Section 404(b)(1) Evaluation of Dredge and Fill Material

ENCLOSURE B

Section 404(b)(1) Evaluation
For the Savannah Harbor Deepening Project

1.0 INTRODUCTION

Section 404(b)(1) of the Clean Water Act (CWA) of 1972 requires that any proposed discharge of dredged or fill material into waters of the United States must be evaluated using the guidelines developed by the Administrator of the U.S. Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army. These guidelines can be found in Title 40, Part 230 of the Code of Federal Regulations. The following evaluation is prepared in accordance with the guidelines and follows the recommended format contained in ER 1105-2-100, of December 28, 1990.

2.0 PROJECT DESCRIPTION

The Georgia Ports Authority (GPA) conducted studies to be used by the U.S. Army Corps of Engineers (USACE) to produce an Environmental Impact Statement (EIS) under Section 203 of the Water Resources Development Act (WRDA) of 1986. Among other concerns, the EIS assessed the potential environmental effects of deepening a portion of the existing Savannah Harbor to better serve the economic interests of the State of Georgia and federal interests in navigation. In order to qualify as a federal navigation project, the study must meet all applicable federal regulations. The EIS explores four (4) deepening alternatives and evaluate each of these according to appropriate environmental and economic criteria. The alternatives include deepening the existing channel by 2 feet, 4 feet, 6 feet, and 8 feet plus appropriate overdredge allowances and advanced maintenance.

A necessary component of the EIS is the evaluation of the proposed discharge of dredged or fill material into waters of the United States, including wetlands, in accordance with Section 404(b)(1) of the Clean Water Act of 1977 (CWA). Guidelines for the CWA generally follow Title 40, Part 230 of the Code of Federal Regulations and were developed by the U.S. Environmental Protection Agency (USEPA) in conjunction with the Secretary of the Army. The purpose of this Enclosure to the EIS is to provide the necessary Section 404(b)(1) evaluation as it pertains to disposal of dredged material from the Savannah Harbor deepening project, as well as future operations and maintenance, into previously designated Confined Disposal Facilities.

2.1 Project Location

Savannah Harbor is a deep-draft harbor located on the South Atlantic U.S. coast 75 statute miles south of Charleston Harbor, South Carolina and 120 statute miles north of Jacksonville Harbor, Florida (USACE, 1996). The Inner Harbor (IH) area proposed for deepening roughly corresponds to channel Stations 0+000 (near Fort Pulaski) to 103+000 (above the Kings Island Turning Basin) and comprises 103,000 river feet. The Bar Channel (BC), or ocean channel, proposed for deepening begins at Station 0+000 and extends to a maximum length[1] of approximately 85,000 feet [Station (-)85+000B] offshore. The maximum proposed project length which could potentially result in being deepened, considering both the IH and BC segments, is therefore approximately 36 miles. Because the dredging and disposal of sediments from the BC out to Station (-)85+000B is governed by Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), the Section 404(b)(1) evaluation *only* addresses the dredging and disposal of sediments from the Inner Harbor. Ocean dredging and disposal associated with improvements to the BC are addressed separately in Enclosure D to the EIS, which presents the requisite Section 103 Evaluation.

[1] Each incremental deepening alternative necessarily lengthens the seaward portion of the Bar Channel to the point where the seabed elevation matches the channel depth.

The information presented in this Enclosure follows the formatting guidance provided in Engineer Regulation (ER) 1105-2-100, Appendix N (USACE, 1990), where such information is applicable to the Savannah Harbor Deepening Project.

2.2 Authority and Purpose

Container traffic at the port of Savannah during 1991-1995 increased by 20 percent, an increase that greatly exceeded projections. Continued growth of the port necessitates that it remains efficient and cost competitive. To this end the port must be able to accommodate ships of the future, i.e., larger and newer vessels with a capacity greater than 6,000 TEUs (20-Foot Equivalent Units). Investigations, most notably the USACE *Reconnaissance Report* of August 1996, have indicated that the best method to accomplish this goal would be through channel deepening. The project aims to achieve these goals with minimal environmental impact.

The Savannah Harbor Comprehensive Study was authorized by a resolution adopted by the Senate Committee on Public Works on July 10, 1972. The House of representatives Committee on Public Works adopted a similar resolution for the study on October 12, 1972.

Study tasks in support of all the above described phases of the *EIS* have been performed by a team, which includes the USACE; Georgia Port Authority (GPA); Lockwood Greene Engineers (LGE); Applied Technology and Management, Inc. (ATM); Booz Allen, and Hamilton; Applied Science Associates; and Rees Engineering and Environmental Services.

3.0 GENERAL DESCRIPTION OF DREDGED OR FILL MATERIAL AND QUANITY OF DREDGED MATERIAL

3.1 Quantity of Dredged Materials

The location of the Inner Harbor (IH) segment of the Savannah Harbor project is shown in Figure C-1. Material (sediment) proposed for removal will originate from the following areas

- existing channel centerline and side slope cuts;
- existing channel wideners and turning basins;
- proposed (new work) side slope and channel centerline cuts;
- proposed (new) channel bend wideners; and,
- excess (non-pay) sediment

Material excavation for the proposed Project will consist of sediments which reside within the maintenance, overdredge and advanced maintenance prisms associated with each of the 2 ft incremental deepening alternatives.

It is important to note that maintenance dredging of the navigation channel is required even for the "No Action" Alternative. This dredging is typically performed on a yearly basis. Analysis of historic data, shown in Table C-1, reveals the annual shoaling rates experienced in the harbor.

Table C-1

Annual Shoaling Rate

Time Period	Channel Depth (feet below MLW)	Annual Shoaling Rate (MCY/year)
1923 to 1925	26	2.8
1931 to 1932	26	4.3
1939 to 1944	30	6.2
1953 to 1954	34	7.2
1953 to 1962	36	7.3
1972 through 1981	38	7.2
FY91 through FY93	38	6.5

The data show that the quantity of sediments required to be excavated from the Navigation Project each year has remained just above 7 million cubic yards over the last 40 years. The *LTMS* indicated that this volume is expected to continue to be removed throughout the 20-year period of analysis. As described below, disposal capacity presently exists for maintenance under the "no action" alternative, as well as for the 8-foot deepening alternative.

Estimates of the volumes (by reach) of new work material to be dredged are shown in Table C-2. The quantity represents the volume of material in the pay prism. The pay prism is defined as the required dredging depth and width plus 2 feet of allowable overdepth. The required prism includes preserving the existing authorized advance maintenance sections in the channel. The maximum depth project is generally an 8-foot deepening below the existing required dredging depths in the navigation channel. The volumes in the table are based on providing a bottom width of approximately 452 feet at (-)50 feet MLW. The bottom width was calculated based on maintaining a bottom width of 500 feet at the existing advance maintenance depth or elevation (-)42 feet MLW, whichever is deeper, and projecting the existing 1 vertical on 3 horizontal side slope to elevation (-)50 feet MLW. There are several new wideners in the project and their volumes are included in Table C-2 (on the following page). The volume of material in the deepened side slope is also included in the quantities in the table.

The USACE has determined that between approximately 22 million cubic yards of sediment will likely be dredged from the IH to achieve the maximum proposed deepening (plus overdredge and advanced maintenance).

Table C-2

Estimated Volume of Material in New Work Prism

Limits of Reach By Station	Volume (cubic yards)
0+000	
	3,752,290
24+000	
	3,952,000
40+000	
	3,070,280
50+000	
	3,206,200
65+000	
	2,824,200
79+000	
	5,355,520
103+000	
TOTAL	22,160,490

Physical and chemical data for were collected according to procedures that were specified in a Sampling and Analysis Plan *(SAP)*. These data were used for characterization of sediments to be dredged on both the new work and O&M sediments so that a wide range of dredged material management alternatives could be considered and properly implemented. A physical description of the sediments contained within the IH is provided in the Geotechnical Appendix to the report *Dredged Material Environmental Effects Evaluation: Savannah Harbor Deepening* (ATM, 1998). Physical characteristics of sampled sediments within the area of Savannah Harbor proposed for deepening include:

- geologic vibracore logs;
- grain size analysis of samples; and
- specific gravity of samples.

3.2 Sediment Characteristics

The sediment characteristics for the different parts of the harbor from which materials are to be dredged are described below:

Upper Harbor Reach. The Upper Harbor Reach extends from STA 103+000 (above the KITB in Garden City) to the Talmadge Bridge. Of the seven channel and one turning basin (SHIHT01NW) cores taken in the Upper Harbor, all produced some quantity of O&M material with a semi-consolidated layer of NW material beneath. The physical analysis for the composite of the O&M material indicates the Upper Harbor O&M sediments are a mixture of sand, silt and clay with the sand fraction dominating at 63.3 percent. With the exception of a deposit containing a gravel layer encountered in the NW material at Station 85+000 and some tight dewatered mud at Station 103+000, the NW material in the Upper Harbor channel appeared similar in the seven cores. Information from the cores and physical analysis showed termination of the NW material from the channel in a gray to green deposit that varied between a well-sorted fine sand to a sandy or silty clay. Penetration in this layer was limited due to its well-consolidated nature. The physical analysis of the bend widener cores for the Upper Harbor indicated that the bend widener areas were dominated by sand size material (greater than 85 percent) in the range of approximately (-)23.5 feet

MLW to (-)32 feet MLW.

Lower Harbor Reach. The Lower Harbor Reach includes representative samples from the Harbor channel and proposed bend wideners from the Talmadge Bridge to the ICW at Fields Cut. The physical analysis of cores from the Lower Harbor reflected similar characteristics to the sediments sampled in the Upper Harbor. The composite sample of the O&M material revealed that it was mostly sand at 55.5 percent, but the silt and clay fraction increased significantly to 18.2 percent and 25.8 percent, respectively. The thickness of the O&M material in the cores of the Lower Harbor fluctuated between nearly 4.0 feet at Station 45+000 to only 0.5 feet at Station 25+000. The NW material of the Lower Harbor was very similar to that of the Upper Harbor in all cores, except at Stations 75+000 and 65+000. Instead of the gray to green sandy and clayey silts encountered at the other stations in the reach, these cores indicated a layer of mud at the top of medium to coarse-grained sand NW material.

Jones Oysterbed Reach. The Jones Oysterbed Reach includes that portion of the Harbor channel along Jones and Oysterbed Islands from Fields Cut to Fort Pulaski (near STA 0+000). The sediments of the Jones Oysterbed Reach differed significantly from the dominant types encountered in the Upper and Lower Harbor Reaches. The composite grain size analysis of the O&M material indicates it was dominated (greater than 81.6 percent) by sand-sized material, while the silt and clay fractions resulted in only 3.3 percent and 10.5 percent respectively. The channel NW samples in this reach were also dissimilar; material from Station15+000 was nearly 50 percent clay and Station5+000 contained over 84 percent sand.

