

# Task SEGDO2

## Refine and Verify Hydrodynamic Salinity Model

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Prepared for:



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## **TASK SEGDO2**

### Refine and Verify Hydrodynamic/Salinity Model

The following outline for Task SEGDO2, Refine and Verify Hydrodynamic/Salinity Model, is being presented to the Stakeholder Evaluation Group (SEG) as a draft task statement for review, modification and approval. The particular components of this task are based on the input received for the Tier I Environmental Impact Statement (EIS) as well as agency comments received to date. This task encompasses the refinement of existing tools to be used in evaluating the potential salinity impacts. Additional tasks will be presented for impact evaluations.

#### **1.0 Task Goals**

This Task has two goals. The first is to refine the hydrodynamic/salinity model to include a relationship between surface water and interstitial salinity. The refined model will then be used to directly project the changes in interstitial salinity within the marshes of the Savannah National Wildlife Refuge. It has been postulated in past Savannah studies, that marsh succession is primarily the result of changes in the interstitial salinity. These in turn are driven by salinity changes in the adjacent surface waters. Under the Tier I EIS, relationships developed under the last deepening project were utilized to identify interstitial salinity changes. Based upon comments received, a data collection effort has been proposed to develop this relationship under the present conditions (Task SEGP313). The modeling effort described herein will analyze the data to quantify this relationship and apply it within the existing hydrodynamic/salinity model.

The second goal is to provide verification of the calibrated hydrodynamic/salinity model using the in-stream data collected in the summer of 1999 (Tasks SEGP311 and SEGP312). The primary purpose for the summer 1999 data collection effort is to establish the interstitial salinity relationship described above, for calibration of the dissolved oxygen model, and development of the relationship between salinity changes below I-95 to chloride changes at the City of Savannah Intake. But since the hydrodynamics are the base forcing mechanisms for a water quality model, verification to this new data set is necessary.

#### **2.0 Project Need**

Concerns were raised under the Tier I EIS that the relationship between surface water salinity, and interstitial salinity has not been developed under post tide gate conditions. Marsh succession has been identified historically as dependent on the changes in interstitial salinity. Therefore, it is important to provide accurate projections of these changes using the most up to date information. The direct calculation of these changes through the model will provide the data necessary to project the spatial variations in potential marsh succession under the proposed deepening project.

One specific request made in the Tier I EIS public comment period was that a convergence test be performed on the existing hydrodynamic/salinity model. This request was made by the USACOE under the guidance of the Waterways Experiment Station (WES). WES requested this test to assure that further refinements of the spatial structure would not influence the solution outcome. This will verify that the present spatial resolution is sufficient for the model purposes.

The dissolved oxygen model is being refined under Task SEGDO1. The hydrodynamic/salinity model provides the baseline hydrodynamics to drive the dissolved oxygen model. To properly calibrate the dissolved oxygen model, it is necessary to verify that the salinity model is accurately projecting the hydrodynamic conditions for the data set being utilized (summer 1999).

### **3.0 Proposed Scope**

To address the issues raised under Section 2.0, and to address inputs received to date from agency personnel, this task has been subdivided into the following 4 components:

- Perform convergence test of the existing hydrodynamic model as requested by the USACOE Waterways Experiment Station.
- Develop interstitial salinity algorithm within existing marsh subroutine and test using 1997 data set.
- Verify hydrodynamic/salinity model against 1999 data set
- Analyze marsh and in-stream data collected under Tasks SEGP311, SEGP312, and SEGP313 and develop relationship between in-stream salinity changes and interstitial salinity changes. Implement relationship developed from data into marsh interstitial salinity algorithm.

The following describes in detail the work to be performed under each component.

#### **3.1 Perform Convergence Test**

Based upon comments received from the Waterways Experiment Station (WES) of the USACOE, ATM will conduct a convergence test of the WQMAP hydrodynamic and salinity model. This test will consist of preparation of a coarse grid of the Savannah Harbor System from Fort Pulaski to the I-95 Bridge using the existing grid system as a baseline. This coarse grid will be run under the 1997 tides and flows used in calibration. The output from this coarse grid will then be compared with subsequent runs where the identical grid structure is systematically refined by reducing the horizontal and vertical grid spacing while maintaining identical shoreline geometry and bathymetry. The goal will be to identify the differences in the model solution under the varying grid resolution. The present grid structure will become one of the convergence test runs as the grid is modified.

