Claiborne and Millers Ferry Locks and Dams Fish Passage Study

Draft Feasibility Report and Integrated Environmental Assessment

May 2023

US Army Corps of Engineers

The Nature Conservancy

EXECUTIVE SUMMARY

DESCRIPTION OF THE REPORT

This integrated report presents the investigation, evaluation, and environmental assessment of providing fish passage on the Alabama River. This system, from the Gulf of Mexico through Mobile River Delta and the Alabama River to the Cahaba River, is highly impaired by two lock and dam structures, Claiborne and Millers Ferry. These structures restrict access of aquatic species in the lower Alabama River to historical spawning areas in the Cahaba River. Providing passage would reconnect over 230 miles in this system allowing access for multiple species of fish, crawfish, mussels, turtles, and more. The report documents the planning process in developing and evaluating alternatives along with the environmental effects identified throughout the process.

PURPOSE AND NEED

The purpose of the study is to evaluate Federal interest in establishing fish passage through restoring connectivity in the Alabama and Cahaba Rivers. The project addresses the loss of habitat connectivity for fish movement in the river system. Individually, these rivers are nationally significant, but, according to The Nature Conservancy, holistically may be in the top 5 in the U.S. for biodiversity. The restoration of connectivity is widely recognized as critical to maintaining biodiversity and ecosystem functions. This project is part of the development of a resilient, productive, and varied habitat in the region which will provide additional resilience in a changing climate.

AUTHORIZATION

This study is authorized by Section 216 of the Flood Control Act of 1970 (33 U.S.C. 549a). Section 216 “authorizes the Corps of Engineers to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due [to]significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest.”

FEDERAL INTEREST

This report documents the determination of Federal interest in establishing fish passage through restoring connectivity from the Gulf of Mexico through the Mobile River Delta and the Alabama River to the Cahaba River and establishes the Tentatively Selected Plan (TSP).

ALTERNATIVES

The final array of alternatives is presented in Table ES.1 and includes combinations of a Fixed Weir Rock Arch and Natural Bypass Channels.

Table ES.1 – Final Array of Alternatives

Alternative	Description
1	No Action Alternative
3	Fixed Weir Rock Arch – Both Dams
5d	Natural Bypass Channel – Both Dams right bank
12b	Fixed Weir Rock Arch – Claiborne, Natural Bypass Channel – Millers Ferry
13b	Natural Bypass Channel – Claiborne, Fixed Weir Rock Arch – Millers Ferry

BENEFITS AND COSTS

The Fish Passage Connectivity Index (FPCI) model was utilized to develop habitat units and was approved for single use for this evaluation on February 27, 2023. Total project costs including construction, real estate, engineering and design, construction management, contingencies, and escalation were developed for alternative evaluation. The benefits derived and costs for each of the final array of alternatives are presented in Table ES.2 below.

Table ES.2 – Benefits and Costs of the Final Array

Alternative*	Fish Passage Connectivity (Avg)	Avg. Annual Habitat Units (HUs)	Total Project Cost	Operations and Maintenance
1 – No Action	0.003	6,513	-	$0
3 – Fixed Weir Rock Arch, Both	0.441	872,331	$227M	$200,000
5d – Natural Bypass Channel, Both	0.523	1,005,661	$188M	$200,000
12b – Fixed Weir Rock Arch CL, Natural Bypass MF	0.507	978,402	$201M	$200,000
13b – Natural Bypass CL, Fixed Weir Rock Arch MF	0.457	899.590	$214M	$200,000

*CL = Claiborne Lock and Dam, MF = Millers Ferry Lock and Dam

THE ECONOMIC ANALYSIS

The Cost Effectiveness Analysis. The cost effectiveness analysis results are presented in Table ES.3, depicting one best buy action alternative, 5d, the natural bypass channel at both project sites. This alternative has the highest ecological lift at 1,005,661 habitat units and the lowest average annual equivalent cost of $8,496,000. Thus, Alternative 5d is the best buy action alternative with an average cost per habitat unit of $8.45.

Table ES.3 – The Cost Effectiveness Analysis

Alternative*	Avg. Annual Habitat Units (HUs)	Avg. Annual Equivalent Cost	Avg Cost per HU	Best Buy?
1 – No Action	6,513	-	-	Yes
3 – Fixed Weir Rock Arch, Both	872,331	$10,360,000	$11.88	No
5d – Natural Bypass Channel, Both	1,005,661	$8,496,000	$8.45	Yes
12b – Fixed Weir Rock Arch CL, Natural Bypass MF	978,402	$8,906,000	$9.10	No
13b – Natural Bypass CL, Fixed Weir Rock Arch MF	899.590	$9,236,000	$10.27	No

*CL = Claiborne Lock and Dam, MF = Millers Ferry Lock and Dam

The Multi-Criteria Decision Analysis (MCDA). One path taken in the MCDA involved a summation of normalized scores for each of the four utilized accounts: Environmental Quality (EQ), Regional Economic Development (RED), National Economic Development (NED) and Other Social Effects (OSE). Another path taken in the MCDA involved applying a radar plot of the normalized scores and calculating the area under the resulting curve. Table ES.4 depicts the results the first MCDA path indicating Alternative 5d has the highest total score of the final array. Further information regarding the details of each of the components of this analysis can be found in Section 4.5 of this report and in Appendix E – Socioeconomics.

Table ES.4 – The Multi-Criteria Decision Analysis

Alternative*	Total Score (summation)	Total Score (area under the curve)
1 – No Action	1.345	0.171
3 – Fixed Weir Rock Arch, Both	3.284	1.342
5d – Natural Bypass Channel, Both	3.538	1.552
12b – Fixed Weir Rock Arch CL, Natural Bypass MF	3.504	1.523
13b – Natural Bypass CL, Fixed Weir Rock Arch MF	3.356	1.398

*CL = Claiborne Lock and Dam, MF = Millers Ferry Lock and Dam

THE TENTATIVELY SELECTED PLAN

Based on the analysis considering project objectives, environmental outcomes, Principles and Guidelines (P&G) criteria, Cost Effectiveness Analysis (CE), and the MCDA, the TSP is Alternative 5d – Natural Bypass Channel at both Claiborne and Millers Ferry Locks and Dams. Alternative 5d has the lowest cost and highest ecological lift of all final array alternatives, is the only best buy action alternative and has the highest total score from the MCDA. This alternative provides connectivity to the Cahaba River while providing the most acceptable method of fish passage. Thirteen Federally listed threatened and endangered species benefit equally or more with Alternative 5d than any other alternative evaluated. Additionally, Alternative 5d is preferred by the non-Federal sponsor (NFS). The TSP becomes the Recommended Plan once endorsed at the Agency Decision Milestone (ADM).

ENVIRONMENTAL IMPACTS

No significant adverse impacts were identified; however, significant benefits to aquatic species including threatened and endangered species would occur. Aquatic species within the Study Area would continue to decline in abundance and diversity under Future Without-Project (FWOP) conditions and the TSP would not only avoid that consequence but also could improve critically imperiled species population such as the Alabama sturgeon by reconnecting the historic spawning sites within the Cahaba River to the Alabama River.

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List of Acronyms

ACHP .....Advisory Council on Historic Preservation
ACT .....Alabama Coosa Tallapoosa River Basin
ADCNR ....Alabama Department of Conservation and Natural Resources
ADEM.....Alabama Department of Environmental Management
ADM ……. Agency Decision Milestone
ADOT .....Alabama Department of Tourism
AEP .....Annual Exceedance Probability
AFB .....Air Force Base
ALDOT .....Alabama Department of Transportation
AMM.....Alternatives Milestone Meeting
AMM-IPR..Alternative Milestone Meeting-In Progress Review
ASA(CW) .Assistant Secretary of the Army for Civil Works
BCR.....Benefit-to-Cost Ratio
BGEPA.....Bald and Golden Eagle Protection Act
BMPs .....Best Management Practices
BO .....Biological Opinion
CAA.....Clean Air Act
CAP.....Continuing Authorities Program
CCD…..... Census County Division
CE……Cost Effectiveness Analysis
CEM …….Conceptual Ecological Model
CEQ …….Council of Environmental Quality
CFR.....Code of Federal Regulations
CM …….Construction Management
CWA.....Clean Water Act
DSAC .....Dam Safety Action Class
DSS.....Decent, Safe, and Sanitary
eDNA.....Environmental DNA
EOP.....Environmental Operating Principles
EQ .....Environmental Quality
ER .....Engineering Regulation
ERDC .....Engineering Research and Development Center
ESA.....Endangered Species Act
FCSA.....Feasibility Cost Share Agreement
FEMA .....Federal Emergency Management Agency
FHWA.....Federal Highway Administration
FMEEP.....Floodplain Management/Emergency Evacuation Plan
FRM ..... Flood Risk Management
FPCI ……. Fish Passage Connectivity Index
FRP..... Flood Response Plan
FWOP..... Future Without-Project Condition
FY ..... Fiscal Year
GRP ……. Gross Regional Product
H&H..... Hydrology and Hydraulics
HEC ..... Hydrologic Engineering Center
HTRW..... Hazardous, Toxic, and Radioactive Waste
HQ ..... Headquarters
HU ……. Habitat Unit
ICLUS..... Integrated Climate and Land-Use Scenarios
IDC..... Interest During Construction
IFR/EA..... Integrated Feasibility Report and Environmental Assessment
IPR..... In Progress Review
LERRDs .. Lands, Easements, Rights-of-way, Relocations, and Disposal
LUST ..... Leaking Underground Storage Tank
MBTA ..... Migratory Bird Treaty Act
MCDA……Multi-Criteria Decision Analysis
MFR..... Memorandum for Record
MOA ..... Memorandum of Agreement
MSL ……. Mean Sea Level
NAA..... No Action Alternative
NAAQS.... National Ambient Air Quality Standards
NAVD ..... North American Vertical Datum
NED ..... National Economic Development
NER…..... National Environmental Restoration
NEPA..... National Environmental Policy Act
NFIP ..... National Flood Insurance Program
NFS..... Non-Federal Sponsor
NHPA ..... National Historic Preservation Act
NPDES .... National Pollutant Discharge Elimination System
NPS ..... National Park Service
NRCS ..... Natural Resources Conservation Service
NRHP ..... National Register of Historic Places
O&M ..... Operation and Maintenance
OMRR&R Operations, maintenance, repair, rehabilitation, and replacement
OSE ..... Other Social Effects

OSHA.....Occupational Safety and Health Administration
P&G.....Principles and Guidelines
P.L......Public Law
PCE(s).....Primary Constituent Element(s)
PDT .....Project Delivery Team
PED.....Preconstruction Engineering and Design
POA.....Period of Analysis
PPA.....Project Partnership Agreement
REC.....Recognized Environmental Conditions
RED.....Regional Economic Development
RECONS..Regional Economic Systems Model
REI ……. Relative Ecological Improvement
ROM.....Rough Order of Magnitude
RM.....River Mile
RPM(s).....Reasonable and Prudent Measure(s)
SAD.....South Atlantic Division
SHU.....Strategic Habitat Unit
SPRA…... Screening for Portfolio Risk Analysis
SRRU ..... Strategic River Reach Unit
SQRA…... Semi-Quantitative Risk Assess
SWAP…... State Wildlife Action Plan
TMDL(s) .. Total Maximum Daily Load(s)
TPCS …... Total Project Cost Summary
TSP..... Tentatively Selected Plan
U.S...... United States
USACE .... U.S. Army Corps of Engineers
USDA ..... U.S. Department of Agriculture
USEPA .... U.S. Environmental Protection Agency
USFWS.... U.S. Fish and Wildlife Service
USGS ..... U.S. Geological Survey
UXO(s) .... Unexploded Ordnance(s)
VT ……. Vertical Team
WCC ..... White Citizens' Council
WQC..... Water Quality Certification
WRDA ..... Water Resources Development Act
WRRDA... Water Resources Reform and Development Act

Units of Measurement

Cubic feet Per Second.....cfs
Cubic yards.....cy
Degrees ..... °
Fahrenheit..... F
Feet or Foot ..... ft
Inch..... "
Miles .....mi
Percent..... %
River Mile .....RM
Square yards .....sy

1.0 INTRODUCTION

This Integrated Feasibility Report (IFR) and Environmental Assessment (EA) presents the results of the Claiborne and Millers Ferry Locks and Dams Fish Passage Study. The Draft IFR/EA integrates plan formulation with documentation of environmental effects, lists potential alternatives for fish passage, and outlines the process used for identifying the Tentatively Selected Plan. It also documents compliance with the National Environmental Policy Act (NEPA) of 1969 and includes input from the Non-Federal Sponsor (NFS) and the public. Sections required for NEPA compliance are denoted with an asterisk (*) in the heading.

The Council on Environmental Quality (CEQ) updated the 1978 regulations for implementing NEPA (Title 40 of Code of Federal Regulations (CFR) Parts 1500-1508) in July 2020 and amended 40 CFR Parts 1502, 1507, and 1508 in April 2022. As such, this Draft IFR/EA has been prepared in accordance with NEPA and the 2020 40 CFR 1500 – 1508 regulations, as amended.

1.1 Study Purpose and Need for Action*

Purpose. The purpose of the study is to evaluate Federal interest in establishing fish passage through restoring connectivity in the Alabama and Cahaba Rivers. The system is highly impaired by two dams which restrict access to historical spawning grounds on the Cahaba River from species present in the lower Alabama River. This disruption of natural fish migration patterns has resulted in a decline in native aquatic species populations. Passage would reconnect over 230 miles of the Alabama and Cahaba Rivers to the Mobile River Delta into the Gulf of Mexico, providing connectivity for multiple species of fish, crayfish, mussels, turtles, etc. These species are extremely important to this freshwater ecosystem and are critical to sustain biodiversity and encourage a healthy ecosystem. This system provides one of the last habitats to many affected species; increased access to historical spawning grounds should result in an increase in the size and distribution of native fish populations.

Need. River ecosystems are complex systems of energy, water, and material flows interacting with a diverse set of organisms. A “healthy” river maintains its connectivity as determined by the geomorphological characteristics of the watershed. These physical connections allow the river ecosystem to be resilient to external stressors within a certain range of natural variation, maintaining a self-sustaining condition of the ecosystem. Disruption of these relations can lead to degradation of the river system. The Claiborne and Millers Ferry locks and dams disrupt the connectivity of the river corridor and alter the distribution and abundance of many river organisms. Additionally, there is a need to maintain the process of carbon sequestration that occurs in the bottomland hardwoods of the delta, a critical process that captures and stores carbon dioxide in the ground thereby improving ecosystem resiliency.

The project directly addresses the loss of habitat connectivity for fish movement in the river system. Individually, these rivers are nationally significant and holistically may be in the top 5 in the U.S. for biodiversity. The restoration of connectivity is widely recognized as critical to

maintaining biodiversity and ecosystem functions. This project is part of the development of a resilient, productive, and biodiverse habitat in the region which will provide additional resilience in a changing climate.

1.2 Study Authority*

This study is authorized by Section 216 of the Flood Control Act of 1970 (33 U.S.C. 549a). Section 216 authorizes the Corps of Engineers "to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due [to]significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."

1.3 Non-Federal Sponsor (NFS)

The NFS is The Nature Conservancy. A Feasibility Cost Share Agreement was executed on November 21, 2021.

1.4 Study Scope

*1.4.1 Study Area**

Claiborne and Millers Ferry Locks and Dams are part of a larger system extending through Alabama, the northwest corner of Georgia, and into Tennessee, and are part of the Alabama-Coosa-Tallapoosa (ACT) River system. The system contains 5 USACE dams and 11 privately owned dams as depicted in Figure 1. Claiborne Lock and Dam is the southernmost lock and dam on the system (approximately 127 stream miles above the mouth of the Mobile River) and Millers Ferry Lock and Dam (approximately another 60 stream miles north of Claiborne). These two locks and dams are the only barriers separating the Cahaba River from the Lower Alabama River, Mobile Delta, and the Gulf of Mexico. The project area extends from the Alabama River below the mouth of the Cahaba River and is approximately 120 river miles long.

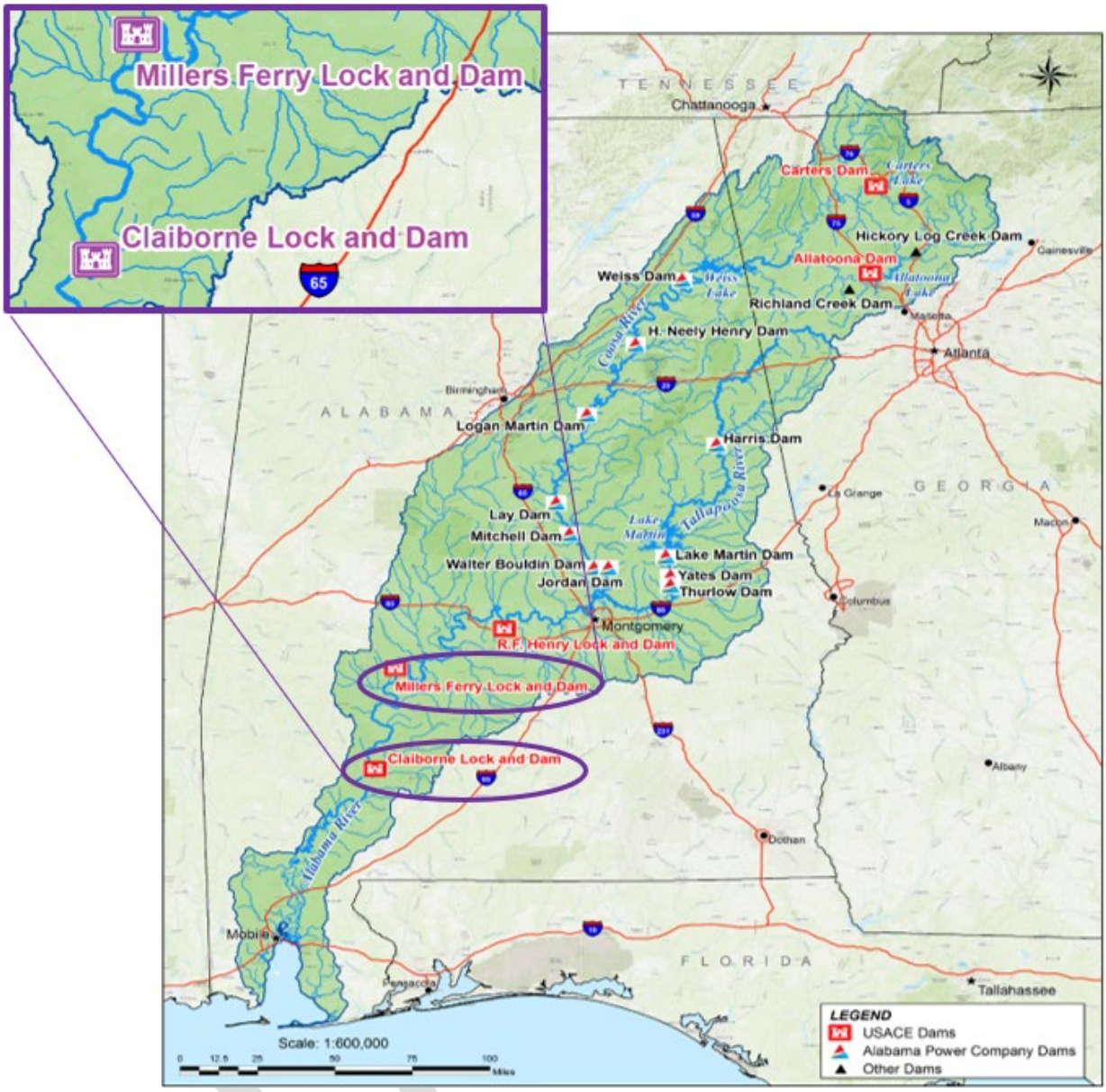

Figure 1 – The Alabama-Coosa-Tallapoosa (ACT) River system

*1.4.2 Project Area**

The project includes two lock and dam projects, Claiborne Lock and Dam (Claiborne) and Millers Ferry Lock and Dam (Millers Ferry).

Claiborne is the southernmost lock and dam on the Alabama River and was constructed between 1966 and 1970. It is primarily a navigation structure, but also reregulates the peaking flow releases from the upstream Millers Ferry Project. Other project purposes include water quality, recreation, and fish and wildlife conservation and mitigation. There is no flood risk management storage for this project. Its features include a lock, fixed crest spillway, gated spillway and right and left dikes as depicted in Figure 2.

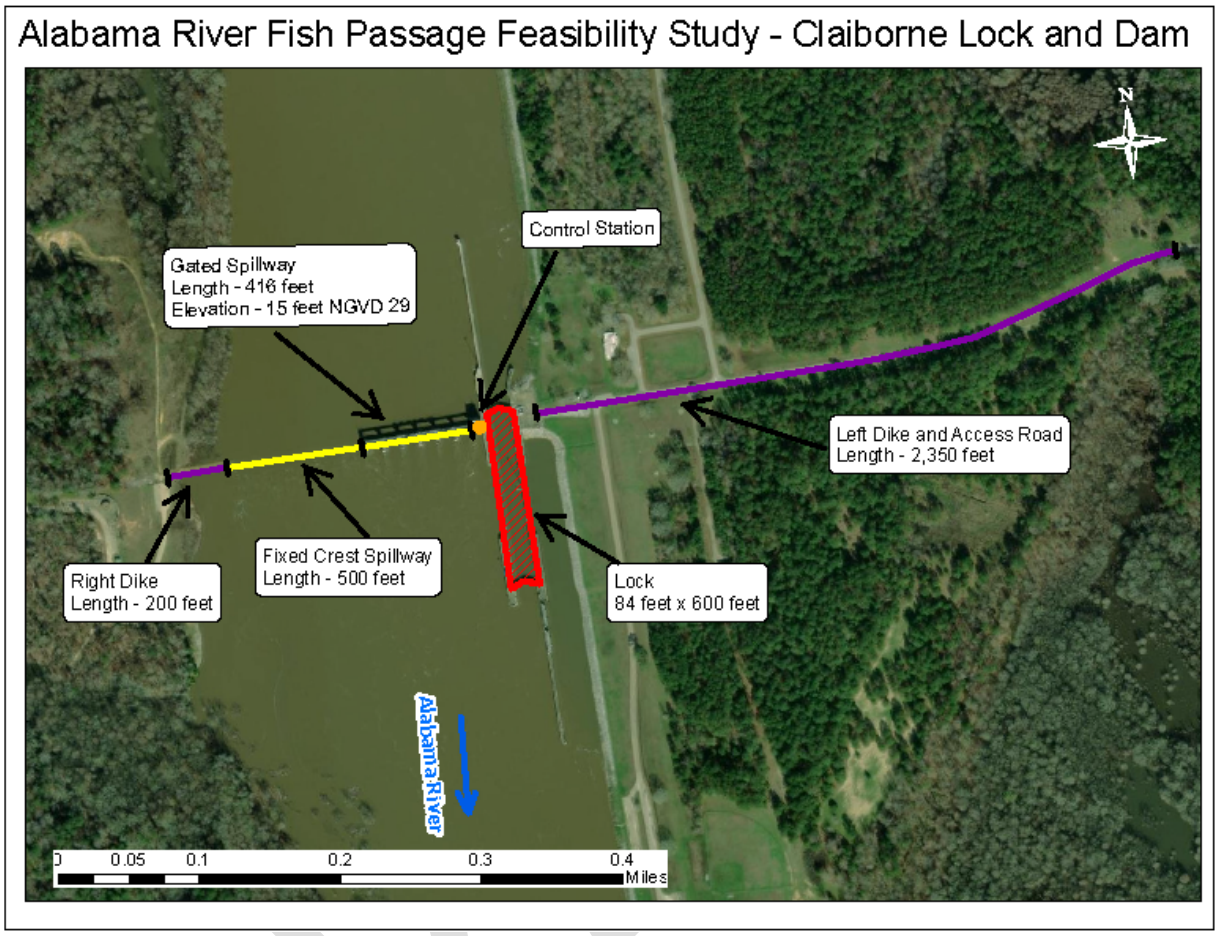

Figure 2 – Claiborne Lock and Dam

Millers Ferry is upstream of Claiborne on the Alabama River and was constructed between 1964 and 1970. Primary project purposes include hydropower and navigation. Other project purposes include recreation, water quality, and fish and wildlife conservation and mitigation. There is no flood risk management storage for this project. Its features include a lock, control station, powerhouse, gated spillway, and right and left dikes as depicted in Figure 3.

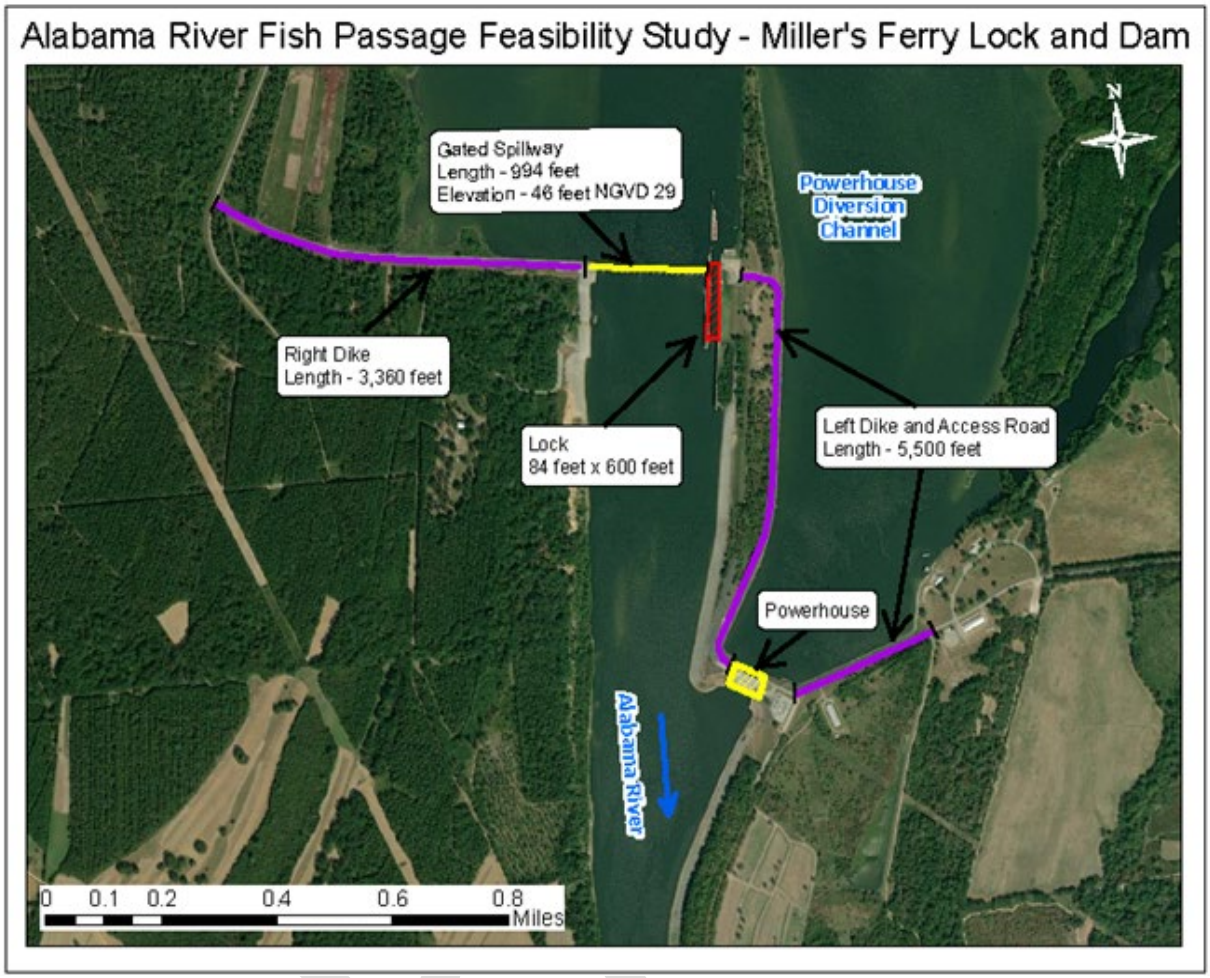

Figure 3 – Millers Ferry Lock and Dam

1.5 Prior Reports and Existing Projects

- House Document No. 66, 74th Congress, 1st session (308 Report) was the first comprehensive report on the optimum use of the water resources in the basin and was prepared by USACE in 1934. This plan contemplated five navigation dams on the Alabama River.
- A resolution by the Committee on Rivers and Harbors, House of Representatives, passed on 28 April 1936, requested a review to determine if changes in economic conditions warranted modifying House Document No. 66, 74th Congress, regarding the Alabama River.
- A resolution of the Committee on Commerce, U. S. Senate, adopted 18 January 1939, requested a review to determine the advisability of constructing reservoirs on the Alabama-Coosa Rivers and tributaries for hydroelectric power development and navigation improvement.

- The Chief of Engineers recommended a general plan for the development of the basin through House Document No. 414, 77th Congress, 1st Session, dated 15 October 1941. Congress authorized the initial partial accomplishment of this plan in the River and Harbor Act of 2 March 1945, (P.L. 79-14). Planning studies to provide navigation facilities with the maximum feasible hydroelectric power for the initially authorized projects began in 1945.
- A site selection report for the entire Alabama River was submitted on 10 December 1945. This report recommended dredging the lower river and building the Claiborne, Millers Ferry, and Jones Bluff locks and dams with power plants at the latter two projects. The first design memorandum for Claiborne, "General Design No. 1," was submitted on 12 April 1963. This report proposed the Claiborne plan to include a navigation lock, a gated spillway, a fixed spillway, a control station, and earth dikes on both banks. Seven other design memoranda dealing with particular project features were submitted over the next four years.
- A contract to construct the Claiborne Lock and Dam was awarded to the Arundel and Dixon Companies as a joint venture on 22 April 1966. The lock and the gated spillway were completed in 1969 and the second stage cofferdam was placed to allow for fixed crest spillway construction. In November 1969, the pool was raised to an elevation of 31 feet National Geodetic Vertical Datum (NGVD), and navigation through the lock was permitted on 15 November 1969. In early December 1969, the pool was raised to an elevation of 32 feet NGVD29 and was maintained between 32 and 33 feet NGVD 29, except during a brief flood period, until mid-May 1970 when the full pool of 35.0 feet NGVD2 9 was attained. (National Geodetic Vertical Datum of 1929 (NGVD 29). The Sea Level Datum of 1929 was named the National Geodetic Vertical Datum of 1929 on May 10, 1973.)
- A contract for the construction of the lock and dam at the Millers Ferry site was awarded to the Morrison-Knudsen and Bates & Rogers Companies, as a joint venture, on 16 October 1964. The lock and a portion of the spillway were completed in June 1968 to the extent that the reservoir could be filled to an elevation of 72 feet NGVD 29 and the lock placed in temporary operation. In March 1969, the pool was lowered to an elevation of 67 feet NGVD 29 due to complications with the cofferdam protecting the powerhouse construction. Use of the lock was suspended. Construction proceeded by late fall of 1969 and included the completion of the spillway so the pool could be raised sufficiently to resume navigation. (National Geodetic Vertical Datum of 1929 (NGVD 29). The Sea Level Datum of 1929 was named the National Geodetic Vertical Datum of 1929 on May 10, 1973.)
- The powerhouse construction at Millers Ferry was awarded under a separate contract on 19 July 1966 to Blount Brothers Company. The first generating unit was placed in operation on 15 April 1970, followed by a second unit one week later. The third unit was

placed in operation on 27 May 1970 at which time the project was considered essentially complete.

