Maumelle River Aquatic Ecosystem Restoration Integrated Feasibility Report and Environmental Assessment

Continuing Authorities Program (CAP) – Section 206

November 2022

Study Description

Maumelle River, Pulaski County, AR, is a single purpose, ecosystem restoration, Continuing Authorities Program (CAP) Section 206 Feasibility Study. The Integrated Feasibility Report (IFR) document contains information relevant to both a Planning and Design Analysis used as a planning document by the U.S. Army Corps of Engineers (USACE) and an Environmental assessment (EA) initiated in 2019 in accordance with the CEQ's implementing regulations for the National Environmental Policy Act (NEPA), 40 CFR Parts 1500 – 1508, and the USACE ER 200-2-2, Environmental Quality: Procedures for Implementing NEPA.

Authority

The study is being performed under the standing authority of the U.S. Army Corps of Engineers (USACE) CAP Section 206 of the Water Resources Development Act (WRDA) of 1996, as amended (335 U.S Code 2201):

> "The Secretary may carry out an aquatic ecosystem restoration and protection project if the secretary determines that the project -
>
> (1) Will improve the quality of the environment and is in the public interest; and
>
> (2) Is cost effective."

Study Purpose

The feasibility study will evaluate opportunities for aquatic ecosystem restoration within the Maumelle River by restoring the natural hydrology of the river and restoring the native aquatic and riparian habitat to sustainably support native fish and wildlife species over the next 50 years. This IFR documents the feasibility study and serves as the decision document for project design and construction.

Study Scope and Location

The study is a CAP feasibility study for aquatic ecosystem restoration. CAP feasibility studies focus on water resource related projects of relatively smaller scope, cost, and complexity. A determination of Federal Interest to support a request for initial study was approved on August 10, 2016.

The study generally includes a three-mile segment of the Maumelle River, shown in Figure ES-1, north of Lake Maumelle and approximately 30 miles west of Little Rock, in Pulaski County, Arkansas. Construction of low water crossings and levees along the Maumelle River several decades ago restricted the natural floodplain of the river and degraded the aquatic ecosystem and riparian corridors by altering the natural hydrology of the river. This alteration caused erosion, sedimentation, and an overall degradation of the environmental ecosystem in the watershed. The study's objectives are to restore stream connectivity, restore the structure and function of riparian and freshwater forested wetlands, and restore floodplain

connectivity in the study area to environmentally optimal conditions to improve habitat for, and increase biodiversity of, native fish and wildlife species.

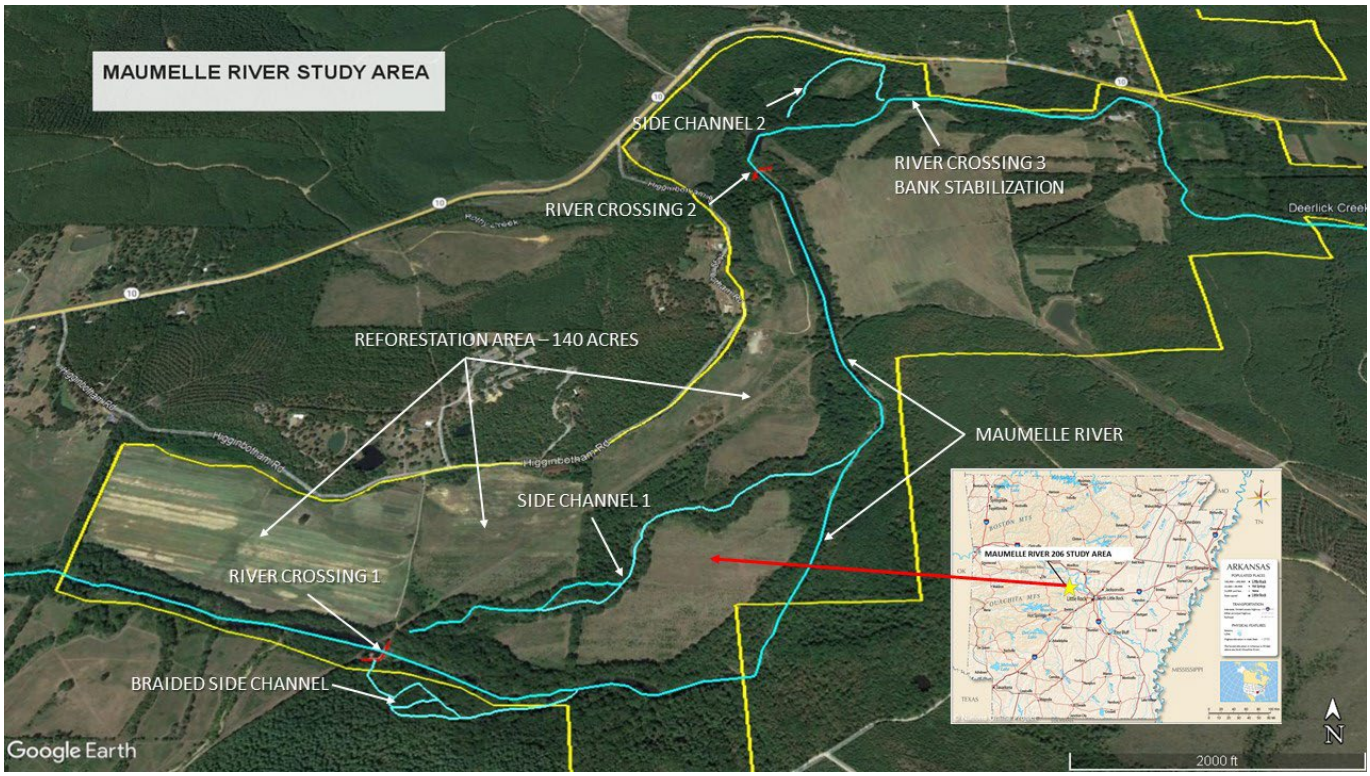

Figure 1.1 Study Area

Study Sponsor

The USACE Little Rock District (SWL) was responsible for the overall management of the study and the report preparation. As the non-Federal Sponsor (NFS), Central Arkansas Water (CAW) has been involved throughout the study process.