The Jones Oysterbed Reach bend widener was composed mainly of sand-sized material (72.3 percent); the silt and clay fractions were 9.5 percent and 16.3 percent, respectively.

Bar Channel. The physical characteristics of the sediments are described in geologic logs of borings previously drilled along the bar channel by the USACE and in geologic logs of vibracore borings drilled by Athena Technologies, Inc. as part of the current study. Geologic logs and grain-sized analyses of sediment samples collected along the bar channel indicate that the physical characteristics of the new work sediments within the proposed dredging depth [(-)46 to (-)54 feet MLW] vary considerably along the reach of the bar channel. Table 2-5 of the *DEIS* provides a summary of grain-size analyses performed on various samples collected along the bar channel.

Generally, the following may be said of bar channel sediments:

Geologic logs of vibracores drilled along the bar channel indicate that O&M material directly overlies organic sands and Miocene sediments along much of the upper reaches of the Bar Channel [Stations 0+000 to (-)023+000B]. The top of the Miocene sediments is typically characterized by the distinct olive gray to green color. These sediments contain relatively high percentages of montmorillinitic clay which have the capacity to “ball-up” during dredging operations, particularly those that use a cutting head and hydraulic lift. Overall, the existing geologic data indicate that much of the material is questionable for beneficial use alternatives. An evaluation of the grain-size analyses of sediment samples indicate that the clay and silt content averages over 70 percent in clay and silt beds commonly found along the upper reaches of the channel [Stations 0+000 to (-)045+000B) where dredging for alternative uses is practical. However, portions of this reach contain fine to coarse-grained sands which may be suitable for alternative uses. These reaches extend from Station 001+000 to Station (-)003+000B, from Station (-)026+000B to Station (-)032+000B, and from Station (-)042+000B to Station (-)048+000B. These sands typically contain lower percentages of clays and silts (generally less than 25 percent). Median grain-size diameters for these sands are on the order of 0.17 to 0.18 mm. Sands seaward of Station (-)058+000B generally are coarser with higher median grain sizes.

3.3 Description of the Proposed Discharge Sites

Operations and Maintenance sediments, as well as New Work materials removed from the Inner Harbor (Station 0+000 and upstream) in recent Harbor expansion events, have traditionally been placed in eight Confined Upland Disposal Facilities (CDFs) provided by the local sponsor. The locations of these facilities relative to the Navigation project are provided in Figure C-1.

Table C-3 provides the CDF area number/name designation (where appropriate), location referenced to Savannah Harbor Channel Station, and existing acreage. In addition to the facilities listed in Table C-1, there are two unconfined facilities shown in Figure C-1. Area 1S, located within the Savannah National Wildlife Refuge on Onslow Island, is adjacent to Channel Stations 104+200 to 107+000. While this site has previously been utilized for dredged material disposal, the site has not been used for some time and now supports mature trees (USACE, August 1996). The second Unconfined Upland Disposal Site is Area 14A, located in South Carolina adjacent to Channel Stations 037+000 to 043+000. The 815-acre area has received dredged material deposits, but none in recent years. According to USACE (August 1996), the South Carolina Coastal Council (now the Office of Ocean and Coastal Resource Management of the South Carolina Department of Health and Environmental Control) prohibits placement of dredged material at disposal sites that are not diked.

As mentioned previously, all sediments excavated from the Bar Channel have historically been deposited in an unconfined offshore open water site, referred to as the Savannah Ocean Dredged Material Disposal Site (ODMDS). The 3,521-acre ODMDS is centered at 31° 56′ 54″ N and 80° 45′ 34″ W, and is located south of the entrance channel and approximately 3.7 nautical miles offshore of Little Tybee Island, Georgia. Ambient water depths surrounding the ODMDS vary between approximately 28 ft and 42 ft MLW. The site is further described in 40 CFR Part 228.15(h)(6), and indicates the only material to be placed in the Savannah ODMDS is from the Savannah Harbor area.

Table C-3

Upland Confined Disposal Facilities
Savannah Harbor Project

Area Number	Area Name	Location (Channel Stations)		Size (Acres)
	Jones/ Oysterbed	0+000 -	27+000	754
14B	N/A	28-000 -	37+000	765
13B	N/A	43+000 -	47+800	628
13A	N/A	47+800 -	57+000 (-2+000 BR)	690
12B	N/A	57+000 - (-2+000 BR)	6+600 BR	710
12A	N/A	6+500 BR -	10+100 BR	1123
2A	Argyle – Hutchinson	93+000 -	103+000	185
1N	Onslow – North	107+500 -	112+600	130

Note: "BR" indicates stationing up the Back River. source: USACE, August 1996

Alternative placement sites (particularly beneficial uses) were investigated as part of the Savannah Harbor Deepening *EIS* and are described more completely in Section 2 of the main text. A *Sampling and Analysis Plan* (*SAP*) was developed to provide representative, comparable, and complete information to evaluate the potential adverse effects of the management of the dredged material proposed for excavation (ATM, 1997). The project-specific SAP was designed to be flexible (e.g., provide information for various disposal options and contaminant pathways) and cost-effective in support of this Section 404(b)(1) evaluation, and the Section 103 evaluation (Enclosure D of the *DEIS*).

Fill material may be required to be added to increase the berm dimensions on those CDFs with inadequate storage capacities (most notably Areas 12A, 14B and Jones/Oysterbed), which could result in minimal wetland impacts. Should diking of Areas 1S and/or 14A be undertaken, existing wetland and bird nesting habitat may be similarly disturbed.

3.4 Description of the Disposal Method

Material excavated from the Inner Harbor (IH) has typically been removed by employing hydraulic cutterhead dredges, with subsequent spoil placement in the CDFs. It is not anticipated that any other means of dredging will be employed for future maintenance or new work activities within the Inner Harbor segment of the Savannah Harbor deepening project.

Material excavated from the Bar Channel (BC) has typically been removed through the use of self-propelled drag-head hopper dredges, with subsequent spoil placement in the Savannah ODMDS. It is not anticipated that any other means of dredging will be employed for future maintenance or new work activities within the Bar Channel segment of the Savannah Harbor project. A relatively short hopper dredging 'window' designated principally for the protection of sea turtles, right whales and humpback whales limits the time during which dredging operations can be undertaken. Dredging by the use of hopper equipment is limited to November 1 through May 31, with no screening or monitoring required from December 1 through March 31.

Because of existing guidance documentation and the dredge window restrictions, the consideration of beneficial use alternatives to offshore disposal was evaluated. Such beneficial uses primarily consist of utilizing hydraulic pipeline dredges to create nearshore sediment mounds, feeder berms, and beach nourishment projects. Beneficial uses previously identified include the construction of a bird island, nearshore submerged berms, and beach placement. These alternatives were considered for material dredged during the maintenance of the channel (O&M material), and are described in the *Long-Term Management Strategy* (*LTMS*) report (USACE, 1996). Construction of a bird island located southeast of Turtle Island is currently being designed as part of a previously approved mitigation plan. The potential use of the dredge material for use in construction of the bird island and the associated impacts are currently being evaluated by the USACE and others. The placement locations for the more permanent submerged berms identified in the *LTMS* are being reserved for future O&M material that would be suitable for berm construction. Therefore, beneficial use alternatives that are being considered for the deepening project are *feeder berms* and *beach placement*. These beneficial uses are summarized in Section 2.2.2.2 of the *DEIS* (1988) while the report *Alternative Ocean Dredged Material Placement Study* (ATM, December 1997) furnishes a detailed evaluation of beneficial use alternatives. For the sake of completeness these alternatives are briefly identified and described below.

The two beaches identified for alternative placement are the northern shores of Tybee Island located just south of the channel, and Daufuskie Island located at least 3.25 miles north of the channel (see Figure 2-3). Both of these beaches have experienced high rates of erosion of their shorelines, and have been recognized by Congress, the state of Georgia, and the state of South Carolina for their importance to the region. Placement of dredge material on either the Tybee Island beach or the Daufuskie Island beach is dependent on the compatibility of the dredge material to the existing beach sediments. The quality of the sediments originating from the bar channel are not characteristic of quality beach sands sought after for beach nourishment projects.

The feeder berm is a large, continuous submerged berm placed in the nearshore environment for the purpose of attenuating wave energy and contributing sands to the sediment system along the shores of Tybee Island. The berm would be constructed parallel to the northeast shoreline of Tybee Island, and would be located south of the bar channel, at least 1,000 feet offshore (Figure 2-3).

The *DEIS,* however, concludes that the overall characteristics of the proposed dredge material along the upper reaches of the bar channel are not desirable for either beach nourishment or for use in a feeder berm. The sediment analyses that led to this conclusion may be found in section 4.1.3.4.3 of the *DEIS*.

3.5 Anticipated Schedule

The earliest anticipated date for the commencement of new work activities in Savannah Harbor is July 1999. This schedule is contingent upon inclusion of an approved EIS in the Water Resources Development Act (WRDA) of 1998, agency review and approval of proposed plans, and any necessary fiscal appropriations. The Inner Harbor and Bar Channel segments of the Project commencement and completion dates are further conditioned by the appropriate agency authorizations and processing to comply with environmental resource protection. part be dependent on the maximum dredge depth(s) authorized for the project.

4.0 FACTUAL DETERMINATIONS

This section considers factors described in 40 CFR Part 230.11(a), 230.20 and applicable portions of Subpart H.

4.1 Physical Substrate Determinations

4.1.1 Substrate Elevation and Slope

New work deepening will result in side slope cuts to achieve the authorized depth of the navigation channel, turning basins, and channel bend wideners where appropriate. Side slopes in the existing channel are not expected to be modified; rather, the desired depth will be attained by continuing the existing slope cuts. However, limited wetlands, marsh and other upland impacts along the Front River will be directly associated with bank sloughing in discrete areas between River Miles 13 and 19 (Fig Island to Kings Island Turning Basins). Such impacts are expected to result from the turning basin and bend widener work attributable to new work dredging. It is anticipated that all material from the Inner Harbor work will be spoiled to the appropriate CDFs, while the Bar Channel sediments will be placed in the ODMDS.

4.1.2 Sediment Type

While operations and maintenance dredge material contain sediments which are derived from the system and/or which have been previously disturbed by prior dredging events, New Work sediments warrant additional discussion. Vibracores were obtained and subsequently sampled at stations detailed in "Dredged Material Environmental Effects Evaluation: Savannah Harbor Deepening"

(ATM, 1998). The material is predominately sand, silts and clays and will be properly conveyed to the CDFs upon removal from the river banks and bottom. Metal and chemical constituents of concern within the dredged sediments will be managed as necessary within the CDFs.

4.1.3 Dredged/Fill Material Movement

The inner harbor dredged material, due to its variable fines content and volumetric storage capacity requirements, will be discharged to the Confined Upland Disposal Facilities currently designated for the Savannah Harbor project. It is not anticipated that beneficial uses such as bird island construction, beach nourishment or underwater berm construction will be accomplished using the Inner Harbor O&M or New Work sediments. Should beneficial use ultimately be deemed viable for the Bar Channel sediments, such fills will be configured in a manner consistent with the theoretical and predictive response of sediments to placement in a nearshore environment.