- A trash gate was installed at Millers Ferry in 2004 to assist in passing drift that gets trapped behind the spillway and powerhouse. It is located directly adjacent to the powerhouse.
- In December 1970, P.L. 91-583 named the lake formed by the Millers Ferry Lock and Dam the William "Bill" Dannelly Lake.

1.6 USACE Planning Process

USACE instituted the “SMART” planning paradigm for feasibility studies in 2012. Under this paradigm, USACE will deliver a study that has **Specific** and **Measurable** objectives and provides a recommendation that is **Attainable** and **Risk-informed** over a **Timely** study period (maximum of three years). USACE has identified key decision points, called milestones, throughout the study period. These milestones bring together the USACE Vertical Team (VT) and the NFS and confirm concurrence on the formulation, decision making, and risk evaluation prior to moving forward. The feasibility study milestones representing key planning decisions are shown in Figure 4 below.

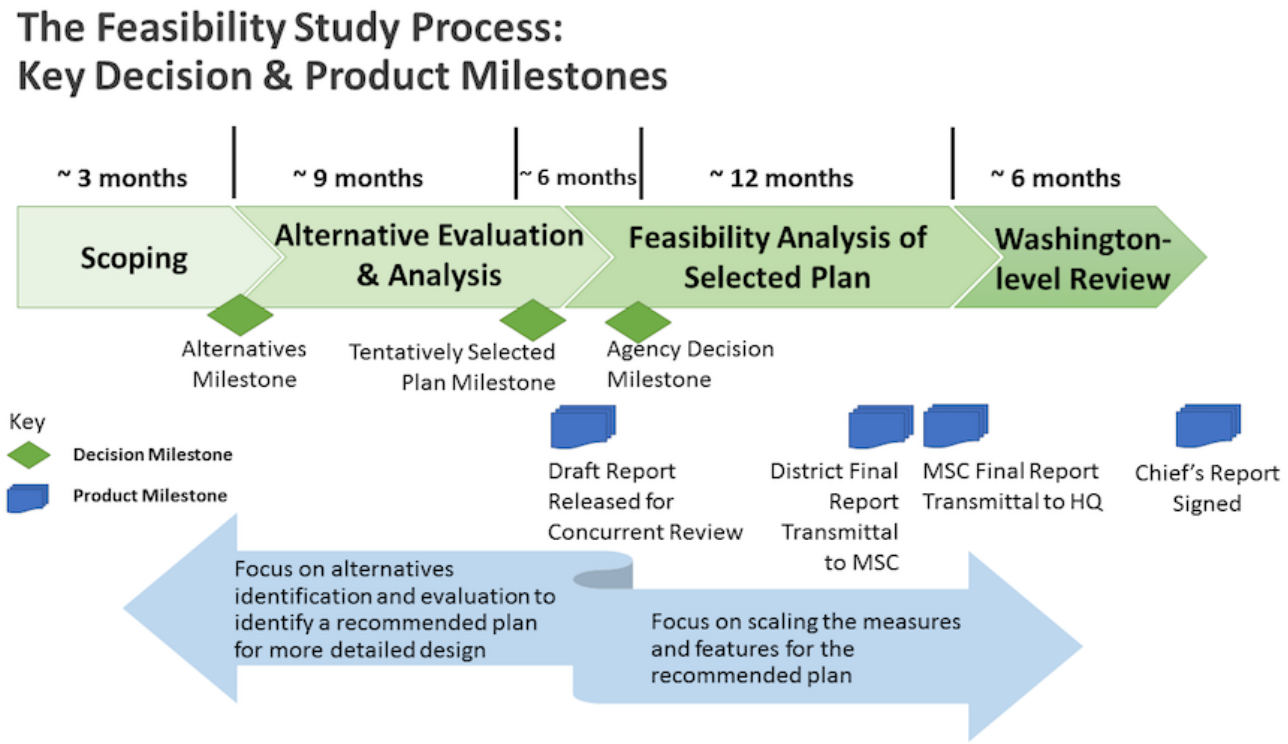

Figure 4 – USACE SMART Feasibility Study Process

USACE maintains adherence to the six-step planning process as defined in the 1983 P&G and the 22 April 2000 Planning Guidance Notebook (ER 1105-2-100) to:

1. Define the Problems, Opportunities, Objectives and Constraints
2. Inventory the study area and forecast FWOP conditions
3. Formulate alternative plans
4. Evaluate alternative plans
5. Compare alternative plans
6. Select a recommended plan

The Project Delivery Team (PDT) follows the planning process as laid out in this report. The formulation that leads to identifying the TSP is iterative. Section 2.0 discusses the formulation process leading to the final array of alternatives. Sections 4.0 and 5.0 discuss the formulation process from the final array of alternatives to selection of the TSP which becomes the Recommended Plan once endorsed at the ADM.

1.7 Resource Significance and the Federal Interest

1.7.1 Technical Significance

Technical significance means that the importance of the environmental resource is based on scientific or technical knowledge or judgement of critical resource characteristics. The Cahaba River is nationally significant, as it is one of eight biodiversity hotspots out of 2,111 watersheds in the contiguous U.S. (UA 2023). Additionally, the World Wildlife Fund indicates that the Mobile/Tennessee/Cumberland River system is among the 19 highest priority places to save on the planet in the next decade. This includes the Alabama River, which has been identified as a “critical watershed” to conserve at-risk fish and mussel species (TNC 1988). It also includes designated critical habitat for Gulf Sturgeon, Alabama Sturgeon, Alabama Moccasinshell, Orangenacre Mucket, and Southern Clubshell. Reconnecting the Cahaba River would restore connectivity down to Mobile Bay, the fourth largest estuary in the contiguous U.S. The project could also accrue benefits under the Endangered Species Act of 1973 (ESA) Section 7(a)1 in the reservoirs formed by Claiborne and Millers Ferry.

1.7.2 Institutional Significance

Institutional significance means that the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, Tribes, or other groups. Many target species are recognized by these groups. The ESA and the Anadromous Fish Conservation Act of 1965 are both recognized institutionally and cover two fish species, seven mussel species, one snail species, and two plant species between Claiborne lock and dam and the mouth of the Cahaba River. State and Federal agencies have formed the Alabama Rivers and Streams network to map restoration options for the river and its species.

1.7.3 Public Significance

Public significance is present if the public recognizes interest in a particular resource. The existence of groups such as the Cahaba River Society, the Cahaba Riverkeepers, the Alabama River Diversity Network, Ducks Unlimited Conservation program, Alabama Scenic River Trail Paddle Race, and the US Fish and Wildlife's (USFWS) collaboration with State agencies and private institutions all exemplify a significant public interest in the project.

2.0 ALTERNATIVE PLAN FORMULATION

2.1 Problem

The problem below was identified in the Scoping Meeting with stakeholders and through coordination with the NFS:

- The geomorphological characteristics of a healthy river aid in maintaining river connectivity, encouraging resilient ecosystems within a certain range of natural variation. Disruption of these relations can degrade the river ecosystem. There has been a loss of habitat connectivity from below Claiborne lock and dam to the Cahaba River above Millers Ferry lock and dam, causing a decline in native aquatic species populations. Species in the lower Alabama River and the Cahaba River have been cut off from their desired spawning habitat because of the restricted longitudinal habitat connectivity for fish movements through the locks and dams. Millers Ferry and Claiborne locks and dams have disrupted natural fish migration patterns resulting in an increased threat to species survival. Improved habitat connectivity, including the movement of threatened & endangered and State-protected species of mussels and host fish, will encourage a healthy ecosystem and increased biodiversity.

2.2 Opportunities

Based on the identified problems, the opportunities identified in the initial steps and iterations of the planning process include the following:

- Restore indigenous peoples' and historic communities' access for sustenance, recreation, cohesion, and resiliency.
- Increase climate resiliency through improved wetland and marshland function.
- Provide a more natural flow regime for seasonal flows, sediment transport, and improved aquatic habitat for downstream ecosystems.
- Restore natural floodplain function.

2.3 Planning Objectives and Constraints

2.3.1 Objectives

Specific planning objectives have been identified to reach the desired outcomes by solving the problems and taking advantage of the opportunities. These planning objectives are focused on

species access and habitat biodiversity and are as follows:

- Increase the spatial distribution of aquatic species while encouraging balanced native populations.
- Reconnect over 230 miles of the Alabama and Cahaba Rivers to the Mobile River Delta into the Gulf of Mexico for migration, spawning, foraging, and nurseries for native fish and mussel species.
- Restore a more natural flow to improve migration and post-spawning life cycle requirements.

2.3.2 Constraints

Planning constraints are significant barriers or restrictions that limit the extent of the planning process. Study-specific planning constraints are statements of attributes unique to a specific planning study that alternative plans should avoid. The following constraints (i.e., limitations on the range of measures and alternatives that can be proposed) have been identified for the study:

- Avoid/minimize adverse impacts to threatened and endangered species
- Avoid increasing exotic/invasive species distribution
- Avoid impacts to physical limitations of the locks and dams head limits, and access to facilities
- Abide by real estate restrictions (i.e., zoning ordinances, covenants, etc.)
- Avoid impacts to properties eligible on the National Register of Historic Places
- Avoid increases in flood elevations that would require mitigation of adverse effects
- Minimize impacts to authorized purposes of navigation and hydropower

2.4 Measure Development and Screening

A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Alternative plans are a set of one or more management measures functioning together to address one or more planning objectives.

The PDT identified a comprehensive list of potential measures and assessed each measure to determine its effectiveness at each lock and dam. Those measures which would not contribute to meeting planning objectives were eliminated. Alternative plans were then developed using the remaining measures, and environmental and engineering criteria were utilized to determine if alternatives could address specific problems in the study area. As the focused array of alternatives were analyzed, the PDT screened them until a TSP was reached based on environmental benefits achieved, cost effectiveness analysis of those benefits and associated alternative costs.

2.4.1 Management Measures

Measures are divided into two categories, structural and non-structural. Structural measures require construction on site where non-structural measures are activities based. Activities can be one time or recurring actions.

Draft measures to address problems and opportunities and meet project objectives were developed through team meetings and coordination efforts, including a Charette and subsequent planning iteration meetings. These measures are listed in .

Table 1 – Measures

A	No Action	
Structural Measures		
B	Dam Removal	Complete removal of the dam structures
C	Fixed Weir Rock Arch	Allows pool to be maintained. A bypass rock ramp
D	Fish Ladder	A type of pool and weirs often used at hydroelectric projects
E	Serpentine Vertical Slot Fishway	Pool type fish ladder
F	Fish Lift	An elevator for fish and water
G	Natural Bypass Channel	Low gradient earthen or rocky channels that mimic natural stream structure
H	Partial Dam removal	Partial removal of dam structure
I	Lock Modification	May be paired with attractant
J	Trap and Haul	Gathering/trapping fish in a reservoir then moving to an upstream location via non-aquatic transportation mode
K	Fish Transport System	Similar to Trap and Haul
L	Fish Cannon	Hydraulic cannon which moves fish from the lower pool to the upper pool of a reservoir
M	Denil-Type Fish Passage	A sloped trough with V-shaped baffles inserted at a 45-degree angle to the sloped floor at regular intervals creating a low velocity zone through which fish can pass
N	Fish Wheel	Similar to a well wheel, two nets with paddles are affixed to each end of a rotating wheel. Water flow pushes the paddles and causes the wheel to rotate, catching the fish in the nets
O	Fish Flume	A structure that allows for the downstream passage of species, often utilized with another measure such as Trap and Haul
Non-Structural Measures		
P	Attractant	Motivation by food, sound, electricity (e.g., Asian carp around Chicago River)
Q	Aeration	Encourages fish to move in certain directions; considered a subset of attractant
R	Gate Operation Modifications	Changes in operation of flood control gates to allow passage of fish

2.4.2 Measure Screening

Management measures were screened based on an appraisal of how well they met planning objectives and avoided planning constraints at each of the locks and dams. The initial measure screening efforts focused on the ability of the measures to meet project objectives through solving identified problems.

Screening is an iterative process of eliminating measures that will no longer be considered based on planning criteria. Criteria were derived for the specific study based on the objectives, constraints, problems, and opportunities of the study/project area. The criteria utilized for the initial evaluation follows.

Criteria 1 – Does it increase spatial distribution/encourage balance? (Objective 1)

Metric 1 – Does it provide connectivity for species across zones (i.e., benthic, littoral, pelagic)?

Criteria 2 – Does the measure provide connectivity for the representative aquatic species? (Objective 2)

Metric 2 – What species typically are aided by the measure? Can we expect this measure to work with our representative species?

Criteria 3 – Does this measure address restoring a more natural flow regime to improve migration and post-spawning life cycle requirements? (Objective 3)

Metric 3 – Does it restore a more natural flow?

Criteria 4 – Does it avoid constraints?

Metric 4 – Check measure against the constraints

In addition, the PDT discussed whether the measure would be feasible and effective at Claiborne and/or Millers Ferry and if so, how information might be gathered regarding the effectiveness of the measure. This discussion led to changing some of the representative species, given the need to collect and analyze available data.

Descriptions of the outcome and reasoning are provided below.

2.4.2.1 Structural Measures

B - Dam Removal – RETAINED for additional information gathering and/or analysis

Since dam removal would fully address project objectives, it is being retained as a measure. However, it would result in a change in project purposes which, as noted under constraints, would require Congressional approval. In addition to impacts on project purposes, removal may impact intakes or outfalls, campgrounds, or other water-based or near shore activities. Given these impacts, dam removal would result in additional time and funding requirements beyond the current scope.

C - Fixed Weir Rock Arch – RETAINED for additional information gathering and/or analysis

The fixed weir rock arch is a bypass rock ramp. These ramps are known to work well for Shad, Herring, and Striped Bass, but their functionality with Sturgeon is not known.

D - Fish Ladder – REMOVED from additional consideration as a distinct alternative

This would work well for strong swimmers, but may be problematic for weaker, smaller, and benthic fish. Fish ladders are salmonid-specific and are not expected to work with the representative species.

E - Serpentine Vertical Slot Fishway - REMOVED from additional consideration as a distinct alternative

A subset of fish ladder; various configurations will be evaluated as additional information is obtained and developed. This alternative is currently too specific and other configurations are more likely.

F - Fish Lift – RETAINED for additional information gathering and/or analysis

Retained due to a lack of information regarding effectiveness. Concerned that it may not have the ability to move species downstream and would need to be combined with other measures to effectively address objectives. Typically used for very tall dams.

G - Natural Bypass Channel - RETAINED for additional information gathering and/or analysis

A natural bypass channel would include either low gradient earthen or rocky channels which mimic natural stream structure and would include attraction flow.

H - Partial Dam Removal - RETAINED for additional information gathering and/or analysis

Partial Dam Removal is likely to be part of other alternatives. Claiborne has a spillway, and something similar might be feasible for Millers Ferry.

I - Lock Modification – REMOVED from additional consideration

Some of the retained measures include aspects of lock modification. This measure was removed in favor of those with greater detail.

J - Trap and Haul – REMOVED from additional consideration

Trap and Haul was removed from additional consideration since it is not practical for representative species in terms of feasibility, cost, and workforce requirements.

K - Fish Transport System – REMOVED from additional consideration

Getting the representative species gathered would be untenable.

L - Fish Cannon – REMOVED from additional consideration

Effective with salmonids but would not work for larger species; gathering target species is untenable. The measure would only move one fish at a time.

M - Denil-Type Fish Passage – REMOVED from additional consideration

Poor passage has been reported for surface dwelling species. It is typically used with barriers which are less than 13 feet in height. In general, it has limited success and will not assist many of the target species.

N - Fish Wheel – REMOVED from additional consideration

Fish Wheels have been primarily used in the quantification and collection of salmonids; no data shows it would be effective in gathering target species. In addition, there is a lack of survivability data for target species since this technology was originally used for fishing.

O - Fish Flume - REMOVED from additional consideration

Effective for the downstream passage of salmonids, but there is no data for the target species and would need to be linked to another measure. This measure would be inefficient.

2.4.2.2 Non-Structural Measures

P & Q – Attractant and Aeration

An attractant is using a specified type of motivation to attract aquatic species such as food, sound, electricity, aeration, etc., to get species to move in certain directions. This measure is ineffective on its own but may be part of a final alternative.

R – Operational Modifications

This measure may be feasible but is not practical. Currently, the gates are operated daily (i.e., opened, closed, “moved”) but this alternative would be significantly more labor intensive; it would require multiple changes per day and constant monitoring. In addition, even with the gates opened, fish would still have to overcome the bulkhead structure, which would not work for benthic fish, such as the sturgeon. Given its limitations, this measure has been removed as a standalone measure, but may be part of a final alternative.

2.5 Formulation of Initial Alternatives and Screening

Alternatives were formulated utilizing combinations of viable measures for each of the dams.

2.5.1 Initial Array of Alternatives

The initial array of alternatives is listed in .

Table 2 – Initial Array of Alternatives*

Alternative		Description
1	No Action Alternative	No Federal Action
2	Dam Removal – Both CL and MF Dams	Complete removal of the dam structures
3	Fixed Weir Rock Arch – Both CL and MF Dams	An in-river fixed weir would replace all or part of the lock and dam structures and would allow pools to be maintained while allowing passage of fish
4	Fish Lift – Both CL and MF Dams	An elevator for fish and water
5	Natural Bypass Channel – Both CL and MF Dams	A channel circumventing the dam structures providing passage to aquatic species
6	Partial Dam Removal – Both CL and MF Dams	Removal of a portion of each dam to allow for aquatic species passage and flow
7	Dam Removal – CL; Fixed Weir Rock Arch – MF	See alt. 2 (CL) & See alt. 3 (MF)
8	Dam Removal – CL; Fish Lift – MF	See alt. 2 (CL) & See alt. 4 (MF)
9	Dam Removal – CL; Bypass Channel – MF	See alt. 2 (CL) & See alt. 5 (MF)
10	Dam Removal – Claiborne; Partial Dam Removal – Millers Ferry	See alt. 2 (CL) & See alt. 6 (MF)
11	Fixed Weir Rock Arch – CL; Fish Lift – MF	See alt. 3 (CL) & See alt. 4 (MF)
12	Bypass – CL; Fixed Weir Rock Arch MF	See alt. 5 (CL) & See alt. 3 (MF)
13	Bypass – CL; Fish Lift - MF	See alt. 5 (CL) & See alt. 4 (MF)
14	Fish Lift – CL; Fixed Weir Rock Arch – MF	See alt. 4 (CL) & See alt. 3 (MF)
15	Partial Dam Removal – CL; Fixed Weir Rock Arch – MF	See alt. 6 (CL) & See alt. 3 (MF)
16	Partial Dam Removal – CL; Fish Lift – MF	See alt. 6 (CL) & See alt. 4 (MF)
17	Partial Dam Removal – CL; Natural Bypass - MF	See alt. 6 (CL) & See alt. 5 (MF)
18	No Structural Change – CL and Fixed Weir Rock Arch – MF	No Change (CL) & See alt. 3 (MF)
19	No Structural Change – CL; Fish Lift – MF	No Change (CL) & See alt. 4 (MF)
20	No Structural Change – CL; Natural Bypass - MF	No Change (CL) & See alt. 5 (MF)

*CL = Claiborne Lock and Dam; MF = Millers Ferry Lock and Dam

2.5.2 Evaluation of Initial Alternatives

The initial array of alternatives was evaluated based on their effectiveness in providing connectivity for the representative species based on professional judgement, experience, and existing information. Alternative effectiveness was discussed both singularly and in combinations. The Decision Management Criteria were developed as follows:

Criteria 1 – Acceptable to Sponsor?
Criteria 2 – Acceptable flood risk?
Criteria 3 – Maintains existing project purposes at acceptable level?
Criteria 4 – Sound and acceptable engineering?
Criteria 5 – Promotes more natural flow?
Criteria 6 – Restores upstream and downstream fish migratory patterns?
Criteria 7 – Relative cost
Criteria 8 – Relative ecological improvement
When available, criteria will include the National Ecosystem Restoration (NER) plan and the four planning accounts: NED/NER, EQ, RED, OSE.

Alternatives were evaluated on their relative ecological improvement based on expert elicitation.

- Any alternative with a low ecological improvement was screened out.
- Any alternative with a medium ecological improvement that violated other screening criteria was screened out.
- Any alternative with a high to extremely high ecological improvement was carried forward, even if it violated other evaluation criteria.

Alternatives were evaluated on relative costs based on expert elicitation. Specific cost was not used significantly as a screening measure prior to the Alternatives Milestone Meeting (AMM) due to the high uncertainty in design dimensions and lengths.

Table 3 depicts the results of the evaluation and screening of the initial array of alternatives.

Table 3 – Evaluation and Screening Criteria

Initial Array of Alternatives*	Acceptable to Sponsor?	Acceptable Flood Risk?	Maintains existing PPs at acceptable level*	Sound and Acceptable Engineering	Promotes more natural flow regime	Restores Fish Migratory Patterns	Relative Cost	Relative Ecological Improvement	Carried Forward
1 - No Action Alternative	N	Y	Y	Y	N	N	0	Extremely Low	Y
2 - Dam Removal, Both Dams	Y	Y	N	Y	Y	Y	$$$$$	Extremely High	Y
3 - Fixed Weir Rock Arch, Both Dams	Y	Y	Y	Y	Y	Y	$$$	Medium	Y
4 - Fish Lift, Both Dams	Y	Y	Y	Y	N	Y	$	Low	N
5 - Natural Bypass Channel, Both Dams	Y	Y	Y	Y	Y	Y	$$$	High	Y
6 - Partial Dam Removal, Both Dams	Y	Y	N	Y	Y	Y	$$$	High	Y
7 - Dam Removal, CL & Fixed Weir Arch, MF	Y	Y	N	Y	Y	Y	$$$$	Medium	Y
8 - Dam Removal, CL & Fish Lift, MF	Y	Y	N	Y	Y	Y	$$$$	Low	N

*CL = Claiborne, MF = Millers Ferry, PP's = Project Purposes

Table 3 – Evaluation and Screening Criteria, Continued

Initial Array of Alternatives*	Acceptable to Sponsor?	Acceptable Flood Risk?	Maintains existing PPs at acceptable level*	Sound and Acceptable Engineering	Promotes more natural flow regime	Restores Fish Migratory Patterns	Relative Cost	Relative Ecological Improvement	Carried Forward
9 - Dam Removal, CL & Bypass Channel, MF	Y	Y	N	Y	Y	Y	$$$$	High	Y
10 - Dam Removal, CL & Partial Dam removal, MF	Y	Y	N	Y	Y	Y	$$$$	High	Y
11 - Fixed Weir Rock Arch, CL & Fish Lift, MF	Y	Y	Y	Y	Y	Y	$$	Low	N
12 – Bypass, CL & Fixed Weir Rock Arch, MF	Y	Y	Y	Y	Y	Y	$$$	High	Y
13 – Bypass, CL & Fish Lift, MF	Y	Y	Y	Y	Y	Y	$$	Low	N
14 - Fish Lift, CL & Fixed Weir Rock Arch, MF	Y	Y	Y	Y	N	Y	$$	Medium	N

*CL = Claiborne, MF = Millers Ferry, PP's = Project Purposes

Table 3 – Evaluation and Screening Criteria, Continued

Initial Array of Alternatives*	Acceptable to Sponsor?	Acceptable Flood Risk?	Maintains existing PPs at acceptable level*	Sound and Acceptable Engineering	Promotes more natural flow regime	Restores Fish Migratory Patterns	Relative Cost	Relative Ecological Improvement	Carried Forward
15 - Partial Dam Removal, CL & Fixed Weir Rock Arch, MF	Y	Y	N	Y	Y	Y	$$$	Medium	N
16 - Partial Dam Removal, CL & Fish Lift, MF	Y	Y	N	Y	Y	Y	$$$	Medium	N
17 - Partial Dam Removal, CL & Natural Bypass, MF	Y	Y	N	Y	Y	Y	$$$$	High	Y
18 – No Structural Action, CL & Fixed Weir Rock Arch, MF	Y	Y	Y	Y	Y	Y	$$$	Medium	N
19 - No Structural Action, CL & Fish Lift, MF	Y	Y	Y	Y	Y	Y	$	Low	N
20 - No Structural Action, CL & Natural Bypass, MF	Y	Y	Y	Y	Y	Y	$$$	Medium	N

*CL = Claiborne, MF = Millers Ferry, PP's = Project Purposes

2.6 Focused Array of Alternatives and Screening

The 20 alternatives in the initial array were evaluated based on technical knowledge and team expertise. These alternatives were weighed against the evaluation and screening criteria, which included: acceptable flood risk, maintains existing project purposes at an acceptable level, sound and acceptable engineering, promotes more natural flow regime, restores fish migratory patterns, and relative ecological improvement (REI). REI held the most weight as a screening criterion; alternatives with low ecological improvement were screened out.

The Focused Array of Alternatives is presented in Table 4 below.

Table 4 – Focused Array of Alternatives

Alternative	Description
1	No Action Alternative
2	Dam Removal – Both Dams
3	Fixed Weir Rock Arch – Both Dams
5	Natural Bypass Channel – Both Dams
6	Partial Dam Removal – Both Dams
7	Dam Removal – Claiborne Fixed Weir Rock Arch – Millers Ferry
9	Dam Removal – Claiborne Natural Bypass Channel – Millers Ferry
10	Dam Removal – Claiborne Partial Dam Removal – Millers Ferry
12	Natural Bypass Channel – Claiborne Fixed Weir Rock Arch – Millers Ferry
17	Partial Dam Removal – Claiborne Natural Bypass – Millers Ferry

2.6.1 Screening of Focused Array

To further screen down from the focused array of alternatives, consideration was given to each alternative's potential impacts to project purposes as well as impacts to public interests. Each alternative included in the focused array meets the goals and objectives and provides a high ecological lift with respect to restoration of fish migration. The purpose of the impacts analysis is to identify alternatives or measures which are likely to have an extreme or unacceptable adverse effect on any project purpose or public interest and to consider screening these from further consideration. To assess the impacts of the alternatives, each measure was considered separately. Consideration was given to impacts to hydropower, navigation, environment, recreation, water supply, as well as impacts to other dams on the river, and private property located in the vicinity of the lakes.

2.6.1.1 Hydropower Analysis

Project authorization at Millers Ferry Lock & Dam includes hydropower. Both a bypass channel and a rock arch weir would have an impact on hydropower production. These measures would both divert some amount of water from being used to generate hydropower to support fish passage. However, this impact would be small compared to the complete loss of hydropower capacity at Millers Ferry associated with dam removal. Dam removal would result in a loss of approximately $33M in annual benefits based on fiscal year 2021 hydropower generation. The removal of Millers Ferry would also end the ability of Miller Ferry hydropower generation to offset the cost of pump back operations at Carters Dam, located upstream of Millers Ferry in the headwaters of the basin. A more in-depth analysis of hydropower benefit changes with respect to a bypass channel and rock weir can be found within Appendix F, Impacts to Hydropower.

2.6.1.2 Navigation Analysis

Project authorization at both Millers Ferry and Claiborne Locks & Dams includes navigation. The navigation system is a low use waterway; however, new industry is awaiting use of the waterway, including the locks at Millers Ferry and Claiborne, once dredging operations are complete. Over $8M was spent in 2022 towards navigation dredging for partial restoration of approved channel depth and $800,000 was spent on dredging operations for small boat access channels. Approximately $12M was appropriated for additional dredging in Fiscal Year 2023 to restore the full navigation channel. Construction of a bypass or rock arch weir would have no measurable impact to navigation on the Alabama River. Dam removal would completely end project support for commercial navigation on the lower Alabama River, and reliable navigable water depths in the channel would not be maintained.

2.6.1.3 Other Dams Analysis

Development of a bypass channel or a rock weir would have no meaningful negative impact outside of the immediate project area. Dam removal would have a negative effect propagating upstream. Removal of Claiborne Lock and Dam would lower the tailwater at Millers Ferry and would cause Millers Ferry to exceed static head limits. Static head limits are the difference between the headwater and tailwater at a dam, dictating the hydrostatic head or pressure that the dam face receives. Upstream of Millers Ferry, R.F. Henry Lock and Dam relies on the Millers Ferry pool to maintain static head limits for dam integrity and stability. To ensure appropriate head limits are maintained at R.F. Henry after removing Millers Ferry dam, a weir structure would need to be built downstream to restore the tailwater at R.F. Henry to acceptable levels. This would directly impact critical habitats for the endangered Heavy Pigtoe mussels, further limiting the habitat that is only found in four areas in the world. In addition, the pool above R.F. Henry would need to be lowered, ending its hydropower production and limiting recreation at the lake.

2.6.1.4 Environment Analysis

Construction of a rock weir or a bypass channel would have a minimal negative impact to the environment. Some wetland mitigation would be required for construction of these measures; however, these would be limited given the small project footprint of the bypass channel and weir.

Dam removal would impact one of the last remaining populations of Heavy Pigtoe mussels found below R.F. Henry Lock & Dam through the lowering of the Millers Ferry pool and the requirement to construct a weir downstream of Robert F. Henry to maintain head limits. Other negative systemwide environmental impacts due to dam removal include extreme sediment migration from changed riverine hydrodynamics, and the potential for contaminated sediment to spread from areas in the lakes downstream to the lower Alabama River and Mobile delta.

