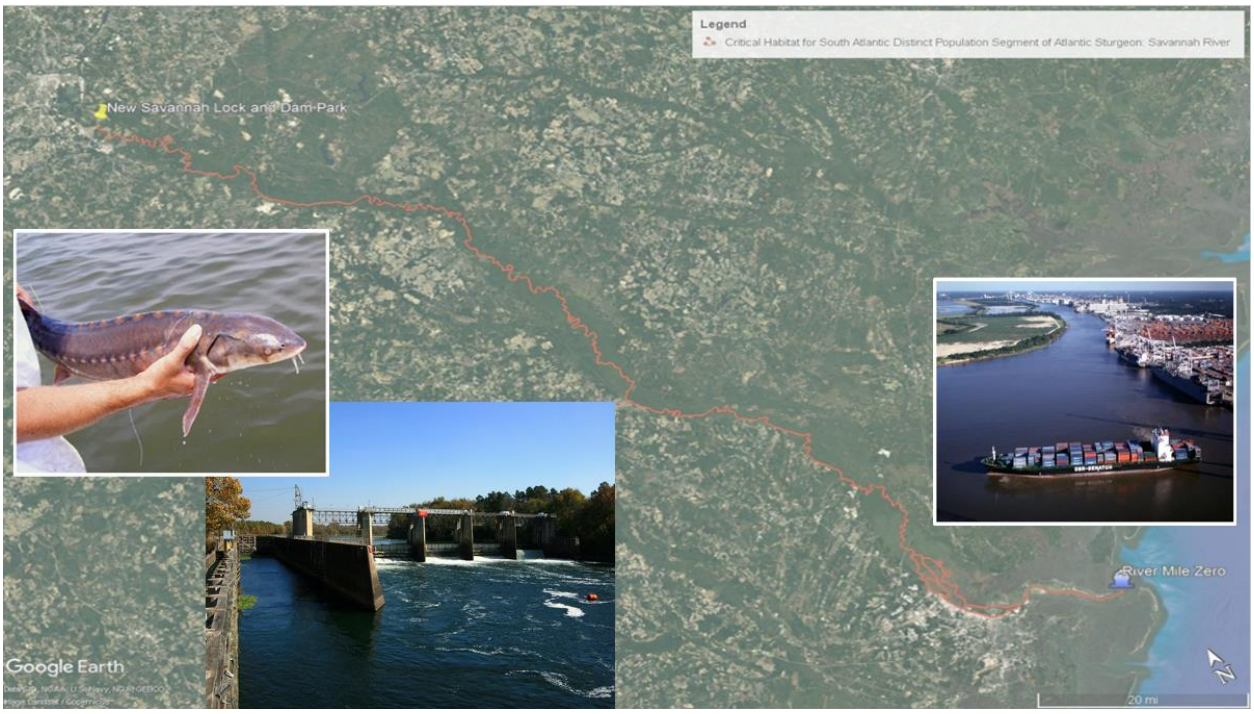
Savannah Harbor Expansion Project, Georgia and South Carolina: Fish Passage at New Savannah Bluff Lock and Dam

Integrated Post Authorization Analysis Report and Supplemental Environmental Assessment



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EXECUTIVE SUMMARY

During development of the Savannah Harbor Expansion Project (SHEP), which was authorized in Water Resources Reform and Development Act (WRRDA) 2014, it was determined that the project would "likely adversely affect" the Atlantic and shortnose sturgeon. In order to mitigate for those impacts, the authorized project included a fish passage at the New Savannah Bluff Lock and Dam (NSBLD). Since 1937, when the NSBLD was built, fish have been unable to migrate to the Augusta Shoals. These shoals are important spawning grounds for sturgeon and other fish species, such as American shad and striped bass.

The Water Infrastructure Improvements for the Nation Act; Title I, Water Resources Development Act of 2016 (WRDA 2016), Section 1319, de-authorized the NSBLD and required modifications to the fish passage as previously authorized as part of SHEP. The law specifies that one of two types of modifications are to occur:

> (1) Section 1319 (c)(1)(A)(i) - repair of the lock wall of the NSBLD and modification of the structure to maintain the pool for navigation, water supply, and recreational activities as existed on the date of enactment of the WRDA 2016 and to allow safe passage over the structure to historic spawning grounds of shortnose sturgeon, Atlantic sturgeon, and other migratory species, or
> (2) Section 1319 (c)(1)(A)(ii) - construction at an appropriate location across the Savannah River of a structure that is able to maintain the pool for water supply and recreational activities that existed on the date of enactment of the WRDA 2016 and remove the NSBLD once construction of the structure is completed.

This integrated Post Authorization Analysis Report and Supplemental Environmental Assessment evaluates alternatives that fulfill either of the above requirements while ensuring the fish passage solution is engineeringly feasible, environmentally acceptable, and is cost effective, while maintaining the functionality of the pool for water supply and recreation, and to meet the Congressional intent in the WRDA 2016, National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) requirements, and stakeholder and sponsor needs.

The final array of alternatives includes the No Action Alternative (NAA) and four action alternatives. One action alternative, Alternative 1-1, repairs the lock wall, dam gates and piers and allows fish to pass adjacent to the lock wall along the Georgia side while maintaining the functionality of the pool for navigation, recreation, and water supply. Three of the alternatives propose a weir to create an in-channel fish passage, remove the lock and dam and partially demolish the dam foundation. Of these three, Alternative 2-3, includes a fixed crest weir with a rock ramp sloping upstream from the existing dam location. Another one of these three, Alternative 2-6, includes a full-width fixed crest weir with a rock ramp sloping upstream from the existing dam location and a floodplain bench to pass flows during high stage flood conditions. Alternative 2-6 also examines four refinements to the weir height which are done as a tradeoff analysis between water supply intakes, recreational impacts and high frequency flooding events. The last of the

three, Alternative 2-8, proposes a full-width in-channel fish passage with a fixed weir and a rock ramp at the existing dam location with a gated flood bypass channel.

The NSBLD structure is historically significant and eligible for the National Register of Historic Places because of its association with historic trends/events in American history (transportation history) and engineering. Project designs and impacts were coordinated with the Georgia and South Carolina State Historic Preservation Offices and federally-recognized tribes to comply with the National Historic Preservation Act.

The National Oceanic and Atmospheric Administration / National Marine Fisheries Service (NOAA/NMFS) participated in the development of the alternatives as a member of the Project Delivery Team. NOAA/NMFS provided feedback on fish species and their probable behavior regarding all conceptual designs. The U.S. Fish & Wildlife Service (USFWS) provided a Draft Fish and Wildlife Coordination Act Report (DFWCAR) on March 21, 2018.

This report recommends Alternative 2-6d, a full-width in-channel fish passage design with a 108.2 NAVD88 (109.0 NGVD29) foot elevation fixed crest weir with a flood bench. The recommended plan provides the highest likelihood of passing fish without delay while maintaining the functionality of the pool for water supply and recreation The report is in compliance with WRDA 2016,Section 1319 (c)(1)(A)(ii).

If approved, the USACE would implement the fish passage feature in accordance with the SHEP biological opinion requirements and begin construction of this mitigation feature no later than January 2021 and complete construction within three (3) years. Following construction, and per the WRDA 2016, the USACE would convey the adjacent park and recreation area to Augusta-Richmond County, GA. This report supplements the Final SHEP 2012 EIS and incorporates it by reference. The cost estimate is provided in Table 30.

Table 30: Project First Cost

Feature Description	**Cost**
Dams	$3,809,000
Locks	$6,569,000
Fish & Wildlife Facilities	$67,512,000
Pumping Plant	$419,000
Cultural Resource Preservation	$641,000
Construction Estimate	*$78,950,000*
Lands and Damages	$140,000
Planning, Engineering, and Design	$4,030,000
Construction Management	$4,031,000
Total Project First Cost	*$87,152,000*

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This report is a combined integrated Post Authorization Analysis Report and Supplemental Environmental Assessment, complying with requirements of the USACE and the Council of Environmental Quality (CEQ), and is intended to reduce duplication and paperwork. An **asterisk (*)** in the table of contents and headings notes paragraphs that are required for National Environmental Policy Act (NEPA) compliance.

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ACRONYMS AND ABBREVIATIONS

Term	Definition	Term	Definition
ACE	Annual Chance Exceedance	OMRR&R/O&M	Operation, Maintenance, Repair, Replacement and Rehabilitation
APE	Area of Potential Effect		
ATR	Agency Technical Review	PA	Programmatic Agreement
CAA	Clean Air Act	PCX	Planning Center of Expertise
CFR	Code of Federal Regulations	PDT	Project Delivery Team
DQC	District Quality Control	PED	Pre-Construction Engineering and Design
EA	Environmental Assessment	PMP	Project Management Plan
EC	Engineer Circular	PL	Public Law
EFH	Essential Fish Habitat	RMC	Risk Management Center
EPA	Environmental Protection Agency	RMO	Review Management Organization
ER	Engineering Regulation	ROM	Rough Order Magnitude
EO	Executive Order	SAFMC	South Atlantic Fishery Management Council
EPA	Environmental Protection Agency	SHEP	Savannah Harbor Expansion Project
ESA	Endangered Species Act	SHPOs	State Historic Preservation Office
FEMA	Federal Emergency Management Agency	SAR	Safety Assurance Review
FONSI	Finding of No Significant Impact	SAD	South Atlantic Division
GA	Georgia	SAS	South Atlantic Savannah
GEPD	Georgia Environmental Protection Division	SC	South Carolina
HEC-RAS	Hydrologic Engineering Center's (CEIWR-HEC) River Analysis System (HEC-RAS)	SCDHEC	South Carolina Department of Health and Environmental Control
HAER	Historic American Engineering Record	SEA	Supplemental Environmental Assessment

Home District	The District responsible for the preparation of the decision document	TMDL	Total Maximum Daily Load
HQUSACE/HQ	Headquarters, U.S. Army Corps of Engineers	USACE	United States Army Corps of Engineers
HTRW	Hazardous, toxic and radioactive waste	USFWS	United States Fish & Wildlife Service
IEPR	Independent External Peer Review	VE	Value Engineering
IPAC	Information, Planning and Conservation System	WIIN	Water Infrastructure Improvements for the Nation
L&D	Lock & Dam	WRDA	Water Resources Development Act
MAFMC	Mid-Atlantic Fishery Management Council		
MCX	Mandatory Center of Expertise		
MOA	Memorandum of Agreement		
MSC	Major Subordinate Command		
NAA	No Action Alternative		
NAAQS	National Ambient Air Quality Standards		
NAVD88	North American Vertical Datum of 1988		
NEPA	National Environmental Policy Act		
NHPA	National Historic Preservation Act of 1966		
NGO	Non-Governmental Organization		
NGVD29	National Geodetic Vertical Datum of 1929		
NFS	Non Federal Sponsor		
NSBLD	New Savannah Bluff Lock and Dam		
NOAA	National Oceanic and Atmospheric Administration		
NMFS	National Marine Fisheries Service		
NRCS	National Resources Conservation Service		
NWI	National Wetland Inventory		

Savannah Harbor Expansion Project, Georgia and South Carolina: Fish Passage at New Savannah Bluff Lock and Dam

Integrated Post Authorization Analysis Report and Supplemental Environmental Assessment

1.0 Introduction

The Water Resources Development Act within the Water Infrastructure and Improvements for the Nation Act of 2016 (WRDA 2016) deauthorized the New Savannah Bluff Lock and Dam (NSBLD) and requires modifications to the fish passage in the authorized Savannah Harbor Expansion Project (SHEP). This Post Authorization Analysis Report evaluates alternatives for a new configuration of the SHEP fish passage, to include either: (1) repair and modification of the existing lock wall of the New Savannah Bluff Lock & Dam (NSBLD) or (2) removal of the entire existing structure after constructing a new water damming structure such as a weir. The SHEP fish passage mitigation feature must allow safe passage over the structure to historic spawning grounds of endangered shortnose (Acipenser brevirostrum) and Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) and other native migratory fish, while maintaining the functionality of the pool for navigation, water supply, and recreational activities.

This Supplemental Environmental Assessment (SEA) was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality's Regulations (40 CFR 1500-1508), and U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 200-2-2. This integrated report and environmental analysis provides sufficient information on the potential adverse and beneficial environmental effects to allow the USACE to recommend a decision on the appropriateness of an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI). In addition this SEA supplements the Final SHEP 2012 EIS and incorporates it by reference.

The navigation deepening project, SHEP, was authorized in the Water Resources Reform and Development Act (WRRDA) of 2014. The project contained a mitigation feature to provide fish passage at the NSBLD (page 28 of Appendix C – Final SHEP 2012 EIS). The fish passage feature was designed to keep the existing lock and dam in place, while building a bypass channel for fish to migrate to the Augusta Shoals, historic spawning grounds for sturgeon and important for other fish including the Georgia state listed robust redhorse. However, this original design is not consistent with the WRDA 2016. The SEA is tiered off the Final SHEP 2012 EIS which includes the no action alternative. Therefore, for the purposes of this unique analysis, the original 2012 SHEP

design is considered the No Action Alternative (NAA) in the comparison of alternatives during plan formulation.

1.1 Study History

1.1.1 New Savannah Bluff Lock and Dam

Construction of the lock and dam was authorized by the 1930 and 1935 Rivers and Harbors Acts to improve commercial navigation at its upper limits on the Savannah River. The 1933 National Industrial Recovery Act included construction of the lock and dam in the Works Progress Administration Program. Section 4 of the Flood Control Act of 1944 authorized the Secretary of the Army to construct, maintain, and operate a public park and recreational facilities at water resource development projects under the control of the Department of the Army. This authority allowed the Secretary of the Army to lease such lands and facilities to Federal, state or local governmental agencies or non-profit organizations for park or recreational purposes for reduced or nominal consideration. The Act further allowed local interests to construct and maintain structures and facilities in the designated recreational areas.

Commercial traffic through the lock had completely ceased by 1979 and, consequently, maintenance of the navigation channel was discontinued. Since then, the lock has been operated to pass infrequent non-commercial recreational vessels as well as migratory anadromous fish species. However, the lock was closed permanently for operation in May 2014 due to concerns about the structural integrity of the lock wall. Although the NSBLD no longer serves commercial navigation, the resulting pool incidentally serves water supply users including two municipalities and four industries; provides water-related recreation opportunities such as general boating, fishing, specialized rowing, and powerboat race events; and promotes regional economic development.

With the cessation of commercial navigation, the lock and dam also ceased to deliver on its single Congressionally-authorized purpose. As a result, funding for the project dwindled. The facility was moved into caretaker status in 1985 when federal funding was further curtailed. Inadequate funding has not allowed the USACE to properly maintain the lock and dam. Since 1993, questions about the continued expenditure of operation and maintenance costs for the dam and economic benefits needed to justify the expenditure were posed. The condition of the dam was inspected and assessed through the USACE's Dam Safety Program in the fall of 2016 and was found to be in poor condition and in need of substantial repair. More information can be found in section 2.2 of this document.

The USACE previously considered rehabilitation of the lock and dam. In 2000, the District prepared a Draft Section 216 Disposition Report which identified the lack of commercial navigation using the lock and recommended removal of the structure at full Federal cost and de-authorization. After release of the draft report for public and agency comment, local interests expressed their views to their Congressional representatives. As a result, Congress authorized the USACE to repair and rehabilitate

the NSBLD at full Federal expense in WRDA of 2000, Section 348. After the repair and rehabilitation, the Secretary would convey the NSBLD, without consideration, to the City of North Augusta and Aiken County, South Carolina. Although that work was authorized, Congress has not appropriated funds to perform the rehabilitation work which led Congress to amend Section 348 of WRDA 2000 to include a fish passage in the Consolidated Appropriations Act of 2001.

The Federal Government owns and operates the NSBLD and is responsible for maintaining the dam although funding is not available due to the priority of lock and dam funding nationwide, see section 2.2, General Existing Condition.

1.1.2 **Savannah Harbor Expansion Project**

The SHEP, which lies 180 miles downstream of the NSBLD, is currently under construction. In compliance with the Endangered Species Act, the USACE is required to reduce or mitigate impacts to both the endangered shortnose and Atlantic sturgeon, two species of fish found in the harbor. Since mitigation for these species could not be accomplished within the footprint of the Savannah Harbor, the Corps and NFS, in coordination with the state and Federal resource agencies, recommended incorporating the fish passage at the NSBLD as an out-of-kind mitigation feature in the SHEP EIS (2012). The NSBLD impacts both species of sturgeon by blocking access to historical spawning grounds. The original SHEP plan (2012 EIS), which includes construction of a fish bypass structure on the South Carolina side and retains the existing NSBLD (Figure 1), is not consistent with the requirements as described in WRDA 2016, Section 1319, c. project modifications, which requires in-channel fish passage.

The fish passage feature described in the 2012 SHEP Plan was initially designed to benefit shortnose sturgeon. Since then, the Atlantic sturgeon has been listed as a protected species, so the design parameters were reviewed to ensure the structure would accommodate the larger Atlantic sturgeon. NOAA concluded that the authorized design in SHEP would be sufficient for passage of Atlantic sturgeon as well as shortnose sturgeon thereby meeting the mitigation requirement.

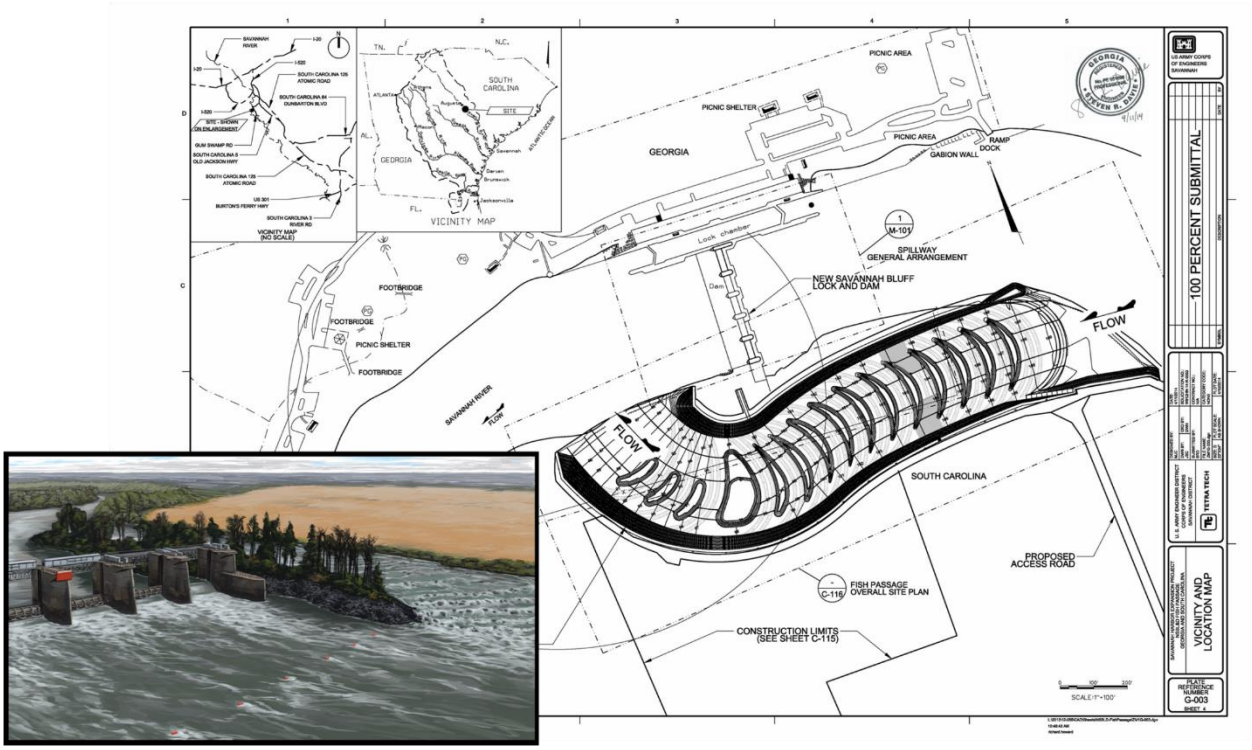


Figure 1: SHEP 2012 Fish Passage Mitigation – Plan A

1.1.3 **Study Authority and Related De-Authorization***

Below is a list of Federal actions leading up to the development of the SHEP fish passage at the NSBLD and the authorizations governing the NSBLD:

- WRDA 1999
  - Required submittal of a favorable Chief's Report for SHEP being completed no later than December 31, 1999, and a favorable Chief's Report was completed October 21, 1999;
  - Required an approved mitigation plan.
- WRDA 2000
  - Authorized Repair and Rehabilitation of the NSBLD with conveyance to the City of N. Augusta
- Consolidated Appropriations Act of 2001
  - Amended Section 348 of WRDA 2000 to include a fish passage.
- WRDA 2014
  - Section 7002(1)(3) of the Water Resources Reform and Development Act of 2014, Public Law 113-121, specifically authorized implementation of the Savannah Harbor Expansion Project in accordance with, and subject to, the conditions contained in the Report of the Chief of Engineers dated August 17, 2012; and having met the conditions in Section 101(b)(9)(B) for compliance with certain conditions. This report included mitigation for sturgeon in the form of a fish passage at NSBLD.

- WRDA 2016
    - Deauthorized the NSBLD
    - Project modification to the SHEP Fish Passage
    - Convey the NSBLD recreation park to the Augusta-Richmond County, Georgia

The section 101(b)(9) of WRDA 1999 (Public Law 106-53), provided legislative authority for SHEP which is worded as follows:

> "*b) PROJECTS SUBJECT TO A FINAL REPORT.—The following projects for water resources development and conservation and other purposes are authorized to be carried out by the Secretary substantially in accordance with the plans, and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed not later than December 31, 1999:*
>
> *(9) SAVANNAH HARBOR EXPANSION, GEORGIA.—*
>
> *(A) IN GENERAL.—Subject to subparagraph (B), the project for navigation, Savannah Harbor expansion, Georgia, including implementation of the mitigation plan, with such modifications as the Secretary considers appropriate, at a total cost of $230,174,000 (of which amount a portion is authorized for implementation of the mitigation plan), with an estimated Federal cost of $145,160,000 and an estimated non-Federal cost of $85,014,000.*
>
> *(B) CONDITIONS.—The project authorized by subparagraph (A) may be carried out only after—*
>
> *(i) the Secretary, in consultation with affected Federal, State of Georgia, State of South Carolina, regional, and local entities, reviews and approves an environmental impact statement for the project that includes—(I) an analysis of the impacts of project depth alternatives ranging from 42 feet through 48 feet;*."
>
> *State of South Carolina, regional, and local entities, reviews and approves an environmental impact statement for the project that includes—(I) an analysis of the impacts of project depth alternatives ranging from 42 feet through 48 feet; and(II) a selected plan for navigation and an associated mitigation plan as required under section 906(a) of the Water Resources Development Act of 1986 (33 U.S.C. 2283(a)); and (ii) the Secretary of the Interior, the Secretary of Commerce, the Administrator of the Environmental Protection Agency, and the Secretary approve the selected plan and determine that the associated mitigation plan adequately addresses the potential environmental impacts of the project."*
>
> *(C) MITIGATION REQUIREMENTS.—The mitigation plan shall be implemented before or concurrently with construction of the project."*

The legislative authority for this Post Authorization Change Analysis is Section 1319 of the 2016 Water Infrastructure Improvements for the Nation Act (WRDA 2016), which is worded as follows:

"SEC. 1319. NEW SAVANNAH RIVER BLUFF LOCK AND DAM, GEORGIA AND SOUTH CAROLINA

(a) DEFINITIONS.—In this section, the following definitions apply:

(1) NEW SAVANNAH BLUFF LOCK AND DAM.—The term "New Savannah Bluff Lock and Dam" means—

(A) the lock and dam at New Savannah Bluff, Savannah River, Georgia and South Carolina; and

(B) the appurtenant features to the lock and dam, including—

(i) the adjacent approximately 50-acre park and recreation area with improvements made under the project for navigation, Savannah River below Augusta, Georgia, authorized by the first section of the Act of July 3, 1930 (46 Stat. 924), and the first section of the Act of August 30, 1935 (49 Stat. 1032); and

(ii) other land that is part of the project and that the Secretary determines to be appropriate for conveyance under this section.

(2) PROJECT.—The term "Project" means the project for navigation, Savannah Harbor expansion, Georgia, authorized by section 7002(1) of the Water Resources Reform and Development Act of 2014 (Public Law 113–121; 128 Stat. 1364).

(b) DEAUTHORIZATION.—

(1) IN GENERAL. — Effective beginning on the date of enactment of this Act —

(A)The New Savannah Bluff Lock and Dam is deauthorized; and

(B) notwithstanding section 348(l)(2)(B) of the Water Resources Development Act of 2000 (Public Law 106–541; 114 Stat. 2630; 114 Stat. 2763A–228) (as in effect on the day before the date of enactment of this Act) or any other provision of law, the New Savannah Bluff Lock and Dam shall not be conveyed to the city of North Augusta and Aiken County, South Carolina, or any other non-Federal entity.

(2) REPEAL. —Section 348 of the Water Resources Development Act of 2000 (Public Law 106–541; 114 Stat. 2630; 114 Stat. 2763A–228) is amended—

(A) by striking subsection (l);

(B) by redesignating subsections (m) and (n) as subsection (l) and (m), respectively.

(c) PROJECT MODIFICATIONS. —

(1)IN GENERAL.—Notwithstanding any other provision of law, the Project is modified to include, as the Secretary determines to be necessary—

(A)(i) repair of the lock wall of the New Savannah Bluff Lock and Dam and modification of the structure such that the structure is able—

(I) to maintain the pool for navigation, water supply, and recreational activities, as in existence on the date of enactment of this Act; and (II) to allow safe passage over the structure to historic

spawning grounds of shortnose sturgeon, Atlantic sturgeon, and other migratory fish; or

(ii)(I) construction at an appropriate location across the Savannah River of a structure that is able to maintain the pool for water supply and recreational activities, as in existence on the date of enactment of this Act; and

(II) removal of the New Savannah Bluff Lock and Dam on completion of construction of the structure; and

(B) conveyance by the Secretary to Augusta-Richmond County, Georgia, of the park and recreation area adjacent to the New Savannah Bluff Lock and Dam, without consideration.

(2) NON-FEDERAL COST SHARE.—The Federal share of the cost of any Project feature constructed pursuant to paragraph (1) shall be not greater than the share as provided by section 7002(1) of the Water Resources Reform and Development Act of 2014 (Public Law 113–121; 128 Stat. 1364) for the most cost-effective fish passage structure.

(3) OPERATION AND MAINTENANCE COSTS.—The Federal share of the costs of operation and maintenance of any Project feature constructed pursuant to paragraph (1) shall be consistent with the cost sharing of the Project as provided by law."

1.1.4 **Study Sponsor**

The Georgia Department of Transportation (GDOT) and the Georgia Ports Authority (GPA), collectively referred to as the non-Federal Sponsors (NFS), entered into an agreement with the USACE, on October 8, 2014, for construction of the Savannah Harbor Expansion Project. GDOT and GPA are the non-Federal sponsors for SHEP and the fish passage feature described in this Post Authorization Analysis Report.

GDOT is the state agency in charge of developing and maintaining all state and federal roadways in the state of Georgia. In addition to highways, the department also has a waterways program through which it partners with the USACE to maintain navigability of Georgia's commercial ports. GDOT also has a limited role in developing public transportation and general aviation programs.

GPA has been in operation since 1945 and is dedicated to providing economic growth to the state of Georgia and the nation. It owns and operates two deepwater terminals at the port of Savannah and the port of Brunswick.

The Garden City Terminal is the largest single container facility of its kind in North America and the fourth busiest container terminal in the United States, encompassing more than 1,200 acres and moving millions of tons of containerized cargo annually. The port of Savannah provides customers with the most efficient, productive port facility in the nation, and has created jobs and business opportunities to benefit more than 9.7 million Georgians.

As one of the state's largest public employers, the GPA directly employs more than 1,100 trained logistics professionals. GPA operations, together with private sector, port-

related operations, account for more than 369,000 jobs statewide, $84.1 billion dollars in revenue, and income exceeding $20.4 billion annually.

1.2 Study Area/Scope

The NSBLD (Figure 2 and Figure 3) study area is located along the Savannah River, and extends approximately 19 miles downstream from the Augusta Shoals to just downstream of the NSBLD. The study area also includes the NSBLD Park, and the floodplain adjacent to the river. The project area (Figure 2) includes the NSBLD, the associated park, and the river just upstream of the dam. The NSBLD is the first dam on the mainstem of the Savannah River encountered by anadromous fishes moving upstream from the Atlantic Ocean approximately 187 miles upstream from Savannah, Georgia.

Figure 2: NSBLD Project Area

Figure 3: Study Area Location Map

1.3 Purpose and Need*

The purpose of the project is to mitigate for impacts to two endangered sturgeon species. The SHEP includes a mitigation feature to provide fish passage at the NSBLD to address adverse impacts to shortnose and Atlantic sturgeon. The plan, described in the 2012 SHEP GRR and Final EIS, was for the construction and operation of a fish bypass around the NSBLD on the South Carolina side of the Savannah River. This feature would ensure USACE and NFS compliance with the Endangered Species Act.

This report documents the evaluations that USACE performed to identify how the SHEP fish passage mitigation feature should be modified to meet the requirement of the WRDA 2016.

1.4 Problems, Opportunities, Objectives, and Constraints*

1.4.1 **Problems**

- The NSBLD blocks native fish from migrating to historic spawning grounds known as Augusta Shoals.
- The SHEP 2012 mitigation plan includes an out-of-channel fish passage not an in-channel fish passage required in the WRDA 2016.

1.4.2 **Opportunities**

- Mitigate for impacts from SHEP construction to the shortnose and Atlantic Sturgeon by constructing a fish passage at the NSBLD.
- Provide access to habitat, such as the Augusta Shoals, for fish communities including the shortnose and Atlantic sturgeon and other species including the Georgia state listed robust redhorse that will afford these species a stable foraging, resting and spawning area.

1.4.3 **Objective**

- Increase access to historic spawning grounds for shortnose and Atlantic sturgeon upstream of the NSBLD to meet the completeness and acceptability of SHEP mitigation
- Maintain the functionality of the pool for navigation, water supply, and recreational activities for 100 years from the start of construction.

1.4.4 **Constraints**

- The study is constrained in developing alternatives based on the “project modifications” authorized in the WRDA 2016. The WRDA 2016 deauthorizes the

NSBLD and provides the Secretary of the Army with options to modify the SHEP fish passage feature as follows:

Option i: Repair the NSBLD lock wall and modify the structure such that the structure is able to:

- Maintain the pool for navigation, water supply, and recreational activities
- Allow safe passage over the structure to historic spawning grounds of shortnose sturgeon, Atlantic sturgeon, and other migratory fish; Or

Option ii: Construct, at an appropriate location across the Savannah River, a structure that is able to maintain the pool for water supply and recreational activities; and removal of the NSBLD on completion of construction of the fish passage structure; and following the construction of the in-channel weir and fish ramp, and demolition of the NSBLD, USACE would convey the adjacent park and recreation lands that are no longer needed to Augusta-Richmond County, Georgia, without consideration.

- Construction of the SHEP fish passage is required to start by January 2021 and be completed within 3 years in accordance with the SHEP Biological Opinion.

1.4.5 **Issues Identified During NEPA Scoping**

USACE issued a public notice on April 3, 2017, requesting assistance from natural resource agencies and the public on identifying issues that it should consider during its evaluation of changes to the SHEP fish passage design. The official scoping period ended on June 3, 2017, during which the District received 677 comments. The scoping identified the following issues/concerns:

- Rehab the lock and dam
- Integrate a fish ladder
- Maintain the pool and riverfront
- Allow fish to move to Augusta Shoals
- Protect the shoals lily (Federally listed species that can be found in Richmond County)
- Ensure boat races continue
- Maintain flood protection
- River is of economic importance to the city

1.4.6 **Assumptions**

- USACE is retaining the 2012 SHEP Plan (Figure 1) as the NAA (page 28 of Appendix C – Final SHEP 2012 EIS http://www.sas.usace.army.mil/Portals/61/docs/SHEP/Reports/EIS/Appendix%20C%20Mitigation%20Planning%20SHEP%20FINAL%20EIS.pdf) because it was the authorized plan on the date of enactment of the 2016 WRDA.

- The SHEP plan does not meet the 2016 WRDA requirements because it is not an in-channel alternative.
- Commercial navigation is not expected to resume in the future.
- Navigation in the pool is considered recreational navigation.
- The lock and dam is not expected to be re-opened due to safety concerns.
- All alternatives discussed in this SEA provide the same output (mitigation lift).
- Appendix D of the SHEP 2012 FEIS provides the details on the monitoring and adaptive management (AM) plan for the fish passage and no additional AM and Monitoring is needed as a result of the project modifications.

1.5 Prior Reports

Savannah Harbor Expansion Project - Final Environmental Impact Statement (January 2012/Revised July 2012)

http://www.sas.usace.army.mil/Missions/Civil-Works/Savannah-Harbor-Expansion/Final-Environmental-Impact-Statement/

Draft Section 216 Report – September 2000

The USACE, with the support of all natural resource agencies, prepared a draft report in September 2000 that recommended the removal of the NSBLD. After public comment, local interests petitioned Congressional representatives to keep the structure in place.

2.0 Current and Future Conditions

This section provides an overview of the existing project area conditions used for the analyses conducted for this study. The description of existing conditions contained in this section includes conditions most relevant to the evaluation of project alternatives. Further description of existing conditions can be found in Appendix C). Impacts of the alternatives being evaluated can be found in Section 3.6.

Existing conditions represent the current conditions within the project area, as well as those future conditions without implementation of those alternatives being evaluated. The following sections describe those general existing conditions.

2.1 Planning Horizon

The planning horizon encompasses the study period, construction period, period of analysis, and project life. The study began on April 3, 2017, and is estimated to be completed on September 3, 2019. The design is estimated to begin on October 1, 2019, and end on October 1, 2020. Any real estate and/or flowage easements that need to be acquired must be obtained prior to award of the construction contract if needed to facilitate construction. The construction period is estimated to begin before January 1, 2021 and end within three years. The period of analysis considers the

impacts of the plan. The period of analysis used for each alternative was 100 years. The life of the project is estimated to be 100 years.

2.2 General Existing Conditions*

The project is comprised of a lock chamber, dam, operations building, and a 50-acre park and recreation area. The dam is 360 feet long and houses five vertical gates, each 60 feet long. Due to the modernization of commercial navigation vessels and infrastructure, the lock, measuring 56 feet wide and 360 feet long, ceased being a viable option for commercial shipping. As a result, the structure and upstream channel fell into disuse. Commercial traffic through the lock had completely ceased by 1979. USACE proposed demolishing the dam in 2000, but local objection to the proposed disposition resulted in Congressional authorization (WRDA 2000) to rehabilitate the lock and dam at full Federal expense and turned over to local government. Congress did not appropriate funds for rehabilitation of the lock and dam, and in 2001, the legislation was amended to include creation of a fish passage at the NSBLD.

The cities of Augusta, Georgia and North Augusta, South Carolina, seven miles upstream of the project area utilize the pool upstream of the NSBLD, an incidental benefit not tied to a federally authorized purpose. Although the project no longer serves commercial navigation, the sole Federal purpose, it does incidentally serve water supply users including two municipalities and four industries. The pool, impounded by the dam, also incidentally supports water-related recreation opportunities such as general boating and fishing, specialized rowing, powerboat race events, regional economic development and tourism. The lock and dam was also operated to pass some migratory anadromous fish species until the lock was closed in May of 2014 due to measured instability of the lower riverside lock wall during lockages.

While no longer serving commercial navigation, the dam is operational. To manage pool levels, the dam spillway gates are operated remotely from the control room at J. Strom Thurmond Dam, some 30 miles north of the NSBLD. The City of North Augusta had operated the lock periodically for recreational boats and provided a means for upstream fish passage during the spring (approximately 90 lock movements per year), but that operation ceased on May 15, 2014.

After the SHEP GRR/FEIS was published, USACE performed a Periodic Assessment and Inspection of the lock and dam. According to the most recent Periodic Inspection (2014), the current condition of the project is poor. That inspection revealed substantial deterioration of the lock and dam, including numerous structural issues (Figure 4 and **Figure 5**).

Figure 4: Cracks in NSBLD

Figure 5: Cracks in NSBLD

While not expecting an imminent collapse, USACE chose prudency and closed the lock indefinitely in May 2014 due to significant safety risks to lock operators and boaters within the lock chamber. The lock wall also served as a prominent fishing location for the local populace. In addition, USACE determined that the condition of the structure could adversely impact the function of the fish bypass around the lock and dam. In response, the District included additional activities in the fiscal year 2017 SHEP cost estimate update that would provide the structural repairs necessary to reduce the risk of a catastrophic failure of the dam and ensure proper hydraulic operation of the fish passage. The lock and dam currently resides in a caretaker status and has a Dam Safety Action Classification (DSAC) of 4. DSAC Class 4 (Low Urgency), dams are inadequate with low risk such that the combination of life, economic, or environmental

consequences with a probability of failure is low and the dam may not meet all essential USACE engineering guidelines.

The USACE Dam Safety Program uses risk to inform how it manages the approximately 700 dams it operates and maintains, with life safety the highest priority. This approach is a best practice adopted to evaluate, prioritize and justify dam safety decisions. Using risk information allows USACE to repair its dams in the most effective manner within a constrained budget.

The Dam Safety Classification System is intended to provide consistent and systematic guidelines for appropriate actions to address the dam safety issues and deficiencies of USACE dams. USACE dams are placed into a DSAC class based on their individual dam safety risk considered as a combination of probability of failure and potential life safety, economic, environmental, or other consequences. The DSAC table presents different levels and urgencies of actions that are commensurate with the different classes of the safety status of USACE dams. These actions range from immediate recognition of an urgent and compelling situation requiring extraordinary and immediate action for unsafe dams through normal operations and dam safety activities for safe dams.

