Task SEGP312
Dissolved Oxygen
Field Data Collection

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TASK SEGP312

Dissolved Oxygen Field Data Collection

The following outline for Task SEGP312, Dissolved Oxygen Field Data Collection, 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).

1.0 TASK GOALS

The goal of this task is to provide sufficient data for use in the calibration and verification of the dissolved oxygen model. The dynamic conditions in the estuarine portion of the Savannah River result in a wide range of dissolved oxygen concentrations. Concerns have been raised that further deepening of the navigation channel may result in lower dissolved oxygen levels due to reduced velocities and increased stratification. Sufficiency of the data set will be based on the ability to calibrate the dissolved oxygen model to appropriately address various causes of oxygen demand, e.g., navigation point sources, non-point sources, SOD, marsh input, upstream loading, agitation dredging, etc. for use in evaluating project effects under critical conditions.

The dissolved oxygen model will be utilized to define the impact of the proposed deepening on the spatial and temporal concentrations of dissolved oxygen within the primary study area. Project effects on dissolved oxygen levels will be evaluated under critical conditions to determine the impact to aquatic species. For the purposes of this task, the primary study area extends from I-95 to the mouth of the Savannah River below Fort Pulaski, and includes the Middle River, the Back River, the Little Back River, and the South Channel.

2.0 PROJECT NEED

The dissolved oxygen model developed under the Tier I EIS was a simplified model whose purpose was to isolate the net impact of the proposed deepening under a set of representative summer conditions. During the public comment period, concerns were raised as to the capability of this simplified model to more completely address the true impacts of the deepening on the absolute levels of dissolved oxygen under a set of critical conditions. The comments focused specifically on the use of literature values for specific rates, kinetic constants, and boundary conditions rather than site-specific measurements. The comments focused on the following issues:

- Quantification of the characteristics and temporal variability of the point source loads within the study area.
- Quantification of the total loads entering the estuarine portion of the system from the upstream basin.
- Quantification of the influx of loads through the offshore and adjacent tributary boundaries.
- Quantification of the interactions between the surface waters and the wide expanse of adjacent marshes.
- Quantification of the site-specific interaction between the surface waters and the bottom sediments (i.e., sediment oxygen demand (SOD) and benthic flux rates).
- Quantification of the site-specific reaeration rates.

For model calibration, concurrent data sets are critical to allow evaluation of the relationships between these various processes and the in-stream dissolved oxygen concentrations. Therefore, a monitoring program has been designed that provides concurrent in-stream measurements of the dissolved oxygen and the in-stream dissolved oxygen demand kinetics and chemistry, such as was done in the summer of 1997. This in-stream data will be supplemented with data to quantify the processes identified above. The data must be collected during the critical warm summer months to provide calibration under the conditions of interest.

3.0 PROPOSED SCOPE

Under the Tier II EIS, three specific data collection efforts will occur concurrently. These are as follows:

- Task SEGP311: Chloride Study Field Data Collection
- Task SEGP312: Dissolved Oxygen Field Data Collection
- Task SEGP313: Marsh Salinity Field Data Collection

The purpose of performing these three tasks concurrently is to optimize the use of field equipment and personnel by allowing overlap in the data needs of each and the use of single stations to cover multiple tasks. Subsequently, although the Scopes are presented separately herein, they have been designed with significant overlap to reduce duplication of effort.

Under this proposed scope of work, the types of data, the locations, and the intervals are presented. The methodologies, mounting methods, protocols, and QA/QC procedures to be utilized during the monitoring program will be outlined in a Detailed Monitoring Plan once the general scopes of work are agreed upon under the SEG process.

3.1 DISSOLVED OXYGEN MONITORING PROGRAM

To address the issues raised under Section 2.0 and to address input received to date from SEG stakeholder representatives, the dissolved oxygen monitoring program is broken down into the following 11 components:

1. In-stream Measurements
2. Sediment/Water Column Interface Measurements
3. Determination of Site-Specific Reaeration Rates
4. Upper Basin Loading
5. Marsh Interaction
6. Wastewater Characterization
7. Meteorological Data
8. Primary Productivity Measurements
9. Local Non-Point Load Determination
10. Tritium Tracer Study
11. Artificial Point Source Load Study

The following provides a description of the work to be performed under each of these components. In addition, some of the components listed above will be completed under the Corps of Engineers (COE) Restoration Project. Those components to be completed

under the COE Restoration Project do not fall under the review of the SEG. For completeness, they are presented herein to show the overall data collection effort. Those components addressed under the COE Project are identified as such.

3.1.1 In-stream Measurements

The in-stream measurements of dissolved oxygen and the associated in-stream water chemistry will consist of continuous monitoring stations collecting data over a 45-day period from August 1, 1999 to September 15, 1999. In addition, periodic discrete samples of water chemistry and detailed profiles of in-situ parameters will be collected throughout the 45-day period.

For the continuous monitoring a total of 24 stations will be established. These stations will monitor the following parameters:

- Water surface elevation
- Temperature
- Conductivity
- Dissolved Oxygen
- pH
- Chloride

Although not necessary for the dissolved oxygen modeling, chloride concentration will be measured at all stations. These stations will serve dual purposes as water quality and chloride monitoring stations. Some of the stations established in the 1997 data collection effort will be re-established under the 1999 Monitoring Program. For these stations, the identification will remain consistent with the numbers established in 1997. Where new stations have been established, based upon additional data needs, new stations identification numbers have been assigned. Figures SEGP312-1A and SEGP312-1B present the water quality monitoring stations to be established under the 1999 Monitoring Program.