4.1.3.1 Physical Effects on Benthos

Discharges from the CDFs coincident with spoiling of Inner Harbor sediments to these facilities are not expected to adversely impact benthic communities. The USACE (August 1996) referenced an earlier study of effluent releases from the Savannah District USACE CDFs which determined that the CDFs retain 99.67 percent of dredged solids (Palermo, 1988). Regardless of the exact percentage of solids concentration in CDF effluent, solids concentrations are anticipated to be of low values and should therefore not result in adverse impacts to benthos in the vicinity of the discharges.

4.1.3.2 Physical Effects on Wetlands

Effluent discharge of O&M and New Work sediments into wetlands along the Wright and Back Rivers will likely continue. However, the solids content of such discharges is not expected to adversely impact CDF-adjacent wetlands. Although the USACE has identified that certain of the CDF dikes will require modification in the form of increased elevation ('raising'), such activity would result in the increased dike elevation moving toward the CDF interior. Therefore, wetlands adjacent to the CDFs so raised would not be impacted. Should unconfined disposal areas 1S and 14A be converted to CDFs (diked), wetlands areas will certainly be impacted. USACE (August 1996) estimates 305 acres of wetlands impact associated with diking and disposal of sediments to Area 14A.

Proposed bend wideners along the channel will result in an increased top width for the navigation channel. This wider top width will encroach into the existing shoreline at six locations (Figure 4-12 of Section 4.8.2 of the *DEIS*) that may potentially have direct wetland losses associated with them. There will some minor wetlands impacts coincident with, and subsequent to, the proposed deepening of the Inner Harbor where bend wideners are subjected to dredging. These six impact areas were determined by digitizing the top of slope of the widened channel (referred to as the "daylight line) from 1 inch = 200 feet blue-line aerial photos. Encroachment areas were defined as any area in which the daylight line was landward of a second line known as the "sloughing easement". The sloughing easement is the buffer area along the channel within which the top of the channel may extend. An additional 0.05 acres of wetland impact is proposed for construction of a debris disposal ramp at Disposal Area 1N on Onslow Island at approximately Station 111+750. A conservative estimate of total wetland area to be directly affected by dredging of bend wideners is 16 acres. The methods used to determine this area and the locations and types of affected wetlands (as well as mitigation for these impacts) are presented in Section 4.8 of the *DEIS*.

Closure of the Middle River by plugging both connections to the Front River and the reopening New Cut have been identified as a feasible avoidance option to minimize environmental effects of the project. The benefit of the Middle River closure will be to isolate significant portions of the SNWR from salinity impacts caused by flows from the Front River. This avoidance measure is believed to reduce the impacts to fresh marsh at the SNWR and avoid impacts to striped bass spawning areas in the Middle and Back Rivers. However, Construction of the avoidance measures will result in the excavation of an additional 20 acres of marsh at New Cut and filling of 15 acres of marsh along the Middle River.

4.1.3.3 Actions Taken to Minimize Impacts

The CDFs to be utilized for disposal and storage of both O&M and New Work dredged sediments have been previously used for the same purpose. The facilities were sited and designed to minimize impacts to benthos, river substrate, and adjacent wetlands areas. Sediment storage, ponding and freeboard elevations have been calculated by the USACE and planned physical changes to the CDFs will occur prior to exceeding their respective storage capacities. The dikes of the confined disposal areas are periodically raised to increase the storage capacity of the sites. With the continuation of that practice, all disposal areas except Disposal Area 2A have a remaining life which extends beyond this study's 20-year period of analysis. No major changes in the use of existing undiked disposal sites are expected. The position of the South Carolina Office of Ocean and Coastal Resource Management (SC OCRM), namely, that all dredged material disposal sites should be confined (diked), to minimize impacts to adjacent marshes, is expected to remain throughout the study period.

5.0 WATER CIRCULATION, FLUCTUATION AND SALINITY DETERMINATIONS

This section considers factors described in 40 CFR Part 230.11(a), 230.20 and applicable portions of Subpart H related to the proposed discharge of dredged sediments.

5.1 <u>Water</u>

Sediments to be dredged from the Savannah Harbor project (both the Inner Harbor and Bar Channel) were recently tested by Applied Technology and Management, Inc. to determine material composition and suitability for beneficial uses, upland disposal, and ocean disposal. The report *Dredged Material Environmental Effects Evaluation: Savannah Harbor Deepening* (ATM, 1998) provides the results of the sediment testing, while the report *Alternative Ocean Dredged Material Placement Study* (ATM, December 1997) furnishes a detailed evaluation of beneficial use alternatives. As a result of these analyses, the Inner Harbor sediments will be placed in the existing Savannah Harbor upland CDFs (discussed previously in this evaluation and presented fully in Section 2 of the *DEIS*,). Testing indicates that the effluent discharges from the CDFs would appear to comply with applicable water quality standards. The Bar Channel sediments will be placed in the Savannah ODMDS (refer to the Section 103 Evaluation in Enclosure D of the EIS) and are suitable for open water disposal.

5.1.1 Salinity

Because the dredged material to be excavated from the Inner Harbor will be disposed in CDFs immediately adjacent to the same estuarine system, any effluent associated with return waters will be discharged into similarly saline waters. Therefore, no measurable alteration of the Inner Harbor salinity regime is anticipated in conjunction with the dredging and spoiling operations.

5.1.2 Water Chemistry/Dissolved Gases (pH and Dissolved Oxygen)

The USACE (August, 1996) references prior monitoring of effluent discharges form the CDFs. In this study, those few samples obtained at the effluent disposal pipes which indicated water quality violations were determined to result in no adverse impact following initial mixing. Because the sediments to be dredged from New Work sections of the project have been adequately tested and evaluated, it is not expected that any significant adverse water chemistry impacts associated with the O&M or New Work sediments will be realized.

5.1.2.1 Clarity/Color/Odor/Taste/Nutrients/Eutrophication

Effluent to be released into the Savannah, Wright and Back Rivers (depending on the CDF receiving the dredged sediment discharge) will originate from the O&M and New Work side slope (where applicable) and bottom sediments and overlying river waters. Effluent from the CDFs primarily originated in the Savannah River as bottom sediments and overlying river water and was not directly involved in any industrial process. On this basis, no significant impact should occur as a result of any of the above listed factors.

5.2 Current Flow and Water Circulation

Current Patterns and Flow/Velocity. Removal of existing operations and maintenance dredged material as well as New Work sediments from the channel, bend wideners and turning basin areas will result in a slight change in the current patterns and velocities in the immediate vicinity of the respective channel features. In the main channel, most notably within the Front River, the most significant impact on flow, will be a decrease in flow velocity. The extent of these changes is addressed in the report *Hydrodynamic and Water Quality Modeling within the Lower Savannah River Estuary* (ATM, 1998).

A 3-dimensional hydrodynamic model was utilized to evaluate the changes in the water surface elevation and the currents through the proposed project. The model was run under the proposed design depth elevation along with the existing design depth elevation plus overdredge depths. Comparison of the longitudinal changes to the water surface elevation from offshore of Fort Pulaski up to the I-95 Bridge and along the Middle River and Little Back River, showed no significant change in the water surface elevation at high tide, with a slight (less than 0.03 meter) rise in the low tide elevations. As shoreline inundation impacts are primarily evaluated at high tide, the model indicates no adverse impacts to adjacent shorelines and marshes due to a rise in the existing water levels. Evaluation of the changes in the velocities within the study area due to the proposed deepening show that throughout the system the deepening will either reduce or not change the tidally driven velocities.

The nearshore feeder berm placement may induce changes in the nearshore current field. The wave refraction and diffraction model, REF/DIF1, was used to examine the effect of the feeder berm on the nearshore wave environment. The modeling revealed that the changes may include a wave focusing on the Tybee Island shoreline. If the feeder berm is selected as an beneficial use alternative, the berm should be designed to minimize any potential wave focusing. The impact to the nearshore current field should be further investigated if the feeder berm is selected as a beneficial use alternative to be constructed.

The hydrodynamic model results for coastal areas as well as the results of wave refraction studies for offshore areas are discussed in section 4.9 of the *DEIS.*

5.2.1 Stratification

Minor modification to the salinity regime is anticipated to result from the proposed Inner Harbor deepening. Such changes are assessed in detail in the “Hydrodynamic and Water Quality Modeling within the Lower Savannah River Estuary” (ATM, 1998) report and are summarized in Section 4.4 of the Environmental Impact Statement. In order to better predict future impacts of dredging on stratification a monitoring program was undertaken in 1997 to quantify the hydrodynamic and physical parameters that cause stratification in the saltwater freshwater interface. One of the major findings of this monitoring program was to confirm the importance of the stratification process and the density driven currents as the primary mechanisms determining the upstream intrusion of salinity. The analysis of the historic data showed that following the decommissioning of the Tide Gate, the maximum salinity intrusion along the Front River occurred primarily during neap-tide, as opposed to maximums during spring tide when the Tide Gate was in operation. During neap-tide conditions there is not enough energy to break down the salinity gradient, and water masses with higher salinity are able to intrude further into the stream. The proposed deepening project would decrease velocities and this may cause an increase in stratification at localized areas of the River. The stratification will lower DO due to the decrease in aeration in those localized areas. The areas in which localized stratification may increase are presented in the report titled *Hydrodynamic and Water Quality Modeling within the Lower Savannah River Estuary* (ATM, 1998) and sections 3.2.1.1 and 4.3 of the *DEIS.*

5.2.2 Hydrologic Regime

The proposed project will have minimal to no impact on the hydrologic regime of surface and groundwaters. The primary hydrologic concern of the proposed deepening is that the groundwater aquifers below the channel might be breached. A study initiated by the USACE to better characterize the hydrogeologic framework of the project area concluded that no breaching and. Hence, no change to the subsurface hydrology is expected to occur.

5.2.3 Normal Water Level Fluctuations

Title 40 CFR 230.24 addresses changes in the normal water-level fluctuation pattern of the affected area *associated with the <u>discharge</u> of dredged or fill material.* Because the Inner Harbor sediments will be spoiled to upland CDFs designated for the proposed deepening, the discharge of effluent from the CDFs is not significant enough to dramatically alter the water levels seen in the Savannah, Wright and Back Rivers.

5.2.4 Salinity Gradients

No appreciable change to the salinity regime is expected other than in the immediate vicinity and mixing zones established at the respective CDF discharges that would be directly attributable to the discharge of dredged or fill material. Salinity changes associated with the proposed deepening to the Front, Middle, Back and Little Back rivers are detailed in the *Hydrodynamic And Water Quality Modeling Within The Lower Savannah River Estuary* (ATM, 1998) report and sections 3.1.8 and 4.4 of the EIS. The results of the model predict a 0 to <1 ppt increase in salinity in the Front and Middle Rivers and a 0-0.4 ppt increase in the Back River.