Problems and Opportunities

Problem Statement:

Use of the land in the study area for timber and sod farming contributed to and perpetuated the loss of bottom land hardwoods, degrading the natural ecosystem along the river. Man-made river crossings (low water crossings) and the construction of levees along the Maumelle River have restricted the natural floodplain of the river and have degraded the aquatic ecosystems and riparian corridors by altering the natural hydrology of the river causing erosion, sedimentation, and an overall degradation of the environmental ecosystem in the study area.

The opportunities identified include:

1. Restore the structure and function of aquatic and riparian ecosystems in the study area,

2.Restore natural hydrology of the Maumelle River in the study area,

3.Provide sustainable solutions to support native fish and bird species,

4.Reduce sediment and nutrient loads entering the Maumelle River and Lake Maumelle,

5.Restore aquatic habitat,

6.Restore riparian corridors,

7.Open the river channel to allow unrestricted movement of aquatic organisms,

8.Protect wetlands and forested areas,

9.Improve water quality.

Planning Objectives

Planning objectives reflect an expression of public and professional issues or concerns about the use of water and related land resources resulting from the analysis of existing and future conditions in the study area. These planning objectives were used in guiding the development of alternative plans and their evaluation for the period of analysis. The following planning objectives were used in formulation and evaluation of alternative plans.

Specific Planning Objectives

1.Restore riparian corridors to the extent practicable.

2.Restore ecological health in the study area.

3.Open river channel to allow unrestricted movement of aquatic organisms.

Planning Constraints

1.CAP funding limits.

2.Avoid impacts to the five federally listed, Threatened and Endangered Species.

3.Avoid impacts to the existing abandoned pipeline upstream of RC-1,

Alternatives

A number of management measures were considered for this study, including removal of low water river crossings, notching of low water river crossings, channel modification, planting of riparian vegetation and bottom-land hardwoods. Because there were multiple areas within the study area for ecosystem restoration, these measures were combined to create alternatives, with each alternative addressing a different area or two different alternatives addressing the same area. The ten (plans A-R below in Table

ES-1 below) alternatives would be combined to create alternative plans for evaluation and comparison. The average annual cost and net average annual habitat units (AAHU) used for comparison and evaluation is shown in Table ES-2.

Table ES-1 – Study Alternatives

Alternative Label	Alternative Name	Description
A	Remove River Crossing 1 (RC1)	Remove all concrete and dispose of off CAW property
B	Notch RC1	Notch in main channel; width should be same as width of Maumelle River above the impounded pool. Concrete removed from notch to be disposed of off CAW property.
C	Remove River Crossing 2 (RC2)	Remove all concrete and dispose of off CAW property.
D	Notch RC2	Notch in main channel; width should be same as width of Maumelle River above the impounded pool. All concrete to be disposed of off CAW property.
E	Open Side Channel 1 (SC1)	Notch levee adjacent to RC1. Material can be used to create microtopography across sod farm (PFP H) or disposed of off CAW property. Remove culverts (metal) in old road (road not needed). Dispose of off CAW Property. Remove culverts (concrete) in old road (road not needed). Dispose of off CAW Property.
F	Open Side Channel 2 (SC2)	Notch levee between Maumelle River and SC2. Width of opening should be approximately equal to average width of SC2. Material can be used for microtopography across sod farm or disposed of off CAW property. Remove road crossing on SC2.
G	Restore Tributary A	Block channelized ditch on west end of field. Excavate/Restore Tributary A. Dirt can spread across fields in low level mounds (pimple mounds) and/or elongated ridges (goal is to create microtopography across field). Remove culvert from road (leave gravel low water crossing for CAW access to river). Block channelized ditch. Notch levee (to reconnect Tributary. A to existing channel). Plug ditch to direct Tributary A flow into existing channel through woods). Plant riparian area with native bottomland hardwood tree species (for riparian restoration).
H	Sod Farm Reforestation	Plant sod fields to bottomland hardwood tree species. (For terrestrial reforestation).
I	Repair River Crossing 3 (RC3)	Construct rock vanes at a 20^{o} angle upstream
R	Combinations of River Crossings	This alternative consists of combining the removal and notching of the river crossing alternatives (RC1 and RC2). Because the AAHUs were not additive, requiring separate AAHU calculations to be developed when they were combined. The combinations were treated as four scales: R1 – Notch RC1 and Remove RC2 R2 – Notch RC1 and Notch RC2 R3 – Remove RC1 and Notch RC2 R4 – Remove RC1 and Remove RC2

Table ES-2 - Average annual cost and net average annual habitat units

Alternative	Description	Average Annual Cost ($1,000)	Net AAHU
A	Remove RC1	$6	10
B	Notch RC1	5	2
C	Remove RC2	7	8
D	Notch RC2	9	5
E	Open SC1	5	12
F	Open SC2	6	6
G	Restore Trib A	30	80
H	Sod Farm Reforestation	25	43
I	Repair RC3 Bank Erosion	5	1
R1	Notch RC1 and Notch RC2	14	12
R2	Notch RC1 and Remove RC2	12	14
R3	Remove RC1 and Notch RC2	15	20
R4	Remove RC1 and Remove RC2	13	22

Best Buy Plans

The array of Best Buy Plans identified through Cost Effective and Incremental Analysis (CEICA) are shown in Table ES-3. A comparative “Is It Worth It Analysis” was performed on this array to identify the recommended plan.