Of the 24 stations, 8 will collect data at two-levels (near bottom and near surface). The locations of these stations are identified in the figures. The two level stations will be at the following locations:

- Front River at Fort Pulaski (GPA-26)
- Front River midway between Fort Pulaski and Fort Jackson (GPA-02 from 1997)
- Front River at Fort Jackson (GPA-04 from 1997)
- Front River below Talmadge Bridge (GPA-21)
- Front River above Talmadge Bridge (GPA-06 from 1997)
- Front River at King's Island Turning Basin (GPA-22)
- Front River above entrance to Middle River (GPA-08 from 1997)
- Front River at Houlihan Bridge (GPA-09 from 1997)

Of the 24 stations, 16 will collect data at one level (bottom, mid-depth, or near surface). The locations of these stations, along with the vertical position of the sensors, are presented on the figures. The single level stations will be at the following locations:

- Elba Island Cut east of the South Channel (GPA-24)

- South Channel near Bird Island (GPA-03)
- Intracoastal Waterway Alternate Route east of South Channel (GPA-23)
- Fields Cut (GPA-25)
- Back River at US Highway 17A Bridge (GPA-05 from 1997)
- Little Back River near New Cut (GPA-07)
- Little Back River at Old Highway 17 Bridge (GPA-15 from 1997)
- Middle River at Old Highway 17 Bridge (GPA-10 from 1997)
- Front River above Steamboat Cut (GPA-11R)
- Middle River below McCoys Cut (GPA-12R)
- I-95 Bridge (GPA-14 from 1997)
- Front River above Big Collis Creek (GPA-16)
- Abercorn Creek near entrance to Savannah River (GPA-18)
- Abercorn Creek at the City of Savannah Intake (GPA-19)
- Abercorn Creek above the City of Savannah Intake (GPA-20)
- Front River above Fort Howard (GPA-17)

All of the stations will be collecting data to allow calculation of salinity (temperature and conductivity). Therefore, these stations will serve a dual purpose of providing in-stream salinity data for the marsh evaluations under Task SEGP313.

Discrete measurements of water chemistry will be collected throughout the seven-week study period. Water chemistry will be collected at all of the continuous monitoring stations at high- and low-slack tide on a weekly basis. In addition, a water chemistry sampling station will be located at Clyo (approximately River Mile 61.0) and will be sampled on a weekly basis. Where sea conditions permit, an additional sampling station will be located offshore. The parameters to be measured are:

- BOD5
- CBOD5
- Ammonia as Nitrogen
- Nitrate + Nitrite
- Total Kjeldahl Nitrogen (unfiltered)
- Total Phosphorus
- Orthophosphate
- Total Suspended Solids
- Turbidity

Grab samples will be collected at the surface and bottom where two levels of in-situ instruments are located, and at one level where only one instrument is located. During the second and seventh sampling weeks, the following additional list of parameters will be analyzed:

- Dissolved Organic Carbon
- Total Organic Carbon
- Filtered TKN
- Total Inorganic Phosphorus
- Dissolved Inorganic Phosphorus
- Total Dissolved Phosphorus

These will provide data on the fraction of particulate to dissolved constituents for use in the water quality modeling.

Four locations will be chosen for a 24-hour evaluation of the diurnal dynamics of the parameters listed above. Grabs will be taken every two hours over a 24-hour period at the four locations as well as vertical profiles of the in-situ parameters (temperature, conductivity, dissolved oxygen, and pH). Figure SEGP312-2 presents the 24-hour diurnal dynamics stations, these are as follows:

- Front River near Fort Pulaski
- Front River above Talmadge Bridge
- Front River above I-95 Bridge
- Little Back River near USF&W Dock

In addition, long-term BOD samples will be collected during the second, fourth, and sixth weeks at seven locations throughout the system at high and low slack tide. Figure SEGP312-3 presents the LTBOD sampling stations, these are as follows:

- Front River near Fort Pulaski
- Front River at Fort Jackson
- Front River above Talmadge Bridge
- Front River at I-95 Bridge
- Little Back River near USF&W Dock
- Inflow from Wilmington River to South Channel
- Clyo

Three tidal cycles will be chosen throughout the data collection period for detailed longitudinal profiling of the following in-situ parameters:

- Temperature
- Conductivity
- Dissolved Oxygen
- pH

Figure SEGP312-4 presents the locations of the stations to be sampled. These stations will be sampled synoptically at low slack and high slack tides on three separate days. These longitudinal profiles will provide more detail on the longitudinal and vertical structure of the salinity and dissolved oxygen. At each station measurements will be taken across the river at four locations to provide the cross-sectional distribution of each parameter as well as the vertical distribution. Due to historical low dissolved oxygen levels in the Sediment Basin on the Back River, sampling will occur in this region during the three longitudinal profiling events.

Bottom mounted ADCPs will be installed along the front river to measure the continuous velocity profile at two locations. Figure SEGP312-5 presents the locations of these instruments. In the 1997 data collection effort, ADCP meters were placed at two locations (GPA-08 and GPA-04). The data from GPA-08 showed primarily unidirectional currents over the water column under a range of flows from 5300 to 11000 cfs. In order to capture the longitudinal structure of the residual velocity profile and to identify the

point at which the inflowing bottom residual velocity goes to zero, the upstream station has been moved to GPA-06.

3.1.2 Sediment/Water Column Interface Measurements

This portion of the dissolved oxygen data collection will consist of determination of the relevant interactions between the water column and the benthic layer as it relates to dissolved oxygen. In particular this means quantification of the sediment oxygen demand and the nutrient fluxes.

At present, this work has been identified as being performed through the United States Environmental Protection Agencies (USEPA) Athens, Georgia office. This work is to be completed under the COE Restoration Project. The locations, durations, and methodologies for these measurements will be prepared by the USEPA Athens, Georgia office and presented within the Detailed Monitoring Plan. The technical aspects of this work will not be reviewed under the SEG process.

3.1.3 Determination of the Site-Specific Reaeration Rates

This portion of the dissolved oxygen data collection will consist of determination of the site-specific reaeration rates within the estuarine portion of the Savannah River. The measurements will be based on a single time period within the seven-week data collection.

Presently it is anticipated that site-specific measurements of the reaeration rates will be evaluated using floating diffusion chambers. ADCP velocity transects, and in-situ water quality transects, will be collected in conjunction with the diffusion chamber measurements. The water quality transects will be measured over the vertical and over the cross-section for the following parameters:

- Temperature
- Conductivity
- Dissolved Oxygen
- pH

At present, this work has been identified as being performed through the United States Environmental Protection Agencies (USEPA) Athens, Georgia office. This work is to be completed under the COE Restoration Project. The locations, durations, and methodologies for these measurements will be prepared by the USEPA Athens, Georgia office and presented within the Detailed Monitoring Plan. The technical aspects of this work will not be reviewed under the SEG process.

3.1.4 Upper Basin Loading

The goal of this sub-task is to quantify the influx of all relevant water quality parameters to the upper reaches of the estuarine portion of the Savannah River. Under Sub-Task 3.1.1 measurements of water chemistry and in-situ parameters will occur at the I-95 Bridge as well as upstream above Fort Howard and at the Clyo gaging station. These data will provide quantification of the influx to the estuarine portion of the river.