#### **3.2 Develop and Implement Interstitial Salinity Algorithm within Marsh Subroutine**

Under this sub-task, the existing marsh subroutine will be modified to provide for a relationship between the projected salinity in the surface waters flooding and drying the marshes, and the temporal and spatial response of the interstitial salinity. Although the exact nature of the relationship will not be identified until the completion of the summer 1999 data collection, the general characteristics may be determined through review of historic measurements of interstitial marsh salinity as well as through interaction with SEG technical representatives. These general characteristics will help identify the nature of the relationship, with the exact coefficients being input on completion of the 1999 data collection and analysis.

The spatial extent of the marsh subroutine coverage area is presently limited to the boundaries of the Savannah National Wildlife Refuge (SNWR). Figure SEGDO2-1 shows the extents of the SNWR within the model domain. This boundary will remain the same for the interstitial salinity projections.

The implementation of the algorithm will be completed prior to, and/or in parallel with, the summer 1999 data collection effort. This will expedite the completion of the interstitial salinity projections once data collection is completed and the data analyzed.

### 3.3 Verify Hydrodynamic/Salinity Model to 1999 Data Set

Under this sub-task, the previously calibrated hydrodynamic/salinity model will be verified against the data collected in the summer of 1999. This will provide the baseline hydrodynamics for the calibration of the dissolved oxygen model. The hydrodynamic/salinity model will be run under the measured offshore tidal conditions, the measured upstream freshwater inflow, and the measured meteorological conditions from the summer of 1999. The model coefficients used in the 1997 calibration will be held constant and the model projections compared against the measured tides, currents, flows, and salinity throughout the system. Figures SEGDO2-2 through SEGDO2-5 present the locations of the stations that will provide data for the model verification. In Figure SEGDO2-5, those stations that will measure both surface and bottom salinity are identified. These locations were taken from the scope of services provided under Tasks SEGP311, SEGP312, and SEGP313.

Model verification will include but not be limited to the following analytical comparisons:

- Graphical comparison of the model versus data for the tides, currents, flows, and salinity.
- Normalized RMS error analysis for the tides, currents, flows, and salinity.
- Comparison of the primary harmonic constituents calculated from the model results and the data for the tides and currents.
- Comparison of the 10<sup>th</sup>, 50<sup>th</sup>, and 90<sup>th</sup> salinity percentiles calculated from the model results and the data.
- Graphical and tabular comparison of the measured and simulated mean water level variations (non-tidal lower frequency variations).
- Graphical and tabular comparison of the measured and simulated residual currents (non-tidal lower frequency variations).

These calculations will be performed for each of the stations presented in Figures SEGDO2-2 through SEGDO2-5.

### 3.4 Update Model Marsh Algorithm using 1999 Interstitial Relationship

Utilizing the data collected under Task SEGP313, a relationship between the interstitial salinity and the in-stream salinity that floods the marshes of the SNWR will be developed. This relationship will be implemented within the hydrodynamic/salinity model marsh algorithm described under Section 3.1. This will provide an up to date projection of marsh interstitial salinity based upon model projections of in-stream salinity.

## **5.0 Deliverables**

The deliverable for this task will be a report that summarizes the work performed under Sections 3.1 through 3.4. The report will include all assumptions, methodologies, data analysis, and equations used in the model algorithms as well as all model to data comparisons. In addition, the report will summarize the findings and conclusions from this work task.