Table ES-3 – Best Buy Plans

Plan	Description	Output (AAHU)	Average Annual Cost ($1,000)	Average Cost Per AAHU ($1,000)	Incremental Cost ($1,000)	Incremental Output (AAHU)	Incremental Cost per Incremental Output ($1,000)	First Cost
1	No Action	0	0					
2	Restore Tributary A	80	$30	$0.38	$30	80	$0.375	$685,000
3	Restore Tributary A, Open SC1	92	35	0.38	5	12	0.417	824,000
4	Restore Tributary A, Open SC1, Sod Farm Reforestation	135	60	0.44	25	43	0.581	1,343,000
5	Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and RC2	157	73	0.46	13	22	0.591	1,718,000
6	Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and RC2, Open SC2	163	79	0.48	6	6	1.000	1,898,000
7	Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and RC2, Open SC2, Repair RC3 Bank Erosion	164	84	0.51	5	1	5.000	2,028,000

Recommended Plan

Through the “Is It Worth It Analysis”, Plan 5 was identified as the Recommended Plan. This plan creates 157 AAHUs and restores 470 acres. This plan achieves all three identified objectives, with Objective 3 (floodplain connectivity) being partially met (reconnection of SC1. SC2 would remain isolated).

Removal of the two low water dams (RC1 and RC2) will restore stream connectivity for numerous aquatic species inhabiting the Maumelle River and Lake Maumelle.

Notching of the earthen levee adjacent to RC1 will reconnect the Maumelle River to side channel 1, thereby restoring floodplain connectivity and restoring important spawning and nursery habitat for many aquatic organisms.

The restoration of Tributary A and riparian reforestation will restore the natural stream channel that once existed on the current sod farm. This restoration, together with the associated blockages of channelized ditches, will decrease sediment and nutrient movement into the Maumelle River and side channels. These reductions will result in a vast improvement of important habitat for many aquatic organisms.

There would be significant beneficial effects from restoring the freshwater forested wetland (bottomland hardwood forest) that historically existed in the study area. This plan restores a native floodplain bottomland hardwood forest that connects riparian forest communities to higher bottomlands (flood <5 year frequency) and upland forested habitats, thereby reducing forest fragmentation and increasing habitat diversity, availability, and connectivity important for numerous native forest-dependent wildlife species, including species of conservation concern (forest interior birds, reptiles and amphibians, and bats), as well as for relatively stable native wildlife species. Reforestation of the sod farm result in the reduction of nutrients currently being transported into side channels. It will also help reduce the spread of invasive species that threaten native habitats.

The restored freshwater forested wetland will maximize water quality benefits by filtering out sediments and chemical constituents. The restored forested wetland will increase the forage availability and cover started in Plan 4. The restored forested wetland will also maximize the organic allochthonous material imported to the aquatic system started in Plan 4, thereby increasing the energy to the lower trophic organisms that drive and support the Maumelle River ecosystem. This plan also reduces the loss of water supply storage in Lake Maumelle due to sedimentation.

Plan 5 provides a significant increase in ecosystem restoration in the study area by completing the riparian reforestation implemented with the Tributary A restoration.

Upon the determination of the recommended plan, costs were refined, and an abbreviated risk assessment was made on the risk to cost and scope, which result in a more risk informed estimate of the project first costs. The estimated first cost for the recommended plan is $2,464,000. This includes $1,354,000 for construction, including monitoring and adaptive management, $547,000 for land and damages, and $462,000 for pre-engineering design and $101,000 for construction management.

ES-4 - Project First Costs (October 2022 Prices)

Feature	First Cost
Construction	$1,354,000
Lands and Damages	547,000
PED	462,000
Construction Management	101,000

Total	$2,464,000

The cost share allocation between the Federal government and the Non-Federal sponsor. Ecosystem restoration is cost shared 65% Federal and 35% Non-Federal, with the Non-Federal sponsor responsible for all lands and damages costs. With an estimated $547,000 for lands and damages, a $315,400 cash contribution would be required by the sponsor to achieve a 35% contribution of $862,400. The 65% Federal share would be $1,601,600.

Table ES-5 – Cost Share Allocation (October 2022 Prices)

Feature	Federal	Non-Federal Sponsor	Total
Construction	$1,354,000		$1,354,000
Lands and Damages		547,000	547,000
PED	462,000		462,000
Construction Management	101,000		101,000
Subtotal	1,917,000	547,000	2,464,000
Non-Federal Sponsor Cash		315,400	
Adjustment to achieve 65/35	-315,400		
Total	$1,601,600	$862,400	$2,464,000
Cost Share Percentage	65%	35%	