Additionally, the USEPA Atlanta Office, in cooperation with the Georgia Environmental Protection Division (GAEPD), will be developing a basinwide model which will extend down below Clyo to the I-95 Bridge. This overlap between the Upper Basin Model and the estuarine model will allow USEPA to provide loading estimates for the estuarine model runs. These loading estimates will be compared with measured values to determine appropriate influx rates and concentrations. The technical aspects of all work described under this section will not be reviewed under the SEG process.

3.1.5 Marsh Exchange Rates

In the public comments to the Tier I EIS, concerns were raised relative to the amount of site-specific data relating to the exchange of nutrients and oxygen demanding material between the surface waters and the adjacent marshes. The comments note that in general "the marsh areas are in equilibrium and do not directly affect water quality in the study area. Previous studies note an exception is the inland marsh of the Savannah National Wildlife Refuge, where dissolved oxygen concentrations during ebbing flow were substantially reduced over those into the marsh during the flood." Under this sub-task, measurements of the specific exchange of nutrients, dissolved oxygen, and oxygen demanding material will be measured.

Marsh flux rates developed by the EPD in the late 1980's will be examined before the data collection begins.

Five representative tributaries, that exchange waters with the marshes of the Savannah National Wildlife Refuge, will be sampled over a tidal cycle to determine the mass balance of inflow versus outflow. Transect locations for the tributaries are shown in Figure SEGP312-6. Transects 1, 3, and 4 are floating-mat marshes with intermediate water. Transect 2 is a floating-mat marsh with fresh water. Transect 5 is a grass-stand marsh with brackish water. In-situ parameters to be measured at 30-minute intervals include:

- Flow rate
- Temperature
- Conductivity
- Dissolved Oxygen
- pH

Composite samples over a 15-minute period, every hour will be collected and analyzed for the following:

- CBOD5
- BOD5
- Ammonia as Nitrogen
- Nitrate + Nitrite
- Total Kjeldahl Nitrogen (unfiltered)
- Total Phosphorus
- Orthophosphate
- Total Suspended Solids
- Turbidity

Additionally, for each of the tributaries, a single long-term BOD sample will be collected on inflow and on outflow. Each tributary will be sampled twice during the seven-week data collection effort.

3.1.6 Characterization of the Point Source Discharges

This portion of the dissolved oxygen data collection will consist of determination of the characteristics of the primary point source loads to the system. Figure SEGP312-7 presents the locations of the primary discharges below the I-95 Bridge.

For each of the discharges, composite samples are to be taken over a 24-hour period on a weekly basis throughout the data collection period. All composites are to be analyzed for the following parameters:

- BOD5
- CBOD5
- Ammonia as Nitrogen
- Nitrate + Nitrite
- Total Kjeldahl Nitrogen (unfiltered)
- Total Phosphorus
- Orthophosphate
- Total Suspended Solids
- Turbidity

Of the seven sampling events throughout the data collection effort, three will include additional composite samples to be analyzed for long-term biochemical oxygen demand.

Finally, hourly readings of the following parameters will be measured concurrently with the hourly composite sample collection:

- Dissolved Oxygen
- Temperature
- Conductivity
- pH

At present, this work has been identified as being completed under the COE Restoration Project. The discharges sampled, sample locations, and methodologies for these measurements will be prepared under a separate document. The technical aspects of this work, and any subsequent modifications, will not come under the SEG review process.

3.1.7 Meteorological Data

Under this task, three meteorological stations will be established along the river. The station locations are presented in Figure SEGP312-8A and SEGP312-8B and are as follows:

- Front River at Fort Pulaski (GPA-26)
- Front River above Talmadge Bridge (GPA-06 from 1997)
- Front River above Fort Howard (GPA-17)

The parameters to be measured continuously throughout the study period are:

- Wind speed
- Wind direction
- Wet/dry bulb air temperature
- Incident solar radiation
- Relative humidity
- Rainfall
- Atmospheric Pressure

The meteorological stations will be the first stations installed and the last to be retrieved.

Atmospheric deposition potential will be examined before data collection begins to determine its significance in the Lower Savannah Estuary. Results from the Chesapeake Bay program and the Tampa Bay project will be utilized for this evaluation. If there appears to be a significant contribution of nitrogen from the atmosphere, a contingency plan will be developed to collect ammonia data at the three meteorological stations.

3.1.8 Primary Productivity Measurements

Data collected throughout the Lower Savannah Harbor Estuary in 1997 suggest that primary production is not a major component of the dissolved oxygen balance in the system. In order to confirm that hypothesis, ATM will collect water samples within the photic zone in conjunction with the water chemistry grab sampling described in Section 3.1.1. The samples will be analyzed for chlorophyll-a. The methodology for sample collection was prescribed by the EPA Athens Laboratory and is presented below.

In order to determine the light available for phytoplankton production, measurements of solar energy and light attenuation will be conducted. Solar radiation will be measured at the meteorological stations, while local vertical profiles of available light will be collected using a portable light meter (e.g., LICOR). After the light attenuation profile is determined, water samples will be collected for chlorophyll-a analysis from the 90, 50 and 10 percent incident light depth (EPA recommendation). However, at shallow locations where light penetration extends to the bottom, water samples will be collected from just below the surface (at 2 feet) and near the bottom. In addition where light penetration is limited (i.e., 10 percent light less than 2 meters), samples will not be collected in layers smaller than 1 meter. Secchi depth will be measured in conjunction with the light penetration.

In Section 3.1.1, the weekly collection of water chemistry samples was outlined. The primary productivity sampling outlined above will coincide with the times and locations of the weekly water chemistry samples.

3.1.9 Local Non-Point Load Determination

The MTRG has recommended that some local non-point source data be obtained during the summer 1999 data collection. At present, it has been recommended that, if feasible,

this task should be performed by the City of Savannah. In addition, it has been recommended that this work be completed under the COE Restoration Project. The locations, duration, and methodologies for these measurements will be prepared by the City of Savannah. The technical aspects of this work will not be reviewed under the SEG process.

3.1.10 Tritium Tracer Study

The MTRG has recommended that a tracer study be conducted using Tritium concentrations presently flowing downstream into the Lower Harbor. This work should be conducted during the summer 1999 data collection. At present, it has been recommended that, if feasible, this task should be performed by ATM. In addition, it has been recommended that this work be completed under the COE Restoration Project. The locations, duration, and methodologies for these measurements will be prepared by the City of Savannah and reviewed by the MTRG. The technical aspects of this work will not be reviewed under the SEG process.