2.6.1.5 Water Supply Analysis

Water supply is not a project purpose at either of the dams. However, water users utilize the lake and peaking releases from Millers Ferry to withdraw water and discharge wastewater. Bypass channels and rock weirs would have no impact on water supply within this context. However, dam removal would disrupt the reliability of flow to permit the release of effluent from two plants located below R.F. Henry, one wastewater and one paper plant. Currently, the water intake inverts are set based on water flow and depth controlled by the locks and dams. If a dam is removed, the normal pool elevation lowers, which would impact the water intakes that are set above the new normal pool. Major infrastructure investments would be required to modify the intakes and discharge structures at these plants.

2.6.1.6 Impact to Recreation and Property

Construction of a bypass channel or rock weir would have no impact on recreation. The pool level at both lakes would not experience a noticeable impact to such an extent that would alter recreation activities on the lakes. Lake recreation, which accounts for approximately $7M annual benefits at Millers Ferry and Claiborne, would be nearly eliminated by the loss of pool from dam removal. Additionally, the value of hundreds of private lake properties surrounding the Millers Ferry pool area would decrease. There are approximately 1000 homes built around the Millers Ferry and Claiborne pools which are there primarily due to their vicinity to the lakes. Based on limited market research, these homes have an estimated average value of $190,000 (rough order of magnitude (ROM)) which totals $190M in property value. These property values would be impacted if the lake were substantially lowered or removed.

2.6.2 Impacts Summary

Consideration was given to the negative impacts of each measure making up the focused array of alternatives. All measures considered meet the study goals and objectives at a

high level, however, dam removal has extreme and unacceptable impacts and violates constraints to avoid impacts to project purposes and the environment. Dam removal would end navigation on the river system, remove hydropower from the lower system, impact hydropower operations at other Federal projects in the system, have a major adverse impact on critical habitat below R.F. Henry and effect the local properties and economies of the poor and underserved communities around the lakes. The focused array including weirs and bypass structures would maintain navigation, have a much lower impact to hydropower, would not create physical constraint issues, would have a much lower impact to critical habitat and would have almost no effect on the economies of the surrounding communities. Therefore, dam removal was screened after careful consideration, carrying forward a focused array of alternatives that meet the objectives without these major impacts.

2.7 Final Array of Alternatives*

Given the ability of other alternatives to meet project goals and objectives and the system impacts from dam removal, the remaining alternatives include various permutations of a natural bypass channel and fixed weir rock arch at each of the lock and dam structures as presented in Table 5 below.

Table 5 – Final Array of Alternatives

Alternative	Description
1	No Action Alternative
3	Fixed Weir Rock Arch – Both Dams
5d	Natural Bypass Channel – Both Dams right bank
12b	Fixed Weir Rock Arch– Claiborne Natural Bypass Channel, right bank – Millers Ferry
13b	Natural Bypass Channel, right bank – Claiborne and Fixed Weir Rock Arch – Millers Ferry

3.0 EXISTING AND FUTURE WITHOUT-PROJECT (FWOP) CONDITIONS*

3.1 Physical Environment*

The Mobile-Tensaw Delta and Cahaba River are nationally recognized, significantly diverse ecosystems. Alabama ranks as one of the highest in the continental U.S. for aquatic diversity in both total and endemic populations. Alabama is home to 93 native reptiles (Reptiles 2020) and 450 fish species which is, “the most found in any other state or province in North America” (Mettee, 2016). Additionally, Encyclopedia of Alabama states, “Alabama is home to the most diverse fauna of freshwater mussels in all of North America, with 180 species” (Garner, 2013). Boshung and Mayden (2004) documented 185 fish species historically occurring within the Alabama River drainage basin including

161 native species, 2 euryhaline species, 4 marine species, and 18 introduced species. Williams et al. (2008) document 51 mussel species historically occurring within the Alabama River drainage basin.

The project area consists of two existing lock and dam projects on the lower Alabama River: Claiborne and Millers Ferry. These structures impede migratory fish from reaching historic spawning habitat and limits freshwater mussel spatial distribution.

*3.1.1 Water Resources**

*3.1.1.1 Hydrology**

3.1.1.1.1 Existing Setting

The study area encompasses the Alabama River from Claiborne Lock and Dam in Clarke and Monroe Counties, Alabama to the mouth of the Cahaba River in Dallas County, Alabama. Millers Ferry Lock and Dam lies on the Alabama River between the two in Wilcox County, Alabama.

The Alabama River begins north of Montgomery, Alabama, where the Coosa and Tallapoosa Rivers join and generally flows westward from Montgomery to Selma, and then follows a more southwesterly path to join the Tombigbee River and form the Mobile River. The river then flows south into the Mobile Bay and eventually into the Gulf of Mexico. This network of rivers is referred to as the ACT River Basin.

*3.1.1.1.2 Future Without-Project Conditions**

The FWOP hydrology is primarily driven by climate change across the basin. The climate change analysis indicated some consensus on an increase in extreme precipitation events in the southeast, however there was not a strong consensus that this change would result in an increase in peak river flows.

*3.1.1.2 Water Quality**

Section 401 of the Clean Water Act (CWA) requires that the State issue water quality certification for any activity which requires a Federal permit and may result in a discharge to State waters. This certification must state that applicable effluent limits and water quality standards will not be violated. The U.S. Environmental Protection Agency (USEPA) delegates authority pursuant to the CWA to the states for monitoring and maintaining clean water standards.

Section 303(d) of the CWA authorizes USEPA to assist states, territories, and authorized tribes in listing impaired waters and developing Total Maximum Daily Loads (TMDLs) for these waterbodies. A TMDL establishes the maximum amount of a pollutant allowed in a water body and serves as the starting point or planning tool for restoring water quality. States are required to submit their list for USEPA approval every two years. For each waterbody on the list, the state identifies the pollutant causing the impairment, when

known. In addition, the state assigns a priority for development of TMDL based on the severity of the pollution and the sensitivity of the uses to be made of the waters, among other factors (40 CFR § 130.7.b.4, 2020). According to the Final 2022 Alabama Department of Environmental Management (ADEM) 303(d) list, the section of the Alabama River directly upstream of Claiborne Lock and Dam is listed for Mercury from Atmospheric Deposition as shown in .

Additionally, Section 402 of the CWA addresses stormwater pollution by requiring a National Pollutant Discharge Elimination System (NPDES) permit for activities that discharge into Waters of the U.S. through point (i.e., a pipe, ditch, or channel) and nonpoint source (i.e., runoff) pollution. All construction sites greater than one acre are required to obtain a NPDES permit.

Impaired water quality is predominantly related to urbanized settings. No significant urbanization growth is anticipated within the surrounding areas. The FWOP conditions would not be significantly changed from the existing setting.

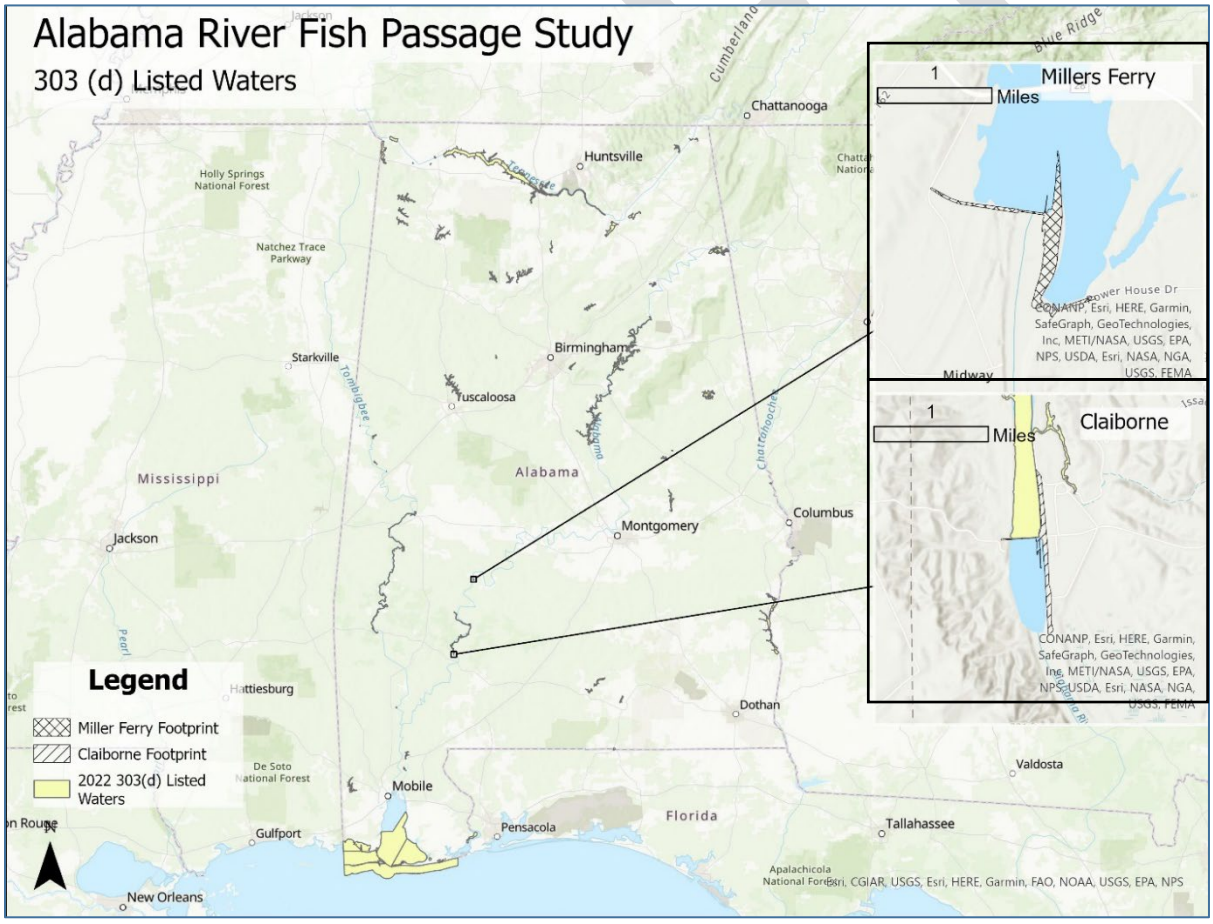

Figure 5 – Location of 303(d) Listed Impaired Waterbodies

3.1.2 Geology and Soils*

3.1.2.1 Millers Ferry Lock and Dam – Site Geology

Millers Ferry lock and dam is in the Gulf Coastal Plain physiographic province. The topography in the area is characterized by rolling hills and prairie land. In the reservoir area flows move southward in wide meanders. The river traverses the Clayton formation of the Tertiary age in the immediate vicinity of the project and chalk and sand formation of the Cretaceous age in the remainder of the area.

The overburdened soils in the area vary in thickness and composition with an average thickness in excess of 30 feet. The right abutment soils are composed primarily of lean clay and silty, clayey sands with little permeable material. The left abutment soils are composed primarily of lean clays underlain by poorly graded sands and gravels which decrease in thickness from 20 feet near the axis line of the dam to zero feet at 1800 feet downstream.

Three geologic formations were penetrated by core at the site. The uppermost is Clayton formation, then Prairie Bluff Formation and Ripley formation. The Clayton formation consists of primarily black, micaceous, marine clay with strata of silty, sandy, chalking limestone throughout the section. The lower member of the Clayton consists of hard, calcareous sandstone of variable thickness underlain by poorly cemented silty, fine-grained sands. The Prairie Bluff is a firm, chalky limestone that can be sliced by a pocketknife. With a high-water content, special care would be needed if exposed to maintain moisture to prevent shrinkage cracks. The thickness of the formation in the area is 10 to 12 feet. Faults were found in four monolith foundations in the land wall of the lock, five monoliths of the spillway, fifteen of the adjacent stilling basin monoliths and throughout the powerhouse area. The faults adjacent to the powerhouse were more numerous in the left intake wall, erection bay, and the right tailrace wall areas. The upper Ripley formation is a hard, calcareous sandstone that varies from less than 1 foot to 6 feet with an average of 2 feet. The lower Ripley formation is a calcareous sandstone interbedded with sand and sandstone.

All the concrete structures, except for the lock floor slabs, were placed on the Prairie Bluff formations.

3.1.2.2 Claiborne Lock and Dam – Site Geology

Claiborne Lock and Dam site is within the Southern Red Hills Divisions of the Gulf Coastal Plain physiographic province. The river meanders through this region and has a broad floodplain generally 25 to 40 feet above the normal river level. Outside the river valley is characterized by gently rolling hills and north facing cuestas developed on harder bed of sedimentary strata. Sediments near the project site are typically coastal plain deposits of interbedded limestones, clays, sand, and sandstone of Paleocene and Eocene age. The Tallahatta Formation of Eocene age underlies the site and provides the foundation for all

structures. The Tallahatta in the project footprint consists of claystone with subordinate sandstone and sand strata. The claystone is a greenish gray, compact, impervious material 20 to 25 feet thick. The field hardness scale for the claystone is “D”, or that the material can be cut with moderate pressure but cannot be completely penetrated. Beneath the lock area an interbedded sand and sandstone occurs directly beneath the alluvial overburden and constitutes the top of the rock.

The sandstone with abundant claystone lens and lamina was generally hard but data from cores were found broken along the horizontal claystone lamina. These surfaces were extremely soft and slick potentially resulting in sliding planes readily occurring. To avoid planes that could lead to differential settling, monoliths of the lock and dam were founded on the hard claystone. Badly broken and jointed zones up to 5 feet thick were encountered in many borings with dips varying from 45 degrees to vertical. The slickensides are interpreted as due to swelling and heaving of the rock mass on either side of the joint with change in overburdened load or water content.

Below existing ground, by 40 feet, a 20 feet thick fat clay is encountered on the left portion of the spillway to the lock walls. Underlying the fat clay is the gravelly sand and clayey fossiliferous sand above sound rock. The top of bedrock occurs at -12.4 feet mean sea level (MSL), respectively.

*3.1.3 Prime and Unique Farmlands**

The Claiborne Lock and Dam vicinity contains a minor amount of prime and unique farmland soils in contrast to the amount within the Millers Ferry Lock and Dam vicinity.

FWOP conditions would be similar to existing conditions. No large-scale urbanization is anticipated due to the depressed economy; therefore, conversion of farmlands would be minimal.

*3.1.4 Climate**

3.1.4.1 Existing Setting

The climate in the Lower Alabama River Basin is generally warm with some seasonal variations. According to U.S. Climate Data, represented in Figure 6, the hottest month of the year tends to be August with an average high temperature of 92° Fahrenheit (F) and average low of 69°F.

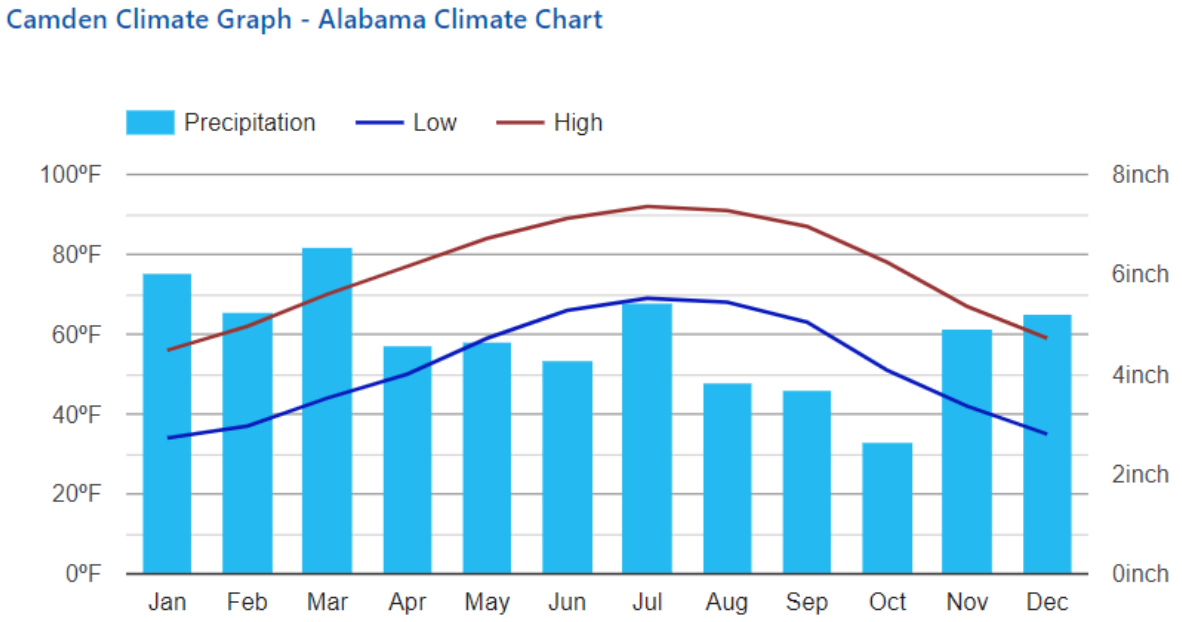

Figure 6 – U.S. Climate Data – Average Monthly Temperatures and Precipitation

The coolest month of the year is January with an average high of 57°F and low of 35°F. Precipitation is heaviest in the project area during the month of March with an average rainfall rate of 5.47 inches (”). Conversely, October is the driest month of the year with an average of 2.68” of rainfall. The average annual precipitation is 51.11”.

*3.1.4.2 Future Without-Project Conditions**

Based on the literature review of relevant climate data, there is a strong consensus of an increase in projected temperature of approximately 2 to 4 degrees by the late 21st Century. There is some consensus that precipitation extremes may increase in the future in terms of both intensity and frequency. However, in general, projections of precipitation have been highly variable across the region. There is not a consensus regarding the direction of trends in peak river flows. In addition, there is uncertainty regarding future hydrology in the region.

The sea level change analysis completed for Claiborne Lock and Dam did not indicate any anticipated impacts to the project area based on a simplified analysis using tide gages located at Mobile, Alabama. There are also no anticipated impacts for Millers Ferry Lock and Dam since the project is in the pool of Claiborne Lock and Dam.

More information regarding climate change is available in Appendix H – Hydrology and Hydraulics, Section H.2. Climate Change.

*3.1.5 Air Quality and Greenhouse Gases**

The USEPA sets National Ambient Air Quality Standards (NAAQS) in accordance with the Clean Air Act (CAA) “for pollutants considered harmful to public health and the

environment." The CAA identifies two types of NAAQS: primary and secondary. Primary standards provide public health protection and secondary standards provide public welfare protection. The USEPA has set NAAQS for six principal pollutants, which are called criteria air pollutants: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and particulate matter (PM10 and PM2.5).

The General Conformity Rule published by the USEPA on November 30, 1993, designates and implements Section 176(c) of the CAA for geographic areas in CAA non-attainment areas for criteria pollutants and in those attainment areas subject to maintenance plans required by CAA Section 175(a). The CAA General conformity Rule applies to Federal actions.

The study area is not located within or near any designated non-attainment areas for any criteria air pollutants as shown in Figure 7.

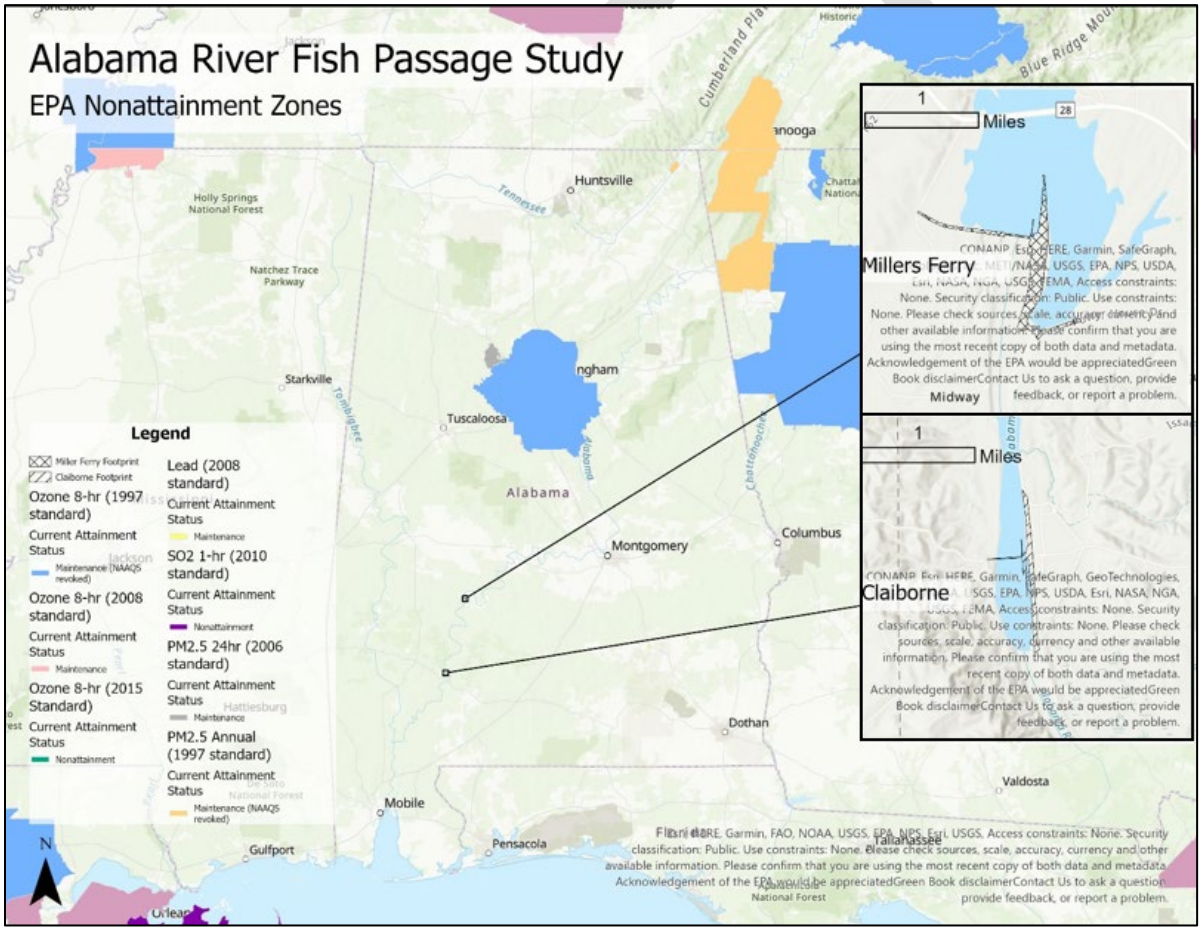

Figure 7 – Nonattainment Zones

Greenhouse gases trap heat and make the planet warmer. According to the USEPA, human activities are responsible for almost all the increase in greenhouse gases in the atmosphere over the last 150 years. (EPA 2023)

Air quality and greenhouse gasses are predominantly driven by urbanized settings. No large-scale urbanization growth is anticipated within the surrounding area due to a depressed economy; therefore, FWOP conditions would be unchanged from the existing setting.

*3.1.6 Hazardous, Toxic and Radioactive Waste (HTRW)**

3.1.6.1 Claiborne

Based on a 2019 Legacy Contamination Survey for the facility (see Appendix E), the L&D itself includes various operational areas where hazardous materials and petroleum have been used or stored, such as a soils lab/shop building where emergency generator diesel drums are currently stored, and an old L&D shop building that is now an equipment storage yard for the recreation O&M contractor. The 2019 survey included interviews with retired L&D employees who recalled the removal of a 1000-gallon diesel tank at the former L&D Shop Building in the lates 1980s. However, there is no documentation to support the existence or removal of the tank, and the interviewee had no recollection of a spill or release associated with the tank. Additionally, four underground 500-gallon butane tanks were burned-off and removed from the former location of the lock tender site homes in 2008. No spills were documented during this effort. Another retired interviewee recalled a burn site located behind the former soils lab/shop building, but could only remember items such as paper products and vegetation being burned there. No evidence was found, nor could any employees recall, that a solid waste dumping area or pit was ever located in this area. Regardless, none of these findings were located along the right bank or within the area of proposed construction for this project. Based on the information contained in the 2019 survey, the consistently undeveloped nature of the area, and the project being located solely on Federally-owned lands, a site visit was not conducted at this time.

A current review of regulatory websites, such as U.S. Environmental Protection Agency's EnviroMapper and EnviroFacts, as well as the National Response Center's database, indicated no new HTRW concerns since the 2019 survey was conducted. See Appendix D for an EnviroMapper screenshot demonstrating a lack of findings. The area searched included the Federally-owned land associated with and adjacent to the Claiborne L&D facility, with the understanding that the project area has historically remained largely undeveloped.

However, the 2019 survey did not appear to include a hazardous materials assessment of the structures located on the right bank, to include the pavilion and the restroom building. Of particular concern for these structures would be Lead-Based Paint (LBP) and Asbestos-Containing Materials (ACM).

FWOP conditions at Claiborne would be consistent with existing conditions. No site cleanups are scheduled and no additional HTRW sites are anticipated.

3.1.6.2 Millers Ferry

The 2021 Legacy Contamination Survey determined that no legacy contamination was identified at Millers Ferry L&D and powerhouse. All areas assessed during the survey were located within the river channel or on the eastern side of the Alabama River. The proposed bypass channel is located on the western side of the River and not impacted by the stored hazardous materials and POLs, nor remaining ACM, located at the facilities within the River and along the east bank. The western side of the River has historically been and remains primarily rural, agricultural, wooded and/or undeveloped land. Structures located along the western side of the River are on private property and are not anticipated to be demolished or otherwise impacted by the proposed construction activities for the bypass channel. Therefore, there are no recognized environmental conditions associated with the planned construction project.

FWOP conditions at Millers Ferry would be consistent with existing conditions. No site cleanups are scheduled and no additional HTRW sites are anticipated.

3.2 Biological Resources*

*3.2.1 Vegetation**

The U.S. Department of Agriculture (USDA) has defined ecological regions of the U.S. through a hierarchal assessment of domains, divisions, and provinces. Based on the USDA Ecoregion Map provided in Figure 8, the study area lies within the southeastern mixed forest province of the Continental U.S. (Bailey 1995).

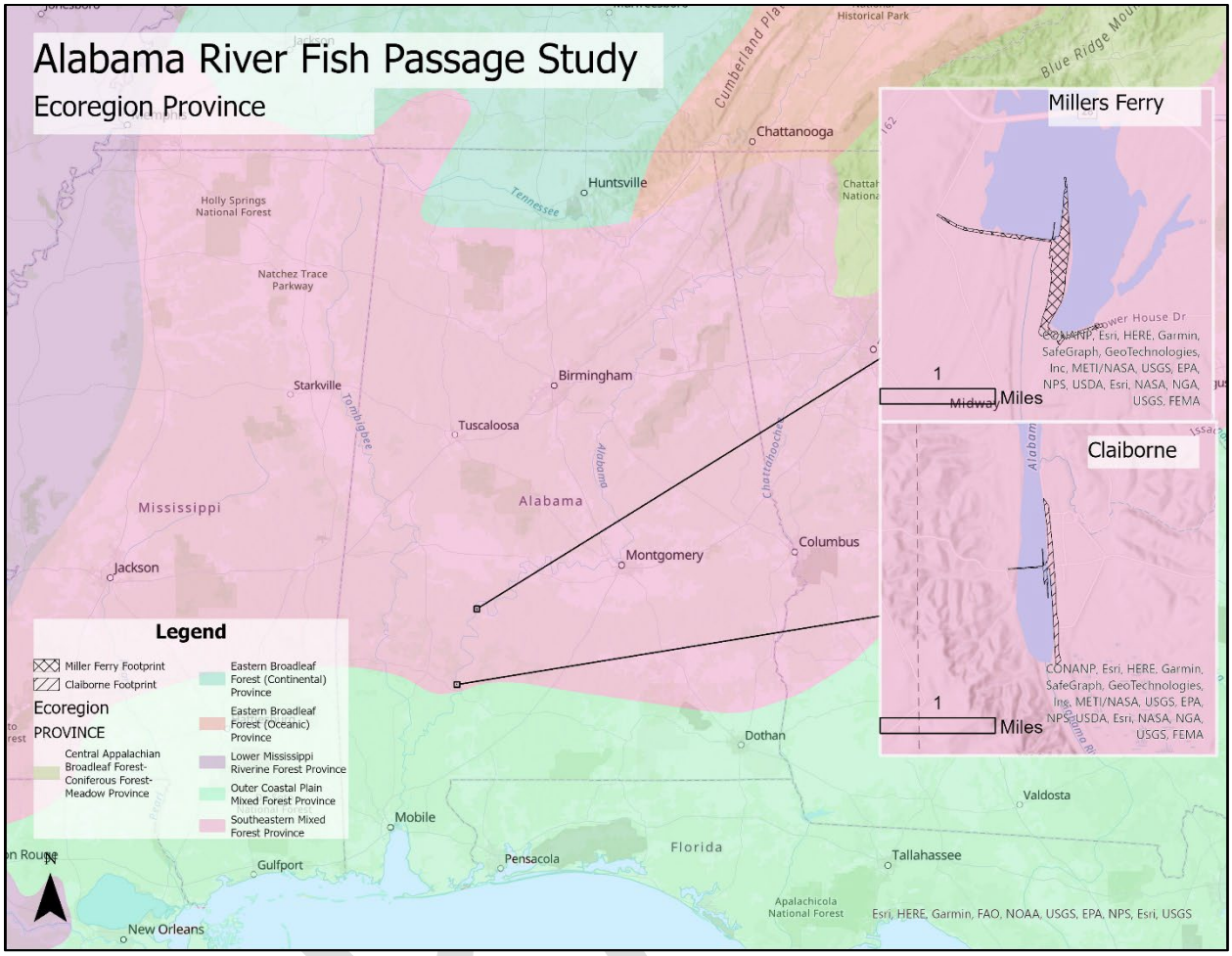

Figure 8 – Study Area Ecoregion Province

After extensive cultivation practices during the 19th century, much of the Piedmont Ecoregion has reverted to pine and hardwood woodlands. Vegetation within the Southern Mixed Forest Province ranges from medium to tall forests of broadleaf deciduous trees and evergreen pine trees (Bailey 1995). Existing habitat within the study area ranges from heavily to moderately disturbed areas. The surrounding habitat includes forested riparian settings. Dominant native plant species throughout the study area include Tulip Poplar (*Liriodendron tulipifera*), White Oak (*Quercus alba*), Northern Red Oak (*Q. rubra*), Black Oak (*Q. velutina*), Post Oak (*Q. stellata*), Hickories (*Carya glabra*, *C. tomentosa*, and *C. cordiformis*), American Beech (*Fagus grandifolia*), Loblolly Pine (Pinus taeda), Virginia Pine (*Pinus virginiana*), Sweetgum (*Liquidambar styraciflua*), Black Cherry (*Prunus serotina*), Flowering Dogwood (*Cornus florida*), Box Elder (*Acer negundo*), and Eastern Red Cedar (*Juniperus virginiana*).