Environmental Compliance

Environmental compliance for this project was initiated in the summer of 2019 and will continue until completion of project construction. An Environmental Assessment has been prepared in accordance with the National Environmental Policy Act and is included within the Integrated Feasibility Report. A Clean Water Act Section 404(b)(1) Analysis was completed for the study with a determination that the proposed placement site for discharge of or fill material complies with the Section 404(b)(1) guidelines. A Short Term Activity Authorization (STAA) application was prepared and submitted to the Arkansas Department of Environmental Quality (ADEQ) for Section 401 water quality certification on September 20, 2021. Water quality certification (STAA) was provided in a letter dated October 14, 2021. A Planning Aid Letter concurring with the Proposed Action was received from the U.S. Fish and Wildlife Service (USFWS) on July 21, 2021. A Fish and Wildlife Service Coordination Act Letter concurring with the Proposed Action was received from the (USFWS) on March 17, 2022. Receipt of these letters concludes coordination under the Fish and Wildlife Coordination Act of 1958. Both letters are included in Appendix C-2 Environmental Compliance. There have been multiple meetings with state and federal resource agencies in order to adequately meet project review purposes. Compliance with Section 106 of the National Historic Preservation Act has been completed by the execution of a Programmatic Agreement (PA) with potentially affected Tribes, Arkansas SHPO, the non-federal sponsor, and USACE. A copy of the PA is included in Appendix C-2. Other applicable permitting requirements, such as instruments for surface water rights and availability, will be obtained before project construction if necessary.

Public Coordination

In accordance with 40 CFR 1501.7, 1503, and 1506.6, the USACE Little Rock District (USACE-SWL) initiated National Environmental Protection Act (NEPA) agency scoping efforts on July 18, 2019 via scoping letters mailed to state and federal resource agencies, requesting information and comments that would assist in the preparation of the Maumelle River Aquatic Ecosystem Restoration Feasibility Study and accompanying Environmental Assessment (EA). This release initiated a 30-day public comment period on the proposed study (July 25 – August 30, 2019). The news release was also placed on the USACE webpage and social media. No public comments were received from this outreach.

An initial agency meeting was held February 18, 2020, with the non-federal sponsor, USFWS, and several state agencies to review the study goals and objectives and begin development of restoration opportunities.

A Notice of Availability of the Maumelle River Aquatic Ecosystem Restoration Integrated Feasibility Report and Environmental Assessment was released on February 17, 2022 for agency and public review. The NOA included a 30-day comment period (February 21 – March 24, 2022). Agency comments are included in Section 1 following the Notice of Availability letter and under the FWCA Section (FWS response). No public comments were received on the Draft Report or EA.

Non-Federal Support

CAW, the NFS for the Maumelle River Aquatic Ecosystem Restoration Feasibility Study, was actively engaged in the formulation of the Alternatives and Tentatively Selected Plan. The NFS has the capability to furnish lands, easements, and rights-of-way for this project.

Conclusion

The proposed actions described in this report are in the national interest. The recommendations contained herein reflect the information available at the time the report was prepared. To ensure all applicable laws and policies are addressed for the Recommended Plan, this feasibility study has undergone concurrent reviews (public, policy, and agency technical review [ATR]). The PDT addressed any outstanding issues raised during the reviews and confirmed the analysis in this IFR-EA and recommendations to move forward with development of the feasibility-level analysis and design.

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Appendices

1 General Information

The Integrated Feasibility Report (IFR) details the planning process undertaken for the CAP Section 206 Maumelle River Aquatic Ecosystem Restoration Feasibility Study and documents the Environmental Assessment (EA) to satisfy the National Environmental Policy Act (NEPA). Central Arkansas Water (CAW) sent a letter of intent to the Little Rock District's (SWL) District Commander on October 6, 2011. The letter contained CAW's desire to initiate a study partnership under the USACE Section 206 Program for Aquatic Ecosystem Restoration (ER). A Feasibility Cost Share Agreement (FCSA) was signed between USACE Little Rock District (SWL) and CAW on September 20, 2018. The Maumelle River Aquatic ER Feasibility Study, hereafter called "Study", is a single purpose, Continuing Authorities Program (CAP) Section 206 Aquatic ER Feasibility Study.

1.1 Study Authority

The study is being performed under the standing authority of the USACE CAP Section 206 of the Water Resources Development Act (WRDA) of 1996, as amended (335 U.S Code 2201):

> "The Secretary may carry out an aquatic ecosystem restoration and protection project if the secretary determines that the project -
>
> 1. Will improve the quality of the environment and is in the public interest; and
>
> 2. Is cost effective."

This is a CAP which focuses on water resource related projects of relatively smaller scope, cost, and complexity. Unlike traditional USACE civil works projects that are of wider scope and complexity, the CAP is a delegated authority to plan, design, and construct certain types of water resource and environmental restoration projects without specific Congressional authorization.

1.2 Study Purpose and Need

The primary purpose of the study is to investigate and determine modifications that would restore degraded ecological structure and function to aquatic and riparian habitat in the Maumelle River study area. This includes assessing opportunities, evaluating alternatives, and selecting a plan from those alternatives. The selected plan must be technically sound, environmentally acceptable, economically feasible, and supported by the local sponsor, CAW, and the Federal Government. The need is to address current erosion, sedimentation, and altered hydrology in the study area that has caused the degraded ecological structure and function.

1.3 Federal Interest

Federal interest in water resources development is established by law. Within the larger Federal interest in water resource development, the USACE is authorized to carry out projects in seven mission areas: navigation, flood damage reduction, ecosystem restoration, hurricane and storm damage reduction, water supply, hydroelectric power generation and recreation. Ecosystem restoration projects improve ecosystem structure and function.