3.1.11 Artificial Point Source Load Study

The MTRG has recommended that an artificial point source load be discharged from the existing Stone Container Facility for a specified period during the summer 1999 field data collection effort. This would provide the dissolved oxygen conditions with and without this discharge, and would allow testing of the model under varying point source load conditions. At present, it has been recommended that, if feasible, this task should be performed through the local industries, under the COE Restoration Project. The locations, duration, and methodologies for this task will be prepared under the supervision of the MTRG. The technical aspects of this work will not be reviewed under the SEG process.

Under the full data collection program (Sections 3.1.1 to 3.1.11), a contingency plan has been identified that will provide for a meeting of the MTRG near the end of the data collection effort to present the measured data collected to date. At that meeting it will be determined if the data set is sufficient for the designed purposes. If the data set is deemed insufficient, the MTRG will propose a time period for extending the data collection effort.

4.0 EVALUATIONS REQUIRED

Under SEG review of this task, criteria need to be defined for the following:

- The range of conditions that need to be captured in the data collection in order to assure a sufficient data set for model calibration.
- Review of QA/QC protocols and methodologies to assure quality data for all sub-tasks including those performed by outside agencies.

5.0 DELIVERABLES

The deliverable for this task will be a data report that presents the methodologies, QA/QC protocols, description of the data collection effort, and all of the raw data collected. Where outside agencies are responsible for the data collection, if they provide the data in a reasonable time frame and format, this data will be included in the report. If

not, the data will be presented as supplemental reports. It is anticipated that the long-term BOD tests will not be completed in time for inclusion in the data report. This information will be provided in a supplemental report.

6.0 SCHEDULE

The field effort is scheduled for a total of 10 weeks on-site. Two weeks will be needed for instrument installation, 7 weeks for data collection, and 1 week for instrument retrieval. The goal is to provide 7 weeks of data starting on August 1, 1999 and running through September 15, 1999. The completion date to be contingent upon the MTRG data assessment meeting to be held in early September. On completion of the data collection effort the report listed under Section 5 will be prepared within six weeks. In order to achieve this schedule the following milestones must be met:

- Detailed Monitoring Plan will be available on April 1, 1999
- Initial Field Reconnaissance: April 12 to 16, 1999
- Begin ordering field equipment, submit permit applications, and prepare for field deployment: April 12, 1999
- Begin set up of field office: July 1, 1999
- Install instruments: July 15 to August 1, 1999
- Collect Data: August 1, 1999 to September 15, 1999 (contingent upon MTRG meeting to be held in early September 1999)
- MTRG Data Review Meeting: Early September 1999
- Retrieve Instruments: September 15 to September 24 (contingent upon MTRG meeting to be held in early September 1999)
- Submit Dissolved Oxygen Data Report: November 1, 1999 (contingent upon MTRG meeting to be held in early September 1999)

7.0 RELATED ISSUES

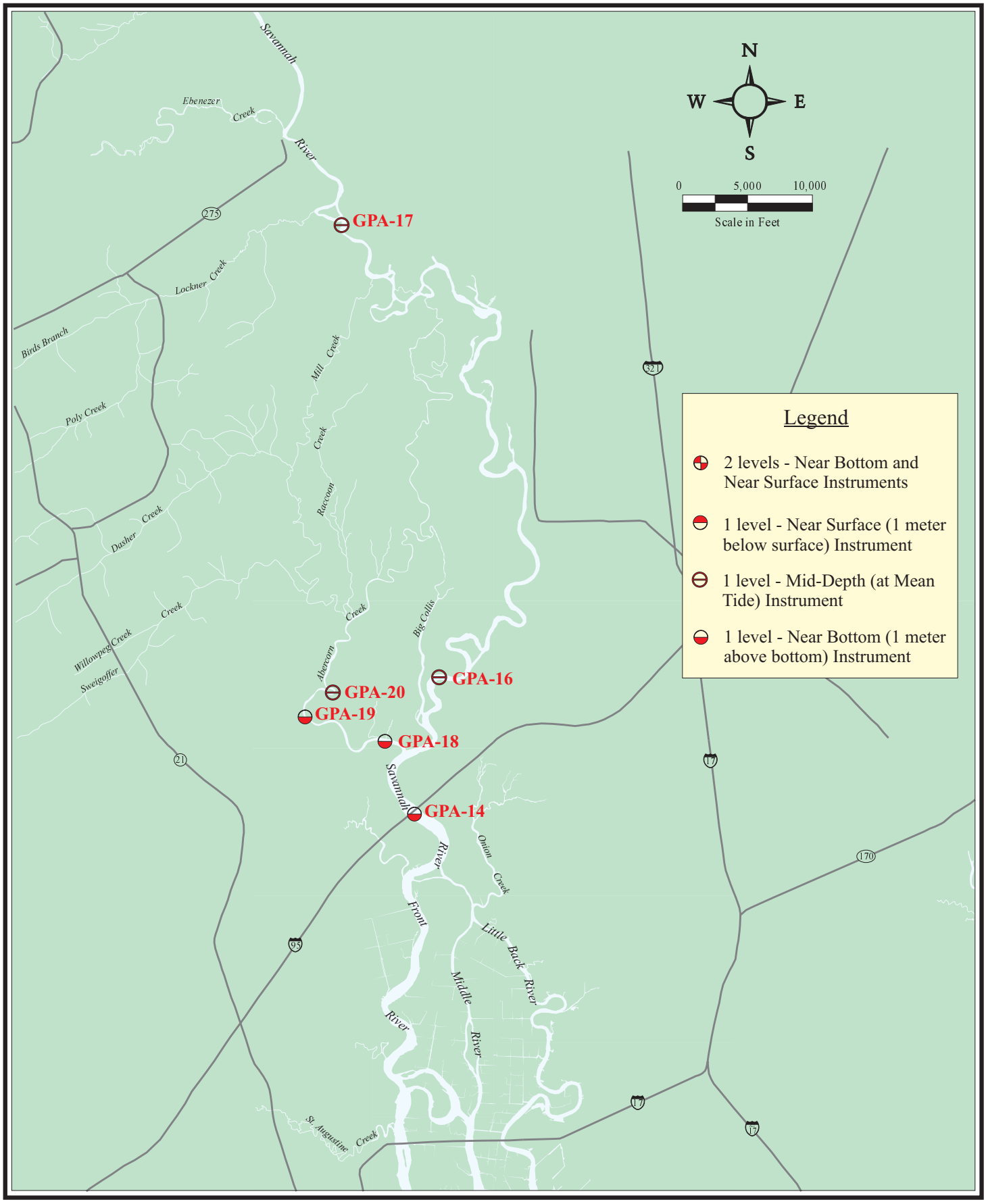
This task will be implemented under a Detailed Monitoring Plan for tasks SEGP311, SEGP312, and SEGP313. In addition, numerous data collection efforts have been identified as being completed under the COE Restoration Project. It is anticipated that these parallel efforts will occur in a timely manner and will parallel the schedule outlined above. The goal is to provide all data within the Data Report excluding the long-term BOD data. If these parallel efforts do not proceed in a timely manner, and data provided in time for inclusion to the Data Report, delays in the calibration of the model to be completed under Task SEGP334 will result.