5.3 <u>Actions That Will Be Taken to Minimize Impacts</u>

Dredged material will be discharged to the CDFs utilizing best management practices to ensure the effluent quality is maintained to the highest possible standards. Turbidity and suspended solids in the effluent from the CDFs will be measured periodically to ensure that those facilities are managed and functioning properly. The *LTMS* identified a 500 mg/L suspended solids standard for determining the acceptability of weir discharges. Beneficial uses of dredged materials such as direct beach placement, and feeder berm development were exhaustively studied in the *DEIS*. These alternatives are being studied in light of suitability of materials, their environmental suitability and logistical-economic considerations. Other management practices as necessary will be implemented at the CDFs to ensure minimal impacts to the estuarine system current patterns.

6.0 SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

Guidance for this section of the 404(b)(1) evaluation is furnished in Title 40 CFR 230.11(c) and 230.21.

6.1 Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

The nature and degree of individual and cumulative effects of potential changes in type and concentrations of suspended particulate and turbidity in the vicinity of the disposal site were evaluated in order to determine whether violations in water quality will occur. The grain size of material, shape and size of suspended particulate plume, and duration of the discharge were all considered for this determination. Prior studies conducted by the USACE (August, 1996) reference earlier tests of CDF effluent which support water quality standard compliance within a minimal mixing zone.

The kinds and concentrations of particulate matter in the vicinity of the weirs is not expected to differ greatly from what is presently deposited in these areas. Normal effluent turbidity is expected to be less than river turbidity during rain events. At other times, mixing with the receiving waters is expected to reduce turbidity rapidly to background levels. A test of one Savannah CDF found a solids retention rate of over 99.93 percent (Palermo, 1988). According to data collected from 1988 to 1994, the average suspended solid level was about 200 mg/L. In the remainder of the regular O&M disposal areas, the average suspended solid level was about 100 mg/L. This level is comparable to the background level of the Savannah River (20 to 50 mg/L). Discharges from the CDFs are expected to readily meet water quality standards with a minimal mixing zone. Additional sediment testing conducted by ATM (1998) indicates that suspended particulate concentrations associated with the proposed deepening will not be substantially different from O&M sediments to the extent that significant changes in previously reported results will occur. No direct discharge of dredged sediments into the estuarine or nearshore waters of the Savannah Harbor is anticipated to occur in conjunction with the proposed deepening.

6.2 Effects (degree and duration) on Chemical and Physical Properties of the Water Column

6.2.1 Light Penetration

During weir releases, there may be a minor temporary reduction in light transmission due to increased turbidity in the area of the weir discharges. These effects would be localized, and limited to only a few weirs at any one time. Moreover, these effects will be minimized by the application of proposed management of weir releases. The estuary is dominated in its natural state by high suspended sediment concentrations in the water column due to upland sources and resuspension by high tidal current velocities. The system is therefore more conducive to intertidal mudflats and at higher elevations vegetated salt marsh. The system does not support abundant submerged aquatic vegetation (SAV) as in microtidal areas which are most affected by turbidity (light penetration). This system is naturally turbid and additional suspended sediment loading of the system is controlled during dredging operations because of oxygen, contaminant, and direct particulate impacts on fish and shellfish. Changes in light transmission may occur to some degree from dredged material discharges, but impacts to biota from suspended sediments are not primarily due to this factor.

6.2.2 Dissolved Oxygen

The dredged material environmental effects evaluation assessed the potential oxygen-demanding burden of the CDF effluents on the receiving system. BOD_5 concentrations from elutriated sediments were below levels established for secondary treatment before mixing. Discharges of oxygen-demanding substances furthermore are not continuous, are localized, and are temporary. Suspended particulate matter is not expected to significantly effect dissolved oxygen levels of the receiving water.

6.2.3 Toxic Metals and Organics

Dredged material is not generically considered as either a "hazardous substance" under the definitions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. 9601(14)) or a "hazardous waste" under the definitions of the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6921 et seq.). Some industries do transport goods through the Harbor that could be considered hazardous or toxic. The U.S. Coast Guard establishes procedures for such movement to ensure those operations are done safely. No such movements have resulted in spills that caused widespread threats to human health or safety. One major oil spill did occur on December 4, 1986 when the Amazon Venture leaked a significant amount of oil into the harbor. The primary source of contaminants that will be found in Harbor dredged materials is adsorbed contaminants from permitted NPDES discharges to the Savannah River Basin. The major dischargers and permitted discharge constituents was evaluated in Tier I of the dredged material environmental effects evaluation (ATM, 1998). The SAP evaluated representative sediments for the presence of and potential environmental effects of these compounds.

There are five areas at proposed bend-wideners where adjacent uplands may be removed. No hazardous or toxic substances are known to exist at hazardous concentrations in any of these sites. No evidence of past disposal practices of materials such as petroleum, scrap metal, ordnance, radioactive materials, organic chemicals (e.g., insecticides), or building products has been found at these sites.

The Upper Harbor NW material is composed primarily of silty clayey Miocene sands and clayey sandy silts that contain between 0.5 percent and 3 percent TOC. Bend wideners are primarily composed of sandy material (87 percent to 96 percent) above the Miocene deposits. Anthropogenic enrichment is confined to the O&M/NW interface. The material from this strata does however contain elevated trace elements (especially Cd, Cr, Mn, Ni, and Zn), but the dry-weight concentrations of these metals were not high to present a significant toxic risk to aquatic biota. Organic contaminants (including 2378-PCDD/PCDF congeners) were rarely detected in these sediments and Organotins were not detected in the wideners. Water column mixing in the Upper Harbor was modeled for Copper which was detected in the elutriated bend wideners sample and was the parameter requiring greatest dilution to meet WQS. The use of the volume dilution method for mixing (using conservative inputs and total aqueous concentrations) showed that Copper meets GA WQS after initial allowance for mixing and at the margin of a zone of less than 84 feet.

The same Miocene deposits were encountered for Lower Harbor NW sediments. This reach contains seven bend wideners and several (4) are potentially enriched with organic matter (3.4 percent to 6.1 percent). These same wideners have a fairly high percentage of fines (58 percent to 71 percent). The analysis of the bend widener material also revealed enrichment with organic compounds and organometallic complexes. PCBs and pesticides did not exceed available benthic SQAGs and phenolic compounds were not detected, but at least one of the bend wideners had more than three PAH concentrations above threshold effects levels (Acenaphthene, Fluorene, Phenanthrene, Low Molecular Weight PAHs, and High Molecular Weight PAHs). None of these concentrations exceeded probable effects levels: the potential combined effects were evaluated and the risk of the potential for PAH-related aquatic impacts is extremely low. 2378-PCDD/PCDF congeners were also detected in the bend widener material, but TBPs were less than the inshore reference. The elutriate results from the Lower Harbor sediments were examined for constituents that require the greatest dilution to meet SC WQS. Conservatively estimated, Total Ammonia released from the bend widener sediments during dredging and slurrification, will meet SC WQS after allowance for mixing in approximately 180 feet along the Wright River. All other constituents from channel samples, bend wideners, and O&M material meet WQS shortly after initial mixing.

The two Jones Oysterbed Reach channel samples were disparate; one composed of almost 90 percent sand-sized or larger material and the other 74 percent fines. TOC ranged from

0.54 percent to 1.1 percent in the finer-grained sample. The bend widener in this reach was similar to the sandy sample. Elevated trace metals were found in these samples as in the two previous reaches. Pesticides, PCBs, and phenolic compounds were either not detected or below available threshold effects levels. PAHs were enriched in the widener and O&M samples but not above screening levels established in the evaluation. TBP_{tPAH} was calculated on these sediments as well in accordance with §404(b)(1) guidance documentation. Channel sediments and O&M material produced TBPs for *Nucula* below the value calculated for the New River reference. The bend widener material produced a slightly higher TBP. PAHs are therefore not expected to produce unacceptable adverse impacts to aquatic organisms. Water column effects from this alternative are not expected to violate SC WQS after initial allowance for mixing.

The inorganic portion of the Nearshore BC NW sediments (channel samples and wideners) is primarily sand-sized (approximately 77 percent) and contains between 0.11 percent and 2.0 percent organic carbon. The channel samples apparently encountered some older marsh mud deposits; organic enrichment is unlikely. Some elevated Cd, Cr, and Zn were encountered in the channel samples, but at lower concentrations than the previous reaches and not at concentrations were the aggregate effect exceeds threshold levels. PAHs were not detected in channel sediments and not above available threshold effects levels in the wideners. Several PAHs were detected in the O&M material above the threshold effects level, but below probable effects levels. Butyltin compounds were also found above screening levels in the O&M material. Possible benthic effects at the ODMDS from these low-level concentrations can be avoided by excavating the O&M overburden simultaneously with the cleaner NW sediments. Pesticides, PCBs, and phenolic compounds were not detected at laboratory reporting limits. Water column effects were modeled for Total Ammonia in the O&M material. Total Ammonia concentrations never rise above the background beyond the boundaries of the ODMDS and are within the limits of chronic federal marine WQC within the required 4hr mixing time.

Additional to the channel and the turning basins, the project in the Upper Harbor will include deepening the Container Berth 7 area from -42 feet MLW to the proposed channel depth. These NW sediments are represented by cores taken at STA 103+000, STA 100+000, and at the Kings Island Turing Basin. The material is expected to be composed of the same clayey Miocene deposits and should be free of anthropogenic contamination. Trace metals will likely be elevated, so the material should be placed in an approved CDF unless further Tier III testing is done to ensure that aquatic effects will not be at unacceptable levels.

6.2.4 Pathogens

Since effluent originates from the Savannah River and no biological organisms are added during the dredging operation, no new pathogens are expected as a result of the dredging.

6.2.5 Aesthetics

Some visual impacts from turbidity are expected from the open water discharges. However, there are expected to be temporary in nature, and diluted by shore currents. Weir releases may also have some visual impacts, but such impacts are expected to be local and not as severe as experienced during a heavy rain event.

6.2.6 Effects on Biota

Suspended particulates may be expected to have some adverse impact on filter feeders, but those impacts are expected to be temporary. Open water disposal would occur infrequently for relatively short periods of time and would be subject to mixing. To minimize any impacts in this area it the USACE has adopted a policy, stated in the *LTMS*, that to the extent possible, no nearshore open water disposal operations would take place during biologically critical reproductive season for area estuarine fish and shellfish. This critical time is presently known to be March 1 to June 1. To further reduce impacts to fish, endangered species, birds and benthic communities, the District would follow the recommendations of the USFWS, which were included in their Section 2(b) Report on the Tybee Island disposal portion of the Savannah Harbor Deepening Project (*EIS* 1993), that whenever possible, open water disposal would be conducted in the early winter months.