Invasive plant species throughout the surrounding area include Japanese Arrowroot (*Pueraria montana* var. *lobata*), Cogongrass (*Imperata cylindrical*), Yellow Iris (*Iris pseudacorus*), Japanese Honeysuckle (*Lonicera japonica*), Star-Of-Bethlehem (*Ornithogalum umbellatum*), Garlic Mustard (*Alliaria petiolate*), and Chinese Wisteria

(*Wisteria sinensis*). No formalized invasive species control plans exist within the study area.

FWOP conditions would be similar to existing conditions.

*3.2.2 Fish and Wildlife Resources**

The Alabama Department of Conservation and Natural Resources (ADCNR) updates its State Wildlife Action Plan (SWAP) on a 10-year basis, which identifies outstanding wildlife diversity on a comprehensive statewide scale. According to the 2015 SWAP, “Alabama surpasses all eastern states in plant and animal diversity, ranking fifth in the nation after California, Texas, Arizona, and New Mexico” despite only contributing 1.6% of area compared to the total area within the entire contiguous continental U.S.

*3.2.2.1 Aquatic Species**

3.2.2.1.1 Existing Setting

Alabama ranks one of the highest among the continental U.S. for aquatic diversity in both total and endemic populations as shown in Figure 9 and Figure 10. Alabama is home to 93 native reptiles (*Reptiles* 2020) and 450 fish species, which is “the most found in any other state or province in North America” (Mettee, 2016). Additionally, Encyclopedia of Alabama states “Alabama is home to the most diverse fauna of freshwater mussels in all of North America, with 180 species” (Garner, 2013). Boshung and Mayden (2004), documented 185 fish species historically occurring within the Alabama River drainage (161 native species, 2 euryhaline species, 4 marine species, and 18 introduced species). Williams et al. (2008), document 51 mussel species historically occurring within the Alabama River drainage area. Table 6 lists some common species found throughout the study area but is not a comprehensive list of all species known to occur.

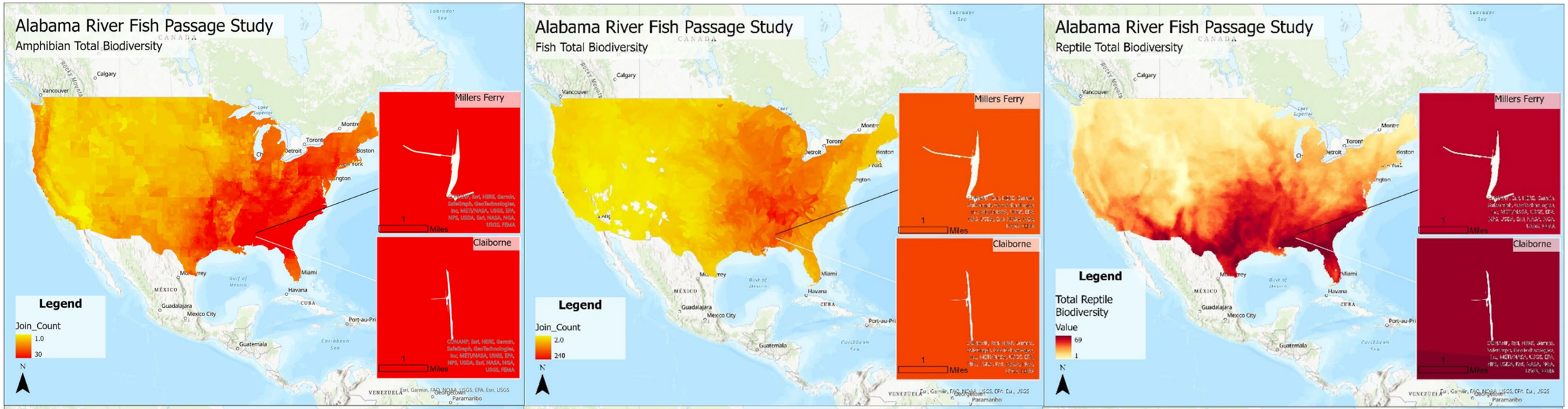

Figure 9 - Total Biodiversity for Multiple Taxa

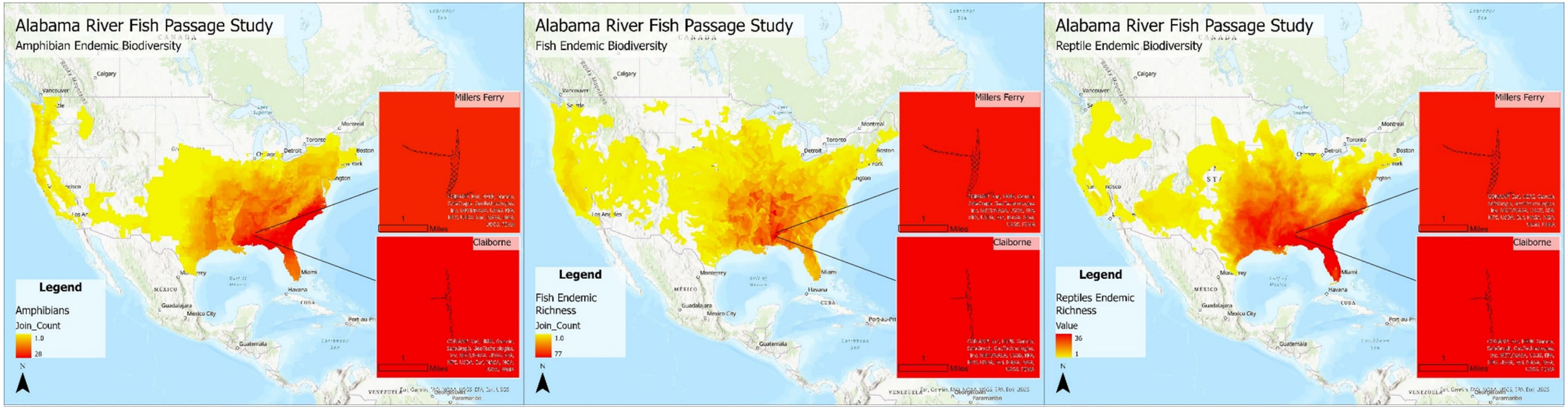

Figure 10 - Endemic biodiversity for multiple taxa

Table 6 – Aquatic Species within the Study Area

Fish	Mussels	Amphibians and Reptiles
Alabama Darter (*Etheostoma ramseyi*)	Threehorn Wartyback (*Obliquaria reflexa*)	Eastern Cottonmouth (*Agkistrodon piscivorus piscivorus*)
Alligator Gar (*Atractosteus spatula*)	Washboard (*Megalonaias nervosa*)	Snapping Turtles (*Chelydra serpentina*)
Black Crappie (*Pomoxis nigromaculatus*)	Bankclimber (*Plectomerus dombeyanus*)	Eastern Spiny Softshell (*Apalone spinifera spinifera*)
Blue Catfish (*Ictalurus furcatus*)	Southern Mapleleaf (*Quadrula apiculata*)	River Cooter (*Pseudemys Concinna*)
Bluegill (*Lepomis macrochirus*)	Fragile Papershell (*Leptodea fragilis*)	Pond Slider (*Trachemys scripta*)
Channel Catfish (*Ictalurus punctatus*)	Alabama Orb (*Quadrula asperata*)	Gulf Coast Smooth Softshell Turtle (*Apalone calvata*)
Flathead Catfish (*Pylodictis olivaris*)	Ebonyshell (*Fusconaia ebena*)	Alabama Map Turtle (*Graptemys pulchra*)
Redbreast Sunfish (*Lepomis auritus*)	Yellow Sandshell (*Lampsilis teres*)	Gulf Coast Spiny Softshell (*Apalone spinifera aspera*)
Redear Sunfish (*Lepomis microlophus*)	Gulf Pigtoe (*Fusconaia cerina*)	American Alligator (*Alligator mississippiensis*)
Spotted Bass (*Micropterus punctulatus*)	Monkeyface Mussel (*Quadrula metanevra*)	Florida Banded Water Snake (*Nerodia fasciata pictiventris*)
Striped Bass (*Morone saxatilis*)	Butterfly Mussel (*Ellipsaria lineolata*)	
Walleye Perch (*Sander vitreus*)	Elephant ear (*Elliptio crassidens*)	
White Bass (*Morone chrysops*)	Fawnsfoot (*Truncilla donaciformis*)	
White Crappie (*Pomoxis annularis*)		

One population of Asian Clams (*Corbicula spp.*) is known to inhabit the upstream portion of the Alabama River outside the study area at the U.S. Highway 80 bridge. No other aquatic invasive species are known to occur within the study area.

3.2.2.1.2 Future Without-Project Conditions

Due to the heavy impediment to the aquatic ecosystem from Claiborne and Millers Ferry, continual decline of aquatic biodiversity and abundance is highly likely. Increased invasive species, such as Asian carp (*Cyprinus carpio)*, Asian clams, and zebra mussels (*Dreissena polymorpha*), presence is likely to occur under FWOP conditions as well.

*3.2.2.2 Terrestrial Species**

Wildlife species vary throughout the Southern Mixed Forest Province. Their presence depends on age and thickness of timber stands, percent of deciduous trees, proximity to clearings, and bottom-land forest types (Bailey, 1995). Though Alabama is more diverse in aquatic species, a variety of terrestrial species exist within the State including 62 native mammal species (Manno and Paemelaere, 2016). According to the 2019 Article h-1284 written by Dr. Thomas Haggerty:

> *"Few states can match Alabama's rich diversity of birds...Currently, the Alabama Ornithological Society recognizes 433 species that have been seen in the state. From this list, about 158 are considered regular breeders within Alabama's borders…"*

Some common species throughout Alabama and the study area are included in Table 7. Known invasive species within the study area include starlings (*Sturnus vulgaris*) and wild boars (*Sus scrofa*).

Table 7 – Terrestrial Species within the Study Area

Mammals	Birds	Reptiles
Eastern Cottontail Rabbit (*Sylvilagus floridanus*)	Blue Jay (*Cyanocitta cristata*)	Gopher Tortoise (*Gopherus Polyphemus*)
Raccoon (*Procyon lotor*)	Northern Mockingbird (*Mimus polyglottos*)	Green Anole (*Anolis carolinensis carolinensis*)
Norway Rats (*Rattus norvegicus*)	American Crow (*Corvus brachyrhynchos*)	Eastern Fence Lizard (*Sceloporus undulates*)
Grey mouse (*Pseudomys albocinereus*)	American Goldfinch (*Spinus tristis*)	Mole Skink (*Plestiodon egregious*)
White-tailed Deer (*Odocoileus virginianus*)	American Robin (*Turdus migratorius*)	Five-Lined Skink (Plestiodon fasciatus)
Greater Mouse-Eared Bat (*Myotis myotis*)	Barn Swallow (*Hirundo rustica*)	Southern Copperhead (*Agkistrodon contortrix contortrix*)
Little Brown Bat (*Myotis lucifugus*)	Barred Owl (*Strix varia*)	Eastern Worm Snake (*Carphophis amoenus amoenus*)
Groundhog (*Marmota monax*)	Blue-gray Gnatcatcher (*Polioptila caerulea*)	Northern Black Racer (*Coluber constrictor constrictor*)
American Red Fox (*Vulpes vulpes fulvus*)	Carolina Chickadee (*Poecile carolinensis*)	Timber Rattlesnake (*Crotalus horridus*)

Mammals	Birds	Reptiles
Striped Skunk (*Mephitis mephitis*)	Carolina Wren (*Thryothorus ludovicianus*)	Eastern Ribbon Snake (*Thamnophis sauritus sauritus*)
Coyotes (*Canis latrans*)	Red-tailed Hawk (*Buteo jamaicensis*)	Eastern Glass Lizard (*Ophisaurus ventralis*)

The FWOP conditions would be similar to existing conditions.

*3.2.3 Protected Species**

*3.2.3.1 Threatened and Endangered Species**

3.2.3.1.1 Existing Setting

The Alabama SWAP categorizes species throughout the State with the Greatest Conservation Need Priorities 1-5, 5 being the highest conservation concern. These species are protected through Alabama State regulations and can be found in the periodically updated SWAP. All Federally protected species under the ESA receive a state priority ranking.

The ESA provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The ESA makes it illegal to "take" a Federally listed species, such as threatened and/or endangered, without a permit. *See* 16 U.S.C. 1538(a)(1)(B)."Take" is defined by the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." 16 U.S.C. 1532(19). The USFWS has statutory authority for the assessment of Federally listed or petitioned species on the land or in freshwater. Those Federally listed species occurring within Monroe and Wilcox Counties, Alabama, are referenced in .

Because of the unique and complex ecosystem, the Alabama Rivers and Streams Network was formed to aid in conservation efforts. It is a conglomeration of non-profit organizations, private companies, State and Federal agencies, and concerned citizens. They have classified watersheds and river reaches within the state of Alabama into Strategic Habitat Units (SHUs) and Strategic River Reach Units (SRRUs). These strategic units have the capacity to support viable and healthy aquatic habitats, populations of imperiled species, and provide good opportunities for restoration and recovery. Figure 11 depicts the study area encompasses SRRU number 24 (Lower Alabama River). Priority species within the Lower Alabama River SRRU includes numerous Federally listed threatened and endangered and other at-risk species (Alabama Rivers and Streams Network, 2020).

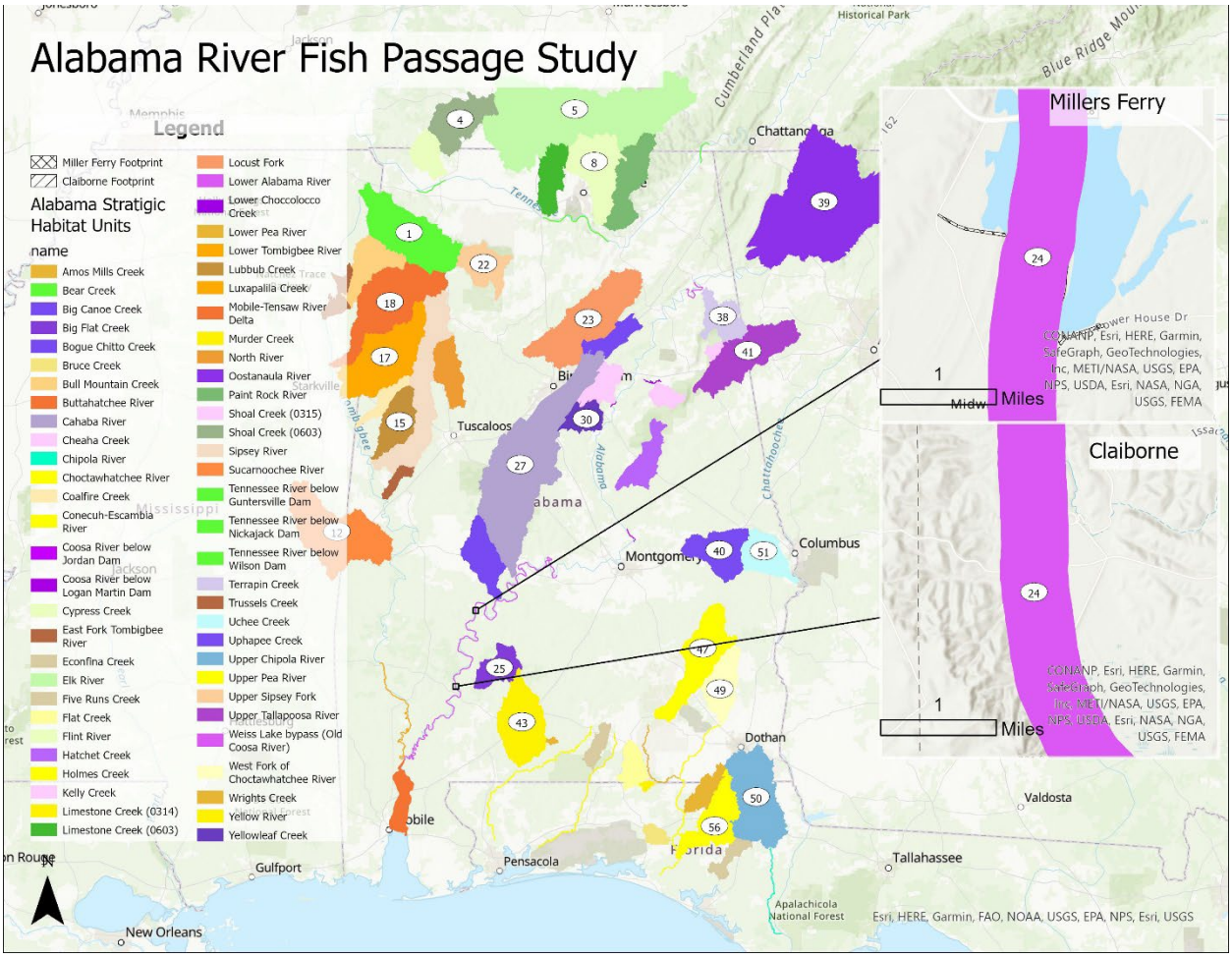

Figure 11 – Strategic Habitat and River Reach Units in the State of Alabama

Additionally, results of recent collections of environmental DNA (eDNA) from water samples have detected the Alabama and Gulf sturgeon in the Alabama River from below Robert F. Henry Lock and Dam (Pfleger et al. 2016). Though Robert F. Henry Lock and Dam is upstream of the study area, the importance of the finding is statistically significant. Although most eDNA detections were from areas below the Claiborne lock and dam, there were eDNA detections past two passage barriers (Pfleger et al. 2016). Gulf Sturgeon at Claiborne Lock and Dam were detected both by eDNA and by sonic tag (Rider et al. 2016).

Table 8 – Threatened and Endangered Species within the Study Area

Common Name	Scientific Name	Federal Status	State Rank	Habitat Description	Habitat Presence
Red Hills Salamander	*Phaeognathus hubritichti*	T		Undisturbed forested slopes and moist ravines with exposed soils	Yes

Common Name	Scientific Name	Federal Status	State Rank	Habitat Description	Habitat Presence
Alabama Sturgeon	*Scaphirhynchus suttkusi*	E	S1	Main channels of major rivers in areas below the Fall Line	Yes
Gulf Sturgeon	*Acipenser oxyrinchus (=oxyrhynchus) desotoi*	T	S2	Main channels of major rivers in areas	Yes
Alabama Moccasinshell	*Medionidus acutissimus*	T	S1	Sand and gravel substrate in clear water of moderate flow in small to large rivers	No
Heavy Pigtoe	*Pleurobema taitianum*	E	S1	Gravel with large component of coarse sand in water exceeding 6 m with variable current	No
Inflated Heelsplitter	*Potamilus inflatus*	T	S2	A variety of substrates and flow regimes	Yes
Orangenacre Mucket	*Lampsilis perovalis*	T	S2	High quality stream and small river habitat on stable sand/gravel/cobble substrate in moderate to swift currents	No
Ovate Clubshell	*Pleurobema perovatum*	E	S1	Sand/gravel shoals and runs of small rivers and large streams	No
Southern Clubshell	*Pleurobema decisum*	E	S2	Highly oxygenated streams with sand and gravel substrate in shoals of large rivers to small streams	No
Tulotoma Snail	*Tulotoma magnifica*	T	S2	Riffles and shoals on the undersides of large rocks	Yes
Georgia Rockcress	*Arabis georgiana*	T	S1	Shallow soil accumulations on rocky bluffs, ecotones of gently sloping rock	Yes

Common Name	Scientific Name	Federal Status	State Rank	Habitat Description	Habitat Presence
				outcrops, outcrops along rivers, and sandy loam along eroding riverbanks	

Key: Federal Rank = T: Threatened; E: Endangered - State Rank = S1: Critically Imperiled; S2: Imperiled; S3: Vulnerable; S4: Apparently Secure; S5: Secure; SX: Presumed Extirpated; SH: Historical (Possibly Extirpated); SNR: Unranked

One stable population of the red hills salamander is located at Haines Island within the study area. The Alabama Sturgeon is critically imperiled and is believed to be extirpated within the Alabama River; however recent eDNA discovery of both Alabama and Gulf sturgeon contradicts that assumption. Although suitable habitat exists within the study area for inflated heelsplitter, only one individual has been observed since 1998 south of the study area. Two populations of Georgia rockcress occur within the study area. Of the entire species range for Tulotoma Snail, only five surviving populations exist within the Alabama River. Notably, the largest and healthiest population of Tulotoma Snail is located immediately downstream of the Edmund Pettus Bridge (Garner at. al, 2011).

Designated critical habitat for the Alabama Sturgeon, is present within the Alabama River throughout the study area. The USFWS has identified five Primary Constituent Elements (PCE(s)) necessary for the conservation for the Alabama Sturgeon: (1) a range of flows with a minimum 7-day flow of 4,640 cubic feet per second (cfs) during normal hydrologic conditions, measured in the Alabama River; (2) river channel with stable sand and gravel river bottoms, and bedrock walls, including associated mussel beds; (3) limestone outcrops and cut limestone banks, large gravel or cobble such as that found around channel training devices, and bedrock channel walls that provide riverine spawning sites with substrates suitable for egg deposition and development; (4) long sections of free-flowing water to allow spawning migrations and development of eggs and larvae; and (5) water temperature not exceeding 90 °Fahrenheit (32 °Celsius), dissolved oxygen content over 4 milligrams per liter, and potential of hydrogen (pH) within the range of 6.0 to 8.5.

*3.2.3.1.2 Future Without- Project Conditions**

Additional Federally listed species as well as critical habitat are highly likely under FWOP conditions. Currently, two species are proposed for listing under the endangered species act and/or under review: Alligator snapping turtle and monarch butterfly.

Species that are currently listed are less likely to be down or delisted, and some may be presumed extirpated or extinct. For example, the Alabama sturgeon is considered critically imperiled and without reconnection to historic spawning grounds the species population is highly likely to become extinct under FWOP conditions. Additionally, the heavy pigtoe (*Pleurobema taitianum*) which has habitat outside the study area relies upon host fish for population distribution. Currently, the heavy pigtoe population is reduced to one location which could be eliminated under FWOP conditions.

*3.2.3.2 Migratory Birds**

The Migratory Bird Treaty Act (MBTA) makes it illegal to “take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter” a species identified in 50 CFR § 10.13. The USFWS has statutory authority and responsibility for enforcing the MBTA under 16 U.S.C. 703-712. The USFWS proposed in the Federal Register (Vol. 83, No. 229, November 28, 2018) both adding and removing species. Migratory species protected by the MBTA are internationally protected through conventions between the U.S. and Canada, Mexico, Japan, and Russia. Any species protected through one or more of the four international conventions is qualified for protection under the MBTA.

The study area is located in the Mississippi Flyway zone as shown in Figure 12. Approximately 25 acres of artificially constructed and filled duck ponds exist adjacent to the right descending bank at Millers Ferry. These ponds could provide temporary stopover sites for ducks along their migratory pattern; however, no surveys have been conducted to confirm its use during migration periods.

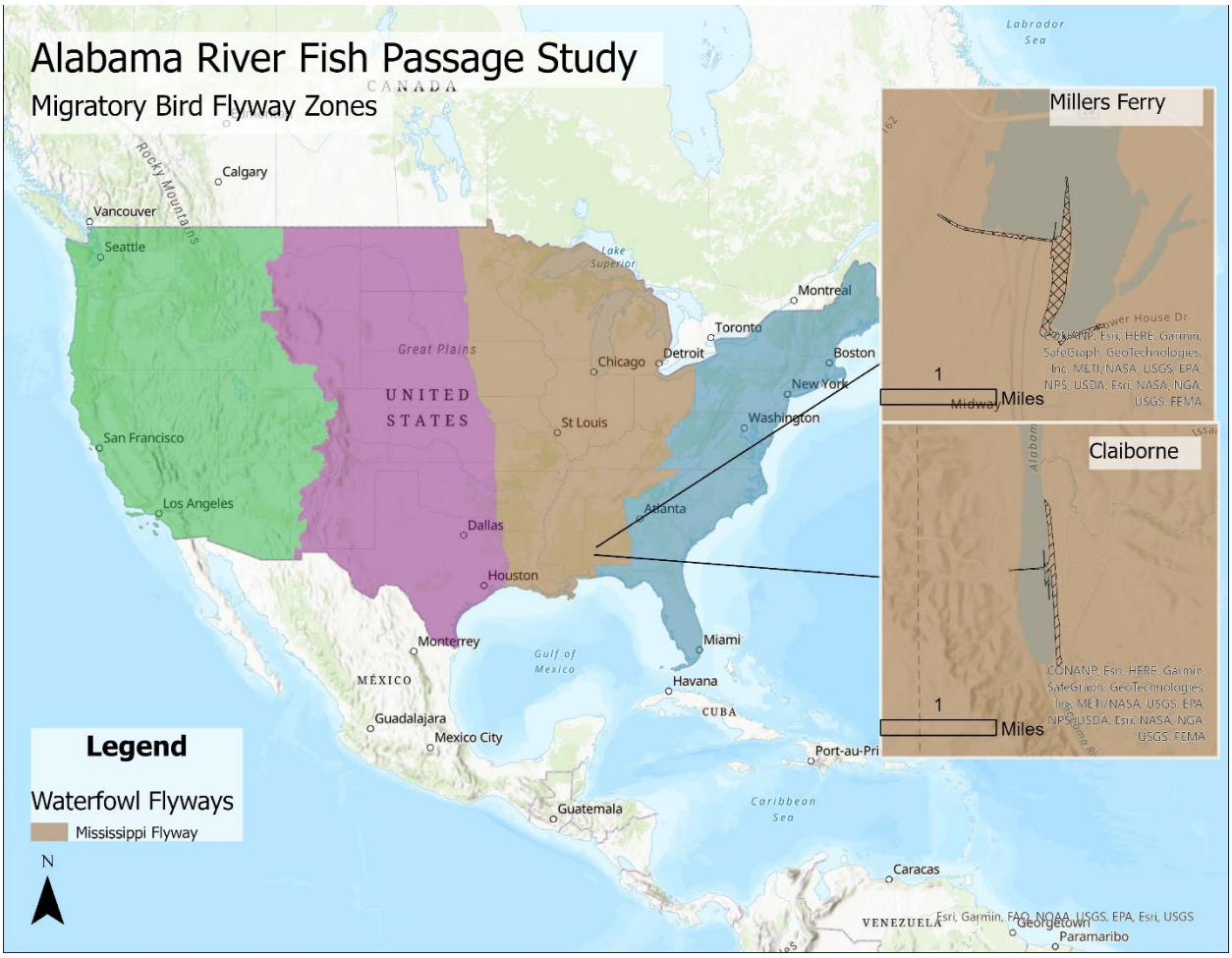

Figure 12 – Migratory Bird Flyway Zones

The FWOP conditions would be similar to existing conditions.

*3.2.3.3 Bald and Golden Eagles**

3.2.3.3.1 Existing Setting

The Bald and Golden Eagle Protection Act (BGEPA) prohibits the "taking" of Bald Eagles (*Haliaeetus leucocephalus*) or Golden Eagles (*Aquila chrysaetos*) as defined in . "Take" is defined by the BGEPA as to "pursue, shoot, shoot at, poison, wound, kill capture, trap, collect, molest or disturb." 16 U.S.C. 668c. "Disturb" is further defined as "to agitate or bother a Bald or Golden Eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." 50 C.F.R. 22.6. The BGEPA extends to activities occurring near nests when eagles are not present.

According to the National Bald Eagle Management Guidelines dated May 2007, Bald Eagles primarily nest near aquatic habitat in mature or dead trees. Man-made structures such as power-poles and communication towers also serve as nesting sites for some Bald Eagles. Bald Eagle nests are distinctly large at four to 6-ft in diameter and 3-ft deep weighing more than 1,000 pounds. Nests are generally constructed with large sticks and lined with soft and pliable greenery such as moss, grass, or lichens.

Project staff previously surveyed the surrounding area at Millers Ferry Lock and Dam and observed six Bald Eagle nests. It is unknown whether those nests were active or inactive. No surveys have been conducted at Claiborne Lock and Dam; however, the probability of active and inactive nests in the surrounding area are high.

*3.2.3.3.2 Future Without- Project Conditions**

Under FWOP conditions the possibility for Bald Eagle population increase is plausible.

*3.2.4 Wetlands**

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into Waters of the U.S., including wetlands. Wetlands are defined as jurisdictional when three criteria are met: hydrologic connectivity, hydric soils, and hydrophyte vegetation (USACE, Wetlands Delineation Manual, 1987). No delineations have been conducted as part of this feasibility study. However, as shown in Figure 13 the presence of wetlands may occur within the focused area.

Activities in Waters of the U.S. regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and mining projects. Section 404 requires a Department of Army Regulatory permit before dredged or fill material may be discharged into waters of the U.S. The basic premise of the program is that no discharge of dredged or fill material may be permitted if: (1) a practicable alternative exists that is less damaging to the aquatic environment (i.e., avoid) or (2) the nation’s waters would be significantly degraded.

FWOP conditions would be similar to existing conditions. No large-scale land use development within the study area that would decrease or increase potential wetland habitats is anticipated.