Upon completion of the deepening evaluation, the dissolved oxygen model will be provided to the United States Army Corps of Engineers (USACOE) under their Restoration Project, for use in evaluating ecosystem restoration alternatives. In addition, the model will be used to quantify the Total Maximum Daily Load (TMDL) for the estuarine portion of the Lower Savannah River.

Figure SEGP312-1A
GPA Water Quality Monitoring Stations
Below the I-95 Bridge

APPLIED TECHNOLOGY & MANAGEMENT, INC.

991312-1A.CDR 03/02/99



991312-1B.CDR 03/02/99

Figure SEGP312-1B
GPA Water Quality Monitoring Stations
Above the I-95 Bridge

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991312-2.CDR 03/02/99

Figure SEGP312-2
24-Hour Dynamic Sampling Stations

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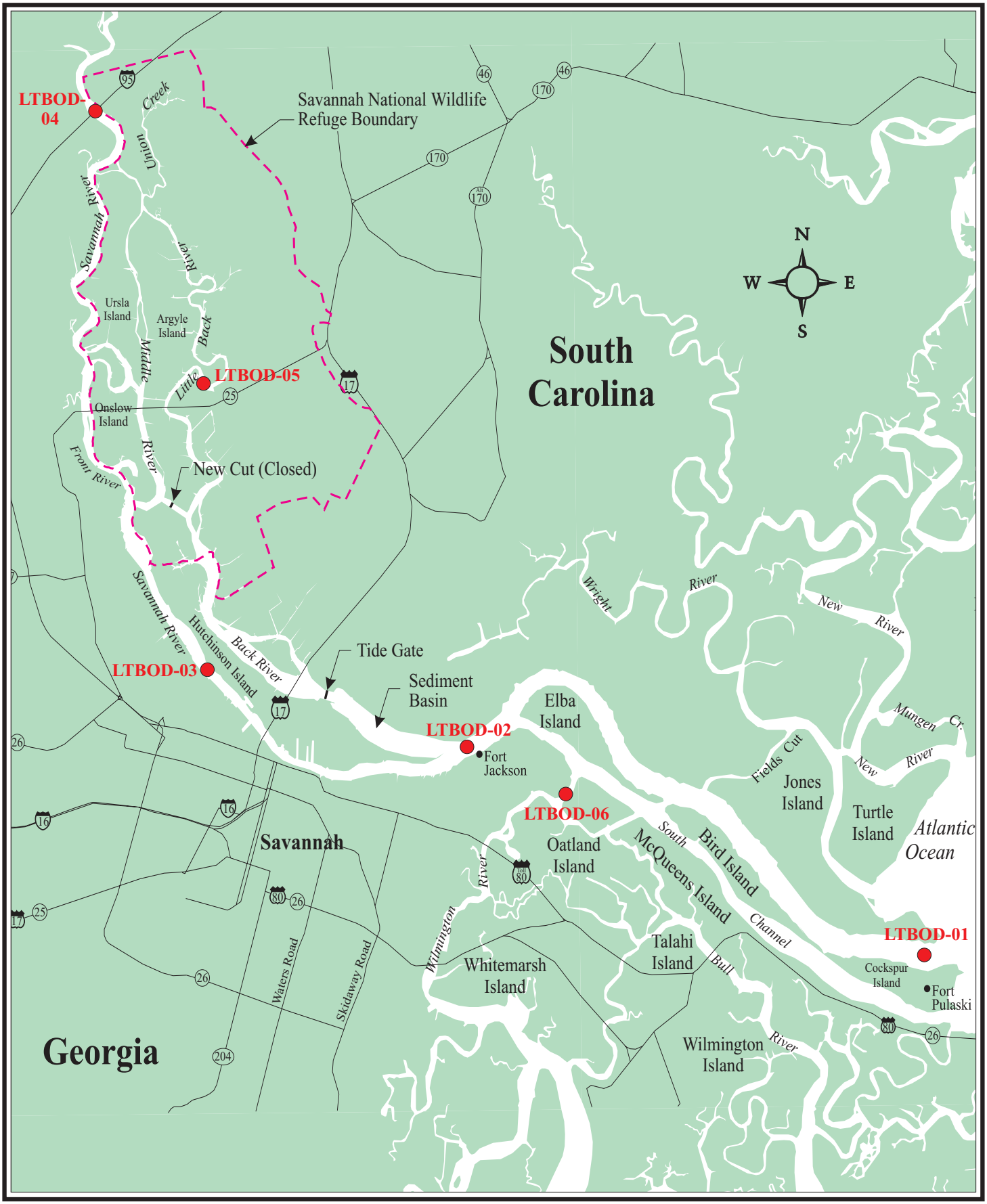

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Figure SEGP312-3
Long-term Biochemical Oxygen Demand
Composite Samples