Representative samples of the proposed dredged material was evaluated for a comprehensive list of constituents and potential contaminants of concern. Available sediment quality assessment guidelines (SQAGs) were applied to the results to assess the potential of impacts on biota. No unacceptable adverse impacts on biota are expected if the material is excavated and managed according to the plan recommended in the *DEIS*.

6.2.7 Primary Production, Photosynthesis

Suspended particulates may be expected to have some adverse impact a negligible affect on primary production because the occurrence of turbidity is localized and temporary. Studies performed by Dr. D. F. Hayes in 1986 on a hydraulic cutterhead dredge operating in Savannah Harbor indicated that average suspended sediment concentrations within 1,600 feet of the dredge were generally raised less than 200 mg/L in the lower water column and less than 100 mg/L and 50 mg/L in the middle and upper water column, respectively. Savannah River has a naturally high suspended sediment load which during storm events is expected to increase well beyond the 200 mg/L increase created by a hydraulic dredge. Also during storm events the higher suspended sediment loads would likely be more uniform throughout the water column due to mixing as the plume proceeds downstream. Based on these considerations it no change to overall productivity of the estuary, the river or coastal waters is expected.

6.2.8 Suspension/Filter Feeders

Suspended particulates may be expected to have some adverse impact on filter feeders, but these impacts will be localized and temporary.

6.3 Actions taken to Minimize Impacts

The deepening project will make use of *existing* disposal facilities that have sufficient capacity for continuing normal dredging maintenance and new work materials. No new disposal facilities are required, and hence impacts to surrounding lands and ecosystems are minimized. As stated previously, timing of open water discharges would be planned to included months of lowest impact to fishery resources. The CDFs, for the deepening project, will be managed according to procedures put forward in the *LTMS*, which include practices to minimize effluent suspended particulates. To ascertain the effectiveness of management of the CDFs, the District has adopted an approved monitoring plan (see section 7 of the *LTMS EIS*).

7.0 CONTAMINANT DETERMINATIONS

The nature of the material to be dredged and the characteristics of the material to be discharged are the focus of this determination. The report *Dredged Material Environmental Effects Evaluation: Savannah Harbor Deepening* (ATM, 1998) provides a detailed assessment of the characteristics and constituents of samples obtained within O&M and NW sediments.

7.1 Ecosystem and Organism Determinations

7.1.1 Effects on Benthos

The deepening and its associated dredging will result in *temporary* disruption in benthic communities. However, recolonization occurs relatively rapidly. There will be a temporary impact on benthic communities at the open water disposal sites as some organisms will be lost by the covering. Some organisms which inhabit the underwater sites are capable of moving of upward burrowing and should survive. Benthic organisms at the nearshore and proposed beach disposal sites are typically subject to changes associated with the daily shifts in their habitat substrate. In addition, these organisms commonly recolonize nourished beaches. Turbidity effects may be produced by unconfined nearshore disposal, but they are expected to be temporary and minor.

7.1.2 Effects on Plankton and Nekton

Impacts form open water discharges would be primarily due to increases in turbidity during the discharge itself and subsequent erosion of any incompatibly sized material. Similar impacts could be produced by both the runoff during unconfined disposal events operations on Jones/Oysterbed island and agitation dredging of berths by dockowners. These operations would occur even in the "no project" condition as part of routine dredging and management. These impacts include a decrease in phytoplankton growth form decreased light availability due to absorption or reflection of light by suspended particulates. A decrease in feeding by nekton could result from reduced phytoplankton availability, limited visibility of prey or interference in feeding behavior from increased particulates. These impacts are expected to be temporary. No significant impacts on plankton or nekton are expected due to effluent from CDFs.

7.1.3 Effects on Aquatic Food Web

Aside form temporary and localized effects of turbidity, no appreciable effects on the aquatic food web are anticipated. As stated previously, the project will make special efforts to minimize any impacts in this area to aquatic resources by restricting or halting nearshore open water disposal operations during the biologically critical reproductive season between March 1 to June 1 and seek to confine open water disposal to the early winter months.

7.1.4 Effects on Special Aquatic Sites

One of the only *direct* effects to aquatic sites will be an estimated 5.16-acre loss of wetlands, in 6 areas along the channel that will result from bend widener excavations along the channel. An additional 30 acres of wetlands will be removed or filled by implementation of the Middle River closure avoidance option. Indirect effects to wetlands are exclusively concerned with salinity intrusion into the SNWR. No other aquatic sites will be affected by the deepening project, except for the possibility of enhancements related to beneficial uses involving beach nourishment and feeder berm development, as previously described. Direct and indirect impacts to wetlands are discussed below in the wetland section.

7.1.5 Sanctuaries and Refuges

A concern exists that the deepening and the subsequent increase in salinity will adversely affect the Savannah National Wildlife Refuge and cause freshwater marsh to be converted to lower-value saltwater marsh. The SNWR is located on the uppermost reaches of Savannah Harbor and encompasses both impounded and unimpounded wetlands and marshes.   The refuge consists of 26,500 acres of palustrine forested wetlands, palustrine and estuarine emergent wetlands, palustrine scrub-shrub wetlands, riverine wetlands, managed waterfowl impoundments and uplands.   In order to asses the potential impacts to SWNR a quantitative plant community study was undertaken by the *DEIS* . The study showed that the existing boundary of the diverse freshwater plant community has not changed dramatically from removal of the Tide Gate as had been predicted by Pearlstine *et al.* (1990). Extensive modeling of projected salinity changes in relation to the proposed deepening of the channel indicate that projected changes in salinity, especially along the Little Back River (0.0 to

0.4 ppt), will be minimal and not approach the dramatic levels as that experienced during operation of the Tidegate. From this set of conditions, it can reasonably be asserted that the existing plant communities in the area of interest in the study area are tolerant of the salinity conditions that existed with the Tidegate, that exist presently, and, hence, and that are expected to occur as a result of the proposed project. A potential zone of impact was identified in the following manner: since the 0.5 ppt contour has been used to approximate the extent of the freshwater system, the change in the physical location of the 0.5 ppt contour was determined. The area between the existing and projected 0.5 ppt contours was delineated and determined to be approximately 1,170 acres. This impact area is described and mitigated in section 4.8.5 of the *DEIS*. Dredge disposal areas are also inhabited by numerous species of wildlife similar to those found at the Refuge and surrounding areas. Nesting terns and plovers can be found on the more sandy areas during spring and summer. Along the canals and inner ditches, wading birds and shore birds congregate and feed. Depending on the amount of water available and time of year, large numbers of waterfowl can be found in the impounded disposal areas. One section of former disposal area and one currently designated disposal area, consisting of portions of Bird Island, Cockspur Island, and Jones-Oysterbed Island, is designated as part of the Tybee Island National Wildlife Refuge. The 400-acre site serves as a resting spot for pelicans, seagulls, egrets, herons, and other birds. Nesting terns claim a part of the refuge to raise their young. Feral hogs, deer, raccoons, opossums, otters, rodents, and other mammals are also found on this site. None of these areas will be adversely impacted, while beneficial impacts to birds and other species will result form the preservation and maintenance of these wildlife refuge areas.

7.1.6 Wetlands

Wetland impacts associated with the harbor deepening project include both *direct* losses and potential losses through *secondary effects*. Direct wetland losses will result from the dredging for the actual deepening of the navigation channel and the construction of the Middle River closure avoidance option. Proposed bend wideners will result in an increased channel top width which, at several locations, will encroach into the existing shoreline. An additional minor direct impact will result from construction of a debris disposal ramp for the dredge spoil disposal area on Onslow Island. The bend wideners will encroach into the existing shoreline at six locations (shown in Figure 4-12 of section 4.8 of the *DEIS*) that may potentially have direct wetland losses estimated to be approximately 5.16 acres. An additional 0.05 acres of wetland impact is proposed for construction of a debris disposal ramp at Disposal Area 1N on Onslow Island at approximately Station 111+750. Construction of the plugs in the Middle River and reopening New Cut will remove or fill 35 acres of wetlands. A total of approximately 40 acres of direct wetland impact will be mitigated as part of this project.

Secondary impacts to wetlands may potentially result from the salinity changes upstream of the deepened channel. A concern exists that increased salinities upstream may induce some subtle changes in the diversity and frequency of salt sensitive vegetation within a restricted area of the SNWR. To facilitate the delineation of the area of greatest potential impact, salinity contours for the existing conditions and the post-deepening conditions were generated. Since the 0.5 ppt contour has been used to approximate the extent of the freshwater system, the change in the physical location of the 0.5 ppt contour was determined. The area between the existing and projected 0.5 ppt contours was delineated and determined to be approximately 1,170 acres. It must be emphasized that the calculation of this affected area represents a worst-case scenario since the contours were estimated using conservative parameters. For example, only stages that exceed 4.5 feet, which is the lowest minimum elevation at which the marshes in the potential impact area flood, were used for the delineation of the contours. It needs to be further emphasized that this 1,170 acre figure **does not** equate to 1,170 acres of impact, it merely indicates the zone in which potential effects, *if any were to occur at all*, would be located. No loss of marsh or drastic shifts in the existing vegetative dominance are expected to occur within the zone. The DEIS proposes the

SNWR to acquire 3000 acres of freshwater wetlands to mitigate for any loss of freshwater diversity that might be caused by the project.

7.1.7 Threatened and Endangered Species

A Biological Assessment of Threatened and Endangered Species (BATES) has been prepared for the continued operation and maintenance of the Savannah Harbor Navigation Project and additionally addresses the proposed deepening (New Work) and is contained in Enclosure A of the *DEIS* (for a summary see section 3.73. of the *DEIS*). The BATES determined that operations associated with the deepening of Savannah Harbor will not have significant adverse impacts on the threatened and endangered species identified as potentially present in the area. The BATES further ensures the protection of marine species that could be affected by dredging operations by the provision of several conditions to be imposed on contractor operations during dredging and filling. These species include manatees, whales, sea turtles. To ensure that dredging operations are not likely to adversely impact sea turtles, all dredging operations would be done in compliance with the appropriate Biological Opinion for navigation channels in the southeast issued by the NMFS.

Of special significance is the shortnose sturgeon, an endangered species that makes use of habitat in the Front River and the Kings Island Turning Basin. The *DEIS* (section 3.7. 3.11) describes the habitat for this fish and evaluates the potential impacts that might occur due to changes in salinity and dissolved oxygen and dredging (section 4.7.1). In summary, the *DEIS* concludes that salinity and DO impacts must be monitored through a long-term study because little is known of juvenile tolerance to these changes in the wild. The major issues are briefly discussed below:

Dredging Impacts. Shortnose sturgeon may be present in Savannah Harbor during routine maintenance dredging. Several field studies indicate that the channel and turning basin down to about RM 17 is a habitat for shortnose sturgeon of all age groups during parts of the year. Overall there will be very little effect on the project maintenance dredging since the same routine and the same volumes (except for the one-time dredging volume of new materials) will be dredged in the “No Action” as well as the worst case scenario.