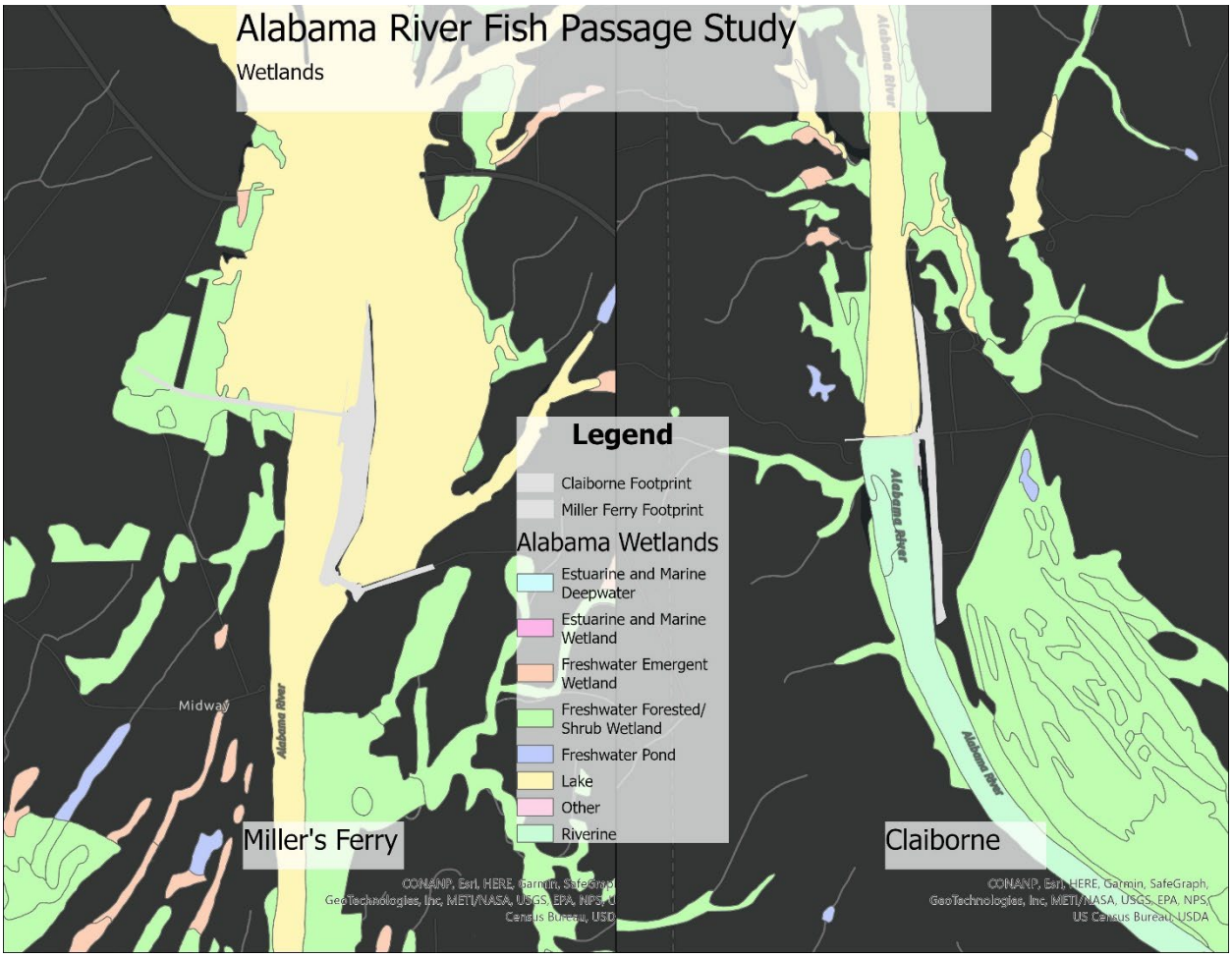

Figure 13 – Wetlands within the Study Area

3.3 Cultural and Historic Resources*

The Alabama River has long served as a major transportation system connecting the Coosa River to the Mobile River. Indigenous tribes established settlements along its tributaries such as the Cahaba Mound and Village site (circa 1500 – 1600 AD) and fortification complexes at its confluences such as the Mounds at Fort Toulouse (circa 1100 – 1400 AD). Many other significant precontact era sites lie within the banks of the Alabama River and the study area. Anthropological and historical records and theories suggests that the site of the Battle of Mabila (circa 1540 AD), one of the first major battles between Indigenous Americans and European explorers, is located near the confluence of the Alabama and Cahaba Rivers although this has not been confirmed archaeologically.

During European settlement, the Alabama River continued to serve as a major transportation system for Indigenous peoples, such as the Alibamu Indians of the Creek Confederacy, French settlers, including Bienville, and eventually British and Americans. The Alibamu Indians invited French settlers to build fortifications at the confluence of

Coosa and Alabama Rivers, what became known as Fort Toulouse (circa 1717 – 1763 AD). William Bartram explored the area, in addition to others in the Southeast, in the 1770s and culminated his findings in "Travels through North and South Carolina, East and West Florida, the Cherokee Country, the Extensive Territories of the Muscolgulges, or Creek Confederacy, and the Country of the Chactaws [sic] (1791)." This book became the basis for 18th century American botany, ornithology, and natural history.

Due to its centralized position among Indigenous, French, British, and American territories during a time when land was becoming scarcer and more valuable, the area saw the development of fortifications such as Fort Claiborne (November 1813) and battles such as the Battle at Holy Ground (December 1813) and other skirmishes as part of the War of 1812 and/or the Creek War. Also, to aid in transportation of supplies and soldiers during this time, the Old Federal Road was expanded to follow alongside the Alabama River near Montgomery and cross the river near Fort Claiborne.

The Alabama River runs through a major portion of Alabama's "Black Belt" region, named for its production of agriculture from a fertile black soil. Because of massive land accruals including the Indian Removal period of the 1830s, Americans were able to develop the Black Belt region into chains of cotton producing plantations with the Alabama River serving as the connector. Towns along the Alabama River, such as Selma and Montgomery, became cities and major distribution and transportation hubs for the region. The large-scale importation of slaves into this area in the 1830s to accommodate this exponential growth further cemented the region as the "Black Belt" of Alabama. Again, due to its importance in strategic positioning, the area saw battle during the Civil War with the Battle of Selma in 1865. After the Antebellum era, the area remained primarily used for agriculture.

Project authorization to provide a 4-foot deep and 200 feet wide navigation channel along the Alabama River was authorized by Congress on June 18, 1878. The authorization was modified to a 6-foot depth in 1892. Proposal for improvements were introduced throughout the early 20th century. The Rivers and Harbors Act of 1945 authorized the feasibly study of installation of projects to provide navigation and hydroelectric power. A site selection report was submitted in 1948 recommending the construction of Claiborne, Millers Ferry, and Jones Bluff locks and dams. Over time, construction of these navigation and hydropower projects led to additional communities in the study area.

*3.3.1 Architectural**

Construction of the Claiborne Lock and Dam was completed in 1969 making the property over 50 years old and eligible for consideration on the National Register of Historic Places (NRHP).

Construction of the Millers Ferry Lock and Dam was completed in 1970 making the property over 50 years old and eligible for consideration on the NRHP.

The Rosemary House and Plantation Store are located approximately 500 meters southwest of the Millers Ferry Lock and Dam. The complex was constructed circa 1858 and documented for the Historic American Building Survey in 1933 (HABS AL-150).

The Prairie Mission Church and Schoolhouse is located approximately 1 mile northwest of the western most reaches of the Dannelly Reservoir. The complex consisting of a schoolhouse, church, and principals house was constructed in 1894 for African American students as part of a Freedman's Board of the United Presbyterian Church of North America. The schoolhouse was in operation until the late 1960s. It was listed on the NRHP in 2001.

The Dellet Plantation and Park is located approximately 2.5 miles south of the Claiborne Dam. The plantation complex was one of the largest in Alabama covering 4,000 acres and consisting of 19 contributing buildings and structures with the oldest dating to the 1850s. The complex was listed as a district on the NRHP in 1993.

*3.3.2 Cultural and Archaeological Resources**

Archaeological surveys conducted within both project areas are limited but have recorded at least 8 potentially eligible sites for listing on the National Register within 1 mile of the Claiborne Lock and Dam and at least 5 potentially eligible sites within 1 mile of the Millers Ferry Lock and Dam.

3.4 Socioeconomics*

*3.4.1 Land use**

Land use within the study area is largely undeveloped as shown in Figure 14. Within the extent of the study area, FWOP conditions would be similar to existing conditions.

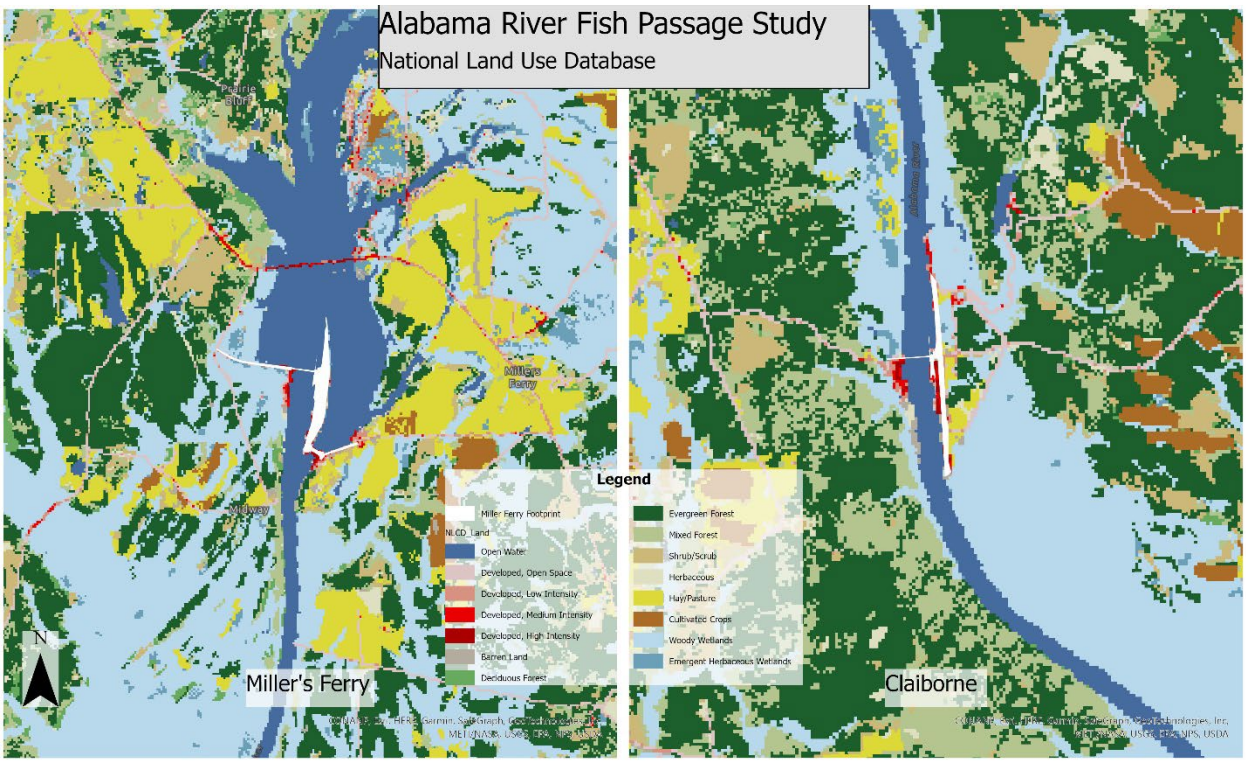

Figure 14 - Land Use Within Study Area

*3.4.2 Noise**

Ambient noise of the study area is low due to the minimal development and rural setting. No major metropolitan cities are located within the study area that would increase noise pollution.

The FWOP conditions would be similar to existing conditions given the study area's rural setting.

*3.4.3 Aesthetics**

Aesthetics is a set of principles concerned with the nature and appreciation of beauty of natural environments. The general aesthetics of the study area is predominantly rural with forests and large undeveloped open terrain.

According to the Planning P&G dated 1983, "Aesthetic attributes are perceptual stimuli that provide diverse and pleasant surroundings for human enjoyment and appreciation. Included in this category are sights, sounds, scents, tastes, and tactile impressions and the interactions of these sensations, of natural and cultural resources."

FWOP conditions would be similar to existing conditions since no significant increase in development is anticipated.

*3.4.4 Recreation**

Existing hunting grounds account for approximately 200 acres at the Claiborne West Bank Hunting Area and approximately 375 acres of bow hunting and small game hunting at the West Bank Dannelly Reservoir which lies adjacent to the Millers Ferry Lock and Dam. Each lock and dam vicinity contains one day-use area which are used for activities such as picnicking. The surrounding area is primarily private land and undeveloped terrain.

The FWOP conditions would be similar to existing conditions because land use within the study area is not anticipated to change significantly.

*3.4.5 Industry**

The U.S. Census Bureau Economic Census for Wilcox and Monroe Counties for 2020 reports a total number of legal establishments at 1,239 employing 16,726 people. Employment opportunities in this region could be considered sparse, but because the two locks and dams fall within Monroe and Wilcox Counties (the Cahaba traversing Dallas County) the area is not only nationally recognized for its biodiversity but is also prominently recognized as located within Alabama's Black Belt National Heritage Area attracting heritage tourism.

Monroe County employment at 5,297 is concentrated within five industry sectors and disaggregates to 1,300 employed within manufacturing, 779 employed within retail trade, 757 employed within transportation and warehousing, 739 employed within health care and social assistance, and 359 employed within accommodation and food services.

Wilcox County employment pattern roughly follows that of Monroe. The 2020 Economic Census reports total employment at 2,117 and disaggregates to 987 employed within manufacturing, 238 within retail trade, 240 within health care and social assistance for the top three industry sectors.

FWOP conditions can be expected to be like existing conditions with respect to industry and employment opportunities.

*3.4.6 Demographics**

The Mobile-Tensaw Delta and Cahaba River are nationally recognized, significantly biodiverse ecosystems with a footprint that traverses seven counties (Mobile, Baldwin, Washington, Clarke, Monroe, Wilcox, and Dallas). Four of the seven counties (Clarke, Monroe, Wilcox, and Dallas) fall within Alabama's Black Belt National Heritage Area (House Resolution 3222) which is widely recognized as the birthplace of the Civil Rights and Voting Rights movements. The two project sites, Millers Ferry Lock and Dam, located within Wilcox County, and Claiborne Lock and Dam, located within Monroe County, are both within the Black Belt National Heritage Area.

Alabama Population and Demographics: The U.S. Census Bureau estimates Alabama to have a total population of 5,074,296 as of July 1, 2022, from extrapolating from the

2020 Decennial Census, which reported the State population at 5,024,279 allowing U.S. Census Bureau to infer growth in the State's population of 1.0% with 51.4% identifying as female. A strong majority of the State's population (98.1%) identify as one race alone, with 68.9% identify as White, 26.8% identify as Black or African American, 4.8% identify as Hispanic or Latino, 1.6% identify as Asian, 0.7% identify as American Indian and Alaska Native, and 0.1% being Native Hawaiian and Other Pacific Islander. Within Alabama there are 1,902,983 households with an average of 2.57 persons per household.

Wilcox County Population and Demographics: The U.S. Census Bureau estimates Wilcox County to have a total population of 10,446 as of July 1, 2022, from extrapolating from the 2020 Census, which reported the County population at 10,600 allowing U.S. Census Bureau to infer a decrease in the County's population of 1.5% with 52.9% identifying as female. A strong majority of the County's population (98.6%) identify as one race alone, with 70.1% identifying as Black or African American, 28.0% identifying as White, 1.5% identifying as Hispanic or Latino, 0.3% identifying as Asian, and 0.2% identifying as American Indian and Alaska Native.

Camden Census County Division (CCD), AL Demographics: The total population according to the 2020 Decennial Census for the Camden CCD was 4,746 with the median household income reported at $38,384 and an employment rate of 37.5% compared with the employment rate of 54.1% for the State. The median household income in the United States was $64,994 in 2020.

Monroe County Population and Demographics: The U.S. Census Bureau estimates Monroe County to have a total population of 19,648 as of July 1, 2021, from extrapolating from the 2020 Census, which reported the County population at 19,772 allowing U.S. Census Bureau to infer a decrease in the County's population of 0.6% with 52.1% identifying as female. A strong majority of the County's population (98.2%) identify as one race alone, with 55.0% identifying as White, 41.3% identifying as Black or African American, 1.7% identifying as Hispanic or Latino, 0.5% identifying as Asian, and 1.4% identifying as American Indian and Alaska Native.

Monroeville CCD, AL Demographics: The total population according to the 2020 Decennial Census for the Monroeville CCD was 8,932 with the median household income reported at $31,641 and an employment rate of 45.7% compared with the employment rate of 54.1% for the State of AL. The median household income in the United States was $64,994 in 2020.

*3.4.7 Public Safety**

No current threats to public safety exist since the study area is predominantly rural with limited public roads.

FWOP conditions would be consistent with existing conditions.

*3.4.8 Traffic**

Claiborne and Millers Ferry Locks and Dams are served by Lock and Dam Rd within Monroe County and Alabama State Route 28 within Wilcox County, respectively.

FWOP conditions would be consistent with existing conditions.

*3.4.9 Navigation**

The Alabama River is considered a low-use navigable waterway. The USACE, Mobile District provides maintenance activities and maintenance dredging of the entire Alabama River navigation channel. Over $8M was spent in 2022 towards navigation dredging for partial restoration of approved channel depth and $800,000 was spent on dredging operations for small boat access channels. Approximately $12M was appropriated for additional dredging in Fiscal Year 2023 to restore the full navigation channel.

FWOP conditions would be similar to existing conditions. It is not anticipated that any substantial increase in budget would occur that would allow this section of the Alabama River to be dredged on a more frequent basis.

4.0 MODELING APPROACH AND PLAN FORMULATION AND EVALUATION

4.1 Conceptual Model

Conceptual ecological models (CEMs) qualitatively describe important relationships between system components. Conceptual models help identify major system stressors and drivers of change and they also serve as a tool to discuss complex systems across multiple disciplines (Swannack et al. 2012). In restoration projects, CEMs are tools that may guide PDTs into synthesizing the understanding of the system, diagnosing underlying problems, identifying monitoring indicators and metrics, and are a supplement to numerical model development (Fischenich 2008).

On January 10-11, 2022, USACE Engineering Research and Development Center (ERDC) facilitated an ecological modeling workshop with USACE Mobile District to engage project stakeholders and develop a set of CEMs to inform decision-making for the fish passage feasibility study. Approximately 22 workshop participants from USACE Mobile District, USACE Headquarters, USEPA, The Nature Conservancy, Alabama Rivers Alliance, and Auburn University with multiple backgrounds (e.g., biology, engineering, fisheries, project planning, regulatory, economics) worked together to discuss the major ecosystem drivers and components that were relevant to the fish passage feasibility study. The final product is shown in Figure 15.

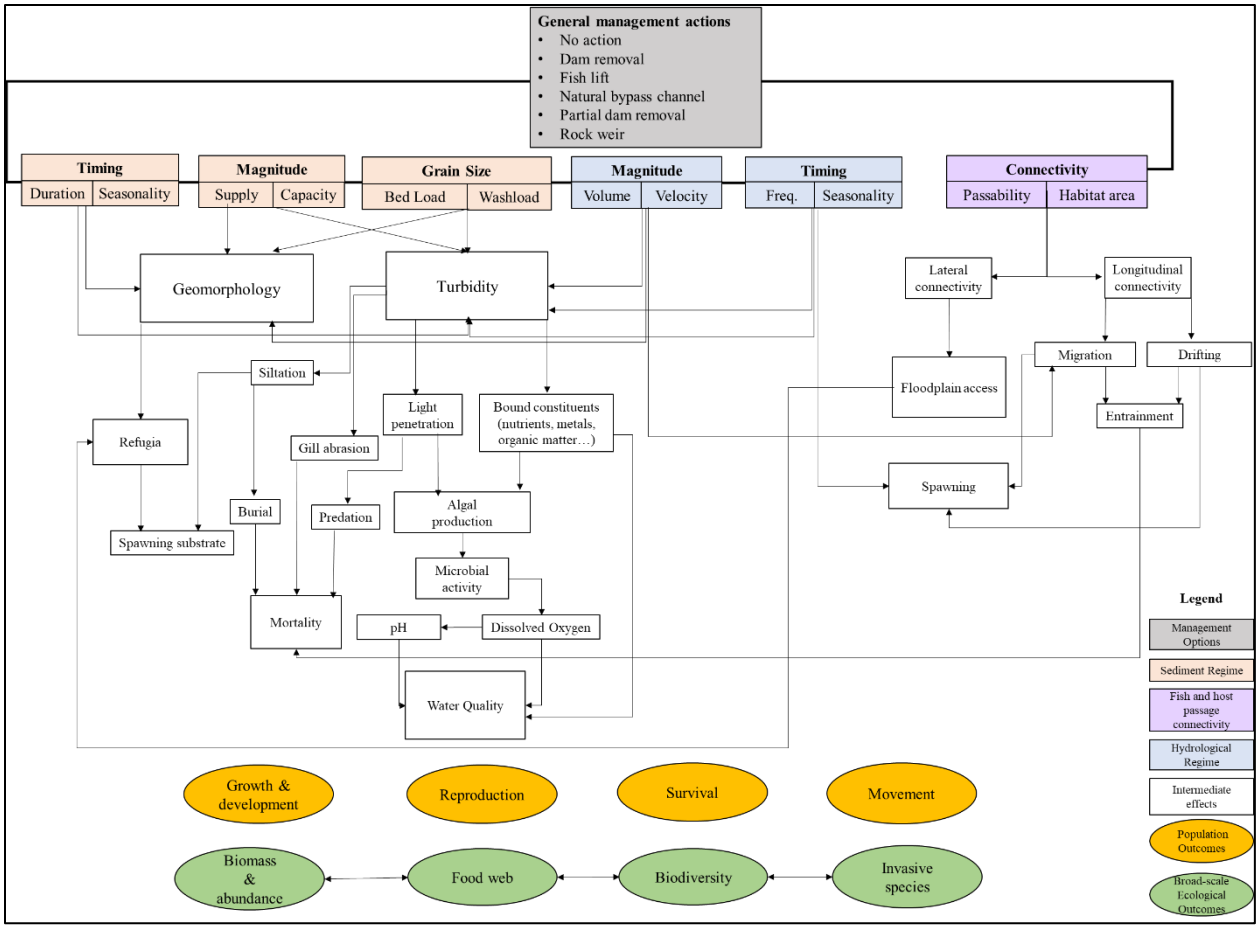

Figure 15 - Fish Passage CEM

4.2 Ecological Model: The Fish Passage Connectivity Index (FPCI) Model

The FPCI model for the Claiborne and Millers Ferry Locks and Dams Fish Passage Study was approved for single use only on February 27, 2023. The study focuses on linear movement of fish species at two Locks and Dams along the Alabama River. All action-alternatives include measures at both locations to achieve a key Study Objective, restoration of connectivity between the Cahaba River, located upstream of Millers Ferry, to the Lower Alabama River and ultimately Mobile Bay. The FPCI model is appropriate for deriving habitat units (HUs) due to the similarity in river systems. The FPCI model was created for the Lock and Dam 22 study on the Mississippi River which is a large riverine system with linear migration for several fish species. Likewise, the Alabama River is a large riverine system, and the study focuses on 19 fishes grouped into guilds based on size/speed.

The FPCI model was originally developed by fisheries, biologists, and hydraulic engineers from USACE, USFWS, Illinois Department of Natural Resources, Illinois Natural History, Missouri Department of Conservation, and Iowa Department of Natural Resources. The

model calculates HUs for each migratory fish species and averages HUs for all migratory fish species for each fish passage alternative. Further explanation can be found in Appendix B-1.

4.2.1 The Formula

The model formula is as follows:

$$\epsilon = \frac{\Sigma_{i\ldots n}[E_i \mathrm{x} U_i \mathrm{x} D_i]/25}{n}$$

Where:

Є = Fish Passage Connectivity Index

i = a migratory fish species that occurs in pool or reach below the dam

n = number of fish species included in the index

E_i = Chance of encountering the fishway entrance

U_i = Potential for species "i" to use the fish passage pathway or fishway

D_i = Duration of availability

A total of 19 species were included in the index (n). The chance of encountering the fishway entrance was determined via expert elicitation. The potential for a species to use the passage was based on known critical swim speeds and the duration of availability was based on available flows. Thus, if a migratory species encounters the passageway and there is sufficient evidence the fish will utilize the passageway and flows are sufficient to support that use, connectivity is achieved. Reference Appendix B-1 for further explanation on calculations used.

4.2.2 Inputs

Model inputs include total available habitat, movement periods for each migratory species, likelihood of species to encounter fishway entrance based on location, species potential to use passage route, and availability of suitable passage conditions during movement and spawning periods.

Habitat types were grouped into three broad categories: Benthic, Pelagic, and Littoral Zones. The total available preferred littoral habitat was surveyed and categorized into five subsections based on site characteristics such as slope, substrate, etc. Preferred habitat was then identified for each of the 19 representative species and summed into total available habitat.

Duration was calculated using ResSIM modeling to show annual percent probability of exceedance.

Expert elicitation was used to determine species likelihood of encountering passageway location using three different flow regimes: 5,000 cfs, 50,000 cfs, and 50,000 cfs.

Velocity outputs were generated using HecRAS modeling to determine the U_i value.

4.2.3 Outputs

The result is a 0-1 FPCI value per species that represents the suitability of the fish passage alternative measure. The FPCI is then multiplied by the linear feet of total available preferred habitat to obtain Habitat Units per species. The individual Habitat Units were then averaged to obtain a single value per each alternative used for Cost Effectiveness Analysis (CE).

4.2.4 The Results

The outcomes from the FPCI model for each of the alternatives in the final array are presented in Table 9 below. Alternative 5d, with a natural bypass channel at both Claiborne and Millers Ferry Locks and Dams, has the highest average connectivity index and average HUs of the final array.

Table 9 – Fish Passage Connectivity Model Results

Alternative[1]	Є = Fish Passage Connectivity (Avg)	Avg. Habitat Units
1 – No Action	0.003	6,513
3 – Fixed Weir Rock Arch, Both	0.441	872,331
5d – Natural Bypass, Both	0.523	1,005,661
12b – Fixed Wier CL, Natural Bypass MF	0.507	978,402
13b – Natural Bypass CL, Fixed Weir MF	0.457	899,590

[1] CL = Claiborne Lock and Dam, MF = Millers Ferry Lock and Dam

4.3 Alternative Costs - Conceptual Level of Design

A Total Project Cost Summary (TPCS) was prepared for each alternative. The TPCS combines the real estate (RE) costs, construction costs, contingency, preconstruction engineering and design (PED), and construction management (CM). The TPCS applies escalation factors to calculate a first cost and total project cost for each alternative. The first cost is used for the CE/ICA.

Table 10 shows the total project costs, estimated operations and maintenance (O&M) costs, and duration of construction for the final array of alternatives. Additional detailed cost development information is provided in Appendix C – Cost.

Table 10 – Total Project Costs

Alternative[1]	Total Project Cost	Annual O&M (FY25)	Construction Duration
1 – No Action	**$0**	**$0**	0 Months
3 – Fixed Weir Rock Arch, Both	$227,000,000	$200,000	24 Months
5d – Natural Bypass Channel, Both	$188,000,000	$200,000	30 Months
2b – Fixed Weir Rock Arch CL, Natural Bypass MF	$201,000,000	$200,000	30 Months
13b – Natural Bypass CL, Fixed Weir Rock Arch MF	$214,000,000	$200,000	24 Months

[1] CL = Claiborne Lock and Dam, MF = Millers Ferry Lock and Dam

4.4 Cost Effectiveness Analysis

The cost effectiveness analysis is presented in Table 11 below.

Table 11 – Cost Effectiveness Analysis

Alternative[1]	Avg Annual HUs	Avg Annual Equivalent Cost	Avg Cost per HU	Best Buy?
1 – No Action	6,513	$0	0	Yes
3 – Fixed Weir Rock Arch, Both	872,331	$10,360,000	$11.88	No
5d – Natural Bypass Channel, Both	1,005,661	$8,496,000	$8.45	Yes
12b – Fixed Weir Rock Arch CL, Natural Bypass MF	978,402	$8,906,000	$9.10	No
13b – Natural Bypass CL, Fixed Weir Rock Arch MF	899,590	$9,236,000	$10.27	No

[1] CL = Claiborne Lock and Dam, MF = Millers Ferry Lock and Dam

Alternative 5d is the only effective and efficient action alternative as displayed in the above Cost Effectiveness Analysis. No other plan generates more HUs. Moreover, no other plan has a lower average annual equivalent cost, inclusive of the opportunity cost of annual hydropower benefits foregone. (Additional details regarding each alternative's hydropower benefits foregone calculations are located within Appendix F, Impacts to

Hydropower.) Thus, Alternative 5d is the only best buy action alternative with an average cost per HU of $8.45.

4.5 Multi-Criteria Decision Analysis (MCDA)

As presented in Table 12 below, each alternative within the Final Array has benefits, displayed as scores, that span the Four Planning Accounts. The benefits were converted to scores ranging from 0-1 using a percent of maximum normalization technique. The criteria used as inputs to the MCDA to generate scores with respect to the Planning Accounts include: HUs for the Environmental Quality (EQ) Account, project first costs, full time equivalent jobs, Gross Regional Product (GRP) for the Regional Economic Development (RED) Account (where a minimum value is desired for each alternative's project first cost), hydropower values for the National Economic Development (NED) Account, and HUs used as a proxy for the Other Social Effects (OSE) Account. A more detailed explanation of the MCDA can be found within Appendix E, Socioeconomics.

Table 12 – The MCDA Scores

Alternative	EQ	RED	NED	OSE
1 - No Action	0.006	0.333	1	0.006
3 - Fixed Weir Rock Arch, Both Dams	0.867	0.666	0.883	0.867
5d - Natural Bypass Channel, Both Dams (CL right bank, MF right bank)	1.000	0.608	0.930	1.000
12b - Fixed Wier Rock Arch, CL and Natural Bypass Channel, MF (right bank)	0.973	0.628	0.930	0.973
13b - Natural Bypass Channel, CL (right bank) and Fixed Wier Rock Arch, MF	0.895	0.646	0.921	0.895

4.6 Planning Criteria

Alternative plans are evaluated by applying numerous, rigorous criteria. The PDT compared plans by their contribution to planning objectives. Per the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, four general criteria are considered during alternative plan screening.

- **Completeness**. The extent to which an alternative provides and accounts for all investments and actions required to ensure the planned output is achieved. These criteria may require an alternative to consider the relationship of the plan to other public and private plans if those plans affect the outcome of the project. Completeness also includes consideration of RE issues, O&M, monitoring, and sponsorship factors. Adaptive management plans formulated to address project uncertainties are also considered.

- **Effectiveness**. Effectiveness is defined as the degree to which the plan will achieve the planning objective. The plan must make a significant contribution to the problem or opportunity being addressed.
- **Efficiency**. The project must be a cost-effective means of addressing the problem or opportunity. The plan outputs cannot be produced more cost-effectively by another institution or agency.
- **Acceptability**. A plan must be acceptable to Federal, state, and local government in terms of applicable laws, regulation, and public policy. The project should have evidence of broad-based public support and be acceptable to the non-Federal cost sharing partner.

  Evaluation Criteria. There are also specific technical criteria related to engineering, economics, and the environment, that also need to be considered in evaluating alternatives. These criteria are:

Environmental Criteria:

- Fully complies with all relevant environmental laws, regulations, policies, executive orders
- Represents an appropriate balance between environmental sustainability and economic benefits and must contribute to NER benefits
- Optimizes flow velocity
- Restores connectivity of the Cahaba River to Mobile River Delta
- Increases Biodiversity
- Maximizes habitat benefits

Economic Criteria:

- The plan would produce EQ benefits
- The plan would display positive monetary or non-monetary effects on ecological, cultural, and aesthetic resources
- Incremental costs of a plan are reasonable in relation to the environmental benefits achieved

Engineering Criteria:

- The plan must represent sound, acceptable, and safe engineering solutions
- The plan would maintain existing project purposes
- The plan would maintain project structural integrity

- The plan would maintain an acceptable level of flood risk

  When appropriate, assumptions, professional judgment, and/or estimates are used to support the decision-making process rather than acquiring new data.