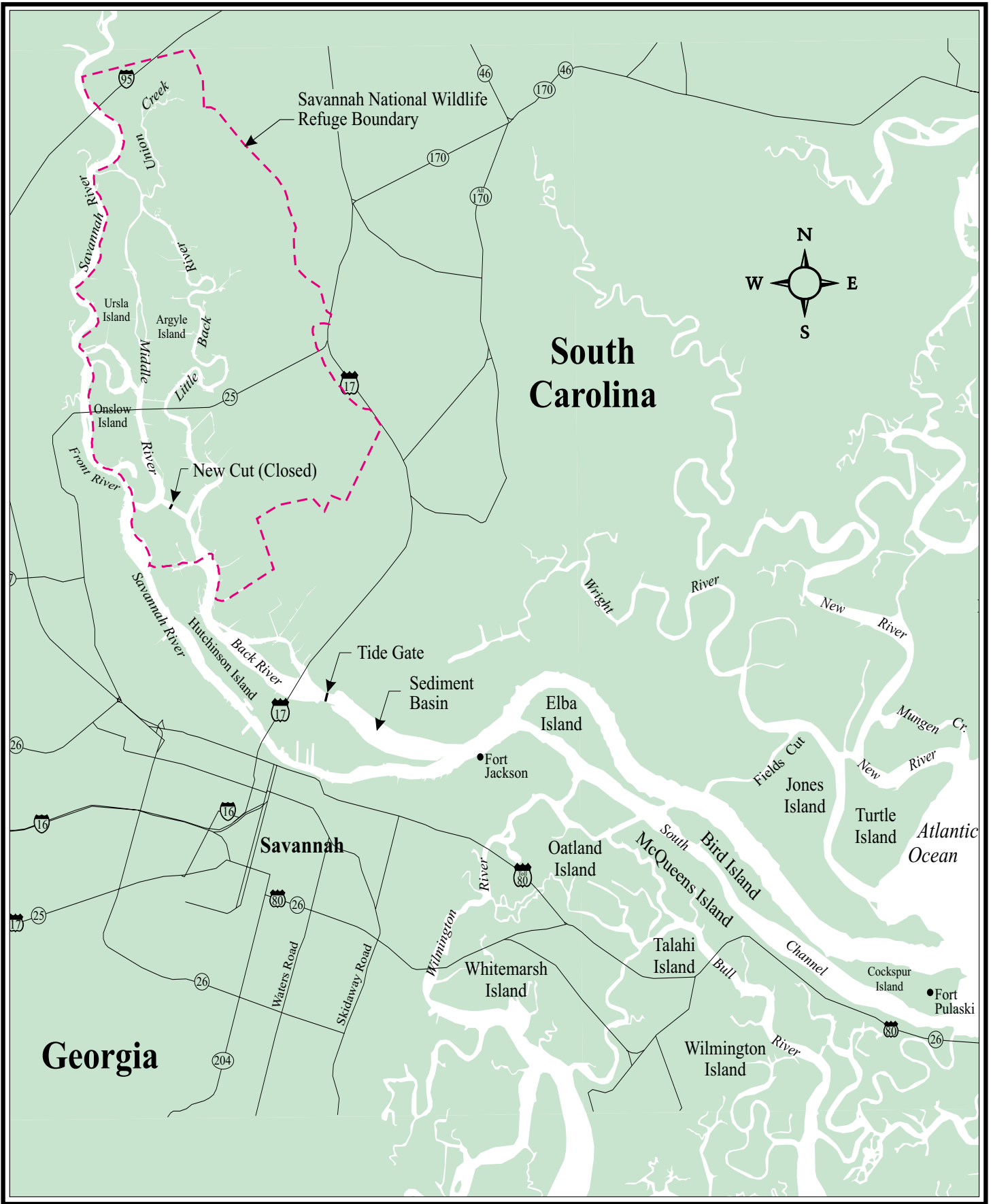
## **5.0 Schedule**

The following schedule is recommended for this project task.

- Approval of task scope: July 6, 1999
- Implement interstitial salinity algorithm: July 6, 1999 – Oct 1, 1999
- Verify hydrodynamic/salinity model: Oct 1, 1999 to Feb 1, 2000
- Finalize interstitial salinity algorithm from data and implement into model: Oct 1, 1999 to Feb 1, 2000
- Final Report Submittal: Mar 1, 2000