Direct impacts from the dredge are considered to be very low. The direct impacts of deepening and dredging in shortnose habitat in the vicinity of KITB, an area that is used by the fish during summer months (and non-spawning fish from February through May) is not known. Based on past experience, one could conclude that since fish return to these areas each year, after dredge maintenance has occurred, then they will continue to do so in the future.

The impacts due to the dredge plume could affect juvenile and adult fish feeding in the area or migrating through the area to spawn. Fish feeding in the area, being mobile, could avoid the dredge plume since a dredge creates a great deal of noise while operating. Furthermore, it is likely that the suspended sediment raised by the dredge does not exceed the high suspended sediment loading which occurs during storm events.

As previously noted, studies (Hayes, 1986) on a hydraulic cutterhead dredge operating in Savannah Harbor showed that the impact to sediment increase is less than that expected for storm events. Hence, direct impact from dredged sediments on shortnose sturgeon, being of a localized nature, are not expected to exceed the impact of a normal storm event.

Regarding the affect of changes in salinity and DO on the shortnose sturgeon, model simulations were performed to ascertain the level of impact. For the modeling simulations an acceptable condition of >8 ppt. was used for salinity and a conservative 3.5 mg/L DO concentration was selected as the model simulation criterion for DO. Locations upriver from the KITB on the Front River

RM 24.4 (GPA-11) are predicted to undergo a decrease at the 90th percentile of 0.1 mg/L DO (bottom) and at RM 21.7 (GPA-09) there will be no predicted change. At RM 20.5 there will be a decrease of 0.1 mg/L. The concentration will then be 3.5 mg/L for the 90th percentile; thus acceptable conditions will be met 90 percent of the time. Further down river of the KITB, at RM 16.6, the maximum decrease will be 0.3 mg/L and the time when acceptable conditions will be met is reduced form 80 percent of the time to 60 percent. Predicted salinity increases in the Front River to the 90th percentile are as follows: at RM 21.7 (GPA-09) there is an increase of 2.0 ppt. At RM 20.5 (GPA-08) there is an increase of 2.8 ppt. At RM 16.6 (GPA-06) there is an increase of 5.2 ppt. According to the model simulation, areas upriver from the KITB experience some increase in salinity and decrease in DO. However, these modest increases may be tolerable to the juvenile population. Tolerances and the relationship between stress and other tolerances have not been researched to give any definitive values. The impact of the increased depth in the turning basin and other juvenile habitats is difficult to evaluate because of the lack of biological data for this species in these areas. Because of the lack of site specific information concerning this species, the *DEIS* proposes that a 5-year study be performed to monitor the effect of deepening on the recruitment of juveniles.

7.1.8 Other Wildlife

Many species of migratory birds use the harbor's confined upland disposal areas. A variety of species of birds are regularly observed in the scrub or brush habitat that surrounds the disposal areas. That habitat is present to some degree on other uplands throughout Chatham County. However, the existing CDFs provide unique habitat in the project area for certain species of migratory birds. The disposal areas provide nesting habitat for only a limited number of migratory bird species, but those species include some of special concern such as least tern, black-necked stilt, and Wilson's plover. Many other species of birds use the disposal areas outside the breeding season, some in high numbers. These avian species are discussed in detail in the following paragraphs in 2 groups, those using the disposal areas for nesting and those using those sites outside the nesting season.

Analyses were previously performed to identify the location and the amount of acreage of various bird habitats that occur for some period of time within each middle harbor disposal site. Those analyses are summarized in Table 3-17 of section 3.7.2 of the *DEIS*.

The estuarine marshes, which line the Savannah River at locations along its entire length, are also areas that support wildlife. Cormorants, seagulls, mergansers, hawks, herons, egrets, ibis, rails and terns can be found resting and feeding in many of these areas. Diamondback terrapins and occasionally alligators also inhabit these estuarine wetlands, along with such mammals as otters, raccoons, and minks.

7.2 Actions to Minimize Impacts

All dredged material excavated from the channel, side slopes, bend wideners and turning basins in the Inner Harbor will be placed in the CDFs associated with this project. A wetlands mitigation plan to compensate for unavoidable impacts to marsh vegetation is contained in Section 4.8 of the *DEIS* and will be further elaborated in a *Mitigation Plan*. The proposed project also makes proposals that may assist in the recovery efforts now underway for striped bass spawning. The hydrodynamic modeling undertaken by the *DEIS* revealed a salinity "hot spot" in the area of Rifle Cut, a channel that brings higher saline waters from the Middle into the Back River spawning area. Closure of the Middle River from the Front River will avoid impacts to the striped bass spawning in the Middle River and Back Rivers and minimize the impacts on freshwater marsh in the SNWR. The *DEIS* has proposed that these and other impacts will be evaluated using the hydrodynamic model. The mitigation plan will be finalized upon completion of the modeling studies.

No additional disposal areas would be required for the project and, hence, no disruption of surrounding areas for disposal capacity will be required.

The project also minimizes impacts by choosing an alternative that maintains the existing channel side slopes at each new project depth. During alternatives analysis it was recognized that the resulting disturbance to the existing channel banks and adjacent lands would cause a number of adverse environmental and economic impacts. The channel design was modified to extend existing side slopes to each project depth and only excavate channel banks and adjacent lands where bend-wideners would be necessary. This design change greatly minimized the environmental impacts, even though it results in limiting operation of the navigation channel to one-way traffic for certain sizes of vessels.

8.0 PROPOSED DISPOSAL SITE DETERMINATIONS

8.1 Mixing Zone Determinations

Reach composites were elutriated with background water from each reach for channel material, bend wideners, and O&M material. The background water and supernate from the appropriate elutriate test (Modified for IH and Standard for BC) were analyzed for a battery of chemical constituents. These data provided input to the screening process for this water quality/mixing evaluation. In accordance with the SAP and agency requirements, both dissolved and total modified elutriate analyses were conducted for the three Lower Harbor composites. In the Upper Harbor, only the total test was run.

The composited samples and elutriate test results were tabularized and compared with applicable federal WQC and WQS from both Georgia and South Carolina. The background water samples appear first beginning in the Upper Harbor and working south. The elutriate results follow and are ordered by reach. In most cases, only three to five contaminants were detected per composite sample. The three contaminants requiring the largest dilutions by simple ratios (of concentration over lowest screening value) were selected for additional evaluation. In order to predict the total potential contaminant load from Lower Harbor CDFs, the modified elutriate tests were conducted on each composite for both total and dissolved contaminant concentrations.

In those cases where the Tier I analysis determined that elutriate analyses did not need to be performed, Tier II “screen relative to WQC” was performed (Offshore Reach only) using the bulk sediment samples (offshore area only) to compute the required dilution. Three background water composites were used for use as the source water for elutriate analyses and input to the dilution formulae. Sampling stations included the main channel in the Upper Harbor, the Lower Harbor, and the Nearshore BC. The same water sample was used for comparison to WQC/WQS, except in the Lower Harbor. A second background water sample was collected in the Wright River for comparison for the Lower Harbor elutriates because the Lower Harbor CDFs discharge to the Wright River.

Following the methodology outlined in the Inland Testing Manual, the contaminant requiring the greatest dilution was input to an appropriate numerical model to determine the applicable mixing zone for each project reach. For the Lower Harbor samples, the larger of the two dilution values resulting from dissolved and total elutriate analyses were selected[2]. Results of previous data collection efforts and analyses by various agencies were also considered during the evaluation. It is noted that the ITM indicates that the primary concern during periodic and temporary dredging and

[2] Analyses of elutriate samples often reveals that the contaminant of concern is dissolved in the aqueous matrix and is therefore not significantly different in the total and dissolved tests. When this happens, the dissolved number may actually exceed the total number because the difference is within the range of error of the laboratory test.

disposal operations is meeting the WQS/WQC as pertains to wildlife, and not the longer-term human health criteria (USEPA/USACE, 1994).

8.1.1 Mixing Analysis

This analysis is based on general assumptions for each reach of probable dredge disposal sites and average conditions and equipment. Because the details of actual dredging equipment, project timing, and disposal locations are unknown, attempts were made to estimate the mixing characteristics in a conservative nature. Design level work will require detailed field measurements, selected dredge and disposal equipment, and additional modeling if refinement of the contaminant mixing zones is desired.

Elevated concentrations of Ammonia-N (Total Ammonia) were detected in all elutriate samples and the background water samples except the Lower Harbor source water. No explicit WQS exist for Ammonia, although South Carolina incorporates the USEPA WQC by reference. The RIM (USEPA/USACE, 1993) for ocean disposal of dredged material cites chronic (35 µg/L) and acute (233 µg/L) Ammonia criteria for Unionized Ammonia, but the USEPA "Gold Book" (USEPA, 1986b) states that insufficient data are available to establish salt water criteria for Ammonia. More recent documentation (USEPA, 1989) provides tabular values for deriving Total Ammonia criteria using ambient pH, salinity, and temperature values for marine waters.

Total Ammonia levels are subject to a wide range of fluctuations. Assessment of the Total Ammonia range expected for the Savannah River deepening project, based on typical temperature, salinity, and pH ranges and the USEPA tables results in chronic values of 450-5,600 µg/L and acute values of 4,250-37,000 µg/L. Studies by SCDNR and NOAA (EMAP) (Ringwood et al., 1996) indicate widely varying Unionized Ammonia levels throughout the southeast, from 5-1,539 µg/L. A summary study by the USACE (Sims and Moore, 1995) presents results of various Ammonia toxicity studies. The conversion from Total Ammonia to Unionized Ammonia (the toxic form) is dependent upon salinity, temperature, and pH. Thus, discrete readings taken at any given time may not be representative of the average Ammonia concentrations for the sampling area. Generally, Total Ammonia levels are not suspect below 20,000 µg/L (Van Dolah, 1998).

For the sampled elutriates, the Ammonia levels are generally an order of magnitude greater for the O&M and bend widener composites than NW composites. This is likely due to the historically maintained channel acting as a settling basin for fine material and organics transported down the river, industrial discharges to the river, and adjacent land runoff. The "Revised Draft Savannah Harbor Advanced Maintenance Sediment Testing Report" (GEL, 1997) found Ammonia levels as high as 22,000 µg/L in the Lower Harbor. Presumably because SC does not give explicit WQS for Ammonia (SCDHEC, 1993), impacts due to this constituent were not discussed and no WQS/WQC were cited. For the Savannah Harbor deepening project, the highest concentration of Ammonia was found in the Lower Harbor bend wideners composite at 34,000 µg/L. This value was applied to the appropriate mixing model to determine potential dilution zone requirements.