Freshwater animal species are disappearing five times faster than terrestrial animals due, partially, to the widespread physical alteration of rivers (Ricciardi and Rasmussen 1999). Of 860,000 river miles within the United States, approximately 24 percent have been impacted by channelization, impoundment, or navigation. The USFWS estimates 70 percent of the riparian habitats nationwide have been lost or altered, and 50 percent of all listed threatened or endangered species depend on rivers and streams for their continued existence.

The Maumelle River isn't exempt from these impacts. Anthropomorphic changes have caused substantial alterations of the natural system. Low water crossings in the stream channel, man-made levees built adjacent to the river channel, the loss of historic Freshwater Emergent Wetlands, the conversion of riparian and bottomland hardwood forest habitats, and degradation of Freshwater Forested Wetlands, has resulted in significant adverse impacts to the structure and function of the natural ecosystem that once existed in the study area.

The Maumelle River watershed location adjacent to the Arkansas River and the Mississippi Alluvial Valley (MAV) makes it an especially important area for Neotropical Migratory Birds (NTMB). Since European settlement, more than 75 percent of the original 24 million acres of floodplain forest, swamps, sloughs, and riverine habitat has been lost, mostly to agriculture. Much of the remnant forest occurs in small, isolated tracts of limited conservation value. As migratory birds travel the MAV and Arkansas River Valley, forested watersheds immediately west of the MAV have become even more important. The restoration of Freshwater Emergent and Forested Wetlands, and forested riparian areas will help meet the biological needs of NTMBs.

A Federal Interest Determination was completed in August 2016. The project has a local sponsor, and there are proven measures, such as removal of one low water crossing and reforestation of several hundred acres of former sod fields, that have been implemented successfully within the region that would address the problems in the study area and fall within the CAP funding limits.

1.4 Study Area

The study area is located along three miles of the Maumelle River, approximately 30 miles west of Little Rock, in Pulaski County, Arkansas (Figure 1.1). Construction of low water crossings and levees along the Maumelle River several decades ago restricted the natural floodplain of the river and degraded the aquatic ecosystem and riparian corridors by altering the natural hydrology of the river. This alteration caused erosion, sedimentation, and an overall degradation of the environmental ecosystem in the watershed. The study's objectives are to restore stream connectivity, restore the structure and function of riparian and freshwater forested wetlands, and restore floodplain connectivity in the study area to environmentally optimal conditions to improve habitat for, and increase biodiversity of, native fish and wildlife species. Lake Maumelle provides part of the water supply for the approximately 500,000 residents in Central Arkansas.