## **6.0 Related Issues**

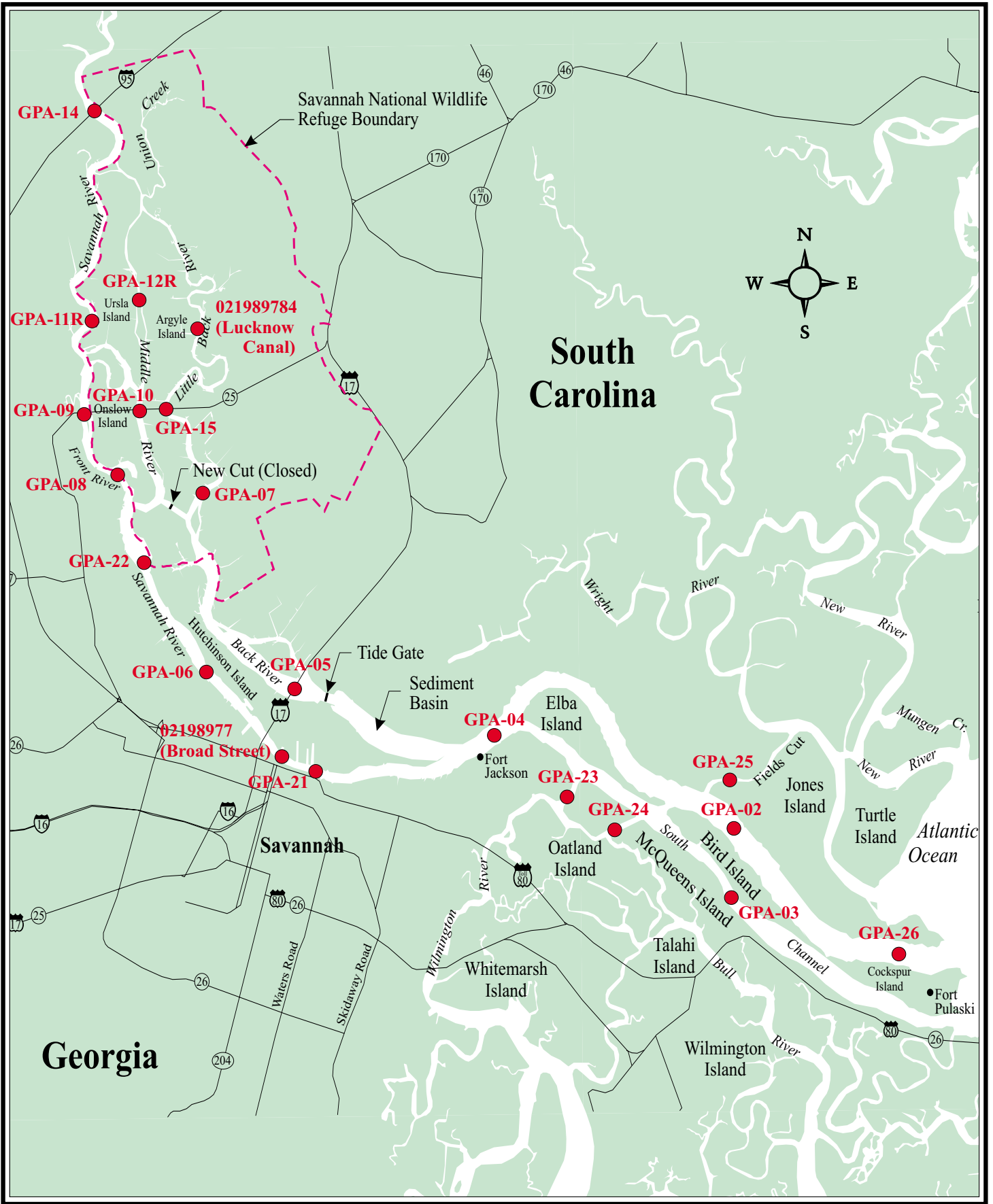
This task will provide the baseline information for the marsh succession evaluations, and therefore must be consistent with the goals and objectives of this work. In addition, the information must be sufficient to allow implementation of the marsh succession evaluation.



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Figure SEGDO2-1  
Extent of the Savannah National Wildlife Refuge