4.7 Best Buy Alternative

As displayed in the Cost Effectiveness analysis, Alternative 5d is the only effective and efficient alternative. No other plan generates more HU's. In addition, Alterative 5d is the lowest cost alternative and thus, the most efficient and effective plan. Hence, Alternative 5d is the only Best Buy Alternative.

5.0 ENVIRONMENTAL EFFECTS AND CONSEQUENCES*

5.1 Affected Environment (40 CFR 1502.15) and Environmental Consequences (40 CFR 1502.16)*

A qualitative assessment of the final array of alternatives was conducted to analyze and consider environmental impacts to resources within the study area during the decision-making/screening process. The No Action Alternative (NAA) is consistent with FWOP conditions, which is the baseline from which to compare all alternatives.

Pursuant to NEPA and the CEQ's implementing regulations, this chapter addresses the impacts in proportion to their significance. *See* 40 CFR § 1502.2(b). Significance requires consideration of context and intensity. The depth of analysis of the alternatives corresponds to the scope and magnitude of the potential environmental impact. Impacts are any adverse or beneficial consequences on the human or natural environment caused by the implementation of an action and include any irreversible or irretrievable commitments of resources should the action be implemented. *See* 40 C.F.R. § 1508.1(g). In addition, impacts on the human and natural environment can be direct or indirect. Direct impacts are those that are caused by the action and occur at the same time and place. Indirect impacts are those that are caused by the action and are later in time or further removed in distance but are still reasonably foreseeable. The NEPA requires a federal agency to consider not only the direct and indirect impacts of a proposed action, but also the cumulative impacts of the action. S*ee* 40 C.F.R. § 1508.1(g).

The terms "adverse" and "beneficial" are used in this document with respect to impacts from the TSP (i.e., identified as the proposed action pursuant to NEPA) and are defined as the following:

- Adverse: a negative impact on the human, natural, and/or physical environment.
- Beneficial: a positive impact on the human, natural, and/or physical environment.

From the purpose of this analysis, the magnitude of impacts is classified as no significant, moderate, or significant and defined as the following:

- No Significant: A resource was not affected, or the effects were localized, small, and of little consequence to the sustainability of the resource.
- Moderate: Effects on a resource were readily detectable, short-term, localized, and measurable.
- Significant: A substantial, or potentially substantial, change to a resource at a degree which most of the resource will either be eliminated or unable to stabilize and continue to decline.

Though the Final Array of Alternatives shows one alignment and design per each measure, other iterations were considered in their development. Other designs and alignments would have similar impacts to the selected measure; however, those impacts would vary in magnitude.

The CEQ updated the 1978 regulations for implementing NEPA in July 2020 and amended in April 2022. Reducing paperwork and redundancy is a common theme with each update. Therefore, Alternatives 12b and 13b will not be highlighted in each effects section as they are comprised of the same measures, thus effects. Only when effects differ will those alternatives be discussed.

*5.1.1 Physical Environment**

*5.1.1.1 Water Resources**

*5.1.1.1.1 Hydrology**

5.1.1.1.1.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA. Changes to the ACT Water Control Manual are possible within the 50-year period of analysis (POA) although updates are anticipated to be minor; therefore, no significant direct impacts are anticipated.

INDIRECT IMPACTS: Impacts to hydrology under the NAA would mimic FWOP conditions; therefore, no indirect impacts are anticipated.

5.1.1.1.1.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: No change in water quantity would occur; however, water flow would be redirected into the passageways. No changes to timing or duration would occur; however, minor impacts to hydropower would occur at Millers Ferry Lock and Dam due to the redirection of flow (see Figure 16).

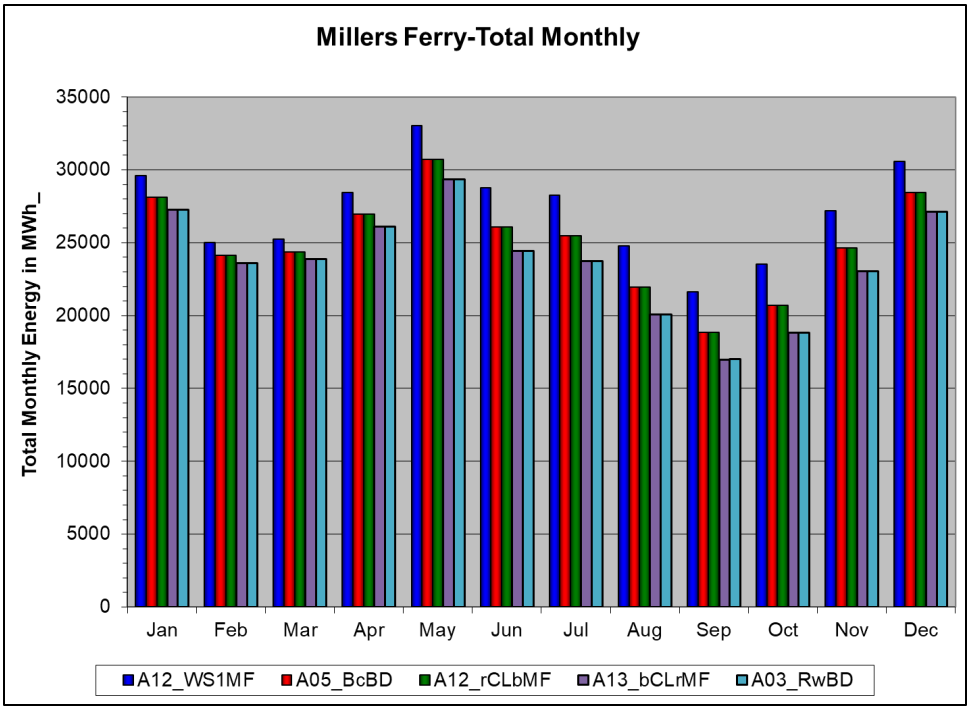

Figure 16 - Millers Ferry Total Monthly Energy Alternatives Comparison to Existing Baseline

INDIRECT IMPACTS: No significant induced flooding would occur. Therefore, no significant indirect impacts are anticipated.

5.1.1.1.1.3 *Alternative 5d - Natural Bypass Channel, Both Dams*

DIRECT IMPACTS: No change in water quantity would occur; however, water flow would be redirected into the passageways. No changes to timing or duration would occur; however, minor impacts to hydropower would occur at Millers Ferry Lock and Dam due to the redirection of flow.

INDIRECT IMPACTS: No significant induced flooding would occur. Therefore, no significant indirect impacts are anticipated.

*5.1.1.1.2 Water Quality**

5.1.1.1.2.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction is proposed under the NAA; therefore, no significant direct impacts to water quality are anticipated under the NAA.

INDIRECT IMPACTS: No significant land use changes involving construction are anticipated under FWOP conditions; therefore, no significant indirect impacts to water quality are anticipated.

5.1.1.1.2.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: As discussed in **Section 3.1.1.2** above Claiborne is 303(d) listed for mercury; therefore, riverbed related construction activities above the dam would disturb

contaminated sediments. Approximately 145,000 cubic yards of material would need to be excavated from the fixed weir rock arch alignment during construction. Best Management Practices (BMPs) would be used; therefore, Alternative 3 would have moderate adverse impacts to water quality.

Direct impacts at Miller's Ferry would occur from increased turbidity during water related construction; however, these impacts would be temporary, minor, and would revert to preconstruction conditions upon completion. No 303(d) waterbodies are listed in the nearby vicinity of the proposed footprint. Approximately 3,300,000 cubic yards of material would be excavated from the fixed weir rock arch alignment; however, BMPs would be used. Therefore, minor impacts to water quality are anticipated.

INDIRECT IMPACTS: Indirect impacts would occur from increased sedimentation transport through each passageway; however, these impacts would be minor. Periodic maintenance would be required to maintain integrity of the structures.

5.1.1.1.2.3 *Alternative 5d - Natural Bypass Channel, Both Dams*

DIRECT IMPACTS: Both bypass locations are considered off-channel and would not significantly impact water quality. Limited water related construction would occur. Therefore, these impacts at both locations would be minor.

INDIRECT IMPACTS: Indirect impacts would occur from increased sedimentation transport through the structure at both locations; however, these impacts would be minor. Periodic maintenance would be required to maintain integrity of the structures.

*5.1.1.2 Geology and Soils**

5.1.1.2.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA. Therefore, no direct impacts to geology and soils are anticipated.

INDIRECT IMPACTS: No significant changes to land use or hydrology are anticipated under FWOP conditions; therefore, no significant indirect impacts to geology and soils are anticipated under the NAA.

5.1.1.2.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Construction of the fixed weir rock arch at both locations would require excavation and grading to achieve the appropriate slope. The proposed footprint at Claiborne would be approximately 11 acres and the Millers Ferry footprint would be approximately 50.2-acres. Compared to the entirety of the study area these direct impacts would be minor.

INDIRECT IMPACTS: No significant changes to land use or hydrology would occur as a result of construction; therefore, no significant indirect impacts to geology and soils are anticipated.

5.1.1.2.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Construction of the bypass channels at both locations would require excavation and grading to achieve the appropriate slope. The proposed footprint at Claiborne would be approximately 11.0-acres and the Millers Ferry footprint would be approximately 50.2-acres. Compared to the entirety of the Study Area these direct impacts would be minor.

INDIRECT IMPACTS: No significant changes to land use or hydrology would occur as a result of construction; therefore, no significant indirect impacts to geology and soils are anticipated.

*5.1.1.3 Prime and Unique Farmlands**

5.1.1.3.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA. Therefore, no direct impacts to prime and unique farmlands would occur.

INDIRECT IMPACTS: The study area would remain consistent with FWOP conditions; therefore, no indirect impacts to prime and unique farmlands are anticipated.

5.1.1.3.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: The construction of the fixed weir rock arch at Millers Ferry would result in the permanent conversion of approximately 0.5 acres of Prime Farmland, while the construction of the fixed weir rock arch at Claiborne would result in no loss of Prime Farmland.

INDIRECT IMPACTS: No significant changes to hydrology, including induced flooding, would occur; therefore, no indirect impacts to farmlands are anticipated.

5.1.1.3.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: The proposed alternative alignment at Claiborne would not cross prime and unique farmland soils. The proposed alternative alignment at Millers Ferry would cross approximately 29 acres of prime and unique farmland soils; however, the majority of the acreage is not currently managed as farmland. Therefore, the proposed alternative would have no significant impacts to prime and unique farmlands.

INDIRECT IMPACTS: No significant changes to hydrology, including induced flooding, would occur; therefore, no indirect impacts to farmlands are anticipated.

*5.1.1.4 Climate**

5.1.1.4.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No activity is proposed under the NAA. Therefore, no direct impacts to the climate are anticipated.

INDIRECT IMPACTS: Under FWOP conditions climate change is anticipated. Improvements to the environment such as increased vegetation and wetlands are known

to improve climate conditions long term; however, no habitat creation would occur under the NAA and no significant habitat improvements are anticipated under FWOP conditions. However, biodiversity is anticipated to decrease under FWOP conditions which correlates to climate impacts (Dasgupta 2021 and Shin et al. 2022). Therefore, no indirect benefits to climate are anticipated. Conversely, indirect adverse impacts due to climate would be a result of climate change and decreased biodiversity but are anticipated to be minor.

5.1.1.4.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Construction for Alternative 3 would take approximately 2 years. Increased emissions would revert to preconstruction levels upon completion; therefore, the proposed alternative would have no significant impacts to the climate.

INDIRECT IMPACTS: No significant increase or decrease in vegetation would occur under the proposed alternative; however, as noted in "Global Change Biology", "Actions to halt biodiversity loss generally benefit the climate" (Shin, Yunne-Jai, et al. May 2022). Since the proposed alternative would in effect increase biodiversity, minor indirect beneficial impacts to climate are anticipated.

5.1.1.4.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Construction for Alternative 5d would take approximately 2.5 years. Increased emissions would revert to preconstruction levels upon completion; therefore, the proposed alternative would have no significant impacts to the climate.

INDIRECT IMPACTS: Approximately 61.2 acres of vegetation would be removed; however, compared to the entirety of the study area, as noted in "Global Change Biology", "Actions to halt biodiversity loss generally benefit the climate." (Shin, Yunne-Jai, et al. May 2022). Since the proposed alternative would in effect increase biodiversity, minor indirect beneficial impacts to climate are anticipated.

5.1.1.4.4 Alternative 12b - Fixed Weir Rock Arch at Claiborne and Natural Bypass Millers Ferry

DIRECT IMPACTS: Construction for Alternative 12b would take approximately 2.5 years. Increased emissions would revert to preconstruction levels upon completion; therefore, the proposed alternative would have no significant impacts to the climate.

INDIRECT IMPACTS: Vegetation would be removed in the immediate footprint of the bypass and weir locations; however, compared to the entirety of the study area this would be a minor indirect impact to the climate.

5.1.1.4.5 Alternative 13b - Natural Bypass, CL and Fixed Weir Rock Arch, MF

DIRECT IMPACTS: Construction for Alternative 3 would take approximately 2 years. Increased emissions would revert to preconstruction levels upon completion; therefore, the proposed alternative would have no significant impacts to the climate.

INDIRECT IMPACTS: Vegetation would be removed in the bypass and weir location; however, compared to the entirety of the study area this would be a minor indirect impact to the climate.

*5.1.1.5 Air Quality and Greenhouse Gasses**

5.1.1.5.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: Under the NAA no construction would occur; therefore, the NAA would have no significant direct impacts since the nearest non-attainment zone is 90 miles away.

INDIRECT IMPACTS: Air quality is indirectly influenced by vegetation and emissions. Under the NAA, vegetation and transportation within the study area would remain consistent with FWOP conditions; therefore, the NAA would have no significant indirect impacts to air quality.

5.1.1.5.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Direct impacts would occur during construction activities but would be temporary and would revert to preconstruction conditions upon completion. Construction is estimated to take 24 months to complete. Therefore, impacts to air quality would be minor.

INDIRECT IMPACTS: No significant indirect impacts are anticipated and no significant change in air quality and greenhouse gases would occur.

5.1.1.5.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Direct impacts would occur during construction activities but would be temporary and would revert to preconstruction conditions upon completion. Construction is estimated to take 30 months to complete. Therefore, impacts to air quality would be minor.

INDIRECT IMPACTS: No significant indirect impacts are anticipated and no significant change in air quality and greenhouse gases would occur.

5.1.1.5.4 Alternative 12b - Fixed Weir Rock Arch at Claiborne and Natural Bypass Millers Ferry

DIRECT IMPACTS: Direct impacts would occur during construction activities but would be temporary and would revert to preconstruction conditions upon completion. Construction is estimated to take 30 months to complete. Therefore, impacts to air quality would be minor.

INDIRECT IMPACTS: No significant indirect impacts are anticipated are required and no significant change in air quality and greenhouse gases would occur.

5.1.1.5.5 Alternative 13b – Natural Bypass, CL and Fixed Weir Rock Arch, MF

DIRECT IMPACTS: Direct impacts would occur during construction activities but would be temporary and would revert to preconstruction conditions upon completion. Construction is estimated to take 24 months to complete. Therefore, impacts to air quality would be minor.

INDIRECT IMPACTS: No significant indirect impacts are anticipated and no significant change in air quality and greenhouse gases would occur.

*5.1.1.6 Hazardous, Toxic, and Radioactive Waste (HTRW)**

5.1.1.6.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No direct impacts would occur since no construction is proposed under the NAA.

INDIRECT IMPACTS: No significant indirect impacts would occur as the study area would be consistent with FWOP conditions under the NAA.

5.1.1.6.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: No significant direct impacts would occur since no introduction of HTRW materials would be involved in Alternative 3. The proposed alignments would not traverse any known recognized environmental conditions.

INDIRECT IMPACTS: No significant indirect impacts would occur as the study area would be consistent with FWOP conditions under Alternative 3.

5.1.1.6.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: The proposed alignment at Claiborne would require vault toilet removal which may necessitate waste mitigation. The current footprint encompass both the pavilion and restroom building and would require their demolition. Worker safety would require a hazardous materials assessment and sampling for LBP and ACM, if necessary, be conducted prior to the initiation of any demolition activities. The gated structures at Millers Ferry would require oil for operation; however, BMPs and operations would limit environmental leeching. Therefore, no significant direct impacts involving HTRW materials are anticipated.

INDIRECT IMPACTS: No significant indirect impacts would occur as the study area would be consistent with FWOP conditions under Alternative 5d.

*5.1.2 Biological Resources**

*5.1.2.1 Vegetation**

5.1.2.1.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction is proposed under the NAA and no significant land use changes would occur. Therefore, no impacts to vegetation are anticipated.

INDIRECT IMPACTS: Under the NAA, no significant increased hydrology which could indirectly affect vegetation would occur; therefore, no indirect impacts to vegetation are anticipated.

5.1.2.1.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Construction of the fixed weir rock arch at Millers Ferry would involve the removal of 15 acres of existing vegetation. Construction of the fixed weir rock arch at Claiborne would involve the removal of approximately 15 acres of existing vegetation.

INDIRECT IMPACTS: No significant land use changes involving habitat degradation or creation is anticipated; therefore, no significant impacts to vegetation are anticipated.

5.1.2.1.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Construction of the Natural Bypass Channel at Millers Ferry would involve the removal of approximately 190 acres of existing vegetation. Construction of the Natural Bypass Channel at Claiborne would involve the removal of approximately 30 acres of existing vegetation.

INDIRECT IMPACTS: No significant indirect impacts to vegetation are anticipated since no increase in water quantity would occur nor a significant change in floodplain inundation.

*5.1.2.2 Fish and Wildlife Resources**

*5.1.2.2.1 Aquatic Species**

5.1.2.2.1.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No direct adverse impacts would occur to aquatic species since the NAA would not involve construction activities.

INDIRECT IMPACTS: Continuation of fish passage would occur at Claiborne lock and dam during high flow events under FWOP conditions but would not be enough to sustain species populations and biodiversity. Indirect adverse impacts would occur under the NAA due to anticipated declining species populations and biodiversity. The NAA would not alleviate this impact; therefore, the NAA would have moderate adverse impacts to aquatic species.

5.1.2.2.1.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Direct impacts to aquatic species would include disturbances from construction activities which could result in direct mortality to slow moving species such as freshwater mussels. Faster mobile species such as fish and reptiles would be more capable of avoiding the construction zones. Habitat would be impacted in the immediate footprint of each location; however, these sites have previously been disturbed from the original construction of each dam. Therefore, direct adverse impacts to aquatic species are anticipated to be minor.

At Millers Ferry approximately 5 acres of river bottom would be directly disturbed and at Claiborne approximately 40 acres of river bottom would be directly disturbed.

Direct beneficial impacts to aquatic species would result from the creation of migratory passageways such as increased spatial habitat for shelter, feeding and reproduction. Beneficial impacts to freshwater mussels would occur since the freshwater mussel life cycle is dependent on fish. As spatial habitat for fish is increased, so does habitat availability for freshwater mussels. The proposed alternative would achieve reconnection of approximately 120 river miles within the Study Area and would have significant benefits to these aquatic species.

According to the FPCI model, Alternative 3 is less beneficial than Alternative 5d although both alternatives achieve the proposed Study Objectives.

INDIRECT IMPACTS: Indirect adverse impacts to aquatic species would involve disturbances from acoustics, vibrations, and hydrology regime changes although these impacts would be minor.

Indirect beneficial impacts would include stable or increased biodiversity. The Alabama River is known as America's Amazon (Raines 2020) due to the high level of biodiversity; however, that status is threatened under FWOP conditions. Therefore, providing benefits which could stabilize biodiversity under the 50-year POA would be significant.

5.1.2.2.1.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Alternative 5d would have less direct impacts than Alternative 3 due to the reduced aquatic footprint of the construction zone. Conversely, according to the FPCI model this alternative would provide more benefits than Alternative 3. The model suggests that Alternative 5d would achieve the most passability compared to all other alternatives for the representative species cohort. When taken into context of the Public, Institutional, and Technical Significance of the Study Area, this alternative would have significant beneficial direct impacts.

At Miller's Ferry approximately 10 acres of river bottom would be affected in the small inlet 3,000 feet upstream of the project. At Claiborne approximately 5 acres of river bottom would be directly affected.

According to the FPCI model, Alternative 5d is more beneficial than Alternative 3 although both alternatives achieve the proposed Study Objectives.

INDIRECT IMPACTS: Indirect adverse impacts to aquatic species would involve disturbances from acoustics, vibrations, and hydrology regime changes. These impacts would be minor when compared to the overall benefit from providing fish passage.

This alternative would indirectly significantly benefit aquatic species by stabilizing or increasing biodiversity. Under FWOP conditions, the high level of biodiversity in the Alabama River are threatened. Therefore, providing benefits which could stabilize biodiversity under the 50-year POA would be significant.

*5.1.2.2.2 Terrestrial Species**

5.1.2.2.2.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA and therefore no direct adverse impacts are anticipated.

INDIRECT IMPACTS: The NAA is unlikely to change FWOP conditions; therefore, no significant indirect impacts are anticipated.

5.1.2.2.2.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Both fixed weir rock arch footprints occur primarily within the Alabama River. Therefore, no direct impacts to terrestrial species would occur.

INDIRECT IMPACTS: No significant indirect impacts to terrestrial species are anticipated since no significant change in hydrology or inundation is likely.

5.1.2.2.2.3 Alternative 5d - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: At Millers Ferry terrestrial species would lose approximately 165 acres of potential habitat as that habitat would be converted to aquatic habitat and 30 acers at Claiborne.

INDIRECT IMPACTS: Indirect impacts to terrestrial species could include actions such as induced flooding, however, no significant indirect adverse impacts are anticipated since water quantity would remain the same and the total floodplain inundation would be consistent with FWOP conditions.

*5.1.2.3 Protected Species**

*5.1.2.3.1 Threatened or Endangered Species**

5.1.2.3.1.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur and no direct “take” of federally listed species would occur under the NAA. Therefore, no direct impacts to threatened or endangered species would occur.

INDIRECT IMPACTS: Declining species population and additional listed species are likely to occur under FWOP conditions. Therefore, the NAA would have moderate indirect adverse impacts to federally listed species since no preventative measures would reduce this potential.

5.1.2.3.1.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Direct mortality to sessile or slow-moving species may result from excavation although the likelihood is minimal.

INDIRECT IMPACTS: Indirect impacts may result from increased turbidity and noise although these impacts would be minor and short-term.

5.1.2.3.1.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: No direct adverse impacts to terrestrial federally listed species would occur due to no suitable habitat within the proposed footprints of the bypass channels. Suitable habitat for inflated heelsplitter occurs within the proposed alternative's footprint and direct adverse impacts may include direct mortality from construction activities. Reasonable and Prudent Measures would be taken to minimize direct take.

Beneficial impacts to federally listed aquatic species would be significant. Not only is reconnection of historic spawning habitat for the Alabama sturgeon and Gulf sturgeon significantly beneficial, but also the ancillary benefits to federally listed mussel species would be significant as well (discussed in indirect impacts).

INDIRECT IMPACTS: Indirect adverse impacts would occur from increased noise disturbance but would be localized and temporary. Beneficial indirect impacts to Federally listed mussel would occur due to the increased spatial distribution of their respective host fish. Figure 17 shows the connection of federally listed mussel species to their known host fish. Host fish within the species cohort list are outlined in blue. Those identified host fish would provide benefits to 11 of the 14 federally listed mussels within the study area. Calculations using the FPCI model show that Alternative 5d would provide the most benefits to the species cohort, indirectly benefiting these federally listed species.

EFFECTS DETERMINATION: Based on the suitable habitat availability along with the direct and indirect adverse and beneficial impacts, the USACE Mobile District determined the Alternative 5d, the TSP, would have *No Effect* on the Alabama Pearlshell and Orangenacre Mucket. The USACE Mobile District determined Alternative 5d *May Affect but is not Likely to Adversely Affect* the Alabama Sturgeon, Georgia Rockcress, Gulf Sturgeon, Inflated Heelsplitter, Southern Clubshell, and Tulotoma Snail. The USACE Mobile District also determined the Alternative 5d would not adversely modify and/or destroy critical habitat for the Alabama Sturgeon. Informal Section 7 coordination has been initiated with the USFWS and a copy of the Biological Assessment is included in Appendix B-2.

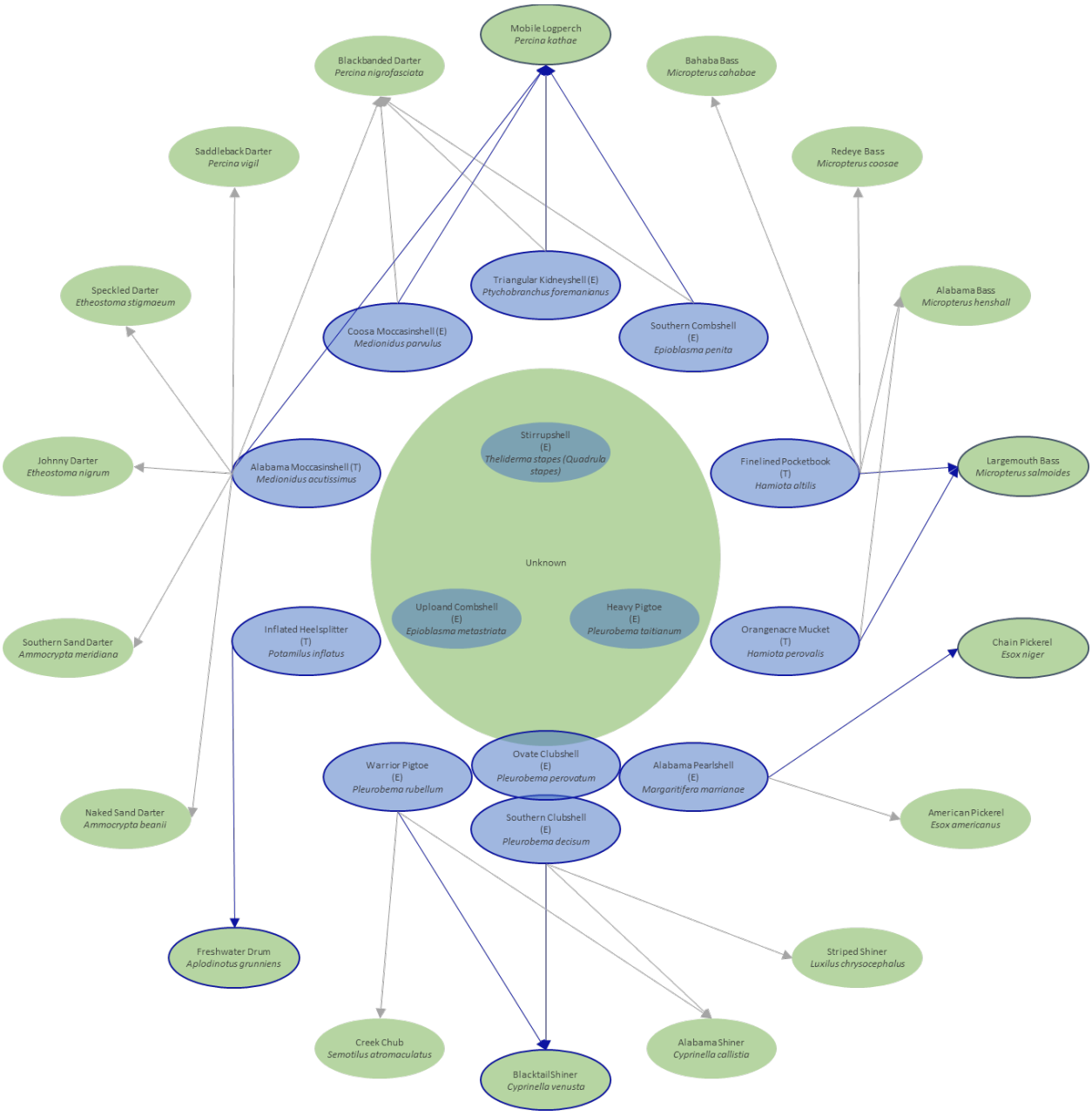

Figure 17 – Federally listed mussels and their host fish

*5.1.2.3.2 Migratory Birds**

5.1.2.3.2.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: Under the NAA, migratory bird populations are anticipated to be consistent with FWOP conditions. No construction would occur; therefore, no direct impacts to these species are anticipated.

INDIRECT IMPACTS: No increased noise disturbances would occur under the NAA which would influence migratory bird behavior; therefore, no indirect adverse impacts are anticipated.

5.1.2.3.2.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: No impacts to migratory birds are anticipated from the construction of either fixed weir rock arch since neither proposed footprint is located within potential stopover habitat.

INDIRECT IMPACTS: Increased noise disturbances from construction activities could influence bird foraging but would be temporary and minor. Noise levels would revert to preconstruction conditions upon project completion.

5.1.2.3.2.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: The construction of the natural bypass channel at Miller's Ferry will result in the loss of approximately 25 acres of potential stopover habitat for migratory waterfowl, as the project footprint would transverse the existing artificial duck pond site. No direct impacts to migratory birds are expected at Claiborne's project footprint.

INDIRECT IMPACTS: Similar to Alternative 3, indirect impacts would include increased noise disturbances resulting from construction. Construction is estimated to complete within two and a half years. Noise levels would revert to preconstruction conditions upon completion.

*5.1.2.3.3 Bald and Golden Eagles**

5.1.2.3.3.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA and therefore no activity within eagle nest buffer zones would occur.

INDIRECT IMPACTS: No indirect impacts would occur.

5.1.2.3.3.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: No eagle nests are present within the proposed alternative footprints; therefore, no direct impacts to Bald Eagles would occur.

INDIRECT IMPACTS: No eagle nests are present within three miles of the proposed alternative footprints. Therefore, no indirect impacts to bald eagles would occur.

5.1.2.3.3.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: No eagle nests are present within the proposed alternative footprints; therefore, no direct impacts to Bald Eagles would occur.

INDIRECT IMPACTS: No eagle nests are present within three miles of the proposed alternative footprints. Therefore, no indirect impacts to Bald Eagles would occur.

*5.1.2.4 Wetlands**

5.1.2.4.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: The NAA would have no direct impacts to jurisdictional wetlands.