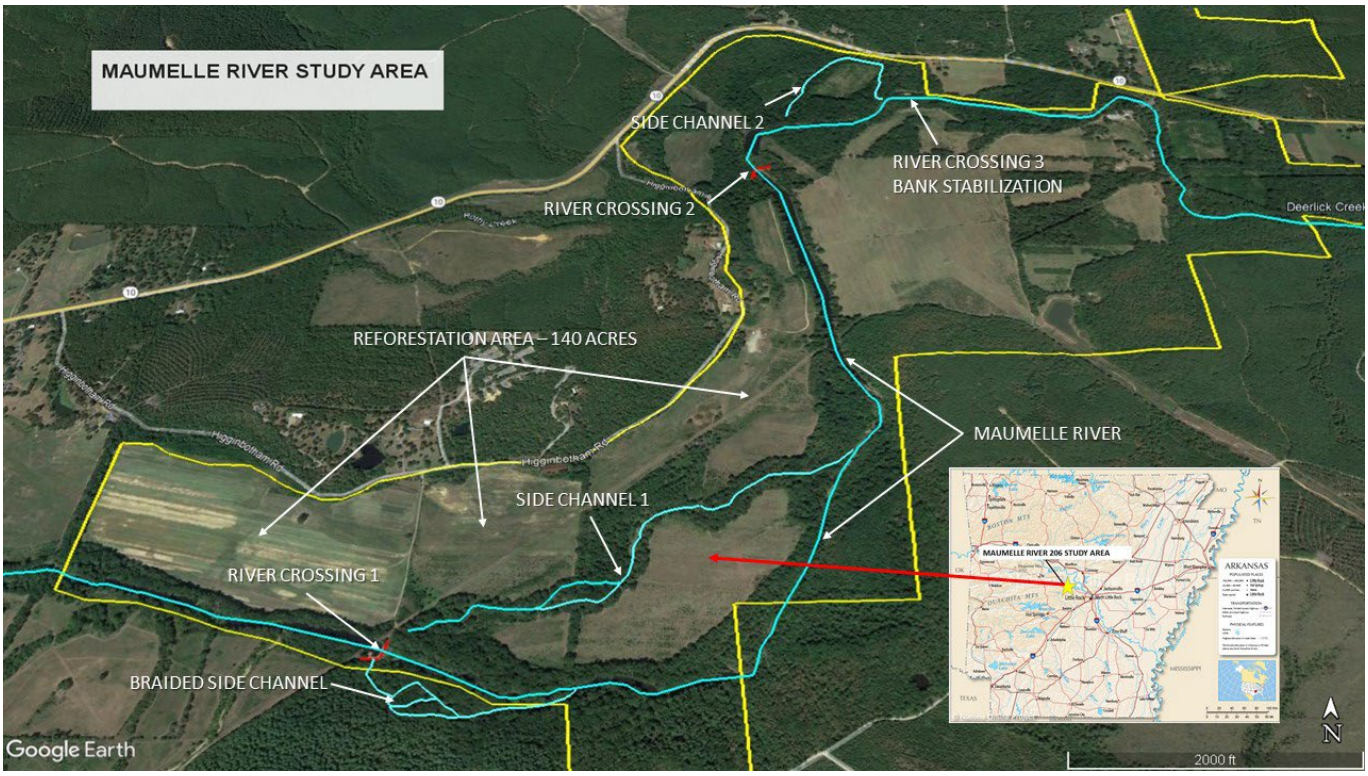

Figure 1.1. Study Area

1.5 Non-Federal Sponsor

Central Arkansas Water (CAW) sent a letter of intent to the SWL District Commander with the desire to initiate a study and serve as the Non-Federal Study Sponsor. CAW owns and operates two raw water supplies, Lake Maumelle and Lake Winona, that provide drinking water for approximately 500,000 customers in central Arkansas. Lake Maumelle is a 13.9-square-mile reservoir that supplies 65 percent of CAW's water demand. CAW has developed a land use plan for managing the watershed that considers multiple benefits of land and water resources in the watershed such as water quality protection, ecological restoration, recreation, education, and aesthetic value.

1.6 Prior Reports and Existing Water Projects

Previous reports by CAW and others on the Maumelle River and its resources include:

1. Comprehensive Land Use and Site Development Plan.

2. Maumelle River & Tributaries Historical & Existing Conditions.

CAW is currently also a sponsor for a water supply storage reallocation study with Little Rock District and Vicksburg District, USACE.

1.7 Planning Process

The USACE plan formulation process, as specified in ER 1105-2-100 (Planning Guidance Notebook), was used to develop measures for problem solving and identifying opportunities, and ultimately to develop an array of comprehensive alternative plans from which a plan is recommended for implementation.

This section presents the rationale for the development of the Recommended Plan. It describes the USACE iterative six-step planning process used to develop, evaluate, and compare the array of management measures and preliminary alternative plans that have been considered. The six steps used in the alternative plan formulation process include:

1. Identifying Problems and Opportunities: The specific problems and opportunities to be addressed in the study are identified, and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified.

2. Inventorying and Forecasting Resources: Existing and FWOP (FWOP / No Action) conditions are identified, analyzed, and forecast for a 50-year period of analysis. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation are characterized and documented.

3. Formulating Alternative Plans: Alternative plans are formulated that address the alternative planning objectives. An initial set of alternative plans are developed and evaluated at a preliminary level of detail and are subsequently screened into a more final array of alternative plans. Each plan is evaluated for its costs, potential effects, and benefits, and is compared with the No Action Plan for the 50-year period of analysis.

4. Evaluating Alternative Plans: Alternative plans are evaluated for their potential to meet specified objectives and constraints, effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans are evaluated using the system of accounts framework NED, Environmental Quality, Regional Economic Development [RED], and Other Social Effects [OSE]) specified in the USACE' Principles and Guidelines (P&G) and Engineering Regulation (ER) 1105-2-100.

5. Comparing Alternative Plans: Alternative plans are compared with one another and with the No Action Plan (FWOP). Results of analyses are presented (e.g., benefits and costs, potential environmental effects, trade-offs, risks, and uncertainties) to prioritize and rank alternative plans.

6. Selecting the Recommended Plan: A plan is selected for recommendation, and related responsibilities and cost allocations are identified for project approval and implementation.

1.8 Problems and Opportunities

Water resources projects are planned and implemented to solve problems, meet challenges, and seize opportunities. In the alternative planning setting, a problem can be thought of as an undesirable condition. An opportunity offers a chance for progress or improvement of the situation. The identification of problems and opportunities gives focus to the alternative planning

effort and aids in the development of planning objectives. Problems and opportunities can also be viewed as local and regional resource conditions that could be modified in response to expressed public concerns. This section identifies the problems and opportunities in the study area based on the assessment of existing and expected FWOP conditions.

The objective of the USACE with respect to ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Restored ecosystems should mimic, as closely as possible, conditions, which would occur in the area in the absence of human changes to the landscape and hydrology. Indicators of success would include the presence of a large variety of native plants and animals, the ability of the area to sustain larger numbers of certain indicator species or more biologically desirable species, and the ability of the restored area to continue to function and produce the desired outputs with a minimum of continuing human intervention. Those restoration opportunities that are associated with wetlands, riparian, and other floodplain and aquatic systems are most appropriate for USACE involvement.

Problem Statement:

Use of the land in the study area for timber and sod farming contributed to and perpetuated the loss of bottom land hardwoods, degrading the natural ecosystem along the river. Man-made river crossings (low water crossings) and the construction of levees along the Maumelle River have restricted the natural floodplain of the river and have degraded the aquatic ecosystems and riparian corridors by altering the natural hydrology of the river causing erosion, sedimentation, and an overall degradation of the environmental ecosystem in the study area.

1. Degraded Ecosystem.

2. Natural Hydrology disrupted. River and floodplain separated by levees.

3. Loss of fish and wildlife habitat quality and diversity.

4. There is little aquatic connectivity between the upstream and downstream habitats. Nutrient loading and sedimentation of the Maumelle River and side channels will continue to occur and increase.

5. There are invasive species in the study area that out-compete native flora. These invasive species will continue to spread in altered habitats.