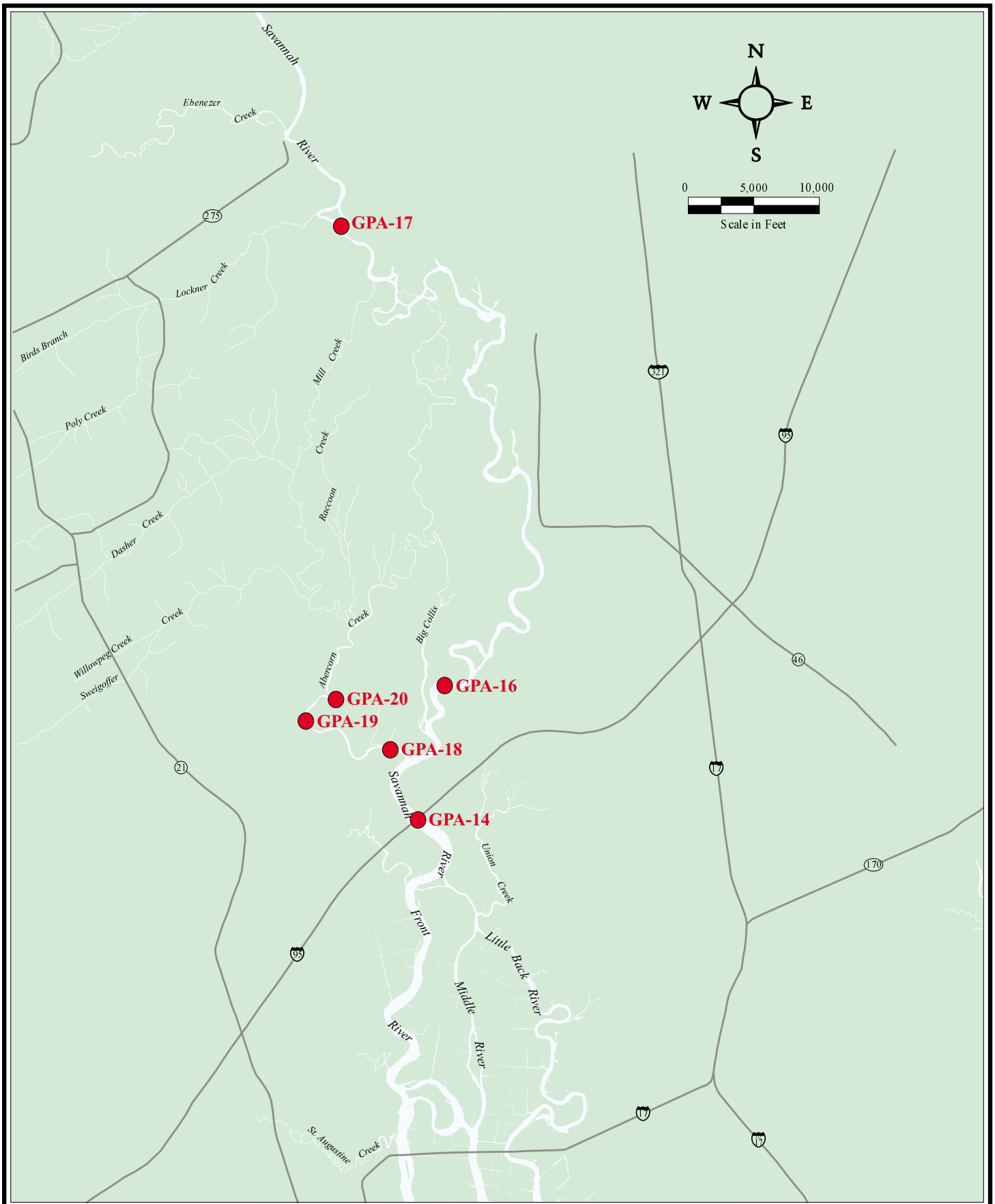




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Figure SEGDO2-2A  
Stations for Comparison of Tides Below the I-95 Bridge

