Biological Opinion and Conference Opinion

Pearl River Basin, Mississippi Federal Flood Risk Management Project, Hinds and Rankin Counties, Mississippi

Ecosphere Project Code: 2022-0006708-S1-002

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EXECUTIVE SUMMARY

This Endangered Species Act (ESA) Biological Opinion/Conference Opinion (BO/CO) of the U.S. Fish and Wildlife Service (Service) addresses the Pearl River Basin, Mississippi, Federal Flood Risk Management Project (the Action). The United States Corps of Engineers (USACE) is proposing a range of alternatives to provide economic and flood reduction benefits to the Jackson metropolitan area in Hinds and Rankin Counties, Mississippi. The alternatives being considered include structural and nonstructural features including existing home elevations and flood proofing, deepening of the floodplain through the excavation of land, installing a new weir, creating new levees, and other associated features. The USACE has not selected a final alternative and may choose from a combination of these project features. The USACE agrees to re-initiate consultation once those components are chosen should they fall outside the scope of our analysis.

The USACE determined that some project alternatives are likely to adversely affect the Gulf sturgeon (*Acipenser oxyrhynchus desotoi*) and its critical habitat, ringed map turtle (*Graptemys oculifera*), Pearl River map turtle (*Graptemys pearlensis*), alligator snapping turtle (*Macrochelys temminckii*), Louisiana pigtoe (*Pleurobema riddellii*), and monarch butterfly (*Danaus plexippus*), and requested formal consultation and conference with the Service. Table 1 reflects the level of take that the Service estimates will be associated with the three structural alternatives being considered. This BO/CO concludes that the Action is not likely to jeopardize the continued existence of these species and is not likely to destroy or adversely modify Gulf sturgeon designated critical habitat. This conclusion fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the ESA of 1973, as amended, with respect to these species and designated critical habitat.

After analyzing the effects of the varying structural features being considered, it is the Service's opinion that the installation of a new weir and its resulting impoundment (i.e., lake) is the feature that will have the greatest adverse effect on the species covered by this BO/CO. Since this feature is being added for recreational and economic development opportunities; and is not likely to provide any flood reduction benefits, we strongly encourage the USACE to remove the weir feature from the final alternative selected in order to avoid and minimize impacts to covered species and their designated critical habitat.

The USACE also determined that the Action is not likely to adversely affect the federally endangered northern long-eared bat (*Myotis septentrionalis*) and proposed for listing tricolor bat (*Perimyotis subflavus*) and requested Service concurrence. The Service concurred with these findings by letter dated June 28, 2024.

Table 1. Estimates of the amount of take caused by the three alternatives being considered by the USACE: by species, life stage, and form of take.

Common Name	Life Stage/Form of Take	Alternative C	Alternative D	Alternative E
Gulf Sturgeon	Adults/lethal	4/year	4/year	0
Ringed Map Turtle	Adults/lethal	1,516	1,196	0
	Adults/nonlethal	4,974	4,717	1,596
	Eggs/lethal	461	364	92
Pearl River Map Turtle	Adults/lethal	88	70	0
	Adults/nonlethal	318	302	84
	Eggs/lethal	20	16	4
Alligator Snapping Turtle	Adults/lethal	13	13	11
	Eggs/lethal	36	28	7
Louisiana Pigtoe	Adults/lethal	53,686	45,653	0
Monarch Butterfly	Acreage surrogate/ permanent	2,562	1,706	0
	Acreage surrogate/ temporary	0	0	1,500

The BO/CO includes an Incidental Take Statement (ITS) that requires the USACE to implement reasonable and prudent measures that the Service considers necessary or appropriate to minimize the impacts of anticipated taking on the listed species. Incidental taking of listed species that is in compliance with the terms and conditions of this statement is exempted from the prohibitions against taking under the ESA.

In the Conservation Recommendations section, the BO/CO outlines voluntary actions that are relevant to the conservation of the listed species addressed in this BO and are consistent with the authorities of the USACE.

Reinitiating consultation is required if the USACE retains discretionary involvement or control over the Action (or is authorized by law) when:

(a) the amount or extent of incidental take is exceeded;
(b) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO/CO;
(c) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
(d) a new species is listed or critical habitat designated that the Action may affect.

CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Mississippi and Louisiana Ecological Services Field Offices.

Date	Consultation
October 23, 2019	The Service provides a BO for Alternative C during previous planning efforts assessing impacts on the Gulf sturgeon, it's critical habitat and RMT
November 9, 2021	Proposal to list the AST as threatened published in the Federal Register
November 23, 2021	Proposal to list the PRMT as threatened published in the Federal Register
December 20, 2022	USACE requests formal conference for PRMT and AST and reinitiation of consultation for the NLEB that had a change in listing from threatened to endangered
January 18, 2023	Service provides response on formal conference request for PRMT and AST, and recommendation to include the Louisiana pigtoe
March 20, 2023	Proposal to list the Louisiana pigtoe as threatened with critical habitat published in Federal Register
February 26, 2024	BA submitted to USFWS analyzing impacts to threatened and endangered species from the proposed project.
May 28, 2024	Final BA submitted for effects of the action on the Gulf sturgeon, its critical habitat, RMT, PRMT, AST, Louisiana pigtoe, Monarch butterfly, NLEB, and TCB
June 7, 2024	DEIS released including new alternatives that the Service did not consider during the 2019 formal consultation on Alternative C.
June 28, 2024	Service agrees to enter into formal consultation for all species other than NLEB and TCB. The Service concurs with a MANLAA determination for these two species.
July 12, 2024	Final rule to list the PRMT as threatened published in the Federal Register.
October 10, 2024	Draft BO provided to the USACE
October 17, 2024	USACE provided comments on draft BO

Abbreviations: U.S. Fish and Wildlife Service (Service), Alligator Snapping Turtle (AST), Draft Environmental Impact Statement (DEIS), Northern long-eared bat (NLEB), Pearl River Map Turtle (PRMT), Ring Mapped Turtle (RMT), Tricolor Bat (TCB), Biological Assessment (BA), Biological Opinion (BO), May affect, but is not likely to adversely affect (MANLAA)

BIOLOGICAL OPINION

1.0 INTRODUCTION

A biological opinion (BO) is the document that states the findings of the U.S. Fish and Wildlife Service (Service) required under section 7 of the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

A BO evaluates the effects of a Federal Action, which include all consequences of the Action and from non-Federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and critical habitat. A Service opinion that concludes a proposed Federal action is not likely to jeopardize the continued existence of a species and is not likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA. "Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Similarly, a conference opinion (CO) is required for a proposed species when a federal action agency determines that a project may jeopardize its continued existence or result in the destruction or adverse modification of proposed designated critical habitat. A CO addresses only species or critical habitat "proposed" for listing and includes the same analyses as a BO. While the prohibitions of the ESA do not yet apply under a CO, a CO follows the same regulations (50 CFR §402.14) and must meet the same standards as a BO, so that the former may be adopted as the latter after the Service issues a final decision listing a species or designating a critical habitat.

The federal action agency for this consultation and conference is the United States Army Corps of Engineers (USACE), and the Federal Action addressed in this document is the Pearl River Basin, Mississippi, Federal Flood Risk Management Project, Hinds and Rankin Counties, Mississippi. This combined BO/CO addresses effects to the Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), ringed map turtle (*Graptemys oculifera*), Pearl River map turtle (*Graptemys pearlensis*), alligator snapping turtle (*Macrochelys temminckii*), Louisiana pigtoe (*Pleurobema riddellii*), and monarch butterfly (*Danaus plexippus)* resulting from an array of flood risk management alternatives being considered for the Jackson metropolitan area in Hinds and Rankin Counties, Mississippi. These species will be collectively referred to as the "covered species" throughout the document.

For simplicity, this document will collectively be referred to as "BO" throughout this document. Any distinctions between formal consultation and conference procedures will be specifically addressed as necessary. Considerations of the proposed alligator snapping turtle and Louisiana pigtoe in this CO should not be construed as an indication that they will or will not be proposed for listing at some point in the future.

The USACE has also requested consultation on the monarch butterfly (*Danaus plexippus*), a candidate species. A candidate species is a plant or animal species that the Service finds warrants a proposal to list as endangered or threatened, but listing is precluded by higher priority listing activities. Although a CO is only recommended for species proposed for listing, the monarch butterfly will be included in the opinion at the request of the USACE.

Critical habitat includes the specific areas within the geographic area, occupied by the species at the time it was listed, that contain the physical or biological features that are essential to the conservation of threatened and endangered species and that may need special management or protection. Critical habitat may also include areas that were not occupied by the species at the time of listing but are essential to its conservation. The prohibition against destruction and adverse modification of critical habitat protects such areas in the interest of conservation. The Action area is located within critical habitat for the Gulf sturgeon, specifically Unit 1.

The Service previously concurred with the USACE's determination that the Action is not likely to adversely affect the northern long-eared and tricolored bats by letter dated on June 28, 2024. This concurrence fulfilled the USACE's responsibilities for the Action under §7(a)(2) of the ESA for these species and critical habitats. We do not address further these species and critical habitats in this BO.

Finally, the USACE determined that the nonstructural alternative (A1) is not expected to impact any of the covered species. The Service concurs with this determination and therefore this alternative will not be further addressed in this BO. Instead, the BO will focus on the structural alternatives that the USACE anticipates will have adverse impacts to covered species.

BO Analytical Framework

A BO that concludes a proposed Federal action is *not* likely to *jeopardize the continued existence* of listed species and is *not* likely to result in the *destruction or adverse modification* of critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA.

> *"Jeopardize the continued existence* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).
>
> "*Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02).

The Service determines in a BO whether we expect an action to satisfy these definitions using the best available relevant data in the following analytical framework (see 50 CFR §402.02 for the regulatory definitions of *action, action area, environmental baseline, effects of the action*, and *cumulative effects*).

a. *Proposed Action*. Review the proposed Federal action and describe the environmental changes its implementation would cause, which defines the action area.
b. *Status*. Review and describe the current range-wide status of the species or critical habitat.

c. *Environmental Baseline*. Describe the condition of the species or critical habitat in the action area, without the consequences to the listed species caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impacts of State or private actions which are contemporaneous with the consultation.
d. *Effects of the Action*. Predict all consequences to species or critical habitat caused by the proposed action, including the consequences of other activities caused by the proposed action, which are reasonably certain to occur. Activities caused by the proposed action would not occur but for the proposed action. Effects of the action may occur later in time and may include consequences that occur outside the action area.
e. *Cumulative Effects*. Predict all consequences to listed species or critical habitat caused by future non-Federal activities that are reasonably certain to occur within the action area.
f. *Conclusion*. Add the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, formulate the Service's opinion as to whether the action is likely to jeopardize species or adversely modify critical habitat.

2.0 PROPOSED ACTION

The purpose of the proposed Action is to identify and evaluate a range of flood risk management alternatives to reduce flood risk in the Jackson metropolitan area; reduce the flood risk to critical infrastructure, including the Savanna Street Wastewater Treatment Plant; and improve access to transportation routes, evacuation routes, and critical care facilities during flood events. The USACE defines the project area to be the Pearl River Basin in Hinds and Rankin Counties, Mississippi between River Mile (RM) 270.0 just south of Byram and RM 301.77 at the dam/spillway of the Ross Barnett Reservoir.

The USACE is the lead federal agency for this Action and the Rankin-Hinds Pearl River Flood and Drainage Control District (RHDD) is the Non-Federal Interest (NFI). After considering a range of initial alternatives, a final array of alternatives was retained for further analysis.

1. <u>Alternative A1</u> - This nonstructural alternative consists of elevation, floodproofing, and voluntary property acquisition. Acquired properties would become permanent/perpetual greenspace that is publicly owned and maintained by the NFI. This alternative is anticipated to have very minimal adverse impacts to the natural environment, including covered species.

2. <u>Alternative C</u> - This alternative was the NFI Locally Preferred Plan (LPP) and consists of clearing and expanding cross-sectional areas of the river channel corridor to increase hydraulic conveyance (i.e., excavation of approximately 20 million cubic yards from RM 284.0 to RM 294, which would be placed adjacent to and behind existing levees (some material would also be placed within the floodplain to create islands), demolition of the existing weir near the J.H. Fewell water treatment plant (WTP) at RM 291, construction of a new weir with a low-flow gate structure at RM 284.3 to create a 2,562 acre year-round recreational water body (i.e., lake) and provide an alternative raw water supply intake location should one be needed in the future,

improvements to the Federal levees, and upgrading an existing non-Federal levee into a federalized ring levee around the Savanna Street Wastewater Treatment Plant (WWTP).

3. Alternative D – This alternative, also referred to as the Combination Thereof Alternative with Weir; includes a combination of features previously considered. This alternative is similar to Alternative C but with a smaller footprint. It includes clearing and expanding cross-sectional areas of the river floodplain to increase hydraulic conveyance (i.e., floodplain excavation/lowering similar to Alternative C), construction of a new weir (with the existing Fewell WTP weir being left in place), federal levee improvements, raising the ring levee around the Savanna Street WWTP, additional levee construction near the Canton Club neighborhood in Northeast Jackson, MS; bridge countermeasures, and limited property acquisition. The NFI has indicated that Alternative D is now their LPP.

4. Alternative E – This alternative, also referred to as the Combination Thereof Alternative without Weir; is the same as Alternative D, but without the construction of a new weir.

The Service analyzed impacts from the Action by grouping impacts primarily associated with 1) channel improvements associated with Alternatives C, D, and E and 2) impacts associated with the construction of a weir and the subsequent impoundment (i.e., lake) that it will create (i.e., Alternatives C and D only).

The Service also determined that other features associated with Alternatives C, D, and E, including the new levees for the Canton Club neighborhood and Savanna Street WWTP, existing federal levee improvements, demolishing the existing J.H. Fewell WTP weir (Alternative C), countermeasures for bridges, hardpoints at base of tributaries, additional pumps to address interior drainage impacts, and a new slurry wall for seepage of existing and new levees (Alternatives C and D) would not have adverse impacts to covered species; and therefore are not further discussed. Additional consultation will be required during the Project Engineering and Design (PED) phase if such features are determined to have a potentially adverse impact on the covered species.

In addition, all three structural alternatives will result in river flow and stage inducements (i.e., increases). The USACE calculated the extent of these inducements to extend to RM 223 just past the confluence of Copiah Creek in Copiah County, Mississippi. The USACE's initial assessment indicates approximately 38,800 acres downstream of the project area could see inducements at the 100-year flood frequency. The Service does not anticipate these inducements will result in adverse effects to covered species at this time. However, additional consultation will be required during the PED phase if the effects of these inducements are determined to adversely impact the covered species.

2.1. Channel Improvements

Alternative C would include the excavation of up to approximately 20 million cubic yards from 1,443 acres of the floodplain from approximately RM 284.0 to RM 294 (10 miles). The USACE described this activity as "channel improvements", therefore, we will use the same terminology in this BO. However, the existing river channel would not be widened, and no excavation of material would occur within the Pearl River channel, instead excavation of the overbank areas would occur (i.e., lowering of the floodplain). This floodplain lowering would range in width from approximately 400 to 2,000 feet. Clearing and grubbing of approximately 2,301 acres would occur prior to placement of the excavated fill material from the channel improvements. Alternative C would also include the relocation of over approximately four miles of a levee further away from the river thus reconnecting some of the floodplain. The construction plan for Alternative C indicated that most of the excavation from the floodplain would occur during the dry season when the likelihood of out-of-bank flows is reduced.

Alternatives D and E will have similar channel improvement activities but without the proposal to relocate levees further away from the river. No excavation of material would occur within the Pearl River channel. Overbank lowering would occur from RM 285 to 294 (9 miles), a similar length to Alternative C. The channel improvement footprint includes excavation of up to 1,016 acres, compared to 1,443 acres for Alternative C. The width of overbank excavation/lowering would vary ranging from 500 to 2,600 feet, slightly wider than Alternative C. The quantity of material excavated from the floodplain would range from 11.3 to 14.1 million cubic yards of material, compared to 20 million cubic yards for Alternative C. The depth of excavation would vary between 0-15 feet to meet the proposed bottom elevation of 250.0 feet National Geodetic Vertical Datum of 1929 (NGVD 29). Clearing and grubbing of approximately 1,501 acres would occur prior to placement of the excavated fill material from the channel improvements, compared to 2,301 acres for Alternative C. The excavated fill material would be used to create land areas ranging from 6.5 to 88 acres. The newly created areas could allow for expanded riverfront access, natural areas, and commercial development, along with recreational opportunities.

Both Alternatives C and D would include islands within the channel improvement excavation area that would be maintained and/or expanded upon from RM 288.0 to RM 292.0. Further, sand bars could be constructed inside the floodplain and along the existing islands to compensate for the loss of sand bar habitat.

2.2. Weir Construction and Impoundment

Alternative C would include the construction of an approximately 1,500-foot-wide weir located at RM 284. The top elevation of the weir would be at 258 feet North American Vertical Datum 1988 (NAVD 88). The weir will create an approximately 2,562-acre impoundment stretching from RM 284 to RM 293.5 (9.5 miles) with an average depth of 22 feet. A 12-foot by 12-foot gate and culvert structure would be built to the east of the new weir to maintain minimum flows through the impoundment during low flow periods. The bottom elevation of the culvert on the upstream side would be approximately 248 feet (NAVD 88) while the downstream side would connect to the existing channel at an elevation of approximately 230 feet (NAVD 88). An approximately 7,300-foot-long channel for fish passage would be constructed east of the low-flow structure and would have an upstream bottom elevation of 256 feet (NAVD 88) and the downstream bottom elevation would be 230 feet (NAVD 88) where it connects to the river channel.

Alternative D would have a new 1,700-foot-wide weir placed at RM 286.5, approximately 2.5 miles upstream from the Alternative C location. The top elevation of the weir would be at 256 NAVD 88, two feet lower than Alternative C and 6 feet higher than the existing J.H. Fewell WTP weir (250 NAVD 88). Downstream low-water hydrologic flows (extreme drought condition minimum flows) within the Pearl River channel would be maintained by means of a 12 x 12-foot low-flow gate. The weir will create an approximately 1,706-acre impoundment from RM 286.6 to RM 294 (7.5 miles). The weir would impound approximately 6 feet of water along the excavated overbanks (about 1,350 ft) and up to 22 feet in the approximately 350 feet across the main channel. Downstream erosion protection from flow over the weir are also part of the conceptual designs. A fish passage channel similar to Alternative C would also be constructed.

Alternative E would not include a weir or associated impoundment. The Draft Environmental Impact Statement (DEIS) does not discuss the post-project conditions for Alternative E, if the excavated overbank areas would be revegetated, or whether these areas would hold water similar to natural oxbows.

2.3. Conservation Measures

The USACE did not identify conservation measures in their final biological assessment (BA) and stated that further coordination with the Service would occur to develop such measures as needed.

2.4. Other Activities Caused by the Action

A BO evaluates all consequences to species or critical habitat caused by the proposed Federal action, including the consequences of other activities caused by the proposed action, that are reasonably certain to occur (see definition of "effects of the action" at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed action (but not part of the proposed action) are reasonably certain to occur. These factors include, but are not limited to:

(1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action;
(2) existing plans for the activity; and
(3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

Alternatives C and D include the construction of additional natural areas and parks within portions of the project fill areas behind the existing levees. While not analyzed in the DEIS, Alternative E could have similar features. Non-consumptive activities, such as hiking, outdoor photography, and wildlife viewing would increase as these areas would be publicly available. Conversion of the forestland and other habitat types that currently exist and are inaccessible to water, will occur with the implementation of these alternatives. These alternatives would increase water-dependent recreational opportunities, such as fishing, boating, and canoeing through additional public access such as boat ramps. Non-consumptive uses may increase because of the inclusion of multipurpose trails, wildlife viewing areas, amphitheaters, and campgrounds. The additional public access boat ramps and pedestrian access points associated with these alternatives would increase recreation within the project area. All three alternatives would improve access to the waterfront (i.e., lake or river depending on which alternative is selected), increasing the opportunity for public recreational utilization.

Activities that would not occur but for the proposed Federal action include relocation or retrofitting of existing infrastructure within the Action area (i.e., roads, bridges, pipelines, powerlines), riverfront access, and commercial/residential development. These activities are expected to increase recreational opportunities, which may stimulate community development, population, and housing. Increased recreational use of the river from the upper end of the new lake (associated with Alternatives C and D) to the Ross Barnett reservoir could occur similar to consequences north of the Ross Barnett Reservoir. Currently, recreational activities (e.g., fishing, boating) do occur within this area north of Lakeland Drive but are not as great as above the Ross Barnett Reservoir (Selman and Jones 2017).

Consumptive uses such as fishing are also expected for Alternatives C and D, which could result in increases in fishing bycatch on trotlines, limblines, and rod/reel. Implementing fishing regulations (i.e., no set lines or commercial nets) could reduce Gulf sturgeon, alligator snapping turtle, Pearl River map turtle, and ringed map turtle mortality due to these actions.

2.5. Action Area

The Action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). Delineating the Action area is necessary for the Federal action agency to obtain a list of species and critical habitats that may occur in that area, which necessarily precedes any subsequent analyses of the effects of the action to particular species or critical habitats.

It is practical to treat the Action area for a proposed Federal action as the spatial extent of its direct and indirect "modifications to the land, water, or air" (a key phrase from the definition of "action" at 50 CFR §402.02). Indirect modifications include those caused by other activities that would not occur but for the action under consultation. The Action area determines any overlap with critical habitat and the physical and biological features therein that we defined as essential to the species' conservation in the designation final rule. For species, the Action area establishes the bounds for an analysis of individuals' exposure to action-caused changes, but the subsequent consequences of such exposure to those individuals are not necessarily limited to the Action area.

Figure 1 shows the locations of all activities that the proposed Action would cause and the spatial extent of reasonably certain changes to land, water, or air caused by these activities, based on the descriptions and analyses of these activities in section 2.1. The Action area for this BO consists of the Pearl River floodplain from the Ross Barnett Dam (RM 301.77) to just south of Georgetown below the confluence of Copiah Creek at RM 223 and includes land in Copiah, Hinds, and Rankin Counties, Mississippi. The Action area is drained by several small creeks that are tributaries of the Pearl River. Small tributaries to the Pearl River within the Action area include Town, Hanging Moss, Eubanks, Lynch, Richland, Hardy, Caney, Purple, Hog Creeks, and many additional tributaries downstream to Georgetown. The Action area also includes riparian areas adjacent to the river where construction activities would occur.

2.6. Tables and Figures

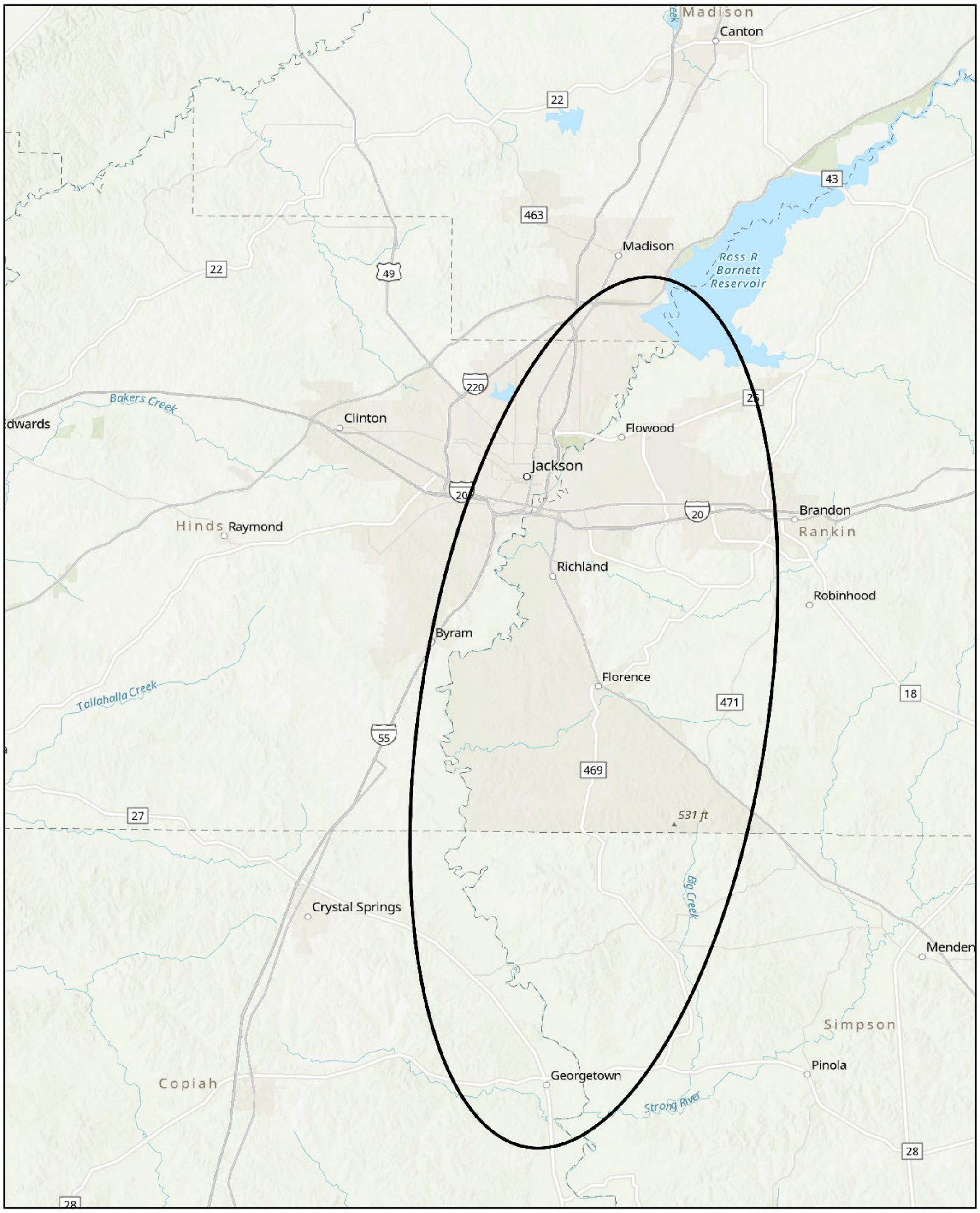


Figure 1. Action Area

3.0 SOURCES OF CUMULATIVE EFFECTS

A BO must predict the consequences to species caused by future non-Federal activities within the Action area, *i.e.,* cumulative effects. "Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include but are not limited to: existing plans for the activity; and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the USACE did not describe, and the Service is not aware of, any future non-Federal activities that are reasonably certain to occur within the Action area. Therefore, we anticipate no cumulative effects that we must consider in formulating our opinion for the Action.

4.0 GULF STURGEON

This section provides the Service's biological opinion of the Action for the Gulf sturgeon.

4.1. Status of Gulf Sturgeon

This section summarizes best available data about the biology and current condition of Gulf sturgeon (*Acipenser oxyrhynchus desotoi*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list Gulf Sturgeon as threatened on September 30, 1991 (56 FR 49653 49658). The Gulf Sturgeon Recovery/Management Plan was finalized September 22, 1995 (USFWS and GSMFS 1995). The Service published its final decision designating critical habitat for Gulf Sturgeon on March 19, 2003 (68 FR 13370 13495). The most recent 5-year status review of the species was completed February 2022.

4.1.1. Species Description

The Gulf sturgeon, also known as the Gulf of Mexico sturgeon, is an anadromous fish (breeding in freshwater after migrating up rivers from marine and estuarine environments), inhabiting coastal rivers from Louisiana to Florida during the warmer months and overwintering in estuaries, bays, and the Gulf of Mexico. It is a nearly cylindrical primitive fish embedded with bony plates or scutes. The head ends in a hard, extended snout; the mouth is inferior and protrusible and is preceded by four conspicuous barbels. The caudal fin (tail) is heterocercal (upper lobe is longer than the lower lobe). Adults range from 1.2 to 2.4 meters (m) (4 to 8 feet (ft)) in length, with adult females larger than males. The Gulf sturgeon is distinguished from the geographically disjunct Atlantic coast subspecies *(A. o. oxyrinchus)* by its longer head, pectoral fins, and spleen (Vladykov 1955; Wooley 1985). King et al. (2001) have documented substantial divergence between *A. o. oxyrinchus* and *A. o. desotoi* using microsatellite DNA testing.

4.1.2. Life History

Like most sturgeons, the Gulf sturgeon is characterized by large size, longevity, delayed maturation, high fecundity, and far-ranging movements. Gulf sturgeon typically live for 20 to 25 years but can reach ages of at least 42 years (Huff 1975). Age at sexual maturity ranges from 8 to 12 years for females and 7 to 9 years for males (Huff 1975). High fecundity has been demonstrated by Chapman et al. (1993), who estimated that mature female Gulf sturgeon weighing between 29 and 51 kilograms (kg) (64 and 112 pounds (lb)) produce an average of 400,000 eggs. Long-range migrations from the open Gulf of Mexico to bays and estuaries to coastal rivers are also common. Migratory behavior of the Gulf sturgeon is likely influenced by sex and reproductive status (Fox et al. 2000), change in water temperature (Wooley and Crateau 1985; Chapman and Carr 1995; Foster and Clugston 1997), and increased river flow (Chapman and Carr 1995; Heise et al. 1999a, b; Sulak and Clugston 1999; Ross et al. 2000 and 2001b; Parauka et al. 2001).