The opportunities identified include:

1. Restore the structure and function of aquatic and riparian ecosystems in the study area.

2. Restore natural hydrology of the Maumelle River in the study area.

3. Provide sustainable solutions to support native fish and bird species.

4. Reduce sediment and nutrient loads entering the Maumelle River and Lake Maumelle.

5. Restore aquatic habitat.

6. Restore riparian corridors.

7. Open the river channel for fish migration and spawning.

8. Protect wetlands and forested areas.

9. Improve water quality.

1.9 Planning Objectives and Constraints

An objective is a statement of the intended purposes of the planning process; it is a statement of what an alternative plan should try to achieve. More specific than goals, a set of objectives effectively constitutes the mission statement of the Federal/non-Federal planning partnership.

Our planning partnerships exist in a world of scarcity where it is not possible to do everything. Our choices are constrained by a number of factors. Planning is no exception. An essential element of any planning study is the set of constraints confronting the planners. A constraint is basically a restriction that limits the extent of the planning process. Constraints, like objectives, are unique to each planning study.

Federal Objective

The P&G states that the Federal objective of water and related land resources project planning is to contribute to NED consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. The P&G use of the term objective should be distinguished from study planning objectives, which are more specific in terms of expected or desired outputs. The P&G's objective (Federal objective) may be considered more of a National goal.

The NER Plan

For ER projects, a plan that reasonably maximizes ER benefits compared to costs, consistent with the Federal objective, shall be selected. The selected plan must be shown to be cost effective and justified to achieve the desired level of output. This plan shall be identified as the NER Plan.

Planning Objectives

Planning objectives reflect an expression of public and professional issues or concerns about the use of water and related land resources resulting from the analysis of existing and future conditions in the study area. These planning objectives were used in guiding the development of alternative plans and their evaluation for the period of analysis. The following planning objectives were used in formulation and evaluation of alternative plans:

1. Restore riparian corridors to the extent practicable.

2. Restore ecological health in the study area.

3. Open river channel for fish migration and spawning.

Planning Constraints

The following are institutional constraints that apply to this study:

- Plans must be consistent with Federal, State, and local laws such as the NEPA, Endangered Species Act (ESA), Fish and Wildlife Coordination Act (FWCA), Clean Water Act (CWA), and the National Historic Preservation Act (NHPA).
- Minimize impacts to culturally significant landmarks and areas.
- The study will be completed within the CAP scope and cost limitations.

The following planning constraints apply to this study:

- Avoid impacts to the existing abandoned pipeline upstream of RC-1.

2 Existing Conditions and Expected Future Without Project Conditions

2.1 Hydrology and Hydraulics

The study focuses on the portion of the Maumelle River, running through land owned by Central Arkansas Water just east of Lake Maumelle in Pulaski County, Arkansas. Starting in the 1950's, the land to either side of the river has been largely deforested and leveled for agricultural purposes. Levees were also constructed adjacent to the channel to prevent flooding of agricultural fields that resulted in disconnected side channels. Historically, four river crossings, or small dams, were installed to provide water storage for irrigation. At the initiation of this study, it was noted that one river crossing had previously failed and was believed to be causing stream bank erosion. During the feasibility phase of the study, the most downstream river crossing, RC4, was completely removed and a new culvert crossing was installed.

The river crossings are acting as grade control structures and removing a crossing has the potential to destabilize the channel and incite erosion. The stability of the channel post removal must be considered before any action occurs. Furthermore, there is interest in reconnecting two side channels. Of interest is the frequency of connectivity as well as the duration of connectivity between the main channel and the side channels.

Sediment transport capacity of the Maumelle River was calculated under 3 conditions: 1) AS IS - the current conditions, 2) Removed - after the removal of the river crossings, and 3) Modified Channel, Removal of River Crossings - after regrading of the river near the river crossing sites. Sediment transport capacity is dependent on grain size. With no indication of clay or sand size sediment in the system, a pebble count was performed at a representative location in the river. This grain size analysis was applied to the entire river reach during the sediment transport capacity analysis. Because the Maumelle River is considered stable in its current condition,

results of the AS IS model indicate that a threshold of 6600 tons/day is an acceptable sediment transport capacity for this river. The smaller gravels contribute to the higher sediment transport capacity values in the system, but the armoring, which is common in a gravel/cobble/boulder river, likely prevents the smaller constituents from mobilizing. None of the results of the two removal scenarios resulted in sediment transport capacities approaching the upper threshold established for this system indicating that the Maumelle River will not suffer significant channel instabilities after the removal of the river crossings.

The duration of connectivity with the side channels is dependent on the elevation to which the connection is excavated. Assuming the elevations pulled from LiDAR are representative of the side channel inverts, a connectivity duration of 3% and 4% can be achieved for side channels 1 and 2 respectively.

It should be noted that the study area lies in a floodway as indicated in FEMA map numbers 05119C0090G and 05119C0255G. A potential rise in flood levels should be considered during the design phase

Table 2.1. Flow Rates

		Annual Exceedance Probability				
	River Station	50%	20%	10%	4%	2%
River Name	Feet	cfs	cfs	cfs	cfs	cfs
Bringle Creek	958	2060	2939	3532	4359	4862
Maumelle River	42161	5046	8271	10591	13962	16052
Maumelle below Bringle	8868	8561	12885	16048	20132	22982

2.2 Climate Change Analysis

While there are concerns related to climate change with the Maumelle Ecosystem Restoration, overall the project will increase resiliency of the Maumelle River Ecosystem. This project cannot prevent a shift in average temperature in the area. But by restoring the sod farm and removing the low head dams, the area will become better fish habitat. Restoring the riparian zones will provide shade to reduce stream water temperatures. It will filter sediment and pollution which can also cause an increase in water temperature. The reforestation of the overbanks will provide storing of flood water and will help in decreasing erosion and increase bank stabilization. Increased vegetation will work to support the animals most threatened by climate change.