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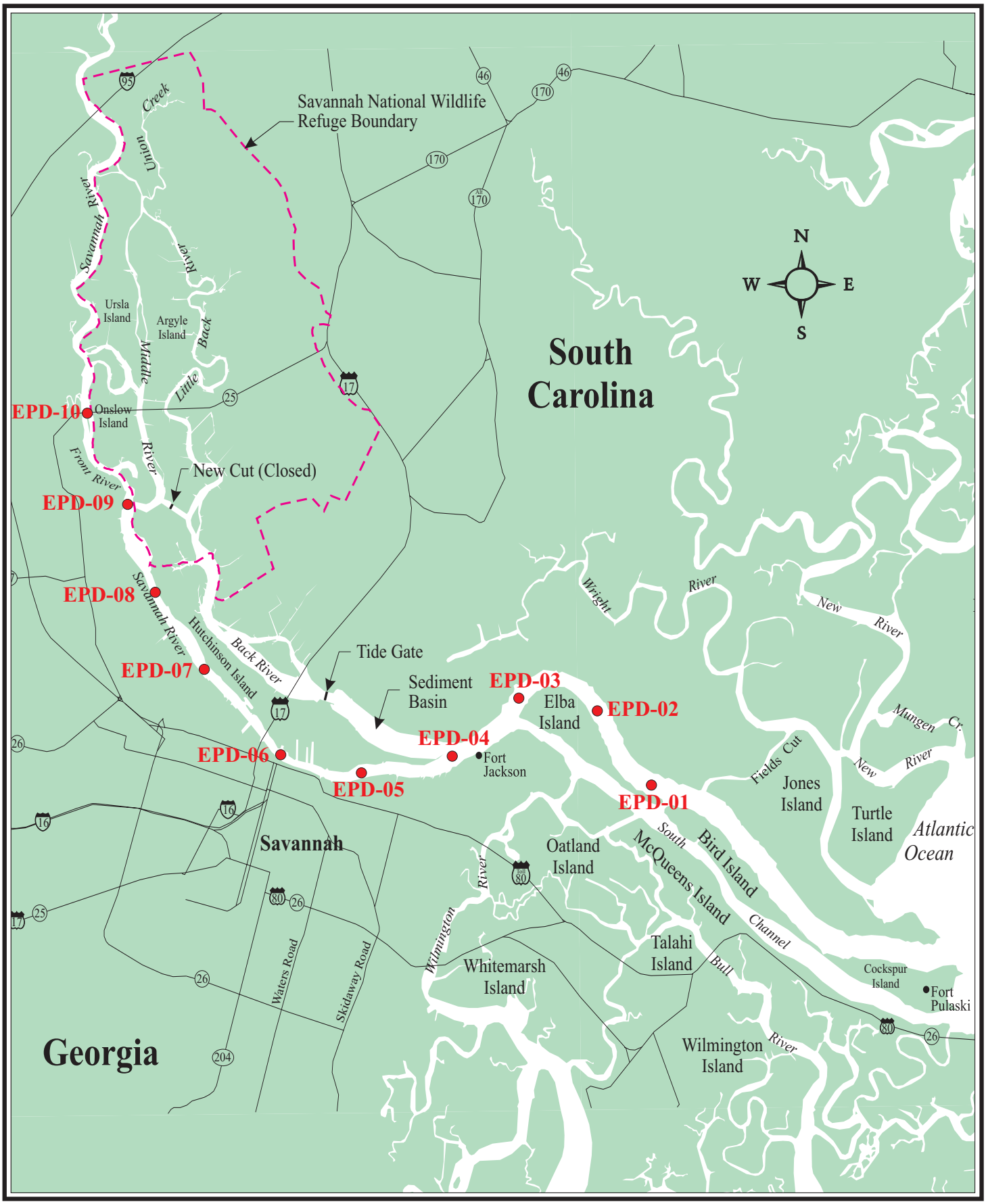

991312-4.CDR 03/02/99

Figure SEGP312-4
Longitudinal Profile Stations

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991312-5.CDR 03/02/99

Figure SEGP312-5
Bottom Mounted ADCP Velocity Profilers

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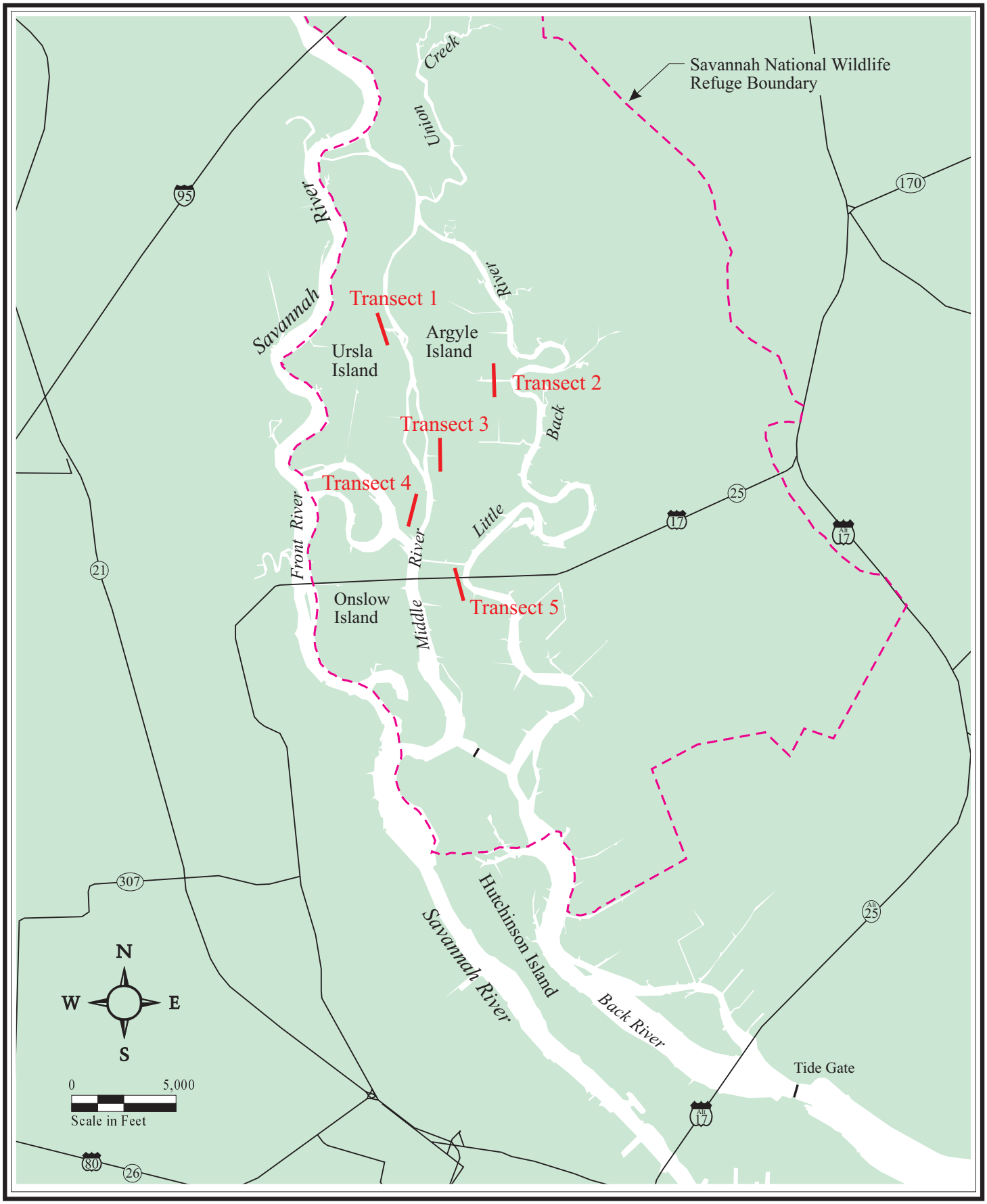