In general, all life stages of Gulf sturgeon migrate into rivers in the spring (from late February to May), where sexually mature sturgeon spawn when the river temperatures rise to between 17 to 25 degrees Celsius (ºC) (75 degrees Fahrenheit (°F)). Similar to Atlantic sturgeon, Gulf sturgeon are believed to exhibit a long inter-spawning period, with male Gulf sturgeon capable of annual spawning, but females requiring more than one year between spawning events (Huff 1975; Fox et al. 2000) and only a small percentage of females spawn in a given year (Sulak and Clugston 1999; Pine et al. 2001). Therefore, Gulf sturgeon population viability is highly sensitive to changes in adult female mortality and abundance (Pine et al. 2001; Flowers 2008).

Spawning occurs in the upper reaches of rivers, at least 100 km (62 miles) upstream of the river mouth (Sulak et al. 2004), in habitats consisting of one or more of the following: limestone bluffs and outcroppings, cobble, limestone bedrock covered with gravel and small cobble, gravel, and sand (Marchant and Shutters 1996; Sulak and Clugston 1999; Heise et al. 1999a; Fox et al. 2000; Craft et al. 2001; USFWS unpub. data 2005; Pine et al. 2006). These hard bottom substrates are required for egg adherence and shelter for developing larvae (Sulak and Clugston 1998). Documented spawning depths range from 1.4 to 7.9 m (4.6 to 26 ft) (Fox et al. 2000; Ross et al. 2000; Craft et al. 2001; USFWS unpub. data 2005; Pine et al. 2006).

Gulf sturgeon eggs are demersal (bottom dwelling) and adhesive, requiring at least two to four days to hatch (Parauka et al. 1991; Chapman et al. 1993). After hatching, larval Gulf sturgeon are particularly sensitive to water temperatures above 25°C (77°F) (Chapman and Carr 1995). Young-of-year (YOY) fish disperse widely throughout the river and remain in freshwater for 10 to 12 months after spawning occurs (Sulak and Clugston 1999). They are typically found in open sand-bottom habitat away from the shoreline and vegetated habitat.

Throughout early spring to late autumn, Gulf sturgeon of all ages remain in freshwater until fall (6 to 9 months) (Odenkirk 1989; Foster 1993; Clugston et al. 1995; Fox et al. 2000; Sulak et al. 2009). They typically occupy discrete areas either near the spawning grounds (Wooley and Crateau 1985; Ross et al. 2001b) or downstream areas referred to as summer resting or holding areas. These resting areas are often located in deep holes, and sometimes shallow areas, along straight-aways ranging from 2 to 19 m (6.6 to 62.3 ft) deep (Wooley and Crateau 1985; Morrow et al. 1998; Ross et al. 2001a, b; Craft et al. 2001; Hightower et al. 2002), and frequently near (not in) natural springs (Clugston et al. 1995; Foster and Clugston 1997; Hightower et al. 2002). The substrates consisted of mixtures of limestone and sand (Clugston et al. 1995), sand and gravel (Wooley and Crateau 1985; Morrow et al. 1998), or just sandy substrate (Hightower et al. 2002). With the exception of YOY fish, Gulf sturgeon do not typically feed during freshwater residency (Mason and Clugston 1993; Gu et al. 2001). Sulak et al. (2012) reported that the vast majority (approximately 94 percent) of juvenile, subadult, and adult Gulf sturgeon sampled from the Suwannee River exhibited complete feeding cessation for the 8 to 9-month summer residency; however, a small percentage (approximately 6 percent) of juveniles and subadults did feed in freshwater.

All non-YOY begin to migrate downstream from fresh to saltwater around September (at about 23°C [73 degrees Fahrenheit (°F)]) through November (Huff 1975; Wooley and Crateau 1985; Foster and Clugston 1997), and they spend the cool months in estuarine areas, bays, or in the Gulf of Mexico (Odenkirk 1989; Foster 1993; Clugston et al. 1995; Fox et al. 2002). During the fall migration, Gulf sturgeon may require a period of physiological acclimation to changing salinity levels, referred to as osmoregulation or staging (Wooley and Crateau 1985). This period may be short (Fox et al. 2002) as sturgeon develop an active mechanism for osmoregulation and ionic balance by age 1 (Altinok et al. 1998). Some adult Gulf sturgeon may also spawn in the fall (Randall and Sulak 2012).

Throughout fall and winter, juveniles feed in the lower salinity areas in the river mouth and estuary (Sulak and Clugston 1999; Sulak et al. 2009), while subadults and adults migrate and feed in the estuaries and nearshore Gulf of Mexico habitat (Foster 1993; Foster and Clugston 1997; Edwards et al. 2003, 2007; Parkyn et al. 2007). Some Gulf sturgeon may also forage in the open Gulf of Mexico (Edwards et al. 2003).

The Gulf sturgeon is a benthic (bottom dwelling) suction feeder: it feeds mostly upon small invertebrates in the substrate using its highly protrusible (capable of extension) tubular mouth. The type of invertebrates ingested varies by habitat but are mostly soft-bodied animals that occur in sandy substrates. YOY Gulf sturgeon feed on freshwater aquatic invertebrates, mostly insect larvae and detritus (Mason and Clugston 1993; Sulak and Clugston 1999; Sulak et al. 2009). Juveniles (less than 5 kg (11 lb), ages 1 to 6 years) forage in lower salinity habitats near the river mouth and in the estuaries, and subadults and adults feed in the estuary and nearshore feeding grounds in the Gulf of Mexico (Foster 1993; Foster and Clugston 1997; Edwards et al. 2003, 2007; Parkyn et al. 2007). Prey in estuarine and marine habitats include amphipods, brachiopods, lancelets, polychaetes, gastropod mollusks, shrimp, isopods, bivalve mollusks, and crustaceans (Huff 1975; Mason and Clugston 1993; Carr et al. 1996; Fox et al. 2000; Fox et al. 2002). Ghost shrimp (*Lepidophthalmus louisianensis*) and haustoriid amphipods (e.g., *Lepidactylus spp.*) are strongly suspected to be important prey for adult Gulf sturgeon over 1 m (3.3 ft) in length (Heard et al. 2000; Fox et al. 2002).

Previous tagging studies indicated that Gulf sturgeon exhibit river fidelity (USFWS and GSMFC 1995). Stabile et al. (1996) identified five regional or river-specific stocks (from west to east): (1) Lake Pontchartrain and Pearl River, (2) Pascagoula River, (3) Escambia/Conecuh and Yellow Rivers, (4) Choctawhatchee River, and (5) Apalachicola, Ochlockonee, and Suwannee Rivers. Dugo et al. (2004) reported that genetic structure occurs at the drainage level for the Pearl, Pascagoula, Escambia/Conecuh, Yellow, Choctawhatchee, and Apalachicola rivers (no samples were taken from the Suwannee population). Gulf sturgeon do make inter-river movements (USFWS unpub. data 2012), and more genetic research is needed to determine if inter-stock movement is resulting in inter-stock reproduction.

4.1.3. Numbers, Reproduction, and Distribution

Historically, the Gulf sturgeon occurred from the Mississippi River east to Tampa Bay. Its present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi east to the Suwannee River in Florida. Sporadic occurrences have been recorded as far west as the Rio Grande River between Texas and Mexico, and as far east and south as Florida Bay (Wooley and Crateau 1985; Reynolds 1993).

In the late 19th century and early 20th century, the Gulf sturgeon supported an important commercial fishery, providing eggs for caviar, flesh for smoked fish, and swim bladders for isinglass, which is a gelatin used in food products and glues (Huff 1975; Carr 1983). Gulf sturgeon numbers declined due to overfishing throughout most of the 20th century. The decline was exacerbated by habitat loss associated with the construction of dams and sills (low dams), mostly after 1950. In several rivers throughout the species' range, dams and sills have severely restricted sturgeon access to historic migration routes and spawning areas (Wooley and Crateau 1985; McDowall 1988).

On September 30, 1991, the Service and the National Marine Fisheries Service (NMFS) listed the Gulf sturgeon as a threatened species under the Act (56 FR 49653). Threats and potential threats identified in the listing rule included construction of dams; modifications to habitat associated with dredging, dredged material disposal, de-snagging (removal of trees and their roots) and other navigation maintenance activities; incidental take by commercial fishermen; poor water quality associated with contamination by pesticides, heavy metals, and industrial contaminants; aquaculture and incidental or accidental introductions; and the Gulf sturgeon's long maturation and limited ability to recolonize areas from which it is extirpated.

The Service and NMFS conducted a 5-year status review in 2009 where we concluded that the following threats continue to affect the Gulf sturgeon and its habitat: impacts to habitats by dams, dredging, point and nonpoint discharges, climate change, bycatch, red tide, and collisions with boats (USFWS and NMFS 2009). Additional threats may include ship strikes and potential hybridization due to accidental release of non-native sturgeon. These threats persist to varying degrees in different portions of the species range. The juvenile stage of Gulf sturgeon life history is the least understood, and perhaps the most vulnerable as this cohort remains in the river for the first years of its life and is, therefore, exposed to most of the threats faced by the species and its habitat. Further, the species' long-lived, late-maturing, intermittent spawning characteristics make recovery a slow process.

Currently, seven rivers are known to support reproducing subpopulations of Gulf sturgeon. Abundance numbers indicate a roughly stable or slightly increasing population trend over the last decade in the eastern river systems (Florida), with a much stronger increasing trend in the Suwannee River and a possible decline in the Escambia/Conecuh River. Populations in the western portion of the range (Mississippi and Louisiana) have never been nearly as abundant, and their current status is unknown as comprehensive surveys have not occurred in the past ten years. The last such effort in 2001 provided an abundance estimate of 430 gulf sturgeon for the Pearl River (Rogillio et al., 2001)

At this time, the Service characterizes the status of the species range wide as stable; however, the status of the subpopulations in the Pearl and Pascagoula rivers is uncertain. These rivers do not have current population estimates and have recently been threatened by hurricanes, the Deepwater Horizon oil spill, and a pot-liquor spill in the Pearl River. One study of juvenile gulf sturgeon using acoustic telemetry revealed that migration into the Pearl River occurred on cycles similar to these reported from other populations, with juveniles occupying the Pearl River during the May through mid-October time-period of each year (Baer et al. 2023).

The Gulf sturgeon continues to meet the definition of a threatened species. While some riverine populations number in the thousands, abundance of most populations is in the hundreds. Loss of a single year class could be catastrophic to some riverine populations with low abundance. Further, while directed fisheries no longer occur, many threats continue, and new ones are arising. Data are not yet available to determine if Gulf sturgeon recovery is limited by factors affecting recruitment (e.g., spawning habitat quantity or quality), adult survival (e.g., incidental catch in fisheries directed at other species), or the late-maturing, intermittent reproductive characteristics of the species.

4.1.4. Conservation Needs and Threats

At the time of the listing of the Gulf sturgeon, several threats were discussed as the reason for the decline of the species. These threats and potential threats include modifications to habitat associated with dredging, dredged material disposal, de-snagging (removal of trees and their roots) and other navigation maintenance activities; incidental take by commercial fishermen; poor water quality associated with contamination by pesticides, heavy metals, and industrial contaminants; aquaculture and incidental or accidental introductions; and the Gulf sturgeon's slow growth and late maturation (56 FR 49653).

Dams restrict the Gulf sturgeon's ability to use upstream areas past the dams for spawning because they are unable to pass through these dam systems (56 FR 49653). The Ross Barnett dam on the Pearl River and the Jim Woodruff Lock and Dam on the Apalachicola are two such dams that block the upstream migration of the species. Not only do dams restrict upstream migration, they can cause altered flow, channel morphology changes, and water quality issues well downstream of their construction (USFWS 2009).

The Pools Bluff and Bogue Chitto sills are part of the USACE owned Pearl River Navigation Project completed in 1956. It includes three navigation locks, two low-head dams (sills), and an overflow structure that facilitated maritime commerce on the Pearl River until 1974. The navigation project includes features in both Louisiana and Mississippi and is currently decommissioned and non-functional. These low-head dams or sills have limited the Gulf sturgeon's migration access to the reaches of the river north of these sills during low water periods; however, surveys have shown that Gulf sturgeon can and do swim past both sills during high water periods (USFWS BRFWCO 2018). A study conducted by the Baton Rouge Fish and Wildlife Conservation Office (BRFWCO) from 2013 to 2016 assessed the Gulf sturgeon's ability to move upstream of the two sills. It was found that of the sturgeon that made the attempt to pass over the sills, 72 percent successfully passed the Poole's Bluff sill and 21 percent successfully made it over the Bogue Chitto sill. It is uncertain if these sturgeons are navigating over or around the structures (Kohl 2003). The removal of the two decommissioned sills remains a high priority conservation action for the Gulf sturgeon within the Pearl River basin.

Dredging activities have also led to habitat degradation for the Gulf sturgeon by modification of important channel features used for spawning and foraging. Dredging can also be detrimental to gulf sturgeon due to direct mortality from entrainment.

Although direct take of Gulf sturgeon is prohibited within the states in the current species range, risk from incidental bycatch due to entanglement in fishing and trawling gear still occurs (USFWS 2009). Shrimpers have continued to document Gulf sturgeon bycatch in shrimp trawls even with the inclusion of sea turtle and fish excluder devises on the trawls. The State of Florida has made it unlawful to use entangling nets (i.e., gill and trammel nets) in state waters and has also restricted the use of other types of nets (i.e., cast nets, seines, etc.). The implementation of these net bans has likely been a benefit to recovery for Gulf sturgeon; however, sturgeon continue to be caught in these nets in states without these types of bans or restrictions.

The threat of poor water quality, while not clearly understood, has been studied and some studies indicate the potential impacts to various life stages of Gulf sturgeon. A study in the Suwannee River by Sulak et al. (2004) indicated that for Gulf sturgeon to have successful egg fertilization a narrow range of pH and calcium ion concentration may be required. It has also been shown that egg and larval development can be vulnerable to various forms of pollution, temperature, and dissolved oxygen (DO) levels. The Bogalusa paper mill spill on the Pearl River in 2011 contributed to a large fish kill, resulting in the death of approximately 28 Gulf sturgeon most of which were juveniles (Slack et al. 2014).

Hurricanes and collisions with boats are also ongoing threats to the species. Hurricanes such as Ivan in 2004, Katrina in 2005, and most recently Michael in 2018 have shown to cause mortality of Gulf sturgeon. While the impacts of the population in the Pearl River from Hurricane Katrina are generally unknown, reports from the first few days after the storm counted at least eight dead Gulf sturgeon (Mike Beiser, MSDEQ, personal communication). After Hurricane Michael, dozens of dead Gulf sturgeon were documented by Florida Fish and Wildlife Conservation Commission (FWC) biologists (Kaeser 2019). Gulf sturgeon have been seen jumping out of the water, possibly as a form of group communication to maintain group cohesion (Sulak et al. 2002). Collisions with boats has been attributed to this jumping behavior resulting in mortality to the species, as well as posing a safety issue to boaters (USFWS 2009).

The most recent 5-year review (2022) confirmed that these threats continue to be ongoing for the Gulf sturgeon.

4.2. Environmental Baseline for Gulf Sturgeon

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Gulf sturgeon, its habitat, and ecosystem within the Action area. The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action area, the anticipated impacts of all proposed Federal projects in the Action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR §402.02).

4.2.1. Action Area Numbers, Reproduction, and Distribution

There have been 24 Gulf sturgeon captured by commercial fishermen in the Pearl River, eight of which being captured within the Action area and the most recent of those captures occurring, a juvenile, in 2008. Adult sturgeon have also been captured by commercial fisherman downstream of the Action area near the Strong River's confluence with the Pearl River during spawning season leading to the possibility that adults that make it past the Poole's Bluff Sill come at least as far as the Strong River to spawn (BRFWC, pers. comm. 2019). The Service suspects that the only true suitable spawning habitat is found north of both sills on the Pearl River and the Bogue Chitto River, but the habitat is only accessible during high flow periods (USFWS 2003). That same area of the river, north of the sill, is also thought to have the gravel substrate necessary for spawning in the Pearl River.

In 2021, a Gulf sturgeon was detected above the J.H. Fewell WTP weir in LeFleur's Bluff State Park and in 2022 the same sturgeon was detected closer to the spillway of the Ross Barnett Reservoir (M. Andres, pers. comm. 2023). In addition, there are unconfirmed sightings of Gulf sturgeon within the Action area (Morrow et. al. 1996; Lorio 2000; Slack, pers. comm. 2002). Just north of the Action area at RM 301.77 is the Ross Barnett Reservoir, which presents a total barrier to migration to Gulf sturgeon (56 FR 49653). Prior to the construction of the Ross Barnett, there are records of Gulf sturgeon found in the vicinity of the damas well as further upstream along the Pearl River; however, since its completion no sturgeon have been captured upstream of the dam (Morrow et al. 1998; Sulak et al. 2016). In 1915, the City of Jackson built a low weir at approximately RM 290.7 to provide the water supply for the city (J.H. Fewell WTP), which continues to provide a large portion of the city's water supply. This weir potentially restricts the Gulf sturgeon's access to the upstream sections of the Action area in low flow periods.

4.2.2. Action Area Conservation Needs and Threats

The Action area consists of up to 281 acres (Alternative C) of riverine habitat that would be impacted by the project. This impacted area of the river consists of habitat that Gulf sturgeon could use to either spawn as adults or feed as juveniles if they migrate to that reach of the river. The status of the Gulf sturgeon in the Action area has been influenced by past channelization and the J.H. Fewell WTP weir. The past channelization and levee construction eliminated 5.34 miles of Pearl River meanders. These previous actions have reduced the amount of river habitat available for the species, including reductions in foraging and spawning areas. The degraded water quality from pollution and storm water runoff into the Pearl River in the Action area could also have impacted the Gulf sturgeon populations in this area. The section of river north of the WTP weir is accessible in high water events; however, in times of low water the species are not able to migrate past the structure. Downstream of Jackson is a ring levee around the Savannah Street Wastewater Treatment Plant. The levee surrounding this plant has, during high water events, overtopped and stormwater has spilled into the river; however, the plant's containment system would be upgraded during the Action to prevent this from occurring in the future. In the area just north of the Action area, the Ross Barnett Reservoir has resulted in an obstruction to Gulf sturgeon migration to the remaining 150 miles of the Pearl River above the Ross Barnett reservoir. Suitable spawning habitat for this species is thought to be south of the Action area on the Pearl River near its confluence with the Strong River due to the substrate of the river bottom at that location.

MDEQ has issued multiple water quality advisories for the Pearl River in Jackson due to ongoing sanitary sewer overflows around the City of Jackson discharging wastewater into various waterbodies that flow into the river (MDEQ 2020). There are two former landfills (Gallatin Street and Jefferson Street) and the former Gulf States Creosote Plant that are located within the proposed project area. The 62-acre Gallatin Street landfill contains urban and industrial trash. Leachates from within the site contain cadmium, lead, and nickel above the regulatory standards. Debris from this landfill is reported to be washing into the river. The 45-acre Jefferson Street (or Lefleurs Landing) landfill also has debris that can be eroded during high river stages. The EPA's PSA/SI done in 2003 found barium, cobalt, manganese, and zinc, as well as creosote residuals consisting of a variety of polycyclic aromatic hydrocarbons (PAHs).

Although recent survey work directed at juvenile fish has demonstrated consistent reproduction and recruitment of juveniles in the Pearl River system (USFWS, USM, unpublished data), the status of the Pearl populations remains uncertain as the results of recent population assessments are not yet available.

4.3. Effects of the Action on Gulf Sturgeon

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action area.

We identified and described the activities included in the proposed Action in sections 2.2 and 2.3. We identified and described other activities caused by the proposed Action in section 2.5. Our analyses of the consequences caused by each of these activities follows.

4.3.1. Effects of Channel Improvements on Gulf Sturgeon

Alternative C would result in the excavation of approximately 20 million cubic yards of material from the floodplain and river channel overbanks. The channel improvement footprint would include 2,302 acres of disturbance. This activity would lower the Pearl River floodplain area through the Action area. Alternatives D and E would remove 11.3 to 14.1 million cubic yards and have a disturbance footprint of 1,501 acres.

Potential direct impacts from the channel improvement activities would include temporary increases in turbidity and suspended solids in adjacent water bodies – the Pearl River and tributaries. Erosion control features could decrease the amount of sedimentation, but the sheer volume of material to be moved makes turbidity in the system likely.

During the construction period and until a vegetative cover is established, all disturbed areas would be subject to erosion. This eroded material would be carried into small tributary streams and into the Pearl River system. Increased sediment and turbidity can result in decreased light penetration and decreased photosynthesis. High levels of sediment can settle on fish spawning areas and smother fish eggs and larvae. Production of benthic organisms also can be reduced by high levels of sediment. Further, sediments can settle on respiratory surfaces of fish and aquatic organisms and interfere with respiration.

Sulak et al. (2016) found it difficult to quantify indirect mortality impacts from natal river habitat alterations including channelization, dredging, impoundments, and bulk heading. This uncorrected and/or uncontrolled alteration of Gulf sturgeon habitat could limit the success of a promising year-class at various stages in the Gulf sturgeon life cycle. Kynard and Parker (2004) found that while juveniles are mostly bottom feeders, they also spent an unusual amount of time in a holding pattern in the water column suggesting that when benthic foraging in the river is scarce, juvenile fish have evolved to drift feed. If this assumption is correct, should the water quality affect the benthic macroinvertebrates in the Action area, the foraging juveniles could move up in the water column to drift feed. Areas that have high concentrations of suspended sediments show a decrease in macroinvertebrate diversity, especially the more sensitive species (Sawyer et al. 2004). Studies from other regions indicate that sedimentation decreases available spawning habitat, increases egg and larvae mortality, and can decrease feeding success of species that rely on visual search strategies (Sawyer et al. 2004; Berman and Rabeni 1987; Henley et al. 2000). The increased sedimentation and turbidity in the river from the channel excavation would have impacts on the macroinvertebrate prey for any juvenile Gulf sturgeon that would be temporarily feeding in the Action area.

The DEIS states that a stormwater pollution prevention plan would be developed during the PED phase to minimize any potential effects to water quality during construction. Provided a plan is successfully developed and implemented, then adverse impacts to Gulf sturgeon associated with channel improvements activities are not likely to rise to the level where take of Gulf sturgeon would be expected. Further coordination with the Service will be required during the PED once a stormwater pollution prevention plan is developed.

4.3.2. Effects of Weir Construction and Impoundment on Gulf Sturgeon

Both Alternative C and D propose a weir with variations in width, height, and location. With the construction of the 1,500-1,700 foot-wide weir structure and resulting impoundment from the weir, changes to the velocity and water surface elevation would occur within the Action area. Low head dams, such as weirs, impede migratory pathways of fish including the Gulf sturgeon. As a way for fish to move past the weir, a fish passage channel would be constructed east of the weir and low flow structure. Such a structure has never been constructed for Gulf sturgeon and therefore is an untested mitigation feature for this species. The recently completed (2022) Lower

Yellowstone Project fish passage structure (i.e. bypass channel) in Montana has provided successful passage for the pallid sturgeon and may be a good model. The design criteria for that project included a bypass channel flow split of greater than 12%, bypass channel cross-sectional velocities of 2-6.0 ft/s, bypass channel depth greater than 4 ft, a bypass channel fish entrance velocity of 2-6 ft/s; and a bypass channel fish exist velocity of less than 6 ft/s. Additional considerations included elements that create variability of flow conditions within or on the margins of the bypass channel without introducing significant turbulence and with depths that exceed one meter.

During the construction of the weir, low flow structure, and fish passage channel, there would be similar impacts to Gulf sturgeon as those associated with the channel excavation and levee relocation. These impacts include increased sedimentation, increased turbidity, and bank destabilization. Excavation of the area for the weir site, low flow structure, and fish passage channel could cause excess sediment to flow downstream approximately 1.6 miles south of the construction area and erosion could be exacerbated in that area until the riverbank has stabilized. See Section 4.3.1 for more information regarding the effects of sedimentation and turbidity.

Dams or impoundments are thought to be one of the main obstacles to Gulf sturgeon recovery in the Pearl River (Sulak et al. 2016). Low-head barrier dams such as the proposed weir structure have consistent influences on stream-fish assemblages which have shown longitudinal declines in species richness from below to above barriers and result in altered population dynamics of a species (Porto et al. 1999; Pringle 1997). Impoundments confine spawning and YOY nursery/feeding habitat to the unimpounded reaches of the river below the dams. In the lower Pearl River, the Poole's Bluff sill blocks access to the river north of the structure during low river stages; however, when the water is high Gulf sturgeon are able to move past the structure (BRWFCO 2018). The migratory blockage caused by the proposed weir structure could impact the sturgeon's ability to swim north of the structure unless there are high water events; however, a conceptual design for a fish passage channel has been included as part of the project to minimize the impacts on aquatic species migration.

Impoundments/dams generally have adverse impacts to riverine fish communities by interrupting migratory movements. With the addition of a fish passage channel in the design of the project, impacts may be minimized to Gulf sturgeon migration providing that flow conditions would meet the needs of the species to be able to navigate the passage. These conditions include water velocity that does not exceed the sturgeon's swim speed and enough water flow levels for the species to be able to swim through it. Studies have shown that Gulf sturgeon cannot swim against currents greater than 1 to 2 meters per second (mps) (3 to 6 fps); however, they can swim up to 2 to 2.5 body lengths per second (Boyd Kynard, pers. comm. 2003; Kohl 2003; Wakefield 2001). Studies on fish passage attraction speed flow has shown that the recommended flow should be between 2 and 4 fps with sustained swim speed ranges for sturgeon to be in the range of 3 to 4 fps (Cheong et al. 2006; White and Mefford 2002). The swimming capabilities of juvenile sturgeon has been tested, and it was documented that juveniles less than 6 inches long can swim at velocities up to 1 mps (3 fps) (Kohl 2003). At this time, there is only a conceptual model of the fish passage channel, ranging from 5-6,000 feet (Alt D) to 7,300 feet (Alt C) in length, with the possible velocities ranging anywhere from 1 to 7 fps. The maximum velocity of 7 fps would push the limits of adult Gulf sturgeon's ability to swim against the current and any juveniles attempting to migrate through the passage would be unable to swim through it. However, depending on where in the channel the velocities would occur at that speed the fish may be able to migrate successfully through it; therefore, the proposed passage feature should be monitored for water velocity and water level conditions.

We also anticipate potential adverse impacts on adult and juvenile Gulf sturgeon during downstream passage through the weir during normal and low flow conditions. For adult sturgeon that are able to migrate upstream above the weir during high flow conditions, or through the fish passage structure year-round, there could be injury or death on the downstream migration through the new weir gate structure if conditions are not favorable for fish to safely pass through the weir gate. Newly hatched juvenile sturgeon could also be injured in the same manner that try to cross the weir gate during downstream migration.

Drifting free embryos are likely the most vulnerable Gulf sturgeon life-stage to adverse effects related to downstream passage over the existing weir. Relatively high-water velocities over the new weir and potential turbulent conditions resulting from placement of rock below the weir may pose a risk of injury or mortality for the weak-swimming free embryos. However, free embryo exposure to such conditions is dependent on reproductive Gulf sturgeon bypassing the new weir, successful spawning, and survival of the fertilized eggs to hatch.

Water velocity is an important factor in the life cycle of Gulf sturgeon. During spawning, flows that are too strong would prevent eggs from settling on and adhering to suitable substrate, while flows that are too low could cause clumping of the eggs and lead to increased mortality from fungal infection and asphyxiation (Wooley and Crateau 1985; USFWS 2003). A study performed by Flowers et al. (2009) on the Apalachicola River presented evidence that flow regime and water velocity influence Gulf sturgeon spawning by stimulating the adults to move to spawning grounds. These flow regimes and water velocities also structure and modify substrate to create suitable areas for egg attachment and provide adequate oxygenation for egg survival (Auer 1996; Fox et al. 2000). Optimal spawning site flows generally are high and have a continuous rate of current flow, approximately > 4.9 fps. There are no spawning sites documented in the Action area, and although recruitment occurs in the Pearl River, the actual site(s) where spawning occurs is unknown at this time.

An examination of low-head dams determined that one issue resulting from such structures is alterations in water temperature caused by anthropogenic influences impacting water quality within the created water body (Cummings 2004). In water, temperature influences other water quality factors such as DO and pH in the water column. In freshwater, when the temperature increases the pH decreases (Kishinhi et al. 2006). Kishinhi et al. (2006) studied the water quality in the Pearl River around Jackson, Mississippi, and in the Ross Barnett Reservoir and found that the mean pH values at all of the sampling sites were within the State's recommended range of 6.0 to 9.0. The optimal pH for sturgeon eggs generally lies in the range of nearly neutral (pH=7.0) to slightly alkaline (pH<8.0) (Sulak et al. 2016). Although water quality parameters were modeled for pre- and post-project, it did not include a model specifically for pH. However, temperature was modeled, and although there were slight differences, none were significantly different from current ranges. Therefore, we can infer that the pH would not have significant changes post-project.

