vicinity of site 38RD223, 38RD224 and 38RD234 will be elevated above grade with successive layers of fill, geotextile matting and gravel in order to protect potential subsurface deposits.

   c. The boundaries of Archaeological Sites 38RD223, 38RD224 and 38RD234 are cordoned off in the field with orange safety fencing, or a similar highly visible barrier which shall remain in place until all construction activity is complete.

   d. An archaeologist will be present to monitor construction activities in the vicinity of Archaeological Sites 38RD223, 38RD224 and 38RD234.

6. At least one copy of the draft technical report of data recovery operations and final public information plans will be submitted to the SHPO for review and approval within two (2) years from the last day of fieldwork. The draft technical report will be consistent with the standards outlined in *South Carolina Standards and Guidelines for Archaeological Investigations* (Council of South Carolina Professional Archaeologists, et al. 2005). The

SHPO reserves the right to submit the draft technical report to qualified professional archaeologists for peer review. If the SHPO elects to utilize this option, SCANA's archaeological consultant will be advised and additional report copies may be requested. If revisions of the draft report are recommended, SCANA is responsible for ensuring that these revisions are addressed in the final report. The final report will be submitted to the SHPO within three (3) months of the receipt of all agency and peer review comments.

7. SCANA, and the SHPO will consult to determine the appropriate format for a public education component. SCANA will ensure that a public education plan is developed and submitted to the SHPO with the draft technical report. All public education materials will be implemented within two (2) years of the last day of fieldwork.

8. SCANA and the SHPO will consult to determine the final disposition of the artifacts recovered in accordance with the Underwater Antiquities Act of 1991 (Article 5, Chapter 7, Title 54, Code of Laws of South Carolina, 1976). SCANA will ensure that artifacts are stabilized and processed prior to their final disposition.

LATE DISCOVERIES

If any unanticipated cultural materials (e.g. large, intact artifacts or animal bones, large clusters of artifacts or animal bones, large soil stains or patterns of soil stains, buried brick or stone structures, or clusters of brick or stone indicating a former structure) in the project area prior to or during construction activities (a "Late Discovery"), then SCANA will temporarily halt any activities in the vicinity of such Late Discovery and will notify the SHPO and the Corps as soon as practical of the Late Discovery. The halt will afford the Corps and the SHPO the opportunity to assess the situation and recommend a course of action within two (2) business days after such notification.

A buffer will be established around the Late Discovery by the construction project manager. The buffer will be flagged by appropriate personnel and posted with signage indicating that no land altering activities will be allowed within this buffer zone until the course of action hereinafter described has been established.

If unanticipated human remains are found or suspected, they should be left in place and protected until appropriate consultation is completed. SCANA is responsible for notifying the Corps, the SHPO, and the local authorities to initiate consultation. Human remains are subject to South Carolina law that addresses abandoned cemeteries and burials including but not limited to S.C. Code Ann. §§ 27-43-10 to 27-43-30, 16-16-600 and 61-19-28 to 61-19-29.

MONITORING AND REPORTING

Every one (1) year following the execution of this agreement, for the life of the agreement, SCANA will provide the Corps and the SHPO a written report describing all work begun or accomplished during the past year under this agreement. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received relating to the efforts to carry out the terms of this MOA. SCANA will also report on plans for the next year. This report may be submitted to the Corps and the SHPO via e-mail.

DISPUTE RESOLUTION

SCANA, the Corps and the SHPO will attempt to resolve any disagreement arising from the implementation of the MOA. This will include any disputes that arise concerning the contents of the report(s), including but not limited to its merit as a cultural resource management document.

AMENDMENT AND MODIFICATION

Any party to this MOA may request that it be amended or modified at any time, whereupon the parties will consult with each other to consider such amendment or modification. Amendments must be agreed to in writing and signed by all signatories. Amendment of this MOA may require a concurrent request to amend the applicable license.

EXECUTION AND DURATION OF THE MOA

This MOA may be executed in counterparts. A copy with all original executed signature pages affixed shall constitute the original MOA. The date of the execution shall be the date of the signature of the last party to sign. This MOA will be in effect for the life of the Permit or until all stipulations are met, whichever is longer. Prior to such time the Corps may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with the stipulation outlined above.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, the parties hereto have caused this MOA to be executed by their duly authorized representative of the last signed date.