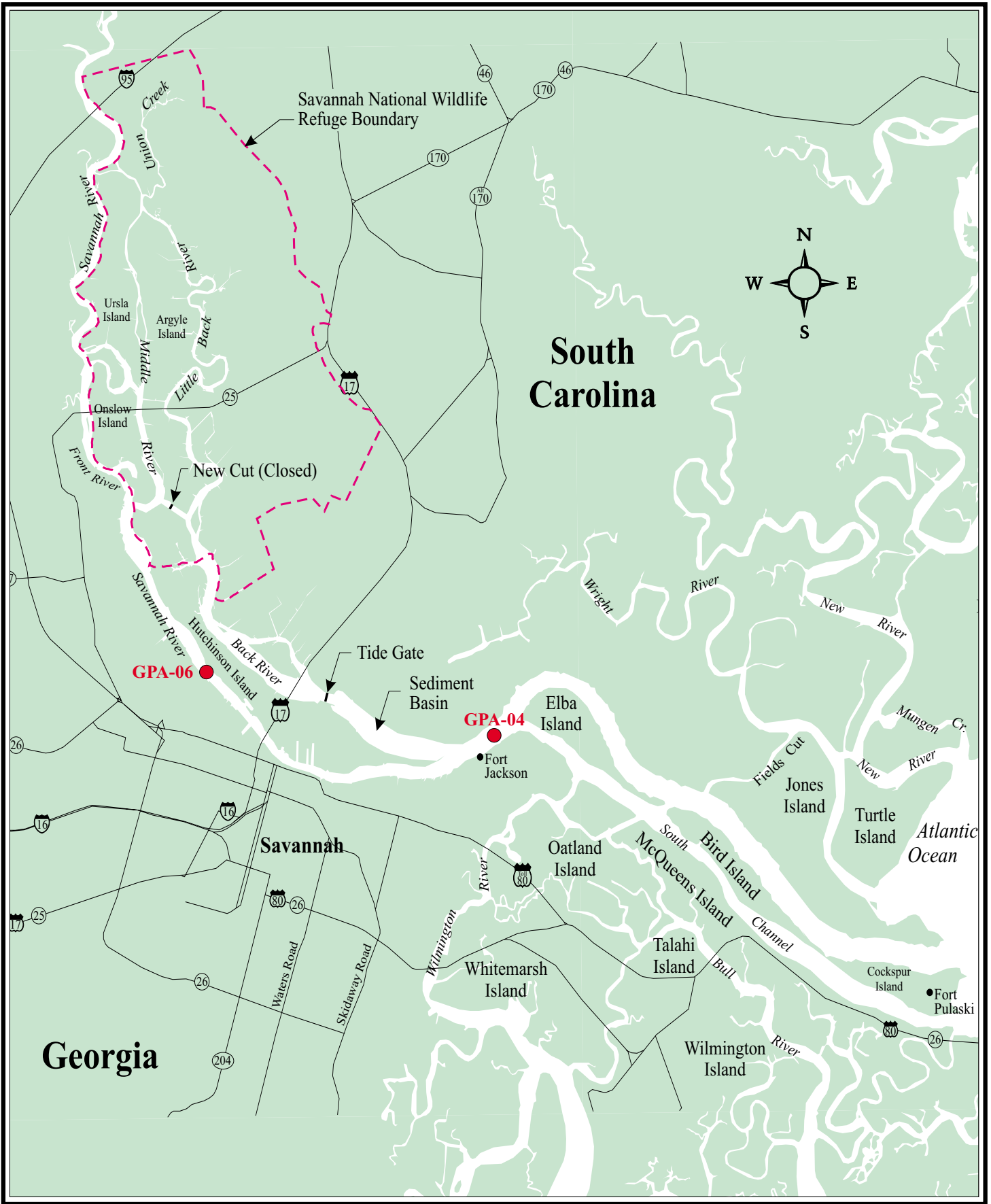




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Figure SEGDO2-2B  
 Stations for Comparison of Tides Above the I-95 Bridge