Dissolved oxygen levels are also important water quality aspects for feeding and the survival of juvenile sturgeon. Secor and Gunderson (1997) studied the effects of temperature and DO on juvenile Atlantic sturgeon (*Acipenser oxyrinchus*). According to this sturdy, reduced oxygen levels resulted in a threefold reduction in growth rate and a reduction in routine respiration rates. Juveniles were more vulnerable to low DO levels and high temperatures; however, in spite of reduced respiration and survival, they continued to feed and grow through reduced activity to allocate more energy to growth. Although specific DO tolerance levels have not been established for the Gulf sturgeon, hypoxia for other *Acipenser* species have been documented to start at 4 milligrams per liter (mg/L) (Cech et al. 1984; Jenkins et al. 1993; Kahn and Mohead 2010; Secor and Gunderson 1998). The DO levels for the Pearl River and Ross Barnett Reservoir were monitored by Kishinhi et al. (2006); the lowest levels of DO occurred in August at 5 mg/L and the highest levels occurred in December at 20 mg/L. The mean concentrations of DO for that study were normally above the minimum of 5 mg/L recommended by the MDEQ for the protection of aquatic life. As with the pre- and post-project water quality modeling for temperature, DO was modeled with slight but not significant differences from pre–project conditions. High temperatures and lower DO levels would be likely to occur during the summer months when juvenile Gulf sturgeon would use the area for feeding, Naturally low DO levels in the summer and fall months would be magnified should lake eutrophication occur due to algal blooms associated with nitrogen and phosphorus runoff from faulty sewer lines, sewer overflows, and other non-point sources (i.e., yards, golf courses, roads and parking lots). Should the DO levels drop below 4 mg/L, Gulf sturgeon would be expected to be adversely impacted within the lake footprint.

4.3.3. Effects of Non-Federal Activities caused by the Federal Action on Gulf Sturgeon

Recreational water sports (e.g., fishing including trot lines, limb lines, and jug lines; and boating) will be expected to increase as a result of the improved access to the Action area. This increase in fishing could lead to more incidental captures of Gulf sturgeon in commercial nets, on set lines, or with rods and reels if sturgeon migrate past the weir through the fish passage channel. Because the Service does not know the degree to which recreational uses will increase, we are unable to estimate the number of sturgeon that could be impacted due to the increase in fishing.

An increase in development adjacent to the improved channel could also lead to a decrease in water quality which would, in turn, impact prey sources and juvenile growth. Although changes in water quality could be measured, estimating the amount or extent of those changes to prey resources and juvenile growth are difficult to predict or anticipate. The relocation or retrofitting of existing infrastructure within the Action area (i.e., roads, bridges, pipelines, transmission lines) would also lead to a decrease in water quality during construction of such actions, although such impacts would be temporary. These impacts to water quality would include increased sedimentation and turbidity from any excavation in or around the river. This increased sedimentation and turbidity would have the same impacts to sturgeon as discussed in Section 4.3.1.

4.3.4. Summary

Channel Improvements - Potential direct impacts from the construction of channel improvements would include temporary increases in turbidity and suspended solids into the Pearl River and its tributaries. However, provided a stormwater and sediment prevention plan is successfully developed and implemented, then adverse impacts to Gulf sturgeon associated with channel excavation activities for Alternatives C, D, and E are not likely to rise to the level where take of Gulf sturgeon would be expected. Further coordination with the Service will be required during the PED phase once a stormwater pollution prevention plan is developed.

Weir Construction and Impoundment - The weir construction and associated impoundment is expected to result in harm of Gulf sturgeon through the potential elimination of up to 18 miles of riverine habitat-use for migrating Gulf sturgeon. Specifically, Alternative C would restrict sturgeon use from the proposed weir at RM 284 to the Ross Barnett Reservoir at RM 301.77 (17.8 miles total). Alternative D would restrict sturgeon use from the proposed weir at RM 286.5 to the Ross Barnett Reservoir at RM 301.77 (15.3 miles total). Harm is also expected to occur to Gulf sturgeon that are able to migrate upstream during high flow events or through the fish passage structure and are then exposed to low DO and low prey availability within the lake. The anticipated changes in DO within the lake would also impact any juveniles foraging in the area as well as their prey base. Harm may also occur to adult and juvenile sturgeon, and drifting free embryos, during downstream migration through the weir gate during low to normal river flows.

The Poole's Bluff sill hinders sturgeon migration upriver, and sturgeon can only pass that sill during high water events. Based on best available data and the probability of high-water events coinciding with northward riverine migration, we estimate that only 72 percent of the Pearl River population can access river habitat north of the Pool's Bluff sill on any given year (Service BRFWCO 2018). In addition, recent Gulf sturgeon monitoring (M. Andres, pers. comm. 2023) has observed one Gulf sturgeon within the Action area in both 2021 and 2022. Therefore, we estimate that the collective activities of the entire Action would disturb a maximum of four sturgeon (and any associated drifting free embryos) per year to the level of harm.

4.4. Cumulative Effects on Gulf Sturgeon

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Gulf sturgeon are not relevant to formulating our opinion for the Action.

4.5. Conclusion for Gulf Sturgeon

In this section, we summarize and interpret the findings of the previous sections for the Gulf sturgeon (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat. "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery

of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

The Gulf sturgeon is an anadromous fish (breeding in freshwater after migrating up rivers from marine and estuarine environments), inhabiting coastal rivers from Louisiana to Florida during the warmer months and overwintering in estuaries, bays, and the Gulf of Mexico. There have been 24 Gulf sturgeon captured by commercial fishermen in the Pearl River, eight of which being captured within the Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223), and the most recent of those captures (juvenile) occurring in 2008. In 2021, a Gulf sturgeon was detected above the J.H. Fewell WTP weir in LeFleur's Bluff State Park and in 2022 the same sturgeon was detected closer to the spillway of the Ross Barnett Reservoir (M. Andres, pers. comm. 2023).

Channel Improvements - Alternatives C, D, and E will result in similar channel excavation activities, which could result in increased sedimentation and turbidity. However, these activities will be temporary in nature, lasting up to two years. Provided adequate water quality and sediment control plans are developed and successfully implemented, then we do not anticipate adverse impacts to rise to the level of take under the ESA. Additional coordination with the Service will be required during the PED phase as these plans are developed.

Weir Construction and Impoundment: Alternatives C and D also include the construction of a weir and impoundment which will result in harm to up to four sturgeon per year utilizing the Action area (1% of the Pearl River subpopulation). This harm will result from the potential elimination of up to 17.8 miles of riverine habitat-use for migrating Gulf sturgeon. Harm is also expected to occur to Gulf sturgeon that are able to migrate over the new weir during high flow events or through the fish passage structure and are then exposed to low DO conditions and low prey availability within the lake due to eutrophic conditions. Harm may also occur to adult and juvenile sturgeon, and drifting free embryos, during downstream migration through the weir gate during low-normal river flows.

A fish passage feature has been designed at the proposed weir as part of the proposed Action for both Alternative C and D; however, the design is preliminary in nature. The construction of a fish passage channel would increase the possibility of sturgeon having the ability to return to the areas north of the new weir should they migrate into the Action area. However, since no such structure has ever been built for Gulf sturgeon within its range, we must consider the possibility that the fish passage structure may not work as designed and therefore Gulf sturgeon would only be able to pass the weir during high flow events.

Our analysis indicates that while the Action would have a negative effect on four sturgeon per year, such yearly effects to one percent of that subpopulation would not be appreciable for the survival and recovery of the Gulf sturgeon.

After reviewing the current status of the species, the environmental baseline for the Action area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Gulf sturgeon.

5.0. CRITICAL HABITAT FOR GULF STURGEON

5.1. Status of Gulf Sturgeon Critical Habitat

This section summarizes best available data about the condition of all designated units of critical habitat for Gulf sturgeon that are relevant to formulating an opinion about the Action. The Service published its decision to designate critical habitat for Gulf sturgeon on March 19, 2003 (68 FR 13370 13495). The most recent 5-year status review of the species was completed June 1, 2022.

5.1.1. Critical Habitat Description

The Service and the National Oceanic and Atmospheric Administration (NOAA) Fisheries jointly designated Gulf sturgeon critical habitat on April 18, 2003 (68 FR 13370, March 19, 2003). Gulf sturgeon critical habitat includes areas within the major river systems that support the seven currently reproducing subpopulations and associated estuarine and marine habitats. Gulf sturgeon use rivers for spawning, larval and juvenile feeding, adult resting and staging, and moving between the areas that support these life history components. Gulf sturgeon use the lower riverine, estuarine, and marine environment during winter months primarily for feeding and, more rarely, for inter-river movements.

Fourteen areas (units) are designated as Gulf sturgeon critical habitat. Critical habitat units encompass approximately 2,783 km (1,729 mi) of riverine habitats and 6,042 square km (km2) (2,333 square miles) of estuarine and marine habitats, and include portions of the 14 Gulf of Mexico rivers, tributaries, estuarine and marine areas. Unit 1 includes the Pearl and Bogue Chitto Rivers in Louisiana and Mississippi.

Critical habitat designation for the Gulf sturgeon used the term "primary constituent elements" (PCEs) to identify the key components of critical habitat that are essential to its conservation and may require special management considerations or protection. Revisions to the critical habitat regulations in 2016 (81 FR 7214, 50 CFR §4.24) discontinue use of the term PCEs and rely exclusively on the term “physical and biological features” (PBFs) to refer to these key components, because the latter term is the one used in the statute. This shift in terminology does not change how the Service conducts a “destruction or adverse modification” analysis. In this BO, we use the term PBFs to label the key components of critical habitat that provide for the conservation of the Gulf sturgeon that were identified in its critical habitat designation rule as PCEs. The PBFs of Gulf sturgeon critical habitat are (68 FR 13370 13495):

- Abundant food items, such as detritus, aquatic insects, worms, and/or mollusks, within riverine habitats for larval and juvenile life stages; and abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, mollusks and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages;
- Riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;

- Riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions;
- A flow regime (*i.e.*, the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging, and for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larval staging;
- Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
- Sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and
- Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., an unobstructed river or a dammed river that still allows for passage).

5.1.2. Conservation Value of Gulf Sturgeon Critical Habitat

The 14 riverine and estuarine/marine habitats were included in the designation because it is believed that with proper management and protection, they collectively represent the habitat that is necessary for the conservation of the species (68 FR 13370, March 19, 2003). These selected units were chosen to be designated because they are areas that contain one or more of the PBFs essential to the species. The analysis of this Biological Opinion focuses on the riverine unit 1 of critical habitat, therefore, therefore, the other 6 riverine units and the 7 estuarine/marine units will not be discussed further.

Unit 1 (494 miles)

The Pearl River distributaries are used for migration to spawning grounds, summer resting holes, and juvenile feeding (68 FR 13370, March 19, 2003). The presence of juvenile sturgeon in the river system indicates successful spawning at some location in the river system. The only suitable spawning habitat believed to occur in the Pearl River system occurs north of the sills on the Pearl River and Bogue Chitto River with access to these areas limited only to periods of high flows (Morrow et al. 1996; Morrow et al. 1998). The typical bedrock and limestone outcroppings preferred for spawning in other river systems do not occur in the Pearl River system; however, sturgeon spawning areas in the Pearl drainage likely include soapstone, hard clay, gravel and rubble areas, and undercut banks adjacent to these substrates (W. Slack, pers. comm. 2001). Even though upstream movement is blocked by Poole’s Bluff Sill during periods of low water, potential spawning sites have been identified upstream of the sill at various locations between Monticello, Lawrence County, Mississippi, and the Ross Barnett Dam spillway, Hinds and Rankin Counties, Mississippi (F. Parauka, pers. comm. 2002) and sturgeon have been reported as far upstream as Jackson, Hinds County, Mississippi (Morrow et al., 1996; Lorio 2000; W. Slack, pers. comm. 2002, M. Andres, pers. Comm. 2023). Suitable spawning habitat occurs within the Bogue Chitto River upstream of the Bogue Chitto Sill (W. Slack, pers. comm. 2001; W. Granger, FWS, pers. comm. 2002; F. Parauka, pers. comm. 2002) and juvenile, adult, and subadult sturgeon have been documented on the Bogue Chitto as far upriver as 1 mile north of Quinn Bridge (Mississippi State Highway 44), McComb, Pike County, Mississippi (W. Slack, pers. comm. 2001; D. Oge, Louisiana Department of Environmental Quality, pers. comm. 2002; F. Parauka, pers. comm. 2002); therefore, the mainstem of the Bogue Chitto River upstream of the Quinn Bridge to Mississippi State Highway 570 has been included in this unit.

5.1.3. Conservation Needs and Threats

The following types of Federal actions, among others, may destroy or adversely modify critical habitat:

- Actions that would appreciably reduce the abundance of riverine prey for larval and juvenile sturgeon, or of estuarine and marine prey for juvenile and adult Gulf sturgeon, within a designated critical habitat unit, such as dredging; dredged material disposal; channelization; in-stream mining; and land uses that cause excessive turbidity or sedimentation;
- Actions that would appreciably reduce the suitability of Gulf sturgeon spawning sites for egg deposition and development within a designated critical habitat unit, such as impoundment; hard-bottom removal for navigation channel deepening; dredged material disposal; in-stream mining; and land uses that cause excessive sedimentation;
- Actions that would appreciably reduce the suitability of Gulf sturgeon riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, believed necessary for minimizing energy expenditures and possibly for osmoregulatory functions, such as dredged material disposal upstream or directly within such areas; and other land uses that cause excessive sedimentation;
- Actions that would alter the flow regime (the magnitude, frequency, duration, seasonality, and rate-of -change of fresh water discharge over time) of a riverine critical habitat unit such that it is appreciably impaired for the purposes of Gulf sturgeon migration, resting, staging, breeding site selection, courtship, egg fertilization, egg deposition, and egg development, such as impoundment; water diversion; and dam operations;
- Actions that would alter water quality within a designated critical habitat unit: including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability, such as dredging; dredged material disposal; channelization; impoundment; in-stream mining; water diversion; dam operations; land uses that cause excessive turbidity; and release of chemicals, biological pollutants, or heated effluents into surface water or connected groundwater via point sources or dispersed non-point sources;
- Actions that would alter sediment quality within a designated critical habitat unit such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability, such as dredged material disposal; channelization; impoundment; instream

mining; land uses that cause excessive sedimentation; and release of chemical or biological pollutants that accumulate in sediments;

- Actions that would obstruct migratory pathways within and between adjacent riverine, estuarine, and marine critical habitat units, such as dams, dredging, point-source-pollutant discharges, and other physical or chemical alterations of channels and passes that restrict Gulf sturgeon movement (68 FR 13399).

5.2. Environmental Baseline for Gulf Sturgeon Critical Habitat

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of designated critical habitat for Gulf sturgeon within the Action area. The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action area, the anticipated impacts of all proposed Federal projects in the Action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR §402.02).

5.2.1. Action Area Conservation Value of Gulf Sturgeon Critical Habitat

Two of the seven PBFs identified for Gulf sturgeon critical habitat (see section 5.1.1) are not known to occur in the Action area: riverine spawning sites and riverine aggregation (resting) areas. Spawning sites and aggregation areas are thought to be downstream of the Action area (see section 4.2.1). The PBFs found in the Action area are food, flow regime, water quality, sediment quality, and migratory pathways.

The Action area occurs on the Pearl River near Jackson, MS. The Pearl River is included in Critical Habitat Unit 1, the Pearl and Bogue Chitto Rivers in Louisiana and Mississippi, which is currently known to support a reproducing subpopulation of Gulf sturgeon. Unit 1 consists of a total of 494 miles. The Action area occurs at the top extent of this Critical Habitat Unit. This section of the river has been previously altered throughout the 20th century by channelization and dredging of the river, levee systems, and the J.H. Fewell WTP weir. As discussed in Section 3, the Ross Barnett Reservoir prevents Gulf sturgeon migration north of the reservoir. The J.H. Fewell WTP weir can impede sturgeon migration up to the Ross Barnett dam except in high flow events. On the Lower Pearl River, the Poole's Bluff sill, a low-head dam, also serves as an impediment to sturgeon migration to the upper reaches of the river except in high water events.

While adult sturgeon do not usually feed in freshwater, juveniles forage extensively in rivers on aquatic insects, worms, and mollusks (Mason and Clugston 1993; Huff 1975; Sulak and Clugston 1999). A specific study of the macroinvertebrates (i.e., detritus, aquatic insects, worms, and/or mollusks) has not been conducted; however, with the varying aquatic species within the Action area that feed on those types of prey it can be assumed that the area does contain enough of these prey items to support the populations of species that inhabit the area.

This area of the Pearl River has been altered in the past by dredging and channelization, losing 5.34 miles of meanders. Suitable spawning substrate within the Pearl River likely includes soapstone, hard clay, gravel, and rubble areas and undercut banks adjacent to these substrates (W. Slack, pers. comm. 2001). Specific surveys have not been conducted on the substrate of the river within the Action area; however, grab samples were taken as part of the Wetland Delineation conducted for the 2019 EIS/Feasibility Study that did not exhibit the suitable substrates necessary for sturgeon spawning in the Pearl River. Critical habitat was designated up to the Ross Barnett dam on the Pearl River due to the potential of spawning sites being identified between Monticello, Mississippi, and the Ross Barnett Reservoir (F. Parauka, pers. comm. 2002); however, migration past the J.H. Fewell WTP weir to any potential spawning ground upstream towards the Ross Barnett Reservoir is impeded unless there is a high-water event.

As discussed in section 4.2.1, the reach of the Pearl River in the Action area can have fairly fast, deep flows during rain events but has shallow baseline flows and can exhibit shallow flows during certain parts of the year. Gulf sturgeon depend on flow regimes in the riverine environment for all life stages including migration, breeding site selection, courtship, egg fertilization, resting and staging, and for maintaining spawning sites in the suitable condition needed for egg attachment, sheltering, resting, and larval staging. Based on average flow rates from 1966 to 2013, this area of the river currently has high flows during the springtime with flows decreasing significantly during the summer (Table 2.1).

Water quality in the Action area was discussed in section 4.2.1; however, a brief summary is provided here as well. Multiple advisories have been issued for the Pearl River in Jackson due to continued discharges of sanitary sewer overflows into the river. In the Action area, there is a former creosote plant as well as two former landfills from which debris periodically washes into the river. Leachates from these landfills were found to contain heavy metals above the regulatory standards. In 2003, the EPA also found barium, cobalt, zinc, and other contaminates in the river in the Action area.

5.3. Effects of the Action on Gulf Sturgeon Critical Habitat

This section analyzes the direct and indirect effects of the Action on critical habitat for Gulf sturgeon. Effects of the Action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action (50 CFR §402.02). Our analyses are organized according to the description of the Action in section 2 of this BO.

5.3.1 Effects of Channel Improvements on Gulf Sturgeon Critical Habitat

The PBFs of flow regime, sediment quality, and migratory pathways would not be impacted by the construction of the channel improvement activities (i.e., excavation of material from the floodplain for Alternatives C, D, and E); therefore, this section will discuss the effects of the excavation and relocation on the PBFs of food and water quality.

Although the excavation and relocation would occur during low water periods, the Action area would still be subject to increased sedimentation and turbidity should a heavy rainfall occur during construction and before vegetation cover could be reestablished. Increased turbidity when rainfall is the highest is a normal part of variations in turbidity following seasonal patterns of rainfall (Kishinh et al. 2006); however, the increase in turbidity would be additive to the normal turbidity surge due to the excess amount of loosened sediment during construction. Important contributors to the decline of aquatic assemblages are habitat degradation, sedimentation, and turbidity (Sawyer et al. 2004; Stewart and Swinford 1995; Henley et al. 2000). The increased turbidity and sedimentation would lead to impacts on water quality, which then leads to impacts on the prey base for juvenile sturgeon. See section 4.3.1 for more information on the effects of sedimentation and turbidity on the juvenile sturgeon food supply. These impacts on water quality would be temporary in nature and would be reduced through erosion control measures.

5.3.2. Effects of Weir Construction and Impoundment on Gulf Sturgeon Critical Habitat

With the establishment of a 2,562-acre (Alt C) or 1,700-acre (Alt D) impoundment from the construction of the weir, changes to water velocity and water surface elevation in the Action area would be anticipated.

Dams and weirs present an obstacle to sturgeon migration and are thought to be the main hindrance to Gulf sturgeon recovery in the Pearl River (Sulak et al. 2016). As a way to offset the effects of the weir on sturgeon migration, the construction of a fish passage channel is part of the proposed action. Kohl (2003) evaluated the opportunity to design a proposed bypass at the Poole's Bluff sill to assist Gulf sturgeon migration north of the sill. That evaluation determined that a bypass channel could assist in sturgeon migration as long as the feature was designed to accommodate sturgeon swim speeds and other factors such as flow. Thus, if the fish passage channel were designed properly, it could provide for sturgeon migration past the weir structure. The impacts that the proposed weir and fish passage channel would have on sturgeon migration are discussed in detail in section 4.3.2.

Gulf sturgeon critical habitat in the Action area is likely to experience reduced water quality during the construction of the weir and fish passage channel as a result of increased sedimentation and turbidity. As discussed in sections 5.3.2 and 4.3.2, this temporary effect would influence the macroinvertebrate community upon which juvenile sturgeon feed. Pools created by impoundments generally consist of fewer taxa of macroinvertebrates than free-flowing river reaches which tend to support a more diverse macroinvertebrate community (Santucci et al. 2005). However, Dean et al. (2002) found that while impounded areas lacked species diversity, the abundance of individuals was similar to that of free-flowing river reaches. As discussed in section 4.3.2, DO and temperature are other important water quality factors for sturgeon. As temperature increases, DO levels decrease which can affect the growth and respiration rates of juvenile sturgeon.

As discussed in section 5.2.1, suitable spawning substrate has not been indicated in this reach of the river; therefore, it is unlikely that spawning occurs in the area. However, sediment quality is important for more than just spawning. Sediment quality is also necessary for the macroinvertebrate food sources of juvenile sturgeon. The impacts to sediment quality on the macroinvertebrate community would be similar to impacts to water quality as described above.

5.3.3. Effects of Non-Federal Activities caused by the Federal Action on Gulf Sturgeon Critical Habitat

The relocation or retrofitting of existing infrastructure within the Action area could lead to a reduction in sediment and water quality from the increased sedimentation and turbidity involved with implementing those actions. The increase in development adjacent to the improved channel could also lead to a reduction in water and sediment quality in the Action area. Effects to water quality would be the same as mentioned above. The effects from decreased reduction in water quality are discussed in sections 4.3.1 and 5.3.1.

5.3.4. Summary of Effects of the Action on Gulf Sturgeon Critical Habitat

<u>Channel Improvements</u> - Potential direct impacts to Gulf sturgeon critical habitat from the construction of channel improvements would include temporary increases in turbidity and suspended solids into the Pearl River and its. tributaries. However, provided a stormwater and sediment prevention plan is successfully developed and implemented, then adverse impacts to Gulf sturgeon PBF's (i.e. flow regime, sediment quality, migratory pathways, food abundance, water quality) associated with channel excavation activities for Alternatives C, D, and E are not expected. Further coordination with the Service will be required during the PED once a stormwater pollution prevention plan is developed.

<u>Weir Construction and Impoundment</u> **-** For the weir and impoundment features associated with Alternatives C and D, we anticipate a total of 17.77 (Alt C) to 15.3 (Alt D) miles of critical habitat could be adversely affected due to the Action. This includes the river mileage from the Ross Barnett Reservoir Dam to the new weir location. We estimate that approximately 3.3 to 3.6 percent of critical habitat Unit 1 and 1.0 percent of the total riverine critical habitat units would be impacted by the Action. Based on the best available data, the collective activities from the Action would affect the PBFs including food, flow regime, water quality, sediment quality, and migratory pathways, however, some of these impacts could be offset by activities such as the successful construction of a fish passage for migratory purposes.

5.4. Cumulative Effects on Gulf Sturgeon Critical Habitat

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. At this time, the Service is unaware of any future state, tribal, local, or private non-Federal actions planned or scheduled that would occur in the Action area. Therefore, cumulative effects are not relevant to formulating our opinion for the Action.

5.5. Conclusion for Gulf Sturgeon Critical Habitat

In this section, we summarize and interpret the findings of the previous sections for Gulf Sturgeon critical habitat (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:
a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.
"*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02).

The Service and the National Oceanic and Atmospheric Administration (NOAA) Fisheries jointly designated Gulf sturgeon critical habitat on April 18, 2003 (68 FR 13370, March 19, 2003). Gulf sturgeon critical habitat includes areas within the major river systems that support the seven currently reproducing subpopulations and associated estuarine and marine habitats. Gulf sturgeon use rivers for spawning, larval and juvenile feeding, adult resting and staging, and moving between the areas that support these life history components. Gulf sturgeon use the lower riverine, estuarine, and marine environment during winter months primarily for feeding and, more rarely, for inter-river movements. Fourteen areas (units) are designated as Gulf sturgeon critical habitat. Unit 1 includes 494 miles of the Pearl River. The Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) represents 16 percent of Unit 1 and 4.6 percent of the total critical habitat for the Gulf sturgeon.

<u>Channel Improvements</u> - Alternatives C, D, and E will result in similar channel excavation activities, which could result in increased sedimentation and turbidity. However, these activities will be temporary in nature, lasting up to five years. Provided adequate water quality and sediment control plans are developed and successfully implemented, then we do not anticipate adverse impacts to rise to the level of adverse modification under the ESA.

<u>Weir Construction and Impoundment</u> - The Action area occurs at the northernmost extent of Critical Habitat Unit 1. As discussed in Section 3, the Action area encompasses the Pearl River and its adjacent lands from the Ross Barnett dam south to the confluence of Copiah Creek near Georgetown, MS, approximately 79 river miles. Within this 79-mile Action area, the Service expects a total of 15.3 to 17.7 miles of critical habitat would be potentially adversely affected by Alternative C and D equaling approximately 3.3 to 3.6 percent of Unit 1 and 1.0 percent of the total riverine critical habitat units being impacted. The remaining 62 miles of the Action area would see flood inducements related to the Action, but these inducements are not expected to adversely impact critical habitat. (Please note that this assessment does not include the estuarine and marine units of critical habitat because none would be affected and because we are specifically addressing changes to the riverine portions of Gulf sturgeon critical habitat due to the PBFs being affected. The PBFs impacted by this Action are food, flow regime, water quality, sediment quality, and migratory pathways.)

Since the impacts of Alternative C and D to lake water quality are inconclusive at this time due to the lack of data, modeling inaccuracies, and the usage of outdated modeling methodologies of the project area (2024 DEIS), we cannot conclude that these alternatives would have minimum adverse effects on the macroinvertebrate community, or that Gulf sturgeon would continue to grow and feed within the new lake footprint under reduced water quality conditions.

The weir structure associated with Alternative C and D would impact the migratory pathway to sturgeon movement into this reach of the river. To offset the effects to sturgeon migration from the weir, a fish passage structure has been designed for just downstream of the weir. Based on the success of pallid sturgeon passage at the recently completed Lower Yellowstone Project in Montana, certain designs would make migration through a fish passage more successful. Specifically, swim speed, water depth, and resting/staging areas should be considered in the design of the fish passage feature in order to improve potential sturgeon migration into the Action area post-construction.

Our analysis indicates that while the Action would have negative effects on up to 3.6 percent of critical habitat Unit 1 and 1 percent of the riverine units as a whole, it is not likely to appreciably diminish the ability of Unit 1 to provide the intended conservation value to the Gulf sturgeon and would not result in an adverse modification to critical habitat.

6.0. RINGED MAP TURTLE

6.1. Status of the Ringed Map Turtle

This section summarizes best available data about the biology and current condition of the ringed map turtle (*Graptemys oculifera*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list ringed map turtle as threatened on December 23, 1986 (51 FR 45907 45910). The most recent published 5-year review was completed January 10, 2020. A new five-year review was requested to be initiated June 6, 2024 (89 FR 48437-48440).

6.1.1. Description of the Ringed Map Turtle

For a thorough description of the ringed map turtle see Jones & Selman (2009); all information in this section can be found in that description unless otherwise cited. The ringed map turtle is a small turtle. Each scute of its upper shell (carapace) has a yellow ring bordered inside and outside with dark olive-brown; its undershell (plastron) is yellow. The head has a large yellow spot behind the eye, two yellow stripes from the orbit backwards, and a characteristic yellow stripe covering the whole lower jaw. Males grow on average to 3.5 inches (89 millimeters) and females to 6 inches (156 millimeters) in plastron length.

6.1.2. Life History of the Ringed Map Turtle

The ringed map turtle's habitat is typically riverine with a moderate current and numerous basking structures. Using data from five studied populations in Mississippi, river conditions have been described as:

- width from 67 to 361 feet (20 to 110 meters);
- mean stream flow rates from 3,000 to 15,000 cfs; and
- river bottom composed of clay, sand, or gravel.

This species has also been observed in oxbow lakes that are connected or disconnected from the Pearl River main river system. It is assumed that turtles observed in disconnected lakes arrived due to flooding and remained or were isolated during construction of the levees. Individuals have been reported from the Ross Barnett Reservoir, although there is no evidence of a breeding population there or in any disconnected lakes (Selman 2018). Basking structures vary from deadwood to man-made structures (e.g., culverts, shopping carts). The turtles are found in rivers that must be wide enough to allow sun penetration for several hours. Turtles prefer basking sites which are partially submerged in areas with the deepest water and swiftest current. The occurrence of downed trees within the river has been strongly associated with the presence of *Graptemys* (Killebrew et al. 2002; Linderman 1997, 1998, 1999). However, ringed map turtles have also been found in areas that are predominately shallow with few deep areas (Selman and Smith 2017).

Recently, a new population was discovered in the Bogue Falaya, a Pontchartrain Basin river system in Louisiana that is west of and isolated from the Pearl River system (Glorioso et al. 2024). Genetic analyses of 23 individuals from the Bogue Falaya demonstrate their genetic distinctiveness relative to sites in the Pearl River, suggesting it is a natural rather than introduced population. Therefore, *G. oculifera* is no longer considered endemic to the Pearl River; however, the Bogue Falaya population is small and currently only occupies ~4 river kilometers (rkm) (Glorioso et al. 2024).