Additionally, elevated concentrations of Manganese were found in all Lower Harbor samples and the Nearshore O&M composite, but no established WQS/WQC exist for Mn. A screening value of 100 µg/L was utilized for rough dilution ratio calculations, although this value represents limits of human consumption of fish tissue (USEPA, 1986). A NMFS analysis of select CDF overflow discharges into the Wright River (Scott and Fulton, 1994) found Mn levels between 659 and 1,300 µg/L, which are the same order of magnitude as the levels detected for this project. The NMFS report cites studies indicating that Mn concentration greater than 2,500 µg/L were required to cause acute toxicity in marine organisms. Similarly, because no Mn concentrations exceed the 2,500 µg/L threshold for this study, Mn was not considered as a contaminant of concern. GEL (1997) also found similar Mn levels and likewise omitted it from consideration as a contaminant. Since Mn was omitted from these analyses, the constituent requiring the next greatest dilution was chosen. Additional details are provided in the following section.

8.1.1.1 Upper Harbor

The critical contaminant in the Upper Harbor Reach is copper (6.4 µg/L), requiring a dilution of 7 to reach WQS (2.9 µg/L). Copper was not detected in the ambient water sampled. To be conservative the ambient water is assumed to contain copper levels just below WQS, which results in the required dilution of 7. By comparison, an assumed ambient Copper concentration equal to half the WQS requires a dilution of only 2.1. According to SCDHEC procedures, an assumed ambient concentration of zero is applied for the non-detect case, resulting in a dilution of 1.2. Dilution with the ambient water just below WQS is thus more difficult than if background levels are assumed lower.

Upper Harbor CDFs ultimately discharge to the Front River so the Georgia WQS were selected as the applicable standards for this reach. According to USEPA STORET data, the average measured value of Total Copper between 1992 and 1993 was 16.3 µg/L, ranging from 10-30 µg/L. Over the period 1992-1997 the reported maximum average copper concentration was 10 µg/L. The Copper concentration determined from elutriate analysis for the Upper Harbor is lower than typical observed values in the ambient river water. Typical riverine and ocean water copper levels average 5 and 3 µg/L, respectively (Riley and Chester, 1981). In furtherance of this evidence, the NMFS report (Scott and Fulton et al., 1994) found copper levels between 5.7 and 10.8 µg/L. They discounted the toxicity of the Cu concentrations because similarly elevated Cu levels at reference sites indicated no significant toxicity to the tested species.

Application of the dilution volume method for mixing (USEPA/USACE, 1994, pp. C-73-C-77), utilizing the conservative Cu concentrations results in a required mixing zone of 84 ft, extending along the channel bank nearest the outfall location. The discharge from the theoretical CDF overflow weir was assumed to have a flowrate of 25.6 cfs, which represents an 18 in. dredge with a slurry velocity of 15 fps (USACE, 1987). The receiving water was assumed to be 10 ft deep[3] with an average tidal velocity of 1.0 fps. The overflow weir outlets are typically 48 in diameter pipes. Thus, the initial plume radius is assumed to be the pipe diameter or 4 ft. The mixing zone required under the conservative case is small compared with typical industrial discharge mixing zones of hundreds of feet. Additional numerical modeling was not deemed necessary for this reach. At the edge of this 84 ft zone Copper levels (and therefore all other contaminants of concern) in the aqueous discharge will meet GA WQS.

8.1.1.2 Lower Harbor

The Lower Harbor elutriate samples include elevated levels of Ammonia, Manganese, and Arsenic (trivalent), which are all typical when compared with related studies. Manganese levels were discussed previously and are not detailed here. Based on the conservative dilution analysis, Ammonia and Arsenic are the critical contaminants for the Lower Harbor sediments. While levels of Ammonia were detected for all Lower Harbor composites, Arsenic was only detected in the O&M material elutriates (maximum 6.6 µg/L). Copper levels were slightly above WQS for all composites. However, background water in the Wright River was found to contain 3.4 µg/L of Cu, which is above the Human Health WQS value of 2.9 µg/l. As described for the Upper Harbor, copper levels cannot be diluted to the WQS and previous studies of similar levels in the Wright River indicated no adverse impacts from elevated ambient levels. Both As and Ammonia were selected for further analysis.

Human Health WQS for As in South Carolina is 1.4 µg/l, although this is a drinking water criteria (Giffen, 1998). Since the PQL for As was 5.0 µg/l, the *practical* WQS was conservatively assumed to be 5.0 µg/L. By comparison, the Georgia and Federal chronic Arsenic WQS/WQC for the protection of wildlife are 36 µg/L. The required dilution for As, computed conservatively (assuming

[3] The overflow does not discharge into the deep portion of the channel.

background water contains 4.9 μg/L As) results in a required dilution of 13.0. However, SCDHEC protocols assume a zero background concentration when a contaminant is not detected. Utilizing SCDHEC methodology with the required WQS of 1.4 μg/L requires a dilution of 3.5. Application of the dilution volume method for mixing zone determinations and SCDHEC protocol results in a mixing zone length of 36 ft for As. This value is well within the 100 ft underdrain mixing zone for the existing §401 Certification for the CDF outfalls that discharge from the Lower Harbor CDFs to the Wright River (SCDHEC, 1995).

Additionally, the measured As levels are well below the Georgia and Federal criteria for the protection of marine organisms. The NMFS report on the Wright River (Scott and Fulton et al., 1994) gives additional detailed information regarding the relationship between Mn and As. NMFS concentrations of As measured at the overflow discharges to the Wright River ranged from 10 to 15.5 μg/L and were not found to significantly impact the Wright River system.

The highest Ammonia concentration reported for elutriated Lower Harbor samples was 34 mg/L for the bend widener composite; this value was also input in the dilution volume mixing model. The applicable WQC for Total Ammonia was determined from the USEPA tabular data, utilizing *in situ* temperature, salinity, and pH data recorded in the Wright River during sampling efforts. The resultant marine chronic and acute WQC were determined to be 2.34 and 15.79 mg/L.

8.1.1.3 Nearshore

The Nearshore Reach also exhibited elevated levels of Manganese and Ammonia. In general, the levels were lower than those found in the Lower Harbor with the exception of the Mn concentration found in the Nearshore O&M composite. This value was the largest of all measured values, at 2,130 μg/L, but is below the 2,500 μg/L cited previously for acute toxicity to marine organisms and similar to Mn levels reported in other studies previously described.

Results of the dilution computations result in Nickel (14.1 μg/L) and Ammonia (17,000 μg/L) being the critical contaminants in the Nearshore Reach. The conservative analysis results in a Ni required dilution of 1.7 to reach Georgia WQS (8.3 μg/L). The Nearshore Reach material is planned for beneficial uses in waters of the state of Georgia, where there is no WQS for Ammonia or in the ODMDS. For completeness, an evaluation of mixing was completed for both Ni and Ammonia.

Mixing estimates for the Nearshore Reach, with placement in the nearshore region, were computed with the D-CORMIX model. D-CORMIX simulates the water quality associated with a negatively-buoyant plume associated with continuous hydraulic pipeline dredge discharge. The desired method of placement in the nearshore zone is by direct pipeline discharge from a cutterhead dredge. Inputs to D-CORMIX included typical dredge discharge details, nearshore currents, bottom slope, and contaminant details for water quality computations. This model was used to estimate turbidity plume dimensions in the "Alternative Ocean Dredged Material Placement Study—Savannah Harbor Deepening" (ATM, December, 1997).

The discharge was assumed to be a 24-in diameter pipe just below the water surface (3 ft), positioned horizontally and pointed downcurrent (as a worst-case scenario). The pipe was assumed to discharge a slurry at a rate of 15 fps and concentration 200 g/L. These values were obtained from conversations with D-CORMIX developers and previous experience (ATM, December, 1997). Site condition values were obtained from available data and project conceptual plans. All other values were input as typical or defaults as specified by D-CORMIX developers. The effluent and WQS contaminant inputs to D-CORMIX were corrected for background contaminant levels according to the program literature (i.e., $C_{eff}' = C_{eff} - C_{ds}$ and $WQS' = WQS - C_{ds}$).

The predicted mixing zones (for either tidal current direction) were computed to be less than 30 ft for both Ni and Ammonia. ATM (December, 1997) predicted a turbidity plume that will extend for much greater distances than these contaminants of concern.

8.1.2 Summary

Constituents were detected in elevated concentrations for all areas sampled and elutriated. None of these are extraordinary for an anthropogenically-impacted estuary like the Savannah River much less an historic commercial harbor. Information gathered in support of the §404(b)(1) water quality assessments is consistent with information reported in related studies in the vicinity. These studies (e.g., Scott and Fulton et al., 1994) demonstrated that similar levels of contaminants should not cause unacceptable adverse impacts to the aquatic environment. Critical contaminants (i.e., those parameters of concern that require the largest dilutions to reach WQC/WQS) were determined and modeled for mixing characteristics typical the receiving body in each reach. Dredging and disposal of offshore, nearshore, and Upper Harbor sediments should not result in unacceptable adverse acute or long-term water column impacts. A conservative analysis indicated that dredged material constituents would meet WQS in the Upper Harbor within an 84 ft mixing zone and in the Lower Harbor within a 36 ft zone.

8.2 Determination of Compliance with Applicable Water Quality Standards

Water quality certifications are being requested from the State of Georgia and the State of South Carolina for the proposed deepening project as part of the *DEIS.* The environmental effects evaluation for the proposed dredged material (ATM, 1998) indicated that the effluent from the Harbor CDFs will meet applicable WQS for all contaminants of concern at the edge of the mixing zone.

8.3 Stormwater Runoff Determinations

The proposed action will not impact any of the dredge disposal areas in any manner that would require a change in existing stormwater management or stormwater regulatory framework. No improvement actions or separate actions for control of stormwater are required for the proposed project beyond the requirements delineated in the *LTMS.* Under the *LTMS* multiple dike raising projects were described for increasing the storage capacity of the CDFs. No separate Stormwater Discharge Permits had to be obtained for the dike improvement actions which are required for continued operation of the CDFs. Guidance from Corps Headquarters titled *NPDES Stormwater Discharge Permit Requirements*, contained in a memorandum dated June 23, 1992, states that discharges of dredged or fill material into waters of the United States that are regulated under Section 404 are exempt from stormwater regulations. Since dike construction and raising projects would occur in areas that were originally wetlands, the runoff which occurs during those construction events would also be considered under this Section 404 Evaluation. The location and size of the CDFs are described in the main *EIS* of the *LTMS* and in Section 2 of the *DEIS.*

8.4 Potential Effects of Human Use Characteristic

Municipal Water Supply. The primary hydrologic concern of the proposed deepening is that the groundwater aquifers below the channel might be breached and adversely impact the City's chief water supply source. A study was therefore initiated to better characterize the geologic and hydrogeologic framework of the project area through the use of a subbottom geophysical survey, borehole core drilling, borehole geophysical logging, permeability analysis of core samples, and test well installation. The investigation provided the most comprehensive hydrogeologic evaluation of potential impacts to groundwater resources by dredging to be performed to date in Savannah Harbor. Due to the thickness and impermeability of the Miocene confining unit, and the impermeability of the in-filling sediments of the relict stream channels, preliminary analysis of data indicates that dredging to the proposed project depths will not impact the Floridan aquifer. The study was performed over that portion of the channel that lies roughly between the Intracoastal Waterway (ICW) at Fields Cut and the area immediately offshore from Tybee Island. Approximately 50 miles of subbottom geophysical surveying was performed along and across the centerline of the present navigation channel. Six core borings were drilled in or near the channel, and two boring were drilled on land near the channel. Four test wells were installed on land at two sites near the channel. Water quality analysis was performed on groundwater samples from the four test wells, and hydraulic head data was collected Permeability and grain size analysis was performed on 22 core samples from six borings. The study generally focused on the upper 150 feet of Oligocene, Miocene, and Recent to Pleistocene sediments below the project area, which included the upper Floridan aquifer (Oligocene), and a zone within the lower Miocene described by a Georgia Geologic Survey report (Clarke and others, 1990) as the "upper Brunswick aquifer".