INDIRECT IMPACTS: No indirect impacts to jurisdictional wetlands are anticipated.

5.1.2.4.2 Alternative 3 – Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Construction of the fixed weir rock arch at Millers Ferry would involve the removal of 2.27 acres of wetlands whereas construction of the fixed weir rock arch at Claiborne would involve the removal of approximately 1/2 acre of wetlands.

INDIRECT IMPACTS: No significant indirect impacts to jurisdictional wetlands

5.1.2.4.3 Alternative 5 – Natural Bypass Channel, Both Dams

DIRECT IMPACTS: An estimated total of 4 acres of wetlands may be impacted at Claiborne whereas the bypass footprint at Millers Ferry may impact approximately 55 acres. Jurisdictional wetland surveys would be conducted to confirm and/or finalize actual impacts.

INDIRECT IMPACTS: No significant indirect impacts to wetlands are anticipated.

*5.1.3 Cultural and Historic Resources**

*5.1.3.1 Architectural**

5.1.3.1.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction is proposed under the no action alternative therefore no impacts are anticipated.

INDIRECT IMPACTS: No construction is proposed under the no action alternative therefore no impacts are anticipated.

5.1.3.1.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Under Alternative 3, fixed weir rock arches would be installed at both dams. Because of these modifications to the structures and their viewsheds, both dams would need to be assessed using the Historic American Buildings Survey (HABS) before impacts can be assessed.

INDIRECT IMPACTS: No indirect impacts are anticipated at this time.

5.1.3.1.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Under alternative 5, natural bypass channels would be excavated alongside both dams. Because of modifications to the viewshed, a viewshed assessment of the Rosemary Plantation along the Millers Ferry alignment would need to occur before impacts to the structures can be evaluated.

INDIRECT IMPACTS: No indirect impacts are anticipated at this time.

*5.1.3.2 Cultural and Archaeological Resources**

5.1.3.2.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction is proposed under the no action alternative therefore no impacts are anticipated.

INDIRECT IMPACTS: No construction is proposed under the no action alternative therefore no impacts are anticipated.

5.1.3.2.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Under Alternative 3, fixed weir rock arches would be installed at both dams. The proposed alignments are within areas that have undergone archaeological survey as part of the construction of the dams therefore impacts are expected to be insignificant.

INDIRECT IMPACTS: Any disposal material area would also have to be assessed for cultural resources before indirect impacts are be assessed.

5.1.3.2.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Under Alternative 5, natural bypass channels would be excavated alongside both dams. The proposed alignment for alternative 5 at Millers Ferry would require Phase1 testing along the entire proposed project area to assess impacts. The proposed alignment Phase 2 testing of at least 4 sites along the alignment at Claiborne to evaluate impacts. A Programmatic Agreement is being drafted to address any significant impacts.

INDIRECT IMPACTS: Any disposal material area would also have to be assessed for cultural resources before indirect impacts are be assessed.

*5.1.4 Socioeconomics**

*5.1.4.1 Land Use**

5.1.4.1.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction or land use alteration would occur under the NAA; therefore, no direct impacts are anticipated.

INDIRECT IMPACTS: No significant land use changes are anticipated under FWOP conditions. The NAA would be consistent with FWOP conditions; therefore, no indirect impacts are anticipated.

5.1.4.1.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: The proposed alternative footprint would not change the land use for construction.

INDIRECT IMPACTS: The proposed alternative would not induce flooding or change water quantity; therefore, surrounding lands would remain consistent with FWOP conditions and no indirect impacts are anticipated.

5.1.4.1.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: The bypass footprint at Millers Ferry would convert the currently utilized duck ponds on Federal property to a fish passageway. This would change the land use within that footprint from recreation to environmental restoration but would remain Federal property. In addition, ducks utilizing those ponds would still have available habitat at the natural bypass channel to feed, rest, and breed. The Claiborne bypass footprint would convert day-use property to environmental restoration lands as well. Public access to the passageways would not be permitted. Therefore, minor direct impacts to land use would occur.

INDIRECT IMPACTS: The proposed alternative would not induce flooding or change water quantity; therefore, surrounding lands would remain consistent with FWOP conditions and no indirect impacts are anticipated.

*5.1.4.2 Noise**

5.1.4.2.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: The study area and its surrounding are not located within a high-density metropolitan area. Metropolitan cities such as Montgomery or Birmingham experience regular elevated noise levels due to continual traffic and construction. The study area experiences minimal traffic during most of the year. Under the NAA, no construction or demolition would be implemented; therefore, there no impacts to noise levels would occur.

INDIRECT IMPACTS: No indirect impacts would occur because of the NAA.

5.1.4.2.2 Action Alternatives

DIRECT IMPACTS: No residential areas surround either footprint. Noise pollution would be minimal and would be limited in areas of construction. Upon completion the noise disturbances would subside to preconstruction levels. Operation of each passageway would not significantly increase noise volumes above existing conditions. All action alternatives would have similar impacts but at differing timeframes. Thus, all are summarized for consolidation purposes. Construction duration for each action alternative is listed in .

Table 13 – Estimated Construction Duration of Action Alternatives

Alternative	Estimated Construction Duration
3	2 years
5d	2.5 years
12b	2.5 years
13b	2 years

INDIRECT IMPACTS: No significant indirect impacts are anticipated for any action alternative. Increased noise during construction would temporarily disturb terrestrial species; however, these species would return to the action area upon completion. Construction would occur in phases which would limit overall disturbances.

*5.1.4.3 Aesthetics**

5.1.4.3.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA and therefore no direct impacts to aesthetics are anticipated.

INDIRECT IMPACTS: The NAA would be consistent with FWOP conditions. Therefore, no indirect impacts to aesthetics are anticipated.

5.1.4.3.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: The proposed alternative alignments are located within a heavily constructed area and would not significantly alter the aesthetics of the Lock and Dams.

INDIRECT IMPACTS: No significant indirect adverse impacts are anticipated.

5.1.4.3.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: The proposed alternative alignments are located off channel in undeveloped rural areas. Undeveloped property would be converted to a natural channel feature which would have a minor impact on aesthetics.

INDIRECT IMPACTS: No significant indirect adverse impacts are anticipated.

*5.1.4.4 Recreation**

5.1.4.4.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction or staging would occur under the NAA; therefore, no impacts to recreational activities or recreational traffic would occur.

INDIRECT IMPACTS: The NAA would be consistent with FWOP conditions; therefore, there are no anticipated indirect impacts to recreation.

5.1.4.4.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Currently, anglers utilize the fixed crest spillway at Claiborne Lock and Dam for recreational fishing. The proposed alternative may impact their ability to access the site; however, ample other areas exist at Claiborne Lock and Dam that anglers could utilize. No such recreation occurs at Millers Ferry. This would result in minor direct impacts to recreation.

INDIRECT IMPACTS: Fishing within the vicinity could benefit from the proposed alternative due to the increased species population resulting from increased spatial connectivity. This would be a minor benefit as the potential species population increase would not be significant.

5.1.4.4.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: The potential construction and its duration would temporarily limit small game hunting at the Claiborne West Bank Hunting Area which accounts for 200 acres. Similarly, 375 acres of bow hunting and small game hunting at the West Bank Dannelly Reservoir location adjacent to the Millers Ferry Lock and Dam also could be infringed upon by the duration of construction. Following project implementation, modifications to operations (both hunting periods and total acreage) are expected to be minor. Moderate impacts to fishing would occur at Claiborne due to the cutoff from the fixed crest spillway which is currently used as fishing access by anglers. However, a pedestrian bridge is included to provide recreational access and for required annual inspection of the spillway abutment.

INDIRECT IMPACTS: Fishing within the vicinity could benefit from the proposed alternative due to the increased species population resulting from increased spatial connectivity. This would be a minor benefit as the potential species population increase would not be significant.

*5.1.4.5 Industry**

5.1.4.5.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: The NAA would have no direct impacts to industries in the study area since no construction would occur.

INDIRECT IMPACTS: The NAA would be consistent with FWOP conditions; therefore, no indirect impacts are anticipated.

5.1.4.5.2 Action Alternatives

DIRECT IMPACTS: Construction would create short-term full-time equivalent positions but would revert to preconstruction conditions upon project completion. No additional personnel other than those existing USACE employees would be required to operate the passageways. This would be a short-term impact to industries in the study area.

INDIRECT IMPACTS: No significant indirect impacts to industries are anticipated for any action alternatives.

*5.1.4.6 Demographics**

5.1.4.6.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur under the NAA that would displace residential homes or businesses. Therefore, no direct impacts to demographics would occur.

INDIRECT IMPACTS: The study area would continue as it exists and would not contribute towards demographic changes. Therefore, no indirect impacts to demographics are anticipated.

5.1.4.6.2 Action Alternatives

DIRECT IMPACTS: No alternatives would displace residential homes or businesses; therefore, no direct impacts to demographics would occur.

INDIRECT IMPACTS: All alternatives would be consistent with FWOP conditions; therefore, no indirect impacts to demographics are anticipated.

*5.1.4.7 Public Safety**

5.1.4.7.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: The NAA would have no direct impact on public safety since no construction would occur.

INDIRECT IMPACTS: The NAA would not increase water quantity or change floodplain inundation. Therefore, the NAA would not increase flooding threats to public safety in the Study Area.

5.1.4.7.2 Action Alternatives

DIRECT IMPACTS: Members of the public would be prevented from accessing construction sites for all action alternatives. Safety fencing to prevent public access to passageways would be installed for each alternative. Therefore, no direct impacts to public safety are anticipated.

INDIRECT IMPACTS: No induced flooding would occur for any action alternative. Therefore, no indirect impacts are anticipated.

5.1.4.8 Traffic

5.1.4.8.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: The NAA would not cause existing roads to be realigned. Therefore, no direct impacts to traffic would occur.

INDIRECT IMPACTS: No increased traffic would occur since no construction is proposed under the NAA. Therefore, no impacts to traffic are anticipated.

5.1.4.8.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Neither footprint of Alternative 3 would necessitate relocation of public or private roads. Therefore, no direct impacts would occur.

INDIRECT IMPACTS: Increased traffic may occur due to construction activities but would be temporary, localized, and would return to preconstruction conditions upon completion.

5.1.4.8.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Access to private property would be limited adjacent to the Millers Ferry footprint. The bypass alignment would sever the private road on the northern end of the property boundary; however, compensation would be required. No public roads would be impacted by either bypass footprint. Thus, direct impacts to overall traffic would be minor.

INDIRECT IMPACTS: Increased traffic may occur due to construction activities but would be temporary, localized, and would return to preconstruction conditions upon completion.

*5.1.4.9 Navigation**

5.1.4.9.1 Alternative 1 - No Action Alternative

DIRECT IMPACTS: No construction would occur within navigable waterways under the NAA; therefore, no direct impacts are anticipated.

INDIRECT IMPACTS: No indirect impacts are anticipated since the NAA would be consistent with FWOP conditions.

5.1.4.9.2 Alternative 3 - Fixed Weir Rock Arch, Both Dams

DIRECT IMPACTS: Neither alignment of the fixed weir rock arches would be located within the thalweg of the Alabama River; therefore, no direct impacts to navigation would occur.

INDIRECT IMPACTS: Construction of the fixed weir rock arches would be located within the river and may have a minor influence on hydrology at the immediate entrance of each passageway; however, the magnitude would not be significant enough to influence navigation. Therefore, this would be a minor indirect impact.

5.1.4.9.3 Alternative 5 - Natural Bypass Channel, Both Dams

DIRECT IMPACTS: Both proposed alignments would be located off-channel and the entrance to each location would be further away from the navigational channel than the fixed weir rock arch alignments. Therefore, there would be no direct impacts to navigation.

INDIRECT IMPACTS: No significant indirect impacts are anticipated.

5.2 Cumulative Impacts*

As stated in Section 1.0, this Draft IFR/EA has been prepared in accordance with NEPA and the 2020 40 CFR 1500 – 1508 regulations, as amended. In compliance, a thorough cumulative assessment to consider past, present, and future actions affecting the study area was conducted. Spatial bounds of the area are set by the completion of Claiborne Lock and Dam (furthest downstream impoundment) and R. F. Henry Lock and Dam (furthest upstream blockade) which create both pools within the study area. Completion of Claiborne Lock and Dam (1969), Millers Ferry Lock and Dam (1974), and R.F. Henry Lock and Dam (1971) defines the baseline (past) whereas the future bound was set at 50 years. A qualitative ecosystem analysis and social impact analysis were used to analyze effects to the resources. Past activities within the surrounding area include construction of the R.F. Henry Lock and Dam upstream of the City of Selma. Past activities within the study area include installation of a trash gate at Millers Ferry as well as regular O&M activities at each site. Recently, the USACE Mobile District completed a Continuing Authorities Program (CAP) Section 14 Study which identified a bank stabilization solution located within the City of Selma limits. Construction of the CAP bank stabilization solution is considered a reasonably foreseeable action as funding has been allocated for the project. The USACE Mobile District also completed a Flood Risk Management Study for the City of Selma which recommended Bank Stabilization and is currently in the PED Phase.

*5.2.1 Physical Environment**

Two noteworthy resources to evaluate for cumulative effects of the physical environment are (1) hydrology and (2) water quality. Other resources considered include geology and soils, prime and unique farmlands, climate, air quality and greenhouse gasses, and HTRW; however, cumulative impacts were not identified for these resources and are not discussed further.

Hydrology: Though the operation of dams occurring along the Alabama River occurs as a “run-of-the-river” system, construction of each lock and dam lead to an overall increase in river stage elevation under normal flow conditions (approximately 15 ft) throughout the study area. However, this increase in normal flow river stage does not affect the peak stages associated with high flow events. During high flow events Miller’s Ferry becomes a true “run-of-the-river” project, passing all inflows until such time that the river naturally rises, inundating the dam. Furthermore, climate change analysis is inconclusive regarding increasing peak flow events over a 50-year POA. Hydrologic modeling using the USEPA ICLUS dataset for future land use identified a peak flow increase of 2% over a 50-year period based on reasonably foreseeable increased land use development occurring within the Alabama River Basin located several miles north of the study area.

Cumulatively, though an increased river stage has occurred, the projects are operated as "run-of-the-river" and do not affect water quantity. No alternative within the final array would have a significant impact on hydrology as none would change river stage nor water quantity within the study area.

Water Quality: With the addition of these impoundments has come the changes to water quality over time. Man-made impoundments can act as "environmental sinks" where harmful chemicals settle at the riverbed due to increased stagnant flow conditions. Though the locks and dams are operated as run-of-the river, the increased river stage has likely created eddies in areas previously unobserved. As noted in Section 3.1.1.2 Claiborne Lock and Dam is listed in ADEM's 303(d) waterbodies for Mercury due to atmospheric deposition. No reasonable or foreseeable actions are known that would involve an active clean-up of 303(d) listed waterbodies. The NAA would be consistent with these trends and additional listed waterbodies could occur under FWOP conditions. No action alternative is likely to address these trends either in the 50-year POA.

*5.2.2 Biological Resources**

Resources considered include vegetation, aquatic species, terrestrial species, threatened and endangered species, migratory birds, Bald and Golden Eagles, and wetlands. Of those, cumulative impacts were identified for aquatic species and threatened and endangered species. All others are not discussed further.

Aquatic Species: As noted in Section 5.2.1, significant alterations to the aquatic environment have occurred since the construction of the locks and dams. Consequently, aquatic species have incurred adverse impacts. The hydrology regime changes have altered the riverine environment to allow for increased sport fish populations and less migratory fish species. Although the Alabama River is recognized as America's Amazon for biodiversity (Raines 2020), the balance over time has shifted. As such, the NAA would continue to decrease biodiversity of aquatic species. All other alternatives would at a minimum maintain biodiversity; however, Alternative 5d would provide the most benefits.

Threatened & Endangered Species: Similarly, threatened and endangered species have increased with the introduction of these impoundments. An increase in threatened and endangered species means more and more species populations are under threat. The NAA would likewise continue this undesirable trend whereas all action alternatives would have positive benefits. Alternative 5d would see the most benefits.

*5.2.3 Cultural and Historic Resources**

No significant cumulative impacts are anticipated with any alternative, but these could change under finalization of archeological and HABS surveys.

*5.2.4 Socioeconomics**

Resources considered include land use, noise, aesthetics, recreation, industry, demographics, public safety, and traffic and navigation. Of those, cumulative impacts were identified for aesthetics and navigation. All others are not discussed further.

Aesthetics: Construction of the locks and dams permanently altered the riverine aesthetics by raising the pool elevation. Implementation of any alternative would not restore the aesthetics to previous conditions.

Navigation: The locks and dams were implemented to facilitate navigation along the Alabama River. Currently, the Alabama River is low use. No alternative within the Final Array would impact the existing or FWOP navigable waterway.

5.3 Public Laws and Executive Orders*

*5.3.1 Environmental Justice (Executive Order 12898)**

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations* dated February 11, 19942/11/1994 directs all Federal agencies to determine whether a "proposed action" would have a disproportionately high and adverse impact on minority and/or low-income populations. The TSP would not adversely impact minority and/or low-income populations. Rather, the TSP would improve climate resiliency by not only avoiding adverse impacts to biodiversity, but also in preventing biodiversity loss. It generally benefits the climate (Shin, Yunne-Jai, et al. May 2022). Climate hazards disproportionately impact the most vulnerable (Yamin, F., et al. October 2005). In effect, the mitigation of climate hazards will have indirect benefits to these communities.

*5.3.2 Protection of Children (Executive Order 13045)**

Executive Order 13045, *The Protection of Children from Environmental Health Risks and Safety Risks*, was issued April 23, 19974/23/1997. Executive Order 13045 applies to significant regulatory actions that concern an environmental health or safety risk that could disproportionately adversely affect children. Environmental health risks or safety risks refer to risks to health or to safety that are attributable to products or substances that the child is likely to encounter or ingest. The TSP would not increase risk to the health and safety of children. Passageway structures would be appropriately suited with safety measures to avoid adversely impacting public safety, including children.

*5.3.3 Tackling the Climate Crises at Home and Abroad (Executive Order 14008)**

Executive Order 14008, *Tackling the Climate Crises at Home and Abroad*, was issued January 27, 2021. Executive Order 14008 directs Federal agencies to take a Government wide coordinated approach, coupled with substantive engagement by community stakeholders, to combat the climate crisis by reducing climate pollution in every sector of

the economy; to increase resilience to the impacts of climate change; to protect public health; to conserve our lands, waters, and biodiversity; to deliver environmental justice to disadvantaged communities; and to spur well-paying union jobs and economic growth.

Consistent with the objectives of this order, the TSP would strengthen biodiversity and improve climate resiliency for ecosystems in disadvantaged communities in the region.

5.4 Other NEPA Considerations*

*5.4.1 Any Irreversible or Irretrievable Commitments of Resources Which Would Be Involved Should the Tentatively Selected Plan Be Implemented**

Any irreversible or irretrievable commitments of resources involved in the TSP have been considered and are either unanticipated at this time or have been considered and determined to present minor impacts. Irreversible and/or irretrievable commitments include temporal and fiscal allocations to reach the current state of this feasibility study. No physical commitments have been implemented.

*5.4.2 Adverse Environmental Effects Which Cannot Be Avoided**

Any adverse environmental effects which cannot be avoided should the TSP be implemented are expected to be minor individually and cumulatively. The significant benefits to the aquatic community outweigh the minor adverse impacts discussed in Section 5.0.

*5.4.3 The Relationship Between Local Short-Term Uses of the Human Environment and Maintenance and Enhancement of Long-Term Productivity**

The TSP constitutes a short-term use of man's environment, will result in minimal adverse environmental impacts, and is not anticipated to affect long-term productivity.

5.5 Seventeen Points of Environmental Quality*

As specified by Section 122 of the Rivers, Harbors & Flood Control Act of 1970 (P.L. 91-611), 17 environmental quality categories of impacts were reviewed and considered in arriving at the final determination. As laid out in Table 14, no significant impacts are anticipated.

Table 14 – Seventeen Points of Environmental Quality Effects Considered

Points of Environmental Quality	Tentatively Selected Plan Effects
Noise	No significant impacts
Displacement of people	No significant impacts
Aesthetic values	No significant impacts
Community cohesion	No significant impacts
Desirable community growth	No significant impacts

Points of Environmental Quality	Tentatively Selected Plan Effects
Tax revenues	No significant impacts
Property values	No significant impacts
Public facilities	No significant impacts
Public services	No significant impacts
Desirable regional growth	No significant impacts
Employment	No significant impacts
Business and industrial activity	No significant impacts
Displacement of farms	No significant impacts
Man-made resources	No significant impacts
Natural resources	No significant impacts
Air	No significant impacts
Water	No significant impacts

6.0 THE TENTATIVELY SELECTED PLAN*

(Also known as the "Proposed Action" pursuant to NEPA)

Based on the analysis summarized herein considering project objectives, P&G criteria, CE Analysis and the MCDA, the TSP is Alternative 5d - the Natural Bypass Channel at both Claiborne and Millers Ferry Locks and Dams.

Alternative 5d has the lowest cost and highest ecological lift of all final array alternatives, is the only best buy action alternative, and has the highest total score from the MCDA. This alternative provides connectivity to the Cahaba River while providing the most acceptable method of fish passage. Sixteen federally listed threatened and endangered species benefit equally or more in alternative 5d than any other alternative evaluated. In addition, alternative 5d is preferred by the NFS.

6.1 Conceptual Design*

The TSP includes the construction of a natural bypass channel at both Claiborne and Millers Ferry Locks and Dams (Figure 18). Both bypass channels would be constructed along the right descending bank of the Alabama River with natural materials such as soil, riprap embankment protection, and stone weirs to create riffle pools. Millers Ferry Natural Bypass Channel includes control gate structures and two vehicular bridges. Additional conceptual design considerations are provided in the following sections. Table 15 displays the TSP design summary. Millers Ferry Bypass Channel is longer due to constraints and the difference in elevation. A historical property is located downstream of

the overflow embankment of Miller Ferry Lock and Dam. The PDT wanted to avoid any potential impacts to the property.

Feasibility level design details and applicable engineering data to support feasibility level engineering design as outlined in ER-1110-2-1150 Engineering and Design for Civil Works Projects are provided in Appendix A – Engineering, Appendix G – Geotechnical Engineering, and Appendix H – Hydrology and Hydraulics.

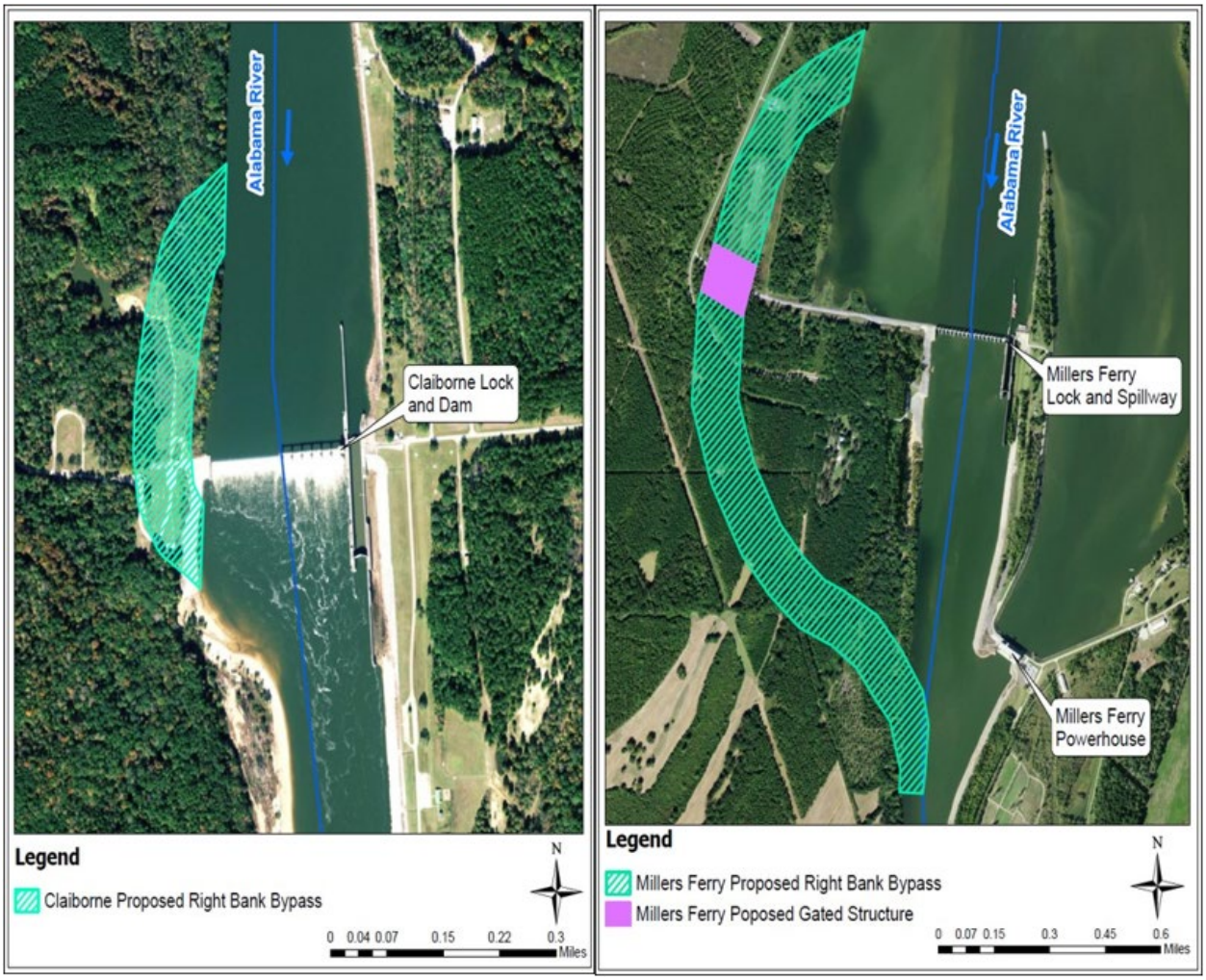

Figure 18 – The TSP, Bypass Channels at Claiborne & Millers Ferry

Table 15 – The Tentatively Selected Plan Design Summary

Design Information	Bypass at Millers Ferry Lock and Dam	Bypass at Claiborne Lock and Dam
Starting Elevation (ft-NAVD88)	75	33.1
Ending Elevation (ft-NAVD88)	31	3.5

Design Information	Bypass at Millers Ferry Lock and Dam	Bypass at Claiborne Lock and Dam
Bottom Width (ft)	100	75
Side Slopes	1V:3H	1V:3H
Channel Construction Materials	Rock	Rock
Slope of Channel (ft/ft)	0.005	0.013
Channel Length (ft)	8500	2100
Depth in Channel at Normal Pool (ft)	5.1	2.0
Number of Pools / Grade Control	44	30
Pool Length (ft)	200 - 210	80
Maximum Velocity within Channel (ft/s)	6.6	7.4
Mean Velocity within Channel (ft/s)	4.2	4
Estimated Flow at Normal Pool (Millers Ferry - 80.1 ft-NAVD88; Claiborne - 35.1 ft-NAVD88; CFS)	1200	1200

*6.1.1 Millers Ferry Natural Bypass Channel**

The natural bypass channel at Millers Ferry includes an approximately 8,500-foot-long channel with 1V:3H side slopes, 100-foot bottom width, 0.5% channel slope, and 44 resting pools or grade control structures each 200-feet in length. Design flow at Millers Ferry normal pool elevation 80.1 ft-NAVD88 is 1,200 cfs. The average depth in channel at normal pool is 5.1 feet. A typical channel section is shown on Figure 19.

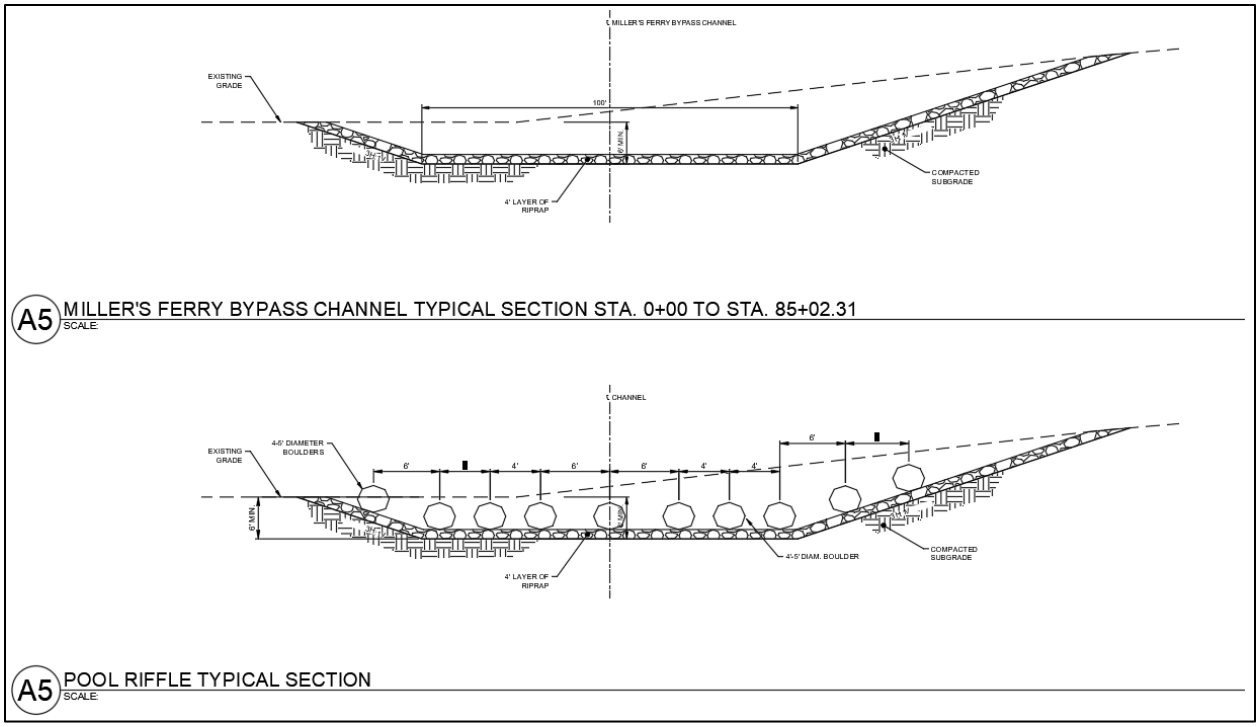

Figure 19 - Typical Cross Section of Bypass Channel at Millers Ferry and Claiborne Lock and Dam

*6.1.2 Claiborne Natural Bypass Channel**

Natural bypass channel at Claiborne includes an approximately 2,100-foot-long channel with 1V:3H side slopes, 80-foot bottom width, 1.3% channel slope, and 30 resting pools or grade control structures each 80-foot in length. Design flow at Millers Ferry normal pool elevation 80.1 ft-NAVD88 is 1,200 cfs. The average depth in channel at normal pool is 2.0 feet. A typical channel section is shown in Figure 19.