The preferred velocity of the ringed map turtle has not been determined; however, Killebrew et al. (2002) determined that the Cagle's map turtle (*Graptemys caglei*) preferred velocities from 0.5 to 2.5 fps. Shealy (1976) stated that the Alabama map turtle (*Graptemys pulchra*) was found in velocities typically ranging from 0.9 fps to 2.7 fps. To aid in the impact determination, the Service examined computer modeled without-project velocities for that reach of the river where the stable Lakeland population is found. Typically, velocities ranged from 0.4 to 2.0 fps. Because those velocities are mean cross-sectional velocities, the Service used that information and the Cagle's map turtle velocities to hypothesize that suitable velocities for the ringed map turtle would likely occur between 0.5 and 2.5 fps.

Nesting habitat consists of large, high sand bars adjacent to the river. Sandbars range in size from 430 square feet (40 square meters) to over 2.2 acres (8,900 square meters) and are generally composed of 39 percent open sand, 38 percent herbaceous vegetation, and 23 percent woody vegetation (Jones 2006). Nesting attempts have also been reported in shell roadbeds and mowed grassy areas adjacent to the river. Nesting occurs during daylight hours from mid-May through mid-July. Nest sites are usually located, on average, 59 feet (18 meters) from water and within 3.3 feet (1 meter) of vegetation, with an average canopy cover of approximately 37 percent.

The diet of the ringed map turtle consists primarily of sponges and other aquatic invertebrates (caddisflies, diptera, mayflies, and mollusks). Lindeman et al. (2023) determined that ringed map turtles are strongly spongivorous, with significant molluscivory occurring only in coastal populations, thus showing the same dietary pattern as other microcephalic map turtles. The presence of wood in diet samples of the ringed map turtle indicate that sponges and vegetative prey items (e.g., filamentous algae) may occur along with animal prey on deadwood substrate (Lindeman et al. 2023, Selman and Lindeman 2018).

Jones (2006) found a minimum of approximately 60 percent of the females reproducing annually, but some females may skip a year between nesting. Nesting was found to only occur during daylight hours and primarily before noon. Nesting is initiated in May and ends in August with multiple (2 to 3) clutches per year being common (annual clutch frequency ranged from 0.96 to 1.42). Clutch size averaged approximately 3.6 eggs per nest. Final nesting attempts usually concluded towards the end of July. Eggs incubate for approximately 64 days (Jones 2006) before pipping and then hatchlings emerge approximately 12 days after pipping (total time in the nest is approximately 76 days).

Mean annual survivorship estimates for males, females, and juveniles were 0.88, 0.93, and 0.69, respectively. Maximum longevity estimates were 48.8 years for males and 76.4 years for females. Average longevity estimates were 13.9 for females and 8.5 years for males. The sex ratio of captured turtles was male-biased before 2000 but unbiased after 2000. Time to maturity varies between male and female turtles. Males mature at about 4.6 years of age while females mature about 9.1 years of age (Jones 2017).

6.1.3. Numbers, Reproduction, and Distribution of the Ringed Map Turtle

The ringed map turtle is primarily restricted to the main channels of the Pearl, Strong, Bogue Chitto, and Bogue Falaya Rivers in Mississippi and Louisiana, although it can inhabit downstream sections of smaller tributaries (e.g., Bogue Lusa Creek, Silver Creek). It occurs in most reaches of the Pearl River from near the coastal saltwater influence in St. Tammany Parish, Louisiana, upstream to Neshoba County, Mississippi. It occupies approximately 50 miles of the Strong River in Simpson, Rankin, and Smith Counties, and approximately 30 miles of the Yockanookany River in Leake County. In the Bogue Chitto River, it is found 189 miles upstream to McComb in Pike County, Mississippi. In the Bogue Falaya, it is known to occur from near the Bogue Falaya Water Park near Covington to 2.27 RM downstream to the confluence with the Abita River. Total occupied river miles are estimated to be 753 miles.

Using 25 years of data at five sites along the Pearl River in Mississippi, Jones (2017) provided long-term trends for the ringed map turtle in the mid- and upper Pearl River, showing relatively stable populations over this time period. One site showed decline (Carthage), three sites showed the initial stages of decline (Ratliff Ferry, Monticello, Columbia), and one site (Lakeland) was relatively stable. In 2023, Devros et al. determined that overall populations have decreased by 12.1% since 2002, with population trends at Lakeland and Columbia increasing since 1988, and population trends at Ratliff Ferry, Monticello, and Carthage declining.

In 2012, Landry conducted a survey on the Pearl River near Bogalusa. Landry & Gregory (2010) conducted the most recent survey of the Bogue Chitto River following up on a 1999 survey of the same reach (Shively 1999). Between 6.51 to 114.7 turtles/kilometer (km) were estimated between the confluence of the river and Warnerton, Louisiana. Turtle concentrations were higher in the downstream reaches, which was supported by Selman (2024) who recorded lower basking densities in upstream reaches compared to downstream reaches. While Landry and Gregory (2010) reported reduced abundance of ringed map turtles in the Bogue Chitto, Selman (2024) observed similar abundances as Shivley (1999).

Recent surveys below the Bogue Chitto River have reported basking densities from 0.3 to 29.4 turtles/rkm on the Pearl River and West Pearl River Navigation Canal (Selman 2024). An additional survey was conducted at Honey Island on the West Pearl River which estimated population densities of 47 turtles/rkm (N. Devros, pers. comm.2024). Dickerson and Reine (1996; summarized in Selman and Jones 2017) surveyed between Pools Bluff and Hwy 90 and found between 15.7 (Bogue Chitto Sill) to 1.4 (Pools Bluff) turtles/km. Along the East Pearl River at Stennis Western Maneuver Area, basking surveys conducted from 2012 to 2015 and abundance was estimated between 1.2 and 6.8 turtles/km (Buhlmann 2017).

Between October 2021 and November 2022, 23 individuals were captured from 3.65 km of the Bogue Falaya in St. Tammany Parish, Louisiana. Subsequent genetic testing indicated this population constitutes a natural and discrete population from all other *G. oculifera* in the Pearl River system. The Bogue Falaya is a major tributary of the Tchefuncte River and is physically isolated from the Pearl River system, as the two river mouths are about 65 km apart and characterized by unsuitable brackish marsh habitat in their lower reach and brackish Lake Pontchartrain between them (Glorioso et al. 2024)

The use of basking surveys to obtain a relatively good indication of the abundance level has been suggested by Jones and Hartfield (1998) and Killebrew et al. (2002). To determine the overall abundance, the Service calculated the occupied river miles within the species' range based on published and unpublished literature and observational data. The U.S. Geological Survey's (USGS) National Hydrography Dataset flowline shapefile was used to determine river miles between known upstream and downstream occurrence records on the mainstem Pearl River and tributaries. The mean number of basking turtles observed for all surveyed reaches was extrapolated to the unsurveyed reaches to estimate a range wide abundance. The Service assumed an even distribution across the range; however, Killebrew et al. (2002) and Lechowicz (undated) found *Graptemys* were not always evenly distributed. The range in abundance displayed in Jones (2017) indicates an unequal distribution for the ringed map turtle; however, the Service could not find literature indicating a better method for determining *Graptemys* distribution and abundance. The Service used an average abundance per river mile for sites surveyed using mark-resight techniques to extrapolate to unsurveyed reaches to estimate range-wide abundance. Calculated population estimates were acquired from Devros et al. (2023) and Selman (2024), with additional basking density information from Landry and Gregory (2010). Based on 481 miles of occupied mainstem river with an average abundance of 150 ringed map turtles per river mile, the Service estimates approximately 71,150 turtles in the mainstem Pearl River. Estimates for the Bogue Chitto are approximately 8,100 turtles using 189 occupied river miles at an average density of 43 turtles per river mile. An additional 3,500 turtles are estimated to occur within the Strong and Yockanookany rivers and other small tributaries, for a total coarse population estimate of approximately 82,750 individuals across the species' range.

6.1.4. Conservation Needs of and Threats to the Ringed Map Turtle

Several threats were identified at the time of listing of the ringed map turtle (1986):

- habitat modification (desnagging, channelization, impoundment, and erosion),
- water quality degradation (pollution & siltation),
- over-utilization (collection for the pet trade and shooting of basking turtles for recreation);
- disturbance of nesting and basking (due to recreation and boating); and,
- The subsequent recovery plan (1988) identified predation as an additional threat.

At the time of listing, 21 percent of the ringed map turtle's range had been modified by channelization or impoundment and an additional 28 percent of that range had construction projects planned or authorized. This includes the Ross Barnett Reservoir and a channelized section within the Action area. While many of the projects have not been constructed, and some are no longer under consideration, some are still authorized and may be initiated if funding becomes available. The ringed map turtle is only found north of Highway 43 on the Ross Barnett Reservoir, and the large earthen dam creates a barrier to turtle movement, though a small remnant population is found in Pelahatchie Creek near the dam. It has been stated that operations of the Ross Barnett Reservoir have created downstream impacts to habitat including channel filling and widening due to collapse of waterlogged banks from sudden water releases to maintain pool elevations (Selman and Jones 2017) and channel instability resulting from captured sediment in the Ross Barnett Reservoir (Hasse 2006; Kennedy and Hasse 2009; Tipton et al. 2004). However, although these habitat impacts are occurring, the Lakeland population of ringed map turtles has increased in recent years and currently has the highest density of ringed map turtles in the range (217.7 turtles/rkm; Devros et al. 2023). Killebrew et al. (2002) stated that populations of Cagle's map turtle (*Graptemys caglei*) found downstream of a dam were decreased due to rapid changes in the water level associated with dam releases. Those dam releases were implicated in the flooding of nests and reduced food availability. Richards and Seigle (no date) stated that fluctuating water levels downstream of a dam altered habitats, reduced turtle movements, and resulted in loss of basking habitat for the northern map turtle (*Graptemys geographica*).

The recovery plan recognized that to reduce the threat of habitat modification, habitat protection was needed. Criteria 1 of the plan identified that protection of a total of 150 miles of the turtle's habitat in two reaches of the Pearl River was needed to delist the species. The reaches must be on opposite ends of the Ross Barnett Reservoir, and there must be a minimum of 30 miles in either reach. Currently there is one protected reach north of the Ross Barnett Reservoir, an approximately 11.8–mile-long ringed map turtle sanctuary., along with protected lands within the Nanih Waiya Wildlife Management Area (WMA) and Mississippi Band of Choctaw Indian tribal lands in Neshoba County, Mississippi. Just south of the Ross Barnett Reservoir one of Mississippi Department of Transportation's mitigation banks protects 21,491 linear feet (approximately four miles) of the east bank of the Pearl River. Approximately 73 miles of at least one bank in the lower Pearl River is within state or federally protected and managed lands (Pearl River and Old River WMAs, Bogue Chitto National Wildlife Refuge), but this area has some of the lowest population densities. Thus, additional protected areas are needed to meet this recovery goal. However, placing lands within a protected status may not be sufficient to preclude the decline of a turtle species (Browne and Hecnar 2007); additional management actions may also be required.

Agricultural, municipal, and industrial effluents may have historically impaired water quality in the lower Pearl River (McCoy and Vogt 1980). Direct effects of water quality on ringed map turtles have not been researched, but negative effects to their primary food sources has (Stewart et al. 2005), as well as extirpations of other sensitive aquatic taxa (Alabama shad, pearl darter, southern walleye, and inflated heelsplitter). Decreases in other *Graptemys* species have been attributed to reduced water quality downstream of development (Killebrew et al. 2002). Selman and Jones (2017) cited studies that pointed to the decrease or loss of *Graptemys* species due to poor water quality in the Pearl River, and gravel mining on the Bogue Chitto River in Louisiana are one of the biggest threats to the riverine environment (Selman 2024). Recovery of some Pearl River populations were noted due to improved water quality (Selman and Jones 2017).

Predation of nests by raccoons, armadillos, and fish crows is well documented with most nests being predated within 14 days (Jones 2006). Predator numbers have increased and may be subsidized by humans which could have an impact on recruitment (Buhlmann 2017; Jones 2006). Jones and Selman (2009) suggested that those predators could have a significant impact to recruitment in the future. A recent increase in American alligators (*Alligator mississippiensis*) was also postulated to have possibly resulted in a decline in adult males and juveniles (Jones 2017). Predation is estimated to destroy approximately 86 percent of nests, of which invertebrates (i.e., ants and fly larvae) predate approximately 24 percent of fertilized eggs within nests.

The impact of human disturbance, primarily recreating (e.g., camping, picnicking, boating) to nesting turtles and/or nests has been pointed to as another source of decline in the population (Jones 2006; Jones 2017; Selman and Jones 2017). Horne et al. (2003) found that even their observation blind reduced *Graptemys flavimaculata* nesting attempts by three times more than without that disturbance. Direct mortality associated with recreational and commercial fishing and recreational boating has been identified as another impact to *Graptemys* populations (Bluté et al. 2010; Selman et al. 2013; Smith et al. 2018). Jones (2017) expressed a concern about those same activities impacting the ringed map turtle. Bluté et al. (2010) found that impacts to the northern map turtle (*Graptemys geographica*) from boat strike could lead to an increased risk of localized extinction. The potential for reduced vigor because of disturbed basking has been found in other *Graptemys* populations as well as the ringed map turtle (Heppard and Buchholz 2018; Selman and Qualls 2011; Selman et al., 2013). Based on basking surveys, it is apparent that *Graptemys* species including the ringed map turtle may habituate to humans. The amount of time required for such habituation is not known and there is some uncertainty as to the degree of habituation that will occur (Jones and Hartfield 1995; Landry and Gregory 2010; Lechowicz 2013; Selman and Jones 2017, Selman and Qualls 2011; Selman et al. 2013).

Listing of the ringed map turtle as federally threatened may have reduced impacts of the pet trade, but collection for the pet trade is still occurring within the Pearl River Basin (Jones 2017; Selman and Jones 2017; Selman 2024).

6.2. Environmental Baseline for the Ringed Map Turtle

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Ringed Map Turtle, its habitat, and ecosystem within the Action area. The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action area, the anticipated impacts of all proposed Federal projects in the Action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR §402.02).

6.2.1. Action Area Numbers, Reproduction, and Distribution of the Ringed Map Turtle

Recent surveys by Selman (2020) provide a current estimate of the number and status of ringed map turtles in the Action area. Ringed map turtles were also observed in oxbow lakes and sloughs adjacent to the Pearl River within the Action area; however, not all oxbow and slough habitat will be altered by the proposed Action. Ringed map turtles are found throughout all reaches of the Pearl River within the Action area, with lower numbers in the channelized sections of the river (just south of RM 293 to approximately RM 287). Approximately 40 percent of the proposed excavation area has little or no riparian habitat and little to no natural basking and feeding habitat, especially within the channelized portion. Selman (2020) found a greater concentration of turtles within forested riparian sites along this portion of the river. He also documented nest sites, turtle nesting crawls, and juvenile turtles all indicative of successful recruitment occurring in all stretches of the Action area, including the area with reduced riparian habitat. A greater abundance of juveniles (10 to 20 percent) was found within the northern channelized section than in other sites outside of the Action area. Selman (2020) postulated that the increased juvenile production may result from the use of narrower sandbanks along the channelized sections as opposed to sand bars, thus reducing predation success. Approximately 31.4 acres of accretion (e.g., sand bars, sand banks) were determined for Alternative C during the 2019 ESA consultation to exist within the Action area based on 2010 National Agriculture Imagery Program color photography; this acreage was spread over approximately 20 sites throughout the Action rea. An updated analysis has not been performed. Selman (2018) documented 20 sandbars within the project area and noted 102 potential nesting crawls. Of the 20 sand bars, 11 were not surveyed but two of those not surveyed were noted as having crawls but the number of crawls were not counted. Two surveyed sand bars had no nests or crawls.

Based on basking survey data, the Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) represents 10.5 percent of the turtle's range having approximately 23 percent of the turtle's range wide abundance. However, we do not anticipate adverse impacts to the species below 1.6 miles of the new weir for Alternatives C and D, therefore, our analysis focuses on the impact to ringed map turtles from RM 301.77 to 282.4 (1.6 miles below the proposed Alternative C weir).

Jones (2006) used nesting survey data from upstream of the project study area to develop a relationship between sandbar size and number of nests. Based on that relationship, the approximate number of turtle nests found on the 31.4 acres of sandbars within the project study area was calculated to be 1,177. With each nest having approximately four eggs per nest (rounded up from 3.6), this corresponds to approximately 4,326 eggs within the excavated area. However, once the 86 percent predation rate of nests and the 24 percent predation rate of eggs by insects are applied to the number of eggs only approximately 461 eggs are likely to hatch.

Not included in the above abundance estimate are the small, isolated populations at Cypress, Crystal, and East and West Maye's Lakes within the project area. There are no construction activities proposed in the immediate vicinity of both Mayes Lakes, Cypress Lake, or Crystal Lake.

Selman (2020) used basking density surveys along with basking frequency data from two *Graptemys* species found in the Pascagoula River to estimate population size within the project study area (Selman and Qualls 2011; Selman and Lindeman 2015). Selman (2020) used correction factors of 20 and 30 percent of the basking population observed to estimate the potential range of turtles missed by such surveys. The Service used survey results from Selman (2020) to determine the number of turtles within the channelized area and upstream and downstream of that area to which we applied the correction factor. Based on those calculations, the Service estimated that up to 1,773 turtles potentially exist in the area that could be impacted by the Action (i.e. up to 10 miles of channel improvements for Alt C)

Selman (2020) also calculated upstream and downstream population density as 220 turtles/rkm (352 turtles/river mile (rmi)) and 182 turtles/rkm (291 turtles/rmi), respectively. Using mark-resight techniques, Devros et al. (2023) provided additional support for a population density of 218 turtles/rkm (348 turtles/rmi) at the upstream river reach. Based on these surveys, we estimate population abundances upstream and downstream of the project area as approximately 2,735 and 466 turtles, respectively (3,201 total). In summary, we estimate a total of approximately 4,974 turtles occur from RM 301.77 to RM 282.4 (Ross Barnett Reservoir to 1.6 miles below Alternative C weir; 2,735 turtles upstream, 1,773 within Alt C footprint, and 466 downstream).

Selman (2020) used information from two *Graptemys* species to develop the potential number of turtles in the project study area. The use of surrogate species is common in conservation biology, particularly when implementing the ESA where needed data may not be available or is difficult to collect. Selman's use of a "correction factor" to determine population size within the project area is based off the peer-reviewed Selman and Qualls (2011) basking behavior study of an ecologically similar species (*Graptemys flavimaculata*, yellow-blotched map turtle) within the Pascagoula River. This species is as equally imperiled as the ringed map turtle and suffers from similar threats. Additionally, surveys using mark-resight techniques in the same river reach corroborated Selman's (2020) estimated population density (Devros et al. 2023). When lacking actual data for a species, we will use the best available information often from a surrogate species (Murphy & Weiland 2014; Caro 2010); Service policy on using surrogate species can be found in Final Rule 80 FR 90 26832-26845.

Throughout this BO the Service has relied upon existing information about the ringed map turtle as much as possible; however, when information is deficient or absent the Service first examined literature regarding other *Graptemys* species, and then other aquatic turtle species to provide the best possible assessment of impacts to the subject species and its habitat.

6.2.2. Action Area Conservation Needs of and Threats to the Ringed Map Turtle

The current status of ringed map turtles in the Action area has been heavily influenced by previous flood control actions and urbanization. Portions of the Pearl River within the Action area have been channelized, desnagged, and contain a cleared floodway where woody vegetation is controlled via herbicide and/or mowing. These actions have reduced the amount of habitat available for this species, including reductions in basking material, potential foraging areas, and nesting sandbars. Relatively few deep areas are also found within this section. Degraded water quality through nutrient and pollution input through this urbanized section of the Pearl River may also be impacting the ringed map turtle populations. Even with these impediments, the ringed map turtle still inhabits all segments of the Action area. Finally, the construction of the Ross Barnett Reservoir just north of the Action area has resulted in a barrier to ringed map turtle migration from and into the Action area. The significantly decreased water velocity within the Ross Barnett Reservoir, the lack of basking material, nesting habitat, and increased development and recreational activities has resulted in the elimination of a viable population of ringed map turtles for the length of the Ross Barnett Reservoir (approximately 16 miles of the Pearl River, i.e., RM 302 to approximately RM 328). An isolated non-reproducing population is found in the Pelahatchie Creek area just east of the dam in the Ross Barnett Reservoir.

The Action area contains one of the reaches selected in the 1988 Recovery Plan for long term population monitoring because of its perceived low population (Stewart 1988). This population, referred to as the Lakeland population, is 3 miles long and is found between the Ross Barnett Reservoir and Lakeland Drive (northern portion of the Action area). The Service's most recent five-year status report states that the population at this location represents the healthiest population south of the Ross Barnett Reservoir. Approximately 30 percent of river within the Lakeland population area will be directly impacted by the project. Selman and Jones (2017) concluded that the Lakeland population is the only stable population they surveyed, and Devros et al. (2023) found that the Lakeland population has been increasing since 2002. There has been no long-term monitoring of the population south of Lakeland drive within the Action area. Selman's recent surveys (2017, 2018) were the first efforts to document population status within this area.

The Ratliff Ferry population and populations to the north became isolated from populations south of the Ross Barnett Reservoir with the construction of that reservoir in 1960 (17 years short of the estimated maximum longevity of a female). The ringed map turtle populations north of the reservoir are beginning to experience a decline, with the Ratliff Ferry population declining by 69% since the late 1980s (Devros et al. 2023). Predation and disturbance of nesting areas are believed to possibly be the greatest factors causing the decline along with sedimentation in the upper portion of its range (Jones 2017).

After studying the Ratliff Ferry and Lakeland populations, Heppard and Buchholz (2019) suggested that increases in boat traffic can be mitigated to some extent by providing greater basking perch abundance and by reducing boat speed and the inter-wake interval of passing boats. They recommended that no wake zones be placed around areas set aside for ringed mapped turtle conservation and that basking refugia be established by restricting boater access. Turtles basked for longer times in no wake zones. The proposed measures would be done to improve the health, survival, and reproduction of the ringed map turtle and reduce the likelihood of boats striking adults. For the Lakeland and the two other populations studied in the northern part of the range, Selman and Jones (2017) attributed some of the population declines to direct mortality from boat strikes.

6.3. Effects of the Action on the Ringed Map Turtle

This section analyzes the direct and indirect effects of the Action on the ringed map turtle. Effects of the Action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action (50 CFR §402.02). Our analyses are organized according to the description of the Action in section 2 of this BO.

6.3.1. Effects of channel improvements on the Ringed Map Turtle

Channel improvements include excavating areas of the floodplain (overbank areas) within the Action area in order to lower the floodplain and improve flood capacity (Note: the Pearl River will not be directly impacted, therefore, we do not anticipate direct adverse effects to adults found within the river). The acreage of excavation and amount of material to be removed varies between Alternative C, D, and E. This excavation would occur from RM 284-294 for Alternative C (10 miles) and RM 285-294 for Alternatives D and E (9 miles).

To decrease sedimentation from the construction site and allow most excavation to occur in a dry environment, excavation of areas away from the riverbank could occur first. This would leave the riverbank and an additional adjacent area separating the river from the excavation area undisturbed. This buffer area would reduce the likelihood of disturbing basking turtles or turtles attempting to nest and would reduce the potential of having nesting sites located within ongoing work areas. Therefore, we do not anticipate the direct killing of adult turtles related to ground disturbance resulting from channel improvement activities (i.e. overbank excavation outside the river channel). However, we can expect some level of harm (nonlethal) due to noise and other disturbances that may alter normal turtle feeding, basking, and nesting activities during the period when overbank excavation is occurring. Some turtles may migrate upstream or downstream to avoid areas with heavy noise and other human disturbance due to construction activities.

Disturbance during basking and nesting by channel improvement activities and the reduction of food sources due to increased turbidity can result in the decreased health of turtles (Chen and Lue 2009; Heppard and Buchholz 2019). All turtles in the channel improvement construction area would likely experience these effects temporarily during the two-year construction period. If turtles move from the construction area into areas already inhabited, the potential for crowding with concurrent increased stress and competition for food and habitat could affect their health, survival, and reproduction (Chen and Lue 2009). These temporary effects would be felt by all turtles in the channel improvement area (1,773 for Alt C, 1,596 for D and E).

During channel improvement activities, nests found above top bank of the river would be destroyed if work were to occur during the nesting season (May-October). The Service estimates that up to 20 percent of nests could be found in overbank habitat away from the river, as the majority would be expected to be laid on sandbars and below top bank of the river. Our 2019 BO estimated that there were 1,177 potential nests on the 31.4 acres of sand bar in the channel improvement area that could have approximately 4,236 eggs (3.6 eggs per nest). However, once the 86 percent predation rate of nests and the 24 percent predation rate of eggs by insects are applied, only approximately 461 eggs are likely to hatch. Therefore, assuming this to be the total number of eggs potentially found within the channel improvement areas that successfully hatch, then 20 percent would represent 92 eggs that could be harmed (lethal) by the channel improvement activities.

The excavated material will be used to upgrade existing levees in the Action area as well as used to create elevated fill for future economic development and recreational parks. This will result in the removal of forested riparian habitat which is the main source of basking and feeding habitat and escape cover used by *Graptemys* (Lechowicz 2013; Lindeman 1997; Lindeman 1998;

Lindeman 1999; Killebrew et al., 2002). Reforestation of the channel improvement area is not planned for Alternative E so naturally occurring basking and feeding habitat may largely be eliminated and not replaced. The loss of this habitat would be reflected in the decreased health, survival, and reproduction; these adverse effects would be felt by all turtles that remain or return to the Action area following channel improvement activities.

We anticipate that once excavation is complete for Alternative E, the 9-mile stretch of river receiving channel improvements will have similar habitat quality as the four miles of river within the Action area that currently has limited wooded bank line, basking habitat, and a reduced ringed map turtle population. The current population estimates for this four-mile stretch is 75.8 turtles/rmi (47.4 turtles/km) (Selman 2020), and the current population of the entire 9 miles of proposed channel improvements is 1,596 (avg of 177.3 turtles/rmi). Therefore, we anticipate the long-term effects of Alternative E will be an estimated 57 percent reduction in the ringed map turtle population within the channel improvement portion of the Action area (from 1,596 turtles pre-project to 682.3 turtles post-project).

However, these adverse effects could be minimized by efforts to reforest the excavated channel overbank areas and the placement and maintenance of basking and foraging material within the channel of the Pearl River. Such efforts could possibly raise the post-channel improvement population estimates for Alternative E to near pre-project levels.

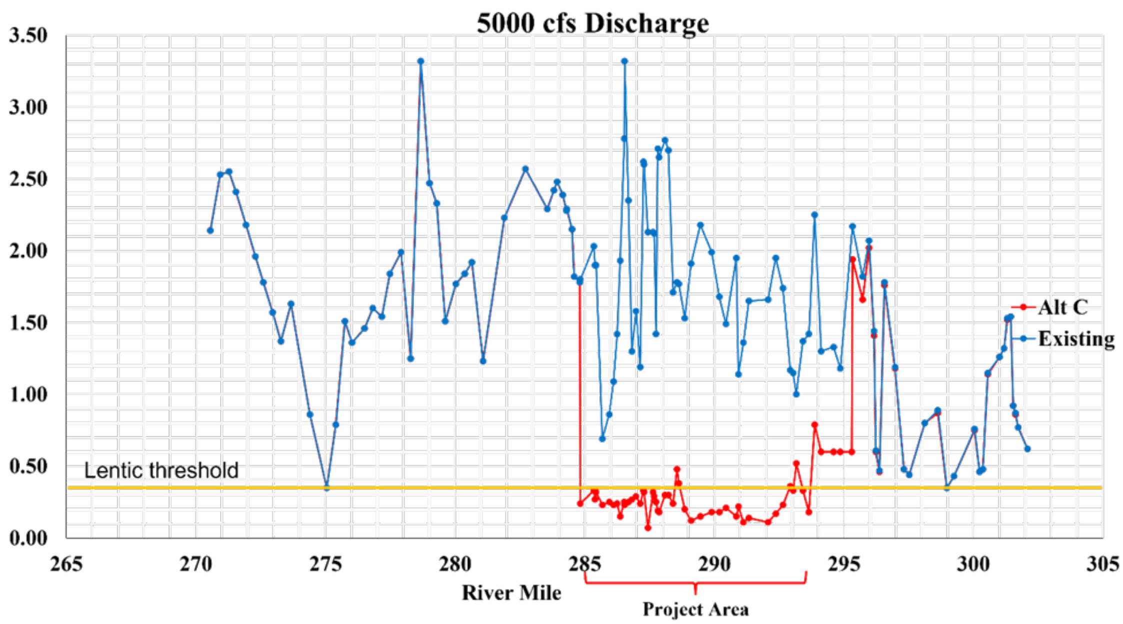
6.3.2. Effects of Weir Construction and Impoundment on the Ringed Map Turtle

The establishment of a 1,700 (Alt D) to 2,562-acre (Alt C) impoundment from weir construction will result in changes in the velocity and water surface elevation within the project area. The June 2024 USACE BA states that the current lotic (i.e., riverine) habitat would be replaced with lentic (lake-like) habitat which has been proven by the Ross Barnett Reservoir and adjacent oxbow lakes to not support viable populations of the ringed map turtle. Approximately 31.4 acres of nesting habitat due to submergence would be lost. The riparian zone would be almost eliminated, and development is likely for most areas of fill surrounding the new impoundment. There also exists the potential for existing nests to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season (DEIS 2024).