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Figure SEGP312-6
Transect Locations for Marsh Nutrient/BOD Exchange Measurements

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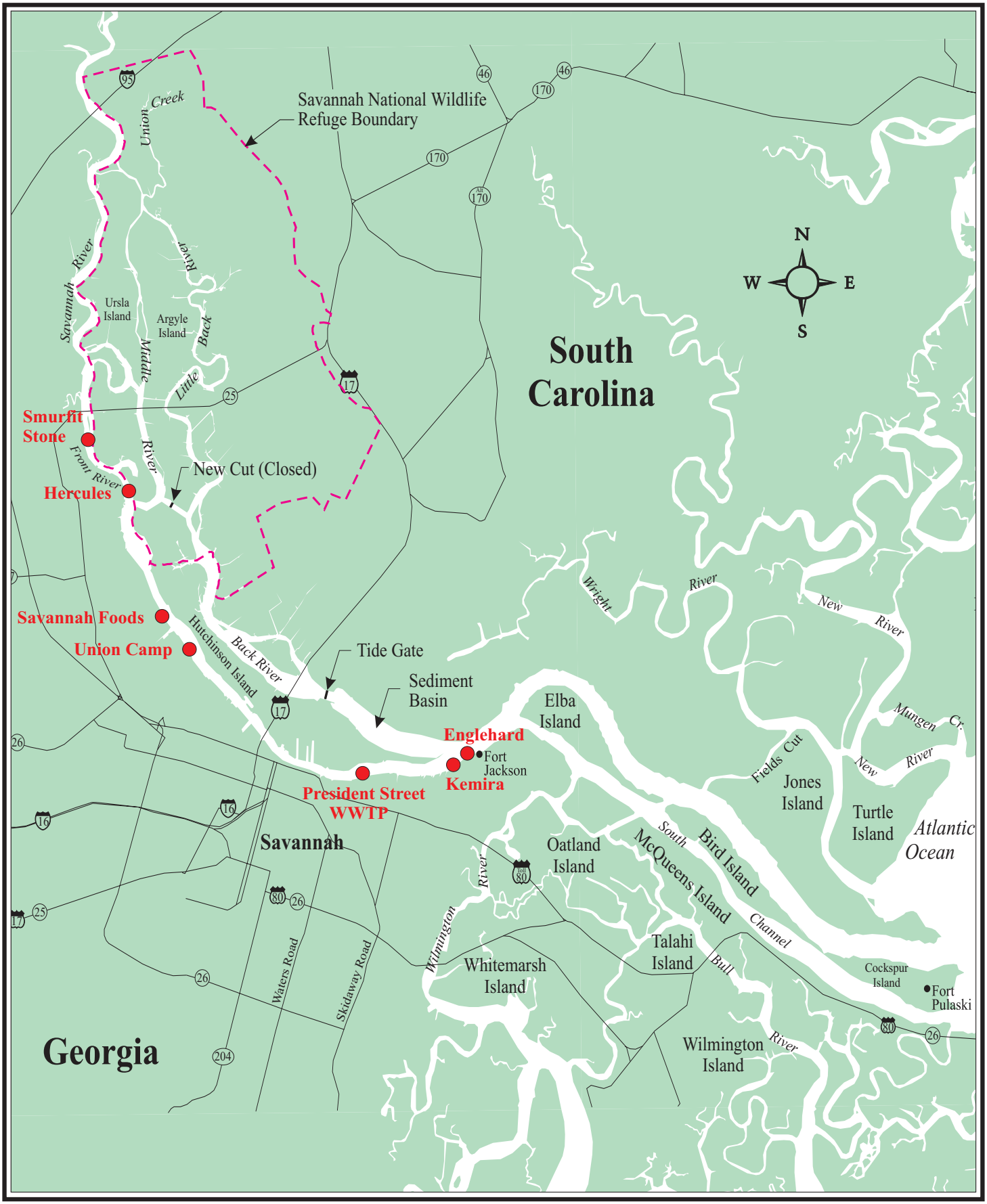