2.2.1 **Environmental Setting**

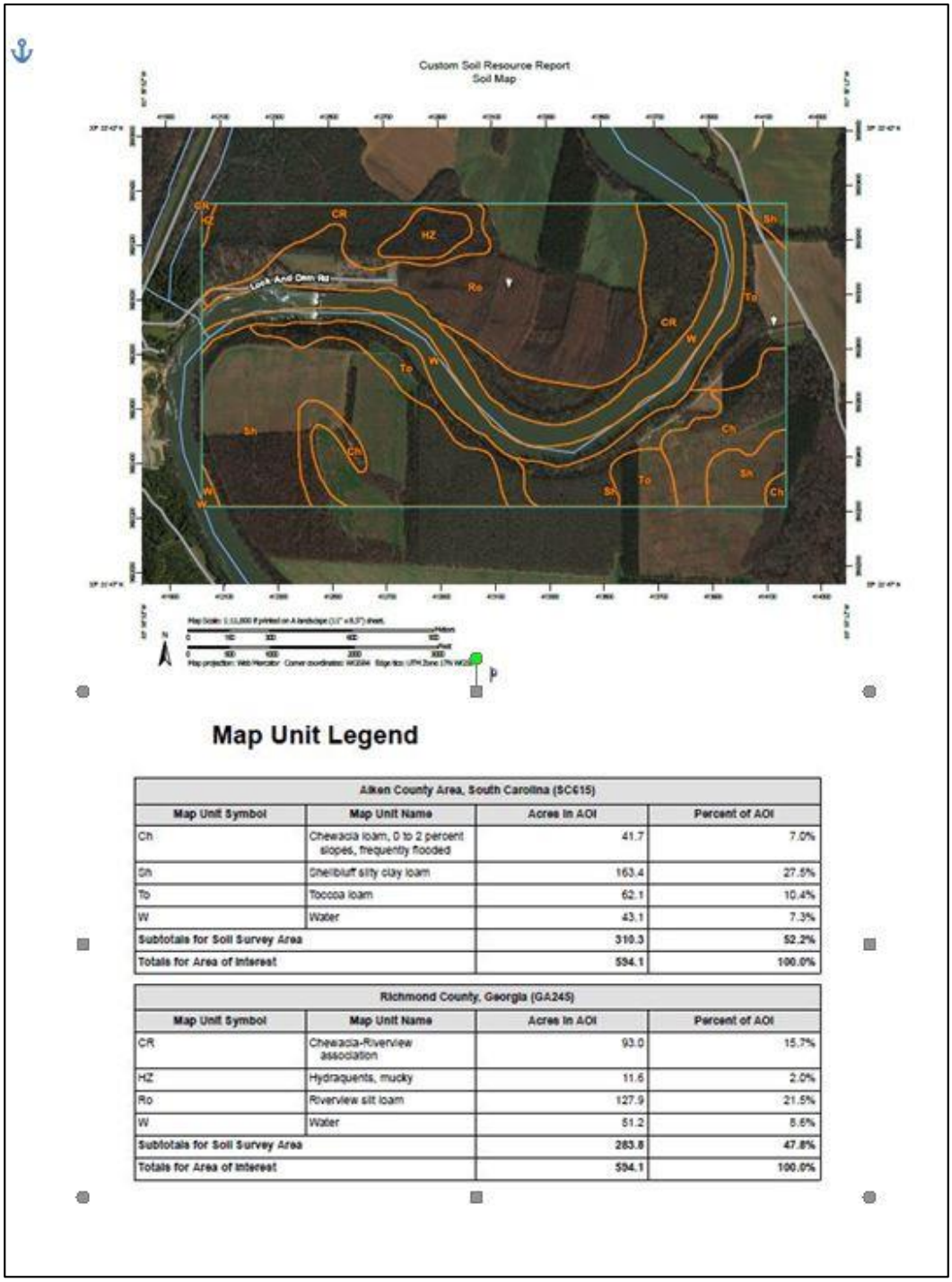
The headwaters of the Savannah River Basin originate in the Blue Ridge Province of Georgia, North Carolina, and South Carolina. The Savannah River Basin then passes through the Piedmont, Fall Line, and Coastal Plain Provinces, paralleling the Georgia and South Carolina border, before reaching the Atlantic Ocean. Approximately 175 square miles of the estimated 10,577-square-mile basin are located in North Carolina, 4,581 square miles in South Carolina, and 5,821 square miles in Georgia.

In the Upper Savannah River, the Chattooga and Tallulah Rivers join in the headwaters of Georgia to form the Tugaloo River. In South Carolina, the Keowee River and Twelve Mile Creek are the major water bodies that join to form the Tugaloo River. The Savannah River forms at the junction of the Seneca River and the Tugaloo River, which flows southeasterly for approximately 300 river miles to the Atlantic Ocean.

The NSBLD project site, located at river mile 187.3, is the first dam on the mainstem Savannah River encountered by anadromous fishes moving upstream from the Atlantic Ocean. The NSBLD is located at the downstream end of Augusta Shoals and at the lower extent of the Fall Line, a unique geologic feature that is the transitional zone between the Piedmont and Coastal Plain Physiographic Provinces of the southeast. It is expressed at the surface by underlying metamorphic rocks, getting its name from the relatively steep gradient the river assumes as it moves through this transitional zone. Unaltered rivers and streams traversing this physiographic feature are characterized by extensive areas of metamorphic rock outcroppings and are dominated by rapids, short pools, and occasional waterfalls.

Based on the current web soil survey for the project area, soils in the area were grouped by County/State (Figure 6). There were four soil types identified in Aiken County, South Carolina:

1. Chewacla loam, 0 to 2 percent slopes, frequently flooded (approximately 7 percent of proposed project area)
2. Shellbluff silty clay loam (approximately 28 percent of proposed project area)
3. Toccoa loam (approximately 10 percent of proposed project area)
4. Water (approximately 7 percent of proposed project area)



Map Unit Legend

Aiken County Area, South Carolina (SC615)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ch	Chewacla loam, 0 to 2 percent slopes, frequently flooded	41.7	7.0%
Sh	Shellbluff silty clay loam	163.4	27.5%
To	Toccoa loam	62.1	10.4%
W	Water	43.1	7.3%
Subtotals for Soil Survey Area		**310.3**	**52.2%**
Totals for Area of Interest		**594.1**	**100.0%**

Richmond County, Georgia (GA245)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CR	Chewacla-Riverview association	93.0	15.7%
HZ	Hydraquents, mucky	11.6	2.0%
Ro	Riverview silt loam	127.9	21.5%
W	Water	51.2	8.6%
Subtotals for Soil Survey Area		**283.8**	**47.8%**
Totals for Area of Interest		**594.1**	**100.0%**

Figure 6: Project Area Soil Typology

There were also four soil types identified in Richmond County, Georgia:

1. Chewacla-Riverview association (approximately 16 percent of proposed project area)
2. Hydraquents, mucky (approximately 2 percent of proposed project area)

3. Riverview silt loam (approximately 22 percent of proposed project area)
4. Water (approximately 9 percent of proposed project area)

The climate within the study area has short mild winters with snowfall being very rare but has brief frost and freeze events occurring, and hot humid summers with a wide diurnal temperature variation throughout the year. According to the U.S. Climate Data website, the average high temperatures for the study area ranges between 76.8° F and 77.3° F. Average low temperatures range between 50.9° F and 51.1° F. Overall average temperatures for the study area range between 63.9 ° F and 64.2° F. Average annual precipitation (rainfall) ranges between 43.58 inches and 52.44 inches. Maximum rainfall generally occurs during the month of June.

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth requirements for the National Marine Fisheries Service (NMFS), regional Fishery Management Councils (FMC), and other federal agencies to identify and protect important marine and anadromous fish habitat. These amendments established procedures for the identification of Essential Fish Habitat (EFH) and a requirement for interagency coordination to further the conservation of Federally-managed fisheries. There are no EFH in the study area.

2.2.2 **Hydrology and Floodplains**

The Savannah River is a major interstate river with a drainage basin of over 10,000 square miles and forms the border between the States of Georgia and South Carolina. The upper natural river system has been fragmented by a series of reservoirs, including three large federal reservoirs (Hartwell Lake, Richard B. Russell Lake, and J. Strom Thurmond Lake). These reservoirs provide hydropower, water supply, recreational facilities, and a limited degree of flood control. J. Strom Thurmond Dam is responsible for most of the flow regulation that affects the Savannah River at Augusta. Stevens Creek Dam, which began generating electricity in 1914 and is located between Thurmond Dam and Augusta, impounds a minor run-of-the-river reservoir compared to the three major reservoirs. Stevens Creek dam and other dams upstream of Hartwell Lake have little impact on flood discharges at Augusta.

The NSBLD project is the lowest dam on the Savannah River at River Mile 187.3, approximately 13 river miles downstream from the city of Augusta in Richmond County, Georgia, and the city of North Augusta in Aiken County, South Carolina. The NSBLD project is physically located just below the fall line in the Sand Hills Region of the Savannah River Watershed between the Piedmont and Upper Coastal Plain Provinces. The project affects a river reach upstream, which extends above the fall line into the Piedmont Province. The Sand Hills Region is a belt of deep sandy soils on gently sloping to strongly sloping uplands. Soils in this area were derived from marine sands, loams, and clays that were deposited on acid crystalline and metamorphic rocks. Elevation ranges from 350 to 500 feet mean sea level (Smith and Hallbick 1979, Perkins and Shaffer, 1977). The Piedmont Province consists of gently rolling to hilly slopes. This area is underlain by acid crystalline and metamorphic rock of Pre-Cambrian origin.

Elevations range from 600 to 1200 feet M.S.L. (Smith and Hallbrick 1979, Perkins and Schaffer, 1977). As the river transitions from the Sandhills to the Piedmont, substrate and structure change from sandy to bedrock and cobble/gravel shoals.

River flows at Augusta and NSBLD are regulated by J. Strom Thurmond Dam and to lesser extent by Stevens Creek Dam. During normal operating conditions flows range from 3,600 cfs to around 8,000 cfs, though there is daily and even hourly variability in flow due in large part to hydropower generation at Thurmond. A statistical analysis of the period-of-record flow data was used to develop a plot of the non-exceedance probability of the mean daily flow at NSBLD and can be seen in Figure 7. Mean daily flows are between 3,600 cfs and 8,000 cfs approximately 66 percent of the time at NSBLD.

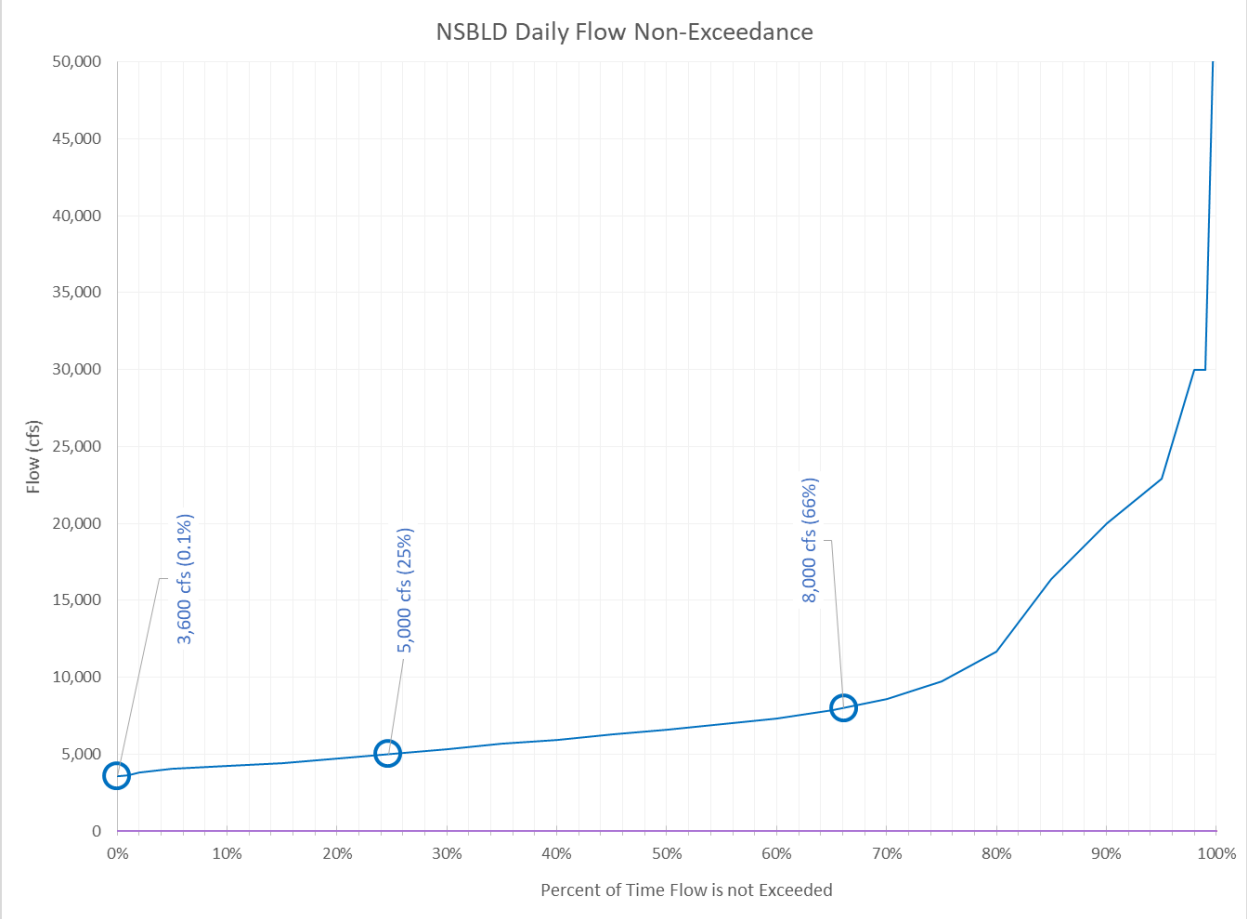


Figure 7: NSBLD Daily Flow Non-Exceedance

The gates at NSBLD are used to help maintain a pool elevation between 111.2 and 114.2 NAVD88 upstream of the dam, and are operated remotely from J. Strom Thurmond Dam. The regulated pool is used to support activities described in the subsequent sections of this report during normal flow conditions. As inflow increases, operational gates are opened to keep a steady pool within the target range; gates are closed as flow decreases. The gates are opened fully as flows approach 25,000 cfs and

water is allowed to flow freely through the dam. For flow levels above the channel capacity of 30,000 cfs water begins to leave the channel and flows around the dam on the South Carolina abutment. The 0.5% Annual Chance Exceedance (ACE) (2-year return interval) flow is approximately 33,000 cfs and serves as a good proxy for the channel capacity flow.

The Augusta Levee System is located on the right bank of the Savannah River between River Mile 187 and 203 in Richmond County, and in the city of Augusta. The levee is between the river and the city of Augusta with considerable industry and residential areas adjacent the levee. The levee has a total design length of 61,125 lf and was designed and constructed to provide protection against a discharge of approximately 500,000 cfs.

Large storms are common in the region and can produce severe flooding in the Augusta- Richmond County area. These storms are usually of the frontal type, lasting two to four days and covering large areas. The summer storms generally consist of thunderstorms, which have high rainfall intensities and are scattered over small areas. In addition, the study area is vulnerable to hurricane and tropical storm activities. These storms usually occur in Georgia from August through October and have produced some of the most severe floods in the area.

Numerous damaging floods have previously occurred in Augusta-Richmond County. However, the September-October 1929 flood is the most severe flood on record. It was caused by two successive storms. The first storm, which began in Alabama, spread eastward covering all of Georgia, northern Florida and South Carolina. Approximately eight inches of rain fell on September 26 and 27. The second storm was caused by a tropical cyclone, which passed around the Florida peninsula, turned northwestward, and moved inland near Pensacola, Florida, on September 30. It moved northeastward across northern Florida and southeastern Georgia and then up the Atlantic Coast. This second successive storm caused approximately seven inches of additional rain to fall over the city of Augusta area.

The September-October 1929 flood registered a reading of 45.6 feet NAVD88 on the Savannah Fifth Street gage. This reading represented a peak flow of 350,000 cubic feet per second (cfs). This value corresponds to a regulated peak flow, including the impacts of the Hartwell, J. Strom Thurmond (formerly Clarks Hill), and Richard B. Russell Reservoirs, of 252,000 cfs. With the Hartwell, Thurmond, and Russell Reservoirs in place, the 1 percent annual chance exceedance (ACE) flood regulated peak flow is computed to be 138,000 cfs at the Butler Creek gage, which corresponds to the 1% ACE unregulated peak flow of 277,000 cfs.

Executive Order (EO) 11988 has an objective to avoid, to the extent possible, long, and short-term adverse impacts associated with occupancy and modification of the base floodplain. Further objectives are the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative and protection and restoration of natural floodplain functions. USACE regulation for

implementing EO 11988 (ER 1165-2-26) defines the base floodplain as the 1% ACE or one percent chance floodplain.

The NSBLD project does not currently serve a flood control function. The entire project impact area lies within the 1% ACE floodplain.

It is important to note that a 1% ACE does not occur once every 100-years, but instead has a 1 in 100 chance of occurring in any given year. The likelihood of one or more 1% ACE floods occurring over a 100 year time period is approximately 63%. The same is true for smaller floods that have a more likely chance of occurrence in any given year. The percent chance of an X-year flood occurring in a single year is 100/X. For example, the 25-year return interval flood has an annual chance of occurrence of 100/25 = 4 percent. Throughout this document floods will be discussed in terms of % ACE, with the corresponding year return interval listed in parentheses.

2.2.3 **Aquatic Resources and Aquatic Habitat**

The study area within the lower Savannah River supports an abundant diversified migratory fish community. Common fish species include American shad, redbreast sunfish, channel catfish, largemouth bass, black crappie, yellow perch, bluegill, striped mullet, and redear sunfish. Other species found within the study area include diadromous fish (those fish that spend portions of their life cycles partially in fresh water and partially in salt water): such as striped bass, blueback herring and shortnose and Atlantic sturgeon. The catadromous (fish that migrate down river to the sea to spawn) American eel has also been documented within the study area. In addition, a small population of robust redhorse, which is listed in the state of Georgia as endangered has been sampled within the Savannah River just below the NSBLD. Detailed information on migratory fish that can be found in the Savannah River near NSBLD can be found on pages 8 to 13 of the Draft Fish and Wildlife Coordination Act Report (FWCAR) included in Appendix D of this report.

Other aquatic species that could be in the study area are freshwater mussels. There are three potential Georgia listed mussel species that could be within the proposed study area; Savannah Lilliput, Altamaha arcmussel, and potentially the delicate spike. Based on the FWCAR the closest survey sites to NSBLD occurred in 2006 and were located approximately 5.8 river miles upstream of NSBLD (across from the upper end of the Dead River cutoff at Beech Island) and approximately 380 meters downstream of NSBLD across from the confluence with Butler Creek. Detailed information can be found on pages 13 to 16 of FWCAR included in Appendix D of this report.

There are a number of exotic aquatic weeds that are present just north of the project area within the Augusta pool. Brazilian elodea (*Egeria densa)* and hydrilla (*Hydrilla verticillata**)*** both grow in the pool, and water hyacinth is a huge nuisance at certain times of the year. Phragmites is also present. Most years the city of Augusta sprays the submergent weeds in early summer to control population growth.

Within the project area near the NSBLD, the only exotic species found has been the common water hyacinth (*Eichhornia crassipes*).

Rocky shoals of the Fall Line are unique habitats characterized by metamorphic rock outcroppings, rapids, short pools, and occasional waterfalls. Large and small impoundments have greatly reduced the amount of riverine and shoal habitat throughout the Piedmont and Fall Line physiographic provinces in the Savannah River Basin as well as other river systems in the Southeast. In general, dams have historically been built along the Fall Line to harness the energy of the water for hydropower as it drops down to the Coastal Plain; therefore, riverine and shoal habitat such as that in the study area has been particularly impacted. The NSBLD and other reservoirs owned by USACE and private entities have cumulatively contributed to the elimination of riverine habitat, fragmentation of habitat and aquatic populations, and/or altered flows and water quality in the Savannah River Basin. As such, only a few, small, riverine "refuges" remain in this area of the mainstem Savannah, most notably the Augusta Shoals, this reach of rare Fall Line shoal habitat persists below Augusta Diversion Dam and above NSBLD.

This habitat harbors the rare Shoals Spiderlily (Hymenocallis coronaria), a bulbose, emergent perennial plant that grows on rocky shoals in streams and rivers at and above the Fall Line. This species a Federal Species of Concern and is listed as Threatened by the State of Georgia. As a result of construction, the NSBLD is thought to have inundated a portion of the Augusta Shoals, and hence eliminated this habitat (USFWS 2000).

Table 26 of Appendix C of the 2012 Final SHEP EIS list the benthic substrate in the Augusta Shoals, the Suitability index (SI) and the frequency of that substrate (https://www.sas.usace.army.mil/Portals/61/docs/SHEP/Reports/EIS/Appendix%20C%20Mitigation%20Planning%20SHEP%20FINAL%20EIS.pdf). Figure 8 is an image of the Augusta Shoals.

Figure 8: Augusta Shoals

2.2.4 **Wetlands**

A wetland investigation was conducted in late 2012 in preparation to complete the final design of the fish passage structure as discussed in the January 2012 Final General Reevaluation Report/Environmental Impact Statement for the SHEP. This report, dated June 2013, can be found in the Appendix C. As part of that 2012 investigation, two wetland (Wetland 1 and Wetland 2) areas were identified:

1. Wetland 1 (edge of Savannah River)

The Savannah River is a navigable waterway that is approximately 450 feet wide at the NSBLD. The USFWS National Wetland Inventory (NWI) map shows the Savannah River as a permanently flooded, unconsolidated bottom, riverine system (R2UBH) downstream of the dam and an impounded, unconsolidated bottom lacustrine system (L1UBHh) just upstream of the dam. The National Resources Conservation Service (NRCS) soils map identifies the river as “water”. The land adjacent to the river is mapped as “Toccoa loam”. Upstream of the dam, the river has shallow banks and a narrow wetland fringe that is vegetated with American elm, Chinese privet, elephant’s ear, and giant cutgrass. Downstream of the dam, the bank is very steep and is heavily armored with large rip rap.

2. Wetland 2 (near Country Highway 201)

A forested wetland was identified near County Highway 201. This area was mapped as a temporarily flooded, broad-leaved deciduous, forested palustrine wetland (PF01A) on the NWI map and was mapped as “Chewacla loam” on the NRCS soils map.

This linear depressional feature, approximately 60 feet wide, cuts through the mixed hardwood forest. The depression is about four feet deep relative to the surrounding uplands. The feature contains mature water tupelo trees, over 24 inches in diameter, and hardly any other vegetation. The ground was covered in leaves and there was no water present at the time of the field investigation, but water stains on the tree trunks indicate that there is periodic inundation, up to four feet deep. Tree trunks were heavily buttressed.

Updated wetland mapping

A recent NWI Map for the project area accessed in September 2017 confirms the findings from the 2012 wetland invitation completed for the project (Figure 9). Two types of Palustrine Forested Broad-Leaved Deciduous wetlands can be found in the area. Those that are seasonally flooded (PFO1C) and those that are temporarily flooded (PFO1A). Similar wetland habitat to Wetland 1 from 2012 can be found along the Georgia side of the river. This has been confirmed over multiple site visits by USACE Environmental Staff members. This wetland fridge is approximately 10 feet wide.

Most of the proposed study area consists of pine trees (predominantly planted), although the wetland area in the Black Creek area is predominantly hardwood. Some of the property contains excavated ponds and the remainder of the site has been clear cut as part of recent timber harvesting. The clear cut areas are naturally regenerating into stands of pine trees and are still under silvicultural land use. Historical aerial photograph and topographic map review indicates that this tract has been entirely forested since at least 1912, except for ponded areas.

Vegetation found within the wetland areas include: loblolly pine, bluestem palmetto, sweetpepperbush, sweetbay magnolia, Ogeechee tupelo, sweetgum; various sedges including Carex albolutescens, Cyperus spp., Scleria spp., Rhynchospora inundata, and other Rhynchospora spp.; red panicum, soft rush, witchgrasses, post oak, willow oak , swamp chestnut oak, water oak, smartweed, and chain fern.

The upland portion of the property consists of loblolly pine, sweetgum, witchgrasses, Beautyberry, Post oak, water oak, braken fern, huckleberry, milkwort, and dogbane.

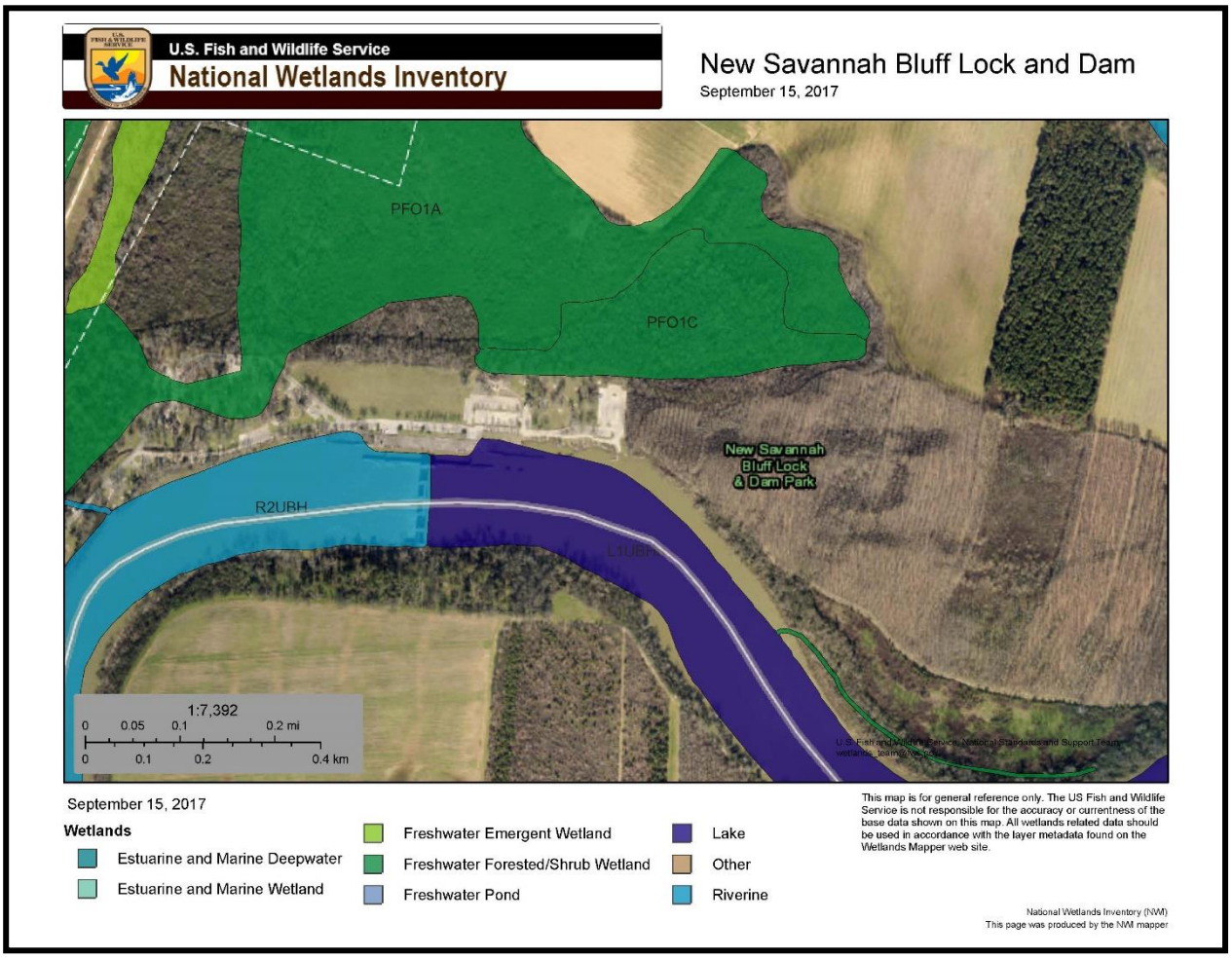


Figure 9: National Wetland Inventory Map for New Savannah Bluff Lock and Dam

2.2.5 **Terrestrial Resources and Wildlife**

Wildlife associated with forested wetlands within the study area are numerous and diverse. The furbearers are an important component of these wetlands and include beaver, muskrat, mink, otter, bobcat, gray fox, raccoon, and opossum. Deer, turkey, and even black bear in the more isolated areas, use the bottomlands. Palustrine emergent wetlands also provide excellent habitat for furbearers including the mink, beaver, and river otter. Terrestrial species from surrounding areas often utilize the fresh marsh edge for shelter, food, and water. These include raccoon, opossum, rabbit, and bobcat.

The study area is part of the Atlantic Flyway. Forested wetlands provide important wintering habitat for many waterfowl species and nesting habitat for wood ducks. Many species of woodpeckers, hawks, and owls use the bottomlands and swamps.
The primary game birds are the bobwhite quail, eastern wild turkey, and the mourning dove. The most common bird species found in the mature forests include the pine warbler, cardinal, summer tanager, Carolina wren, ruby-throated hummingbird, blue jay,

hooded warbler, eastern towhee, and tufted titmouse. The red-cockaded woodpecker, a Federally-listed endangered species, is found in mature longleaf pine habitats.

The study area also provides excellent habitat for a large number of reptiles and amphibians. Wetland habitats support many kinds of frogs including the bullfrog, bronze frog, southern leopard frog, several species of tree frogs, cricket frogs, and chorus frogs. Turtles found in the wetlands include the river cooter, Florida cooter, pond slider, eastern chicken turtle, snapping turtle, mud turtle, and stinkpot. Snakes found in the wetlands include the red-bellied water snake, banded water snake, brown water snake, eastern mud snake, rainbow snake, and eastern cottonmouth. The American alligator can be observed in streams and ponds of the Coastal Plain study area.

For more information on Terrestrial Resources and Wildlife within the project area, please reference the draft Fish and Wildlife Coordination Act Report in Appendix D2

2.2.6 **Threatened and Endangered Species**

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1543) regulates activities affecting plants and animals classified as endangered or threatened, as well as the designated critical habitat of such species.

The USFWS's Information, Planning, and Conservation System (IPAC) website (http://ecos.fws.gov/ipac/) indicated several federally listed species potentially within the study area. These included a total of six federally listed endangered species, two federally listed threatened species, and one federally listed candidate species as well as over 20 species of birds that are protected by the Migratory Bird Treaty Act. The American bald eagle, which is within the study area, is not only protected by the Migratory Bird Treaty Act, but the Bald and Golden Eagle Protection Act, and is also listed in the states of Georgia and South Carolina as threatened. Table 1 identifies the species that have been listed by the USFWS as occurring or possibly occurring within the NSBLD study area.

Table 1: Federally Endangered, Threatened and Candidate Species Likely to Occur in the NSBLD Study Area

Category	Common Name	Scientific Name	Federal Status	Critical Habitat Designated Y/N
Birds	Red-cockaded Woodpecker	*Picoides borealis*	Endangered	N
Birds	Wood Stork	*Mycteria americana*	Threatened	N
Fishes	Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered	Yes (NOAA NMFS)
Fishes	Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered	N
Flowering Plants	Harperella	*Ptilimnium nodosum*	Endangered	N
Flowering Plants	Relict Trillium	*Trillium reliquum*	Endangered	N

Flowering Plants	Smooth Coneflower	*Echinacea laevigata*	Endangered	N
Mammals	Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	N
Reptiles	Gopher Tortoise	*Gopherus polyphemus*	Candidate	N

The Savannah River was identified as a spawning river for Atlantic sturgeon based on capture location and tracking locations of adults and the collection of larvae. Based on the August 17, 2017, Federal Register publication of the final rule of the Savannah River as critical habitat for Atlantic sturgeon (Figure 10) (https://www.federalregister.gov/documents/2017/08/17/2017-17207/endangered-and-threatened-species-designation-of-critical-habitat-for-the-endangered-new-york-bight), it was concluded by National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) that because sturgeon cannot currently pass above the NSBLD, they believe that dam is the farthest upstream extent of spawning habitat accessible to Atlantic sturgeon in the occupied reaches of the Savannah River.

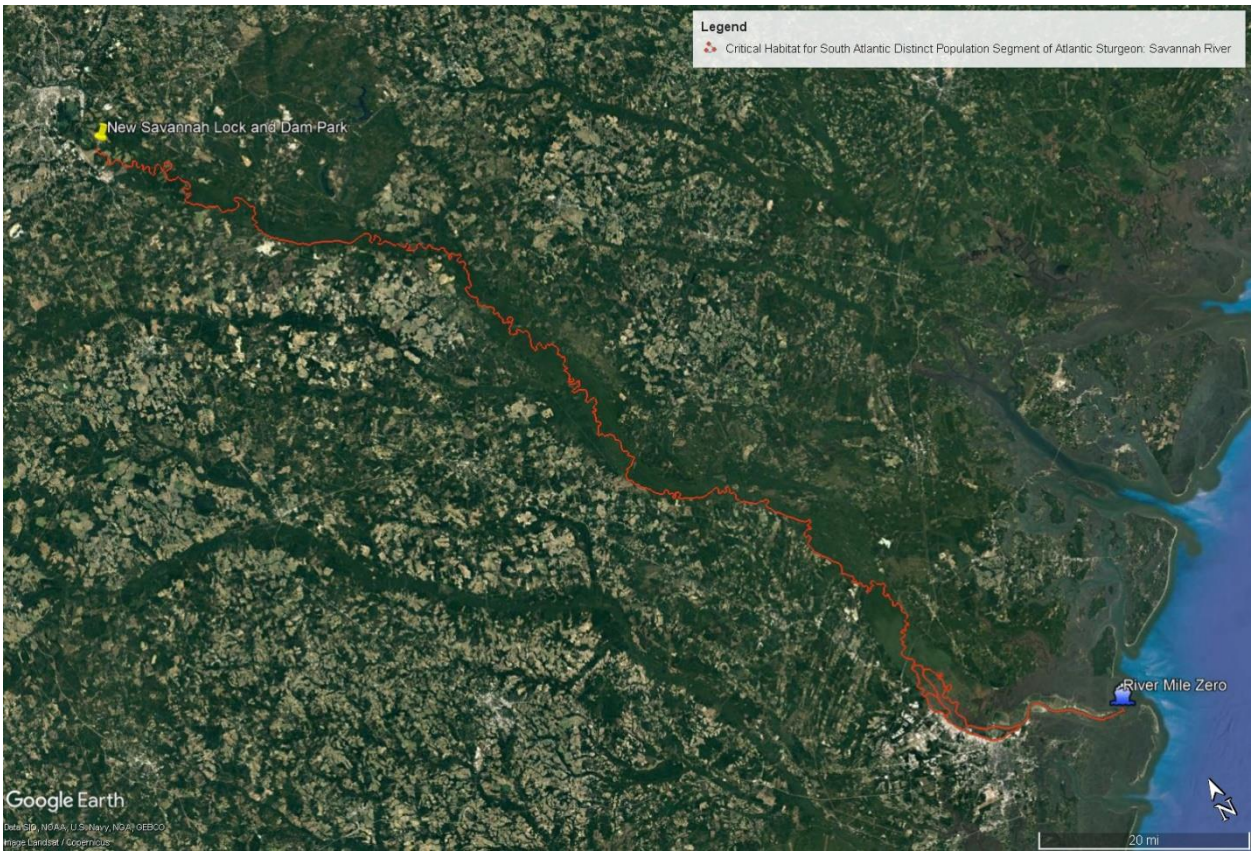


Figure 10: Atlantic Sturgeon Critical Habitat

As a result, the recently designated critical habitat for Atlantic Sturgeon from the NMFS, includes the study area downstream of the NSBLD. The critical spawning habitat for Atlantic sturgeon directly downstream of the NSBLD is defined as "hard bottom substrate (*e.g.,* rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.,* 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge,

growth, and development of early life stages". The gravel bar (Figure 12 and Figure 11) directly below the NSBLD would be defined as critical habitat. The location of the gravel bar has been relatively stable for the past 15 years.

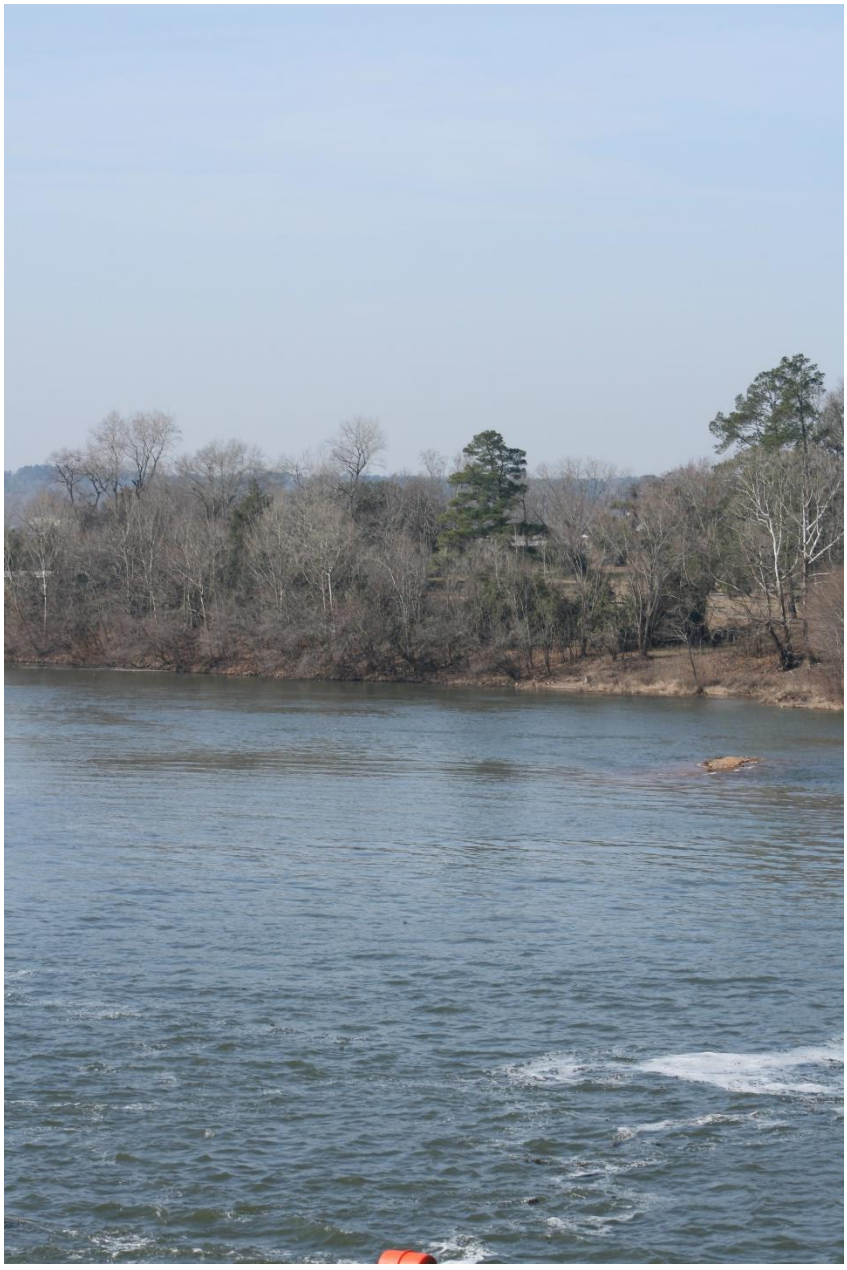


Figure 11: Gravel Bar Downstream of NSBLD

Figure 12: General Location of Gravel Bar

In December 2017, USACE Savannah District re-initiated consultation with NMFS with regards to the recently designated Savannah River as critical habitat for Atlantic sturgeon and various project features for the SHEP, including the SHEP Fish Passage Mitigation feature.