The lake conditions of the Ross Barnett Reservoir have precluded the ringed map turtle from persisting once the reservoir was filled. Selman's (2020) survey of lakes within the Action area determined that turtles were present, but the populations were predominated by males and only one juvenile was observed. Additionally, densities of ringed map turtles found in oxbow lakes were 10-fold lower than densities observed in riverine environments, thus characterizing these environments as ecological sinks only supported by immigration from the river during high-water events (Selman 2020). This is supported in other map turtle species, such as the Cagle's map turtle that was absent from five impoundments. Killebrew et al. (2002) attributed that absence to the lack of riverine habitat including shoreline for nesting (including sandbars), shoreline vegetation for food and shelter (fallen trees or undercut banks exposing roots), and basking structure. Increased turtle abundance in small riverine lakes was attributed to the relatively unaltered shoreline, lack of development along the shoreline (any development was not close to the shoreline), and the small size of the lakes (a few hundred yards in length). Lakes small enough to still maintain lotic conditions were observed to have a greater abundance of turtles if they also possessed the previously mentioned habitat characteristics (Killebrew et al. 2002). A decrease in Cagle's map turtle populations occurred after repairs to a dam that was no longer retaining flows but was followed by an eventual increase once sandbars, riparian habitat, and snag habitat returned. However, if these habitat features did not return and/or if shoreline development occurred the turtle populations did not fully recover or were extirpated. Linderman (1998) stated that habitat characteristics (deadwood and current) and shoreline development could explain the difference in *Graptemys* abundance in reservoirs. Sealy (1976) stated that the Alabama map turtle (*Graptemys pulchra*) could persist within a lake type environment but stated its degree of success in a lentic versus a lotic habitat has not been determined. Selman and Qualls (2009) did not observe any *Graptemys* in nonflowing lake-like conditions created by gravel mines in the Pascagoula River, although another survey documented presence of both *Graptemys* endemic to the Pascagoula River in oxbow lakes, albeit at very low densities (Berry 2019).

Killebrew et al., (2002) found that Cagle's map turtle would be found between approximately 0.6 and 2.6 fps with an optimum velocity around 2.5 fps. Examination of modeled mean cross-sectional velocities estimated at an average of approximately every 1,100 feet for the river miles where the Lakeland population is found indicates that the turtle is found in velocities between 0.4 and 2.3 fps. We hypothesize that this range represents the suitable velocities for the ringed map turtle. Because those velocities are mean cross-sectional velocities, the actual suitable velocities may vary from those values; however, since all velocities for the project are mean cross-sectional values, their application to the impact assessment is appropriate.

Based on available velocity data for Alternative C, the range of velocities reported fall below the lentic threshold of 0.10 m/s (0.33 fps) (Pellett et al. 1983) throughout most of the year, particularly during the active or breeding season for many riverine obligates (Note: velocity data has not been run for Alternative D and therefore, until such data is provided, we must assume it will have similar velocities as Alternative C). The graph below (Graph 1) depicts pre- and post-project (Alternative C) velocities within the study area (which includes the pooled area) for 5,000 cfs.



Graph 1. Existing velocities at 5,000 cfs discharge rate compared to project-induced velocities. Lentic threshold of velocity is 0.10 m/s (0.33 ft/s) (Pellet et al. 1983). Monthly discharge averages (1966-2013) presented from RM 270 – RM 302.

Average annual discharge in the project area is 4,700 cfs. Based on current data, average discharges greater than 20,000 cfs do not occur at any time throughout the year. Only 9 percent of the daily Jackson gage records (1966-2013) show discharges between 10,000 and 20,000 cfs. Daily discharges greater than 20,000 cfs occur infrequently (4.4%). Even throughout predicted high flow season (December – April), average discharges reported are less than 10,000 cfs in the area. Consequently, three of those months are considered inactive season for some riverine species (i.e., map turtles). Noteworthy, with project modifications, once discharges decrease below 10,000 cfs, the modified channel's velocities would significantly decrease and lake-like velocities would occur (below 0.33 fps; Graph 1). Low flow (lake-like) conditions are expected to occur throughout most of the year with approximately 73 percent of daily gage records below 5,000 cfs (268 days per year).

Lotic-like velocities ranging from 0.75 – 3.3 fps exist in the project area under the average discharge conditions of 4,700 cfs. However, post-project construction, velocities fall below the lentic threshold at discharges at or below 10,000 cfs. That project-induced lentic condition persists throughout the channelized reach (RM 284 – RM 294) especially at/and below average flow conditions (*i.e.*, ≤ 5,000 cfs) mentioned above. Further, at discharge rates ≤ 1,000 cfs, average velocities will be reduced from 1.15 fps (range 0.3 – 3.7 fps) to 0.06 fps (range 0.02 – 0.17 fps), below the lentic threshold. This trend remains fairly constant throughout the modified channel portion with variations caused primarily by differences in the proposed cross-section of the channel.

At infrequent high flows (*i.e.*, 40,000 cfs or greater), a significant reduction in velocity is not anticipated within the channelized reach. Neither are velocities at discharges of 5,000 – 20,000 cfs expected to be significantly different (pre- and post-project scenarios) in the reach beyond the channelized section; north of RM 297. However, a project-induced increase in velocity in a portion just upstream of the upper limit of the pool (approximately RM 296 – RM 297) is anticipated at discharges above 10,000 cfs.

Between RM 293 (upper end of the improved channel) and RM 295, the river and floodplain will not be altered, but the water surface elevation will be reduced several feet for discharges between 10,000 cfs and 50,000 cfs. In this same general area, there will be an increase in velocities (i.e., 1.28 fps to 5.85 fps) for discharges greater than 40,000 cfs. This decrease in water surface and increase in velocities could result in scouring and destabilization of the banks (i.e., head cutting) upstream to the Ross Barnett Reservoir.

Alterations in riverine and riparian forest conditions are expected to have long-term negative impacts to the ringed map turtle population within the Action area. Due to the removal of all woody structure within the impoundment, the number of turtles may be lower than typically found in other lake-like waterbodies.

The impounding of the Pearl River via weir construction and the resulting creation of a 9.5-mile-long pool for Alternative C and 7.5-mile-long pool for Alternative D will result in the removal of riverine features (*i.e.*, swifter flowing water, snags, sandbars) that provide suitable habitat for the ringed map turtle. Other generalist turtle species (red-eared slider) more adapted to slow-flow conditions would likely flourish in the impoundment (Selman 2020) and displace the ringed map turtle.

Cummings (2004) examination of low head dams determined that the biggest issue is anthropogenic influences impacting water quality within the created water body including temperature. Butts and Evans (1978) found that channel dams resulted in lower dissolved oxygen (DO) levels within the pool and the downstream design of the weir influenced the amount of oxygen reintroduced to the water column. Ramped weirs had less re-aeration than water falling over vertical weirs but the greatest influences on DO levels were the water velocity over the dam and the distance water fell. The proposed weir is a vertical weir. Data within the study displays that DO levels within the pool may exhibit wider DO fluctuations typically associated with ponds. Helms et al. (2011) found no physiochemical changes associated with mill dams, and Smith et al. (2017) found that dams did not impact local abiotic factors. Gangloff et al. (2011) found that streams with weirs had lower nitrogen concentrations but observed few statistical differences between habitat variables measured in streams with intact, breached, and relict low-head dams. Santucci et al. (2005) observed that DO and pH levels in pools experienced wide daily fluctuations and at times did not meet state water quality standards.

Within the proposed channel improvement area, there are eight streams draining approximately 61 square miles of predominately urban areas. Drainage from urban areas typically has increased nutrient loadings, concentrations of pesticides, herbicides, and various hydrocarbon products, and especially for the project area, increased sewage overflow spills (MDEQ 2012). High nutrient levels could result in eutrophication of the proposed waterbody. Fluctuations and stratifications in the water quality (e.g., DO) similar to what occurs in the Ross Barnett Reservoir (larger but similar in depth) could be expected. Killebrew et al., (2002) found that even though areas downstream of development were meeting water quality standards there were decreases or localized extirpation of Cagle's map turtle. Selman and Jones (2017) cited reports that indicated that prior to improved water quality standards local populations near developed areas were extirpated. Jones and Hartfield (1999) also cited a study that found decreased turtle body size downstream of Jackson. This was attributed to poorer and/or reduced food sources because of decreased water quality and the potential influence of contaminants.

Once construction is complete and water pools behind the weir, the mean water depth will increase from approximately 6.7 feet to approximately 21 feet, which is 14 feet above the existing water surface. If this occurs during nesting season (May to October), it could flood existing nests reducing recruitment from that year's nests. However, filling of the area would likely occur during the higher flow periods, December through May, thus avoiding their nesting time. If filling took place in May, it could impact approximately 100 percent of the nests. Details of how the filling will be undertaken have not been finalized but would be coordinated with the Service.

The proposed weir and impoundment will result in the fragmentation of the free-flowing river habitat that is likely to limit migrations, cause isolation, and diminish genetic flow (Gallego-Garcia et al., 2018) between the population north of the new impoundment (i.e. Lakeland population) and populations south of the new weir. This fragmentation may make reproduction more difficult (Jian et. al., 2013) and decrease adaptive capacity of this impacted population as genetic diversity is lost. The Lakeland population may see increased inbreeding and reduced reproductive fitness and survival due to the new weir and impoundment (Turcotte et al., 2022). Turtles downstream of the proposed weir are likely to experience short-term impacts associated with increased sediment/siltation on sandbars and basking material during construction of the weir and fish passage structure. Effectively controlling downstream sediment run-off, especially during high rain events, will be very difficult. However, once sediment runoff issues have dissipated due to high streamflow events, we expect habitat greater than 1.6 miles downstream of the weir to remain suitable for the ringed map turtle as long as current river flows are maintained. We would expect such effects to last less than two years after project completion.

The fish -passage channel would provide approximately one mile (0.1 percent of the species range) of flowing water during low flow periods when the channelized area would experience low velocities. Depending on the width and velocities of this feature, it could provide additional habitat for the ringed map turtle and could prevent isolation of the populations up and down stream of the weir. However, if the fish-passage does not have suitable velocities that can be traversed by turtles, geographic isolation of the most stable population of ringed map turtles (Lakeland) would occur. This population is already isolated from upstream populations due to the construction of the Ross Barnett Reservoir, and construction of a downstream weir would limit connectivity to downstream populations. This could cause local population declines and potential extirpation of the Lakeland population of an estimated 2,911 individuals.

Sediment transport modeling indicates there would be some loss of sediment within the improved channel. Literature regarding the impact of weirs on sediment transport supports that analysis. The loss of sediment will not be comparable to that experienced with large dams but could result in some instability within a limited area downstream of the weir. The Service anticipates approximately 1.6 miles, approximately 0.2 percent of the species range, downstream of the weir would experience some degree of instability that would occur over several years with the capture of small amounts of sediment. Impacts from this would result primarily from an increase in turbidity decreasing potential food sources. The degree of instability and time over which this will occur is unknown but monitoring of this area would be conducted. Eventually, a state of equilibrium would be reached, and the impacts would no longer affect the turtle.

Alternative C proposed offsets to turtle losses that could be implemented as part of the Action including: creation and protection of 31.4 acres of nesting habitat and adjacent basking habitat and predator control; (2) the establishment and enforcement of no-wake zones to reduce boat strikes and disturbance during basking; (3) the placement of public access conditions to reduce disturbances to basking and nesting behaviors and habitats; (4) the creation of an approximately one mile fish bypass, and (5) the protection of 10 miles of riverbank that would prevent the development and destruction of riparian habitat utilized by ringed map turtles and also reduce nesting and basking disturbances. In addition, up to 1,600 individuals would be trapped, tagged, data collected, tracked, observed, and monitored in the Action area.

Alternative D currently does not propose these specific conservation measures, and the USACE states continued coordination with the Service would occur to determine if these measures are still applicable. Due to the expected lake-like conditions of an impoundment resulting from both Alternative C and D, it's unclear at this time the level of benefit such features would provide for the ringed map turtle. Further consideration of such features will be evaluated during the PED phase should alternative D be selected.

Relocation of turtles, especially aquatic turtles has had varied success (Attum et al., 2013; Attum and Cutshall 2015; Bogossian 2010; Sealy 1976). Soft releases (i.e., including a period of acclimation prior to full release) of turtles has reduce the movement of turtles away from the point of release (Attum and Cutshall 2015); some increased success has also been noted in the relocation events that occur prior to estivation and with greater distances moved. Differential movement between the sexes of mature adults has been noted but relocated juveniles tend to move less than relocated adults. Time until return has taken up to three years (Sealy 1976). The potential to capture and release individuals from areas where they would never contribute to the population and possibly be affected by construction and relocate them so that they may contribute to the population would be the goal of this action. Tracking of the released turtles would aid in the knowledge needed to ensure the continued survival of the species. Previous populations studies (i.e., Jones 2017) resulted in the handling of over 1,600 turtles with no known mortality. While a positive conservation action, the activity would result in the harassment of turtles. Additional coordination with the Service and the MDWFP will be conducted once a final alternative is selected so that the extent of turtle relocations and monitoring efforts can be determined.

Headstarting of turtles has also been demonstrated to increase population growth rates relative to wildlife populations with natural recruitment (Mullin et al. 2023). Headstarting is a conservation tool that assumes raising turtles in protected *ex situ* environments to larger body sizes, then releasing them back into the wild, increases their survivorship compared to wild, non-headstarted turtles. Turtle headstarting typically includes collecting and artificially incubating eggs, then rearing the hatchling turtles to a larger body size in protected *ex situ* environments, followed by releasing the headstarted turtles back into their natural habitat where their survivorship is greater than that of wild hatchlings. Mullin et al. also observed only a small increase in survivorship from multi-year headstarting (two years vs. one year), indicating diminishing returns for headstarting turtles past one year.

Based on the information provided above, we estimate the activities associated with the weir construction and associated impoundment will result in all turtles from RM 284-293.5 for Alternative C and RM 286.5-294 for Alternative D being harmed by the reduction in food sources and competition from generalist turtle species such as the red-eared slider. Similar conditions exist in the Ross Barnett Reservoir where only a small population of ringed map turtles still exist within Pelahatchie Creek (12 turtles/rkm; 19 turtles/rmi; P. Lindeman, unpub. data). Therefore, we anticipate the long-term effects of weir construction and impoundment will be up to a 90 percent reduction in the ringed map turtle population within the weir impoundment (i.e., lake). This would result in a reduction of the current population of 1,684 individuals to approximately 168 individuals after Alternative C weir construction and resulting impoundment (1,329 individuals reduced to 133 for Alternative D).

We also anticipate as many as 4,974 turtles from RM 301.77 to RM 282.4 for Alternative C; and 4,717 turtles occur from RM 301.77 to RM 283.4 for Alternative D being harmed due to the competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

Finally, there exists the potential for all existing nests to be flooded during filling of the pool area if this occurs during the May to October nesting season~~.~~ Our 2019 BO estimated that there were 1,177 potential nests on the 31.4 acres of sand bar in the channel improvement area that could have approximately 4,236 eggs (3.6 eggs per nest). However, once the 86 percent predation rate of nests and the 24 percent predation rate of eggs by insects are applied, we estimate only 461 eggs (Alt C) are likely to hatch. Therefore, we estimate up to 461 eggs for Alternative C and 364 eggs for Alternative D could be harmed (lethal) due to flooding of nests during the nesting season.

6.3.3. Effects of Non-Federal Activities caused by the Federal Action on Ringed Map Turtle

Recreational water sports (e.g., fishing, boating) will likely increase within the impoundment of Alternative C and D, as well as the Lakeland area upstream of the impoundment, as a result of improved access to the Action area. This could lead to greater disturbance in basking and nesting behaviors with resulting declines in health and nesting success (Heppard and Buchholz 2019; Selman et al. 2013). Boat wakes can cause shelving of sandbars resulting in turtles nesting in areas closer to the water surface (Selman et al. 2013), which in turn could result in more frequent flooding of turtle eggs and mortality. Efforts to create no-wake zones and restricted access on sandbars for the yellow-blotched map turtle on the Pascagoula River have had limited success due to the lack of enforcement capabilities by the MDWFP (Pearson, pers obs). Because the Service does not know the rate and degree to which recreation will increase, we are unable to estimate the number of nests and individuals potentially impacted. Mortality resulting from boat strikes could also impact the population (Carriere and Blouin-Demers 2010; Selman et al. 2013; Smith et al. 2018). Because larger turtles use deeper water habitats and are typically females, they have an increased potential of being killed, thus reducing their future contribution to the population (Selman et al. 2013; Smith et al. 2018).

Increased development adjacent to the improved channel could also lead to further decreases in water quality, impacting food resources in the improved channel. However, the Service is unable to estimate the rate and degree to which this will occur.

Activities that would not occur but for the proposed Federal action include relocation or retrofitting of existing infrastructure within the Action area (i.e., roads, bridges, pipelines, powerlines), riverfront access, and development. Effects resulting from these activities would include the temporary disturbance to basking, foraging, and nesting activities. In addition, temporary and localized increases in turbidity and sedimentation could impact forage species.

6.3.4. Summary of the Effects of the Action on the Ringed Map Turtle

Channel Improvements: These activities will avoid direct impacts to the Pearl River, sandbars, and up to top bank, therefore, we do not anticipate death to adults to occur as result of the channel improvement activities; however, turtles (up to 1,596) could be impacted by noise and other disturbances that alter normal feeding, nesting, and basking behavior, or forces turtles to flee the project area upstream and downstream. There also exists the potential for nests laid above the top bank and within the area proposed for excavation to be destroyed should this work occur during nesting season. We estimate that channel improvements could result in the destruction of approximately 92 eggs within the Action area as a result of channel improvements.

Once this activity is completed for Alternative E (channel improvements only, no weir), we anticipate up to a 57 percent reduction in the ringed map turtle population within the channel improvement section due to reduced basking, foraging, and nesting habitat, similar to the population of turtles within the existing four-mile stretch of river within the Action area that has no or limited wooded riparian habitat. There is very little discussion in the 2024 DEIS about habitat conditions that will or could exist with the selection of Alterative E (channel improvements only). Therefore, our estimates are a worst-case scenario where basking and nesting habitat is unavailable post-project. These adverse effects could be considered temporary if conservation measures are established that improve habitat conditions within the Action area. Such measure could include reforestation of the excavated channel overbank areas and the placement and maintenance of basking, foraging, and nesting material within the channel of the Pearl River. Such efforts could possibly raise the after-channel improvement conditions to near pre-project conditions. Further analysis of post-project conditions of Alternative E will be required should it be selected.

Weir and Impoundment: We anticipate the permanent loss of 9.5 miles of occupied ringed map turtle habitat as the result of Alternative C and 7.5 miles for Alternative D. As discussed in

Section 6.3.2, lake-like conditions are anticipated within the newly created impoundment which will be unsuitable for riverine specialists like the ringed map turtle and more favorable to generalist turtle species such as the red-eared slider. The ringed map turtles present in the Action area once the lake is created are expected to either move into suitable habitats upstream and downstream of the lake or remain in the lake during their life but not successfully reproduce, similar to the small remanent population of ringed map turtles found within Pelahatchie Creek and Ross Barnett Reservoir. Therefore, we anticipate take in the form of harm (lethal) to up to 90% of ringed map turtles from the construction of the weir and lake (estimated at 1,516 individuals for Alt C and 1,196 for Alt D). There is also the potential for all existing nests to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season; potentially destroying 461 eggs for Alternative C and 364 eggs for Alterative D.

Finally, we anticipate as many as 4,974 turtles from RM 301.77 to RM 282.4 for Alternative C; and 4,717 turtles occur from RM 301.77 to RM 283.4 for Alternative D taken in the form of harm (nonlethal) due to the temporary competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

6.4. Cumulative Effects on the Ringed Map Turtle

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. At this time, the Service is unaware of any future state, tribal, local, or private non-Federal actions scheduled to occur in the Action area. Therefore, cumulative effects are not relevant to formulating our pinion for the Action.

6.5. Conclusion for the Ringed Map Turtle

In this section, we summarize and interpret the findings of the previous sections for the ringed map turtle (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or

b) result in the destruction or adverse modification of designated critical habitat. "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

The ringed map turtle is primarily restricted to the main channels of the Pearl, Strong, Bogue Chitto, and Bogue Falaya Rivers in Mississippi and Louisiana, although it can inhabit downstream sections of smaller tributaries (e.g., Bogue Lusa Creek, Silver Creek). The total coarse population estimate is approximately 82,750 individuals across the species' range. The Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) represents 10.5 percent of the turtle's range having approximately 23 percent of the turtle's range wide abundance.

However, we do not anticipate adverse impacts to the species below 1.6 miles of the new weir for Alternatives C and D, therefore, our analysis focuses on the impact to ringed map turtles from RM 301.77 to 282.4 (1.6 miles below the proposed Alternative C weir).

<u>Construction of Channel Improvements</u> (Alternatives C, D, and E) may result in the destruction of up to 92 eggs if work is done during the nesting season. We do not anticipate death to adults to occur as result of the channel improvement activities, however, all turtles within the limits of channel improvement activities could be impacted by noise and other disturbances that alter normal feeding, nesting, and basking behavior, or force turtles to flee the project area upstream and downstream. We anticipate once channel improvements are complete for Alternative E, this 9-mile section of river may see up to a 57 percent reduction to the current ringed map turtle population and will be similar to population estimates for a four-mile impaired stretch of the river within the Action area. However, these adverse effects could be minimized by efforts to reforest the excavated channel overbank areas and the placement and maintenance of basking and foraging material within the channel of the Pearl River. Such efforts could possibly raise the post-channel improvement population estimates for Alternative E to near pre-project levels.

<u>Construction of the Weir and Impoundment</u> (Alternatives C and D only) will result in the harm (lethal) to 90% of ringed map turtles remaining in the new lake (1,516 individuals for Alt C, 1,196 for Alt D) due to a significant reduction in food sources, basking habitat, and nesting habitat. There also exists the potential for all existing nests and eggs (461 eggs for Alternative C; 364 eggs for Alternative D) to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season. Finally, we anticipate as many as 4,974 turtles from RM 301.77 to RM 282.4 for Alternative C; and 4,717 turtles from RM 301.77 to RM 283.4 for Alternative D will be taken in the form of harm (nonlethal) due to the competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

Approximately 9.5 and 7.5 river miles of ringed map turtle habitat would be altered from lotic to lentic habitat as a result of channel modifications and creation of a lake (i.e., construction of the weir and impoundment) for Alternatives C and D, respectively. This represents approximately 1.3 percent of the species range. We anticipate once channel improvements AND weir construction are complete, the 7.5- 9.5-mile impounded section of river will see up to a 90 percent reduction to the current ringed map turtle population and will be similar to population estimates for oxbow lakes and the relict Pelahatchie Bay population.

After reviewing the current status of the ringed map turtle, the environmental baseline for the Action area, and the effects of the Action, it is the Service's biological opinion that implementation of the Action is not likely to jeopardize the continued existence of the ringed map turtle. No critical habitat has been designated for this species; therefore, none will be affected.

7.0. PEARL RIVER MAP TURTLE

This section provides the Service's biological opinion of the Action for the Pearl River map turtle.

7.1. Status of Pearl River Map Turtle

This section summarizes best available data about the biology and condition of the Pearl River map turtle (*Graptemys pearlensis*) throughout its range that are relevant to formulating an opinion about the Action. The Service published a final rule to list the Pearl River map turtle as threatened on July 12, 2024 (89 FR 57206-57236).

7.1.1. Species Description

The Pearl River map turtle (*Graptemys pearlensis*) inhabits rivers and large creeks with sand and gravel bottoms in the Pearl River drainage in Mississippi and Louisiana (Lindeman 2013). The species was separated from the Pascagoula map turtle (*Graptemys gibbonsi*) in 2010 (Ennen et al. 2010), shortly after *G. gibbonsi* was petitioned for federal listing under the ESA, as a part of the 2010 Petition to List 404 Aquatic, Riparian and Wetland Species from the Southeastern United States by the Center for Biological Diversity (CBD 2010).

Map turtles (genus *Graptemys*) are named for the intricate pattern on the carapace that often resembles a topographical map. In addition to the intricate pattern, the shape of the carapace (top half of shell) in map turtles is very distinctive. The carapace is keeled, and many species show some type of knobby projections or spikes down the vertebral scutes (located down the midline of the carapace). Marginal scutes (located along the edge of the carapace) are also serrated and this trait is most pronounced in the three species of closely related microcephalic (small-headed) map turtles, including the black-knobbed map turtle (*G. nigrinoda*), ringed map turtle (*G. oculifera*), and yellow-blotched map turtle (*G. flavimaculata*). Among the megacephalic clade of map turtles, these traits are present but less pronounced in adults (Lovich and McCoy 1992). The megacephalic clade of map turtles includes the Pascagoula map turtle, Barbour's map turtle (*G. barbouri*), the Escambia map turtle, the Pearl River map turtle, and the Alabama map turtle. This group has the largest adult female body size and greatest degree of sexual dimorphism in the genus *Graptemys*, with adult females being over two times the carapace length of adult males on average. Megacephalic map turtles are defined by the following combination of characteristics (Lovich and McCoy 1992).

1. Large female size reaching 11.6 to 13.0 inches (in) (29.5 – 33.0 centimeters (cm)) in maximum carapace length;
2. Extreme sexual dimorphism in adults, SDI ([sexual dimorphism index], size of larger sex divided by size of smaller sex, Gibbons and Lovich 1990) is 2.42 – 2.58;
3. Head is broad, particularly in adult females, with greatly expanded alveolar surfaces (flattened surfaces for crushing; turtles do not have teeth) of jaws;
4. Head pattern consists of an interorbital blotch (between the eyes on the dorsal surface of the head) and large postorbital blotches (posterior to the eye); and
5. Vertebral scutes with salient spines.

Additional information can be found at https://ecos.fws.gov/ecp/species/10895.

7.1.2. Life History

Reproduction: Information on Pearl River map turtle reproductive biology is lacking; we have little information on species specific clutch frequency, age of maturity, and other reproductive parameters. Pearl River map turtles excavate nests and lay their eggs on sandbars and beaches along riverbanks during the late spring and early summer months. Nesting locations may also include steep outer-bend cutbanks (L. Pearson, pers. obs.). Typically, male map turtles mature in 2-3 years, while females mature much later, around 9 years of age (Lindeman 2013; Vogt et al. 2019).

Nesting habitat: At a beach on the Pearl River downstream of the Strong River, a nest was found in fine sand 82 feet (ft) from the water (Vogt et al. 2019). Three confirmed Pearl River map turtle nests found on sandbars along the Pearl River were dug in relatively fine sand ranging from 23-180ft from the water's edge and averaging 5.2ft from the closest vegetation (Ennen et al. 2016). Another account states that nests are typically near the vegetation lines of sandbars (Anderson 1958). One nest found on the Pearl River upstream of Columbia included four eggs and was laid on a steep outer-bend cutbank consisting of a clay/sand mixture (L. Pearson, pers. obs.).

Diet: The diet of the Pearl River map turtle varies between females and males, and females grow proportionally larger heads and jaws as they age. A recent study on fecal samples of Pearl River map turtles found that mature females consume mostly Asian clams (*Corbicula fluminea*), while males and unsexed juveniles eat insects, with mature males specializing in caddisfly larvae and consuming more mollusks than juveniles (Vučenović and Lindeman 2021).

Basking: An early account with combined data for Pearl River map turtles and Pascagoula map turtles of all sizes suggested that the turtles select logs or debris emerging from deep water as basking structures and dive into the water at the slightest disturbance (Cagle 1952), but demographic differences in basking behavior have not been studied in Pearl River map turtles. Recent surveys indicate that Pearl River map turtles prefer basking on logs or deadwood with a diameter greater than 20 cm (70% of observations), with more turtles preferring these logs at angles less than 45 degrees (Devros et al. 2023).

Predators: Little has been documented on predators of this species. American alligators (*Alligator mississippiensis*) and humans are the only significant predators of mature individuals (Ennen et al. 2016), and human persecution by shooting basking turtles has been related to local population reduction in some turtle populations (Marion 1986; Buhlmann and Gibbons 1997).

Habitat: Pearl River map turtles occur in sand and gravel-bottomed rivers and creeks with dense accumulations of deadwood; they have not been documented in oxbow lakes or other floodplain habitats. They were notably absent from lakes where their sympatric microcephalic species, the ringed map turtle, is present (Selman 2020), but do occur at the upstream reach of Ross Barnett Reservoir, an impoundment of the Pearl River (Lindeman 2013), albeit at very low densities (Selman and Jones 2017).

Emergent deadwood serves as thermoregulatory basking structure, foraging structure for males and juveniles (Selman and Lindeman 2015, and as an overnight resting place for males and juveniles (Cagle 1952). Moderate-to-high basking densities of Pearl River map turtles were always associated with moderate-to-high deadwood densities, but some sites with ample deadwood structure did not have high densities of basking map turtles, indicating that those sites may lack other important characteristics (Lindeman 1999).

Pearl River map turtles have been observed in several streams that were thought to be too shallow or narrow for the genus *Graptemys* by previous researchers (McCoy and Vogt 1979; Selman et al. 2009) and this indicates a potential difference in habitat selection. While the Pearl River map turtle is present near the same dense accumulations of deadwood and large sandbars as the ringed map turtle, the Pearl River map turtle ranges farther upstream into smaller tributaries (Lindeman 2013) and notable differences in relative abundance between the two species have been documented in specific streams on several occasions (Devros et al. 2023). Pearl River map turtle density was greater on mainstem reaches and large tributaries than on small tributaries, but they were outnumbered by ringed map turtles in mainstem reaches (Lindeman et al. 2020). A suggested explanation for the difference in tributary tolerance between Pearl River map turtles and ringed map turtles is dietary requirements; ringed map turtles graze on algae, sponges, and other invertebrates on submerged deadwood, a community that is sunlight dependent, while Pearl River map turtles rely more heavily on benthic mussels that may be more tolerant of shaded tributary streams (Lindeman et al. 2020).