Analysis of data from the study indicates sediments within the lower Miocene, where the "upper Brunswick" is supposed to occur, were consistently found to be more like confining materials than aquifer materials. The upper and lower Miocene sediments should be considered as confining materials for the Floridan aquifer below. The thickness of the combined upper and lower Miocene confining units, below the proposed project dredging depth of –54 feet MLW in the study focus area, was found to range from about 45 to 60 feet, except in certain areas where relict stream channels have cut down into the Miocene to as deep as –73 feet MLW. In the remaining project area the confining unit thickness below -54 feet MLW is generally greater than 60 feet, and in the upper reaches of the harbor is over 225 feet thick.

Due to the thickness and impermeability of the Miocene confining unit, and the impermeability of the in-filling sediments of the relict stream channels, preliminary analysis of data indicates that dredging to the proposed project depths will not impact the Floridan aquifer.

The City of Savannah has expressed a concern that increased salinity due to deepening may increase chloride levels at the water intake for the Plant. The intake is located on Abercorn Creek, a tributary of the Savannah River immediately upstream from the I-95 Bridge (RM 29). The City of Savannah provides water to various industries in the region. Under their present contract they are required to provide water with Chloride concentrations less than 12 mg/L. In Section 3.1 of the *DEIS* the impacts of the last deepening upon the salinity levels at the US-17 Bridge along the Front River was quantified. The analyses identified that salinity intrusion within the Front River was increased due to the 4.0 foot deepening which occurred in 1994. Analysis of the City of Savannah data appears to indicate that some impact to the Chlorides occurred following the last deepening. Although the levels of impact are difficult to quantify due to the variable nature of the system, and the number of factors that influence chlorides are many, the results of these analyses identify that the proposed deepening may create additional violations in the 12 mg/L concentration limits.

8.5 Recreational and Commercial Fisheries

Commercial and sport fishing within Savannah Harbor is low due to heavy vessel traffic levels and recurring maintenance dredging, which removes bottom habitat and limits benthic communities. Several marine finfish taken around the mouth of the harbor include spotted sea trout, spot, croaker, and other bottom species. Cobia and tripletail provide for a limited amount of sport fishing in the outer channel. In the Savannah River (Schmitt and Hornsby, 1985) the striped mullet *(Mugil cephalus*) has been found to be by far the most abundant species sampled in the estuarine habitat followed by largemouth bass *(Micropterus salmoides*) and bowfin *(Amia calva*). Biomass in the estuary was composed primarily of common carp *(Cyprinus carpio*), bowfin, and spotted sucker (*Minytrema melanops*). Game fish were poorly represented in the estuarine habitat. The principal species harvested in the estuarine portion of the river were shown to be croaker/spot (*Micropogon undulatus/Leiostomus xanthurus),* white catfish (*Ictalurus catus*), silver perch (*Bairdiella chrysura*), and spotted seatrout (*Cynoscion nebulosus*). Weights of fish harvested were represented principally by white catfish, red drum (*Sciaenops ocellata*), striped bass (*Morone saxatilis*), spotted seatrout, hardhead catfish (*Arius felis*), bluefish (*Pomatomus saltatrix*), and channel catfish (*Ictalurus punctatus).* Anadromous fish collected in the estuarine habitat included striped bass, American shad (*Alosa sapidissima*), hickory shad *(Alosa mediocris*), and blueback herring (*Alosa aestivalis*). Though neither species was encountered during the sampling by the state, both Atlantic sturgeon and shortnose sturgeon are known to inhabit the Savannah River estuary.

The greatest concern on fishery resources is that there be no adverse impact to the recovery program for striped bass spawning. Model simulations of dissolved oxygen and salinity under the proposed deepening do not predict adverse impacts to striped bass spawning recovery efforts in the Little Back and Back Rivers, though an increase in salinity in the Middle Rivermay cause a minor impact to the limited spawning that presently occurs there. In the Front River (above RM 24), where almost 80% of the spawning currently occurs, salinity will remain below 1 ppt salinity and a DO above 5 mg/L. Similarly, the areas in the Little Back River which currently have salinities below 1 ppt and are suitable for spawning are predicted to remain so after the project. To avoid this limited impact, the Middle River will be closed off from the Front River flows. The decrease in dissolved oxygen levels (0-0.3 mg/L) within the King's Island Turning Basin may affect the juvenile shortnose sturgeon. The *DEIS* recommends a 5-year study that would monitor the recruitment of juveniles.

8.6 <u>Water Related Recreation and Aesthetics</u>

Because nearly all the dredged material excavated from the Inner Harbor will be placed in Confined Upland Disposal Facilities which have been previously constructed and used, the proposed work is not expected to significantly impact the other designated uses of the Savannah, Wright and Back Rivers. No more than very minor impacts are expected. No inner harbor dredging above River Mile 5 is conducted from March 16 to May 31 of each year to comply with conditions in state Water Quality Certifications intended to protect spawning striped bass. If possible, any open water discharges would be scheduled to avoid the most critical time period for larval and estuarine fish and shellfish of March 1 to June 1. Open water placement of dredged materials could be used to construct the plugs for the closure of the Middle River from the Front River. Although this closure will be constructed to minimize salinity impacts to the SNWR marsh and striped bass spawning areas, fish migration routes and boating access from the Front River to the Middle and Back Rivers will be reduced.

8.7 <u>Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves</u>

Portions of disposal areas 1N, 1S, and 2A are located within the boundaries of the Savannah National Wildlife Refuge. The USACE Savannah District has existing agreements with the U.S. Fish and Wildlife Service concerning discharge of dredged material to Refuge lands. Fort Jackson and Fort Pulaski are historic monuments located upland (adjacent) to the Savannah River channel targeted for deepening.

The mitigation of the C.S.S. *Georgia* may involve archaeological excavation and removal of the entire wreck site from the channel bottom. The site consists of between 4000 and 6400 cubic yards of material. About one-half of the material consists of vessel parts (casemate, hull, machinery, etc.) and its historic contents (iron and brass ordnance, and objects of glass, ceramic, leather, wood, paper, metal, etc.). The remaining 2000 to 3200 cubic yards of material consists of sediments (sand, silts, and clay) that encase the vessel and artifacts. These sediments need to be removed in order to record and recover the vessel and its contents. Most sediment will be removed using hand-held hydraulic dredges and airlifting devices with a diameter usually not exceeding 6 inches. Small-diameter water jets may also be used.

Dredged material will usually be screened at the water surface in order to retrieve small objects missed by the archaeological excavator. The effluent will then be returned to the river. Tidal river currents usually restrict the archaeological working window at the site to the time period one and one-half hours before and after low or high tide. As a result, excavation will usually be limited to a maximum of two 3-hour periods each day. The work will continue for approximately one and one-half years.

8.8 Determination of Cumulative Effects on the Aquatic Ecosystem

The major cumulative impacts that were considered for this project were (1) long-term impacts to striped bass spawning; and (2) long-term transformation of freshwater marsh to brackish marsh due to increases in salinity. The proposed project is not expected to affect striped bass spawning recovery efforts. The least salinity increase will occur in the Little Back River. Above Rifle Cut the expected increase will be in the 0.1 ppt range and will therefore not pose any threat to spawning. The long-term effect of salinity on freshwater marsh is predicted to be negligible. Because all water quality standards are being met through an extensive sediment sampling and testing program no adverse long-term degradation to water quality is expected to occur.

8.9 Determination of Secondary Effects on the Aquatic Ecosystem

No more than minimal secondary impacts have been identified. Those impacts, stemming mainly from construction of landside facilities, receive separate environmental reviews prior to the projects receiving approval for construction. Implementation of the proposed hydraulic dredging of berths with direct deposition of sediments into CDFs would have a secondary benefit of reducing the number of agitation dredging events conducted in the harbor. The closure of the Middle River will minimize salinity impacts on the SNWR marsh and avoid impacts to striped bass spawning areas. Construction of this closure will reduce fish migration routes from the Front to the Back and Middle Rivers.

9.0 FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

9.1 Determinations

(a) An ecological evaluation of discharges of dredged material associated with the proposed approximate 8-foot deepening has been made following the evaluation guidance in 40 CFR 230.6, in conjunction with the evaluation considerations in 40 CFR 230.5. The evaluation concluded that the proposed project is in full compliance with Section 404(b)(1) of CWA. Applicable State WQS will be met for CDF effluent discharges at the edge of the proposed mixing zones. The least environmentally damaging practicable alternatives were chosen to meet the project goals and objectives.

(b) The work will be conducted in accordance with state Water Quality Certifications to the extent practicable. Should it become apparent that operation of the project is resulting in a violation of state Water Quality Standards, coordination with the appropriate state will be initiated to determine the appropriate course of action. The disposal operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

(c) Operation of the project will not jeopardize the continued existence of any federally listed threatened or endangered species or its designated critical habitat. The Project will follow the provisions which the USFWS and NMFS state, through the Section 7 consultation process, as necessary.

(d) The project will be operated in accordance with the Marine Protection, Research, and Sanctuaries Act of 1972. A Section 103 Evaluation has been conducted and is contained in Enclosure B to the *DEIS*.

(e) The proposed discharges will not result in significant degradation of the Waters of the United States. There will be no significant adverse effects on human health and welfare, municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, special aquatic sites, life stages of aquatic life and other wildlife dependent on aquatic ecosystems, aquatic ecosystem diversity, productivity and stability, or recreational, aesthetic and economic values.

(f) The discharges will include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem, including mitigation for possible wetland losses as a result of the project.

9.2 <u>Findings</u>

Based on the determinations made in this Section 404(b)(1) Evaluation, the finding is made that with the conditions enumerated in both the BATES for this project and the proposed dredged material environmental effects evaluation, the proposed discharges comply with the Section 404(b)(1) Guidelines.