The NMFS, the U.S. Geological Survey (USGS) and the USFWS have collaborated to develop passage design guidance for use by engineers and other restoration practitioners considering and designing nature-like fishways (https://www.fws.gov/northeast/fisheries/pdf/NMFS_2016_Federal_Interagency_NLF_Passage_Design_Guidelines.pdf). USACE has used these guidelines and coordination with NMFS to develop the design criteria.

Section 3.6.6 provides more information on terms and conditions given to USACE Savannah District by NMFS for sturgeon relevant to the SHEP Fish Passage Mitigation project.

In addition to federally-listed species, both the state of South Carolina and the state Georgia have identified rare, threatened, and endangered species within the study area comprising of amphibians, birds, crayfish, dragonflies, fish, mammals, mussels/snails, plants, and reptiles. In total, there are six state listed rare species, 11 threatened state listed species, 15 endangered state list species, and two state listed unusual species. In the state of Georgia, there are six rare species 13 threatened species including the rocky shoals spider lily, and the Savannah Lilliput, six endangered species including the robust redhorse, and two unusual species. In the state of South Carolina, there are two threatened species and five endangered species. Table 2 and Table 3 shows the state listed species for both Aiken County South Carolina and Richmond County Georgia along with information on whether or not their preferred habitat has the potential to be within the project area. This information can also be found in Appendix C1.

Table 2: South Carolina's State Listed Species

County/ State	Species Type	Scientific Name	Common Name	State Protection Status	Habitat Requirements	Habitat has the potential to Exist in Project Area
Aiken, South Carolina	Fishes	Acipenser brevirostrum	Shortnose Sturgeon	E	Estuaries; lower end of large rivers in deep pools with soft substrates	Yes
Aiken, South Carolina	Reptiles	Clemmys guttata	Spotted Turtle	U	Heavily vegetated swamps, marshes, bogs, small ponds, and tidally influence freshwater wetlands; nest and possibly hibernate in surrounding uplands	No
Aiken, South Carolina	Mammals	Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps	Yes
Aiken, South Carolina	Reptiles	Gopherus polyphemus	Gopher Tortoise	T	Sandhills; dry hammocks; longleaf pine-turkey oak woods; old fields	No
Aiken, South Carolina	Birds	Haliaeetus leucocephalus	Bald Eagle	T	Edges of lakes and large rivers; seacoasts	Yes
Aiken, South Carolina	Amphibians	Lithobates capito	Gopher Frog	R	Sandhills; dry pine flatwoods; breed in isolated wetlands	Yes
Aiken, South Carolina	Birds	Picoides borealis	Red-cockaded Woodpecker	E	Open pine woods; pine savannas	Yes

Table 3: Georgia's State Listed Species						
County/ State	Species Type	Scientific Name	Common Name	Sate Protection Status	Habitat Requirements	Habitat has the potential to Exist in Project Area
Richmond, Georgia	Fishes	*Acipenser brevirostrum*	Shortnose Sturgeon	E	Estuaries; lower end of large rivers in deep pools with soft substrates	Yes
Richmond, Georgia	Reptiles	*Clemmys guttata*	Spotted Turtle	U	Heavily vegetated swamps, marshes, bogs, small ponds, and tidally influence freshwater wetlands; nest and possibly hibernate in surrounding uplands	No
Richmond, Georgia	Mammals	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat	R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps	Yes
Richmond, Georgia	Fishes	*Elassoma okatie*	Bluebarred Pygmy Sunfish	E	Temporary ponds and stream backwaters with dense aquatic vegetation	No
Richmond, Georgia	Invertebrates	*Fusconaia masoni*	Atlantic Pigtoe	E	Medium sized streams to large rivers from the Ogeechee River northward; coarse sand and gravel at downstream edge of riffles; fast flowing and well oxygenated water	No, this habitat is located upstream of project area
Richmond, Georgia	Mammals	*Geomys pinetis*	Southeastern Pocket Gopher	T	Sandy well-drained soils in open pine woodlands with grassy or herbaceous groundcover; fields and grassy roadsides	Yes
Richmond, Georgia	Reptiles	*Gopherus polyphemus*	Gopher Tortoise	T	Sandhills; dry hammocks; longleaf pine-turkey oak woods; old fields	No
Richmond, Georgia	Birds	*Haliaeetus leucocephalus*	Bald Eagle	T	Edges of lakes and large rivers; seacoasts	Yes
Richmond, Georgia	Reptiles	*Heterodon simus*	Southern Hognose Snake	T	Sandhills; fallow fields; longleaf pine-turkey oak	No
Richmond, Georgia	Amphibians	*Lithobates capito*	Gopher Frog	R	Sandhills; dry pine flatwoods; breed in isolated wetlands	Yes
Richmond, Georgia	Fishes	*Moxostoma robustum*	Robust Redhorse	E	Medium to large rivers, shallow riffles to deep flowing water; moderately swift current	Yes
Richmond, Georgia	Birds	*Picoides borealis*	Red-cockaded Woodpecker	E	Open pine woods; pine savannas	Yes

Richmond, Georgia	Invertebrates	*Toxolasma pullus*	Savannah Lilliput	T	Large rivers to small creeks, oxbows, and sloughs; found in silty sand and sand in shallow water along banks to about 1 foot deep in some lakes, ponds, streams, and big rivers	Yes
Richmond, Georgia	Vascular Plants	*Astragalus michauxii*	Sandhill Milkvetch	T	Longleaf pine-wiregrass savannas; turkey oak scrub	No
Richmond, Georgia	Vascular Plants	*Berberis Canadensis*	American Barberry	E	Cherty, thinly wooded slopes	No
Richmond, Georgia	Vascular Plants	*Ceratiola ericoides*	Rosemary	T	Ohoopee Dunes; deep sandridges	No
Richmond, Georgia	Vascular Plants	*Chamaecyparis thyoides*	Atlantic White-cedar	R	Clearwater stream swamps in fall line sandhills	No
Richmond, Georgia	Vascular Plants	*Cypripediumacaule*	Pink Ladyslipper	U	Upland oak-hickory-pine forests; piney woods	Yes
Richmond, Georgia	Vascular Plants	*Hymenocallis coronaria*	Shoals Spiderlily	T	Rocky shoals of broad, open rivers	No,
Richmond, Georgia	Vascular Plants	*Macbridea caroliniana*	Carolina Bogmint	R	Bogs; marshes; alluvial woods	No
Richmond, Georgia	Vascular Plants	*Nestronia umbellule*	Indian Olive	R	Mixed with dwarf shrubby heaths in oak-hickory-pine woods, often in transition areas between flatwoods and uplands	No
Richmond, Georgia	Vascular Plants	*Sarracenia rubra*	Sweet Pitcherplant	T	Fall Line sandhill bogs; whitecedar swamps	No
Richmond, Georgia	Vascular Plants	*Scutellaria Ocmulgee*	Ocmulgee Skullcap	T	Mesic hardwood forests; bluff forests	Yes
Richmond, Georgia	Vascular Plants	*Stewartia malacodendron*	Silky Camellia	R	Along streams on lower slopes of beech-magnolia or beech-basswood-Florida maple forests	No
Richmond, Georgia	Vascular Plants	*Stylisma pickeringii var. pickeringii*	Pickering's Morning-glory	T	Open, dry, oak scrub of sandhills	No
Richmond, Georgia	Vascular Plants	*Symphyotrichum georgianum*	Georgia Aster	T	Upland oak-hickory-pine forests and openings; sometimes with Echinacea laevigata or over amphibolite	Yes

2.2.7 **Air Quality**

The Clean Air Act (CAA), which was last significantly amended in 1990, requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The CAA established two types of national ambient air quality standards- primary and secondary. Primary standards are levels established by the EPA to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards are levels established to protect the public welfare, including protection from decreased visibility and damage to animals, crops, vegetation, and buildings.

The EPA has set six National Ambient Air Quality Standards (NAAQS) that regulate six pollutants: carbon monoxide (CO), lead (Pb), nitrogen oxide (NO_x), ozone (O_3), sulfur dioxide (SO_2), and particulate matter ($PM_{2.5}$ and (PM_{10}). Geographic areas have been officially designated by EPA as being in attainment or non-attainment for air quality based on an area's compliance with the NAAQS. Richmond County, Georgia and Aiken County, South Carolina are currently in attainment for the NAAQS for all criteria pollutants. Therefore; the project area is under no Federal or State restrictions for the purpose of improving air quality to meet any air quality standards.

2.2.8 **Water Quality**

The portion of the Savannah River near the NSBLD is classified by the South Carolina Department of Health and Environmental Control (SCDHEC) as "Freshwater." This designation is defined as "freshwaters suitable for primary and secondary contact recreation and as a source of drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses" (SCDHEC 2014).

Georgia Environmental Protection Division's (GAEPD) database indicates that the mainstem Savannah River near the NSBLD currently supports its designated use of fishing.

Several areas on the mainstem Savannah River in Aiken County, near the proposed project, are included on the South Carolina's 2016 303d list of Impaired Waters. These areas are impaired for fish consumption due to mercury levels, an impairment that appears to be fairly common in other reaches of the mainstem Savannah River (SCDHEC 2016).

2.2.9 **Cultural Resources**

Cultural resources considered in this section are those defined by the National Historic Preservation Act (NHPA) as properties listed, or eligible for listing, in the National Register of Historic Places (NRHP) and are referred to as historic properties. Historic

properties include buildings, structures, sites, districts, objects, cultural items, Indian sacred sites, archaeological artifact collections, and archaeological resources. Eligibility for listing in the NRHP is based on one or more of four criteria: a) association with important historic events or patterns of history, b) association with persons important in history, c) representative of the work of a master or exemplary as a type, or d) have yielded or may yield information important to history or prehistory.
Section 106 of the NHPA and its implementing regulations at 36 CFR Part 800 require the lead Federal agency to assess the potential effects of an undertaking on historic properties that are within the proposed project's Areas of Potential Effect (APE). The APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 CFR Part 800.16[d]). The APE is a subset of the study area (Figure 2 and Figure 3). The APE for this study covers the upstream channel to 13th Street Bridge; the downstream channel to 0.5 miles of the dam, the river bank and associated Floodplain extending 0.1 miles from the river bank starting at 13th Street Bridge and ending 0.5 miles downstream of the dam; and in-channel navigation features and submerged archaeological sites that may be exposed due to lower pool elevations (Figure 13). Several other Federal laws may be applicable to these resources, including the Archaeological and Historic Preservation Act of 1974, the American Indian Religious Freedom Act of 1978, the Archaeological Resources Protection Act of 1979, the Abandoned Shipwreck Act of 1987, and the Native American Graves Protection and Repatriation Act of 1990.

The APE also includes the NSBLD structure (lock chamber, dam, operation building) the park and recreation area owned by USACE in Georgia; areas required for construction, construction access and lay down on privately-owned property; (Figure 14). A viewshed of the proposed fish passage is also included as part of the APE. A 0.15 mile radius from NRHP eligible or potentially eligible properties was used in the viewshed analysis. For the NSBLD structure; this area would extend below the dam, include portions of the recreation area that are adjacent to the NSBLD, and spread across the river in South Carolina to privately owned property. The upstream limits would encompass the existing boat ramp and the proposed area of weir construction. The same radius is applied to other historic structures (the bridges) and eligible and potentially eligible archaeological sites.

Known and anticipated archaeological resources of potential NRHP eligibility are likely associated with historic period settlements and commercial use of the river. Existing information on recorded archaeological and historic resources has been gathered from Georgia's Natural, Archaeological, and Historic Resources Geographic Information Systems (GNAHRGIS), which is compiled by the Historic Preservation Division of the Georgia Department of Natural Resources, in collaboration with the Georgia Archaeological Site File at the University of Georgia. South Carolina sites information was obtained from ArchSite, the online cultural resource information system maintained by the South Carolina Institute of Archaeology and Anthropology and the South Carolina Department of Archives and History.

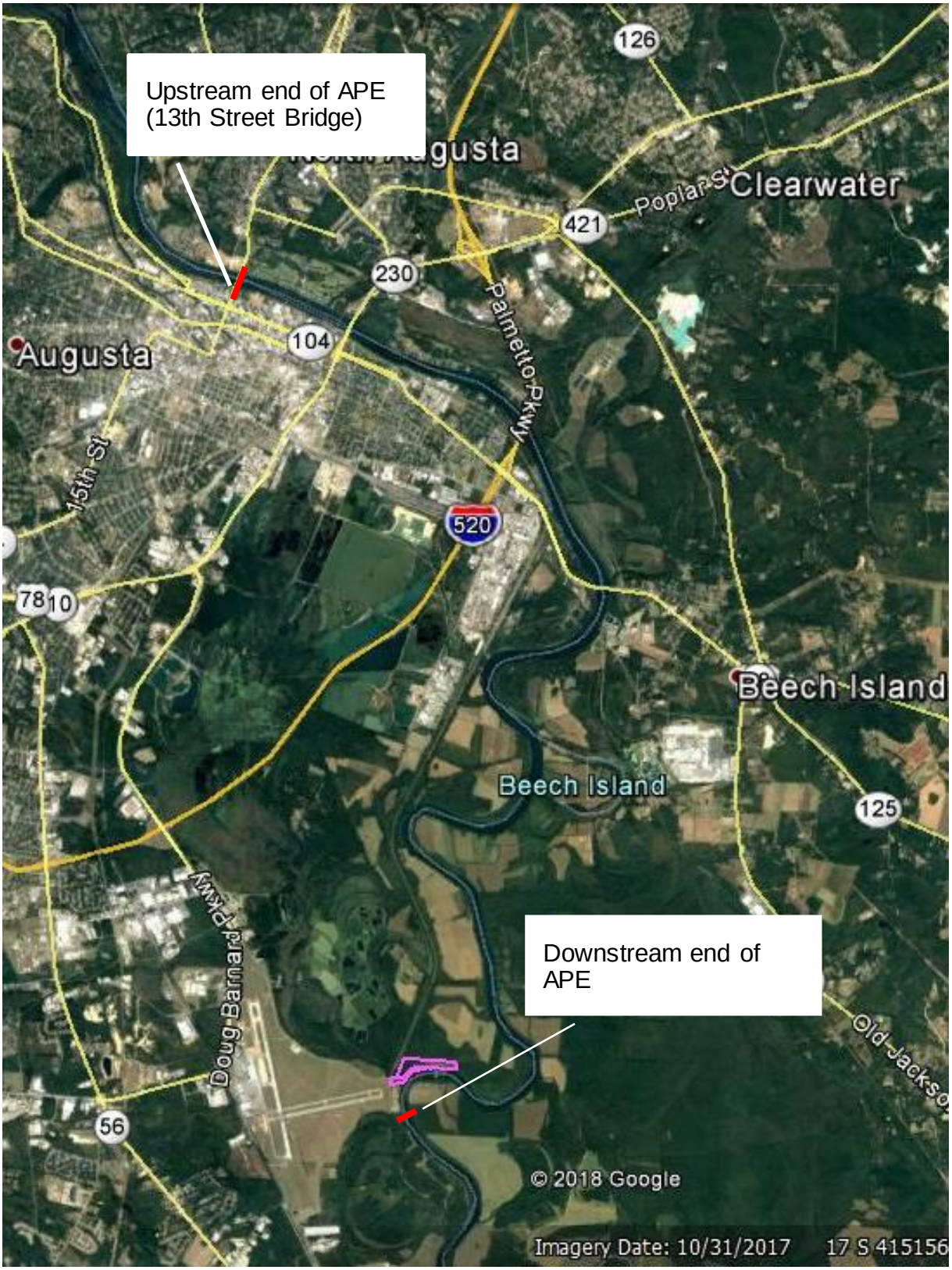


Figure 13: Aerial Showing Extent of River within APE.

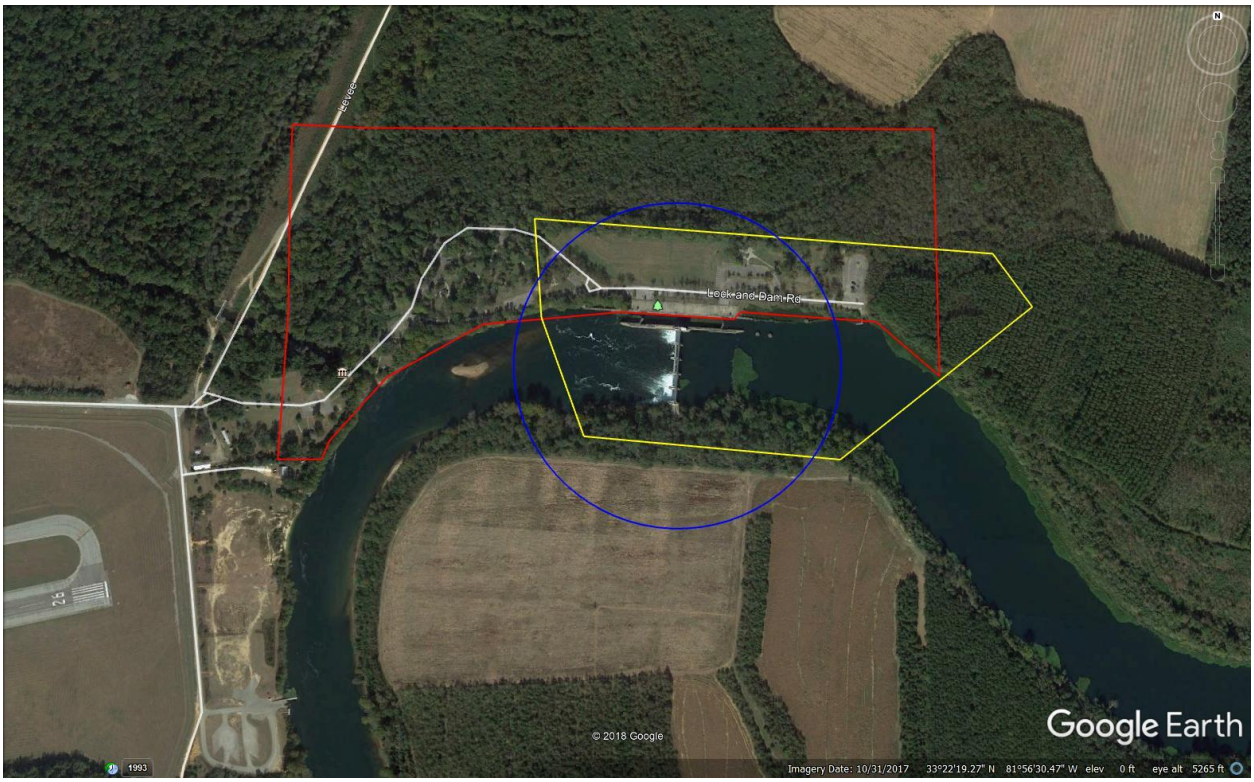


Figure 14: APE Limits of Construction (Yellow), Cultural Viewshed (Blue) and NSBLD Park Boundary (Red).

Six historic properties are located within the APE, one of which is the NSBLD. The structure, authorized by Congress in 1933 as a Public Works Administration project under President Franklin D. Roosevelt's New Deal, was completed in 1937 (Figure 15). The structure consists of a lock chamber, dam, gates, and operation building (Figure 16). The federal NSBLD Project includes an approximately 50-acre park and recreation area (with facilities) in addition to the lock and dam (Figure 17). Channel improvements, such as low wing dams and training dikes, combined with the deeper pool created by the dam, allowed steamboats to haul cotton goods from the mills in Augusta as well as passenger ferry traffic to and from Savannah. Barge traffic for oil and timber peaked during the 1960s then steadily declined until it ceased in 1979. Consequently, after USACE dredged the river in 1979, maintenance of the navigation channel was discontinued.

Figure 15 : NSBLD After Completion, 1937 (USACE-SAS).

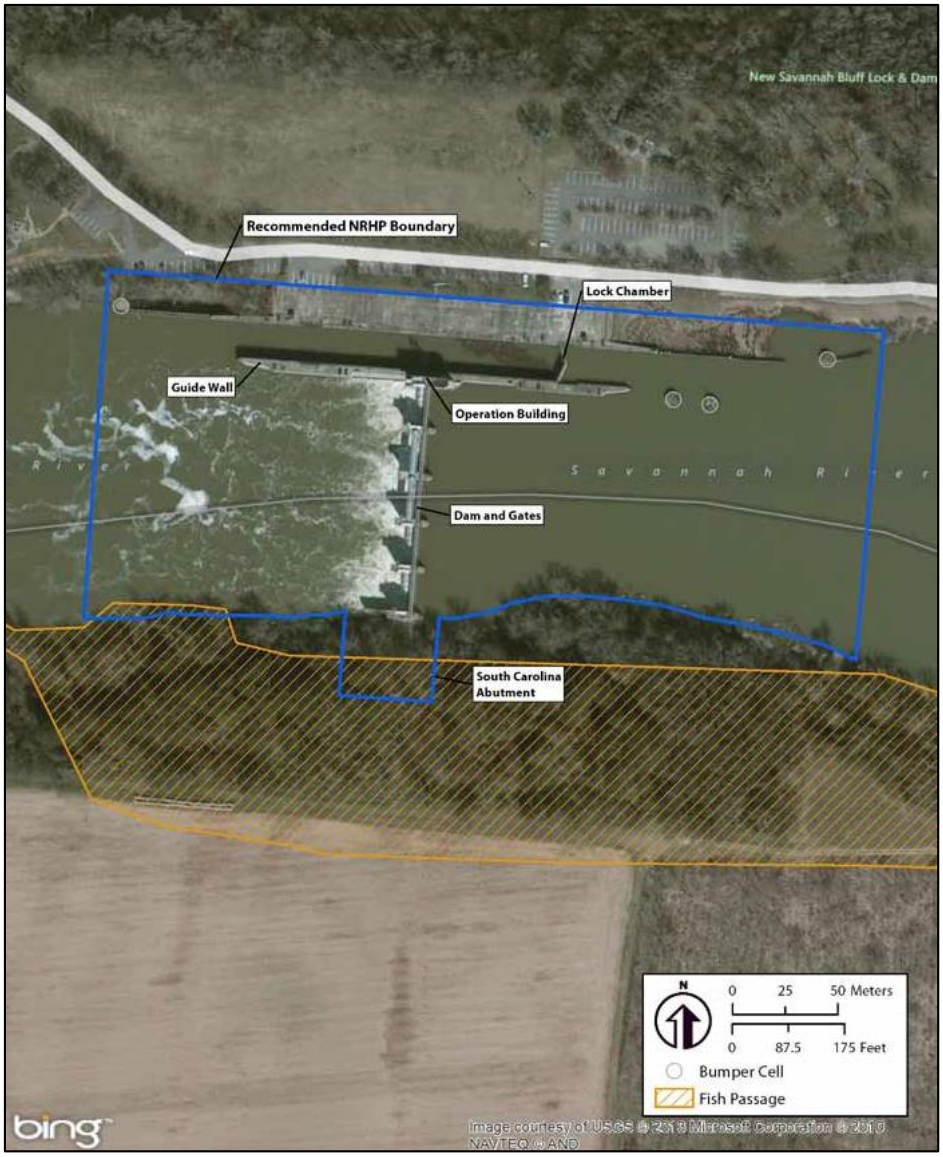


Figure 16: NSBLD National Register of Historic Places Boundary with No Action Alternative proposed fish passage design

Figure 17: Recreation area facing east (December 2012)

The dam proper, as distinguished from the lock, contains five vertical lift gates distributed among six concrete piers (Figure 18). The pier next to the lock is integral with the operations building and the southernmost pier serves as the South Carolina abutment. The lock is on the north (Georgia) side of the river adjacent to the dam (Figure 19). The lock's useable chamber is 56 feet wide and 360 feet long and the lift height is approximately 15 feet.

Figure 18: Downstream View of Dam and Gates, Facing Northeast (December 2012)

Figure 19: Operation Building Showing Relationship with Navigation Lock, Facing West (December 2012)

A survey conducted in 2012 determined that the resource retains a high degree of architectural/engineering integrity as physical changes to the lock and dam have been minimal since its completion (Brockington and Associates 2013). As a result, the resource is eligible for the NRHP under Criteria A (transportation history) and C (engineering) (Appendix C).

The remaining five historic properties within the APE represent a wide variety of resource types and are located primarily in the floodplain of the Savannah River. One site represents the remains of a twentieth century rear-wheel paddleboat. Two early-mid nineteenth century railroad bridges cross the Savannah River downstream of the 5th Street Bridge. The archaeological remains of the New Savannah historic settlement is also within the APE. In addition to the historic properties seven archaeological sites (prehistoric and historic) with unknown National Register status are located within the APE. These resources are not considered historic properties under the definition found in 36 CFR 800 as they require further evaluation before a NRHP eligibility determination can be made.

Limited cultural resources investigations have been conducted within the APE. Brockington and Associates (2013) conducted a historic structures evaluation and terrestrial and underwater archaeological surveys in support of the proposed construction of the fish passage as analyzed in the 2012 FEIS for SHEP. The archaeological fieldwork did not include the 50-acre recreation park. Archaeological investigations conducted within the APE for proposed Georgia Department of Transportation (GDOT) and South Carolina Department of Transportation (SCDOT) projects in the 1970s (Bowen 1979) and late 1990s – early 2000s (Rinehart 1995; Brockington and Associates 2000) resulted in the identification of many of the historic properties located within the APE in Aiken County.

USACE conducted a bathymetric survey in January 2018 and identified a training wall as well as three features that may be remnants of navigation features. Reports of the Chief of Engineers from the late 1880s – to mid 1930s reference numerous wing dams, training walls, pile dikes and other features USACE constructed to aid with navigation through the shallow areas of the Savannah River from downtown Augusta (5th Street Bridge) to NSBLD. Low training walls helped prevent the formation of sandbars, and wing dams and pile dikes, which were constructed of brush fascines and loaded with gravel and stone, were used to prevent erosion along the riverbanks. No diver investigations have been performed to further investigate the returns. No definitive NRHP eligibility determinations have been made for these features.

USACE will conduct archaeological investigations in accordance with the 2012 SHEP Programmatic Agreement (PA) signed by the Georgia and South Carolina State Historic Preservation Offices (SHPOs) (Appendix C). The General Stipulations section of the PA contains processes for identifying and evaluating archaeological resources. Investigations pertaining to historic resources (i.e., buildings and structures) will be conducted as outlined in 36 CFR Part 800, the implementing regulations for Section 106 of NHPA.

2.2.10 **Noise**

For purposes of regulation, noise is measured in A-weighted decibels (dBA). This unit uses a logarithmic scale to weigh sound frequencies. Table 4 shows typical noise levels and corresponding impressions. The project area within the Savannah River Basin is not densely populated or heavily industrialized, though forest and agricultural practices are employed within the Savannah River Basin. Watershed noises associated with traffic and agriculture and forestry practices are the predominant sources of noise in the project area. Naturally occurring noises (buzzing of insects, bird calls, etc.) are also common within the project areas. Background levels at the lock and dam vary depending on the airport (70 to 80 dBA) usage, recreation in the park (30 to 80 dBA) and the operation of the gates. The sound of the river drowns it out from any distance at all, hearing protection is not required when you are standing next to the hoisting equipment. The dominate sound is the rushing of water through the gates (60 to 70 dBA).

Table 4: Typical Noise Levels and Impressions

Source	Decibel Level	Subjective Impression
Normal breathing	10	Threshold of hearing
Soft whisper	30	---
Library	40	Quiet
Normal conversation	60	---
Television audio	70	Moderately loud
Ringing telephone	80	---
Snowmobile	100	Very loud
Shouting in ear	110	---

Thunder	120	Pain threshold

2.2.11 **Recreation**

2.2.11.1 Boat Docks

The most common motor boats typically seen navigating the NSBLD pool, include runabouts, pontoons, bass boats, and ski boats. Most of those water craft can operate with 2 feet or more of water depth. With less than 2 feet of water depth, there would most likely be adverse impacts to operating those motor boats. There were 161 docks in the pool that were included in this analysis. Table 5 provides the number of boat docks at existing depths. These docks require a permit under Section 10 of the Rivers and Harbors act of 1899.

Table 5: Existing Depths at Boat Docks

Impact Zone	Depth Below Dock (feet)	Existing
No Impact	=>3.5	140
Minor Impact	<3.5 and =>3	8
Moderate Impact	<3 and => 2.5	5
High Impact	<2.5 and =>2	4
Adverse Impact	< 2	4

2.2.11.2 Special Events

Ironman 70.3

The Ironman 70.3 is a one-day triathlon event that usually occurs in September and includes swimming in the Savannah River. The swimming course is a point-to-point course that starts at 6th Street at the Riverfront Marina. Athletes enter the water and swim with the current for 1.2 miles along the shoreline until they exit the swim course at the Augusta Rowing Complex public boat ramp.

In 2017, the Ironman 70.3 totaled $4,716,616 in estimated economic impact on the Augusta economy (https://www.augustasportscouncil.org/economic-impact). Total Estimated Economic Impact (EEI), the sum of all the direct, indirect and induced spending estimates, is calculated based on research commissioned by both the Georgia Department of Economic Development (GDEcD) and Destination Marketing Association International (DMAI) in conjunction with globally recognized research vendors, the U.S. Travel Association and Tourism Economics.

Head of the South Regatta

Hosted by the Augusta Rowing Club, the Head of the South (HOTS) Regatta is one of the largest head races in the Southeast Region and the 5th largest in the nation. Every year since 1997 rowers have competed on the Savannah River in Augusta, Georgia. In November 2017, approximately 2,500 out-of-town rowers and coaches and 1,500 visiting spectators from multiple states came to the Regatta.

As seen in Figure 20, the HOTS Regatta course starts just upstream of 13th Street Bridge near the Hammonds Ferry development in North Augusta, goes past the River Walk Amphitheater, and finishes just downstream of the Augusta Rowing Club Boathouse. All those areas allow for spectators to view the event.

Along the course, there are danger and course buoys. The danger buoys indicate shallow areas. The course crosses over the upstream end of the training wall at the Railroad Bridge just upstream of the 5th Street Bridge and before the finish line near the Augusta Rowing Club Boathouse.

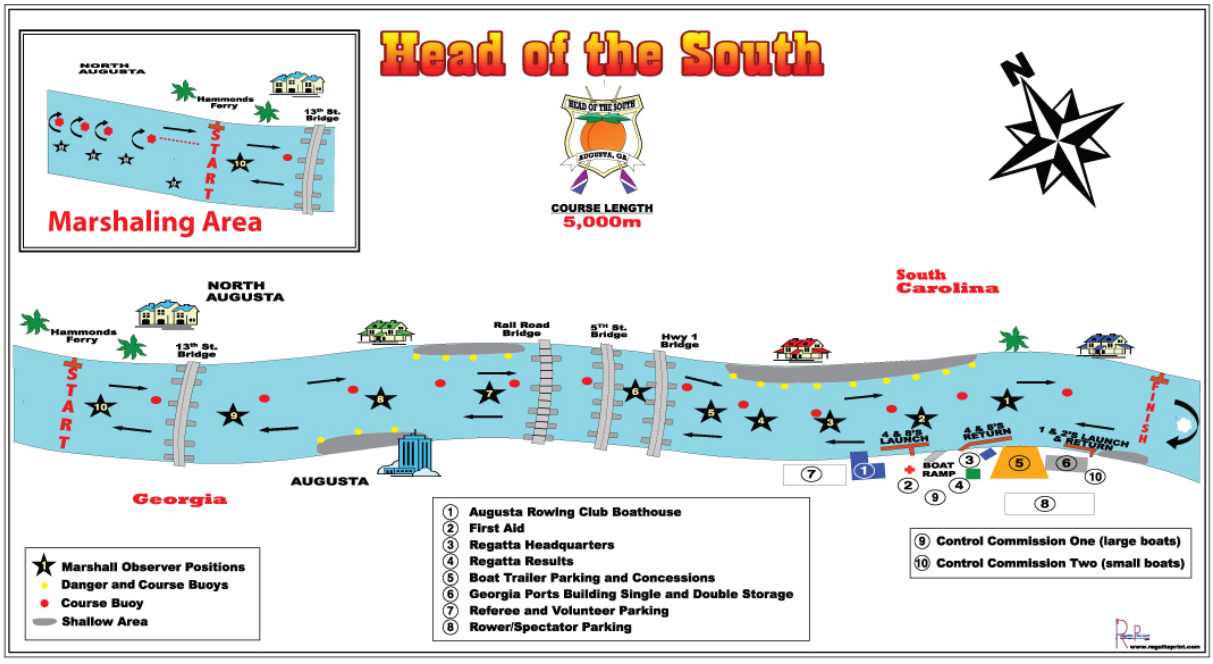


Figure 20: Head of the South Regatta Course

Existing water surface elevations in the NSBLD pool range between 113 and 115 feet at the 5th Street Bridge. Below water surface elevations of 114 feet, based on the NSBLD gauge, vegetation is exposed approaching the shallow banks of the river along the course from Highway 1 Bridge to the Augusta Rowing Club Boathouse. The vegetation can entangle the oars and flip sculls thus endangering the people in them. Currently, the gates on the NSBLD are adjusted to increase the water surface elevation and

prevent the weeds from being a hazard along the course. Sculls and sweep rowers do not draft deep enough to have contact with the training wall.

In 2017, the HOTS totaled $1,650,120 in estimated economic impact on the Augusta economy (https://www.augustasportscouncil.org/economic-impact). Total Estimated Economic Impact (EEI), the sum of all the direct, indirect and induced spending estimates, is calculated based on research commissioned by both the Georgia Department of Economic Development (GDEcD) and Destination Marketing Association International (DMAI) in conjunction with globally recognized research vendors, the U.S. Travel Association and Tourism Economics.

Augusta Southern Nationals

The Augusta Southern Nationals drag boat event last occurred on July 15, 2016. It was cancelled in 2017 by the sanctioning body, the Lucas Oil Drag Boat Racing Series, because of financial losses incurred with the series. No event occurred in 2018.

2.2.12 **Aesthetics**

The lower part of the basin with the study area is characterized by a meandering course with few tributaries and slow currents. The natural beauty of the Lower Savannah River has been preserved by a number of factors. Among these are: (1) the Floodplain forests are generally intact, (they have not been exploited extensively for timber, except for the economically valuable cypress); (2) the pattern of large landholdings extensively used for forestry and recreation has resulted in a low population level in the region, thereby leaving no motive for intensive development; and (3) the major uses of the area, that of recreation (hunting, fishing, and boating), have had little permanent effect on the natural environment.

The NSBLD Park provides visitors a place to enjoy the outdoors by providing a place to fish, boat, and have picnics. The project area is in an undeveloped area on the Georgia side of the project surrounded by trees and a couple of open field areas for recreational opportunities and looks out to privately-owned undeveloped farmland on the South Carolina side with the Savannah River in between. The historic lock and dam structure is also a unique feature people can visit while visiting the area.

2.2.13 **Water Supply**

There are eight water supply intakes in the pool upstream of the NSBLD in the study area. Since the NSBLD was a single-purpose navigation project, USACE does not have any water storage agreements with the owners of these water intakes. The Mason Sod Farm is inactive and so was not included in the detailed analysis. The Augusta-Highland Intake was not included in the detailed analysis as it is far enough upstream of NSBLD that changes in pool elevation at the dam have little effect on the pool elevation at the intake.

The six water users located in Table 6 were evaluated as part of this analysis as they are most likely to be impacted by any changes to NSBLD. The six intakes consist of two for municipal water supply and four for industrial/commercial use. A separate intake report was prepared under task-order to determine existing water-intake capacity and specifications and what, if any, modification to the intake systems would be required to maintain withdrawal capacity (CDM-Smith, 2018). The intake report is not available to the public because it contains industry protected information. This document summarized the findings of a hydraulic analysis of intake and pump capacity. Only the results of the study are summarized in this chapter.

Table 6: Water Supply Intakes

Water User	Permitted	Intake Location River Mile	Permitted Monthly Avg (MGD)	Pool Required to prevent Pump Cavitation* (ft NGVD29)
North Augusta	Yes- SC	202.1	19	114
River Golf Club	Yes- SC	200.0	1	unknown – estimated at 112
Augusta	Yes- GA	198.2	15	111.3
SCE&G (Urquhart Plant)	Yes- SC	195.6	217	unknown – estimated at 107
Kimberly Clark	Yes- SC	195.6	53	107
Potash/Fibrant/Chem Trade/Augusta Sulfate	Yes- GA	194.5	18.1	112

* The cavitation limits were provided by the water user withdrawing raw water from the river unless noted as unknown and estimated. The unknown cavitation limits were estimated using engineering judgment based on visual observation, discussions with the intake owners/operators, and previously known operational impacts at low pool levels.

Figure 21 shows the locations of water supply intakes in the pool upstream of the NSBLD. The analysis focused on the net positive suction head (NPSH), minimum submergence, pump performance, and capacity.

Figure 21: Water Intake Locations

Site visits to each water user location were conducted during the week of November 26, 2017, to obtain copies of record drawings, pump information, photographs, and other relevant details of each specific intake site for use in the hydraulic analysis. The level of detail for each intake analysis was dependent upon the available information provided by each respective water user. Table 7 lists existing pool elevations evaluation at each location. River Golf Club stated that they do not withdraw water from the Savannah River so further analysis was not performed.

Table 7: Pool Elevation (ft NGVD29) @3600 cfs	
Location	**Existing**
NSBLD	114.0
Potash/Fibrant/ et al.	114.2
SCE&G	114.3
Kimberly Clark	114.3
Hicks Raw Water	114.4
City of North Augusta	114.7

2.2.14 **Environmental Justice**

The concept of Environmental Justice is based on the premise that no segment of the population should bear a disproportionate share of adverse human health or environmental effects. E.O. 12898, Federal Actions to Address Environmental Justice

in Minority and Low Income Populations, requires each Federal agency to make achieving environmental justice part of its mission. Specifically, the agency must identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations. In addition, E.O. 12898 requires each federal agency to conduct its programs, policies, and activities so that they do not exclude, deny benefits to, or discriminate against persons (including populations) because of race, color, or national origin.