Accounts from before the Pearl River map turtle and Pascagoula map turtle were taxonomically divided described ideal habitat as rivers and creeks with sand or gravel bottoms, abundant basking structures, and swift currents (Lovich 2009; USFWS 2006).

7.1.3. Numbers, Reproduction, and Distribution

The Pearl River map turtle is endemic to the Pearl River drainage in Mississippi and Louisiana. The occupied range of the Pearl River map turtle includes portions of the Pearl River, West Pearl River, Bogue Chitto, East Pearl River, Yockanookany River, Strong River, Holmes Bayou, Pearl River Navigation Canal, Lobutcha Creek, Tuscolometa Creek, Pelahatchie Creek, Purvis Creek, Pushepatapa Creek, Topisaw Creek, Magees Creek, Hobolochitto Creek, and West Hobolochitto Creek.

This species has also been reported in upper reaches of the Ross Barnett Reservoir (where conditions are more lotic and less lentic) and has never been observed in any lentic waterbody. It is likely that the species will be discovered in smaller creeks in the future but at low population densities (W. Selman, pers. comm. 2020b).

The global population wis estimated to be 21,841 individuals, with 61% occurring on mainstem reaches, 34% occurring in four large tributaries, and the remaining 5% spread amongst other smaller tributaries (Lindeman et al. 2020). Generally, abundance of the species declined with the size of the river reach surveyed, where tributaries generally had lower numbers of turtles compared to mainstem reaches (Lindeman et al. 2020).

Forty-nine percent (49%) of the total range occupied by the Pearl River map turtle is in the mainstem Pearl and West Pearl rivers, with the remaining 51% of the occupied range found in various tributary systems (Lindeman et al. 2020). Tributary populations have been shown to be less densely populated compared to mainstem populations, although some tributaries (e.g., Bogue Chitto River, Strong River) contain relatively large populations of Pearl River map turtles, including some that have only recently been discovered. For example, the species was first found in Yockanookany River in 1994, and extensive upstream range extensions have now been reported in several tributary systems, including Yockanookany River, Strong River, and Bogue Chitto River (Lindeman 1998; Lindeman 2013; Lindeman et al. 2020); these three tributaries together are inhabited by nearly one-third of the entire species, with nearly half occurring in stretches not known to be part of the species' range prior to the 21st century (Lindeman et al. 2020).

7.1.4. Conservation Needs and Threats

For the Pearl River map turtle to survive and reproduce, individuals need suitable habitat that supports essential life functions at all life stages. Several elements appear to be essential to the survival and reproduction of individuals: mainstem and tributary reaches within the Pearl River drainage that have sandbars, adequate flow, adequate supply of invertebrate prey items including insects and mollusks, an abundance of emergent and floating basking structures of various sizes, and sand or gravel substrates.

Long-term viability will require resilient populations to persist into the future; for the Pearl River map turtle, this will mean maintaining quality tributary and mainstem habitat and water quality to support many redundant populations across the species range, while preventing barriers to dispersal between populations such as dams or impoundments.

The following discussion provides a summary of the factors that have historically affected the species and are affecting or could be affecting the current and future condition of the Pearl River map turtle throughout some or all of its range.

Climate Change: In the southeastern United States, climate change is expected to result in a high degree of variability in climate conditions with more frequent drought, more extreme heat (resulting in increases in air and water temperatures), increased heavy precipitation events (e.g., flooding), more intense storms (e.g., frequency of major hurricanes increases), and rising sea level and accompanying storm surge (IPCC 2013). Warming in the southeast is expected to be greatest in the summer, which is predicted to increase drought frequency, while annual mean precipitation is expected to increase slightly, leading to increased flooding events (IPCC 2013; Alder & Hostetler 2013). This variability in climate may affect ecosystem processes and communities by altering the abiotic conditions experienced by biotic assemblages resulting in potential effects on community composition and individual species interactions (DeWan et al. 2010). These changes have the potential to impact Pearl River map turtles and/or their habitat.

Water Quality: Degradation of stream and wetland systems through reduced water quality and increased concentrations of contaminants can affect the occurrence and abundance of freshwater turtles (DeCatanzaro and Chow-Fraser 2010). Infrastructure development increases the percentage of impervious surfaces, reducing and degrading terrestrial and aquatic habitats.

Increased water volume and land-based contaminants (e.g., heavy metals, pesticides, oils) flow into aquatic systems, modifying hydrological and sedimentation regimes of rivers and wetlands (Walsh et al. 2005). Sedimentation and pollution can have adverse impacts on mollusk populations that the Pearl River map turtles prey upon (Vučenović and Lindeman 2021). A wide range of current activities and land uses can lead to sedimentation within streams that can include agricultural practices, construction activities, stormwater runoff, unpaved roads, forestry activities, utility crossings, and mining.

Channel and Hydrology Modifications and Impoundments: Stream channelization, point-bar mining, and impoundments have been listed as potential threats in a report from before the Pascagoula map turtle and Pearl River map turtle were taxonomically separated (USFWS 2006). Channel modification is recognized as a cause of decline in the ringed map turtle, a sympatric endangered species (Lindeman 1998). Considerably low densities of Pearl River map turtles were observed in the lower reaches of the Pearl, where much channelization and flow diversion has occurred (Lindeman et al. 2020).

Within the upper Pearl River drainage, the Ross Barnett Reservoir was constructed between 1960 and 1963 to provide a water supply for the City of Jackson and the associated area, as well as recreational opportunities on the 33,000 ac (13,355 ha) lake and the 17,000 ac (6,880 ha) surrounding it (Pearl River Valley Water Supply District 2020, entire). A total of 20.9 rm (33.6 km) of the Pearl River is submerged beneath the Ross Barnett Reservoir, which has 38.2 rm (61.5 km) of shoreline (Lindeman et al. 2020). Pearl River map turtles have not been observed in the Ross Barnett Reservoir or any other lentic system. Low population densities of Pearl River map turtles have been observed upstream of the Ross Barnett Reservoir, possibly due to recreational boating and extended recreational foot traffic or camping on sandbars by reservoir visitors (Selman and Jones 2017). Additionally, the change from a riverine to lentic habitat can impact freshwater mollusk populations, as seen in the heavily altered Tombigbee River system (Hamstead et al. 2019), and these mollusks are a primary prey item of Pearl River map turtles (Vučenović and Lindeman 2021).

Agriculture: Agricultural practices such as traditional farming, feedlot operations, and associated land use practices can contribute pollutants to rivers. These practices degrade habitat by eroding stream banks, which results in alterations to stream hydrology and geomorphology. Nutrients, bacteria, pesticides, and other organic compounds are generally found in higher concentrations within agricultural rather than forested areas. Contaminants associated with agriculture (e.g., fertilizers, pesticides, herbicides, and animal waste) can cause degradation of water quality and habitats through instream oxygen deficiencies, excess nutrification, and excessive algal growths, with a related alteration in aquatic community composition (Petersen et al. 1999).

Urbanization: Urbanization is a significant source of water quality degradation that can reduce the survival of aquatic organisms. Urban development can stress aquatic systems by altering stream morphology and water chemistry, increasing the frequency and magnitude of high flows, and increasing sedimentation rates, nutrient loads, contamination, and toxicity in streams, all of which decrease diversity of fish, aquatic insects, plants, and amphibians (Coles et al. 2012; CWP 2003).

Mining: Impacts of sand and gravel mining can be direct or indirect. Direct impacts include physical changes to the river system and the removal of gravel and floodplain habitats from the system. Indirect impacts include shifting of habitat types due to channel and sedimentation changes; changes in water quality, which change the chemical and physical conditions of the system; and hydraulic changes which can impact movement of species and habitat availability.

7.2. Environmental Baseline for Pearl River Map Turtle

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Pearl River map turtle, its habitat, and ecosystem within the Action area. The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action area, the anticipated impacts of all proposed Federal projects in the Action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.

7.2.1. Action Area Numbers, Reproduction, and Distribution

Recent surveys by Selman (2020) provide a current estimate of the number and status of Pearl River map turtles in the Action area. Pearl River map turtles were found throughout all reaches of the Pearl River within the Action area, but in low basking densities (0.4-3.2/rkm). Pearl River map turtles were absent from all oxbow lakes surveyed. The mean number of Pearl River map turtles observed for all stretches surveyed was 7.2 turtles per survey with densities averaging 1.4/rkm. These densities fall within most previously reporting basking densities for the Pearl River map turtle (range 0-7 per rkm) with only a few sites having densities exceeding Selman's observations (range 10-52.5: Columbia, Monticello, White Bluff, Selman and Jones 2017, Devros et al. 2023; portions of the Bogue Chitto River, Shively 1999). Selman also indicated that this population has undergone a significant population decline since the 1980's (Selman and Jones 2017). Selman postulated that water quality and riverine regulation at the Ross Barnett Reservoir may have likely impacted prey item presence and availability; and that localized extinctions are higher in small populations like Pearl River map turtle due to environmental and demographic stochastic events.

The Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) represents 10 percent of the turtle's range having approximately 10 percent of the turtle's range wide abundance. However, we do not anticipate adverse impacts to the species below 1.6 miles of the new weir for Alternatives C and D, therefore, our analysis focuses on the impact to Pearl River map turtles from RM 301.77 to 282.4 (1.6 miles below proposed Alternative C weir), representing 2.4 percent of the turtle's range.

Because no in-depth reproductive assessments have been conducted for the Pearl River map turtle, nest and egg numbers were estimated using available, albeit limited, information. It is estimated that 93 Pearl River map turtles are within the project study area (approximately 10 miles of channel improvements for Alt C), with 26% of these turtles being female based on sex ratios observed during basking counts (Selman 2020). We also assume that a minimum of 60% of females are gravid per year (see Jones 2006), which leads to approximately 13.7 Pearl River map turtles gravid per year. The mean clutch size is approximately 6.4 eggs, with approximately two clutches laid annually (Vogt et al. 2019). This totals approximately 27.4 nests and 175 eggs laid within the project study area. Assuming that predation rates are similar to the ringed map turtle, only 14% of nests would survive (4 nests; 26 eggs), and 24% of the above-mentioned intact eggs would be predated by insects, leaving approximately 20 eggs that are likely to hatch.

Selman (20202) used basking density surveys along with basking frequency data from two *Graptemys* species found in the Pascagoula River to estimate population size within the project study area (Selman and Qualls 2011; Selman and Lindeman 2015). Selman (2020) used correction factors of 10 and 15 percent of the basking population observed to estimate the potential range of turtles missed by such surveys. The Service used the mid-point between Selman's ranges (i.e., 12.5 percent) as a reasonable method to estimate potential numbers upstream and downstream of the project area. The Service also used survey results from Selman (2020) to determine the number of turtles within the 10-mile project area. Based on Selman's (2020) calculations, an estimated 93 Pearl River map turtles potentially exist in the area that could be impacted by Alternative C. Upstream and downstream of the project area, the Service estimated approximately 159 and 66 turtles, respectively (225 total; see Selman 2020, Devros et al. 2023). In summary, we estimate a total of approximately 318 turtles occur from RM 301.77 to RM 282.4 (Ross Barnett Reservoir to 1.6 miles below Alternative C weir; 159 turtles upstream, 93 turtles within Alt C footprint, and 66 downstream).

Selman (2020) used information from two *Graptemys* species to develop the potential number of turtles in the project study area. The use of surrogate species is common in conservation biology, particularly when implementing the ESA where needed data may not be available or is difficult to collect. Selman's use of a "correction factor" to determine population size within the project area is based off the peer-reviewed Selman and Qualls (2011) basking behavior study of an ecologically similar species (*Graptemys gibbonsi*, Pascagoula map turtle) within the Pascagoula River. The Pearl River map turtle was only designated as a separate species from the Pascagoula map turtle in 2010, indicating that these two species have very similar morphological and life-history traits. When lacking actual data for a species, we will use the best available information often from a surrogate species (Murphy & Weiland 2014; Caro 2010); Service policy on using surrogate species can be found in Final Rule 80 FR 90 26832-26845. Throughout this BO, the Service has relied upon existing information about the Pearl River map turtle as much as possible; however, when information is deficient or absent, the Service first examined literature regarding other *Graptemys* species, and then other aquatic turtle species to provide the best possible assessment of impacts to the subject species and its habitat.

7.2.2. Action Area Conservation Needs and Threats

We anticipate that the conservation needs and threats to the Pearl River map turtle in the Action are similar to those of the ringed map turtle. Please refer to 6.2.2. regarding the conservation needs and threats to the ringed map turtle.

7.3. Effects of the Action on Pearl River Map Turtle

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the Action area.

We expect the effects of the action on Pearl River map turtle to be similar to the effects on the ringed map turtle. Please see 6.3 for more information.

The only exception when comparing effects to the Pearl River map turtle verses the ringed map turtle is in how the impoundment is expected to impact each species. Limited numbers of ringed map turtles have been documented in the oxbows adjacent to the Pearl River and in a small tributary to the Ross Barnett Reservoir, indicating their ability to survive, albeit in low numbers, in such lentic conditions. However, no Pearl River map turtles were detected in these same areas (Selman 2020). Therefore, Pearl River map turtles appear to be more sensitive to the conversion of riverine conditions to lake-like conditions. Accordingly, we anticipate the effects of the weir construction and subsequent impoundment to be more pronounced on the Pearl River map turtle population. Once weir and impoundment construction are complete, we anticipate the remaining Pearl River map turtles will move into suitable habitat upstream or downstream of the new lake, and the 7.5-9.5 miles of new impoundment will become unsuitable for Pearl River map turtles.

7.3.1. Effects of Channel Improvements on the Pearl River Map Turtle

Channel improvements include excavating areas of the floodplain (overbank areas) within the Action area in order to lower the floodplain and improve flood capacity (Note: the Pearl River will not be directly impacted, therefore, we do not anticipate direct adverse effects to adults found within the river). The acreage of excavation and amount of material to be removed varies between Alternative C, D, and E. This excavation would occur from RM 284-294 for Alternative C (10 miles) and RM 285-294 for Alternative’s D and E (9 miles).

To decrease sedimentation from the construction site and allow most excavation to occur in a dry environment, excavation of areas away from the riverbank could occur first. This would leave the riverbank and an additional adjacent area separating the river from the excavation area undisturbed. This buffer area would reduce the likelihood of disturbing basking turtles or turtles attempting to nest and would reduce the potential of having nesting sites located within ongoing work areas. Therefore, we do not anticipate the direct killing of adult turtles related to ground disturbance resulting from channel improvement activities (i.e., overbank excavation outside the river channel). However, we can expect some level of harm (nonlethal) due to noise and other disturbances that may alter normal turtle feeding, basking and nesting activities during the period when overbank excavation is occurring. Some turtles may migrate upstream or downstream to avoid areas with heavy noise and other human disturbance due to construction activities.

Disturbance during basking and nesting by channel improvement activities and the reduction of food sources due to increased turbidity can result in the decreased health of turtles (Chen and Lue 2009; Heppard and Buchholz 2019). All turtles in the channel improvement construction area (up to 93 estimated) would likely experience these effects temporarily during the two-year construction period. If turtles move from the construction area into areas already inhabited, the potential for crowding with concurrent increased stress and competition for food and habitat could affect their health, survival, and reproduction (Chen and Lue 2009). These temporary effects would be felt by all turtles in the channel improvement area (estimated 93 for Alt C and 84 for Alt D and E).

During channel improvement activities, nests found above top bank of the river would be destroyed if work were to occur during the nesting season (May-October). The Service estimates that up to 20 percent of nests could be found in overbank habitat away from the river, as the majority would be expected to be laid on sandbars and below top bank of the river. However, once the 86 percent predation rate of nests and the 24 percent predation rate of eggs by insects are applied, only approximately 20 eggs are likely to hatch. Therefore, assuming this to be the total number of eggs potentially found within the channel improvement areas that successfully hatch, then 20 percent would represent 4 eggs that could be harmed (lethal) by the channel improvement activities.

We anticipate that once excavation is complete for Alternative E, the 9-mile stretch of river receiving channel improvements will have similar habitat quality as the four miles of river within the Action area that currently has limited wooded bank line, basking habitat, and a reduced Pearl River map turtle population. The current population estimates for this four mile stretch is 20.5 turtles (5.1 turtles/rmi [3.2 turtles/rkm]) (Selman 2020), the estimated population in the remaining 5 miles is 63.5 turtles, and the total current population of the entire 9 miles of proposed channel improvements is 84 (avg of 9.3 turtles/rmi). Therefore, we anticipate the long-term effects of Alternative E will be an estimated 45 percent reduction in the Pearl River map turtle population within the channel improvement portion of the Action area (from an estimated 84 turtles pre-project to 46 turtles post-project).

However, these adverse effects could be minimized for Alternative E by efforts to reforest the excavated channel overbank areas and the placement and maintenance of basking and foraging material within the channel of the Pearl River. Such efforts could possibly raise the post-channel improvement population estimates for Alternative E to near pre-project levels.

7.3.2. Effects of Weir Construction and Impoundment on Pearl River Map Turtle

The establishment of a 1,700 (Alt D) to 2562-acre (Alt C) impoundment from weir construction will result in changes in the velocity and water surface elevation within the project area. The June 2024 USACE BA states that the current lotic (i.e., riverine) habitat would be replaced with lentic (lake-like) habitat which has been proven by the Ross Barnett Reservoir to not support the persistence of the Pearl River map turtle. The riparian zone would be almost eliminated, and development is likely for most areas of fill surrounding the new lake. There also exists the potential for existing nests to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season (DEIS 2024). See 6.3.2. for a more detailed analysis of these effects.

Based on this information, we estimate the activities associated with the weir construction and associated impoundment will result in all turtles from RM 284-293.5 for Alternative C and RM

286.5-294 for Alternative D being harmed by the reduction in food sources and competition from generalist turtle species such as the red-eared slider. There are currently no records of Pearl River map turtles from the Ross Barnett Reservoir, Pelahatchie Bay, or the oxbows along the Pearl River within the Action area (Selman 2020). This is unlike the ringed map turtle where small populations of those turtles exist. Therefore, we anticipate the long-term effects of weir construction and impoundment will be the elimination of the Pearl River map turtle population (88 individuals for Alt C, 70 for Alt D) within the weir impoundment (i.e., lake).

Finally, there also exists the potential for all existing nests to be flooded during filling of the pool area if this occurs during the May to October nesting season. We estimate approximately 27.4 nests, and 175 eggs could be found yearly within the project study area. However, once the 86 percent predation rate of nests and the 24 percent predation rate of eggs by insects are applied, we estimate only 20 eggs (Alt C) are likely to hatch. Therefore, we estimate up to 20 eggs for Alternative C and 16 eggs for Alternative D could be harmed (lethal) due to flooding of nests during the nesting season.

We also anticipate as many as 318 turtles from RM 301.77 to RM 282.4 for Alternative C; and 302 turtles occur from RM 301.77 to RM 283.4 for Alternative D being harmed due to the competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

7.3.3. Effects of Non-Federal Activities caused by the Federal Action on Pearl River Map Turtle

Recreational water sports (e.g., fishing, boating) will likely increase within the impoundment of Alternative C and D, as well as the Lakeland area upstream of the impoundment, as a result of improved access to the Action area. This could lead to greater disturbance in basking and nesting behaviors with resulting declines in health and nesting success (Heppard and Buchholz 2019; Selman et al. 2013). Boat wakes can cause shelving of sandbars resulting in turtles nesting in areas closer to the water surface (Selman et al. 2013) which in turn could result in the flooding of turtle eggs and mortality. Efforts to create no-wake zones and restricted access to sandbars for the yellow-blotched map turtle on the Pascagoula River have had limited success due to the lack of enforcement capabilities by the MDWFP (Pearson, pers obs). Because the Service does not know the rate and degree to which recreation will increase, we are unable to estimate the number of nests and individuals potentially impacted. Mortality resulting from boat strikes could also impact the population (Carriere and Blouin-Demers 2010; Selman et al. 2013; Smith et al. 2018). Because larger turtles use deeper water habitats and are typically females, they have an increased potential of being killed, thus reducing their future contribution to the population (Selman et al. 2013; Smith et al. 2018).

Increased development adjacent to the improved channel could also lead to a decrease in water quality impacting food resources in the improved channel; however, the Service is unable to estimate the rate and degree to which this will occur.

Activities that would not occur but for the proposed Federal action include relocation or retrofitting of existing infrastructure within the Action area (i.e., roads, bridges, pipelines, powerlines), riverfront access and development. Effects resulting from these activities would include the temporary disturbance to basking, foraging, and nesting activities. In addition, temporary and localized increases in turbidity and sedimentation may result in impacts to forage species.

7.4. Cumulative Effects on Pearl River Map Turtle

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. At this time the Service is unaware of any future state, tribal, local, or private non-Federal actions scheduled to occur in the Action area. Therefore, cumulative effects are not relevant to formulating our pinion for the Action.

7.5. Conclusion for Pearl River Map Turtle

In this section, we summarize and interpret the findings of the previous sections for the Pearl River map turtle (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.
  "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

The Pearl River map turtle is endemic to the Pearl River drainage in Mississippi and Louisiana. The global population is estimated to be 21,841 individuals, with 61% occurring on mainstem reaches, 34% occurring in four large tributaries, and the remaining 5% spread amongst other smaller tributaries (Lindeman et al. 2020). The Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) represents 10 percent of the turtle's range having approximately 10 percent of the turtle's range wide abundance. However, we do not anticipate adverse impacts to the species beyond 1.6 miles downstream of the new weir for Alternatives C and D, therefore, our analysis focuses on the impact to Pearl River map turtles from RM 301.77 to 282.4 (1.6 miles below proposed Alternative C weir), representing 2.4 percent of the turtle's range.

<u>Construction of Channel Improvements</u> (Alternatives C, D, and E) may result in the destruction of up to four eggs if work is done during the nesting season. We do not anticipate death to adults to occur as result of the channel improvement activities, however, all turtles within the limits of channel improvement activities could be impacted by noise and other disturbances that alter normal feeding, nesting, and basking behavior, or forces turtles to flee the project area upstream and downstream. We anticipate once channel improvements are complete for Alternative E, this 9-mile section of river receiving channel improvements will see up to a 45 percent reduction to the current Pearl River map turtle population within the Action area and will be similar to population estimates for a four-mile impaired stretch of the river within the Action area. However, these adverse effects could be minimized by efforts to reforest the excavated channel

overbank areas and the placement and maintenance of basking and foraging material within the channel of the Pearl River. Such efforts could possibly raise the post-channel improvement population estimates to near pre-project levels.

Construction of the Weir and Impoundment (Alternatives C and D only) will result in the harm (lethal) to all Pearl River map turtles remaining in the new impoundment (88 individuals for Alternative C; 70 for Alternative D) due to a significant reduction in food sources, basking habitat, and nesting habitat. There also exist the potential for all existing nests and eggs (up to 20 eggs for Alternative C; 16 eggs for Alternative D) to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season. Finally, we anticipate as many as 318 turtles from RM 301.77 to RM 282.4 for Alternative C; and 302 turtles occur from RM 301.77 to RM 283.4 for Alternative D taken in the form of harm (nonlethal) due to the temporary competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

Approximately 7.5-9.5 river miles (roughly 1 percent of the species' range) of Pearl River map turtle habitat would be altered from lotic to lentic habitat as a result of channel modifications and creation of an impoundment. We anticipate that as a result of weir construction and impoundment, there will be an eventual complete elimination of the Pearl River map turtle population within the 7.5-9.5-mile impoundment (i.e., lake).

After reviewing the current status of the Pearl River map turtle, the environmental baseline for the Action area, and the effects of the Action, it is the Service's biological opinion that implementation of the Action is not likely to jeopardize the continued existence of the Pearl River map turtle. No critical habitat has been designated for this species; therefore, none will be affected.

8.0 ALLIGATOR SNAPPING TURTLE

This section provides the Service's conference opinion of the Action for the alligator snapping turtle.

8.1. Status of Alligator snapping turtle

This section summarizes best available data about the biology and condition of the alligator snapping turtle (*Macrochelys temminckii*) (AST) throughout its range that are relevant to formulating an opinion about the Action.

AST was proposed for listing on November 9, 2021, as federally threatened (86 FR 62434-62463). The Service also proposed a Section 4(d) rule which provides conservation for AST by prohibiting the following intentional take activities, except as otherwise authorized or permitted: importing, exporting or possession and other acts resulting in unlawfully taken specimens from any source; delivering, receiving, transporting, or shipping wild caught individuals in interstate or foreign commerce in the course of commercial activity; and selling or offering for sale wild caught individuals in interstate or foreign commerce. The proposed 4(d) rule further provides for AST conservation by prohibiting the following take activities that are incidental to otherwise lawful actions, except as otherwise authorized or permitted: take resulting from commercial or recreational fishing bycatch and take resulting from habitat alteration and/or activities that reduce the amount of or access to habitat, especially nesting habitat for female turtles. Section 4(a)(3) of the ESA requires the Secretary of the Interior (Secretary) to designate CH concurrent with listing to the maximum extent prudent and determinable. While the proposed rule states that the designation of CH may be prudent, the extent to which the identification and mapping of CH would affect AST is unknown and therefore not determinable at this time. The map of current occurrences (2000 to present) for AST was published in December 2022.

8.1.1. Species Description

ASTs are the largest species of freshwater turtle in North America that occurs in the watersheds flowing into the Gulf of Mexico from northern peninsular Florida and western Georgia to northeast Texas; and inland watersheds flowing from the Mississippi to the Ohio River drainage from Missouri and southern Illinois to Louisiana (Pritchard 1989; Lovich 1993). Sexually mature adults are greater than 330 mm carapace length (CL), large juveniles (subadults) are greater than 180 mm CL, small juveniles are less than 180 mm CL, and hatchlings (those turtles less than one year old) are an average size of 37.4 mm CL.

This species is fully aquatic, with overland movements generally restricted to nesting females and hatchlings moving from the nest to water. The minimum home range of this species varies between 44 to 610 ac (Sloan and Taylor 1987). The linear home range of this species from Louisiana study was reported between 0.88 mi to 2.17 mi (Harrel et al. 1996). One Texas study reported similar findings where adult females averaged both greater movement distances and total observed home range (0.43 to 2.63 mi) than adult males (0.18 to 1.42 mi) (Munscher et al. 2021). However, home range size seems to vary based on habitat type and quality (see Cozad et al. 2023), with long-distance movements of up to 15 miles in six weeks observed in western Mississippi (P. Delisle, pers. comm. 2023).

8.1.2. Life History

Juveniles and hatchling turtles, occupy shallower water habitats than adults and have less ability to move overland during environmental disturbances, where they may be exposed to higher predation threats from raccoons and other small mammals. Adult and large juvenile AST can inhabit a wide range of aquatic habitats but are generally found in the deeper waters of rivers and their major tributaries to meet their thermoregulatory needs to stay cool during warmer seasons. However, they can also be found in small streams, bayous, canals, swamps, lakes, ponds, and oxbows. Small juveniles and hatchlings generally inhabit shallower water with woody canopy cover and/or structural cover like woody debris where they are less likely to become prey to aquatic predators (Spangler et al. 2021; Bass 2007).

Male and female ASTs reach sexual maturity in 11-21 years and 13-21 years, respectively (Ernst and Lovich 2009; Reed et al. 2002). Mating takes place underwater (Ernst and Lovich 2009) and has been observed in captive ASTs from February to October, but geographic variation among wild populations is not well understood (Reed et al. 2002). Females ovulate in spring and are thought to breed yearly, though poor foraging success may cause females to skip a breeding year. No more than one clutch per year per female has been observed in the wild and clutch sizes across the species' range vary from 9 – 61 eggs, with a mean of 27.8 eggs (Ernst and Lovich 2009). Nesting females usually represent the only adult life stage to venture onto land (Ernst and Lovich 2009). Previous studies indicate that females leave the water during the late night or early dawn hours and complete nesting during the day (Ernst and Lovich 2009). Most nesting activity for this species has been reported to occur between May and July (Reed et al. 2002), with areas in the southern part of the range (e.g., Georgia, Florida, and Louisiana) beginning in April and extending through May and areas in the north and western portion of the range, occurring between late May through June to early July (Ernst and Lovich 2009; Carr et al. 2010). Preliminary reproductive surveys in western Mississippi documented oviductal eggs observed via radiography on 17 April 2024, with first observed nesting occurring May 8, 2024, and ending last week of May (L. Pearson, pers. obs.).

8.1.3. Numbers, Reproduction, and Distribution

The range-wide abundance of AST is estimated to be between 68,154 and 1,436,825 (a range of 1,368,671). This enormous range in the estimated abundance illustrates the very high degree of uncertainty that exists in abundances at local sites and the ability to extrapolate local abundance estimates to a much broader spatial scale (SSA, 2021).

AST are associated with aquatic habitats like large rivers, major tributaries, bayous, canals, swamps, lakes, ponds, and oxbows (Service 2021). Typically, shallow water depths are occupied in early summer, and deeper depths are occupied in late summer and mid-winter, which indicates a thermoregulatory shift in habitat selection and use. When compared to adults, hatchlings and juveniles tend to occupy shallower water depths. AST are also associated with structure like tree root masses, stumps, and submerged trees, and may occupy areas with a high percentage of canopy cover or undercut stream banks. Most nesting occurs from April to May in the southern portion of the range and from late May to early July in the north and western portions of the range. Nest site selection is variable, and nests have been observed from approximately 8 to 656 ft (2.5 to 200 m) landward from the nearest water body (Service 2021).