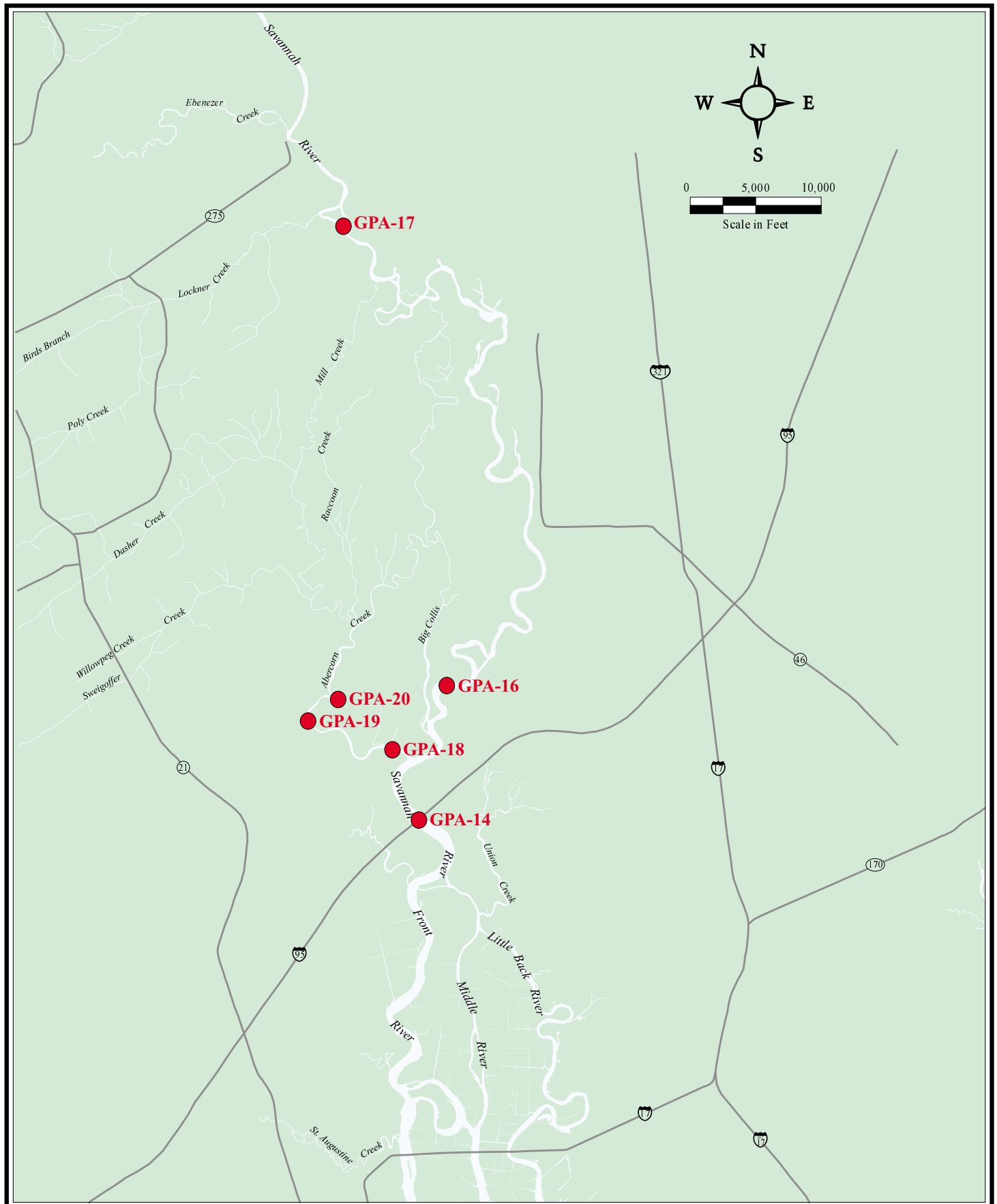




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Figure SEGDO2-3A  
Stations for Comparison of Currents Below the I-95 Bridge



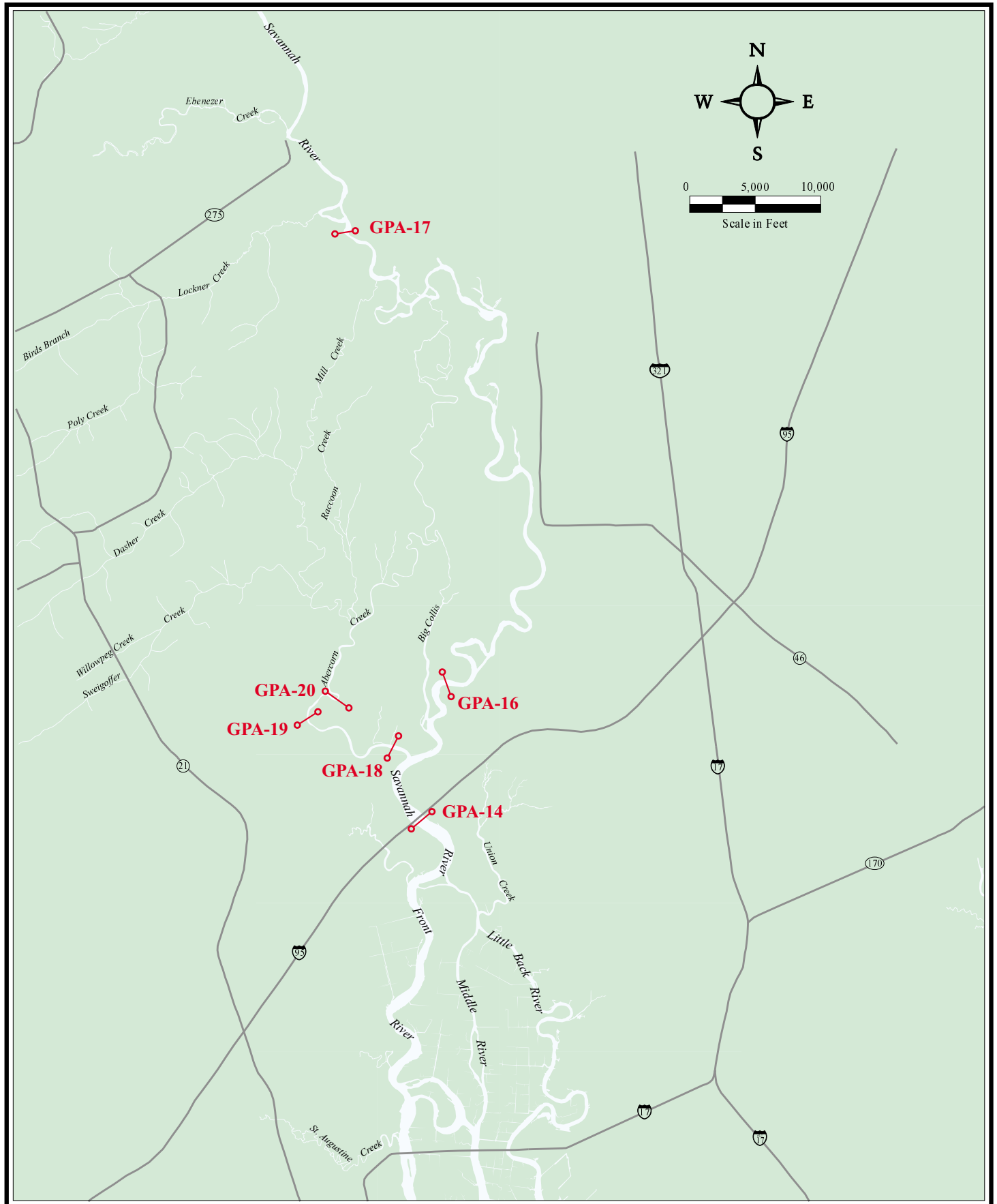


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Figure SEGDO2-3B  
 Stations for Comparison of Currents Above the I-95 Bridge