2.2.14.1 Demographic and Economic Conditions

The Augusta-Aiken, GA-SC Metropolitan Statistical Area (MSA) consists of Aiken County, SC; Edgefield County, SC; Richmond County, GA; Columbia County, GA; Burke County, GA; and McDuffie County, GA. It is the second largest metro area in Georgia. The total population in 2018 (Table 8) covered by Augusta-Aiken MSA is 594,799. The projected 2030 population is 653,560. The medium age is 38 (Table 9). There are 233,375 households and 158,344 families. There are more than 2 times the number of households that own their homes than there are renters. The household average income is $68,835 while the median income is $50,924. The labor force includes 279,489 people of which 12,260 are unemployed, 258,107 are employed, and 9,122 are armed forces. Below the poverty level is 18.2 percent of the population which is less than the state (18.5%) and greater than the national (15.6%) levels.

Table 8: Demographics (2018)	
Population (2018/2030)	594,799/653,560
Sex (2018 Male/Female)	289,682/305,117
Households	233,375
Families	158,344
Owned/Rented Dwellings	159,534/73,841
Average Household Income	$68,835
Household Median Income	$50,924
Unemployed/Employed/Armed Forces	12,260/258,107/9,122
Unemployment Rate	4.4%
Bachelor's Degree or Higher	25.7%
Population below poverty level	18.2%

Source: https://augustaeda.org/economic-overview-augusta-msa

Table 9: Age Distribution		
Age Distribution	**Total**	**% of Total**
0-4	37,285	6.27
5-9	38,407	6.46
10-19	77,940	13.10
20-29	83,793	14.09
30-39	79,012	13.28
40-49	70,353	11.83

50-59	77,943	13.10
60-64	37,764	6.35
65+	92,302	15.52

Ethnicity Distribution

The Augusta-Aiken MSA (Table 10) is predominately composed of white and black ethnicities.

Table 10: Ethnicity Distribution		
Ethnicity	**Total**	**% of Total**
White	326,124	54.83
Black	208,708	35.09
American Indian	1,765	0.30
Asian	12,736	2.14
Pacific Islander	665	0.11
Other	558	0.09
Multi-race	12,613	2.12
Hispanic	31,673	5.23

Household Income Distribution

In 2016, households (Table 11) in the Augusta-Aiken MSA earned a median yearly income of $48,543. In 2016, the Georgia and US median household income were $53,559 and $57,617, respectively. In comparison, the Augusta-Aiken MSA median household income was $5,016 (9.4 percent) lower than Georgia's median household income and $9,074 (16 percent) lower than the nation median household income. Exactly, 34.7 percent of the Augusta-Aiken MSA households earn more than the national average each year.

Table 11: Household Income		
Household Income	**Total**	**% of Total**
<$10k	19,356	8.29
$10-20k	24,734	10.56
$20-30k	23,734	10.17
$30-40k	22,385	9.59
$40-50k	21,990	9.42
$50-60k	17,961	7.70
$60-75k	22,329	9.57
$75-100k	28,881	12.38
>$100k	52,086	22.32

Household Expenditure

Household expenditures average $53,330 per year (Table 12). The majority of earnings get spent on shelter, transportation, food and beverages, health care, and entertainment.

Table 12: Household Expenditure		
	Total	**% of Total**
Average per year	$53,330	
Shelter	$11,009	20.64
Transportation	$10,123	18.89
Food and Beverages	$7,854	14.73
Health Care	$4,305	8.07
Entertainment	$2,981	5.59
Other	$17,058	31.99

Total Employees by Occupation can be found in Table 13.

Table 13: Total Employees by Occupation		
	Total	**% of Total**
Services	103,835	43.76
Retail Trade	52,642	22.18
Manufacturing	19,686	8.3
Public Administration	15,755	6.64
Transportation	13,599	5.73
Finance, Insurance and Real Estate	10,428	4.39
Wholesale Trade	9,246	3.90
Construction	8,321	3.51
Agricultural, Forestry, Fishing	2,474	1.04
Unclassified	1,189	0.50
Mining	126	0.05
Total	**237,301**	

The Augusta-Aiken MSA is 55% white and 45% minorities (Table 8). Approximately 20% of the population of this MSA live below the national poverty line. Some subsistence fishing occurs at the NSBLD. No Environmental Justice communities were identified in the study area although such communities exist in the MSA.

3.0 Formulation of Alternative Plans

3.1 Planning Strategy

The primary planning strategy is to ensure that the plans formulated meet the planning objectives and avoid planning constraints. Based on the project modifications authorized by Congress in Section 1319 of WRDA 2016 and comments received in response to the first public notice, the Project Delivery Team (PDT) identified management measures that would best fulfill the intent of WRDA 2016 and consider the public comments.

Management measure are features that can be implemented at specific geographic locations as the building blocks in formulating alternative plans. The PDT created an initial array of alternatives by using one or a combination of those management

measures. The initial array of alternatives were screened to determine which alternatives would best serve to meet the planning objectives and avoid the planning constraints. Those alternatives that were considered for further evaluation in the planning process were identified by the beneficial and adverse effects used in the evaluation criteria. Some alternatives were refined or re-scaled to better achieve the planning objectives and stay within the limits of the planning constraints.

The WRDA 2016 modified the SHEP fish passage in one of two ways. Neither modification allows for the authorized SHEP 2012 GRR/FEIS fish bypass design to be implemented. The project modifications only include the construction of an in-channel fish passage. However, since this report is tiered off of the SHEP 2012 GRR/FEIS fish bypass design, for the purposes of this analysis, the original design is used as the NAA for comparison of alternatives during formulation. The current and future conditions described in this document are used as the base of comparison for the effects analysis for water supply and recreation compared to the date of enactment of WRDA 2016 and do not include the construction of the SHEP 2012 Fish Passage.

3.1.1 **Evaluation Criteria**

Potential beneficial and adverse impacts of project modifications in the WRDA 2016 to uses associated with the NSBLD project are identified below:

- Impacts to Navigation in the Pool
- Impacts to Water Supply Intakes (number of commercial water intakes affected)
- Impacts to Recreation in the Pool
- Impacts from Induced Flooding (acres)
- Impacts to Real Estate
- Construction Investment Costs
- Operation and Maintenance Costs

Table 14 shows the criteria used for evaluating project impacts. The flow used to evaluate the project impacts, with the exception of impacts to water supply intakes, is 5,000 cfs, the low average of the normal flow. The flow used to evaluate impacts to water supply intakes is 3,600 cfs, which is the minimum flow during times of drought. That flow would represent the worst case scenario or the lowest water surface elevation. Flows greater than 3,600 cfs occur 99 percent (Figure 7) of the time during any given year. Flows greater than 5,000 cfs occur 77 percent of the time during any given year.

Table 14: Explanation of Evaluation Criteria

Project Impact	Criteria
Impacts to Recreational Navigation (in pool)	If the NSBLD pool maintains a navigation channel of 3 feet depth with 5,000 cfs, then there are no impacts to recreational navigation.
Impacts to Water Supply Intakes at 3,600 cfs	0-1 = low impact 2-4 = medium impact 5-7 = high impact

(Number affected)	
Impacts to Recreation at 5,000 cfs	Number of Boat Docks with Depth < 2 feet: 0-9 = low impact 10-19 = medium impact 20 or greater = high impact
Impacts from Induced Flooding at various frequency events *	0-25 acres = low impact 25-50 acres = medium impact >50 acres = high impact
Impacts to Real Estate at 5,000 cfs	0-20 parcels = low impact 20-40 parcels = medium impact >40 parcels = high impact
Construction Costs	<$35M = low impact $35-70M = medium impact $>70M = high impact
O&M Costs	passive structure = low impact actively managed = high impact
* Alternatives with flood impacts from increasing the frequency of the 1 percent exceedance event would be eliminated from further analysis if flowage easements cannot be obtained prior to construction start.	

3.1.1.1 Rating Criteria

A rating scale was used to compare the impacts of project modifications to the NSBLD project. Early in the plan formulation process, it was assumed that each alternative would have the ability to pass fish equally, thus initially, fish passage was not included as a criteria. All the project impacts were given even weight. As shown in Table 15, criteria rating factors were based on a scale of +1 for positive (indicated by "low impact"), 0 for neutral (indicated by "medium impact") and -1 for negative (indicated by "high impact").

Table 15: Explanation of Evaluation Criteria Rating Factors

Project Impacts	Value Evaluated	+1	0	-1	Basis
Navigation	Channel Depth	=> 3 feet		< 3 feet	If channel depth 3 feet or greater, then no impact to recreational navigation
Water Supply	Number of Intakes Affected	0-1	2-4	>4	Hydraulic model results for with-project conditions.
Recreation	Number of Docks with Depth < 2'	0-9	10-19	>19	Model results.

Flooding	Number of Acres Flooded	0-25	25-50	>50	Total number of acres flooded.
Real Estate	Number of Flooded Parcels	0-20	21-40	>40	Professional judgment to determine approximate order of magnitude costs.
Construction Costs	Investment Cost	<$35M	$35-$70M	>$70M	Inundation maps used to identify impacted parcels.
O&M Costs	Likely O&M Requirements	Passive		Active	Professional judgment. Passive structures would likely require minimal O&M, while an actively managed structures (with gates) would likely require additional resources.

3.1.1.1.1 *Navigation*

With regards to this study, navigation refers to the recreational navigation pool. Recreational navigation, the ability to float any watercraft (canoe, kayak, and recreational boats) upstream of the lock and dam consistent with the uses prior to December 16, 2016, the enactment date of WRDA 2016. The WRDA 2016 project modifications do not give authority to restore commercial or recreational navigation through the lock. If the lock wall is repaired, the repairs would address dam safety concerns associated with the lock wall only; construction of an operational lock is not required.

3.1.1.1.2 *Water Supply*

There are eight water supply intakes in the pool upstream of the NSBLD. Since the NSBLD was a single-purpose navigation project, USACE does not have water storage agreements with the owners of these water intakes.

Six of the eight intakes were evaluated because of the location of the intake in the state water use permit and proximity to the project area. The Augusta-Highland Intake was not included in the detailed analysis as it is far enough upstream of the NSBLD project that changes in pool elevation at the dam have little effect on the pool elevation at that intake. The Mason Sod Farm intake is inactive and thus was not included in the detailed analysis. The remaining six intakes consist of two for municipal water supply and four for industrial/commercial use. A list of the river intakes and relevant information are presented in Table 16.

Table 16: Water Intake and User Information

Water User	Permit State	Intake Location (River Mile)	Permitted Monthly Average (mgd)
City of North Augusta	South Carolina	202.1	19.2
River Golf Club	South Carolina	200.0	1
City of Augusta	Georgia	198.2	15

SCE&G (Urquhart Plant)	South Carolina	195.6	217
Kimberly Clark	South Carolina	195.6	53
PCS Nitrogen/Potash and Fibrant	Georgia	194.5	18.1

The required pool elevation to determine impacts to pumping and permitted capacities for each intake was compared to each action alternative's pool elevation. If the pool elevation for the with-project condition was below the required minimum pool, it was determined that the intake would be impacted and some modification would be required by the water user to allow for continued use. Modification, in the form of lowering the water intakes, lowering the pumps, and/or installing more powerful pumps, would be required for any alternative that negatively impacts water supply intakes. A cost estimate for any modifications were provided in the analysis.

The findings were coordinated with each of the water supply users and potential modifications for each of the alternatives to the intake design were provided to the industrial or municipal water user.

3.1.1.1.3 *Recreation*

Two recreation components were evaluated: boat docks and special events. The criterion used for boat docks focused on water depth around the docks. If water depth at the dock would be less than 2 feet for the action alternative, but at or greater than 2 feet for the NAA, then that boat dock would be considered adversely impacted. The criterion used for the special events primarily focused on water surface elevation. In order to make the events safe, sufficient water surface elevation would be required. That elevation would be achieved by controlling water outflows for J. Strom Thurmond Dam and Lake during normal operations.

3.1.1.1.4 *Flooding*

As is the case with population growth, urban sprawl moves farther into rural areas. This sprawl causes more paved or otherwise impervious surfaces leading to increased runoff that greatly affects how widespread and quickly flood waters flow across the landscape. It also slows the rate at which flood waters recede once the rain ends. One of the primary issues that the surrounding community identified as potentially being affected by a new structure to replace the NSBLD is an increase in flooding. During high river flows, USACE typically raises the gates of the NSBLD out of the water to reduce adverse impacts by the high flows. Raising the gates has the primary purpose of increasing the flow capacity of the river at that location, which subsequently reduces flood heights upstream. A fixed crest weir would not have the ability to increase flow capacity within the channel and could result in higher water levels upstream during high flow events. The community expressed concern about potential adverse impacts to the FEMA Base Flood Elevation (i.e. 1% ACE or 100-year flood) and the FEMA flood insurance rates. Any alternative which rose the Base Flood Elevation as evaluated using the effective FEMA hydraulic model was eliminated from further evaluation after the initial screening, as discussed in section 3.3.

The effective FEMA model is relatively coarse and intended primarily to determine water surface elevation for large flow events, like the 1% annual chance exceedance (100-year) flood event. Flooding during more frequent flood events (e.g. 10% ACE or 10-year flood) is also a concern and a more detailed hydraulic model was developed to evaluate changes to water surface elevations and inundation extents for these more frequent events. This model was used to evaluate the 50%, 20%, 10%, 4%, 2%, and 1% annual chance exceedance events (the 2-, 5-, 10-, 25-, 50-, and 100-year floods respectively) for alternatives in the final array, as discussed in section 3.5. The results of the detailed hydraulic model for each alternatives were used to determine the number of properties and acreage that could potentially be flooded by those more frequent storm events. If an alternative induced additional flooding depth for any of the return interval events, the number of parcels and acres impacted were tabulated as outlined Table 14. To the extent possible, subjective measures of the severity of flooding were avoided. If a parcel experienced even a 0.01ft increase in inundation depths as a result of the with-project condition, that parcel was counted as "flooded". Please see additional discussion regarding model development and the methodology used to asses flooding impacts in sections 2.2 and 2.4.1 of Appendix A.

3.2 Management Measures

Management measures are features or activities that can be implemented at a specific geographic location to address one or more planning objectives and avoid constraints. Based on the two types of project modifications in the WRDA 2016 and the objectives of the study, the following management measures were created.

Management measures based on project modifications of the WRDA 2016 Section 1319 (c)(1)(A)(i) which allows for repair of the lock wall and modification of the structure to maintain the pool for navigation, water supply, and recreational activities, as in existence on the date of enactment of the WRDA 2016, and to allow safe passage over the structure to historic spawning grounds of shortnose sturgeon, Atlantic sturgeon, and other migratory fish include: repair the lock wall, repair dam gates and piers, remove the dam gates and piers, and construct an in-channel fish passage.

Management measures based on study objectives based on guidance in project modifications of the WRDA 2016 Section 1319 (c)(1)(A)(ii) which allows for construction at an appropriate location across the Savannah River of a structure that is able to maintain the pool for water supply and recreational activities, as in existence on the date of enactment of the WRDA 2016, and removal of the NSBLD on completion of construction of the structure include: remove the lock wall, remove dam gates and piers, remove dam to foundation, construct an in-channel fish passage structure, construct a Floodplain bench, and construct a bypass channel with a flood gate.

Management measures include:
(1) Repair lock wall
(2) Repair dam gates and piers
(3) Remove lock wall

(4) Remove dam gates and piers
(5) Remove dam to foundation
(6) Construct an in-channel fish passage
(7) Construct a floodplain bench
(8) Construct a high-flow, flood gate and bypass channel

3.2.1 **Location of Fish Passage Structure along River**

The WRDA 2016 states that the USACE could consider constructing a replacement structure at an appropriate location across the Savannah River that would maintain the pool for water supply and recreational activities. Location is not considered a management measure when evaluating the same solution. However, it is important to note that the USACE investigated different locations both upstream and downstream of the existing NSBLD projecting.

Several locations upstream of the existing dam location were evaluated, but no suitable locations for placement of a rock weir were found upstream of the dam. The placement of any large structure within the channel reduces the available conveyance to pass high flows. The further upstream a structure is placed, the more dramatic the impacts of reduced conveyance are on water surface elevation, resulting in additional flooding compared to existing conditions. Locating the structure upstream of the current location would induce flooding in the overbank areas if a normal pool were to be maintained during normal flow conditions. The construction of a fish passage structure upstream of the current location that would result in significant flooding in the overbank areas was deemed infeasible and not considered for further evaluation.

Several locations downstream of the existing dam location were evaluated, but no suitable locations for placement of a rock weir were found. A larger and taller structure would need to be placed in the river channel downstream of the existing location in order to provide normal pool elevations comparable to existing conditions. A potential location a mile downstream of the existing dam location would need to span the width of the floodplain, resulting in a structure over a mile long. The construction of a fish passage structure that would span the full width of the floodplain was deemed infeasible and not considered for further evaluation.

The existing location of the NSBLD project at the fall line provides the best location where a structure can be placed without adversely impacting water surface elevations during flood events.

3.3 Formulation of the Initial Array of Action Alternatives

After determining that the best location for an in-channel fish passage structure would be at the existing NSBLD project location, the management measures were combined to form alternatives (Table 17).

Two alternatives were formulated from management measures based on project modifications of the WRDA 2016 Section 1319 (c)(1)(A)(i): (1) repair the lock wall and the dam gates and piers to facilitate an in-channel fish passage through the lock chamber and into the adjacent area of the park on the Georgia side of the river and (2) repair the lock wall and remove the dam and replace it with an in-channel fish passage.

Table 17: Initial Array of Action Alternatives
Repair the lock wall and the dam gates and piers to facilitate an in-channel fish passage through the lock chamber and into the adjacent area of the park on the Georgia side of the river
Repair the lock wall and remove the dam and replace it with an in-channel fish passage
Remove lock wall and dam gates and piers, and remove dam to foundation down to elevation 91.22 (NAVD88) and construct an in-channel fish passage structure using a fixed weir with a rock ramp at the existing dam site
Remove lock wall and dam gates and piers, and remove dam to foundation down to elevation 91.22 (NAVD88) and construct an in-channel fish passage structure using a fixed weir with a rock ramp at the existing dam site with a floodplain bench on the Georgia side of the existing dam location
Remove lock wall and dam gates and piers, and remove dam to foundation down to elevation 91.22 (NAVD88) and construct an in-channel fish passage structure using a fixed weir with a rock ramp at the existing dam site with an active flood passage structure in an excavated bypass channel through the park on the Georgia side of the river

Three alternatives were formulated from management measures based on project modifications of the WRDA 2016 Section 1319 (c)(1)(A)(ii): (1) Remove lock wall and dam gates and piers, and remove dam to foundation down to elevation 91.22 (NAVD88) and construct an in-channel fish passage structure using a fixed weir with a rock ramp at the existing dam site; (2) Remove lock wall and dam gates and piers, and remove dam to foundation down to elevation 91.22 (NAVD88) and construct an in-channel fish passage structure using a fixed weir with a rock ramp at the existing dam site with a floodplain bench on the Georgia side of the existing dam location; and (3) Remove lock wall and dam gates and piers, and remove dam to foundation down to elevation 91.22 (NAVD88) and construct an in-channel fish passage structure using a fixed weir with a rock ramp at the existing dam site with an active flood passage structure in an excavated bypass channel through the park on the Georgia side of the river.

A range of the widths and heights of the fixed rock-weir that would accommodate the in-channel fish passage was established to scale the physical dimensions of the action alternatives.

Twenty-four fixed crest weir designs using the HEC-RAS 1D were modeled with varying rock-weir crest width and elevation. The HEC-RAS 1D model is a coarse intermediate evaluation using the existing 1D FEMA effective model of the Savannah River to evaluate of the most likely impacts possible for with-project alternatives. The weir width varied from 380 feet to 920 feet. The dam structure of NSBLD is approximately 380 feet in width; an assumed total removal of the dam is the basis for selecting 380 feet as the minimum width for the rock weir. Total removal of both the dam and lock would result in a rock weir approximately 500 feet in width, the full width of the river channel. A concrete esplanade to the north of the land-side lock wall could be removed for an additional 50 feet of weir width without impacting the access road through the park. A scenario that includes removal of the lock, dam, and esplanade would result in a rock weir 550 feet in width. Finally, the total distance from the South Carolina riverbank to the north boundary of the park property is approximately 950 feet. A scenario that includes removal of the lock, dam, and esplanade as well as the excavation of a majority of the existing park would result in a weir approximately 920 feet in width. These 24 scenarios were modeled, with variations on the weir crest elevation. See Appendix A section 2.1.3 for more details.

The weir configuration for fish passage that is ultimately adopted must balance maintaining a pool for water supply and recreation and minimizing residential flooding impacts, while being the most cost-effective solution. The most influential parameter to change the 1% ACE water surface elevation is weir width. Weir height does have some impact within each model grouping; however, it is less significant in relation to width. A weir 380 feet in width, regardless of the crest elevation, would likely be unable to meet project objectives due to increases to the 1% ACE water surface. Alternatively, a weir 920 feet in width would meet project objectives better than a weir 380 feet, but would likely be much more expensive to construct. The 500 foot wide and 550 foot wide alternatives yield nearly identical results, with the 550 wide alternatives being much more costly due to the required demolition of the esplanade.

Based on impacts to flooding and water supply, the following scenarios (Table 18) from the 1D analysis were carried forward for a more detailed analysis using HEC-RAS 2D:

Table 18: Scenarios to be Evaluated in 2D HEC-RAS

Scenarios	Weir Length (ft)	Weir Elevation (ft NGVD29)	Impacts to 100-yr WSE <1ft	Impacts to Drought WSE <1ft	Carried forward to 2D Analysis
4	380’	110	No	Yes	Yes
7	500’	107	Yes	No	Yes
10	500’	110	Yes	Yes	Yes
22	920’	110	Yes	No	Yes

The 380' and 920' weir widths serve as the minimum and maximum weir widths that were considered in the more detailed 2D analysis. The 500' weir width scenarios serve as a starting point for additional fish passage structure refinement that was carried out in the 2D analysis phase.

The HEC-RAS 2D model focused on the area-of-interest, from just south of NSBLD to the Augusta Shoals 20 miles to the north. One-meter resolution LiDAR data were obtained for the overbank areas in Aiken and Richmond counties for use in the model and included the leveed area of the city of Augusta. Detailed hydraulics analysis of permitted upstream water intake infrastructure and upstream bathymetric, side-scan sonar, multi-beam, and obstruction identification surveys were completed.

Those alternatives that were not screened out in the 1D HEC-RAS evaluation were carried forward to the 2D HEC-RAS model for further analysis. Based on USACE discussion, alternatives in addition to those from the 1D HEC-RAS model screening were analyzed with the 2D HEC-RAS model as well. All alternatives evaluated fall into two broad categories, which are prescribed in the WRDA 2016:

1) Repair of the NSBLD lock wall and modification of the NSBLD structure to facilitate fish passage

2) Removal of the NSBLD structure with construction of fish passage structure

Fifteen alternatives that were evaluated with the 2D HEC-RAS model are listed below. The numbering scheme for the alternatives matches the categories of action presented in the 2016 WRDA, with alternatives that repair the NSBLD lock wall and structure having leading "1", while alternatives that would remove NSBLD have a leading "2". A list of alternatives evaluated with the 2D HEC-RAS model is presented in Table 19, and a detailed description of each alternative is presented in the following sections. Alternatives 1-2 (380' wide weir at elevation 110'), 2-3 (500' wide weir at elevation 107'), 2-5 (500' wide weir at elevation 110'), and 2-9 (920' wide weir at elevation 110') were carried forward from the initial 1D HEC-RAS analysis. The additional alternatives presented were formulated through ongoing discussion with the USACE and reformulation refinements of the alternatives from the 1D HEC-RAS model.

Table 19: List of Intermediate Alternatives with Refinements

Alternative Number	Alternative Description
2012 SHEP GRR (NAA)	Construct a 285' wide fixed crest weir at elevation 110 around SC side of NSBLD
1-1	Repair lock wall, retain dam, 200' wide fish passage ramp on GA side
1-2	Repair lock wall, remove dam, 380' wide fish passage ramp in place of dam
2-1	Remove lock and dam, 500' wide fixed crest weir @ elevation 105

2-2	Remove lock and dam, 500' wide fixed crest weir @ elevation 106
2-3	Remove lock and dam, 500' wide fixed crest weir @ elevation 107
2-4	Remove lock and dam, 500' wide fixed crest weir @ elevation 107.6
2-5	Remove lock and dam, 500' wide fixed crest weir @ elevation 110
2-6a	Remove lock and dam, 500' wide fixed crest weir @ elevation 110 with floodplain bench
2-6b	Remove lock and dam, 500' wide fixed crest weir @ elevation 107 with floodplain bench
2-6c	Remove lock and dam, 500' wide fixed crest weir @ elevation 108 with floodplain bench
2-6d	Remove lock and dam, 500' wide fixed crest weir @ elevation 109 with floodplain bench
2-7	Remove lock and dam, 500' wide fixed crest weir @ elevation 110 with bypass channel and one 50' wide gate
2-8	Remove lock and dam, 500' wide fixed crest weir @ elevation 110 with bypass channel and two 50' wide gates
2-9	Remove lock and dam, excavate park, 920' wide fixed crest weir @ elevation 110

3.4 Alternatives Eliminated from Further Consideration

The USACE developed, in addition to the NAA, eleven structural alternatives (Figure 22) to address the study objectives and constraints. Assuming that all alternatives have the ability to provide effective fish passage, recreational navigation, water supply, and recreation were evenly weighted. Alternative scoring utilized a scale of +1 for positive (indicated by "low" in reference above), 0 for neutral (indicated by "med") and -1 for negative (indicated by "high"). Additionally, the evaluation of flooding (1 percent chance of flooding) was a constraint. In order to reduce induced flooding, no alternatives were carried forward if they had a negative (indicated by "high") result.

WIIN Act Alternative No.	Alternative	Navigation in pool	Water Supply	Recreation	Score (higher is better)	Flooding	Acres Flooded	Preliminary Screening
1 - 1	Repair lock wall, retain dam, GA ramp	1	0	1	2	+	0	Yes
1 - 2	Repair Lock, 380' Ramp	1	0	1	2	-	1000	No
2 - 1	Fixed Crest @ 105	1	-1	0	0	+	0	No
2 - 2	Fixed Crest @ 106	1	-1	0	0	+	0	No
2 - 3	Fixed Crest @ 107	1	-1	1	1	+	21	Yes
2 - 4	Fixed Crest @ 107.6	1	-1	1	1	-	80	No
2 - 5	Fixed Crest @ 110	1	0	1	2	-	2000	No
2 - 6	Floodplain Bench	1	0	1	2	+	0	Yes
2 - 7	1x50' Gate	1	0	1	2	-	80	No
2 - 8	2x50' Gate	1	0	1	2	+	0	Yes
2 - 9	920' wide Weir	1	0	1	2	-	750	No

Figure 22: Intermediate Array of Alternatives with Refinements

Ultimately, USACE must recommend an alternative that best solves the overriding issue, which in this case is controlling the natural flow of the river. The stakeholders' desire continued access to the impounded water that the lock and dam has provided since 1937 and USACE's objective is to satisfy that need. As such, the team identified the associated risks for undertaking the project and developed eleven action alternatives (Figure 22) that address the objective. The USACE was informed by the flooding and water supply impacts identified by the 1D model. These alternatives also include adding refinements to reduce minor flood events. Again that objective is to identify the most cost effective fish passage alternative that addresses the legal requirements (Congressional language in WRDA 2016 and Endangered Species Act), as well as stakeholder and environmental concerns. Table 20 shows the alternatives eliminated from further consideration.

Table 20: Alternatives Eliminated from Further Consideration

WRDA 2016 Act	Alternative No.	Alternatives	Description	Rational for Eliminating
1	2	**Repair Lock, 380' Ramp**	Repair lock; remove dam to depth of 92.0 feet; 380' fish ramp structure through dam site	A weir 380 feet in width, regardless of the crest elevation, would likely be unable to meet project objectives and would not avoid the constraint of not increasing the 1 percent annual chance (100-year) water surface elevations.

2	**1**	**Fixed Crest @ 105**	Lock and dam removed, including foundation down to 92.0 feet; 500' wide weir with rock ramp	Adverse impacts to recreation and water supply intakes in the pool.
2	**2**	**Fixed Crest @ 106**	Lock and dam removed, including foundation down to 92.0 feet; 500' wide weir with rock ramp	Adverse impacts to recreation and water supply intake in the pool.
2	**4**	**Fixed Crest @ 107.6**	Lock and dam removed, including foundation down to 92.0 feet; 500' wide weir with rock ramp	Concerns over additional flooding in the overbank areas for the 2-year and 5-year return interval flows.
2	**5**	**Fixed Crest @ 110**	Lock and dam removed, including foundation down to 92.0 feet; 500' wide weir with rock ramp	Major induced flooding in the overbank areas for the 2-year and 5-year return interval flows.
2	**7**	**1x50' Gate**	Lock and dam removed, including foundation down to 92.0 feet; 500' wide weir with rock ramp. Active flood passage on GA side	Major induced flooding in the overbank areas for the 2-year and 5-year return interval flows.
2	**9**	**920' wide Weir**	Lock and dam removed, including foundation down to 92.0 feet; 902' wide weir with rock ramp.	Major induced flooding in the overbank areas for the 2-year and 5-year return interval flows.

3.5 Final Array of Alternatives with Refinements

The final array of alternatives include the NAA and four action alternatives. It is important to note that all of the alternatives in the final array includes the conveyance of the approximately 50 acre park to Augusta-Richmond County upon project completion. One alternative, Alternative 1-1, repairs the lock wall and dam gates and piers and allows fish to pass through the lock while maintaining normal pool elevations with some subsequent changes in fluctuation. Three of the alternatives propose a weir to create an in-channel fish passage, remove the lock and dam and partially demolish the dam foundation. Of these three, Alternative 2-3, includes a fixed crest weir with a rock ramp sloping upstream from the existing dam location. Another one of these three, Alternative 2-6, includes a fixed crest weir with a rock ramp sloping upstream from the existing dam location with a floodplain bench for high stage flood conditions. The last of the three, Alternative 2-8, uses an in-channel fish passage with a fixed weir with a rock ramp at the existing dam location with a gated flood bypass channel.

In the process of examining the final array of alternatives, it was determined that Alternative 2-6 could be scaled or refined. Alternative 2-6 includes four refinements to the weir height. This was done as a tradeoff analysis between water supply intake and recreational impacts and high frequency flooding events or low flow flooding of property.

For alternatives with similar measures, cost was the over-riding criteria with flooding as a secondary consideration. Of those alternatives that advanced to the final array of alternatives, a final array of seven action alternatives, consisting of four action alternatives and three refinements of alternative 2-6 (Table 21), were identified to address the fish passage objective.

Table 21: Final Array of Alternatives with Refinements	
Alternative	**Description**
NAA	No Action Alternative – SHEP 2012 Plan A
1-1	Repair Lock Wall GA Side Fish Passage 112-115 NGVD29 (111.2-114.2 NAVD88)
2-3	Fixed Crest Weir 107 NGVD29 (106.2 NAVD88)
2-6a	Fixed Crest Weir 110 NGVD29 (109.2 feet NAVD88) Floodplain Bench
2-6b	Fixed Crest Weir 107 NGVD29 (106.2 feet NAVD88) Floodplain Bench
2-6c	Fixed Crest Weir 108 NGVD29 (107.2 feet NAVD88) Floodplain Bench
2-6d	Fixed Crest Weir 109 NGVD29 (108.2 feet NAVD88) Floodplain Bench
2-8	Fixed Crest Weir 110 NGVD 29 (109.2 feet NAVD88) w/ Gated Bypass Channel

3.5.1 **Description**

This section describes the final array of alternatives. A detailed description of the alternatives can be found in the Appendix A, Section 2.3. Conceptual drawings of the focused array of alternatives and additional figures showing the work limits and construction footprint for each alternative can be found in Attachment 1 of Appendix A. Work limits generally encompass the width of the river from NSBLD to 1,000ft upstream and the adjacent NSBLD park; though details vary by alternative.

Construction of the weir will occur via cofferdam to maintain water levels for water supply needs and in accordance with the biological opinion. The means and method for demolition will be determined by the contractor; however, explosives are not recommended in the critical habitat for sturgeon. The sponsor and the Corps will develop a material management plan for the contractor to decrease costs of hauling material and for landfill fees. Alternatives for the management of material include coordinating with local municipalities and agencies who may be able to reuse the material for other construction projects or developing a confined area to maintain the material until it can be used. Additional discussion regarding construction methods, dam demolition, and heavy equipment usage can be found in Section 4.4.2.

Access to the fish passage structure for each alternative is possible from the Georgia side of the river through the use of the existing roadway network. The Butler Creek Bridge provides access to the NSBLD park and project site, and preliminary analysis

indicates that this bridge is suitable for all vehicles that do not require a weight permit for other roads in Georgia.

Temporary access roads for project construction and permanent access roads required for on-going project maintenance have been identified in the conceptual designs for the with-project condition, available in Attachment 1 to Appendix A.

Sediment behind the dam will not be removed as part of this project. It will serve as the base for the fish passage and rocks and gravel will be placed over the existing sediment. Borings will be taken to determine if the assumption that the material is suitable as a base is true during detailed design. In conjunction with the collection of borings, samples will be gathered for chemical analysis.

3.5.1.1 No Action Alternative

The NAA typically represents the most likely future without project condition. As described previously (Sections 1.0 and 1.2.2), USACE is retaining the 2012 SHEP Plan (Figure 1) as the NAA (page 28 of Appendix C – Final SHEP 2012 EIS) because it was the authorized plan on the date of enactment of the WRDA 2016.

The 2012 SHEP fish passage structure was planned and later designed to be constructed in the upland area along the east bank of the Savannah River, in Aiken County, South Carolina. A rendering of the 2012 SHEP fish passage and the design drawing are provided below. The cost of the 2012 SHEP fish passage is $63,000,000 at FY19 price levels.

3.5.1.2 Alternative 1-1 – Repair Lock Wall Georgia Side Fish Passage (Recommended for further consideration)

Alternative 1-1 (Figure 23) consists of repairing the NSBLD gates and piers and the riverside lock wall (Figure 24). Additionally, a 200' wide fish ramp structure would be constructed through the lock chamber and into the adjacent area of the park on the Georgia side of the river. The fish passage structure would be constructed with boulders and stone sized following the same design that was previously-approved for the bypass. The structure would have a 2 percent slope upstream to the weir crest, and a 10 percent slope downstream from the crest to the river bed. Ultimate weir crest elevation of 110 feet NGVD29 (109.2 NAVD88). A new boat ramp will not be needed for this alternative.

Access to the fish passage structure for this alternative is possible from the Georgia side of the river through the use of the existing roadway network, and a new ¼ mile long access road. Staging during construction will be in the existing parking lots in NSBLD Park.

Alternative 1-1 includes stabilizing the lock wall adjacent to the dam and removing the lock wall adjacent to the park area, making repairs to cracks in the concrete dam

structure, maintenance to the gates, and building the weir for fish passage. The total investment cost of Alternative 1-1 is $81,169,203. This alternative also requires a major rehabilitation of the structure at a midpoint in a 100-year lifecycle of the project which has an average annual cost of $285,000, and annual operation and maintenance costs are $720,000 per year to maintain the dam until major rehab and maintain the fish passage.

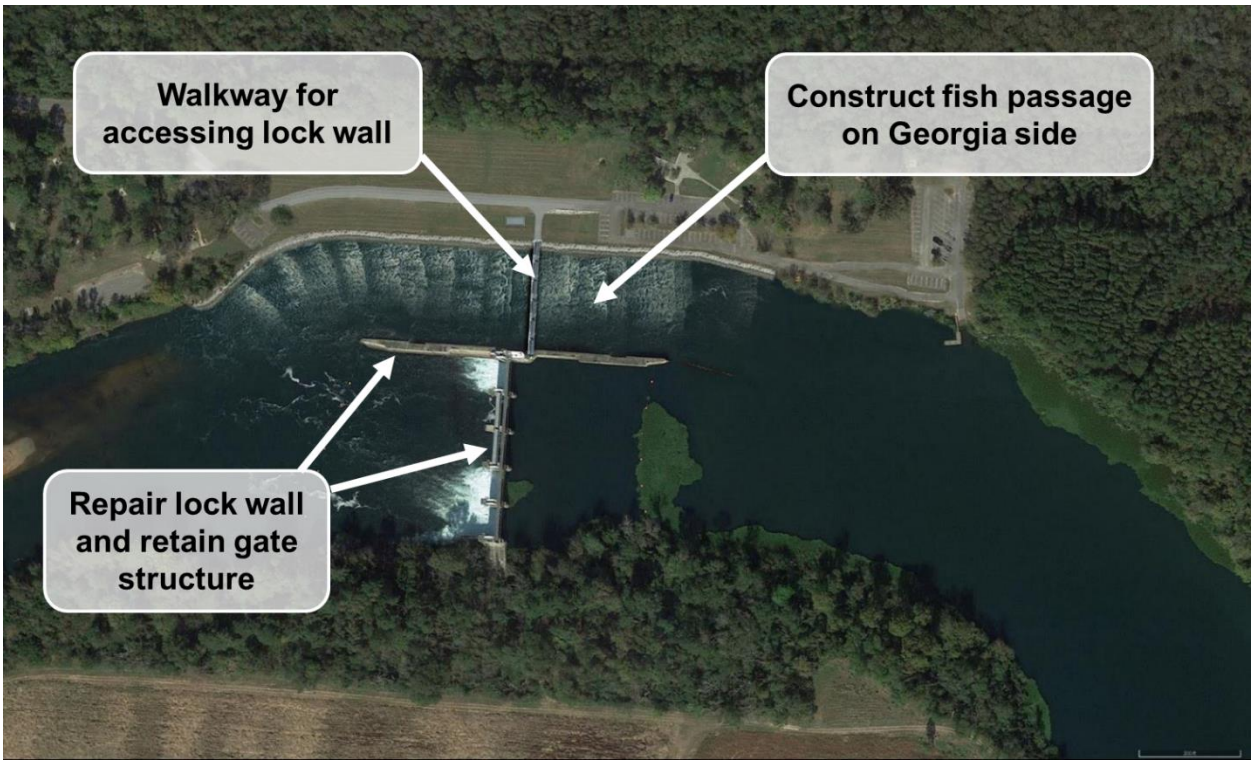


Figure 23: Rendering of Alternative 1-1.