AST were historically found in 14 states: Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Missouri, Mississippi, Oklahoma, Tennessee, and Texas. Currently, the species is known to occur in those states listed above except Indiana and Kansas. Due to the aquatic nature of the species, the AST is confined to river systems that flow into the Gulf of Mexico, extending from the Ochlockonee River in Florida to the northern extent of the Trinity River in Texas (Powell et al. 2016; Enge et al. 2023; Rosenbaum et al. 2023). In the Mississippi Alluvial Valley, those northern states with river systems flowing into the Mississippi River historically included Kansas (Lovich 1993), Missouri (Lescher et al. 2013), Illinois (Kessler et al. 2017), Indiana (Kessler and Dreslik 2021), and Kentucky (Baxley et al. 2014). In the Gulf Coastal Plain, its historical range extended from Oklahoma and eastern Texas to southern Georgia and northern Florida.

8.1.4. Conservation Needs and Threats

Historic threats from extensive overexploitation through commercial and recreational harvest in the last century resulted in significant declines of this species throughout much of its range, with recent, large-scale trapping industries operating in the mid-South (Dobie 1971; Sloan and Lovich 1995). Captive farm-raised turtles are allowed to be commercially harvested in Louisiana. Recreational harvest is still permitted for personal use with the restriction of one turtle per day per person or per vehicle in Louisiana, and one turtle over 24-inch carapace length per person per year in Mississippi.

The main threats facing AST across the range between the period of 2000 and 2023 are nest predation (Holcomb and Carr 2023), recreational bycatch and hook ingestion, illegal intentional harvest (including export for pet trade and international consumption), commercial bycatch by trot or limb lines, and habitat alteration (Shook 2020; Shook et al. 2023; Rosenbaum 2023). Although commercial and recreational regulatory restrictions have decreased the number of AST being harvested across the range (except for Louisiana and Mississippi), populations have not rebounded or responded to local state conservation measures. This lag in population response is likely due to any of the following factors: large size, slow growth rate, delayed sexual maturity (ranging from 11-21 years with average age of 17 years), low clutch size, low hatchling survivorship, large temporal intervals between reproduction, high adult survivorship, long life spans, ease in which individuals can be collected by hooking, and nest predation (fire ants, racoons, armadillos and other small mammals). Long generation times correspond to slower evolutionary changes and this species is less likely to adapt and persist in response to increased environmental changes (Rosenbaum 2021). This species' inability to maintain sustainable numbers increases its susceptibility to overexploitation and extirpation (Reed et al. 2002). Habitat alteration is considered a major threat to survival of all life stages of this species. Reduced water levels and temperature shifts within AST suitable habitat motivates these aquatic turtles to seek deeper water or move overland to adjacent aquatic habitats to maintain moisture and cool their bodies (Pearson et al. 2021; Enge et al. 2014). In a Florida study, during low water levels, important microhabitats such as undercut banks and woody debris associated with banks become less available and AST moved overland to submerged woody debris within river channels or woody wetlands (Enge et al. 2014). In this same study, during high water levels, AST used floodplains and were found to be more likely located under trees and among root systems (Enge et al. 2014). These turtles were also observed to repeatedly move between the floodplain and the river channel, making overland movements when these habitats were no longer connected by water. Although previous studies of AST indicated overland movement to be rare or absent (Prichard 2006), Enge et al. (2014) and Delisle et al. (2023) found AST will move over land to access suitable habitat when low water levels occur. In other studies, overland movement, prompted by habitat alterations, forced AST to traverse roads or railroad tracks, which decreased their chance of survival (Shook et al. 2023). Loss of woody canopy cover also reduces shading of suitable habitat, allowing sunlight to heat up the water and their body temperatures, which also prompts AST to move to other suitable habitat to maintain respiratory and circulatory functions.

AST can be killed or harmed incidentally during fishing and other recreational activities (Service 2021). Some of these threats from recreational and commercial fishing for other species include fishhook ingestion; drowning when hooked on trotlines (a fishing line strung across a stream with multiple hooks set at intervals), limb lines, bush hooks (single hooks hung from branches), or jug lines (line with a hook affixed to a floating jug); and injuries and drowning when entangled in various types of nets and fishing line. Baited hoop nets are also used to capture fish and may entrap ASTs that enter the mouth of the traps and are unable to escape. Boats and boat propeller strikes may also injure or kill ASTs (Enge et al. 2014). Declining water availability, quantity, and quality across the species' range is likely to further reduce the species' viability in the future (86 FR 62441). Nest predation rates for ASTs are high, and raccoons are the most common nest predators (Service 2021). Other predators include nine-banded armadillos, Virginia opossums, bobcats, river otters, and invasive red fire ants (Service 2021). Additional threats such as disease, nest parasites, and climate change effects, may affect the species but do not currently pose a threat to the species' overall viability (86 FR 62439).

8.2. Environmental Baseline for Alligator Snapping Turtle

This section describes the best available data about the condition of the AST in the Action area without the consequences caused by the proposed Action.

8.2.1. Action Area Numbers, Reproduction, and Distribution

Surveys for the AST have been conducted across the species' range and have varied in methodology. In an attempt to standardize trapping efficiency and effort among turtle surveys, researchers calculated catch per unit effort (CPUE) using the number of ASTs divided by trap nights. CPUE is generally considered a coarse proxy for relative abundance; however, there are currently no guidelines as to what CPUE values indicate low, medium, or high relative abundance. In Mississippi, state-wide CPUE averaged 0.18, with sites ranging from 0 to 0.92 CPUE (Pearson et al. 2023). The Pearl River system averaged 0.11 CPUE. Increases in CPUE, a coarse proxy for relative abundance, was correlated with increased river size, more surrounding wetlands/floodplains, and flatter surrounding land (i.e., Mississippi alluvial plain, coastal plain; Pearson et al. 2023).AST have been documented at multiple locations within or adjacent to the Action area including one individual 1.2 miles north of the J.H. Fewell WTP, one individual 0.6 miles south of the J.H. Fewell WTP weir, one individual from LeFleur's Bluff State Park, and seven individuals within Crystal Lake just to the east of the Action area in 2018 (MS Heritage Program, Pearson et al. 2023). Based on these records, the Service assumes AST occupy the entire project study area from RM 301.77 to 282.4 on the Pearl River. Mark-recapture studies on the Pearl River near Georgetown, MS indicated a population estimate of 22.5 AST/rmi (Pearson, pers comm). Therefore, a conservative estimate is that there are 1,772 AST within the Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) representing anywhere from 0.1 to 2.6 percent of the turtle's range wide abundance (Note: range wide estimates are from 68,154-1,436,825 individuals).

However, we estimate that habitat conditions within the project study area are not as favorable for AST as near Georgetown, especially in the four-mile reach that has been channelized with riparian habitat clearing. Therefore, a reasonable population estimate is 11.25 AST/rmi (half of Georgetown population estimate) within the project study area from the Ross Barnett Reservoir to 1.6 miles downstream of the proposed Alternative C weir.

Therefore, we estimate a total of approximately 218 turtles occur from RM 301.77 to RM 282.4 (Ross Barnett Reservoir to 1.6 miles below Alternative C weir; 93 upstream, 107 within Alt C footprint, and 18 downstream).

8.2.2. Action Area Conservation Needs and Threats

Historic threats from extensive overexploitation through commercial and recreational harvest in the last century resulted in significant declines of this species throughout much of its range, with recent, large-scale trapping industries operating in the mid-South (Dobie 1971; Sloan and Lovich 1995). Recreational harvest is still permitted for personal use with the restriction of one turtle per open season in Mississippi.

The main threats facing AST across the range between the period of 2000 and 2023 are nest predation (Holcomb and Carr 2023), recreational bycatch and hook ingestion, illegal intentional harvest (including export for pet trade and international consumption), commercial bycatch for non-game species by trot or limb lines, and habitat alteration (Shook 2020; Shook et al. 2023; Rosenbaum 2023). Habitat alteration is also considered a major threat to survival all life stages of this species. Reduced water levels and temperature shifts within AST suitable habitat, motivates these aquatic turtles to seek deeper water, or move overland to adjacent aquatic habitats to maintain moisture and cool their bodies (Pearson et al. 2021; Enge et al. 2014). Within the Action area, sections of the Pearl River have been previously altered by channelization and dredging of the river, and the removal of riparian vegetation and in-stream woody debris. Recreational bycatch and hook ingestion may also be a threat.

There is currently no recovery plan for AST nor have the survival needs of the species been fully determined by the Service.

8.3. Effects of the Action on Alligator Snapping Turtle

In a CO for a proposed for listing species, the effects of the proposed action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action area.

8.3.1. Effects of Channel Improvements on Alligator Snapping Turtle

We anticipate adverse effects to individuals of the AST will occur through the disturbance of habitat associated with the removal of excavation material from the floodplain and overbank area. Although AST are mobile and can avoid some in-water activities, AST may be killed or injured due to construction within oxbow lakes and other impoundments found within the channel improvement area (Note: the Pearl River will not be directly impacted, therefore, we do not anticipate direct adverse effects to adults found within the river). Death and injury could occur due to crushing if there are AST individuals attempting to nest within the channel improvement or near shore areas of oxbows and other water impoundments.

Alterations to natural banks during nesting season may reduce the amount of suitable nesting habitat for the AST and result in long term effects on future AST recruitment. Loss of tree canopy cover may also result in the female having to travel longer distances to locate suitable nesting substrate with adequate canopy cover. While we are not aware of any historic AST nesting activity within the project study area, it is reasonable to assume that AST nesting does occur, as there are ten observations of AST within or adjacent to the Action area. Each of these actions would lead to stress, require additional energy expenditure by, and effect the reproductive process for individual AST should they remain within the Action area and attempt to nest.

Additional sediment released into the water column from activities associated with floodplain and overbank excavation could also occur and have a detrimental impact on AST within the Action area. However, since a stormwater and sediment control plan has not been provided, we are unable to fully assess whether sedimentation and decreased water quality would result in adverse impact at this time.

For most of their lives, the AST inhabit aquatic habitats and only periodically surfaces to breath. Females will only become terrestrial during the nesting season and nesting will occur anywhere from 2 to 100 meters from the bank shoreline in usually sandy material. This species is long lived and can migrate long stretches of rivers for suitable foraging, nesting, and resting habitats. Downed logs and woody debris provide ample cover for the AST in deeper water habitat. The project activities described within may impact both water quality and quantity, cause erosion and sedimentation, modify substrates, and shelters of downed logs, all of which can affect AST growth, survival, and reproduction.

The Service anticipates that the proposed Action is reasonably certain to cause incidental take of individual AST resulting from channel improvement activities. These activities will likely disrupt the movement, breeding, feeding, and sheltering of adult and or juvenile AST and may not be detectable or measurable due to the species' secretive nature. Actual streambank and floodplain habitat degradation may be detectable, but directly attributing specific effects of that degradation to individuals would be difficult. Further, the crushing of individual AST by construction equipment or from falling debris will be difficult to detect as the species spends most of its life underwater and mortality events will likely remain undetected. Incidental take associated with foraging or sheltering behaviors is also difficult to determine as the species can migrate great distances in search of suitable habitats and foraging opportunities.

The majority of authorized take for the species is expected to occur in the form of lethal harm. Based on our estimates, we expect the extent of incidental take in the form of lethal harm will be 11 adult (10 percent of total population of 107) and/or juvenile ASTs and seven eggs (15 percent of 107 AST are females, 80% of female nest annually, clutch sizes averaging 27.6 eggs= 359 eggs; 90% predation rate = 36 eggs with 20% harmed due to the Action = 7 eggs) for the proposed channel improvement activities.

8.3.2. Effects of Weir Construction and Impoundment on Alligator Snapping Turtle

Although AST are mobile and can avoid instream construction activities, AST could be killed or injured due to construction associated with the installation of the proposed weir and fish passage structure. The equipment and material used to install the weir and fish passage may physically harm or kill any AST that remain in the immediate project area.

It's unclear at this time on whether the resulting impoundment would have an adverse impact on the AST. We expect AST remaining in the Action area may benefit from the deeper water depths of 6-22 feet post-project. However, the lack of woody debris within the impoundment and the removal of most riparian habitat along the new lake may negate any benefits that the deeper water provides. If sandbars or steeply sloping banks are created, these areas could prove suitable for nesting AST. Finally, potential lower water quality and lake eutrophication from excess nutrient input could lower the prey items for AST. Therefore, even though improved water depths are expected to benefit AST, it's difficult to determine if the lake will result in a net improvement over current pre-project conditions since woody debris, suitable nesting sites, and available prey items may be limited.

The majority of authorized take for the species is expected to occur in the form of lethal harm from the in-water work associated with weir and fish passage construction. We estimate the extent of incidental take in the form of harm will be two adults and/or juvenile ASTs for the proposed weir construction and impoundment (in addition to the 11 harmed from channel improvement activities). There also exists the potential for existing nests (up to 36 eggs for Alternative C; 28 eggs for Alternative D) to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season.

8.3.3. Effects of Non-Federal Activities caused by the Federal Action on Alligator Snapping Turtle

Activities that would not occur but for the proposed Federal action include relocation or retrofitting of existing infrastructure within the Action area (i.e., roads, bridges, pipelines, powerlines), riverfront access and development. Effects resulting from these activities could include death and injury from the direct crushing of individuals during the construction of bridge bents and other associated road, powerline, and pipeline instream work. Disturbance and/or permanent removal of potential nesting habitat is also expected. An increase in development adjacent to the improved channel could also lead to a decrease in water quality which would, in turn, impact prey sources and AST growth. Although changes in water quality could be measured, estimating the amount or extent of those changes to prey resources and AST growth are difficult to predict or anticipate.

Recreational water sports (e.g., fishing and boating) will be expected to increase as a result of the improved access to the Action area. This increase in fishing could lead to more incidental captures of AST in hoop nets or with rods and reels. Because the Service does not know the degree to which recreational uses will increase, we are unable to estimate the number of AST that could be impacted due to the increase in fishing.

8.4. Cumulative Effects on Alligator Snapping Turtle

Cumulative effects are those "effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the Action area" considered in this Opinion (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Activities performed by local municipalities (e.g., Hinds and Rankin counties), the RHDD, and private entities may occur in the area, but there are no known projects planned for within the Action area. Thus, the Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the Action area currently, therefore, no cumulative effects are anticipated.

8.5. Conclusion for Alligator Snapping Turtle

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the CO for the AST, which is to determine whether the Action is likely to jeopardize its continued existence.

AST was proposed for listing on November 9, 2021, as federally threatened (86 FR 62434-62463). The Service also proposed a Section 4(d) rule which provides conservation for AST by prohibiting the following intentional take activities, except as otherwise authorized or permitted: importing, exporting or possession and other acts resulting in unlawfully taken specimens from any source; delivering, receiving, transporting, or shipping wild caught individuals in interstate or foreign commerce in the course of commercial activity; and selling or offering for sale wild caught individuals in interstate or foreign commerce. The range-wide abundance of AST is estimated to be between 68,154 and 1,436,825. We estimate up to 1,772 AST could be found within the Action area (Ross Barnett at RM 301.77 to Copiah Creek at RM 223) representing anywhere from 0.1 to 2.6 percent of the turtle's range wide abundance. Our population estimate for AST in the project study area is 218 AST, including 107 adults within the 9.5-miles of potential impoundment, 93 adults upstream of the impoundment to the Ross Barnett Reservoir, and 18 adults 1.6 RM downstream.

<u>Channel Improvements</u>: Alternatives C, D, and E will result in similar channel excavation activities, which may result in death and injury to 11 adults and/or juvenile AST and 7 eggs that are within the construction limits of the channel improvement activities. We anticipate adverse effects to individuals of the AST will occur through the disturbance of habitat associated with the removal of excavation material from the floodplain and overbank area. Death and injury could

also occur due to crushing if there are AST individuals attempting to nest within the channel improvement or near shore areas of oxbows and other water impoundments.

Additional sediment released into the water column from activities associated with floodplain and overbank excavation could also occur and have a detrimental impact on AST within the Action area. However, since a stormwater and sediment control plan has not been provided, we are unable to assess whether sedimentation and decreased water quality would result in adverse impacts at this time.

Construction of the Weir and Impoundment (Alternatives C and D only) will result in the death of turtles and eggs associated with channel improvement activities described above AND death and injury to two adults and/or juvenile that are within the construction limits of the weir and fish passage structure (13 total adults/juvenile). The equipment and material used to install the weir and fish passage may physically harm or kill any AST that remain in the immediate project area. We do not anticipate direct death or injury related to the creation of an impoundment, and the negative and positive benefits of this feature to AST are difficult to quantify or measure at this time. There also exists the potential for existing nests (up to 36 eggs for Alternative C; 28 for Alternative D) to be flooded during filling of the pool area behind the weir if this occurs during the May to October nesting season.

We also anticipate adverse effects to individuals will occur through the disturbance of habitat associated with the installation of rip-rock in tributaries for bank/stream stabilization, and the installation/repair of bridge bents and other associated bridge work.

After reviewing the status of the AST, the environmental baseline for the Action area, the effects of the Action (both detrimental and beneficial activities proposed), it is the Service's conference opinion that the Action is not likely to jeopardize the continued existence of the AST.

9.0. LOUISIANA PIGTOE

This section provides the Service's conference opinion of the Action for the Louisiana pigtoe.

9.1. Status of Louisiana Pigtoe

This section summarizes best available data about the biology and condition of the Louisiana pigtoe (*Pleurobema riddellii*) throughout its range that are relevant to formulating an opinion about the Action.

Louisiana pigtoe was proposed for listing on March 20, 2023, as federally threatened (88 FR 16776-16832). The Service also proposed a Section 4(d) rule which provides conservation for the species. In addition, designated critical habitat is proposed for 1,028.2 river miles in three counties in Arkansas, six parishes in Louisiana, two counties in Mississippi, one county in Oklahoma, and 21 counties in Texas. Additional information on Louisiana pigtoe can be found at https://ecos.fws.gov/ecp/species/10233

The proposed Action is not located within proposed critical habitat, therefore, no adverse impacts to proposed critical habitat will occur.

9.1.1. Species Description

The Louisiana pigtoe is a rare freshwater mussel with a thick, inflated, triangular to sub-quadrate shell. The beaks are elevated well above the hinge line but are sometimes eroded. The external shell is without sculpturing and reddish-brown, dark brown, or black in color. The interior shell surface (nacre) is typically white, rarely peach tinted, and iridescent posteriorly. Pseudocardinal teeth (molar-like structures located near the beaks on the interior surface) are heavy to massive, triangular, and rough with the anterior tooth in the left valve compressed and parallel to the margin. The lateral teeth, two in the left valve and one with a basal flange in the right, are short and straight or slightly curved. Soft tissues are described as white to off-white. Individuals approaching 5 inches (127 mm) in length have been collected in Texas. The Louisiana pigtoe is a medium-sized freshwater mussel (shell lengths to greater than 62 mm) with a brown to black, triangular to subquadrate shell without external sculpturing, sometimes with greenish rays. Burlakova et al. (2011a) considered the species rare throughout its range. Other native mussel species in the Pearl River (e.g., Mississippi Pigtoe, *Pleurobema beadleianum;* southern pigtoe, *Fusconaia cerina*) can easily be mistaken for Louisiana pigtoe when identified by shell morphology alone. A recent survey suggested experienced malacologists had a 76% success rate accurately identifying the species in the Little River, Oklahoma, when field identifications were compared with genetic analysis results (Inoue 2018).

9.1.2. Life History

Freshwater mussels, including Louisiana pigtoe, have a complex life history involving an obligate parasitic larval life stage, called glochidia, which are wholly dependent on host fish. As freshwater mussels are generally sedentary, dispersal is accomplished primarily through the behavior of host fish and their tendencies to travel upstream and against the current (positive rheotaxis) in rivers and streams. Mussels are broadcast spawners; males release sperm into the water column, which is taken in by the female through the incurrent aperture (the tubular structure used to draw water into the body of the mussel). The sperm fertilizes the eggs, which are held during maturation in an area of the gills called the marsupial chamber. The developing larvae remain in the marsupial chamber until they mature and are ready for release as glochidia, to attach on the gills, head, or fins of fishes (Vaughn and Taylor 1999; Barnhart et al. 2008). Glochidia die if they fail to find a host fish, attach to the wrong species of host fish, attach to a fish that has developed immunity from prior infestations, or attach to the wrong location on a host fish (Neves 1991; Bogan 1993). Glochidia encyst (enclose in a cyst-like structure) on the host's tissue, draw nutrients from the fish, and develop into juvenile mussels for weeks or months after attachment (Arey 1932). The glochidia will remain encysted for about a month through a transformation to the juvenile stage. Once transformed, the juveniles will excyst (release) from the fish and drop to the substrate. Freshwater mussel species vary in both onset and duration of spawning, how long developing larvae are held in the marsupial gill chambers, and which fish species serve as hosts. The mechanisms employed by mussel species to increase the likelihood of interaction between host fish and glochidia also vary by species.

Freshwater mussels are generally considered to be long-lived and slow-growing (also see Haag and Rypel 2010), with some individuals estimated to be decades or even centuries old based on measured growth rates (Strayer et al. 2004). Due in part to their long-life spans, recruitment is episodic, and populations may be slow to recover from disturbance. Thin-shelled mussels often live 4–10 years while thick-shelled mussels (like Louisiana pigtoe) can live for 20–40 years, or longer (Howells et al. 1996).

The primary host fish for Louisiana pigtoe has not been confirmed. Marshall (2014) suggested bullhead minnow (*Pimephales vigilax*), red shiner (*Cyprinella lutrensis*), and blacktail shiner (*Cyprinella venusta*) as potential fish hosts based on a fish host distribution modeling effort; of which, bullhead minnow and blacktail shiner are both present in the Action area.

Adult freshwater mussels, including Louisiana pigtoe, are filter-feeders, siphoning suspended phytoplankton, zooplankton, rotifers, protozoans, detritus and dissolved organic matter from the water column (Strayer et al. 2004) and from sediment; juvenile mussels are capable of using their foot to collect food items from sediments (pedal feeding; Vaughn et al. 2008). Glochidia derive what little nutrition they need from their obligate fish hosts (Barnhart et al. 2008). Stable isotope studies suggest some mussel species feed on coarse particulate organic matter (CPOM) or bacteria and fungi associated with and decomposing the CPOM (Bonner et al. 2018). Freshwater mussels must keep their shells open (gaped) to obtain food and facilitate gas exchange. They are sometimes able to sense perturbations to water quality and may respond by temporarily closing their shells (Bonner et al. 2018). Food supply is not generally considered limiting in the environments inhabited by Louisiana pigtoe.

9.1.3. Numbers, Reproduction, and Distribution

Louisiana pigtoe occurs in medium to large-sized streams and rivers in flowing waters (0.3-1.4 m/s) over substrates of cobble and rock or sand, gravel, cobble, and woody debris; they are often associated with riffle, run, and sometimes larger backwater tributary habitats (Ford et al. 2016; Howells 2010a; Williams et al. 2017b). Specimens are typically found in shallower waters (0.1-1.2 m in depth; Howells 2010a); however, recent surveys found Louisiana pigtoe as deep as 3.33 m in the lower Neches River (downstream of B.A. Steinhagen Lake) (Corbett 2020). Other specimens collected from the Neches River occupied substrates of gravel mixtures at depths between 0.57-1.12 m in run habitat with flow velocities of 0.44-0.66 m/s (Glen 2017).

The range of the Louisiana pigtoe is comprised of multiple river drainages throughout portions of east Texas, Louisiana, west Mississippi, southeast Oklahoma, and southwest Arkansas (Vidrine 1993, p.66; Howells et al. 1997; Randklev et al. 2013b; Randklev 2018). The total length of occupied reaches of these rivers is approximately 1,142 river miles. In Mississippi, the species has been observed from the Pearl River (Johnson et al. 2019; Ellwanger et al. 2023) and the estimated length of occupied reach in the Pearl River is 280.8 river miles.

9.1.4. Conservation Needs and Threats

Louisiana pigtoe are not adapted to lentic or non-flowing environments (e.g., reservoirs and impoundments) and do not persist or thrive in habitats unless they are free-flowing (lotic), such as unimpeded stream and river reaches. Since this species evolved in, and is adapted to, free-flowing environments, it requires (i.e., necessary to meet life-history requirements) unaltered rivers and streams that are free from major impoundments and other structures that impede flow. Free-flowing water provides appropriate oxygenation, nutrition, thermal buffering, and access to fish hosts for reproduction and dispersal. Louisiana pigtoe require adequate, but not excessively high flows, which may lead to scouring of suitable substrates. While some mussel species are more tolerant of dewatering or have adaptations to avoid stranding (Bonner et al. 2018), Louisiana pigtoe is not well adapted to persist in habitats subject to rapid and frequent dewatering (Mitchell et al. 2018).

Louisiana pigtoe require natural, high quality (pollutant free) water and are sensitive to both point and non-point source contaminants that deteriorate water quality and degrade their habitat. Contaminants are capable of altering the chemical, physical, and biological characteristics of a stream to the point where mussels or their host fish can no longer survive. A variety of pollutants can cause lethal and sub-lethal effects in aquatic biota, but mussel-specific data are generally lacking regarding their sensitivity to the more than 80,000 chemical compounds and their metabolites that are currently in commerce and are routinely released into the environment. Contaminants that are sometimes elevated in rivers and are a concern to mussel health include excess nutrients such as ammonia, which is highly toxic to aquatic organisms, chemicals related to wastewater disinfection such as chlorine, trace metals like copper or cadmium (March et al. 2007, Wang et al. 2010), dissolved solids (e.g., salinity), pharmaceuticals and personal care products (e.g., musks, fragrances, growth hormones, estradiol), and a variety of pesticides commonly used for residential and commercial applications; these pollutants, individually or collectively (i.e., synergism) can interfere with the ability of mussels or their host fishes to feed, breed, or otherwise meet their life history needs (Cope et al. 2008).

Since freshwater mussels live in the substrate of benthic environments, the composition of the substrate material is vital to their ability to properly anchor and remain firmly in place. A firm and stable substrate comprised of the appropriate mix of materials is necessary for mussels to withstand changes in stream flow such as perturbations associated with storm events and prevent transport downstream. Sediments such as shifting sands and unconsolidated silts generally do not provide appropriate anchoring substrate, and thus appropriate habitat, for Louisiana pigtoe.

Threats to the Louisiana pigtoe include changes in water quality, altered hydrology, changes to habitat structure/substrate, habitat fragmentation, direct mortality, invasive species, and climate change (2023 SSA)

9.2. Environmental Baseline for Louisiana Pigtoe

This section describes the best available data about the condition of the Louisiana pigtoe in the Action area without the consequences caused by the proposed Action.

9.2.1. Action Area Numbers, Reproduction, and Distribution

The Pearl River basin in Louisiana and Mississippi has a single population of Louisiana pigtoe within the mainstem Pearl River. Additional surveys are needed, but based on the limited information available, we estimate the length of the Pearl River population at 280.8 river miles encompassing portions of St. Tammany and Washington parishes, Louisiana; and Copiah, Hinds, Lawrence, Marion, Pearl River, Rankin, and Simpson counties, Mississippi. The Species Status Assessment (2023) determined that occupied habitat reach length was in high condition; habitat structure/substrate, hydrology, and water quality were in moderate condition; and abundance and reproduction/recruitment were in low condition due to the few individuals observed and lack of juvenile or gravid female presence (Johnson et al. 2019).

Johnson et al. (2023) genetically confirmed the presence of the Louisiana pigtoe in the Pearl River with the range of the species reaching from the East Pearl River and West Pearl River in the south to the Spillway of Ross Barnett Reservoir in the north. Of those genetically confirmed individuals, five live individuals were found over a two-mile stretch of the Pearl River (RM 299 -301.77) below Ross Barnett reservoir dam among five separate sites (R. Ellwanger, pers. comm. 2023). Assessment of shell material at the Mississippi Museum of Natural Science documented the species 100 yards above the J.H. Fewell WTP weir in the Action area (MMNS2745, R. Ellwanger, pers. comm. 2023). Additional quantitative surveys below Ross Barnett Reservoir by the Mississippi Ecological Services Field Office in 2023 estimated densities of 0.52 Louisiana pigtoe per square meter (R. Ellwanger, pers. comm. 2023).

However, the habitat conditions of the Pearl River within the project study area, specifically the four-mile reach of channelized river, are lower compared to the sections of the Pearl River where

Louisiana pigtoe has been documented. Therefore, we estimate only 10 percent of the river within the project study area in suitable for the Louisiana pigtoe (Wagner, Ellwanger, pers comm. 2024). Consequently, we estimate approximately 53,686 Louisiana pigtoe could be found within the proposed 9.5-mile impoundment for Alternative C (10% of 1,028,989 square meters at 0.52 LA pigtoe per square meter) and 45,653 Louisiana pigtoe within the 7.5-mile impoundment for Alternative D (10% of 875,0009 square meters at 0.52 LA pigtoe per square meter). This would constitute approximately 3.4 percent of the Pearl River population and 0.8 percent of the range wide population estimates for Alternative C (2.7 and 0.6 percent for D, respectively).

9.2.2. Action Area Conservation Needs and Threats

Previous flood and water control projects, including the channelization of the Pearl River, removal of riparian habitat, and the construction of the J.H. Fewell WTP weir have negatively altered the habitat required for this species within the Action area. Ellwanger (2023) described much of the Pearl River below Ross Barnett to be unstable with backwaters almost non-existent, sediment constantly moving, and stable benthic habitat confined to the periphery of the river.