SIGNATORIES:

Department of the Army, Corps of Engineers

By:___________________ Date __________

Print Name:____________________________

Title: _______________________________

INVITED SIGNATORIES:

South Carolina Department of Archives and History

By:___________________ Date __________

Print Name:____________________________

Title: _______________________________

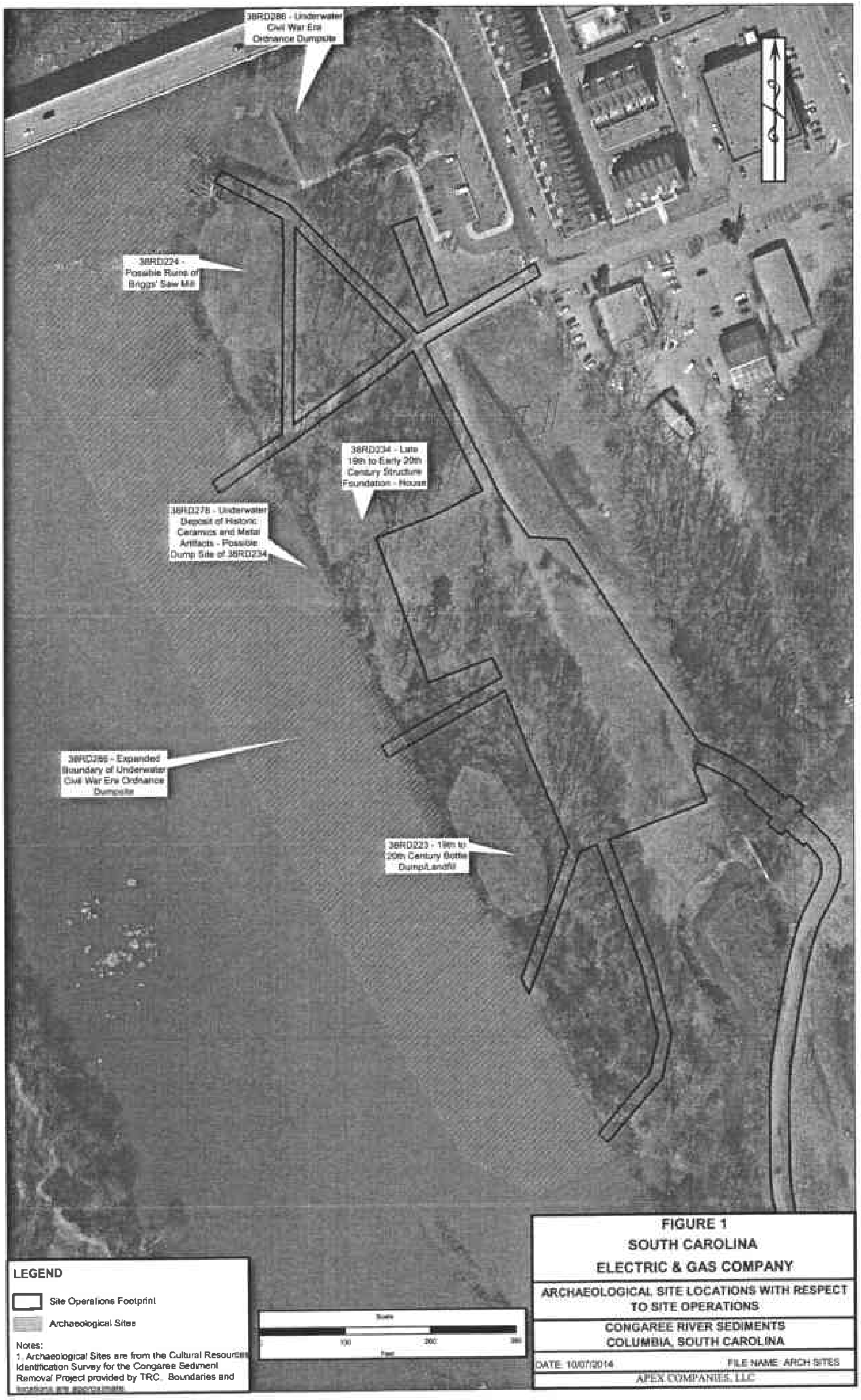
SCANA

By:___________________ Date __________

Print Name:____________________________

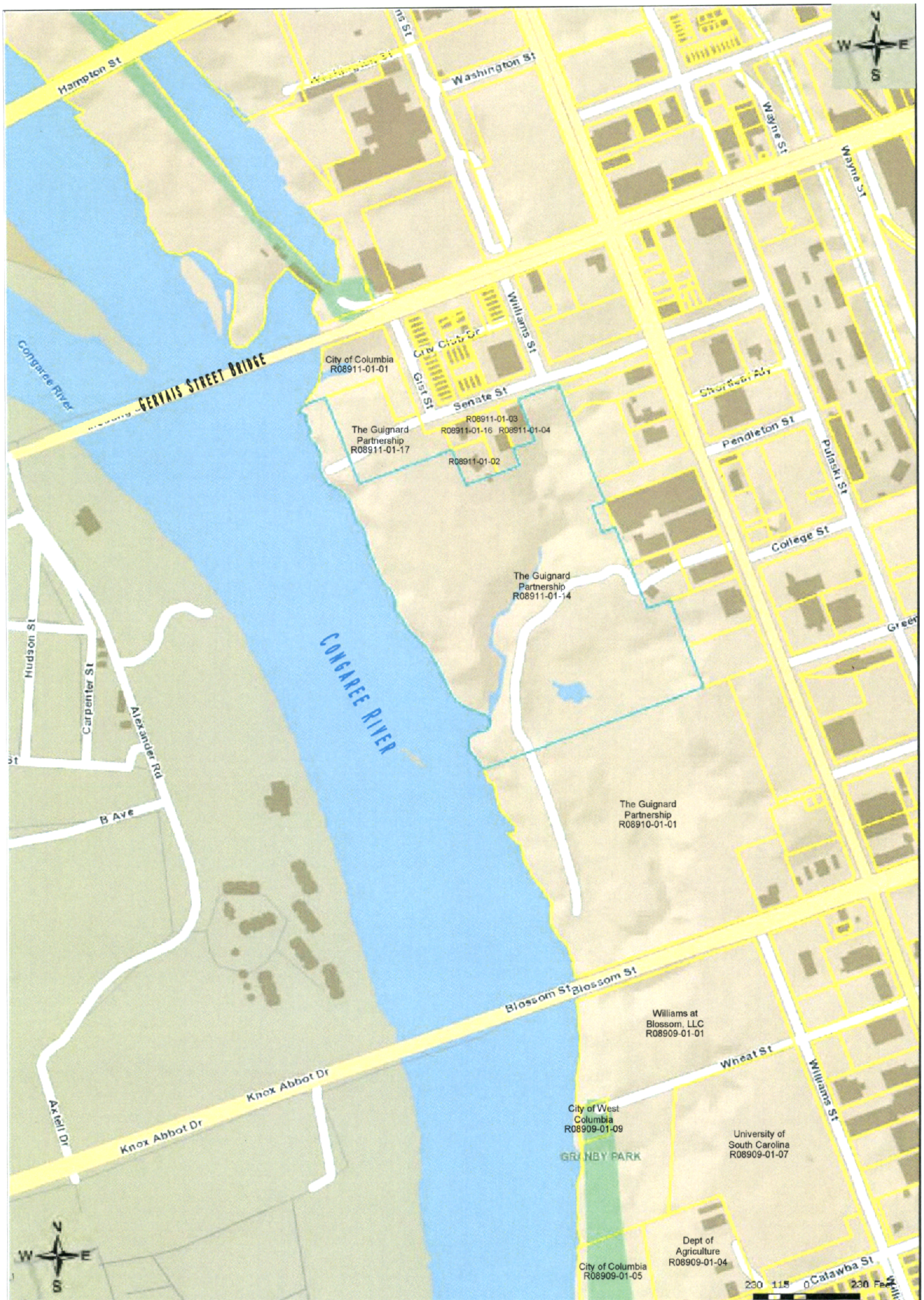
Title: _______________________________

ATTACHMENTS


38RD286 - Underwater Civil War Era Ordnance Dumpsite
38RD224 - Possible Ruins of Briggs' Saw Mill
38RD234 - Late 19th to Early 20th Century Structure Foundation - House
38RD278 - Underwater Deposit of Historic Ceramics and Metal Artifacts - Possible Dump Site of 38RD234
38RD286 - Expanded Boundary of Underwater Civil War Era Ordnance Dumpsite
38RD223 - 19th to 20th Century Bottle Dump/Landfill
LEGEND
Site Operations Footprint
Archaeological Sites
Notes:
1. Archaeological Sites are from the Cultural Resources Identification Survey for the Congaree Sediment Removal Project provided by TRC. Boundaries and locations are approximate.
FIGURE 1
SOUTH CAROLINA
ELECTRIC & GAS COMPANY
ARCHAEOLOGICAL SITE LOCATIONS WITH RESPECT TO SITE OPERATIONS
CONGAREE RIVER SEDIMENTS
COLUMBIA, SOUTH CAROLINA
DATE: 10/07/2014
FILE NAME: ARCH SITES
APEX COMPANIES, LLC

ATTACHMENT E

ADJACENT PROPERTY OWNERS MAP



Hampton St
Washington St
Williams St
Gist St
Senate St
Wayne St
Pulaski St
Pendleton St
College St
Congaree River
GERVAIS STREET BRIDGE
CONGAREE RIVER
City of Columbia
R08911-01-01
The Guignard
Partnership
R08911-01-17
R08911-01-03
R08911-01-16
R08911-01-04
R08911-01-02
The Guignard
Partnership
R08911-01-14
The Guignard
Partnership
R08910-01-01
Hudson St
Carpenter St
Alexander Rd
B Ave
Axtell Dr
Knox Abbot Dr
Knox Abbot Dr
Blossom St
Blossom St
Williams at
Blossom, LLC
R08909-01-01
Wheat St
Williams St
City of West
Columbia
R08909-01-09
GRANBY PARK
University of
South Carolina
R08909-01-07
Dept of
Agriculture
R08909-01-04
City of Columbia
R08909-01-05
Catawba St
230 115 0 230 Feet
N
W
E
S