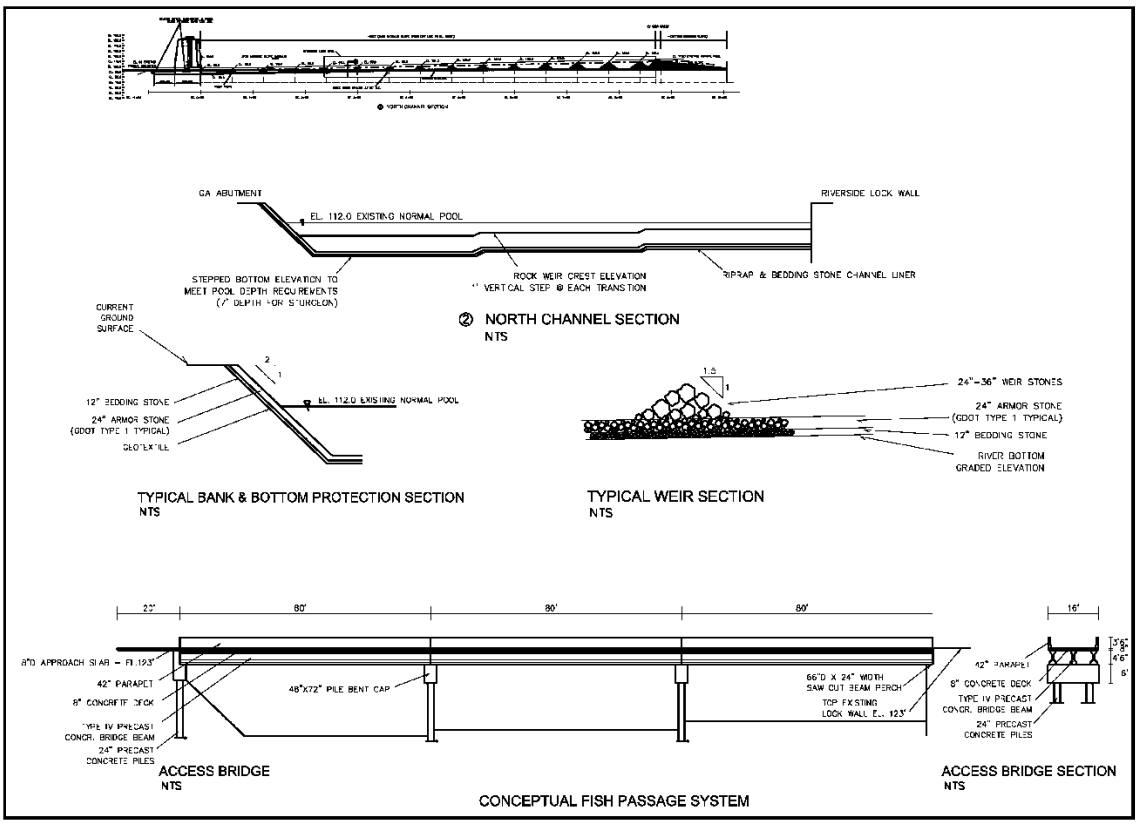


Figure 24: Repair Dam - 2 Percent Slope Concept.

3.5.1.3 Alternative 2-3 – Fixed Crest Weir (500' Wide at Elevation 106.2' NAVD88) (Recommended for further consideration)

Alternative 2-3 (Figure 25) consists of a fixed crest weir with a rock ramp sloping upstream from the existing dam location. The fish passage structure would be constructed with boulders and stone sized following the same design that was previously-approved for the bypass. The structure would have a 2 percent slope upstream to the weir crest, and a 10 percent slope downstream from the crest to the river bed. The lock and dam would be removed, including the foundation, down to elevation 91.22 (NAVD88). The weir would be 500 feet in width with an average crest elevation of 106.22 feet (NAVD88, 107.0 NGVD29). A new boat ramp will not be needed.

Access to the fish passage structure for this alternative is possible from the Georgia side of the river through the use of the existing roadway network. Staging during construction will be in the existing parking lots in NSBLD Park.

The total investment cost of this alternative is $86,242,697 which includes planning, engineering, and design; demolition of the lock and dam; and installing a coffer dam to maintain water levels while rock and boulders are installed to make the fish passage weirs. OMRR&R for Alternative 2-3 is approximately $35,000 annually which includes

labor and material to repair the rock weir such that it supports the purposes of mitigation and maintaining the pool elevation.

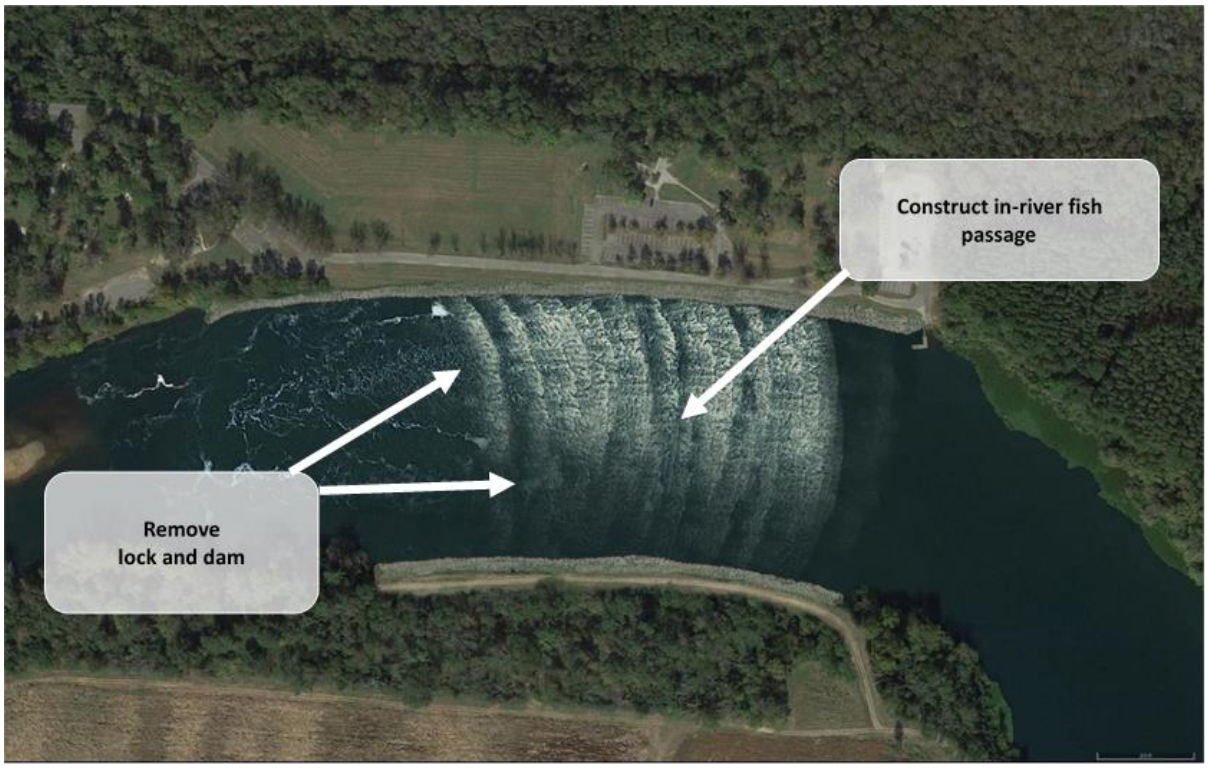


Figure 25: Rendering of Alternative 2-3.

3.5.1.4 Alternative 2-6a – Fixed Crest Weir (500' Wide at Elevation 109.2 NAVD88) with Bench (Recommended for further consideration)

Alternative 2-6a (Figure 26) consists of a fixed crest weir with a rock ramp sloping upstream from the existing dam location as described in alternative 2-3. The lock and dam would be removed, including the foundation down to elevation 91.22 (NAVD88) And the fish passage structure would be constructed 500 feet in width as described in Alternative 2-3 with these changes: The weir would be 500 feet in width with an average crest elevation of 109.22 feet NAVD88 (110.0 NGVD29). A floodplain bench (Figure 27) approximately 275 feet in width would be excavated to elevation 110 feet NAVD88 (110.8 NGVD29) on the Georgia side of the existing dam location. The bench would ease the passage of flood waters past that point in the river. The bench would be grassed or rock lined to prevent erosion. A new boat ramp will be built just upstream of the existing boat ramp and will require 10 acres of commercial forested land.

Access to the fish passage structure and floodplain bench for this alternative is possible from the Georgia side of the river through the use of the existing roadway network, and a new 3/4 mile long access road. Staging during construction will be within the existing footprint of NSBLD Park.

The cost of this alternative is $123,299,062 which includes planning, engineering, and design; labor to obtain real estate easements, demolition of the lock and dam and installing a coffer dam to maintain water levels while rock and boulders are installed to make the fish passage weirs. OMRR&R costs are $45,000 annually and include labor and material to repair the rock weir such that it supports the purposes of mitigation and maintaining the pool elevation.

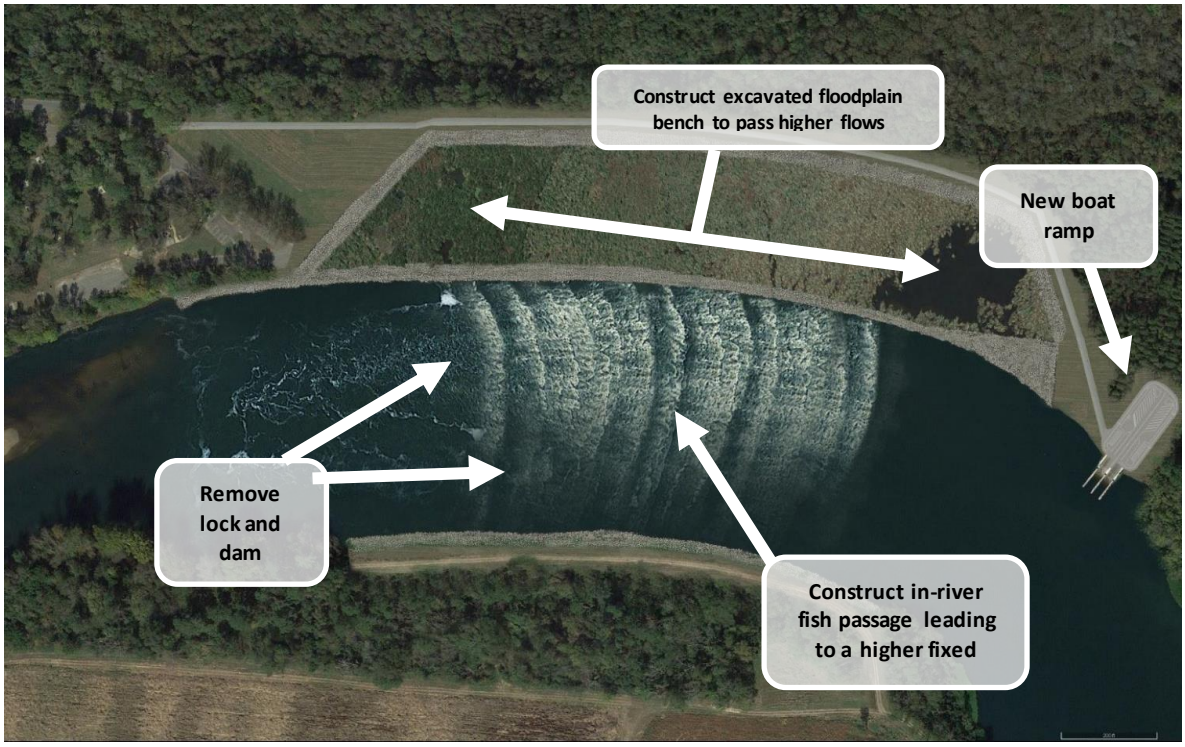


Figure 26: Rendering of Alternative 2-6a.

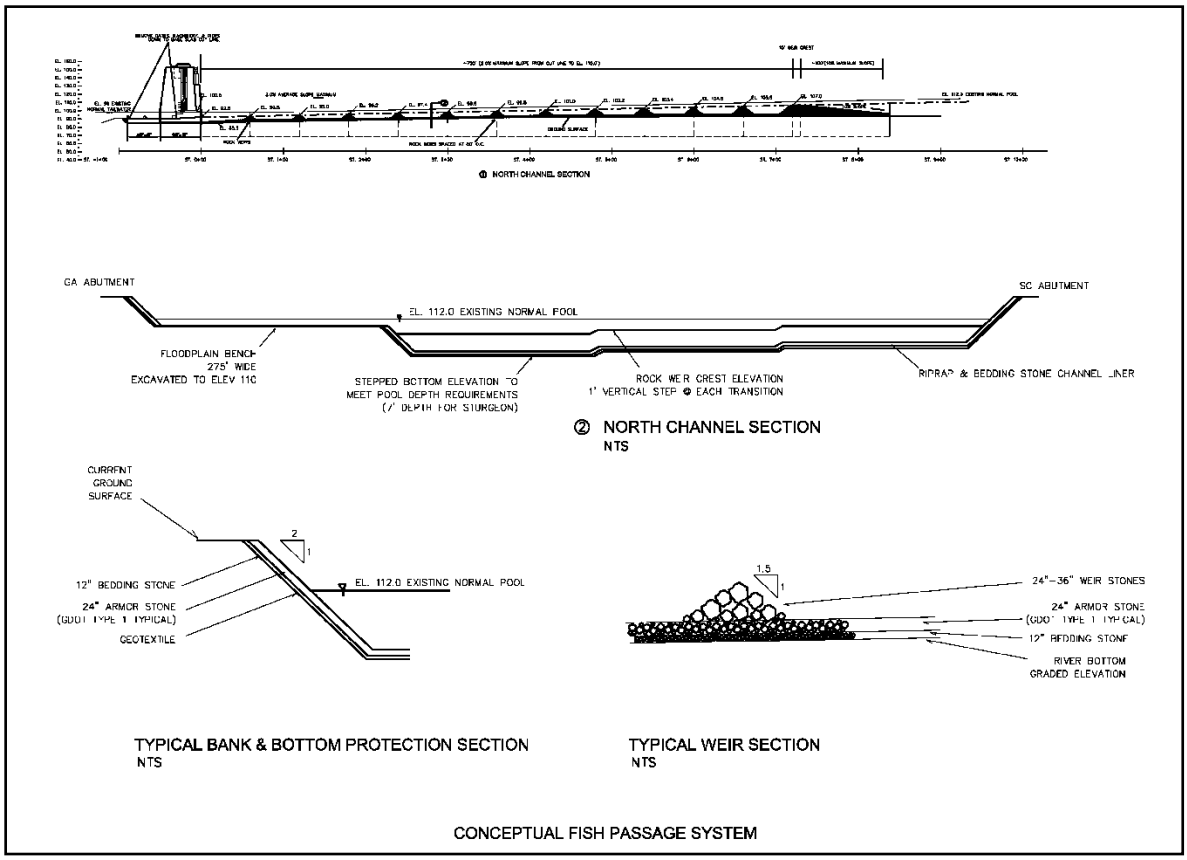


Figure 27: Floodplain Bench - 2 Percent Slope Detail.

3.5.1.5 Alternative 2-6b – Fixed Crest Weir (500' Wide at Elevation 106.2') with Bench (Recommended for further consideration)

Alternative 2-6b (Figure 28) consists of a fixed crest weir with a rock ramp sloping upstream from the existing dam location as described in Alternative 2-3. The lock and dam would be removed, including the foundation, down to elevation 91.22 (NAVD88) and the fish passage structure would be constructed 500 feet in width as described in Alternative 2-3 with the following changes. The weir would have an average crest elevation of 106.2 feet (NAVD88, 107.0 NGVD29). A floodplain bench (Figure 27) approximately 275 feet in width would be excavated to elevation 110 (NAVD88) on the Georgia side of the existing dam location. The bench would ease the passage of flood waters past that point in the river. The bench would be grassed or rock lined to prevent erosion. The floodplain bench would be partially inundated for the 1-yr return interval flow of 16,500 cfs. A new boat ramp will be built just upstream of the existing boat ramp and will require 10 acres of commercial forested land.

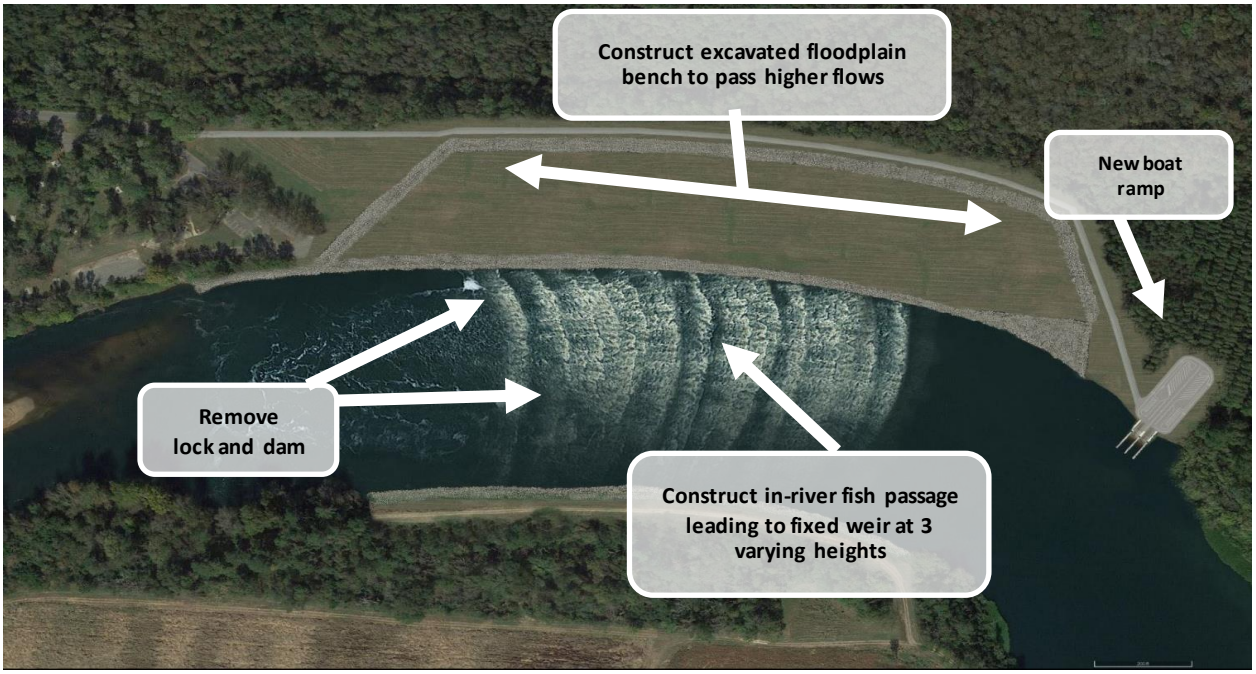


Figure 28: Rendering of Alternative 2-6 refinements b, c, and d.

Access to the fish passage structure and floodplain bench for this alternative is possible from the Georgia side of the river through the use of the existing roadway network, and a new 3/4 mile long access road. Staging during construction will be within the existing footprint of NSBLD Park.

The cost of this alternative is $99,583,220 and includes planning, engineering, and design; demolition of the lock and dam and installing a coffer dam to maintain water levels while rock and boulders are installed to make the fish passage weirs. OMRR&R costs $45,000 annually and includes labor and materials to repair the rock weir such that it supports the purposes of mitigation and maintaining the pool elevation.

3.5.1.6 Alternative 2-6c – Fixed Crest Weir (500') Wide at Elevation 107.2') with Bench (Recommended for further consideration)

Alternative 2-6c (Figure 28 consists of a fixed crest weir with a rock ramp sloping upstream from the existing dam location as described previously in alternative 2-3. The lock and dam would be removed, including the foundation, down to elevation 91.22 (NAVD88) and the fish passage structure would be constructed 500 feet in width as described in Alternative 2-3 with the following changes. The weir would have an average crest elevation of 107.2 feet (NAVD88, 108.0 NGVD29). A floodplain bench (Figure 27) approximately 275 feet in width would be excavated to elevation 110 (NAVD88) on the Georgia side of the existing dam location. The bench would ease the passage of flood waters past that point in the river. The bench would be grassed or rock lined to prevent erosion. The floodplain bench would be partially inundated for the 1-yr return interval flow of 16,500 cfs. A new boat ramp will be built just upstream of the existing boat ramp and will require 10 acres of commercial forested land.

Access to the fish passage structure and floodplain bench for this alternative is possible from the Georgia side of the river through the use of the existing roadway network, and a new 3/4 mile long access road. Staging during construction will be within the existing footprint of NSBLD Park.

The cost of this alternative is $100,497,617 which includes planning, engineering, and design; demolition of the lock and dam and installing a coffer dam to maintain water levels while rock and boulders are installed to make the fish passage weirs. OMRR&R costs are $45,000 annually and include labor and material to repair the rock weir such that it supports the purposes of mitigation and maintaining the pool elevation.

3.5.1.7 Alternative 2-6d – Fixed Crest Weir (500' Wide at Elevation 108.2') with Bench (Recommended for further consideration)

Alternative 2-6d (Figure 28) consists of a fixed crest weir with a rock ramp sloping upstream from the existing dam location as described in alternative 2-3. The lock and dam would be removed, including the foundation, down to elevation 91.22 (NAVD88) and the fish passage structure would be constructed 500 feet in width as described in Alternative 2-3 with the following changes. The weir would have an average crest elevation of 108.2 feet (NAVD88, 109.0 NGVD29). A floodplain bench (Figure 27) approximately 275 feet in width would be excavated to elevation 110 (NAVD88) on the Georgia side of the existing dam location. The bench would ease the passage of flood waters past that point in the river. The bench would be grassed or rock lined to prevent erosion. The floodplain bench would be partially inundated for the 1-yr return interval flow of 16,500 cfs. A new boat ramp will be built just upstream of the existing boat ramp and will require 10 acres of commercial forested land.

Access to the fish passage structure and floodplain bench for this alternative is possible from the Georgia side of the river through the use of the existing roadway network, and

a new 3/4 mile long access road. Staging during construction will be within the existing footprint of NSBLD Park.

The cost of this alternative is $96,351,524 and includes planning, engineering, and design; demolition of the lock and dam and installing a coffer dam to maintain water levels while rock and boulders are installed to make the fish passage weirs. OMRR&R costs are $45,000 annually and include labor and materials to repair the rock weir such that it supports the purposes of mitigation and maintaining the pool elevation.

3.5.1.8 Alternative 2-8 – Fixed Crest Weir (500' Wide at Elevation 109.2') with 2 Gates (Recommended for further consideration)

Alternative 2-8 (Figure 29) consists of a fixed weir with a rock ramp at the existing dam site with an active flood passage structure in an excavated bypass channel through the park on the Georgia side of the river. The lock and dam would be removed including the foundation down to elevation 91.22 (NAVD88) and the fish passage structure would be constructed 500 feet in width as described in Alternative 2-3. The structure in the bypass channel would consist primarily of two 50' gates (Figure 30) used to pass high flows. The bypass channel would ease the passage of flood waters past that point in the river. A new boat ramp will be built just upstream of the existing boat ramp and will require 10 acres of commercial forested land.

Access to the fish passage structure and gated bypass for this alternative is possible from the Georgia side of the river through the use of the existing roadway network, and a new 3/4 mile long access road. Staging during construction will be within the existing footprint of NSBLD Park.

The cost of this alternative is $170,139,594 and includes planning, engineering, and design; demolition of the lock and dam, installing a coffer dam to maintain water levels while rock and boulders are installed to make the fish passage weirs, and building the gated structure. Operation and maintenance costs are $320,000 annually which include labor and material to maintain the functionality of the gates and to repair the rock weir such that it supports the purposes of mitigation and maintaining the pool elevation. This alternative also requires a major rehabilitation of the structure at a midpoint in a 100-year lifecycle of the project which costs $249,000 annually.

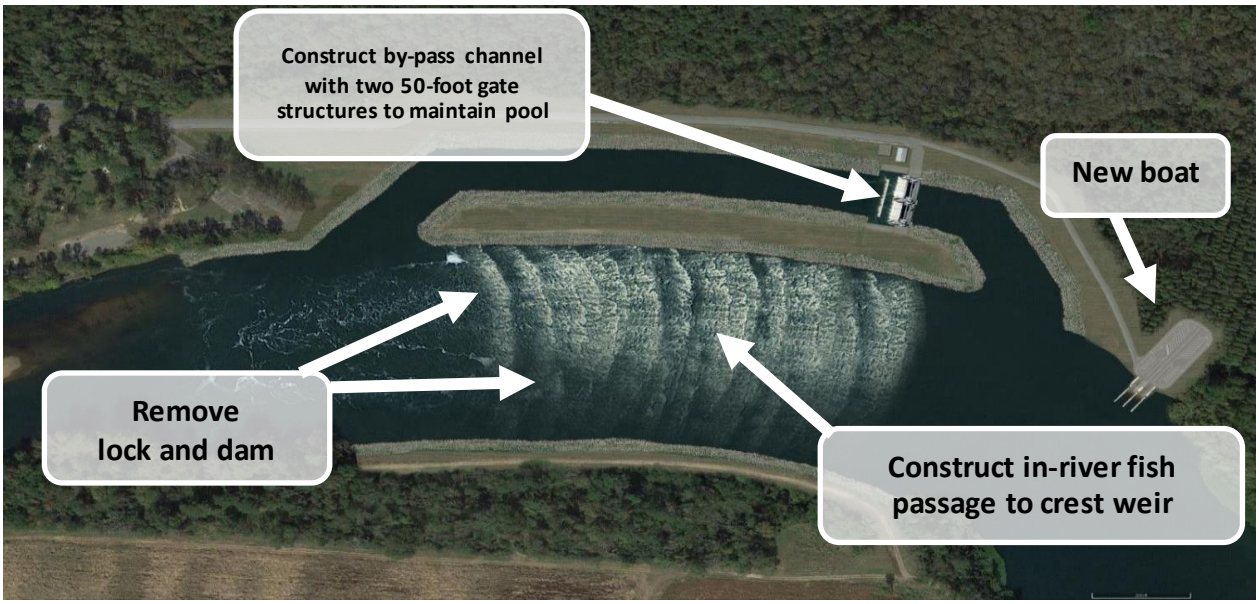


Figure 29: Rendering of Alternative 2-8.

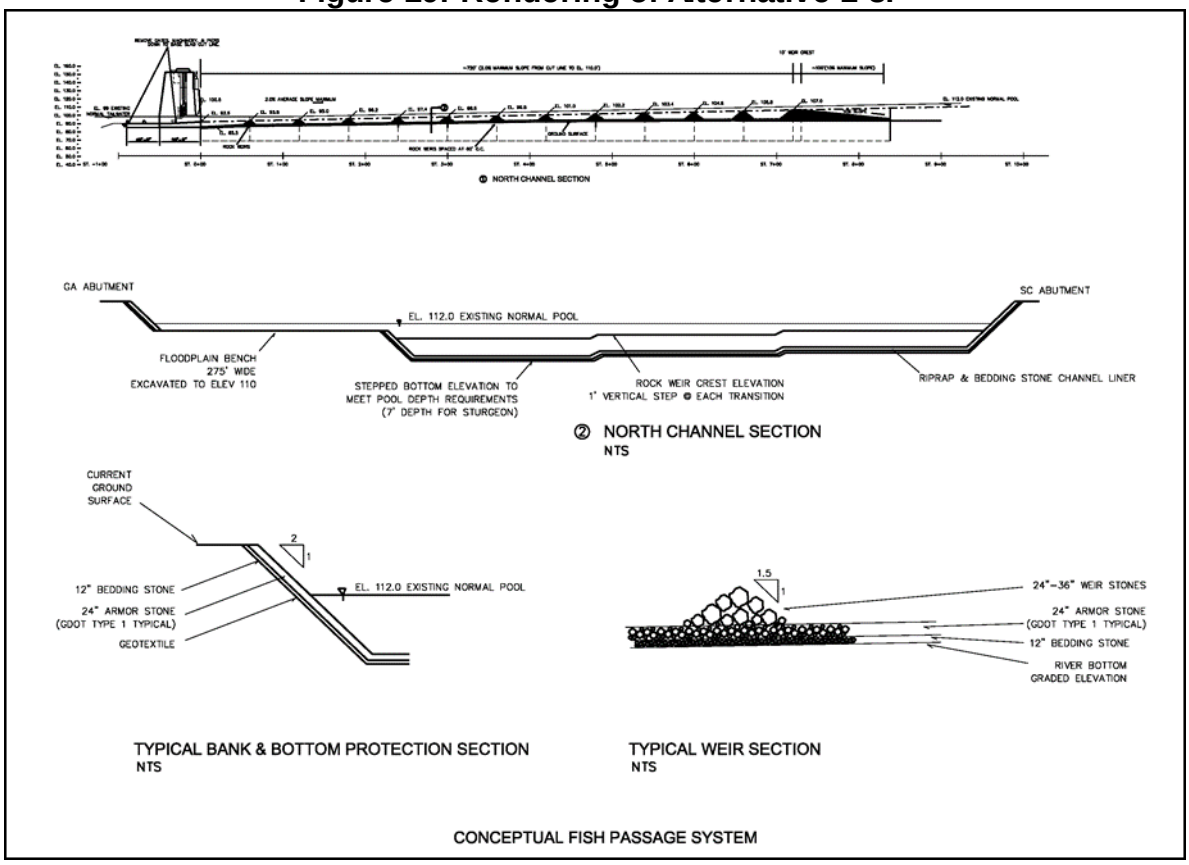


Figure 30: Bypass Channel - 2 Percent Slope Detail.

3.6 Environmental Effects*

This section describes general potential impacts of implementing the final array of alternatives described in Section 3.5.1. Results from the HEC-RAS modeling, information gathering/database searches, coordination with state and federal resource agencies, as well as best professional judgment were used to determine the various effects of each of the alternatives being evaluated. For the purposes of this analysis, the original design is used for comparison of alternatives and as the No Action Alternative (NAA) during formulation. The current and future conditions described in this document and used as the base of comparison for the effects analysis assume the SHEP 2012 Fish Passage has not been constructed.

Cumulative impacts are also discussed in the section below. Cumulative impacts result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal), organization, or person undertakes such actions.

3.6.1 Climate Change – Upstream River Effects

Climate change (Appendix K) has the potential to affect all of the missions of the USACE. The Climate Preparedness and Resilience Community of Practice develops and implements practical, nationally consistent, and cost-effective approaches and policies to reduce potential vulnerabilities to the Nation's water infrastructure resulting from climate change and variability. The Ogeechee-Savannah watershed is not highly vulnerable (top 20% of watersheds nationwide) to the impacts of climate change on any of the four business lines evaluated (Ecosystem Restoration, Recreation, Water Supply, Flood Risk Reduction). Despite the USACE Watershed Climate Vulnerability Tool results for the Ogeechee-Savannah on a CONUS level, climate change literature suggests a wetter and warmer climate in the future.

3.6.1.1 Future Conditions with No Action Alternative and Project Alternatives 1-1, 2-3, 2-6 a-d, and 2-8:

Climate change is expected to have a minimal and equal impact on all alternatives studied. No alternative would have an impact on climate change.

3.6.2 Hydrology and Floodplains

Currently, the gate openings at NSBLD are adjusted multiple times daily to provide, to the extent possible, a steady pool elevation upstream as inflow varies. This type of operation would not be possible under any of the alternatives considered. Complete removal of the dam would preclude any active management of the pool using gates, and pool elevations would be purely a function of river flow. Alternatives that leave the dam gates in place would require all flow under normal conditions be directed over the fish-passage structure, with gates operated only to pass flood waters. In either case,

variation in river flow would have a much larger impact on pool elevation under all alternatives. Impacts to the pool elevation under normal flow and flood conditions for each alternative are presented below.

The pool elevation under normal flow and flood conditions for each alternative were determined using a hydraulic model (HEC-RAS) of the Savannah River. The model uses a terrain model, hydrologic inflows, and significant hydraulic structures (e.g. dams and weirs) to compute water surface elevations, depths, velocities, and flooding extents for the scenarios evaluated. Impacts to the pool elevation under normal flow and flood conditions for each alternative are presented below.

Normal flow conditions for the purpose of this analysis range from 3,600 cfs to 8,000 cfs; this range of flow is seen approximately 66% of the time. Flood conditions for a range of return-interval flows (e.g. 5-year flood) were also evaluated. However, the 50% annual chance exceedance (2-year) flood presents the best point of comparison for alternatives as this is approximately the flow level where flow leaves the channel and impacts the overbank areas. Flow levels much larger than the 50% ACE have the majority of flow in the overbank areas, and any changes to the lock and dam have little impact (if any) on water surface elevation or flooding extents for larger flood events. For additional discussion regarding hydraulic model development, model output, normal flow conditions, and flood conditions please see Section 2.2.3 in Appendix A.

Any modifications to the structure of NSBLD are likely to have an impact on water surface elevations within the pool of the Savannah River upstream of the existing lock and dam. Normal pool elevations upstream of the dam are likely to be lower during normal flow conditions, and there will be more variability in the pool elevation due to the construction of a fish passage structure. It is important to note that any changes to NSBLD or construction of any fish-passage structure will not impact the flow levels at Augusta or releases from Thurmond Dam.

Changes in pool elevation for the with-project alternatives will be greatest immediately upstream of the existing dam location but will be less pronounced further upstream. As we move from the location of the lock and dam to 5th Street Bridge and North Augusta, all of the water surface profiles for all alternatives begin to converge. Figure 31 illustrates the attenuation of depth variance that gradually occurs from downstream to upstream. The further upstream, the more impacts decrease with each alternative. Impacts on the normal pool are greatest near the structure and are dampened further upstream regardless of which alternative is selected. In addition, Figure 31 compares the depths of the existing condition and each alternative along the river from the lock and dam upriver to the 5th Street Bridge and the city of North Augusta. The range in water level elevations decreases incrementally and the magnitude of depths attenuate from river mile 188 upriver of the NSBLD to river mile 202 in the Augusta metropolitan area. Each alternative is a step-wise increment.

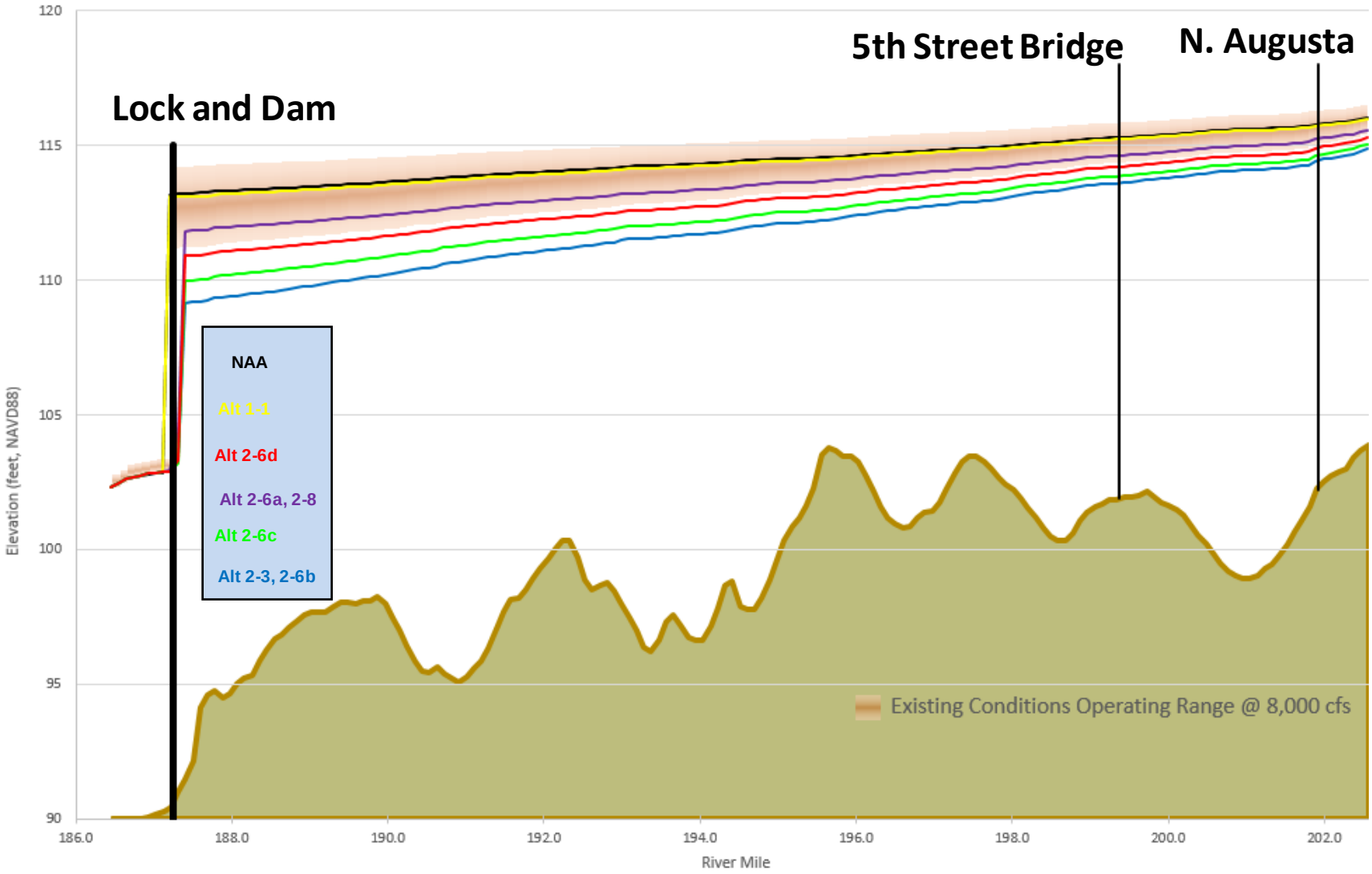


Figure 31: Attenuation of Depth Variance at 8,000 cfs

3.6.2.1 Future Conditions with No Action Alternative:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents. A range of flows for normal conditions (3,600 cfs to 8,000 cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would result in a pool elevation between 112.5 feet and 114.0 feet NAVD88 (111.7 and 113.2 feet NGVD29) at the dam under the range of "normal" flows ("average" normal pool of 114.0 feet NGVD29). The pool at 5th St. Bridge would be around elevation 114.2 feet NAVD 88 during normal flow conditions. Figure 31 shows where this alternative aligns within the existing condition band.

This alternative would not cause any direct or indirect additional flooding for the 50% through 1% ACE flood events as the dam gates would remain in place and operational during high flows.

3.6.2.2 Future Conditions with Alternative 1-1:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents for the with-project condition. A range of flows for normal conditions (3,600cfs to 8,000cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would have direct impact by lowering the normal pool elevation near the lock and dam by 1.2 feet during normal flow conditions, with the impacts to pool elevation attenuating as you move upstream. The pool at 5th St. Bridge would be around elevation 113.5 feet NAVD88 (0.7 feet lower than the NAA) during normal flow conditions. Figure 31 shows where this alternative aligns within the existing condition band.

This alternative would not cause any direct or indirect additional flooding for the 50% through 1% ACE flood events as the dam gates would remain in place and operational during high flows.