9.3. Effects of the Action on Louisiana Pigtoe

In a CO for a proposed for listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the Action area.

9.3.1. Effects of Channel Improvements on the Louisiana Pigtoe

Potential direct impacts from the construction of channel improvements and overbank modifications would include temporary increases in turbidity and suspended solids in adjacent water bodies including the Pearl River and tributaries. Erosion control features could decrease the amount of sedimentation, but the sheer volume of material to be moved makes turbidity in the system likely. Additional sediment released into the water column from activities associated with floodplain and overbank excavation could occur and have a detrimental impact on Louisiana pigtoe within the Action area. However, since a stormwater and sediment control plan has not been provided, we are unable to fully assess whether sedimentation and decreased water quality would result in adverse impact at this time.

Instream activities will not occur, therefore, direct death or injury to mussels from heavy machinery is not anticipated. The 2024 DEIS does not elaborate on the expected conditions of the Pearl River once channel improvements are complete and a weir is not installed (Alternative E). Therefore, it’s not clear at this time whether channel improvements will impact river stability within the project study area compared to current conditions.

9.3.2. Effects of Weir Construction and Impoundment on Louisiana Pigtoe

The establishment of a 1,700 (Alt D) to 2562-acre (Alt C) impoundment from weir construction will result in changes in the velocity and water surface elevation within the project study area. The June 2024 BA states that the current lotic (i.e., riverine) habitat would be replaced with lentic (lake-like) habitat which would eliminate available habitat and host fishes for the Louisiana pigtoe. We concur with this assessment and expect all Louisiana pigtoe within the impoundment area to die due to the elimination of the free-flowing water that provides appropriate oxygenation, nutrition, thermal buffering, and access to fish hosts for reproduction and dispersal. Louisiana pigtoe downstream of the proposed weir may also experience short-term impacts associated with increased sediment/siltation associated with weir construction activities.

The Service anticipates incidental take of Louisiana pigtoe will be difficult to detect because individuals (especially juveniles) of mussels are small and difficult to detect unless observed undisturbed in their environment.

9.3.3. Effects of Non-Federal Activities caused by the Federal Action on Louisiana Pigtoe

Activities that would not occur but for the proposed Federal action include relocation or retrofitting of existing infrastructure within the Action area (i.e., roads, bridges, pipelines, powerlines), riverfront access and development. Death and injury could occur as a result of instream activities associated with addition of rip rock in the mouth of tributaries, stabilization of bridge bents and other road/pipeline/powerline repairs. Temporary and localized increases in turbidity and sedimentation could also adversely impact Louisiana pigtoe downstream of these activities.

9.4. Cumulative Effects on Louisiana Pigtoe

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. At this time the Service is unaware of any future state, tribal, local, or private non-Federal actions scheduled to occur in the Action area. Therefore, cumulative effects are not relevant to formulating our opinion for the Action.

9.5. Conclusion for Louisiana Pigtoe

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the CO for the Louisiana pigtoe, which is to determine whether the Action is likely to jeopardize its continued existence.

Louisiana pigtoe was proposed for listing on March 20, 2023, as federally threatened (88 FR 16776-16832). The range of the Louisiana pigtoe is comprised of 1,142 river miles in multiple river drainages throughout portions of east Texas, Louisiana, west Mississippi, southeast Oklahoma, and southwest Arkansas. The Pearl River basin in Louisiana and Mississippi has a single population of Louisiana pigtoe within 280.8 river miles of the mainstem Pearl River. There are an estimated 45,653 to 53,686 Louisiana pigtoe within the impoundment section of the proposed study area for Alternative D and C, respectively.

<u>Construction of Channel Improvements</u> (Alternatives C, D, and E) may result in increased sedimentation and decreased water quality during construction activities. Burying of individuals or mussel beds is possible during this time of increased sedimentation. Best management

practices will be implemented, however, many of these details have not been provided at this time to determine if take of Louisiana pigtoe would occur. Additional consultation will be required once a final alternative is selected, and stormwater/sediment control plans have been developed.

Construction of the Weir and Impoundment (Alternatives C and D only) will result in death of all Louisiana pigtoe in the new impoundment (53,686 for Alt C; 45,653 for Alt D) due to altered hydrology, decreased water quality, reduced host fish movement and dispersal of mussel glochidia, sediment deposition, and other changes that alter the physical, chemical, and biological characteristics of free-flowing rivers. Approximately 7.5-9.5 river miles of potential Louisiana pigtoe habitat would be altered from lotic to lentic habitat as a result of channel modifications and creation of an impoundment. This constitutes 2.7 to 3.4 percent of the total Louisiana pigtoe population range within the Pearl River and 0.6-0.8 percent of the estimated range wide population.

After reviewing the current status of the Louisiana pigtoe, the environmental baseline for the Action area, and the effects of the Action, it is the Service's conference opinion that implementation of the Action is not likely to jeopardize the continued existence of the Louisiana pigtoe. The Action is not located within proposed critical habitat, therefore, no adverse impacts to proposed critical habitat will occur.

10.0. MONARCH BUTTERFLY

This section provides the Service's conference opinion of the Action for the monarch butterfly.

10.1. Status of Monarch Butterfly

The monarch butterfly is a candidate species and not yet listed or proposed for listing. Consultation with the Service under section 7 of the ESA is not required for candidate species, like the monarch. We encourage agencies, however, to take advantage of any opportunity they may have to conserve the species. Therefore, the USACE requested this species be considered in this opinion. For information on monarch conservation, visit https://www.fws.gov/initiative/pollinators/monarchs; http://www.mafwa.org/?page_id=2347.

10.1.1. Species Description

The monarch, *Danaus plexippus*, is a species of butterfly in the order Lepidoptera (family Nymphalidae) that occurs in North, Central, and South America; Australia; New Zealand; islands of the Pacific and Caribbean, and elsewhere (Malcolm and Zalucki 1993). Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side and lower side of forewings and hindwings (Bouseman and Sternburg 2001). Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches (Commission for Environmental Cooperation, 2008). The bright coloring of a monarch is aposematic, as it serves as a warning to predators that eating them can be toxic.

10.1.2. Life History

During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.), and larvae emerge after two to five days (Zalucki 1982; CEC 2008). Larvae develop through five larval instars (intervals between molts) over a period of 9 to 18 days, feeding on milkweed and sequestering toxic cardenolides as a defense against predators (Parsons 1965). The larva then pupate into chrysalis before enclosing 6 to 14 days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter into reproductive diapause (suspended reproduction) and live six to nine months (Cockrell et al. 1993; Herman and Tatar 2001).

The eastern population of North America's monarchs overwinters in the same 11 to 12 mountain areas in the States of Mexico and Michoacan from October to late March. Monarchs roost for the winter in oyamel fir forests at an elevation of 2,400 to 3,600 meters (nearly 2 miles above sea level). The mountain hillsides of oyamel forest provide an ideal microclimate for the butterflies. Here temperatures range from 0 to 15 degrees Celsius. If the temperature is lower, the monarchs will be forced to use their fat reserves. The humidity in the oyamel forest assures the monarchs won't dry out allowing them to conserve their energy.

10.1.3. Numbers, Reproduction, and Distribution

Two North American populations, the migratory populations located east and west of the Rocky Mountains, have been monitored at their respective overwintering sites in Mexico and California since the mid-1990s. While these populations fluctuate year-to-year with environmental conditions, these census data indicate long-term declines in the population abundance at the overwintering sites in both populations.

In eastern North America, monarchs travel north in the spring, from Mexico to Canada, over two to three successive generations, breeding along the way (Flockhart et al. 2013). Individual monarchs disperse as far north as they can physiologically tolerate based on climatic conditions and available vegetation; the most specific predictors of the northern distribution of individual monarchs are monthly mean temperature and precipitation (Flockhart et al. 2013; Flockhart et al. 2017). The number of generations of monarchs produced in a given year can vary between three and five and is dependent upon environmental conditions (Brower 1996). While a majority of the eastern monarchs shift to the more northern reaches of their range, western monarchs continue to occupy and breed in warmer climates throughout the summer, while also expanding to include the farther reaches of their range. In the spring in western North America, monarchs migrate north and east over multiple generations from coastal California toward the Rockies and to the Pacific Northwest (Urquhart and Urquhart 1977; Nagano et al. 1993). In the southwestern states, migrating monarchs tend to occur more frequently near water sources such as rivers, creeks, roadside ditches, and irrigated gardens (Morris et al. 2015).

Based on the past annual censuses, the eastern North American population has been generally declining over the last 26 years. Although the numbers at the overwintering sites have declined, we did not find a corresponding change in the spatial extent of the population during the breeding season.

10.1.4. Conservation Needs and Threats

The primary drivers affecting the health of the two North American migratory populations are primarily: loss and degradation of habitat (from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence and incompatible management of overwintering sites in California, urban development, and drought), continued exposure to insecticides, and effects of climate change. Relative to the recent past, both the eastern and western North American populations have lower abundances and declining population growth rates.

Plants in the milkweed family (*A. sp*) are the sole host plant for the monarch butterfly. A body of researchers have concluded that the decline of milkweed host plants is the primary influence on monarch population status (e.g., Oberhauser et al. 2001, Brower et al. 2012, Pleasants and Oberhauser 2013). The decline of milkweeds, according to the above research, is primarily connected and as a result of the increased use of the genetically modified herbicide-resistant crops, especially in the agricultural Midwest region of the USA. Some enumeration of the loss has been attempted – Pleasants (2016) estimated that almost a billion milkweeds have been lost since 1999 – in both the agricultural landscape of the Midwest but also within the lower Great Plains Region due primarily to development and conversion of grasslands to cultivated lands.

A reduction in nectar availability is a threat to monarchs during reproductive and migratory periods. Nectar in Great Plains grassland habitats, for example, is important especially to monarchs in the Eastern North America population. This includes habitats in the Texas and Oklahoma migratory corridors and along the coast from Louisiana to Mexico where monarchs nectar extensively and store fat to survive winter (Brower et 27 al. 2006; Tracy 2018). A diversity of nectar resources would help to ensure that areas function as monarch habitat during multiple seasons. During the fall, for example, milkweed is no longer blooming and areas only function as monarch habitat if they contain sufficient amounts of late blooming species, like members of the aster or sunflower family (Asteraceae ⁄ Compositae) (Rudolph et al. 2006; Inamine et al. 2016). In Arkansas, in addition to reductions in the diversity of nectar plant species, drought also decreased nectar availability and the ability of migrating monarchs to accumulate lipid reserves for overwintering (Brower et al. 2015). In many areas, nectar resources may typically be poor for monarch in the absence of management intended to foster their abundance and diversity. Without frequent fire in the forested portions of the Ouachita Mountains Physiographic Region in Arkansas, for example, nectar resources may remain chronically low (Rudolph et al. 2006). In areas like this, road and utility rights-of-way also provide nectar resources (Rudolph et al. 2006).

10.2. Environmental Baseline for Monarch Butterfly

This section describes the best available data about the condition of the monarch butterfly in the Action area without the consequences caused by the proposed Action.

10.2.1. Action Area Numbers, Reproduction, and Distribution

Since 1994, when systematic monitoring of monarchs on their Mexican wintering grounds began, the Eastern North American population has generally declined (Vidal and Rendón-Salinas 2014). In the winter of 2013-2014, numbers fell to about 14 million after consistently numbering in the hundreds of millions in the 1990s and early 2000s. In the two decades before standardized monitoring, monarch numbers may have been as high or higher than was originally documented in 1994 (Vidal and Rendón-Salinas 2014).

No systematic surveys have been conducted in the Action area for the monarch butterfly. However, they have been documented recently (2018-2023) within the immediate area involved in the action. Specifically, there are six recorded observations in Hinds County, concentrated near Lefleurs Bluff State Park/Mayes Lake and extend both north and south along the Pearl River. Based on iNaturalist data, the species is assumed to be present in low numbers throughout the state.

10.2.2. Action Area Conservation Needs and Threats

We would anticipate the conservation needs and threats to the monarch butterfly to be similar to the threats described for the larger Eastern North America population, which primarily include loss and degradation of habitat (change in nectar and milkweed resources, loss of urban greenspace and mowing); use of herbicides and insecticides; climate change (drought, storm events, temperature extremes); and collection/tourism. The current status of the monarch butterfly in the Action area has been heavily influenced by previous flood control actions, urbanization, removal of riparian habitat, use of herbicides, and mowing have negatively altered the habitat required for this species within the Action area. These actions have reduced the amount of habitat available for this species, including reductions in suitable breeding and foraging areas.

10.3. Effects of the Action on Monarch Butterfly

The effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the Action area.

10.3.1. Effects of Channel Improvements on Monarch Butterfly

Alternative C would include clearing and grubbing of approximately 2,301 acres due to channel excavation and fill deposit on levees and behind levees. This would result in the removal of the monarch butterfly host plant, milkweed, where present, and would also destroy nectar plants that the species feeds upon. These activities could result in death to adult monarch butterflies, larvae, and eggs should ground disturbance take place during the breeding season (March through April). Overall, Alternative C will negatively impact the availability, spatial distribution and quality of breeding and migration resources for the species.

Alternatives D and E would include clearing and grubbing of approximately 1,501 acres due to channel excavation and fill deposit on levees and behind levees. If herbicides or mowing is used to maintain levees, additional impacts to the species may occur. Results of herbicide toxicity studies suggest that various types of herbicides may result in direct effects to lepidopterans if exposed at recommended field application rates for the labeled land use/cover type.

For Alternative E, once construction is complete, we would anticipate the habitat conditions to return to near pre-project conditions provided excavated overbank areas are allowed to naturally revegetate. If this is the case, then the effects of the Action on the monarch butterfly would occur primarily during the two-year construction period and the time required for disturbed areas to revegetate. The 2024 DEIS did not describe the habitat conditions of the overbank areas once construction is completed for Alternative E.

10.3.2. Effects of Weir Construction and Impoundment on Monarch Butterfly

Alternative C and D would create an approximately 2,562- and 1,706-acre impoundment, respectively. This would result in the permanent removal of potential habitat (milkweed, nectar plants, etc.) for the monarch butterfly. Suitable habitat would be submerged year-round and therefore breeding and feeding habitat would no longer be present within the footprint of the impoundment. Vegetated areas adjacent to the new impoundment could provide suitable habitat if allowed to naturally revegetate. If herbicides are used to maintain the impoundments, additional impacts to the species may occur. Results of herbicide toxicity studies suggest that various types of herbicides may result in direct effects to lepidopterans if exposed at recommended field application rates for the labeled land use/cover type.

10.3.3. Effects of Non-Federal Activities caused by the Federal Action on Monarch Butterfly

An increase in recreational and economic development adjacent to the improved channel could also lead to an increase in impervious surfaces and therefore a decrease in suitable monarch butterfly habitat. However, since the 2024 DEIS does not describe in detail the amount of such development that will occur, it is difficult to predict or anticipate the amount of take that could occur as a result.

10.4. Cumulative Effects on Monarch Butterfly

Cumulative effects are those "effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the Action area" considered in this conference opinion (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Activities performed by local municipalities (e.g., Hinds and Rankin counties), the RHDD, and private entities may occur in the area, but there are no known projects planned for within the Action area. Thus, the Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the Action area currently, therefore, no cumulative effects are anticipated.

10.5. Conclusion for Monarch Butterfly

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the CO for the monarch butterfly, which is to determine whether the Action is likely to jeopardize its continued existence.

There has been a decline in the overall population of the monarch butterfly since 1994, however, there is no such trend data for the Action area. We must assume that the threats listed for the species range-wide are the same for the Action area, which include loss and degradation of habitat (change in nectar and milkweed resources, loss of urban greenspace and mowing), use of herbicides and insecticides, climate change (drought, storm events, temperature extremes), collection/tourism.

<u>Channel Improvements</u> for Alternatives C, D, and E will result in harm to the monarch butterfly through a reduction in breeding and feeding habitat (milkweed and nectar plants) and the death of larvae and eggs during the breeding season. Specifically, we anticipate impacts to the monarch butterfly from the clearing and grubbing of 2,301 acres for Alternative C and 1,501 acres for Alternatives D and E. For Alternative E, these impacts would be expected to be temporary in nature as many of these disturbed acres could be allowed to naturally revegetate.

<u>Weir Construction</u> for Alternatives C and D will also result in the creation of a new water impoundment (2,562 and 1,706 acres respectively). These acres will see a permanent loss of suitable monarch butterfly habitat as milkweed and nectar plants would not exist in submerged water conditions.

After reviewing the status of the monarch butterfly, the environmental baseline for the Action area, and the effects of the Action, it is the Service's opinion that the Action is not likely to jeopardize the continued existence of the monarch butterfly.

11.0. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3(19)). In regulations, the Service further defines:

- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" (50 CFR §17.3) and
- "incidental take" as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant" (50 CFR §402.02).

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to a Federal agency action that would not violate ESA §7(a)(2) is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, USACE must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. USACE has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if USACE fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document. In order to monitor the impact of incidental take, USACE must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

If the AST, Louisiana pigtoe, or monarch butterfly are listed under the ESA, the measures described below are non-discretionary, and must be undertaken by USACE as appropriate, for the exemption in 7(o)(2) to apply.

11.1. Amount or Extent of Take

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section(s) of this BO. We reference, but do not repeat, these analyses here.

11.1.1. Gulf Sturgeon

The Service anticipates that Alternatives C and D are reasonably certain to cause incidental take of Gulf sturgeon consistent with the definition of harm resulting from construction of the weir and impoundment of the Pearl River (see sections 4.3 and 4.5). The Service anticipates a maximum of four sturgeon per year to be affected to the level of harm due to the effects of decreased water quality on foraging habitat in the impoundment, the inability of sturgeon to pass over the weir during normal and below normal flows, and mortality and injury to adult, juvenile, and drifting free embryos during downstream passage over the new weir during normal and below normal flows.

The Service anticipates that with successful stormwater and sediment control measures in place, Alternative E will not result in take of Gulf sturgeon. Since such measures have not been presented at this time, additional consultation will be required during the PED phase should this alternative be selected.

11.1.2. Ringed Map Turtle

The Service anticipates that Alternatives C and D are reasonably certain to cause incidental take of ringed map turtle consistent with the definition of harm resulting from construction of the weir and impoundment of the Pearl River (see sections 6.3 and 6.5). The Service anticipates a maximum of 1,516 ringed map turtles for Alternative C and 1,196 turtles for Alternative D (90% of current population within the impoundment footprint) would be affected to the level of harm (lethal and nonlethal) due to the effects of decreased food sources, basking habitat, and nesting habitat; death and injury due to heavy machinery, and increased competition from generalist turtle species such as the red-eared slider. Up to 461 eggs would be harmed by Alternative C and 364 eggs by Alternative D if construction work and filling of the lake is done during the May to October nesting season. We also anticipate as many as 4,974 turtles (6 percent of the population; 1,773 turtles within Alt C footprint, 2,735 upstream, and 466 downstream of impoundment) found within the Action area may be taken in the form of harm (nonlethal) due to the temporary competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

The Service anticipates that Alternative E is reasonably certain to cause incidental take of ringed map turtles consistent with the definition of harm resulting from channel improvement activities. The Service anticipates a maximum of 92 eggs could be destroyed by channel improvement activities if they occur during the May to October nesting season. No death of adult ringed map turtles is expected; however, we can expect some level of harm (nonlethal) to up to 1,596 turtles due to noise and other disturbances that may temporarily alter normal turtle feeding, basking and nesting activities during the period when overbank excavation is occurring. Some turtles may migrate upstream or downstream to avoid areas with heavy noise and other human disturbance due to construction activities.

11.1.3. Pearl River Map Turtle

The Service anticipates that Alternatives C and D are reasonably certain to cause incidental take of Pearl River map turtle consistent with the definition of harm resulting from construction of the weir and impoundment of the Pearl River (see sections 7.3 and 7.5). The Service anticipates a maximum of 88 Pearl River map turtles for Alternative C and 70 turtles for Alternative D (100% of current population within the impoundment footprint) would be affected to the level of harm (lethal and nonlethal) due to the effects of decreased food sources, basking habitat, and nesting habitat; death and injury due to heavy machinery, and increased competition from generalist turtle species such as the red-eared slider. Up to 20 eggs would be harmed by Alternative C and 16 eggs by Alternative D if construction work and filling of the lake is done during the May to October nesting season. We also anticipate as many as 318 turtles (1.4 percent of the population; 88 turtles within Alt C footprint, 164 upstream, and 66 downstream of impoundment) found within the Action area may be taken in the form of harm (nonlethal) due to the temporary competition for reduced basking, foraging, and nesting habitat as turtles are displaced into other areas. The upstream Lakeland population is also anticipated to be harmed through population isolation and inbreeding, resulting in reduced reproductive fitness and survival.

The Service anticipates that Alternative E is reasonably certain to cause incidental take of Pearl River map turtles consistent with the definition of harm resulting from channel improvement activities. The Service anticipates a maximum of four eggs could be destroyed by channel improvement activities if they occur during the May to October nesting season. No death of adult Pearl River map turtles is expected, however, we can expect some level of harm (nonlethal) to up to 84 turtles due to noise and other disturbances that may temporary alter normal turtle feeding, basking and nesting activities during the period when overbank excavation is occurring. Some turtles may migrate upstream or downstream to avoid areas with heavy noise and other human disturbance due to construction activities.

11.1.4. Alligator Snapping Turtle

The Service anticipates that Alternatives C and D are reasonably certain to cause incidental take of AST consistent with the definition of harm resulting from construction of the weir and impoundment of the Pearl River (see sections 8.3 and 8.5). The Service anticipates a maximum of 13 AST would be affected to the level of harm (lethal) via death and injury of individuals related to heavy equipment removing overbank material from the floodplain and the installation of the weir and fish passage structure. Up to 36 eggs would be harmed if construction work for Alternative C is done during the nesting season (28 for Alt D).

The Service anticipates that Alternative E is reasonably certain to cause incidental take of AST consistent with the definition of harm resulting from channel improvement activities. The Service anticipates a maximum of 11 turtles would be harmed (lethal) via death and injury of individuals related to heavy equipment removing overbank material from the floodplain. Up to seven eggs would be destroyed if construction work is done during the nesting season.

11.1.5. Louisiana Pigtoe

The Service anticipates that Alternatives C and D are reasonably certain to cause incidental take of Louisiana pigtoe consistent with the definition of harm resulting from construction of the weir that would result in impoundment of the Pearl River (See sections 9.3 and 9.5). The Service anticipates a maximum of 53,686 Louisiana pigtoe for Alternative C (and 45,653 for Alt D) would be harmed (lethal) due to altered hydrology, decreased water quality, reduced host fish movement and dispersal of mussel glochidia, sediment deposition, and other changes that alter the physical, chemical, and biological characteristics of the free-flowing Pearl River.

The Service anticipates that with successful stormwater and sediment control measures in place, Alternative E will not result in take of Louisiana pigtoe. Since such measures have not been presented at this time, additional consultation will be required during the PED phase should this alternative be selected.

11.1.6. Monarch Butterfly

The Service anticipates that Alternatives C and D are reasonably certain to cause incidental take to monarch butterfly consistent with the definition of harm resulting from construction of the weir and impoundment of the Pearl River. The level of take is difficult to quantify because there is no information on density or demographics for the monarch butterfly in the Action area. Therefore, detecting take that occurs incidental to the Action is not practical. Take would be exceeded if the acreage thresholds provided below are exceeded.

We anticipate harm from the permanent loss of 2,562 acres of potentially suitable breeding and feeding habitat (milkweed and nectar plants) due to permanent water inundation resulting from Alternative C. We anticipate the permanent loss of 1,706 acres for Alternative D.

The Service anticipates that Alternative E (channel improvements only) is reasonably certain to cause incidental take of monarch butterfly from the clearing and grubbing of up to 1,500 acres of potentially suitable breeding and feeding habitat for excavation and fill. These impacts would be considered temporary if suitable breeding and feeding habitat is restored to these areas. These impacts would also be reduced if activities occur outside the breeding season.

11.2. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary or appropriate to minimize the impact of incidental take caused by the Action on listed wildlife species. RPMs are described for each listed wildlife species in the subsections below.

11.2.1. All species

RRM 1: The USACE will coordinate with the Service during the PED phase on the development of a stormwater pollution prevention plan (all alternatives).

RPM 2: A sediment, water quality, and velocity analysis within and downstream of the proposed impoundment will be conducted and coordinated with the Service (Alternatives C and D only).

11.2.2. Gulf Sturgeon

RPM 3: The USACE will coordinate with the Service on final design of the fish passage channel and the monitoring and adaptive management plan for the fish passage channel (Alternatives C and D only).

RPM 4: In cooperation with the Service and MDWFP, the USACE will identify and implement a monitoring strategy to determine if the amount or extent of take is exceeded during project construction (all alternatives).

11.2.3. Ringed Map, Pearl River Map and Alligator Snapping Turtles

RPM 5: The USACE will establish or fund a headstarting program and release turtles into suitable habitat within the Pearl River Basin over a five- year period (all alternatives).

RPM 6: The USACE will coordinate with the Service on a plan to protect, restore, or enhance habitat within the channel improvement area post-project (Alternative E only).

RPM 7: The USACE will coordinate with the Service on a plan to protect, restore, or enhance habitat within the impoundment should additional data collected during PED indicate velocities will be within the range of suitability for ringed map and Pearl River turtles (Alternative C and D only).

11.2.4. Louisiana Pigtoe

RPM 8: The USACE will establish one mussel bed downstream of the new weir, similar to the conditions that exist just downstream of the Ross Barnett Reservoir (Alternative C and D only).

RPM 9: The USACE will develop a Service-approved plan and strategy for the rescue and relocation of Louisiana pigtoe from the impoundment to upstream reaches (Alternative C and D only).

11.2.5. Monarch butterfly

RPM 10: The USACE will minimize effects of pesticide and insecticide exposure to the monarch butterfly within the project area by utilizing targeted applications or in a non-targeted manner with a Service-approved plan.

RPM 11: The USACE will promote milkweed and nectar source plantings for impoundments and levees.

11.3. Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, the USACE must comply with the terms and conditions (T&Cs) of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, the USACE must require any permittee, contractor, or grantee to implement these T&Cs through enforceable terms that the USACE includes in the permit, contract, or grant document.

11.3.1 Gulf Sturgeon

T&C #1 (RPM #3). The USACE will create a Gulf sturgeon technical team consisting of the USACE, Service, RHDD, and MDWFP, as appropriate, to develop the design standards for the fish passage structure. The lower Yellowstone pallid sturgeon fish passage structure should be evaluated as a potential model.

T&C 2 (RPM #4). The USACE will monitor the amount of and extent of incidental take of Gulf sturgeon during project construction (up to five years). Such monitoring will quantify the number of telemetered Gulf sturgeon that encounter the new weir during upstream migration but are blocked from passing upstream, the number of telemetered Gulf sturgeon that attempt or successfully pass through the fish passage structure, and the number of telemetered Gulf sturgeon that are injured or killed during downstream passage through the weir gate.

11.3.2. Ringed Map, Pearl River Map, and Alligator Snapping Turtles

T&C 3 (RPM 5). The USACE will fund or establish a headstarting project to include collection of eggs from the project study area before construction, incubating eggs in a climate controlled facility, raising juveniles to one year or greater, then release back into the Pearl River and/or tributaries according to a Service-approved headstarting plan.

T&C 4 (RPM 6). The USACE will develop and implement a plan to protect, restore, or enhance instream habitat for Alternative E, including: the revegetation of riverbanks, the placement of instream woody habitat, the creation of sandbars, and other features beneficial to turtle species.

T&C 5 (RPM 7). The USACE will develop and implement a plan to protect, restore, or enhance impoundment habitat for Alternative C and D if velocity analysis indicates post-weir velocity will be within the range of suitability for map turtles. Such features of a plan will include the placement of instream woody habitat, reforestation of lake edges, the creation of sandbars, and other features beneficial to turtle species; and the legal protection and enforcement of nesting sandbar habitats.

11.3.3. Louisiana Pigtoe

T&C 6 (RPM 8). The USACE will establish one mussel bed downstream of the new weir for Alternative C or D after all weir, fish passage, and overbank excavation has occurred. The design standards will be based on the recommendations of a USACE-led mussel technical team consisting of the USACE, Service, and MDWFP, as appropriate.

T&C 7 (RPM 9). The USACE will make every reasonable effort to collect and relocate Louisiana pigtoe from the proposed impoundment area for Alternative C and D to areas upstream of the impoundment. This effort will be coordinated with the Service and MDWFP.

11.3.4. Monarch Butterfly

T&C 8 (RPM 10 and 11). The USACE will create a monarch butterfly technical team consisting of the USACE, Service, RHDD, and MDWFP, as appropriate, to develop a pesticide application and milkweed/nectar planting plan for areas deemed suitable for monarch butterfly habitat.

12.0. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the USACE.

1. Design and implement a plan to remove the Poole's Bluff and Bogue Chitto sills (i.e. obsolete fish passage barriers downstream of the proposed Action).
2. Establish one mussel bed within the channel improvement area (Alternative E only). The design standards should be based on the recommendations of a USACE-led mussel technical team consisting of USACE engineers, hydrologist, biologists along with Service biologists and MDWFP, as appropriate.
3. Conduct turtle and mussel surveys within terrestrial habitat mitigation lands.

13.0. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the USACE retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the USACE is required to immediately request a reinitiation of formal consultation.

14.0. LITERATURE CITED

4.0 Gulf Sturgeon

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