991312-7.CDR 03/02/99

Figure SEGP312-7
Locations of Primary Discharges Along the
Lower Savannah River

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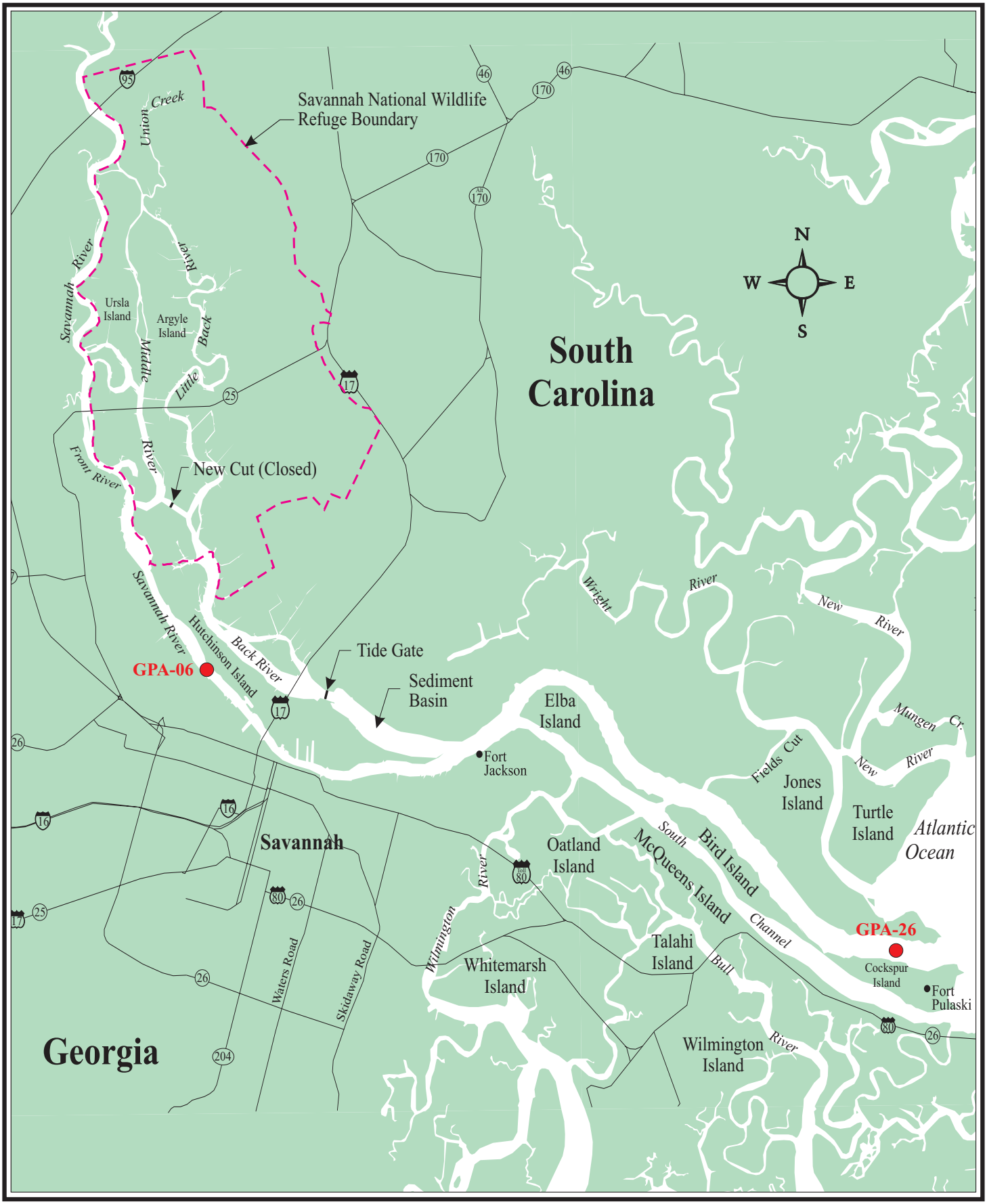

991312-8A.CDR 03/02/99

Figure SEGP312-8A
Locations of Meteorological Stations
Below the I-95 Bridge

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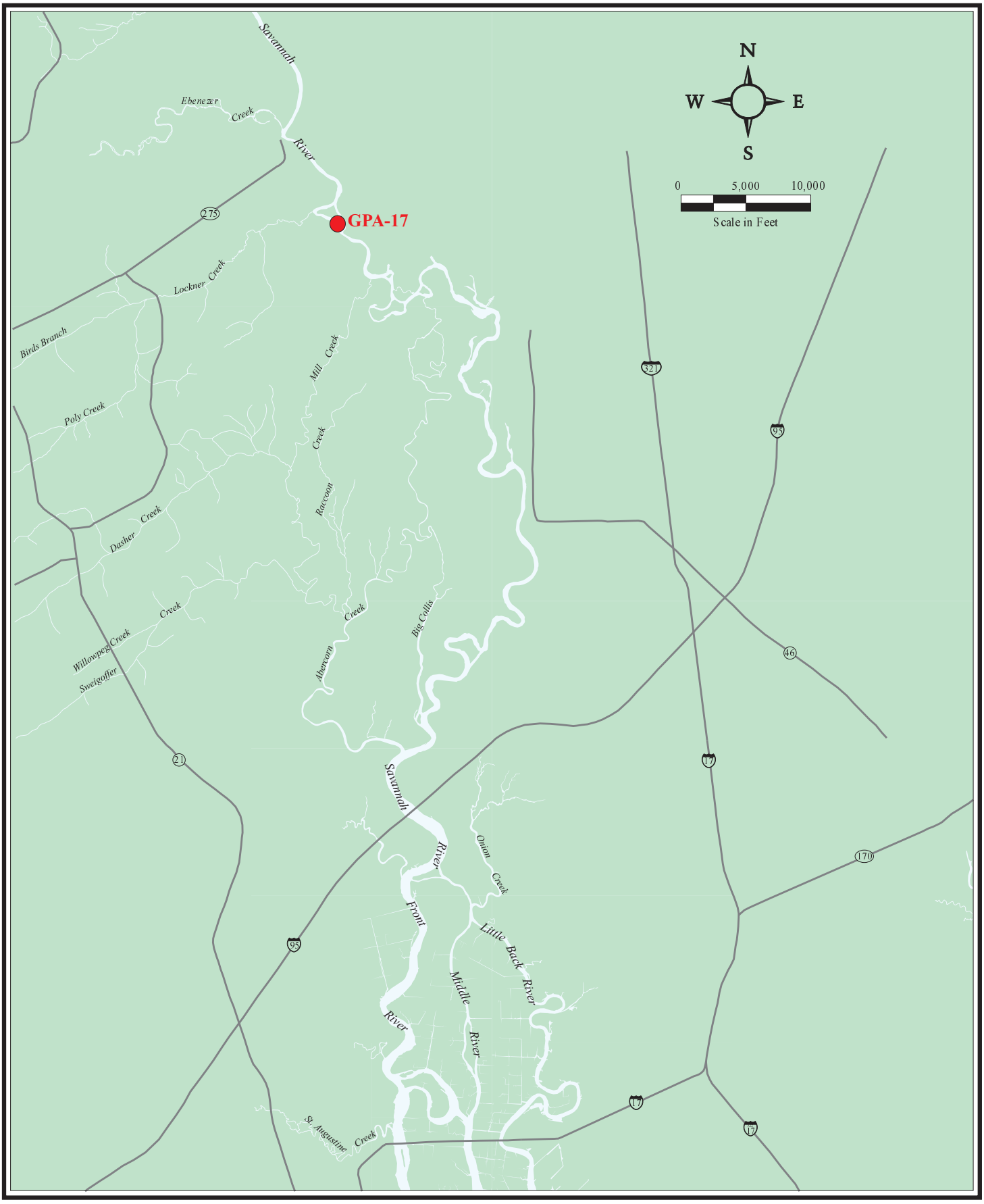

991312-8B.CDR 03/02/99

Figure SEGP312-8B
Locations of Meteorological Stations
Above the I-95 Bridge

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