3.6.2.3 Future Conditions with Alternative 2-3:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents for the with-project condition. A range of flows for normal conditions (3,600 cfs to 8,000 cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would result in direct impact to pool elevation. The pool at the weir would fluctuate between elevation 107.9 feet and 109.1 feet NAVD88 during normal river flows, with an elevation of 108.4 being representative of normal conditions. The pool at 5th St. Bridge would be around elevation 111.6 feet NAVD88 (2.6 feet lower than NAA)

during normal flow conditions. Figure 31 shows where this alternative aligns below the existing condition band.

This alternative would not cause any indirect additional flooding for the 50% through 1% ACE flood events. The relatively low weir crest elevation provides sufficient conveyance to pass high flows without inducing additional inundation in the overbanks.

3.6.2.4 Future Conditions with Alternative 2-6a:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents for the with-project condition. A range of flows for normal conditions (3,600cfs to 8,000cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would provide normal pool elevations between 111.0 feet and 111.8 feet NAVD88 near the lock and dam, with an elevation of 111.6 feet NAVD88 (1.7 feet lower than existing) being representative of normal conditions. The pool at 5th St. Bridge would be around elevation 113.2 feet NAVD88 (1.1 feet lower than NAA) during normal flow conditions.

This alternative may cause a minor increase in flooding depth (generally less than 0.5 feet) for dozens of parcels for the 50% ACE flood event. The duration of the event does not change. No structures are impacted. Larger flows (less frequent flood events) would have the same inundation footprint and depth as under existing conditions. Figure 31 shows where this alternative aligns within the existing condition band. This minor increase in inundation does not impact special habitats, does not impact structures, and is temporary.

3.6.2.5 Future Conditions with Alternative 2-6b:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents for the with-project condition. A range of flows for normal conditions (3,600 cfs to 8,000 cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would provide normal pool elevations between 107.9 and 109.1 NAVD88 near the lock and dam, with an elevation of 108.3 feet NAVD88 (4.9 feet lower than NAA) being representative of normal conditions. The pool at 5 th St. Bridge would be around elevation 111.6 feet NAVD88 (2.6 feet lower than NAA) during normal flow conditions. Figure 31 shows where this alternative aligns below the existing condition band.

This alternative would not cause any additional flooding for the 50% through 1% ACE flood events. The relatively low weir crest elevation and flood bench provide sufficient conveyance to pass high flows without inducing additional inundation in the overbanks.

3.6.2.6 Future Conditions with Alternative 2-6c:

The results of the model indicate this alternative would provide normal pool elevations between 108.8 feet and 110 feet NAVD88 near the lock and dam, with an elevation of 109.3 feet NAVD88 (4.0 feet lower than NAA) being representative of normal conditions. The pool at 5th St. Bridge would be around elevation 112 feet NAVD88 (2.2 feet lower than NAA) during normal flow conditions. Figure 31 shows where this alternative aligns below the existing condition band.

This alternative would not cause any additional flooding for the 50% through 1% ACE flood events. The relatively low weir crest elevation and flood bench provide sufficient conveyance to pass high flows without inducing additional inundation in the overbanks.

3.6.2.7 Future Conditions with Alternative 2-6d:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents for the with-project condition. A range of flows for normal conditions (3,600cfs to 8,000cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would provide normal pool elevations between 109.7 feet and 110.9 feet NAVD88 near the lock and dam, with an elevation of 110.2 feet NAVD88 (3.0 feet lower than NAA) being representative of normal conditions. The pool at 5th St. Bridge would be around elevation 112.4 feet NAVD88 (1.8 feet lower than NAA) during normal flow conditions. Figure 31 shows where this alternative aligns slightly below the existing condition band.

This alternative would not cause any additional flooding for the 50% through 1% ACE flood events. The relatively low weir crest elevation and flood bench provide sufficient conveyance to pass high flows without inducing additional inundation in the overbanks. This alternative is not expected to cause any increase in flooding depth within the study area.

3.6.2.8 Future Conditions with Alternative 2-8:

A hydraulic model (HEC-RAS) of the Savannah River incorporating the geometry configuration of this alternative was used to compute water surface elevations, depths, velocities, and flooding extents for the with-project condition. A range of flows for normal conditions (3,600cfs to 8,000cfs) and flood conditions (50% to 1% ACE) were evaluated using the hydraulic model. The results of the model indicate that this alternative would provide normal pool elevations between 111.1 feet and 112.5 feet NAVD88 near the lock and dam, with an elevation of 111.9 feet NAVD88 (1.3 feet lower than NAA) being representative of normal conditions. The pool at 5th St. Bridge would be around elevation 113.4 NAVD88 (0.9 feet lower than existing) during normal flow conditions. Figure 31 shows where this alternative aligns within the existing condition band.

This alternative would not cause any additional flooding for the 50% through 1% ACE flood events. The inclusion of the bypass channel with gated structure would provide sufficient conveyance to pass high flows without inducing additional inundation in the overbanks.

3.6.3 Aquatic Resources and Aquatic Habitat

3.6.3.1 Future Conditions with No Action Alternative

Adverse environmental impacts to aquatic resources from the NAA are expected to be limited to short term impacts during construction, since the long term impacts are expected to be very beneficial for migratory fish species. For creating the rock weir, rock would be used for fill material throughout the water column. The use of rock instead of soil for the base of the rock weir would greatly reduce short term turbidity and water quality impacts downstream; and secondary impacts to aquatic wildlife.

Long term beneficial impacts could occur to aquatic species from the potential local increased dissolved oxygen from creation of turbulence at the rock weir. The rock weir would also improve habitat in general for fish and wildlife species by improving habitat diversity.

The environmental benefits for the fish passage structure allows for the upstream migration of a variety of migratory fish species including sturgeon, American shad, Hickory shad, blueback herring, striped bass, and American eel. The structure also allows for fish such as Atlantic and shortnose sturgeon to return downstream once they have spawned in their historic spawning grounds further upriver at the Augusta shoals.

The no action alternative design would be expected to allow fish to migrate up the river to reach spawning habitat. There is however the potential that they will have the challenge of finding the bypass structure. The design of this alternative has the potential to cause migration delays and during high flow conditions will likely cause false attraction to the operating gates which could lead immigrating fish to the lock structure and gated system and not the fish passage structure.

With implementation of the no action alternative design it is expected that the changing water flows/water velocities as a result of the alternative's design will not cause the already existing coverage of nuisance and exotic vegetation within the immediate project such as common water hyacinth (*Eichhornia crassipes)*, within the river to spread or increase within the study area or downstream of the existing lock and dam structure. It has also been shown that exotic species do not grow well in higher water velocities. It is expected therefore that with the creation of the fish passage weir structure, there will be an increase in water velocity which should prohibit the spread of exotic species within the project area and downstream of the lock and dam area where water velocities are currently higher.

As a result of the proposed construction design of the no action alternative, there would be a conversion of approximately 0.21 acres of vegetated wetland to rocky shoals type habitat where the fish passage structure would be constructed. There would also be a conversion of approximately 11 acres of half forested upland habitat and half agriculture farmland to rocky shoals type habitat as a result of the creation of the fish passage structure. The type of vegetated wetland as well as the upland forested habitat and the agriculture farmland that would be removed as part of the fish passage construction is not considered to be rare or unique to the study area and would still be present in other areas adjacent to the project area. The creation of the rocky shoals type habitat is rarer within the project area and does provide valuable spawning habitat value for state and federal listed species such as the robust red horse and the Atlantic and shortnose sturgeon.

No impact to the downstream habitat is expected to occur because of a release of sediment. The fish passage will be dug and the rocks placed in the dry with erosion control measures in place.

3.6.3.2 Future Conditions with Alternative 1-1

Adverse environmental impacts to aquatic resources from Alternative 1-1 are expected to be limited to short term impacts during construction, since the long term impacts are expected to be very beneficial for migratory fish species as discussed in Section 3.6.3.1. With implementation of Alternative 1-1, there would be a conversion of approximately 5 acres of the existing river bottom to rocky shoals type habitat as well as a conversion of approximately 5.53 acres of existing upland/park habitat to rocky shoals type habitat to create the fish passage structure when compared to the NAA. As discussed in Section 3.6.3.1, the river bottom and existing upland park habitat that will be converted to the rocky shoals type habitat is not rare or unique habitat to the project area and the creation of the rocky shoals type habitat is rarer within the study area and creates valuable habitat for aquatic species.

No impact to the downstream habitat is expected to occur because of a release of sediment. Sediment behind the dam will not be removed as part of this project. It will serve as the base for the fish passage and rocks and gravel will be placed over the existing sediment. Borings will be taken to determine if the assumption that the material is suitable as a base is true during detailed design. In conjunction with the collection of borings, samples will be gathered for chemical analysis. Erosion control measures will be used.

3.6.3.3 Future Conditions with Project Alternatives 2-3 and 2-6a-d:

Adverse environmental impacts to aquatic resources from the proposed alternatives are expected to be limited to short term impacts during construction, since the long term impacts are expected to be very beneficial for migratory fish species. For creating the rock weir, rock would be used for fill material throughout the water column. The use of

rock instead of soil for the base of the rock weir would greatly reduce short term turbidity and water quality impacts downstream; and secondary impacts to aquatic wildlife.

Long term beneficial impacts could occur to aquatic species from the potential local increased dissolved oxygen due to turbulence at rock weir. The rock weir would also improve habitat in general for fish and wildlife species by improving habitat diversity. Alternative 2-3 and Alternatives 2-6a-d fish passage design would be expected to be more beneficial on migratory fish (including protected species such as the shortnose and Atlantic sturgeon) since they will not have the challenge of finding the bypass structure and would allow for improved movement throughout the ecosystem.

With implementation of Alternative 2-3 and Alternatives 2-6a-d, it is expected that the changing water flows/water velocities as a result of the alternative's design will not cause the already existing coverage of nuisance and exotic vegetation such as common water hyacinth (*Eichhornia crassipes)*, within the river to spread or increase within the study area or downstream of the existing lock and dam structure. It has also been shown that exotic species do not grow well in higher water velocities. It is expected therefore that with the creation of the fish passage weir structure, there will be an increase in water velocity which should prohibit the spread of exotic species within the project area and downstream of the lock and dam area where water velocities are currently higher.

Table 22 shows the conversion of existing river bottom to rocky shoals type habitat as well as the conversion of existing upland/park habitat which is mainly concrete parking areas to rocky shoals type habitat when compared to the NAA.

Table 22: Aquatic Habitat Conversion Information for Alternatives 2-3 and 2-6a-d

Alternative	Conversion from Existing River Bottom to Rocky Shoal Type Habitat	Conversion from Existing Upland/Park habitat to Rocky Shoals Type Habitat
Alternative 2-3	10.24 acres	0.5 acres
Alternative 2-6a	12.61 acres	0.5 acres
Alternative 2-6b	10.24 acres	0.5 acres
Alternative 2-6c	11.07 acres	0.5 acres
Alternative 2-6d	11.88 acres	0.5 acres

As discussed in Section 3.6.3.1, the river bottom and existing upland park habitat that will be converted to the rocky shoals type habitat is not rare or unique habitat to the project area and the creation of the rocky shoals type habitat is rarer within the study area and creates valuable habitat for aquatic species.

No impact to the downstream habitat is expected to occur because of a release of sediment. Sediment behind the dam will not be removed as part of this project. It will serve as the base for the fish passage and rocks and gravel will be placed over the existing sediment. Borings will be taken to determine if the assumption that the material

is suitable as a base is true during detailed design. In conjunction with the collection of borings, samples will be gathered for chemical analysis. Erosion control measures will be used. No sediment will be released during demolish of the lock and dam. The base slab will remain in the riverbed and not disturbed.

3.6.3.4 Future Conditions with Alternative 2-8

Adverse environmental impacts to aquatic resources from Alternative 2-8 are expected to be limited to short term impacts during construction, since the long term impacts are expected to be very beneficial for migratory fish species as discussed in Section 3.6.3.1. With implementation of Alternative 2-8, there would be a conversion of approximately 19 acres of the existing river bottom to rocky shoals type habitat as well as a conversion of approximately 0.5 acres of existing upland/park habitat to rocky shoals type habitat to create the fish passage structure when compared to the NAA. There would also be a conversion of approximately 5.5 acres of existing upland/park land which is mainly composed of a concrete parking lot to river bottom when compared to the NAA. As discussed in Section 3.6.3.1, the river bottom and existing upland park habitat that will be converted to the rocky shoals type habitat is not rare or unique habitat to the project area and the creation of the rocky shoals type habitat is rarer within the study area and create valuable habitat for aquatic species.

No impact to the downstream habitat is expected to occur because of a release of sediment. Sediment behind the dam will not be removed as part of this project. It will serve as the base for the fish passage and rocks and gravel will be placed over the existing sediment. Borings will be taken to determine if the assumption that the material is suitable as a base is true during detailed design. In conjunction with the collection of borings, samples will be gathered for chemical analysis. The bypass channel will be dug and the gates constructed in the dry with erosion control measures in place. No sediment will be released during the demolition of the lock and dam. The base slab will remain in the riverbed and not disturbed.

3.6.4 **Wetlands**

3.6.4.1 Future Conditions with No Action Alternative:

With implementation of the NAA, there would not be any impacts to the existing wetlands within the study area as a result of induced inundation from the removal of the lock and dam however, there would be some impacts to riverine wetlands as a result of the construction of the fish passage. A narrow vegetated wetland fringe along approximately 672 ft of the Savannah River (Approximately 0.21 acres) and small forested wetland swale located along the proposed access road (approximately 0.02 acres). These impacts and mitigation for them are described in the SHEP 2012 FEIS and Appendix C.

3.6.4.2 Future Conditions with Alternative 1-1:

The majority of the wetlands immediately adjacent to the river between the NSBLD leading up to the Augusta shoals as through the city of Augusta is freshwater forested/shrub wetland and are classified as being temporary flooded: surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for the most of the season.

With implementation of Alternative 1-1, it is expected that the wetlands immediate adjacent to the river between the NSBLD leading up to the Augusta shoals as through the city of Augusta would continue to be temporarily flooded as it occurs during existing conditions. While it is expected that water levels may very slightly from the existing conditions as result of the creation of the fish passage structure, the overall composition of the wetlands will not change and therefore the plant and animal communities should not be impacted. The wetlands that are present will continue to be wetland that will be temporarily flooded for brief periods of time (from a few days to a few weeks) during the growing season it would just depend on how much water would be within the wetland that might change slightly. The water levels may also change slightly based on whether or not we are in the lower average flow events or in the higher average flow events. During the higher average flow events, it is expected that the water levels within the wetlands should remain relatively consistent to existing conditions. During the lower average flow events (such as during drought conditions), it is expected that the water levels will lower slightly from existing conditions but it should not change the composition of the wetlands because they are already only flooded temporarily, and only for days/weeks at a time.

The wetlands near the Augusta shoals are also temporarily flooded but have a slightly different classification. These wetlands have surface water that is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface. The water levels in this portion are the river are not expected to change as result of the Alternative 1-1 from what is seen as part of the existing conditions. As a result, the composition of these wetlands will not be altered and therefore will not impact the plant and animal communities.

With implementation of Alternative 1-1, there would not be any impacts to the wetland within the project area when compared to the NAA as a result of induced inundation or the need to construct an access road (wetland 2) however, there would be some impacts to riverine wetlands as a result of the construction of the fish passage. Table 23 presents the acres of wetlands impacted with each alternative in comparison of the NAA. Alternative 1-1 would have the least amount of impacts to wetlands as a result of construction of the fish passage structure.

Table 23: Acres of Wetland Impacts from construction		
Alternative	Length of Impact	Acres of Wetland Impacts
NAA	3,872 feet	0.21
1-1	251.36 feet	0.06
2-3	1430.86 feet	0.33
2-6a	1963.71 feet	0.45
2-6b	1347.89 feet	0.31
2-6c	1602.66 feet	0.37
2-6d	1795.88 feet	0.41
2-8	1973.8 feet	0.45

3.6.4.3 Future Conditions with Project Alternative 2-3:

With implementation Alternative 2-3, there would not be any impacts to the wetlands within the project area as a result of induced inundation. However, there would be some impacts to riverine wetlands as a result of the construction of the fish passage when compared to the NAA. Table 23 presents the acres of wetlands impacted with each alternative in comparison to the NAA. This alternative would have the same impact as the NAA of impacts to wetlands. As discussed in Section 3.6.4.2, the composition of wetlands within the project area will not be altered as a result of Alternative 2-3 and therefore will not impact the plant and animal communities.

3.6.4.4 Future Conditions with Project Alternative 2-6a:

With implementation of Alternative 2-6a, as a result of removing both lock walls and the removal of the dam gates and piers, and partial demolition of the dam foundation, impacts to wetlands within the study area are expected when compared to the NAA (Table 23). In addition there would be impacts associated with induced inundation which would cause an increase in flooding within the existing wetlands (**Table 24**) in the project area for the 50% ACE event when compared to the NAA:

Table 24: Wetland Inundations for Alternative 2-6a under a 50% ACE		
Wetland Type	**Inundated Area (acres)**	**Average Inundated Depth Increase (inches)**
Freshwater Forested/Shrub Wetland	403	2.16
Lake	38	2.28
Riverine	2	1.92
Freshwater Emergent Wetland	103	1.80

Freshwater Pond	69	2.04

In summary, a flow of 30,000 cfs has a 50/50 chance of occurring in any single year and that flow would cause the wetlands within the project area to be flooded a little bit under existing conditions. With Alternative 2-6a, those wetlands are still flooded once every two years, but they're flooded by the additional depths listed in Table 24.

The majority of the wetland impacts from inundation will occur within the Freshwater Forested/Shrub Wetland and Freshwater Emergent Wetland sections within the project area. The water regimes for these wetland areas are not expected to change as a result of Alternative 2-6a and it is expected that the frequency of the additional water depth would not occur enough that would cause long term or irreparable damage to the existing wetlands within the project area. This alternative would have slightly more impact to wetlands compared to the NAA. As discussed in Section 3.6.4.2, the composition of wetlands within the project area will not be altered as a result of Alternative 2-6a and therefore will not impact the plant and animal communities.

3.6.4.5 Future Conditions with Alternative 2-6b:

With implementation of Alternative 2-6b, there would be no inundation impacts to wetlands within the project area. Table 23 presents the acres of wetlands directly impacted with each alternative in comparison to the NAA. This alternative would have slightly more impact than the NAA of impacts to wetlands as a result of construction of the fish passage. As discussed in Section 3.6.4.2, the composition of wetlands within the project area will not be altered as a result of Alternative 2-6b and therefore will not impact the plant and animal communities.

3.6.4.6 Future Conditions with Alternative 2-6c:

With implementation of Alternative 2-6c, there would be no inundation impacts to wetlands within the project area. There would be some impacts to the existing wetlands as a result of a small construction footprint. Table 23 presents the acres of wetlands directly impacted with each alternative in comparison to the NAA. This alternative would have slightly more impact to wetlands than the NAA. As discussed in Section 3.6.4.2, the composition of wetlands within the project area will not be altered as a result of Alternative 2-6c and therefore will not impact the plant and animal communities.

3.6.4.7 Future Conditions with Alternative 2-6d:

With implementation of Alternative 2-6d, there would be no inundation impacts to wetlands within the project area. There would be some impacts to the existing wetlands as a result of a small construction footprint needed. Table 23 presents the acres of wetlands directly impacted with each alternative in comparison to the NAA. This alternative would have slightly more impact to wetlands than the NAA. These impacts are very similar to the impacts covered by SHEP 2012 FEIS and Appendix C. Appendix C3 of this document has the updated 404(b)(1) Analysis. As discussed in Section

3.6.4.2, the composition of wetlands within the project area will not be altered as a result of Alternative 2-6d and therefore will not impact the plant and animal communities.

3.6.4.8 Future Conditions with Project Alternative 2-8:

With implementation of Alternative 2-8, while there would not be any impacts to existing wetlands within the project area as a result of induced flooding from the removal of the lock and dam. There would be some impacts to the existing wetlands as a result of a small construction footprint needed. Table 23 presents the acres of wetlands directly impacted with each alternative in comparison to the NAA. This alternative would have slightly more impacts to wetlands than the NAA. As discussed in Section 3.6.4.2, the composition of wetlands within the project area will not be altered as a result of Alternative 2-8 and therefore will not impact the plant and animal communities.

3.6.5 Terrestrial Resources and Wildlife

3.6.5.1 Future Conditions with No Action Alternative:

With implementation of the NAA, there would be minor effects on terrestrial and wildlife resources in the study area with approximately 11 acres of upland and agricultural habitat being converted to fish passage habitat as a result of the fish passage design. It is expected that there will other available upland and agriculture areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5.

3.6.5.2 Future Conditions with Project Alternative 1-1:

With implementation of Alternative 1-1, there would be minor effects on terrestrial and wildlife resources in the study area when compared to the NAA with approximately 5.53 acres of the upland habitat being converted to fish passage habitat as a result of the fish passage design. It is expected there will other available upland and park habitat areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5.

3.6.5.3 Future Conditions with Project Alternative 2-3:

With implementation of Alternative 2-3, there would be negligible effects on terrestrial and wildlife resources in the study area when compared to the NAA with approximately 0.5 acres of existing upland/park habitat that would be converted to fish passage habitat as a result of the fish passage design. It is expected that there will other available upland and park habitat areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5.

3.6.5.4 Future Conditions with Project Alternative 2-6a:

. With implementation of Alternative 2-6a, there would be negligible effects on terrestrial and wildlife resources in the study area when compared to the NAA with approximately 0.5 acres of existing upland/park habitat being converted to fish passage habitat as a result of the fish passage design. It is expected that there will other available upland/park habitat areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5.

3.6.5.5 Future Conditions with Project Alternative 2-6b

With implementation of Alternatives 2-6b, there would be negligible effects on terrestrial and wildlife resources in the study area when compared to the NAA with approximately 0.5 acres of existing upland/park habitat being converted to fish passage habitat as a result of the fish passage design. It is expected that there will other available upland/park habitat areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5.

3.6.5.6 Future Conditions with Project Alternative 2-6c-d

With implementation of Alternatives 2-6c-d, there would be negligible effects on terrestrial and wildlife resources in the study area when compared to the NAA with approximately 0.5 acres of existing upland/park habitat being converted to fish passage habitat as a result of the fish passage design. It is expected that there will other available upland/park habitat areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5

3.6.5.7 Future Conditions with Project Alternative 2-8:

With implementation of Alternatives 2-8, there would be negligible effects on terrestrial and wildlife resources in the study area when compared to the NAA with approximately 0.5 acres of existing upland/park habitat being converted to fish passage habitat as a result of the fish passage design. It is expected that there will other available upland/park habitat areas within the project area for the terrestrial and wildlife resources to use for habitat as described in Section 2.2.5

3.6.6 Threatened, Endangered and Protected Species

Under the Endangered Species Act (ESA), the primary species of concern for the fish passage are the shortnose and Atlantic sturgeon. Consultation for these species in regards to the fish passage is covered under SHEP.

On October 13, 2017, the USACE received an amendment to the NMFS Biological Opinion for the SHEP which satisfies USACE Savannah District's requirements under Section 7. Within the amendment, under Reasonable and Prudent Measure 9.3.2.1 it states "To protect spawning sturgeon and their offspring, no in-water construction will be performed at the downstream entrance of the fish passage channel during the late winter/spring spawning period through the early summer larval period." Term and

Condition 3 for sturgeon states “To minimize effects to spawning sturgeon and their offspring, no in-water fish passage construction downstream of the NSBLD shall occur between August 15 and April 15 of any year.” Clarification is required on where the “no in-water work” line begins because the entrance to the fish passage in some designs that are being considered may be downstream of the dam.

In addition, USACE will adhere to the following protective measures during construction of the fish passage to reduce possible impacts to sturgeon during construction activities and maintain critical habitat for Atlantic sturgeon.

Protective Measures:

a) Appropriate erosion and turbidity controls shall be used wherever necessary to limit sediments from entering the water.
b) Dredging and construction shall be conducted with minimum environmental impact.
c) No construction debris shall be allowed to enter the water.
d) To ensure passage throughout the habitat, adequate pathways must be provided at all times so that fish can migrate between foraging habitat and spawning habitat; no blocking of the channel is allowed.
e) Normal water flows must be maintained throughout the construction areas.
f) USACE shall not reduce flows during spring/early summer to aid in the construction of the fish passage.

Additional information about the amended Biological Opinion for the SHEP which includes discussion on the Fish Passage feature from October 2017 can be found in Appendix D3.

In August 2017, NOAA finalized a rule that designated the Savannah River as critical habitat for Atlantic sturgeon. NOAA’s designation of critical habitat for Atlantic sturgeon included four physical and/or biological features (PBF) essential to the conservation of the species and was intended to increase the number of adults spawning, then protect the eggs/larvae/juveniles they produce so those individuals survive to subsequent life stages and ultimately spawn themselves.

In December 2017, the USACE provided NMFS with a Section 7(a)(2)/7(d) Evaluation to re-initiate consultation on the SHEP (which includes the Fish Passage project at NSBLD) as a result of NOAA’s August 17, 2017, final rule designating the Savannah River as critical habitat for Atlantic sturgeon and consultation is currently ongoing. A copy of the Section 7(a)(2)/7(d) Evaluation can be found in Appendix C2.

The analysis concludes that the proposed fish passage structure at NSBLD “May Affect but Not Adversely Modify" critical habitat for Atlantic sturgeon for the Hard Substrate PBF for all three life stages of the Atlantic sturgeon. As a result of the construction of the fish passage at the NSBLD, the gravel bar downstream of NSBLD may spread out or move to a new location by the change in flow direction changing the location of where potential substrate is available for the settlement/development of fertilized eggs as well

as the growth and development of juveniles. This habitat will not be lost, however there is the potential it could be moved slightly as a result of the change in water flow as a result of the construction of the fish passage structure.

The analysis also concluded that the fish passage structure at the NSBLD will not impact the juvenile life stage of critical habitat for the salinity gradient and soft substrate PBF for Atlantic sturgeon. The fish passage feature will occur in habitat where salinities are less than 0.5 ppt, which is not preferable habitat for juvenile foraging and physiological development as they prefer water where the salinities range from 0.5 to 30 ppt.

The construction of the fish passage structure at the NSBLD will not impact critical habitat for juvenile Atlantic sturgeon for the unobstructed water depth PBF since there are no designs that would cause obstructions within the 0.5 to 30 ppt range. It was determined that implementation of the fish passage feature at NSBLD will remove an obstruction that has prevented Atlantic sturgeon from passing between the river mouth and their historic spawning sites. It also important to note that the area above the NSBLD was not designated as critical habitat.

Also concluded in the analysis is that the construction of the fish passage structure at NSBLD has the potential to impact the water quality PBF for larval Atlantic sturgeon. The USACE will follow best management practices during the construction of the fish passage structure to reduce impacts to critical habitat for Atlantic sturgeon during all life stages, especially during the spawning period, as discussed above with the measures in the BO.

The conclusion from the Section 7(a)(2)/7(d) Evaluation analysis stated that the protective measures that will be used during the construction of the fish passage at the NSBLD should reasonably protect Atlantic sturgeon and not jeopardize their critical habitat. Once NOAA NMFS has evaluated this analysis with regards to critical habitat for Atlantic sturgeon, USACE Savannah District may receive another amended Biological Opinion for the overall SHEP, which includes the Fish Passage feature.

Appendix C pages 65- 81 (Compensation), and page 128 (Selected Plan) https://www.sas.usace.army.mil/Portals/61/docs/SHEP/Reports/EIS/Appendix%20C%20Mitigation%20Planning%20SHEP%20FINAL%20EIS.pdf) of the 2012 Final SHEP EIS describes the mitigation planning process. Table 24 of that document presents the benthic substrate in the Augusta Shoals, the Suitability index (SI) and the Frequency of that substrate. All alternatives provide equal access to these substrates. All alternative discussed in this SEA provide the same output (mitigation lift).

In addition, all fish passage designs being evaluated will open up additional miles of river to state listed species such as robust redhorse allowing for an increase in riverine spawning habitat and diversify any potential genetically isolated populations

3.6.6.1 Future Conditions with No Action Alternative:

The intent of the fish passage feature is to improve access to natural upstream spawning habitat that has been blocked for several decades by the NSBLD structure. With implementation of the NAA, the construction and operation of the fish passage around the NSBLD was initially designed to benefit shortnose sturgeon. As the Atlantic sturgeon was being listed as a protected species, the design parameters were reviewed to ensure the structure would accommodate the larger Atlantic sturgeon. NOAA concluded that the design in the FEIS would be sufficient for passage of Atlantic sturgeon as well as shortnose sturgeon thereby meeting the mitigation requirement from the SHEP. NOAA has provided information to USACE that the not in-channel fish passage structure will likely lead to delay of immigrating diadromous fish, in particular shortnose and Atlantic sturgeon, because the entrance to the fish passage structure is approximately 450 feet downstream from the existing gate system of the dam. Therefore, during high flow conditions, false attraction to the operating gates will lead immigrating fish to the dam and not the fish passage structure. The length of the delay was not determined and would require additional study and modeling effort. A short delay would not impact spawning, but a long delay could cause the individual to not reach the spawning area during the prime spawning window.

3.6.6.2 Future Conditions with Alternative 1-1:

Regarding Alternative 1-1, in comparison to the NAA, NOAA has provided information to USACE that the partial width fish passage structure will likely lead to delay of immigrating diadromous fish, in particular shortnose and Atlantic sturgeon because the entrance to the fish passage structure is approximately 450 feet downstream from the existing gate system of the dam. Therefore, during high flow conditions, false attraction to the operating gates will lead immigrating fish to the dam and not the fish passage structure thereby causing a migratory delay. The length of the delay was not determined and would require additional study and modeling effort. A short delay would not impact spawning, but a long delay could cause the individual to not reach the spawning area during the prime spawning window. While the fish passage structure design of Alternative 1-1 will function as a way for fish to transverse up and down the river, it is not as effective as other designs being evaluated. Per the conclusion in the Section 7(a)(2)/7(d) determination this alternative would be the most likely one to cause the downstream gravel bar to shift locations.

3.6.6.3 Future Conditions with Alternative 2-3:

Regarding Alternative 2-3, in comparison to the NAA, NOAA has provided information to USACE that this design is the most favorable alternative design being evaluated for shortnose and Atlantic sturgeon and does not anticipate any major fish passage issues with the concept. It is anticipated that Alternative 2-3 design will result in fewer impacts on existing habitat, no false attraction, and will likely pass the full suite of diadromous species.

3.6.6.4 Future Conditions with Alternative 2-6a:

Regarding Alternative 2-6, in comparison to the NAA, NOAA has provided information to USACE that this design is the second most favorable alternative design being evaluated for shortnose and Atlantic sturgeon and does not anticipate any major fish passage issues with the concept. Like alternative 2-3, we anticipate that proper design of this concept will result in no major fish passage issues. However, the floodplain bench could result in fish stranding during high flow events if not properly designed. During flood events, we assume that most fish species find refugia to avoid spending excessive energy during the high flow event. The proposed floodplain bench may prove to be an attractive refugia spot for diadromous fish. As floodwaters recede, safe egress out of the floodplain is essential to avoid mortality events. In coordination with NMFS engineer the interface between the floodplain bench and the fish passage structure will be designed to ensure that there are not any mortality events as a result of the fish passage design. This also includes a slope built into the floodplain bench from the upstream inland corner downstream riverside.

3.6.6.5 Future Conditions with Alternative 2-6b-d:

Regarding Alternatives 2-6b-d, in comparison to the NAA, NOAA has provided information to USACE that the design of these alternatives could be just as beneficial as Alternative 2-6a. The floodplain bench design for each of the alternatives has the potential to enhance/create additional off channel habitat for sturgeon and other fish species in addition to the fish passage structure itself. The biggest issue to address would be to avoid fish stranding when the water recedes from high flow events and that the fish can have safe egress in and out of the floodplain. USACE believes that the way Alternatives 2-6b-d will be designed, the water from the floodplain bench should travel downstream thereby directing the fish to the main channel and should not create any disconnect or ponding issues. In coordination with NMFS engineer the interface between the floodplain bench and the fish passage structure will be designed to ensure that there are not any mortality events as a result of the fish passage design. This also includes a slope built into the floodplain bench from the upstream inland corner downstream riverside.

3.6.6.6 Future Conditions with Alternative 2-8:

Regarding Alternative 2-8, in comparison to the NAA, NOAA has provided information to USACE that this design is the third most favorable alternative design being evaluated. The diversion channel provides refuge for predators who may take advantage of migrating fish who just swam up the fish passage structure. In addition, when operated, the gates will provide a false attraction flow that may disorient migrating fish. The length of the delay was not determined and would require additional study and modeling effort. A short delay would not impact spawning, but a long delay could cause the individual to not reach the spawning area during the prime spawning window. Though neither of these issues are likely major problems, compared to alternatives 2-3 and 2-6, the fish passage design of Alternative 2-8 is less enticing from a fish passage perspective.

3.6.7 **Air Quality**

3.6.7.1 Future Conditions with No Action Alternative and Project Alternatives 1-1, 2-3, 2-6 a-d, and 2-8:

With all of the alternatives being considered, there would be minor temporary dust generation from vehicles driving over unpaved areas during construction of the proposed alternatives and there would also be minimal temporary impacts from vehicle emissions during the construction activities. However, there are no more than minor impacts anticipated from these activities. Construction of the proposed alternatives at the proposed site would follow all federal, state, local regulations and applicable policies for road and building construction. Operation and maintenance is not expected to result in any adverse air quality impacts.

There would not be any new point sources of air pollution created and no additional non-point sources would be expected from operation of the proposed alternative. Since Richmond County is currently in attainment for the NAAQS for all criteria pollutants, the construction and operation of the proposed alternatives would not be expected to contribute to a change in this designation.

3.6.8 **Water Quality**

The anticipated impacts to water quality as result of the alternatives being evaluated are expected to be temporary and minor in nature. The 404(b)(1) analysis for the draft recommended plan can be found in Appendix C-3. Based on the determinations made in this Section 404(b)(1) evaluation, the proposed project is still consistent with applicable state water quality standards as described in SHEP 2012 FEIS. Implementing the proposed action would not cause or contribute to degradation of the waters of the United States. The 401 Water Quality Certificate for the SHEP includes relevant best management practices to minimize impacts to water quality within the project area.

3.6.8.1 Future Conditions with No Action Alternative and Project Alternatives 1-1:

The No Action Alternative along with Alternative 1-1 would temporarily increase turbidity downstream during construction of the rock weir however after construction, there would be no adverse impacts on turbidity, sedimentation, or erosion. Some minor long term beneficial impacts to water quality would occur from implementing the rock weir by increasing dissolved oxygen levels within the area.

3.6.8.2 Future Conditions with Project Alternatives 2-3, 2-6a-d, and 2-8:

With implementation of Project Alternatives 2-3, 2-6, 2-6b, and 2-8, short term water quality effects would result from the removal of the lock and dam structure. In comparison to the NAA, the demolition phase of the removal would increase sedimentation and turbidity in the areas downstream from the study area. The effects of the lock and dam demolition would only be present until the removal operation is complete.

Sediment behind the dam will not be removed as part of this project. It will serve as the base for the fish passage and rocks and gravel will be placed over the existing sediment. Borings will be taken to determine if the assumption that the material is suitable as a base is true during detailed design. In conjunction with the collection of borings, samples will be gathered for chemical analysis.

The restoration of the free-flowing river with the fish passage weir structure, as opposed to the current pooled water condition which currently exists in the NSBLD area, would result in increased dissolved oxygen concentrations and lower water temperatures during the summer. Increased dissolved oxygen concentrations would be particularly apparent in the restored portions of the project area where the dam currently exists which currently provides no re-aeration benefits under the existing pooled condition.

3.6.9 **Cultural Resources**

3.6.9.1 Future Conditions with No Action Alternative

The NAA would have an adverse visual impact on the NRHP-eligible NSLBD structure. Consultation conducted in 2012 with the Georgia and South Carolina SHPOs determined that construction of the fish passage itself would have an indirect, yet visual effect on the historic structure's viewshed (Appendix D). The creation of the diversionary channel would change the surrounding landscape, permanently altering the public's concept of how the dam was designed to function. A Memorandum of Agreement (MOA) with the Georgia and South Carolina SHPOs and interested parties would be required to mitigate the adverse effect. Historic American Engineering Record (HAER) documentation and interpretative signage were discussed as possible mitigation measures.

Consultation also determined that the alterations to the gates and sills required for proper function of the fish passage would be negligible and would not be considered an adverse effect to the architectural or historical integrity of the structure.

No other historic properties would be affected as the existing pool elevation and operations would remain the same.

3.6.9.2 Future Conditions with Alternative 1-1

Implementation of Alternative 1-1 would have an adverse impact on the NRHP-eligible NSBLD structure as the removal of the lock chamber would adversely affect the integrity

of the structure, altering the appearance and functionality of the structure. Construction of the fish passage within the lock chamber would also cause an adverse effect. Initial Section 106 consultation with the Georgia and South Carolina SHPOs regarding adverse impacts to the structure resulted in a determination that execution of an MOA would be necessary to mitigate adverse effects. HAER documentation and an interpretive component (i.e., signage, exhibit, etc.) would be possible mitigation measures. The MOA would be coordinated with the Georgia and South Carolina SHPOs and any interested parties.

No historic properties located in the floodplain 0.5 miles downstream of the dam or upstream to the 13th Street Bridge would be affected by changing water pool elevations caused by the implementation of Alternative 1-1. No sites would be subject to bank line recession or increased access nor exposure that could result in vandalism or artifact looting. Water velocities would not change drastically so as to affect the piers of the two historic railroad bridges downstream of downtown Augusta.

Hydrologic modeling has determined that the training wall and associated navigation features would not be exposed by lower water levels nor would the features pose hazards to any recreational watercraft users. The most common motor boats typically seen on the river include roundabouts, pontoons, bass boats, and ski boats which can operate with 2 feet of water depth. There would be sufficient water depth for these common watercraft to operate safely without impacting the navigation feature with their motors or vessels.

A Phase I archaeological investigation of the USACE-owned 50-acre tract would be required to identify and evaluate historic properties prior to construction activities and transfer to a non-federal entity. Mitigation of any NRHP-eligible archaeological sites would be conducted in accordance with the 2012 SHEP PA.

3.6.9.3 Future Conditions with Alternatives 2-3, 2-6a-d, and 2-8

With implementation of Alternatives 2-3, 2-6a-d, and 2-8, the NRHP-eligible NSBLD structure would be adversely affected as the alternatives would necessitate demolition of the entire NSBLD structure (lock chamber, lock wall, dam, gates, and operation building) down to the foundation. None of the structure would remain visible above the waterline. Execution of a MOA with the Georgia and South Carolina SHPOs and any interested parties would be required to mitigate the adverse effect. HAER documentation and an interpretative component (i.e., signage, exhibit, etc.) would be possible mitigation measures. A copy of the MOA is included in Appendix C.