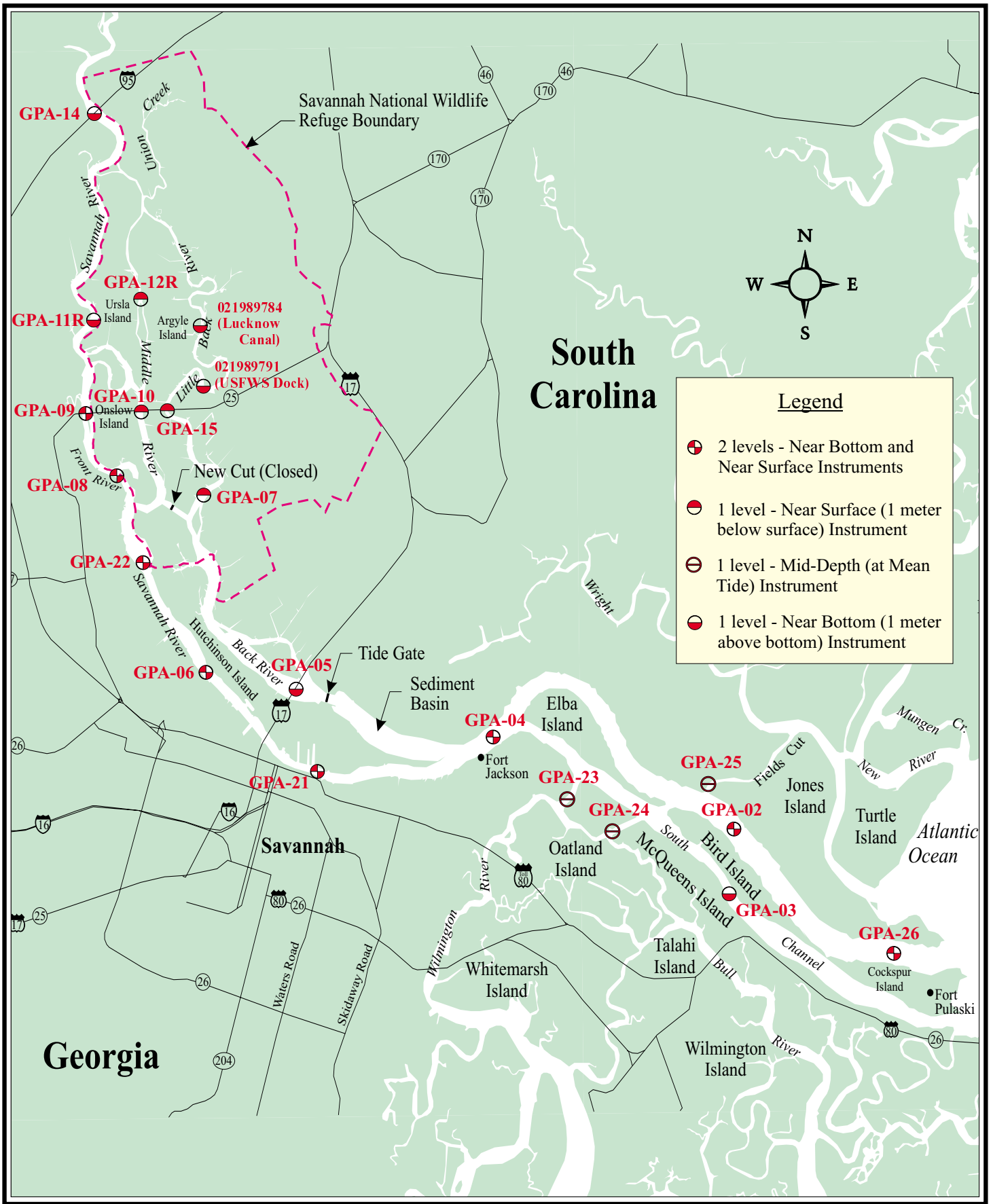




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Figure SEGDO2-4B  
 Cross-Sections for Comparison of Flows Above the I-95 Bridge





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Figure SEGDO2-5  
Stations for Comparison of Salinity