The bypass channels will be constructed generally of various sizes of sand, rock, and boulders, and will be of a pool and riffle design to emulate natural fishways. A series of riffles would be used in the fishway to control the water surface elevation and velocity of the pools. In general, there will be a 1-foot drop in water surface elevation between pools. The boulders will be staggered along the top of the riffle and along the downstream side of the structure so that the fish will not encounter the entire head loss at the crest of the weir. This will effectively create a two-step drop within section of each riffle weir. The boulders will be arranged so that passing fish can position their bodies to burst through the higher velocities associated with the weirs. Long bodied fish such as the Gulf sturgeon, Alabama sturgeon, and paddlefish will require considerable room downstream of the gaps in between boulders to navigate through them.

The layout of the riffles extends across the bottom of the bypass channel and may extend slightly up the side slopes. Riffles would be aligned in a curved manner perpendicular to

bypass channel centerline to ensure velocity profile created by the riffle varies along the flow area to best accommodate the passing of both large and small fish. Fish orient their body in flowing water using the helical flow pattern found in channels to identify the upstream direction and using current breaks (eddies) for resting and feeding. The arched configuration creates complex flows through the riffle step and is desirable in emulating a natural stream. The pool between the riffles will be designed to ensure adequate resting room for fishes before and after each riffle passage.

Riffle weirs will provide steps along the bypass channel for fish to overcome elevation increases moving downstream to upstream. Large boulders will be embedded in the top of the riffles and along the approach slope to create conditions for the fish to swim between them. Spaces between boulders would be graduated from tightly spaced near the side slopes to wider gaps between boulders in the middle of the bypass channel. This creates lower flow areas near the bank and higher flow areas in the middle to accommodate the swimming abilities of all fishes. The bed of the fishway would have an elliptical shape, being deepest in the middle section of each riffle. It is important to use irregular stones to increase roughness and to have a variety of spaces between the boulders. Design research indicates the following items should be considered during the PED phase to ensure an adequate design for the riffles and boulder configuration:

- velocities achieved by the riffles structure are appropriate to pass all fish
- there is a varied, non-uniform flow regime
- past constructed bypass channels that have been successful are considered in the final design
- consider a closer boulder spacing near the banks with a wider spacing between the boulders in the center
- consider the radius of the arch to concentrate flow
- there is a channel of flow through the center of the structure
- consider structural stability during floods for the design of the structure

*6.1.3 Vehicular Bridge Crossings**

The vehicle bridge crossings will consist of a 3-span bridge, with a total bridge length of approximately 76 feet. The superstructure for the bridges would be steel girders and beams supporting steel grating. Bridge girders shall be fixed at one end and free at the other to allow for expansion and contraction. The substructure would consist of pier walls and concrete abutments. It is anticipated the substructure will be pile supported.

The bridge loading shall be designed to AASHTO HS20 loading allow for truck traffic used during maintenance of the spillway structures. Wind and seismic loading on the bridge shall be accordance with ASCE 7 and all applicable USACE design manuals.

The concrete structures supporting the bridge will be constructed using a minimum of 4000 psi concrete reinforced with 60 ksi steel. The structures will be designed with

consideration for mass concrete pours and admixtures shall be used to minimize the heat generated.

The abutments and wing walls will be designed to withstand lateral loads in combination with vertical loads associated with the bridge structure. Lateral load should include earth pressures, seismic loads, and lateral water pressure associated with the flow.

Additional feasibility level design details are provided in Appendix A – Engineering.

*6.1.4 Control Gate Structures**

Steel fabricated sluice gates constructed to withstand maximum hydrostatic pressures at flood stage and debris impact will be used to control the flow of water in the bypass channel at Millers Ferry. The gates will be remotely operated from an offsite location with a local override in the event of an emergency or loss of power. It is anticipated that the gates will be constructed using steel fabricated gates that can withstand hydrostatic pressure and debris impact. Remote operation design details will be developed during the PED phase. Additional feasibility level design details are provided in Appendix A – Engineering.

6.1.5 Dam Safety

Modifications to existing dams impose additional dam safety risks to people and property upstream and downstream of the project. Risk is defined as a function of the loading condition, expected performance of the dam, likelihood of failure, and the expected consequences. Risk increases with an increase in the likelihood of failure or an increase in the potential consequences. Modifications to existing dams should not increase the risks associated with the project.

USACE routinely inspects and assesses the risk associated with dam failure across the USACE Mobile District's inventory. Each of the projects are inspected and investigated for risk including life loss and economic consequences for dam failure. On a 10-year cycle, the projects are re-evaluated for a Dam Safety Action Class (DSAC) rating following an initial Screening for Portfolio Risk Analysis (SPRA) and subsequent semi-quantitative risk assessment (SQRA). The SQRA identifies potential failure modes that lead to loss of pool or loss of service for each of the dam project features. Five action classes are used by the USACE dam safety portfolio risk management program. A rating of 1 has a very high likely hood of downstream consequences while a rating of 5 has a very low risk of downstream consequences. Figure 20 provides a summary of the DSAC ratings.

The USACE Mobile District projects along the Alabama River are considered run-of-the-river projects and have a DSAC rating of 4 referred to as a Significant Hazard Dams. The life loss risk downstream is considered low in the event of dam failure. Claiborne Lock and Dam had a periodic assessment completed in 2018. Claiborne Lock and Dam is scheduled to have a periodic inspection in June 2023. Millers Ferry Lock and Dam had a

periodic assessment completed in 2013 and currently has a periodic assessment under advanced technical review. The periodic inspection for Millers Ferry that supports the periodic assessment that is under review was completed in December 2022.

In addition, any new construction that affects the historic damming surface is required to have a risk informed decision following USACE engineering and construction bulletins. During the feasibility phase of design, a risk cadre will evaluate any associated risks (study, implementation, outcome, & schedule risks) to construct the fish passage.

URGENCY OF ACTION (DSAC)	ACTIONS FOR DAMS IN THIS CLASS***	CHARACTERISTICS OF THIS CLASS
VERY HIGH (1)	Take immediate action to avoid failure. Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures, including operational restrictions. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. Expedite investigations to support remediation using all resources and funding necessary. Initiate intensive management and situation reports.	CRITICALLY NEAR FAILURE: Progression toward failure is confirmed to be taking place under normal operations. Dam is almost certain to fail under normal operations to within a few years without intervention. OR EXTREMELY HIGH INCREMENTAL RISK**: Combination of life or economic consequences with likelihood of failure is very high. USACE considers this level of life-risk to be unacceptable except in extraordinary circumstances.
HIGH (2)	Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures, including operational restrictions as warranted. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. Expedite confirmation of classification. Give very high priority for investigations to support the need for remediation.	FAILURE INITIATION FORESEEN: For confirmed and unconfirmed dam safety issues, failure could begin during normal operations or be initiated as the consequence of an event. The likelihood of failure from one of these occurrences, prior to remediation, is too high to assure public-safety. OR VERY HIGH INCREMENTAL RISK**: The combination of life or economic consequences with likelihood of failure is high. USACE considers this level of life-risk to be unacceptable except in extraordinary circumstances.
MODERATE (3)	Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures, including operational restrictions as warranted. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. Prioritize investigations to support the need for remediation informed by consequences and other factors.	MODERATE TO HIGH INCREMENTAL RISK**: For confirmed and unconfirmed dam safety issues, the combination of life, economic, or environmental consequences with likelihood of failure is moderate. USACE considers this level of life-risk to be unacceptable except in unusual circumstances.
LOW (4)	Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Conduct elevated monitoring and evaluation. Give normal priority to investigations to validate classification, but do not plan for risk reduction measures at this time.	LOW INCREMENTAL RISK**: For confirmed and unconfirmed dam safety issues, the combination of life, economic, or environmental consequences with likelihood of failure is low to very low and the dam may not meet all essential USACE guidelines. USACE considers this level of life-risk to be in the range of tolerability but the dam does not meet all essential USACE guidelines.
NORMAL (5)	Continue routine dam safety activities and normal operations, maintenance, monitoring, and evaluation.	VERY LOW INCREMENTAL RISK**: The combination of life, economic, or environmental consequences with likelihood of failure is low to very low and the dam meets all essential USACE guidelines. USACE considers this level of life-safety risk to be tolerable.

*At any time for specific events a dam, from any action class, can become an emergency requiring activation of the emergency plan.
** INCREMENTAL RISK is used to inform the decision on the DSAC assignment; NON-BREACH RISK is not reflected in this table.
***DSAC 1 and 2 dams with no life loss will be referred to the appropriate business line program and are given lower priority in the dam safety program.

Figure 20 - USACE Dam Safety Action Classification Jan 2014 (ER 110-2-1156)

6.1.6 Navigation Impacts

The TSP, including a bypass channel at Claiborne and Millers Ferry Locks and Dams would have no measurable impact to navigation on the Alabama River.

6.1.7 Floodway / Floodplain Impacts for Areas Downstream of USACE Dams

USACE completed Dam Break Studies and resulting inundation mapping for both Millers Ferry and Claiborne Dams (July 1983). A dam breach at either Millers Ferry or Claiborne

would not result in out of bank flooding. The only consequences would be low water above the dam and a loss of navigation until the respective pool is restored.

Inundation mapping was prepared during July 1983 Dam Break Studies to delineate conditions that may cause the greatest impact during severe dam failure. Sudden changes in river stages and turbulence caused by a major dam break at either Millers Ferry or Claiborne Dams would be greatest if initially the river was in a low-flow condition. This is true because natural, rainfall-produced flood on the Alabama River may be larger than floods produced by a dam failure. In the more extreme flood events, a dam break may have no noticeable effect on river stages.

An examination of the July 1983 inundation maps for both Millers Ferry and Claiborne Dams indicates that major out-of-banks flood will not result from a dam failure; however, emergency and contingency plans can be prepared using the information presented. Some of the more important factors that can be determined include:

- Peak river elevations at location along the river
- The rate of rise in river stages and the time available for warnings to prepare

*6.1.8 Public Access and Security**

Some type of locked fence prohibiting unauthorized access to the project was considered. Coordination with the District's Safety Office and Office of Counsel will be required in this area.

*6.1.9 Construction Considerations**

Each natural bypass channel is likely to be implemented in two stages. Stage 1 would include design and construction of any cofferdams, gate structures, bridges and debris boom. Stage 2 would include the design and construction of the bypass channels. Monitoring and adaptive management would occur prior to construction (pre-construction monitoring) and after construction is complete (post-construction monitoring and adaptive management). Further construction considerations will be refined during the PED phase.

6.2 Cost Estimates

A TPCS was prepared for each alternative. The TPCS combines the RE costs, construction costs, contingency, PED, and construction management (CM). The TPCS applies escalation factors to calculate a first cost and total project cost for each alternative. The first cost is used for the economics analysis to determine cost effectiveness for each alternative.

shows the total project costs, estimated O&M costs, and duration of construction for the Tentatively Selected Plan alternative. Additional detailed project cost development information is provided in Appendix C – Cost.

Table 16 – Total Cost and Duration, TSP

Alternative	Total Project Cost	Annual O&M (FY25)	Construction Duration
5d – Natural Bypass Channel, both CL and MF	$188,000,000	$200,000	30 Months

6.3 Benefits

The TSP has benefits that span the Four Planning Accounts, EQ, OSE, RED, and NED.

Environmental Quality. EQ utilized the FPCI to measure benefits to aquatic species within the study area. A total of 19 species were identified to represent the biodiversity within the study area and are referenced as the species cohort. The FPCI calculates the "passability" for each alternative by evaluating the potential for species cohort to locate the passageway based on fish behavior, the potential to use the passageway based on critical swimming speeds, and the duration of passageway availability. These factors determine the connectivity index value which is then multiplied by available habitat to determine habitat units per each alternative. Essentially, higher habitat units mean the species cohort is more able to find it, use it, and access it better than compared alternatives. Alternative 5d provides the highest habitat units compared to all other alternatives in the Final Array.

Other Social Effects. Building on the application of HUs used to measure ecological lift and accounted for within the EQ Account, HUs are also used to capture the benefits within the Other Social Effects Account attributable to biodiversity strength and its relationship with climate positive impacts on vulnerable communities. Additional details on this topic are documented in Appendix E, Socioeconomics, Section 1.1.6.2.

Regional Economic Development. Benefits from the TSP also fall within the RED Account. The USACE certified model RECONS, applied the project first cost as the expenditure to estimate how construction spending will fall into direct, indirect and induced effects to local regions as measured through jobs, gross regional product, labor income, and sales. These benefits from the TSP are detailed in Table 4 within Appendix E, Socioeconomics.

National Economic Development. The TSP also has impacts on NED Benefits. Captured through the Hydropower Analysis Center's evaluation (and further detailed within Appendix F, Impacts to Hydropower), the TSP minimizes the hydropower benefits foregone of $1,307,000 annually from among the action alternatives within the final array.

This project also serves to monitor, evaluate, learn from, and adapt to future fish passage projects using lessons learned from this initial project. There are significant gaps in knowledge for this project given the limited understanding of natural fish movement, fish

movement in response to flow conditions, and the diversity of fish species and their habitat requirements. This information is needed for project planning and design to determine if the project objectives are met and to apply lessons learned to future fish passage projects through adaptive management. An adaptive management plan is being developed to gain information needed for project planning and design, monitoring, evaluating project performance, learning about fish migration behavior in the system, and to plan and design future fish passage projects.

6.4 Real Estate

The Nature Conservancy provided a NFS Acquisition Capability Assessment dated 26 August 2022 indicating that the Nature Conservancy does not have condemnation authority for this project. The Nature Conservancy will require the assistance of the State of Alabama to provide RE acquisition support for this project. In addition, the conceptual design does not account for potential damages to access of private landowners, as well as the location of placement areas.

Once the Project Partnership Agreement (PPA) process is complete, the USACE Mobile District Engineering Division will review the final design for advertisement and construction.

After this process, the tract register and tract maps will be updated to reflect any modifications to include final staging areas, access requirements, and restoration features. A notice to proceed with land acquisition will be issued by USACE Mobile District Real Estate Division after reviewed design documents have been issued. Upon completion of the land acquisition process, the NFS shall provide an Authorization for Entry for Construction and Attorney's Certificate of Authority to enable USACE and USACE contractors to complete the implementation phase.

The NFS must comply with the Uniform Relocation Assistance and Real Properties Acquisition Policies Act of 1970, as amended, 42 U.S.C. 4601 et seq. (P.L. 91-646, “the Uniform Act”), as defined in the Uniform Act, as a consequence of project implementation. Please reference the Real Estate Appendix for further information.

6.5 Mitigation

Coordination with the USFWS suggests the project may require compensatory mitigation.

A wetlands functional assessment will be performed based upon a refined project alignment to determine final cost of mitigation wetlands, if any.

Further consultation with USFWS and ADEM may reduce or eliminate wetland mitigation need based upon ecological lift gained from the restoration project.

6.6 Operation and Maintenance, Repair and Replacement

An efficient maintenance program will be required to provide maintenance consistent with the requirements of the project as established and ensure continued performance of the Alabama River as authorized by Congress. An effective maintenance control program will have complete records of all maintenance work performed since inadequate maintenance can result in costly breakdowns. USACE and the NFS must establish, provide, and agree on schedules for inspections with regards to each's responsible portions of the project.

The O&M requirements of USACE will include the gated flow control structure in the bypass channel at Miller's Ferry Lock and Dam. Types and frequency of maintenance will be dependent on annual inspections of the structure and gates and recommended repair or overhaul tasks to be performed on the individual items of equipment. USACE should provide a schedule for the frequency of inspections, preventative maintenance for the gate machinery, and for inspection of debris that may hinder the use of the structure after occurrence of high water and overflow events. USACE should maintain complete historical maintenance records from the time the equipment was placed in operation. The O&M requirements of the NFS will include the entirety of both natural bypass channels regarding the purpose to pass fish for aquatic ecosystem restoration and maintenance of all material in the bypass other than the gated flow control structure at Miller's Ferry. The NFS will be responsible for inspection of the natural bypass channels for debris and possible sediment removal after occurrence of high water and overflow events, preventative maintenance of the area surrounding the bypasses such as repairs to the structures that threaten the performance of the structures purpose and of the adjacent USACE's projects. The NFS will also be responsible for the mowing, grassing, and cleanup within the project site boundaries of the bypass channels. The NFS should provide a schedule for the frequency of inspections, preventative maintenance, and for inspection and removal of debris or sediment that may hinder the use of each structure. The NFS should maintain complete historical maintenance records from the time the equipment was placed in operation.

6.7 Monitoring and Adaptive Management

The primary purpose of the Fish Passage Project is to increase the opportunity for upriver fish passage, thereby increasing access to upstream mainstem river and tributary habitats. Increased access to upriver habitat should result in an increase in the size and distribution of native migratory fish populations.

In addition, this project will provide an opportunity to monitor, evaluate, learn from, and adapt future fish passage projects using lessons learned here. Monitoring can help fill gaps in knowledge, such as our understanding of natural fish movements, fish movements in response to flow conditions, the diversity of fish species and their habitat requirements, and the novelty of a fish passage for the Alabama River.

This information is needed for project planning and design, to determine if the project objectives are met and to apply lessons learned to future fish passage projects through adaptive management. An adaptive management plan will be developed collaboratively with stakeholders and The Nature Conservancy to gain information needed for project planning and design, monitor and evaluate project performance, learn about fish migration behavior and hopefully to plan and design future fish passage projects.

Monitoring and adaptive management would occur prior to construction (pre-construction monitoring) and after construction is complete (post-construction monitoring and adaptive management). Monitoring would be initiated before construction, would continue during construction, and would continue for up to ten years after the completion of construction of each restored area. A monitoring and adaptive management team composed of the USACE and TNC staff would conduct the data acquisition. The monitoring and adaptive management plan would be implemented in a phased approach as each separable element in the project is constructed. Monitoring and adaptive management would be initiated at the end of the construction of each restoration area, and a ten-year clock for each separable element would start at that time.

Monitoring would focus on evaluating project success and guiding adaptive management actions by determining whether the project has met performance standards (). Validation monitoring would involve various degrees of monitoring with quantitative metrics aimed at verifying that restoration objectives have been achieved for biological resources. Effectiveness monitoring would be implemented to confirm that project construction elements perform as desired. Monitoring would be carried out until the project has been determined to be successful. Monitoring would occur for up to 10 years or less depending on when success criteria are met. Monitoring objectives have been tied to original baseline measurements that were performed during site characterization field visits. Adaptive management measures would be considered upon first instance or indication of failure to meet a performance standard. Metrics and specific adaptive management triggers would be further developed during preconstruction engineering and design.

Table 17 - Modeling criteria, performance standards, and adaptive management

Measurement	Performance Standard	Adaptive Management
Temperature	60-70 degree F	Implement aeration device(s)/measures
Dissolved Oxygen	>5 ppm	
Velocity	>80% Ucrit per cohort grouping	Perform, modify, or maintain operations and maintenance
Pool Depth	>5’ at Claiborne during GS migration and spawning and >2’ during normal flow conditions	

	>5<6' at Millers Ferry US end with gates open	
Species Diversity	>60% of Representative Surroundings	Modify or maintain slope/pool/tiered dimensions to accommodate for ideal assemblage
Invasive Species	<10% of Species Diversity	
Federally Protected Species	Presence/Absence	

Preconstruction Monitoring

The USACE Engineering Research and Design Center will establish targeted Vemco arrays and tag sample Gulf sturgeon to determine baseline conditions. Existing literature and surveys will be used to develop baseline conditions for other species assemblage.

6.8 Risks & Uncertainty

Reducing Risk and Uncertainty. Reducing risk of adverse outcomes from construction and operation of a Fish Passage project is a critical reason for adaptive management and monitoring of the project sites. Monitoring the physical performance of the project, its effects on the structural integrity of the dam, and the navigation and recreational conditions will help guide future fish passage projects to reduce risk.

The uncertainty about the ecological effectiveness of the project in passing fish will be reduced by monitoring project performance. The adaptive management experiments will help analyze the relationship between size and type of fish and fish passage for the large number of fish in the river.

6.9 Environmental Operating Principles

USACE has reaffirmed its environmental commitment by formalizing Environmental Operating Principles (EOP) applicable to all its decision-making and programs. The formulation of alternatives considered for implementation met all the EOPs.

The EOPs are:

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all USACE activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments.

- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.
- Employ an open, transparent process that respects views of individuals and groups interested in USACE activities (USACE 2002).

The EOPs were considered and adhered to during the plan formulation process. Alternative 5d promotes sustainability and economically sound measures by incorporating the most natural and least cost methods for restoring fish connectivity.

6.10 Responsibilities, Federal and Non-Federal

(a) The NFS shall provide a minimum of at least 35 percent of project design and construction costs assigned to aquatic ecosystem restoration and as further described below:

(1) The NFS shall provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;

(2) The NFS shall, on non-Federal property, perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project; however, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the NFS with prior specific written direction, in which case the NFS shall perform such investigations in accordance with such written direction;

(3) The NFS shall, assume, as between the Federal Government and the NFS, on non-Federal property, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

(4) The NFS shall, provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that

are in excess of one percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

(b) The NFS shall, operate, maintain, repair, rehabilitate, and replace those portions of the project not integral to the federal locks and dams or other federal properties, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government in the Operations, Maintenance, Replacement, Repair and Rehabilitation (OMRR&R) manual and any subsequent amendments thereto;

(c) The NFS and Federal government shall provide a right to enter, at reasonable times and in a reasonable manner, upon property that the respective parties now or hereafter, own or control for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project.

(d) The NFS shall hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

(e) The NFS shall agree that, as between the Federal Government and the NFS, the NFS shall be considered the operator of those portions of the project not integral to the federal locks and dams or other federal properties for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

(f) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

(g) Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, PL 88-352 (42 U.S.C. 2000d), Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all

applicable Federal labor standards and requirements, including but not limited to, 40 U./S.C. 3141 – 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis- Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);(h) Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires the non-Federal interest to participate in and comply with applicable Federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing a PPA, and implement the plan not later than one year after completion of construction of the project;

(i) Do not use Federal funds to meet the NFS's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

(j) Prevent obstructions of or encroachment on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the level of performance it affords, hinder operation and maintenance or future periodic nourishment, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

7.0 ENVIRONMENTAL COMPLIANCE*

This Study was conducted in accordance with the USACE EOPs which were developed to ensure each mission includes totally integrated sustainable environmental practices.

The seven re-energized EOPs are available at the following webpage: https://www.usace.army.mil/Missions/Environmental/Environmental-Operating-Principles/.

Federal laws and Executive Orders applicable to the TSP are listed in **.** The TSP is in compliance with NEPA.

Table 18 – Public Law - Environmental Compliance Status

STATUS	PUBLIC LAW (US CODE)/EXECUTIVE ORDER
P	E.O. 14008 of January 27, 2021
P	Archeological and Historic Preservation Act of 1974, as amended (54 U.S.C. 3125)
P	Bald and Golden Eagle Protection Act (16 U.S.C. § 668 et seq)
P	Clean Air Act of 1972, as amended (42 U.S.C. 7401 et seq)
P	Clean Water Act of 1972, As Amended (33 U.S.C. 1251 et seq)
P	Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. 1251 et seq)
P	Comprehensive Environmental Response, Compensation & Liability Act of 1980 (42 U.S.C. 9601)
P	Endangered Species Act of 1972 (16 U.S.C. 1531)
P	Executive Order 11988, Floodplain Management
P	Executive Order 12898, Environmental Justice
P	Executive Order 13045, Protection of Children
P	Fish and Wildlife Coordination Act of 1958, as amended (16 U.S.C. 661)
P	Flood Control Act of 1944, as amended, Section 4 (16 U.S.C. 460b)
P	Historic and Archeological Data Preservation (16 U.S.C. 469)
P	Migratory Bird Conservation Act of 1928, as amended (16 U.S.C. 715)
P	Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703)
P	NEPA of 1969, as amended (42 U.S.C. 4321 et seq)
P	National Historic Preservation Act, as amended (154 U.S.C. 300101 et seq.)
P	Native American Religious Freedom Act of 1978 (42 U.S.C. 1996)
P	Native American Graves Protection and Repatriation Act (25 U.S.C. 3001)
P	National Trails System Act (16 U.S.C. 1241)
P	Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq)
P	Rehabilitation Act of 1973 (29 U.S.C. 794)
P	Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901-6987)
P	River and Harbor Act of 1888, Section 11 (33 U.S.C. 608)
P	River and Harbor Act of 1899, Sections 9, 10, 13 (33 U.S.C. 401-413)
P	River and Harbor and Flood Control Act of 1962, Section 207 (16 U.S.C. 460d)
P	River and Harbor and Flood Control Act of 1970, Sects 122, 209 and 216 (33 U.S.C. 426 et seq)
P	Submerged Lands Act of 1953 (43 U.S.C. 1301 et seq)
P	Superfund Amendments and Reauthorization Act of 1986 (42 U.S.C. 9601)
P	Toxic Substances Control Act of 1976 (15 U.S.C. 2601)
P	Wild and Scenic River Act of 1968 (16 U.S.C. 1271 et seq)

*** Full compliance achieved with signed FONSI**

7.1 Consultation and Coordination*

In accordance with Section 1005 of the Water Resources Reform and Development Act of 2014, cooperating agency letters dated December 13, 2021, were mailed to Federal

and State agencies and are included in Appendix B-2. An Interagency Meeting was held January 10-11, 2022, to gather environmental data and discuss actionable measures for the creation of the CEM. An expert elicitation meeting with Cooperating Agencies was held on September 14, 2022, to discuss species swimming behavior for use in the selected habitat model. Regular monthly meetings are held with Cooperating and Participating Agencies in accordance with the communications plan. Cooperating and Participating Agencies will also receive copies of the Draft and Final IFR/EA to review.

*7.1.1 Endangered Species Act**

Coordination with USFWS is ongoing. A concurrence with USACE's determination is anticipated and will be included in the Final IFR/EA Environmental Appendix.

*7.1.1.1 USACE Position**

Section to be updated following receipt of Final Biological Opinion.

*7.1.2 Fish and Wildlife Coordination Act**

Coordination with USFWS is ongoing. A Draft Fish and Wildlife Coordination Act Report was received on April 14, 2023 and is included in Appendix B-2. A copy of the Planning Aid Letter is included in Appendix B-2.

7.1.2.1 USFWS Position

"Based on the analyses presented by the Corps on March **1,** 2023, the Service tentatively supports the selected alternative (5d) of construction of natural bypass channels at both Claiborne and Millers Ferry L&D and currently prefers this option over the No Action Alternative. However, more information on design, particularly on details that will address downstream migration, additives for fish attraction to passage structures, and other factors that will affect the passability of the structures, including but not limited to the timing and duration of flows through the bypass channel, will be needed in order for the Service to fully evaluate this alternative in the final FWCAR. In addition, the Service recommends that the Corps consider wetland mitigation, migratory bird conservation measures, and recreational area preservation or improvement to conserve all habitats potentially affected by the project and to benefit all resources. We look forward to continuing to work with the Corps and other partners and stakeholders during the next phase of the study to finalize the design of the selected alternative and to conserve fish and wildlife resources."

*7.1.3 National Historic Preservation Act**

The Alabama State Historic Preservation Officer and affected Indian tribes will be notified of area of potential effect during the agency comment period. A programmatic agreement is currently being proposed.

*7.1.4 Public Involvement**

Three open-house style public meetings are scheduled for May 2023. The draft IFR/EA will be made available to the public for review on the USACE Mobile District website.

*7.1.5 Charette**

A Planning Charette was held December 6-7, 2021. Environmental agencies were invited.

*7.1.6 Public and Agency Review**

Public and Agency Review of the Draft IFR/EA is scheduled for May 2023.

7.2 Areas of Concern*

No areas of concern have been identified to-date. Public and Agency comment period is scheduled for May 2023.

8.0 DISTRICT ENGINEER'S RECOMMENDATION / SIGNATURE PAGE

I have considered all significant aspects of the public interest including environmental, social, and economic effects, engineering feasibility and any other elements bearing on the decision. There has been no controversy concerning this study or the proposed project and the NFS and local stakeholders are in support of the proposed action. The plan complies with all seven of the USACE EOPs.

Based on the analysis, Alternative 5d is the TSP. The plan includes a natural bypass channel at both Claiborne and Millers Ferry Locks and Dams, both constructed along the right descending bank of the Alabama River with natural materials such as soil, riprap embankment protection, and stone weirs to create riffle pools. Additionally, Millers Ferry Natural Bypass Channel includes a control gate structure and two vehicular bridges over the bypass channel. The channel dimensions and slopes have been optimized to meet the water velocities needed to support fish passage based on swim speeds of the native representative species identified in this study.

The total project cost is $188,000,000 with an estimated $200,000 in annual O&M for both bypass channels. Operating and maintaining the bypass channels will include regular removal of sediment from the channels totaling $85,500 annually, a NFS responsibility, as well as regular maintenance on the gate control structure at Millers Ferry, a federal responsibility.

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 the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

DATE:_____ _____

[CURRENT DE]
Colonel, U.S. Army
District Commander

9.0 PROJECT DELIVERY TEAM AND LIST OF PREPARERS

lists the functional PDT members and does not account for supervisory personnel or Vertical Team members. Each member of the PDT co-authored the Draft IFR/EA.

Table 19 – Project Delivery Team Members

MEMBER	DISCIPLINE
Jonas White	Project Manager
Tonya Harrington	Principle Planner
Heather Bulger	Lead Biologist
Chris Marr	Engineering Technical Lead
Ashley Throop	Hydraulic Engineer
Jody Huang	Hydraulic Engineer
Johnny Lee	Structural Engineer
Allan Annaert	Cost Engineer
Jack Cape	Civil Site Engineer
Stephen Phillips	Economist
John Tetreau	Realty Specialist
Derek Kendrick	Operations
Kenneth Jackson	Cost Engineer
Chase Rourke	Geotechnical Engineer
Alexandria Smith	Anthropologist
Terry Rickey	Biologist
Ashley Forwood	Plan Formulator
Brook Cotton	Hazardous, Toxic, and Radioactive Waste

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