No historic properties located in the floodplain 0.5 miles downstream of the dam or upstream to the 13th Street Bridge would be affected by changing water pool elevations caused by the implementation of Alternatives 2-3, 2-6a-d, or 2-8. No sites would be subject to bank line recession or increased access nor exposure that could result in vandalism or artifact looting. Water velocities would not change drastically so as to affect the piers for the two historic railroad bridges.

Water depths over the training wall would be lower than the existing level for all of the alternatives that require demolition of the structure, except Alternatives 2-6a and 2-8. Lower water elevations that would result for Alternatives 2-3, and 2-6b-d would create potential hazards to recreational watercraft due to areas that would have less than 2 feet of water over the training wall. These areas would be located approximately 1,000 feet upstream of the 5th Street Bridge, at the 5th Street Bridge and approximately 3,000 feet downstream of the 5th Street Bridge. While not exposed above the water, these areas would not have the needed clearance for boaters. USACE would place buoys and post signs to warn boaters of the potential hazards in order to avoid direct impacts to the resource. No additional cultural investigations such as archival research or diver investigations would be conducted as the impacts would be mitigated through avoidance. The other possible navigation features identified in the bathymetric survey would not be affected by lower water levels.

Cultural resources investigations of the USACE-owned 50-acre tract would be the same as detailed in Alternative 1-1. Archaeological investigations would also be required beyond the USACE-owned tract as the project footprint would extend to an adjacent privately owned parcel. A new boat ramp would be required for alternatives 2-6a-d and 2-8 and archaeological investigations would be conducted of that area as well. Mitigation of NRHP-eligible archaeological sites would be conducted in accordance with the 2012 SHEP PA.

3.6.10 **Noise**

3.6.10.1 Future Conditions with No Action Alternative and Project Alternatives 1-1, 2-3, 2-6a-d, and 2-8:

The site of the proposed activity is in a sparsely populated area. The project would generate additional noise during the construction activities during daytime hours. However, no long-term impacts are expected from the increase in noise levels generated by the proposed project alternatives.

3.6.11 **Recreation**

Impacts on Boat Docks in NSBLD Pool

Table 25 displays the total number of docks by impact zone for each alternative based on flows at 5,000 cfs. There are five impact zones: no impact; minor impact; moderate impact; high impact; and adverse impact. For more details see Appendix G.

Table 25: Total Number of Docks by Impact Zone for Each Alternative (5,000 cfs)

Impact Zone	Depth Below Dock (feet)	NAA SHEP Plan A	Alt 1-1	Alt 2-3	Alt 2-6a	Alt 2-6b	Alt 2-6c	Alt 2-6d	Alt 2-8

No Impact	=>3.5	140	136	124	134	124	125	127	136
Minor Impact	<3.5 and =>3	7	2	2	2	2	4	6	2
Moderate Impact	<3 and => 2.5	5	8	4	4	4	4	1	3
High Impact	<2.5 and =>2	4	3	3	6	3	3	3	7
Adverse Impact	< 2	5	12	28	15	28	25	24	13

Table 26 displays the change in the number of docks by impact zone for each alternative from the Existing Condition at 5,000 cfs.

Table 26: Change in Number of Docks Impacted by Zone for Each Alternative in Comparison to Existing Condition (at 5,000 cfs)

Impact Zone	Depth Below Dock	NAA SHEP Plan S	Alt1-1	Alt2-3	Alt2-6a	Alt2-6b	Alt2-6c	Alt2-6d	Alt2-8
No Impact	=>3.5	0	-4	-16	-6	-16	-15	-13	-4
Minor Impact	<3.5 and =>3	-1	-6	-6	-6	-6	-4	-2	-6
Moderate Impact	<3 and => 2.5	0	3	-1	-1	-1	-1	-4	-2
High Impact	<2.5 and =>2	0	-1	-1	2	-1	-1	-1	3
Adverse Impact	< 2	1	8	24	11	24	21	20	9

3.6.11.1 No Action Alternative – SHEP Plan at 5,000 cfs

For the NAA at 5,000 cfs, one additional dock would have less than two feet of water depth below the dock (Table 25).

3.6.11.2 Alternative 1-1, Retain Dam with Georgia-side Fish Passage at 5,000 cfs

Alternative 1-1, Retain Dam with Georgia-side Fish Passage, includes adverse impacts to eight additional docks in comparison to the existing condition at 5,000 cfs.

3.6.11.3 Alternative 2-3, Fixed Weir at 5,000 cfs

Alternative 2-3, Fixed Weir, includes adverse impacts to 24 additional docks in comparison to the existing conditions at 5,000 cfs.

3.6.11.4 Alternative 2-6a, Fixed Weir with Floodplain at 5,000 cfs

Alternative 2-6a, Fixed Weir with Floodplain, includes adverse impacts to 11 additional docks in comparison to the existing conditions at 5,000 cfs.

3.6.11.5 Alternative 2-6b, Fixed Weir with Dry Floodplain at 5,000 cfs

Alternative 2-6b, Fixed Weir with Dry Floodplain, includes adverse impacts to 24 additional docks in comparison to the existing conditions.

3.6.11.6 Alternative 2-6c, Fixed Weir with Dry Floodplain at 5,000 cfs

Alternative 2-6c, Fixed Weir with Dry Floodplain, includes adverse impacts to 21 additional docks in comparison to the existing conditions.

3.6.11.7 Alternative 2-6d, Fixed Weir with Dry Floodplain at 5,000 cfs

Alternative 2-6d, Fixed Weir with Dry Floodplain, includes adverse impacts to 20 additional docks in comparison to the existing conditions.

3.6.11.8 Alternative 2-8, Gated Bypass Channel at 5,000 cfs

Alternative 2-8, Gated Bypass Channel, includes adverse impacts to 9 additional docks in comparison to the existing conditions.

To maintain a privately owned dock in the Federal navigation channel requires a Department of the Army permit to comply with Section 10 of the Rivers and Harbors Act of 1899. Boat docks in the study area are largely unpermitted. Property owners should contact the USACE Regulatory office in their state to apply for a permit. The implementation of the fish passage does not interfere with the continued general use of boat docks including the impacted docks if extended and permitted.

Special Events

3.6.11.9 Future Conditions with No Action Alternative and Project Alternatives 1-1, 2-3, 2-6a-d, and 2-8:

The Savannah River Basin Water Control Manual allows for temporary deviations if approved by the district commander to increase flows from J. Strom Thurmond to meet water surface elevations required for the special events except when in drought contingency operations and flood conditions. As a result, the Ironman 70.3 and Head of the South Regatta would not be adversely impacted by any of the alternatives outside of periods of drought and flood.

3.6.12 **Aesthetics**

3.6.12.1 Future Conditions with No Action Alternative and Alternative 1-1:

The NAA as well as Alternative 1-1 would have slight improvements to aesthetic quality by repairing a debilitated structure in an advanced state of disrepair. Short term adverse impacts would be restricted to short term impacts during construction activities during daytime hours during construction of the project.

3.6.12.2 Future Conditions with Project Alternatives 2-3, 2-6a-d, and 2-8:

Alternatives 2-3, 2-6, 2-6b, and 2-8 would be very beneficial by removing a large man made concrete structure and restoring the river to a more natural appearance. The rock weir would also create a more aesthetically pleasing view of the river channel. The

overall impact would be an improvement to aesthetics. Short term adverse impacts would be restricted to short term impacts during daytime hours during construction of the project.

3.6.13 **Water Supply**

The analysis considered the NAA, Alternative 1-1, Alternative 2-6a, Alternative 2-6b, Alternative 2-6c, and Alternative 2-6d expected pool levels. The expected pool levels for Alternatives 2-3 and 2-8 are essentially identical to Alternatives 2-6b and 2-6a respectively. Therefore, Alternatives 2-3 and 2-8 were not modeled. Table 27 lists the projected pool elevations evaluated for each alternative.

Table 27: NSBLD Pool Elevations for Fish Passage Alternatives At Intakes

Location	Pool Elevation (ft NGVD29) @3600 cfs								
	Existing	NAA	Alt 1-1	Alt 2-3	Alt 2-6a	Alt 2-6b	Alt 2-6c	Alt 2-6d	Alt 2-8
NSBLD	114.0	113.5	112.4	108.7	111.8	108.7	109.6	110.5	111.9
Potash/Fibrant/ et al.	114.2	113.9	112.8	109.9	112.3	109.9	110.6	111.3	112.4
SCE&G	114.3	114.0	112.9	110.2	112.5	110.1	110.7	111.4	112.5
Kimberly Clark	114.3	114.0	112.9	110.2	112.5	110.1	110.7	111.4	112.5
Hicks Raw Water	114.4	114.1	113.1	110.9	112.7	110.9	111.3	111.9	112.8
City of North Augusta	114.7	114.5	113.7	111.9	113.3	111.9	112.2	112.6	113.3

3.6.13.1 Future Conditions with No Action Alternative and Project Alternatives 1-1, 2-6a, 2-6d, and 2-8:

The analysis concluded that no water users are adversely affected by any of these alternatives. A simulation of alternative 2-6d is described in the engineering appendix. The simulation was coordinated with water supply users confirmed no impacts to water supply users.

3.6.13.2 Future Conditions with Project Alternatives 2-3, 2-6b, and 2-6c:

The analysis concluded that only two water users are adversely affected and would require proposed modifications. Table 28 details which Alternative Pool Elevations were identified in the analysis that would require proposed modifications.

Table 28: Proposed Water Users Requiring Modifications

Water User	Alternative Pool Elevations that Require Pump Station Modifications
City of Augusta	Alternative 2-3, Alternative 2-6b, Alternative 2-6c
Kimberly Clark	Alternative 2-3, Alternative 2-6b

City of Augusta Proposed Modifications:

The hydraulic analysis for the City of Augusta Pump Station concluded that the following modifications would need to be made to their existing system for Alternative 2-3, Alternative 2-6b, and Alternative 2-6c, and recommended modifications for Alternative 2-6d:

▪ Installation of a new vacuum priming system (two 10-hp priming pumps, control panel, 240-gallon vacuum tank) and appurtenances in the existing raw water pump station building and connection to the existing 6-inch vacuum piping stub-outs.
▪ Installation of a new concrete pad (5-foot by 8-foot by 4-inch thick) on existing building slab to support the vacuum priming system.
▪ Installation of a new 480-volt MCC bucket with a 60-amp, 3-pole circuit breaker and associated conduit and wire to the new vacuum priming system.

The conceptual cost estimate to implement these modifications totaled to $228,000.

Kimberly Clark Proposed Modifications:

The hydraulic analysis for the Kimberly Clark pump station concluded that the following modifications would need to be made to their existing system for Alternative 2-3 and Alternative 2-6b:

▪ Removal of the two existing 300-hp vertical turbine Worthington model pumps and appurtenances and demolition of pump pedestals.
▪ Replacement of the two existing Worthington model pumps with two vertical turbine Goulds model pumps that have similar hydraulic characteristics and electrical demand.
- Replacement shall include motors, pedestals, suction column, bowl assembly, and all appurtenances required for complete operation.

The conceptual cost estimate to implement these modifications totaled to $925,671.

3.6.14 Environmental Justice

3.6.14.1 Future Conditions with No Action Alternative and with the Action Alternatives 1-1, 2-3, 2-6b, 2-6c, 2-6d, 2-8

There would be no disproportional direct, or indirect impact to trigger an Environmental Justice issue. There would be no additional flooding of any community. Subsistence fisherman would be able to fish along the rocked edge of the river.

3.6.14.2 Future Conditions with the Action Alternatives 2-6a

There would be no disproportional direct, or indirect impact to trigger an Environmental Justice issue. Subsistence fisherman would be able to fish along the rocked edge of the river. The properties that could be flooded are not part of an Environmental Justice community

3.6.15 Hazardous Toxic and Radioactive Waste (HTRW)

Preliminary Assessment Screenings (PASs) are conducted to determine if hazardous or regulated substances were stored, released into the environment, are part of, affected by, or were disposed of on site. The purpose of a PAS is to develop sufficient information to adequately assess the health risk, define the nature, magnitude and extent of any environmental contamination and identify the potential environmental contamination liabilities associated with a real estate property acquisition, transfer or disposal transaction. PASs were performed routinely by USACE Savannah District personnel at the NSBL&D and records were maintained.

An asbestos, hazardous waste, and regulated building materials (HBM) survey was conducted on April 2017 by Timothy A. Jones who is an EPA Map trained asbestos inspector, chemist, and journeyman plumber. The reports are attached in an appendix to this document.

The following is a summary of the cumulative knowledge about HTRW in the project area.

Sediment

Sediment behind the dam will not be removed as part of this project. It will serve as the base for the fish passage and rocks and gravel will be placed over the existing sediment. Borings will be taken to determine if the assumption that the material is suitable as a base is true during detailed design. In conjunction with the collection of borings, samples will be gathered for chemical analysis.

Asbestos

The asbestos survey attempted to test all accessible suspect materials on the Georgia state side and made assumption of ACM for those items that were either not accessible or could not be destructively tested. These items historically contained asbestos greater than 1%. No inspection of structures on the South Carolina side of the dam were made. However, it can be assumed for this report, that any items similar to the Georgia side will have the same results.

Lead-based paint

A complete lead-based paint (LBP) survey was not conducted. The paint chips tested contained various levels of lead which is in keeping with the age of the structure and its proximity to water. Lead in the paint surfaces may vary during application and should not be construed to apply to all like-color painted surfaces. The presence of lead will require that demolition debris be tested for lead using the lead leachate method (TCLP). Painted metal was not tested for lead or any other metals, (neither the lead nor the repaint primer metal of choice, zinc). Metals removed from the site should be recycled. Metal-containing paints on metal items are not a recycling concern. However, OSHA's Lead in Construction standard does cover all levels and types of lead. This includes paint as well as plumbing joints, electrical joints, anchorage of metal into concrete and other components not accessible during the inspection. It is required by law (Hazard Communication Standard) that the contractors be made aware of the presence of LBP and lead-containing items.

Underground Storage Tanks (USTs)

A diesel fuel UST believed to have serviced the generator was removed by Anderson Columbia in the 1990's. An attempt was made to obtain the closure report for this tank. No leakage or spills were noted and there was no follow-up activity after the removal. No other USTs, oil water separators, or other subsurface items of potential contamination source were identified.

Aboveground Storage Tanks (ASTs)

One above ground diesel fuel tank of approximately 250 gallons serves the emergency generator. No signs of spillage or leakage have been reported.

Hydraulic Fluid

Approximately 500 gallons of hydraulic oil including three five-gallon containers are contained in the NSBLD. At this time there are no records that the hydraulic system fluids have been tested to determine whether the system is contaminated with PCBs. Due to the age of the structure, PCB-containing oils could have been used. Even if the fluids were changed out there is a potential for residual PCBs to have contaminated the new fluids. Analytical testing needs to be conducted.

Transformer

There is no record that the small transformer in an electrical cabinet has had its dielectric fluid tested for PCBs. This needs to be done to ensure that it is not contaminated with PCBs. The age of the transformer is not known and there are no visible tags on it.

Mercury vapor and florescent lights

A count of regulated lighting was conducted and is included in the attached Hazardous Building Materials Survey Report. These lights must be removed and

shipped for recycling or waste disposal under the Universal Waste Law. They cannot be demolished with the general building materials.

Antifreeze

Approximately 10 gallons of antifreeze is assumed to be in the emergency generator. It needs to be removed to be recycled or disposed of as a regulated waste prior to removal of the generator.

Refrigerant gas

One window air conditioner is present. It is assumed that it contains coolant fluid/gas. Its age is unknown. If present, the coolant must be safely removed before demolition.

Electronic Data Report (EDR)

A one-mile radius EDR was obtained for the target property identified as: New Savannah Bluff Lock and Dam, 1853 Lock and Dam Road Augusta, Georgia 30906. The EDR is contained in Appendix J – HTRW.

The findings of the EDR are discussed below.

The target property is listed as a Resource Conservation and Recovery Act (RCRA) Conditionally Exempt Small Quantity Generator (CESQG) of hazardous waste for Waste Code D008/ Waste Name: Lead. The target properties RCRA ID Number is: GAR000045997.

In 2013, the target property submitted a GA Tier 2 report for the storage of the chemical, Quintolubirc 822-300 Hydraulic Fluid. The maximum and average daily amount of the chemical report on site for 2013 was 18,326 pounds. No other finding were listed for the target property.

A check of Local/Regional Water Agency Records indicate that a United States Geological Survey (USGS) well is located one half to one mile west of the site. The well has a recorded depth of 220 feet. The well ID Number is: USGS40000262835. No other finding were identified within the one mile radius.

Lock Tenders Dwelling

The Lock Tenders Dwellings and the structures supporting the residence were all removed in the early 1980's. Four non-recreation buildings still remain in the area. According to Mr. Scott Hyatt (USACE Operations Project Manager, J. Strom Thurmond Project), the city of Augusta placed a mobile home on the site of the old houses when they took over the lock and park, and the well that furnished water to the Lock Tenders Dwellings was closed and the area was furnished with water from a municipal water supply.

3.6.15.1 Future Conditions with No Action Alternative and Project Alternatives 1-1, 2-3, 2-6a-d, and 2-8:

A Hazardous Building Material survey of NSBLD was conducted in April 2017. Material found during the survey included lead joints, lead-based paint, motor oil, and hydraulic oil. Disturbance of lead-based paint during construction/demolition must adhere to OSHA worker protection rules and other application state and federal regulations. A detailed discussion of the survey and its results can be found in the Hazardous Building Materials Survey of NSBLD dated April 2017 and can be found in Appendix J – HTRW.

An asbestos inspection and survey of NSBLD was also conducted in April 2017. Several samples of building materials were identified during the survey that contain or are assumed to contain asbestos, including roofing materials, flange gaskets, and exterior caulking. A detailed discussion of the survey and its results can be found in the Asbestos Survey of NSBLD dated April 2017 and can be found in Appendix J - HTRW.

In addition to these surveys discussed above, a site visit was performed and a Phase I HTRW Environmental Report is included in Appendix J - HTRW.

Construction and operation of the proposed alternatives is not be expected to result in any associated increase of hazardous waste generation at the site. Any HTRW materials identified in analysis will be reviewed for appropriate disposal measures.

3.6.16 Cumulative Impacts

Council on Environmental Quality regulations (40 CFR 150.7) require an analysis of the cumulative impacts resulting from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes these other actions. Cumulative impacts can result from individually minor, but collectively significant, actions. This section of the SEA addresses the cumulative effects arising from the Proposed Action when combined with other ongoing or proposed actions within in the Savannah River Basin near the study area.

Within the last decade or so, the next two dams located upstream of the NSBLD received new operating licenses from FERC. Provisions were included in their license agreements that if fish passage occurred at NSBLD, fish passage structures would also have to be installed at those dams. Providing fish passage at NSBLD would open up more than 20 miles of river to the next upstream dam at Augusta Shoals. But with passage at the other two dams included, it would effectively result in fish being capable of moving past Augusta Shoals and the SCE&G Stevens Creek Dam all the way to the J. Strom Thurmond Dam, located 36 river miles upstream of NSBLD.

There have also been some plans to build up recreational opportunities within the study area including looking at a proposal to create a Whitewater Park around the NSBLD. The Augusta Commission has recently looked into hiring a consultant to review and

evaluate the area around the NSBLD for the Whitewater Park that would allow folks from around the area experience the Savannah River.

There should be no cumulative effects on the evaluated environmental resources such as aquatic resources, wetlands, or water quality. There should be a positive cumulative impact on the endangered Atlantic and shortnose sturgeon.

Appendix L of the 2012 SHEP EIS (https://www.sas.usace.army.mil/Portals/61/docs/SHEP/Reports/EIS/Appendix%20L%20Cumulative%20Impacts%20Analysis%20SHEP%20FINAL%20EIS.pdf) has a detailed discussion of cumulative impacts for the SHEP including the impacts associated with the Fish Passage feature. The alternatives being evaluated will not alter that analysis and all of the alternatives will be impacted by community development and sprawl in the same way.

3.7 Plan Selection

Since the passing of the WIIN Act on December 16, 2016, the USACE modeled 33 alternatives to meet the intent of Congress as expressed in the WRDA 2016. After modeling 33 scenarios, they were evaluated using criteria based on specific objectives and constraints (as described in section 3.1.1.1). The USACE eliminated alternatives that demonstrated an increased risk of induced flooding for the 1 percent annual exceedance event and those that would not maintain pool levels sufficient for water supply and recreational activities. The time needed to acquire such parcels could delay the start of construction, and as a result, cause us to be out of compliance with the SHEP Biological Opinion Amendment 2 dated October 2017.

Four (4) action alternatives and several optimizations remained for final analysis (Table 29):

1) NAA SHEP 2012 Plan A, fish passage that goes around the NSBLD in-place on the South Carolina side;
2) Alternative 1-1, Repair lock wall and retain dam with Georgia Fish Passage;
3) Alternative 2-3, Fixed Crest Weir (107 feet NGVD29 or 106.2 feet NAVD88);
4) Alternative 2-6, Fixed Crest Weir with Floodplain Bench with various optimizations for weir height.
    a) Alternative 2-6a, Fixed Crest Weir with Floodplain Bench (110 feet NGVD29 or 109.2 feet NAVD88);
    b) Alternative 2-6b, Lowered Fixed Crest Weir with Dry Floodplain Bench (107 feet NGVD29 or 106.2 feet NAVD88);
    c) Alternative 2-6c, Lowered Fixed Crest Weir with Dry Floodplain Bench (108 feet NGVD29 or 107.2 feet NAVD88);
    d) Alternative 2-6d, Lowered Fixed Crest Weir with Dry Floodplain Bench (109 feet NGVD29 or 108.2 feet NAVD88);
5) and (8) Alternative 2-8, Fixed Crest Weir with Gated Bypass Channel (109 feet NGVD29 or 108.2 feet NAVD88).

Table 29: Final Analysis							
Alternatives	**Fish Passage[1]**	**Recreational Navigation**	**Recreation**	**Water Supply[2]**	**Flowage Easements**	**Total Score**	**Average Annual Cost**
No Action Alternative (NAA)	0	1	1	1	1	4	$3,570,000
1-1	0	1	1	1	1	4	$3,930,000
2-3	1	1	-1	0	1	2	$3,153,000
2-6a	1	1	0	1	0	3	$4,507,000
2-6b	1	1	-1	0	1	2	$3,646,000
2-6c	1	1	-1	1	1	3	$3,679,000
2-6d	1	1	0	1	1	4	$3,529,000
2-8	0	1	1	1	1	4	$6,721,000

[1]NAA, 1-1 and 2-8 were given a score of 0 because the risk of failure to reach the spawning ground during prime spawning season after a delay is an unacceptable risk.
[2]Modifications to mitigate for impacts to water supply intakes are included in the alternative cost estimates for 2-3, 2-6b, and 2-6c.

In compliance with the WRDA 2016 and HQ USACE guidance (Appendix H), the objective of this study is to meet the completeness and acceptability of SHEP mitigation ensuring the best possible way of passing endangered fish species in the most cost effective manner while maintaining the functionality of NSBLD pool for navigation, water supply, and recreation. The matrix shown in Table 29 was used to select the alternative(s) that best maintains recreational navigation, water supply, and recreation based on the criteria established in section 3.1.1. Fish passage evaluation criteria was established that assigned a "+1"rating to an action alternative if there would be successful migration without any delay. A "0" rating was given to an action alternative if there would be successful migration with a possible delay. A "-1" rating was given to an action alternative if fish would be unable to pass.

Alternatives 2-3, 2-6b, and 2-6c exhibited a rating of "-1" under recreation and; therefore, were eliminated from being selected as the recommended plan. Alternatives 2-3 and 2-6b also received a rating of "0" under water supply because both could potentially negatively impact two water supply intakes. The cost of modifications to the water supply intake infrastructure is included in the average annual cost described in Table 29. Additionally, by selecting a rating of "-1" for recreation contributes to the selection of an alternative with fewer impacts to boat docks.

Alternative 2-6a induces nuisance flooding requiring the purchase of flowage easements for approximately 100 parcels. For that reason, Alternative 2-6a received a flooding rating of "0". The cost associated with obtaining flowage easements is include in the average annual cost described in Table 29. The purchase of those parcel would increase the length of the project that would likely exceed the required start date of construction of January 2021 and be out of accordance with the completion date in the

SHEP Biological Opinion. Therefore, Alternative 2-6a was eliminated from being selected as the recommended plan. The time needed to acquire such parcels could result in non-compliance with the SHEP Biological Opinion Amendment 2 dated October 2017.

Alternative 1-1 and Alternative 2-8 are not the best ways to pass endangered fish because the features could create false attraction flows and delay or prevent passage to upstream spawning grounds. Hence, Alternative 1-1 and Alternative 2-8 received ratings of "0" for fish passage. Possible delays due to false attraction toward the inside corner of the NSBLD lock wall and adjacent dam for Alternative 1-1 and the flood bypass structure for Alternative 2-8 could occur. Those delays could delay or prevent fish from getting to the spawning grounds.

Alternative 1-1, 2-8, and Alternative 2-6d all measured equally on the selection matrix, thus a cost effectiveness analysis was performed. The average annual cost for both Alternatives 1-1 and 2-8 exceed the average annual cost of Alternative 2-6d because they include major rehabilitation at year 50 and annual operation and maintenance costs for Alternatives 1-1 and 2-8 are approximately 7 to 16 times greater than Alternative 2-6d. Therefore, Alternative 2-6d was the most cost-effective fish passage that best meets the objectives of the study.

Alternative 2-6d received the best ratings for passing endangered fish species, met Congressional intent, and met NEPA and ESA requirements. It also has a higher fixed crest weir and; hence, pool elevation than alternatives 2-3, 2-6b, and 2-6c. Although Alternative 2-6a has a higher fixed crest weir than Alternative 2-6d, it also would induce nuisance flooding and flowage easements for approximately 90 real estate parcels would need to be obtained. So while the alternative was not eliminated for flowage easements, the score was zero, and as a result, the alternative did not compete with the final three alternatives with optimal-scoring.

Related to the scoring of zero for flowage easements for 2-6a, flowage easements would be needed to maintain water levels during construction and when employing the use of cofferdams at the height of the recommended plan. Furthermore, the process of obtaining real estate flowage easements for federal projects from private landowners requires negotiation with the landowner and may require processing by the state and federal governments. The length of time expected for this transaction is estimated to take 36 months. If this report is approved in September 2019, contract award scheduled for fall 2020 would be delayed and risk compliance with the Biological Opinion.

The average annual cost for Alternative 2-6d was the lowest of the final, optimal-scoring alternatives 1-1 and 2-8, but it is not the least cost alternative. For these reasons, Alternative 2-6d was selected as the recommended plan.

Table C-1: Annualized Cost Summary

	Description	Alternatives Summary - 100 yr project life, 3.5% interest rate used to calculate annualized costs							
		SHEP Plan A	Alt 1-1_2% Slope	Alt 2-3_2% Slope	Alt 2-6a_2% Slope	Alt 2-6b_2% Slope	Alt 2-6c_2% Slope	Alt 2-6d_2% Slope	Alt 2-8_2% Slope
Initial Cost	04 Dams	$0	$0	$3,834,417	$3,834,417	$3,834,417	$3,834,417	$4,023,316	$4,802,926
	05 Locks	$29,907,405	$38,929,704	$6,890,306	$6,890,306	$6,890,306	$6,890,306	$6,937,586	$8,784,290
	06 Fish & Wildlife Facilities	$32,045,376	$30,673,831	$58,892,630	$91,838,168	$73,536,969	$75,599,723	$71,300,408	$98,229,248
	13 Pumping Plant	$0	$0	$1,581,447	$0	$1,581,447	$312,541	$442,767	$0
	15 Floodway Control and Diversion Structures	$0	$0	$0	$0	$0	$0	$0	$38,682,202
	18 Cultural Resources	$429,336	$709,182	$676,488	$644,274	$644,274	$644,274	$677,173	$665,652
	Construction Estimate Totals	***$62,382,116***	***$70,312,718***	***$71,875,287***	***$103,207,165***	***$86,487,413***	***$87,281,261***	***$83,381,250***	***$151,164,318***
	01 Land and Damages	$307,140	$31,875	$3,598,208	$4,727,819	$138,107	$138,107	$140,178	$0
	30 Planning, Engineering & Design	$2,809,403	$3,483,163	$3,554,546	$5,102,506	$4,274,921	$4,315,622	$4,124,359	$7,262,539
	31 Construction Management	$2,712,264	$3,797,448	$3,592,455	$5,160,471	$4,324,379	$4,364,127	$4,503,538	$7,354,337
	Project Cost Totals	***$68,210,923***	***$77,625,203***	***$82,620,497***	***$118,197,962***	***$95,224,820***	***$96,099,117***	***$92,149,324***	***$165,781,194***
	IDC	$2,711,800	$3,544,000	$3,622,200	$5,201,100	$4,358,400	$4,398,500	$4,202,200	$4,358,400
	Investment Cost	**$70,922,723**	**$81,169,203**	**$86,242,697**	**$123,399,062**	**$99,583,220**	**$100,497,617**	**$96,351,524**	**$170,139,594**
Annualized Cost	Investment Cost	$2,565,000	$2,935,000	$3,118,000	$4,462,000	$3,601,000	$3,634,000	$3,484,000	$6,152,000
	Adaptive Monitoring Costs	$0	$0	$0	$0	$0	$0	$0	$0
	Monitoring Costs	$0	$0	$0	$0	$0	$0	$0	$0
	O&M	$720,000	$710,000	$35,000	$45,000	$45,000	$45,000	$45,000	$320,000
	Major Rehab	$285,000	$285,000	$0	$0	$0	$0	$0	$249,000
	Total Annual Cost	**$3,570,000**	**$3,930,000**	**$3,153,000**	**$4,507,000**	**$3,646,000**	**$3,679,000**	**$3,529,000**	**$6,721,000**

4.0 Recommended Plan

The Recommended Plan is Alternative 2-6d; a 2% Slope, Fixed Crest Weir crest elevation of 108.2 ft NAVD 88 (109.0 NGVD29) with Floodplain Bench.

4.1 Plan Components

The scope of work for this SHEP project feature is to construct a fish passage at NSBLD. The design of the Alternative 2-6d, a fish passage with a fixed crest weir and a floodplain bench is currently at 15% concept level design. This plan consists of a fixed crest weir with a rock ramp sloping upstream from the existing dam location and a low-lying floodplain bench in the right overbank to provide additional flow conveyance. The lock and dam would be removed, including the foundation down to elevation 91.2 (NAVD88). The resulting concrete rubble is assumed to be hauled off and disposed of at a landfill facility for cost purposes, but could potentially be put in the scour hole. The weir would be 500 feet in width with an average crest elevation of 109.2 feet NAVD88 (110.0 NGVD29). A floodplain bench approximately 275 feet in width would be excavated down to elevation 110 (NAVD88) on the Georgia side of the existing dam location. The bench would ease the passage of flood waters past that point in the river. The bench would be grassed lined to prevent erosion. Velocities in the floodplain bench would range from 2ft/s to 6ft/s for the 1% ACE flow.

The slope the rock-ramp structure is 2% on the downstream side of the crest, and slopes down from the crest to the river channel invert at a 10% slope in accordance with the most recent federal interagency guidance on nature-like fish passage structures for Atlantic Coast diadromous fish.

The channel bottom will be excavated out a few feet below the existing river bottom after using a cofferdam to cut off roughly half the river. The weir will span the width of the river (roughly 500') and will have roughly 60 feet in between steps. Cross sections can be found in attachment 1 of the engineering appendix. The modified channel will have 12" of crushed stone base/DGA, topped with 3 feet of rip rap. The banks will also be lined with bedding stone and rip rap to prevent erosion. The weir steps are assumed to be constructed with special boulders/river stone.

4.2 Cost Estimate

4.2.1 Project Costs

The SHEP Fish Passage cost estimate includes the removal of the lock and dam, excavation of the low-lying floodplain bench, construction of the fixed weir and associated cofferdam, lands and damages, engineering design, and construction management. This estimate is based on the 15% concept level design. The cost estimate assumes that the construction contract will be advertised as a full and open and unrestricted project.

MII software was used to develop the cost estimate. Using a combination of 2016 cost book items and user-created items based on historical crew makeups and production rates, the alternatives were priced out with bottoms-up estimates utilizing labor, equipment and materials with estimated quantities for the work required. The estimate does not include any escalation markups, as escalation will be applied in TPCS sheets. The cost estimates includes contingency (as calculated by an Abbreviated Risk Analysis) for each Civil Works Breakdown Structure feature of work.

The cost estimate assumes a work schedule of 6 days a week, 10 hours per day. The LS&H percentage for all marine contractors increased to 150% to account for work on navigable waterways. The Davis-Bacon Wage Rates used for the Richmond County, GA area - Combo of GA165 09/08/2017, GA90 07/14/2017, and GA16 10/13/2017, as well as the August Wage Survey rates from 2017 (included in backup). The local Augusta/surrounding labor pool assumed to be sufficient to handle the demand for this project (i.e., no subsistence/per diem included for craft workers)

Sales tax of 7% included for all items, unless sales tax is included in price quote (will be noted in either Project Item or CSI task). Gas and Diesel prices updated on 7 Sep 18 from: <http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp>. Used Lower Atlantic prices as of 3 Sep for gas and on-road diesel. Subtracted $0.364/gallon for off-road diesel for GA. The Price for electricity updated on 7 Sep 18 from: <http://www.eia.gov/fuelelectric.html>. The used GA commercial electric price per Kwh for May 18 (latest one). The cost of money updated on 7 Sep 18 from http://www.fms.treas.gov/prompt/rates.html

4.2.1.1 SHEP Project Costs and Section 902 Determination

WRDA 2018 authorized a Post Authorization Change Report (PACR) for the SHEP and increased the Section 902 of the Water Resources Development Act (WRDA) of 1986, as amended, which is based on the Fiscal Year (FY) 2019 cost estimate from $1.019B project first cost. The Post Authorization Change Report (PACR) documented the project progress, costs expended to date, proposed plan for future construction activities, and presented an updated cost estimate for the project. The PACR cost estimate did not include the additional cost of the WRDA 2016 required modifications to the SHEP Fish Passage over the 2012 SHEP Plan Fish Passage. Changes to the cost estimate as a result of this Post Authorization Analysis Report for the SHEP Fish Passage feature will have a negligible impact on the 902 limit and no need for an increase is indicated at this time.

4.2.2 **Economic Costs**

The project first cost (Table 30) is estimated at $87,152,000 at the FY20 Price Level.

Table 30: Project First Cost	
Feature Description	**Cost**

Dams	$3,809,000
Locks	$6,569,000
Fish & Wildlife Facilities	$67,512,000
Pumping Plant	$419,000
Cultural Resource Preservation	$641,000
Construction Estimate	*$78,950,000*
Lands and Damages	$140,000
Planning, Engineering, and Design	$4,030,000
Construction Management	$4,031,000
Total Project First Cost	*$87,152,000*

4.3 Cost Sharing

The Cost Share (Table 31) between Federal and Non Federal Partners for the SHEP is defined in the 2014 Project Partnership Agreement which for general navigation features and is 25% Non-Federal and 75% Federal.

The Non-Federal Cost Share for the Fish Passage is described in the WRDA 2016 (c) (2) states that the "The Federal cost share of any Project feature constructed pursuant to paragraph 7002(1) of the Water Resources Reform and Development Act of 2014 (Public Law 113-121; 128 Stat. 1364) for the most cost-effective fish passage structure."

Table 31: Cost Share Table

Cost Share	Non-Federal	Federal	Reference
General Navigation Features (Excluding Overdepth)	25%	75%	2014 PPA
SHEP Fish Passage	All costs above 75% Federal cost limit for original SHEP Plan	75% Federal limit of original SHEP Plan A	WRDA 2016 Sec. 1319 (c) (2)
O&M Fish Passage if selected alternative per Section 1319(c)(1)(A)(i), WRDA 2016)	0%	100%	WRDA 2016 Section 1319 (c) (3)*
O&M Fish Passage	All O&M costs for Navigation, Recreation, and/or Water Supply	All O&M costs for Fish Passage only	WRDA 2016 Section 1319 (c) (3)*

IAW HQUSACE Implementation Guidance dated May 25, 2017

The cost share for O&M of the Fish Passage is outlined in the HQUSACE Implementation Guidance for Section 1319, WRDA 2016. Dependent upon which of the two (2) alternatives in the legislation are implemented, the O&M cost responsibility is different. If alternative 1 is chosen (repair the lock wall), the O&M responsibility is 100% Federal. If alternative 2 is chosen (removal of NSBLD), the O&M responsibility for the fish passage is 100% Federal and any associated O&M costs for navigation, water supply or recreation are a Non-Federal responsibility.

4.4 Design and Construction

4.4.1 Design Considerations

The design presented within this document for the recommended plan, Alternative 2-6d, is an approximate 35% design effort. Once the plan is approved, a full design will be developed prior to the start of construction. Efforts to support the full design after approval of this report will include subsurface investigations to include laboratory testing of materials within the water and on land as well as bathymetric and topographic surveys of the full site.

All access to the construction site will be on the Georgia side of the river within the construction footprint identified. The construction footprint will extend outside the current federal property limits. The areas outside of the federal lands identified as necessary for construction are shown and discussed in the Real Estate Appendix (Appendix E).

Boat Ramp & Park – Construction of the boat ramp and access route through the existing park includes

- A paved road along the north side of the park area leading from the existing park road system around the floodplain bench to the parking area for the boat launch ramp facility. This roadway will serve as a haul route for materials and equipment during construction and an as an access road upon completion of the construction activities.
- gravel paths to and from comfort stations, parking facilities, boat launching ramp, and floating courtesy dock
- security lighting at the boat launch and parking area
- paved concrete boat launching facility
- courtesy dock with gangway access to floating platform
- throwable lifesaving devices for visitors

Floodplain Bench – Construction of the floodplain bench includes removal of approximately 10 ft depth of soil along the banks on the Georgia side of the river over an area of approximately 16 acres. After excavation, the floodplain bench will be seeded with grass seed. Woody vegetation (trees and shrubs) will not be allowed to grow in the floodplain bench as they would act as an obstruction to the flow of water across the bench.
The bench will be lined with riprap to protect the newly formed banks from erosion on both banks (Georgia and South Carolina).

Fish Passage – The fish passage design will be a rock arch rapid design, which is a fish passage design style that emulates natural rapids. The full design of the recommended plan has not yet been developed. However, features of the rock arch rapids will be similar to the previous design efforts for a fish passage structure at this location. Those efforts resulted in a full design developed for the previously authorized fish passage project with the aid of an AE contractor in 2013. In addition to the previous full design,

USACE has also utilized both (1) expertise through coordination with NOAA/NMFS fish passage design experts and (2) the 2016 joint publication by NOAA, USGS, and USFWS "Technical Memorandum Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes". This design allows for a range of velocity and flow conditions across the structure and allows for the opportunity for successful passage of a range of fish species of ally body types, sizes and swimming capabilities. The specific design features regarding weir opening width, depth and maximum velocities as well as the minimum depth and length of the resting pools between the weirs will be developed during the full design. Utilizing the sources stated above with the understanding that the structure will be fully developed after this report is approved, the features of the fish passage include:

- Configuration of rock boulders in a manner that provides a weir surface over and between the boulders throughout the length of the ramp.
- Slope of the structure between the base to the top of the ramp will have an average slope no steeper than 2% (1:50).
- The structure would have a terraced cross section, meaning that the bottom elevation of the structure varies across the ramp going from the shallowest depth along the South Carolina bank to the deepest depth along the Georgia bank. This terraced cross section mimics the flow around a bend in natural channels where the thalweg, or deepest portion of the river, would be located along the outer bend with the shallowest portion of the river along the inside of the bend, where sandbars would typically form. This terraced structure allows for flow to concentrate in this outer bend along the Georgia side of the river with slower moving, more shallow water depths along the South Carolina side of the river.
- Since the structure will span the full width of the river the design will be such that it is able to withstand the forces of the full river flow for a full range of possible conditions. The armoring along the banks along with the weir stone placement and design will protect the structure from the potentially damaging forces of water.

4.4.2 **Construction Methods**

Construction of the recommended plan, Alternative 2-6d, will take place in a manner that allows for the pool levels to remain at or above the levels expected after construction of the fish passage structure is completed. USACE is aware of the unintended consequences that can come with lowering the pool and all efforts will be made to ensure these do not occur during this construction activity. Constructing in this manner may require the use of temporary sheetpile cofferdams and staged construction of the fixed crest weir. The pool will be held in place by the gated structure at the NSBLD until the fixed crest weir is in place and able to hold the pool without the aid of the NSBLD.

The work is anticipated to take place in two stages where a cofferdam would be constructed in the river potentially between gates 2 and 3 and extend upriver through the full length of the structure. The cofferdam would then turn and tie-in to the bank. It is

expected that the cofferdam will be constructed in the wet with marine-based equipment. Once constructed, the area within the cofferdam would be dewatered allowing work to construct the fixed crest weir and fish passage structure to proceed in the dry using more conventional heavy civil construction equipment. The pool will then be regulated through the use of the remaining gates on the structure. Once work is completed behind the first stage cofferdam the cofferdam would be reconfigured allowing water flow through the newly completed project area while the remaining area is dewatered behind the reconfigured cofferdam. Once stage 2 is completed the cofferdam would be removed allowing the structure to pass water flow as designed. This method is conceptual at this point and will likely undergo revision while developing the full design during the Planning, Engineering and Design (PED) phase; however, it would allow the pool to remain in place throughout the construction period.

Construction activities within the water will take place utilizing barges, activities that are on land will require the use of heavy civil construction equipment to include cranes, excavators, dump trucks, rollers, etc. Construction activities that require driving sheetpile will utilize machinery such as crane mounted hammers. Efforts can be made to minimize the noise of the hammers while driving the sheetpile. Several rock quarries have been identified within a 20 mile radius of the project area. Weir stones will be sourced from local rock quarries.

Construction activities will include demolition and removal of the NSBLD and all the appurtenant features to include the lock wall, the esplanade, the fender system, gates, piers, walkways, generator, electrical motors, hydraulic systems, and the operations building. The demolished material will be removed from the site and disposed at an appropriate location. There is the potential to reuse the mass concrete from the demolished structure as a base fill material within the fish passage structure or the large scour hole just downstream of the structure. This has been done successfully in many other USACE projects and would involve cutting or crushing the mass concrete to the appropriate size for the designated reuse. Reuse of cut or crushed material requires the removal of any reinforcing members that may protrude from the mass concrete. If the reinforcing member can be removed then it is removed, if it cannot be removed, then it will be cut flush with the edge of the mass concrete. There is also the potential to reuse the excavated material from the floodplain bench as a base fill material within the fish passage structure. This material will fully undergo subsurface investigations and borings to identify the quality of the material prior to design and construction.

4.5 Lands, Easements, Rights-of-Way, and relocations LERR

The non-Federal sponsor has the responsibility to acquire all real estate interests required for the Project. The non-Federal sponsor shall accomplish all alterations and relocations of facilities, structures and improvements determined by the government to be necessary for construction of the Project. Appendix E has real estate report.

4.5.1 **Lands**

Due to the construction of alternative 2-6d, the existing government owned boat ramp will become unusable due to safety concerns. To offset the loss of the boat ramp, approximately ten (10) acres of privately owned lands shown on Figure 32 will be acquired in fee adjacent to the existing boundary line and a new boat ramp and parking area will be constructed. The Augusta-Richmond County public records has this property classified as Conservation Easement. Any such easements will need to be released over the portion of the property required for the project.

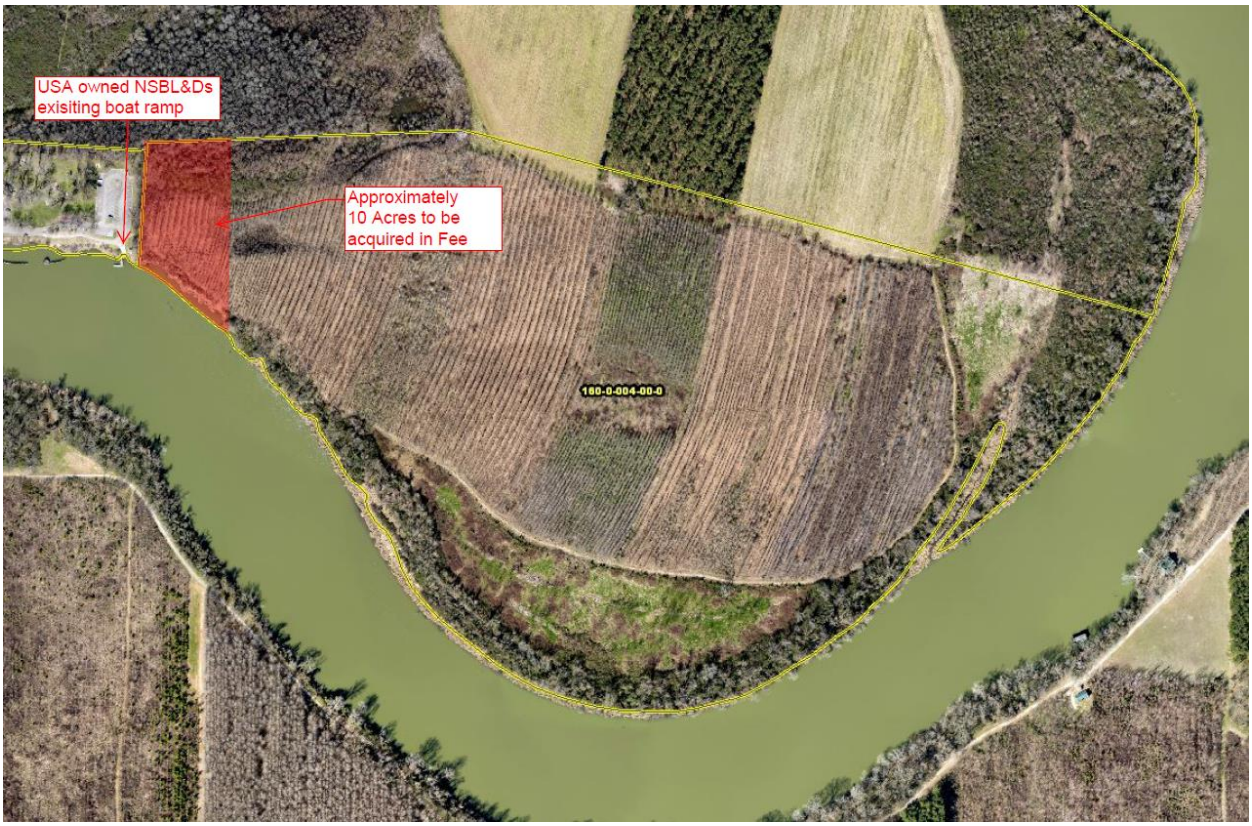


Figure 32: Real Estate Requirements

4.5.2 **Easements and Rights-of-Ways**

The existing NSBLD project has Perpetual Flowage Easements over 682.39 acres of which 178.75 acres are located in Georgia and 503.64 acres in South Carolina. No additional easements or right-of-ways will be required for this project.

4.5.3 **Utility/Facility Relocation**

There are no utility/facility relocations associated with this project.

4.5.4 **Transfer of Ownership**

Approximately 50 acres of fee owned lands and improvements located in Georgia along with a portion of the lock and dam are currently under a ten (10) year lease to

Richmond County, Georgia. As authorized by the WINN Act and upon project completion, all fee owned lands located on the Georgia side of the lock and dam that are currently leased to Augusta-Richmond County will be disposed of to Augusta-Richmond County. A map of the 50 acres currently leased is shown on Figure 33. All remaining fee and easement lands will be retained by the Government.

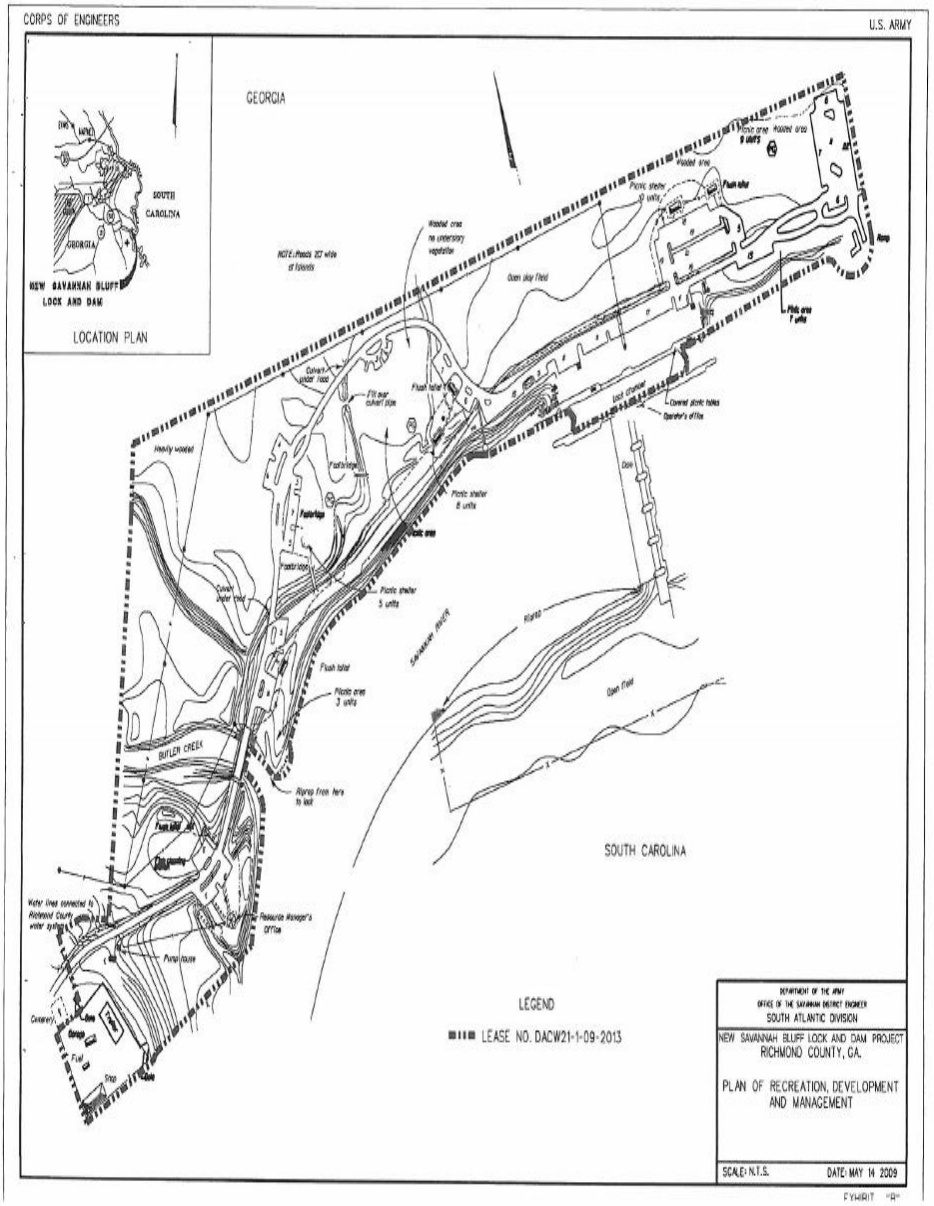


Figure 33: NSBLD Park

4.6 Operations, Maintenance, Repair, Replacement, and Rehabilitation (Federal and Non Federal Sponsor's Responsibilities)

All future Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) would be the responsibility of the owner. Annual routine O&M would include labor, parts and materials, and minor contract repairs.

For the recommended plan, alternative 2-6d, routine maintenance would include:

Boat Ramp & Park – The owner (Augusta-Richmond County) will maintain clean, accessible routes to and from facilities to include paved routes, and gravel paths to and from comfort stations, parking facilities, boat launching ramp, floating courtesy dock. The owner will maintain security lighting at the boat launch and parking area. Ensure the safe operating condition of the gangway, handrails, stairways, transitions, boat mooring (i.e., cleats), and throwable lifesaving devices for visitors. Annual inspections will be conducted at the facilities to ensure the facility is maintained and is safe and suitable for public use. All components should be repaired or replaced when they no longer perform the design function or fails to meet the design specifications.

Floodplain Bench – The owner (NFS) will maintain the floodplain bench in a manner that will allow unobstructed flow of water across the full width of the floodplain bench. The owner will maintain a healthy, vigorous stand of grass that is free of weeds and bare spots within the floodplain bench to protect the earthen bench from erosion under the flow of floodwaters. Grass should be mowed to a height of 3-6 inches with a maximum height of 12 inches. Trees or other woody vegetation will not be allowed to grow in the footprint of the floodplain bench.

Rock Ramp – Minimal maintenance and repairs are expected because the fish passage and fixed crest weir structure as the basis of design mimics a natural channel and spans the full width of the river. The Corps will monitor fish passage, and if needed make repairs to ensure effective fish passage. The structure will need an annual inspection to ensure that the structure is free from debris, sediment accumulation, has an intact, stable shoreline, and shows no signs of undermining or erosion, either upstream or downstream of the structure.

4.7 Project Specific Considerations

The approval of this Integrated Post-Authorization Analysis Report and Supplemental Environmental Assessment is necessary to achieve the requirements for mitigation to be completed during construction of the Savannah Harbor Expansion Project, Georgia and South Carolina, Fish Passage at NSBLD. Also, in accordance with the SHEP Biological Opinion, Amendment No. 2, construction of this mitigation feature must begin no later than January 2021 and complete construction within 3 years.

4.8 Project Implementation

The report is scheduled to complete the necessary reviews and obtain approval in August 2019. Funds must be appropriated to the SHEP project so that design of the

fish passage can start in FY20 in order to maintain the construction start no later than January 2021.

4.9 Project Concerns and Controversies

The city of North Augusta, businesses and industries along the Savannah River in the project area, and the local people are concerned about the lowering of the pool when the weir is installed and the lock and dam are removed. They are concerned about the changes in the view shed along the riverfront portions of the city and the changes to individual water front properties both residential and business. The same stakeholders are passionate about keeping the historic lock and dam structure.

Separately, the city of Augusta and the Savannah Riverkeeper are developing plans to install a white water park as part of the project modifications. This local city project is being conducted independent to the Post Authorization Analysis report development, the selection of the recommended plan, and the implementation of the Federal SHEP Fish Passage at the NSBLD project feature.

4.10 Risk and Uncertainty

The purpose of this analysis is to identify the most cost effective fish passage that least impacts water supply and recreation and maintains navigation in the pool. The recommended plan is the most cost effective alternative that provides the highest pool elevation for fish passage without inducing increased flooding adjacent to the Savannah River. Within these criteria for selection of the recommended plan, there are risks to the implementation of the fish passage.

As discussed earlier in Section 4.4.1, USACE Savannah District has both (1) coordinated with NOAA/NMFS fish passage design experts and (2) referenced the 2016 joint publication by NOAA, USGS, and USFWS “Technical Memorandum Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes” in drawing conclusions about uncertainty in the design and implementation of the fish passage structure. The fish passage was designed to meet the fish passage criteria for the shortnose and Atlantic sturgeon as discussed in the 2016 Technical Memorandum by modifying the slope of the weir from 1.5% to 2.0% will enable shortnose and Atlantic sturgeon to successfully traverse the fish passage structure. The refined slope best suits their body shape and maneuverability. With regard to the draft recommended plan, the fish passage has low risk and medium uncertainty in the ability that fish will successfully pass over the weir based on NOAA research findings. It is anticipated that the proper design of this alternative will result in successful fish passage. There is a potential risk that floodplain bench may result in fish stranding during high flow events. In order to minimize this potential risk, USACE Savannah District will work closely with NOAA fish engineers and biologist to design the floodplain bench and its interface with fish passage structure to minimize risk to allow for safe egress out of the floodplain as high flow events recede. Under some alternatives studied, false attraction to the operating gates could lead migrating fish to

the dam and not the fish passage structure thereby causing a migratory delay. The length of the delay was not determined and would require additional study and modeling effort. A short delay would not impact spawning, but a long delay could cause the individual to not reach the spawning area during the prime spawning window. NOAA NMFS will monitor the fish and determine the level of success of migration.

CDM Smith, Inc., under contract with the USACE, evaluated the water intakes and stated that while the recommended plan, alternative 2-6d, did not impact the city of Augusta water intake, modifications to the pumping system are recommended for performance improvements. The city of Augusta may choose to make these optional modifications to improve performance of the system during low flow conditions and if there is debris limiting intake pump efficiency.

The HEC-RAS 2D model predicted that the docks along the Savannah River that may be adversely impacted by the changes in the pool elevation when the recommended plan is implemented. As a result, a survey of the shoreline was conducted and an application developed to communicate the impacts of the recommended plan on individual properties and those with docks. The shoreline web application is discussed in section 5.5.1.

USACE simulated the recommended plan conditions to mimic weir height of 111.0 ft NGVD 29 (110.2 ft NAVD 88) at 5,000 cubic feet per second (cfs) at the NSBLD from February 13-15, 2019. During the simulation, there were some differences noted between the water surface elevations predicted by the model and those observed and recorded at the 5th Street Bridge (USGS gage 02196670). Using this gage, the water surface elevation at the 5th Street Bridge was closer to an average of 109.7 ft NAVD 88 (110.5 NGVD 29) during the simulation which was approximately 0.5 feet less than the recommended plan elevation predicted by the model. Ordinarily, the flashboards at Stevens Creek Dam even out the flows released from Thurmond for hydropower generation, reregulating the flow such that the hourly discharge throughout the day is equal to the average daily discharge from Thurmond. Since the flashboards were down for repairs during the simulation, this more constant flow was not held, and as a result, the low conditions were lower than planned for the simulation and the slope of the pool was reduced by the lack of continuous flow. This is a risk and uncertainty that was not previously considered. In the past twenty years, the flashboards have not been down for this length of time. While the Corps can work with J. Strom Thurmond to maintain continuous flows for the recreational events, the Head of the South crew regatta and the Ironman, this is not how the Corps operates that facility.

5.0 Environmental Compliance*

5.1 Public Involvement

The USACE issued a public notice to inform stakeholders and natural resource agencies that it is conducting an evaluation to identify the best way to modify the SHEP Fish Passage as required by the WRDA 2016. Numerous comments were received on

the proposed study. In addition, the USACE participated in an education workshop on May 31, 2017, that was hosted jointly by the Augusta Chamber of Commerce, the city of Augusta, and the city of North Augusta. That workshop provided additional information on the issues in the community that could be affected by the SHEP fish passage feature.

Due to the complex nature of the project, the historical relativity and local interests, and the nature of the changes posed by the project and the WRDA 2016 legislation, the USACE developed a wide range of opportunities for public engagement at various points during the planning process.

5.1.1 **Public Web Site**

SHEP Fish Passage webpages are located on the USACE website, www.sas.army.mil. The link to information about the fish passage is prominently placed in the upper right hand side of the home page as shown in Figure 34.

Figure 34: District Website

The USACE home page also contains a blog called “Balancing the Basin,” (Figure) located at the bottom middle of the home page, where users can post questions and subscribe to updates from the USACE. By following the link below, users can search for “fish passage” and see the blog posts related to the development of this report.

Figure 35: Balancing the Basin Blog

http://balancingthebasin.armylive.dodlive.mil/

The Fish Passage webpage (Figure 35) shows the lock and dam in the title banner; provides an overview of the project; describes the planning process and timeline in the “getting to a solution” button; the “historic overview” button concisely describes the study history; and the public can “stay informed, get involved,” to find a script from the June 27 public meetings and the slides that were presented. There is also a text description of the alternatives on the “stay informed, get involved” button. The web address for the SHEP Fish Passage is, http://www.sas.usace.army.mil/Missions/Civil-Works/Savannah-Harbor-Expansion/SHEP-Fish-Passage/. This website includes a Shoreline and Depth Impact tool. This tool is meant to show the relative location of the shoreline and depth at docks in the Augusta pool for the various fish-passage alternatives at New Savannah Bluff Lock & Dam. The shorelines and depths presented here are not definitive, but should be compared to one another to show the relative changes from one alternative to the next. This tool assumes normal flow conditions of 5,000cfs and uses the best available survey and modeling data to provide approximate shoreline locations.

Figure 35: SHEP Fish Passage Website

5.1.2 **Public Outreach Meetings**

On June 27, 2018, the USACE held an open house to inform the public of the USACE's overall purpose for the analyses – to find and recommend the most cost-effective fish passage alternative as required by the 2016 WRDA. The open house provided the public an opportunity to learn more about the proposed alternatives the USACE is studying. Reopening the spawning grounds remains a mitigation requirement of the Savannah Harbor Expansion Project.

Through a Public Engagement Grant called the *Grand Collaboration Challenge*, the Collaboration Planning Center of Expertise provided experienced techniques in building transparency and opening up the dialogue with the public through this public engagement forum. They developed visual concept renderings of each alternative, the presentation slides and messaging, and facilitated the meeting presentations and discussions.

A public meeting was held in November 14, 2018 to introduce the selection of the Recommended Plan and answer questions.

5.1.3 **Public and Agency Review**

The draft integrated report and Supplemental Environmental Assessment was released for a 30-day public review beginning on February 15, 2019 and was extended an additional 30 days to April 16, 2019. The documents were made available for review through the USACE website. A public workshop/event(s) was held on March 6, 2019, during the public review period. Approximately 400 comments were received and comments and responses are included in Appendix L. The USACE will post the final report on our public website when it is approved.

5.1.4 **Key Leader Engagements**

On April 16, 2019, Secretary R.D. James, toured the NSBLD on foot and received an aerial tour of the project area. The intent of the site visit was to share information about the condition of the NSBLD, alternative 2-6a real estate inundation, location of the training wall, and the locations of water supply users within the project area. On May 29, 2019, SAD Commander, BG Diana Holland, received the exact same tour to inform her final determination on the recommended plan for the fish passage.

COL Hibner met with Augusta, Georgia, Mayor Hardie Davis and North Augusta, South Carolina, Mayor Bob Pettit on May 21, 2019.

On June 11, 2019, COL Hibner met with the USACE Commanding General, LTG Todd Semonite to provide an update on the SHEP Fish Passage project. On June 12, COL Hibner met with Senators Perdue and Senator Isakson from Georgia, Senator Graham and Senator Scott from South Carolina, and Congressman Wilson SC-2 and Allen GA-12.

5.2 Compliance with Environmental Laws, Statutes and Executive Orders*

Table 32 summarizes compliance of the proposed action with applicable Federal/State laws.

Table 32: Relationship of Project to Environmental Requirements	
Federal Statutes	**Level of Compliance***
Clean Air Act	Full
Clean Water Act	Full
Coastal Barrier Resources Act	N/A
Coastal Zone Management Act	N/A
Comprehensive Environmental Response, Compensation and Liability Act	Full
Endangered Species Act	Full
Estuary Protection Act	N/A
Farmland Protection Policy Act	N/A
Federal Water Project Recreation Act	N/A
Fish and Wildlife Coordination Act	Full
Flood Control Act of 1944	Full
Land and Water Conservation Fund Act	N/A
Magnuson Fishery Conservation and Management Act	N/A
Marine Mammal Protection Act	N/A
National Environmental Policy Act	Partial
National Historic Preservation Act	Partial
North American Wetlands Conservation Act	N/A
Resource Conservation and Recovery Act	N/A
Rivers and Harbors Act	N/A
Water Resources Development Acts of 1976, 1986, 1990, and 1992	Full
Water Resources Planning Act	Full

Watershed Protection and Flood Prevention Act	Full
Wild and Scenic Rivers Act	N/A
Executive Orders (EO), Memoranda, etc.	
Migratory Bird (E.O. 13186)	N/A
Protection and Enhancement of Environmental Quality (E.O. 11514)	Partial
Federal Statutes	Level of Compliance*
Protection and Enhancement of Cultural Environment (E.O. 11593)	Partial
Exotic Organisms (E.O. 11987)	Full
Floodplain Management (E.O. 11988)	Full
Protection of Wetlands (E.O. 11990)	Full
Relating to Protection and Enhancement of Environmental Quality (E.O. 11991)	Partial
Environmental Justice in Minority and Low-Income Populations (E.O. 12898)	Full
Invasive Species (E.O. 13112)	Full
Protection of Children from Health Risks and Safety Risks (E.O. 13045)	N/A
Prime and Unique Farmlands (CEQ Memorandum, 11 August 1980)	N/A

*Level of Compliance:
Full Compliance (Full): Having met all requirements of the statute, E.O., or other environmental requirements.

Partial Compliance (Partial): Not having met some of the requirements at current stage of planning. Compliance with these requirements is ongoing (e.g. Coordination of this document with the public, and relevant resource agencies, including resolution of adverse effects to historic properties in accordance with stipulations in the PA and the MOA and notifying and filing with the ACHP will result in full compliance.)

Non-Compliance (NC): Violation of a requirement of the statute, E.O., or other environmental requirement.
Not Applicable (NA): No requirements for the statute, E.O, or other environmental requirement for the current stage of planning.

5.3 Compliance with State Statues

The following environmental compliances would require updating as a result of the recommended alternative since activities associated with the proposed action would require the placement of materials in the waters of the U.S. and the removal of the lock and dam would cause temporary water quality impacts within the study area.

Section 404(b)(1) Evaluation (Appendix H of the FEIS) – materials are being placed in the waters of the U.S. to create the fish passage structure. As a result of the proposed action, an updated Section 404(b)(1) Evaluation can be found in Appendix C.

1. Section 404(b)(1) Evaluation (Appendix H of the FEIS) - materials being placed in the waters of the U.S. to create the fish passage structure as well as the removal of the lock and dam. As a result of the proposed action, an updated Section 404(b)(1) Evaluation can be found in Appendix C.
2. Section 401 Certification (Appendix Z of the FEIS) materials are being placed in the waters of the U.S. to create the fish passage structure. No additional water quality certificate will be needed because the type of material being placed in the river is consistent with what was described in the SHEP 2012 FEIS.

5.4 Coordination and Regulatory Compliance

5.4.1 **Regulatory Compliance**

Environmental compliance for the proposed action would be achieved upon completion of the following:

- Coordination of this SEA and draft Finding of No Significant Impact (FONSI) with appropriate agencies, tribes, organizations, and individuals for their review and comments.
- Coordination with NOAA NMFS to amend the Biological Opinion for the SHEP (which includes the Fish Passage Feature) to incorporate critical habitat for Atlantic sturgeon.
- U.S. Fish and Wildlife Service (USFWS) confirmation that the proposed action would not likely adversely affect any endangered or threatened species or their critical habitat.
- Concurrence by the Georgia and South Carolina State Historic Preservation Officers with USACE's determination of effect on cultural resources and resolution of adverse effects.
- Receipt and acceptance or resolution of all USFWS Fish and Wildlife Coordination Act recommendations.
- Receipt and acceptance or resolution of all EPA's comments on the air quality impact analysis documented in the SEA.

The draft FONSI will not be finalized and signed until the proposed action achieves environmental compliance with applicable laws and regulations, as described above.

5.4.2 **Interagency Collaboration:**

NOAA and USFWS are invited to participate in the study as a technical members of the PDT. The USACE team members are coordinating with State and Federal agencies with regulatory review responsibilities as required by applicable laws and procedures.

Recommendations of the USFWS in accordance with the draft Fish and Wildlife Coordination Act Report (FWCAR) are included in Appendix D. The following list of conservation recommendations from USFWS along with USACE's responses are shown below.

USFWS Position/Recommendation 1: Fishway Slope

ALT 2-6 proposes a rock ramp similar to the previous design (i.e., an arch rapids NLF). This hybrid-type NLF may operate as a step-pool or a roughened channel depending on hydraulic conditions. Accordingly, the Service recommends that arch rapids are also designed at slopes less than 3%. The materials provided to the Service suggest the fishway would be constructed as described in ALT 1-1. However, the stationing in Figure 5 suggests a steeper slope. If this alternative is selected, the Service strongly recommends maintaining a slope less than 3% measured longitudinally along the approximate thalweg.

USACE Response:

The upstream slope for the proposed structure is 2% along the thalweg.

USFWS Position/Recommendation 2: Boulder Structure and Arrangement

The previous design was an arch-rapids hybrid type NLF based on approaches originally outlined in Aadland (2010). Since the previous design was submitted, the Service gained additional experience in this technology and issued new criteria (Turek et al., 2016). While we remain supportive of the arch-rapids type NLF, specific slope, depth, width and velocity criteria presented in Turek et al. (2016) should be carefully considered before advancing this (or another alternative) to the final design stage. Schooling fish such as American shad may be reluctant to enter (or pass through) gaps in the rocks of an arch rapids NLF. Sizing those gaps to accommodate the target species is critical. Turek et al. (2016) provides species-specific criteria for sturgeon, eel, shad and river herring; for species not listed in this document (e.g., the state listed Robust Redhorse) and in the absence of better performance data, the Service recommends conservative assumptions on these design criteria and, where possible, the use of a surrogate to estimate the geometric parameters that influence boulder structure and arrangement.

USACE Response:

The criteria discussed here will be considered during the detailed design phase of the project. The fish passage is designed to pass shortnose and Atlantic sturgeon. Attempts will be made not to limit the use by other species.

USFWS:

Additional we note that the incorporation of the floodplain bench in ALT 2-6 may have the ancillary benefit of providing enhanced passage along the bankside where, presumable, side slopes transitioning into the floodplain bench are mild.

USACE Response:

The "side slope" from the channel to the floodplain bench will be determined from geotechnical considerations. If environmental or fish passage concerns dictate a more mild slope, we can take this into account but we need to know this sooner rather than later.

USFWS Position/Recommendation 3: Turbulence, Energy Dissipation, and Pool Sizing

Turbulence has been shown to influence both swimming behavior and performance of fish (Lupandin 2005, Enders et al. 2003, Pavlov et al. 2000). American Shad have demonstrated a particular sensitivity to increased turbulence and associated air entrainment in pool-type fishways (Haro and Kynard 1997). Minimizing turbulence and air entrainment within fishways is generally considered advantageous for fish passage (Towler et al., 2015). This is particularly true for American Shad. The energy dissipation factor (EDF) is a well-known fishway design parameter that correlates with turbulence and air entrainment. The Service recommends that efforts are made to eliminate or minimize unnecessary turbulence in the design; in practice, this will necessitate sizing the pools in the fishway to meet the recommended EDF limit for American Shad of 3.15 ft-lbf/s/ft3 or 150 W/m3.

USACE Response:

These criteria will be considered during the detailed design phase. The fish passage is designed to pass shortnose and Atlantic sturgeon. Attempts will be made not to limit the use by other species.

USFWS Position/Recommendation 4: Weir Crest, Low Flow Notch and Bench

ALT 2-6 proposes to establish hydraulic control in the upper NLF with a 10-foot wide weir with a crest elevation of 109.22 feet NAVD88. Typically, the cross-sections of roughened channel NLFs vary in channel elevation. This promotes a diversity of hydraulic conditions that make the NLF passable at low, moderate, and high flows. However, the proposed constant elevation weir crest will create largely uniform flow conditions in the upper fishway. If this alternative is selected, the Service would recommend incorporating a low flow notch through the weir that transitions into a near parabolic channel NLF cross-sections (characteristic of lowland river channels).

USACE Response:

The weir crest for Alt2-6a will be consist of three "tiers", the highest of which will be adjacent to the South Carolina abutment and have an elevation of 110.22ft NAVD88. The middle tier will have an elevation of 109.22, and the third tier will have an elevation of 108.22. Each tier will be span approximately one third (~150ft) of the NLF structure. This configuration is detailed in the concept design drawings for the alternative.

USFWS:

We note that ALT 2-6's inclusion of a floodplain bench may enhance passage at high flows. However, we do not have sufficient information on the hydraulics of ALT 2-6 to determine the stage at which the floodplain bench will be engaged

USACE Response:

The floodplain bench varies in elevation, with a "crest" collinear with the crest of the NLF. The invert of the flood bench crest is at elevation 110ft NAVD88, and slopes upward at 1% slope to approximate elevation 112.5 where it ties into existing ground on the north side of the park area. This configuration is detailed in the updated concept design drawings.

USFWS Position/Recommendation 5: Maintenance

With the removal of the lock, spillway and gates, fish passage will be effectively passive. Operations, for flood management or other purposes, are not anticipated. However, the NLF will require maintenance. NLFs are composed of rock and other natural materials. Their long-term stability is subject to hydraulic forces that, in turn, are dependent on river hydrology. While rock weir size, material stability and the estimated design life of this structure must be determined at a later design stage, the need for a maintenance plan and budget clearly exists. A maintenance plan is a key component to ensuring long-term success of the facility. Such a plan provides descriptions of the project and inspection, maintenance schedules, contingencies, effectiveness-monitoring methods, and any adaptive management measures. Considerations should also assess the feasibility and potential cost of modifying any final project design to adapt to meet inadequacies of fish passage goals. Should ALT 2-6 be selected, the Service would request that the USACE develop a fishway maintenance plan in consultation with the natural resource agencies.

USACE Response:

We are currently developing an O&M plan and will consult with the agencies as we do so.

6.0 Mitigation*

The appropriate application of mitigation is to formulate an alternative that first avoids adverse impacts, then minimizes adverse impacts, and lastly, compensates for unavoidable impacts.

The proposed action avoids adverse impacts by:

1. Potential impacts to the 100 year flood event were avoided by eliminating all alternatives that would have impacted it.
2. Potential impacts to more frequent flood even were avoided by adding the floodplain bench to Alternative 2-6.
3. Potential impacts to more frequent flood even were avoided by lowering the weir height in Alternative 2-6.

The proposed action minimizes adverse impacts by:

1. Potential impacts to recreation was were minimized by performing a tradeoff analysis between Flooding and Recreation with the four 2-6 alternatives.

Wetlands impacts due to the Recommended Plan are very similar to the impacts covered by SHEP 2012 FEIS and Appendix C. Mitigation for 0.41 acres of wetlands would be required. Appendix C3 of this document has the updated 404(b)(1) Analysis. Two potential mitigation banks are located in the vicinity.

Mitigation of NRHP-eligible archaeological sites would be conducted in accordance with the 2012 SHEP PA. Compensatory mitigation is not warranted for the recommended plan.

Appendix D of the SHEP 2012 FEIS provides the details on the monitoring and AM plan for the fish passage and no additional AM and Monitoring is needed as a result of the project modifications.

7.0 District Engineer's Recommendations

I recommend that **Alternative 2-6d – 110.2 NAVD88 (109.0 NGVD 29) foot elevation fixed crest weir with a flood bench** be constructed. The Recommended Alternative has a total project cost at the midpoint of construction in FY19 price levels of approximately **$92,149,000**. This alternative provides the most cost effective fish passage, does not require flowage easements, minimizes impacts to water supply intakes, maintains the pool for recreation. The recommended plan meets the requirements in the 2016 WRDA and is compliant with all applicable environmental approvals of the project. Anticipated costs (Table 33) are as follows:

Table 33: Cost Estimate to Implement Recommended Alternative

	Totals	Non-Fed	Fed[2]
Total Project Cost	$92,149,000	$43,106,982	$53,244,542
OMRRR[1]	$4,500,000	$0	$4,500,000
Total Lifecycle Cost	$96,649,000	$43,106,982	$57,744,542

[1]OMRRR activities include personnel and materials costs to maintain the rock weir for mitigation purposes. Calculations for OMRRR activities to maintain the pool for water supply, and recreation are not included in the current cost estimate.
[2]Federal cost limited to 75% of the original SHEP Plan in accordance with Section 1319, WRDA 2016.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to South Atlantic Division (SAD) for final approval. However, prior to transmittal to SAD for approval, the sponsor, the States, and interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further. Final decision authority for this Savannah Harbor Expansion Project (SHEP), Georgia and South Carolina, Fish Passage at New Savannah Bluff Lock and Dam (NSBLD), Integrated Post-Authorization Analysis Report and Supplemental Environmental Assessment was delegated to the MSC Commander, South Atlantic Division.

Date 10/29/19

Daniel H. Hibner, PMP
Colonel, U.S. Army
Commanding

8.0 List of Report Preparers

Name	Position	Years of experience
Nathan Dayan	Biologist – Environmental Team Lead	22 years
April Patterson	Project Manager	7 years
Jeff Morris	Plan Formulator/Economist	25 years
Laura (Beth) Williams	Chief of H&H	17 years
Robin Armetta	Biologist	8 years
Julie Morgan-Ryan	Cultural Resources	23 years
Jason LaVecchia	Lead Engineer	10 years
Sarah Moore	Climate Change	8 years
Robert (Vince) Moody	H&H Modeler	16 years
Taylor Canfield	Cost Engineer	11 years
John Hinely	Real Estate	28 years

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b) Engineer Regulation (ER) 1110-1-12, Change 2, Quality Management, 30 Sept 2006
c) ER 1105-2-100, Planning Guidance Notebook, Appendix H, Policy Compliance Review and Approval of Decision Documents, Amendment #1, 20 Nov 2007
d) SHEP Project Management Plan (PMP) approved 5 November 2012
e) SHEP Fish Passage at NSBLD Project Management Plan (PMP) Addendum Draft dated March 2017
f) SHEP PMP Quality Management Appendix B dated January 2015
g) USACE Quality Control Plan, dated 2008

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