The ecosystem restoration project is itself potentially vulnerable to climate change, though those same vulnerabilities are present without the project, and considerations should be made for increasing temperatures and increased extreme precipitation. Considerations should be taken when planting to make sure that vegetation are adapted for wet climatic conditions and increased temperature. For example, bald cypress and tupelo gum could be planted in the lower elevations. Species will vary as elevation increases. As for increasing temperature, hardwood seedlings from regional sources would be well adapted for climatic variations as the surrounding native vegetation. Overall, the project will increase the resilience of the Maumelle River's ecosystem to climate change.

2.3 Environmental Resources – Affected Environment

This section presents a description of the environmental resources and baseline conditions that could be affected from implementing the Recommended Plan. Unless stated otherwise, it is assumed some of the existing conditions will continue to degrade in the FWOP. The No Action Alternative is intermittently referred to as the FWOP scenario.

In compliance with NEPA, Commission on Environmental Quality (CEQ), and 32 Code of Federal Regulations (CFR) 775 guidelines, the discussion of the affected environment (i.e., existing conditions) focuses on those resource areas that are potentially subject to significant impacts. In addition, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

For each resource area section, the resource is: (1) generally defined, (2) given an appropriate project area, and (3) described for existing conditions. The project area for each resource is a geographic area within which the Proposed Action may exert some influence. The existing conditions discussion for each resource area presents the condition of the resource within the respective project area.

2.3.1 Resource Significance

In compliance with the CEQ NEPA regulations (40 CFR 1500.1(b), 1501.7(a)(2) and (3), and 1502.2(b)), as well as guidance for USACE ecosystem restoration projects, ER 1105-2-100 Section 2.3 Significant Resources and Significant Effects, require the identification of significant resources and attributes that are likely to be affected by one or more of the Plans. “Significant” is defined as “likely to have a material bearing on the decision-making process”. Resource significance is determined by the importance and non-monetary criteria. The criteria are defined as:

- Institutional Recognition: The importance of the resource or attribute is acknowledged in the laws, adopted plans, and other policy statements of public agencies or private groups.

- Public Recognition: The resource or attribute is considered important by some segment of the public.

- Technical Recognition: The importance of the resource or attribute is based on scientific or technical knowledge or judgment of critical resource characteristics.

2.3.2 Institutional Recognition

Significance based on institutional recognition means that the importance of the environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies or private groups. The institutional recognition of resource significance for the study area is demonstrated by the following laws, policies, treaties, plans, and cooperative agreements established for the conservation and protection of these environmental resources.

- ESA - The U.S. Fish and Wildlife Service’s Information for Planning and Consultation (IPaC) identifies four federally listed species that may be present in the study area: northern long-eared bat (*Myotis septentrionalis*), red knot (*Calidris canutus*), piping

plover (*Charadrius melodus*), eastern black rail (*Laterallus jamaicensis ssp. jamaicensis*), and one candidate species – monarch butterfly (*Danaus plexippus*). It is anticipated that the ecosystem restoration proposed, such as native bottomland hardwood species plantingsin the study area would provide benefits for the northern long-eared bat, however such benefits (e.g. loose bark, snags) would likely occur beyond the 50-year study horizon, as bottomland hardwood species take several decades to mature and exhibit such characteristics. .

- Arkansas Natural Heritage Commission (ANHC) Species of Conservation Concern – Three species of global and/or state concern species tracked by ANHC have been recorded in the study area. These species include Ouachita bluestar (*Amsonia hubrichtii*), Sticky hedge-hyssop (*Gratiola brevifolia*), and Leafy Barbara's-buttons (*Marshallia caespitosa var. signata).* Leafy Barbara's-buttons is currently be studied by professionals for possible description as a new species.

- Migratory Bird Treaty Act (MBTA) - The U.S. has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. These migratory bird conventions impose substantive obligations on the U.S. for the conservation of migratory birds and their habitats. The Maumelle River lies adjacent to, and is a tributary to, the Arkansas River, which is positioned on a natural migratory route. The proposed restoration of forested wetlands will serve as migratory stop-over habitat and/or summer nesting habitat for numerous species of neotropical migratory birds each year.

- WRDA of 1990 - This WRDA established an interim goal of no overall net loss of wetlands in the U.S. and set a long-term goal to increase the quality wetlands, as defined by acreage and function. The proposed TSP for the Maumelle River study will enhance and restore forested wetlands and riverine habitat within the project area.

- Executive Order (EO) 13112: Invasive Species - EO 13112 recognizes the significant contribution native species make to the well-being of the Nation's natural environment and directs Federal agencies to take preventive and responsive action to the threat of non-native species invasion and to provide restoration of native species and habitat conditions in ecosystems that have been invaded. The Maumelle River study addresses non-native invasive species by formulating plans to restore riparian and wetland habitats with native vegetative species that will help reduce the spread of these species.

- EO 13186: Migratory Birds - ER 13186 directs Federal agencies to promote the conservation of migratory bird populations through restoring and enhancing habitat. Because the Maumelle River study area supports neotropical migratory birds and their habitats, their institutional significance is recognized from a regional, national, and international perspective.

- Audubon Priority Bird List 2021 – This is a list of bird species of conservation concern that benefit most from various conservation efforts. There are several species that utilize the mesic hardwood forest habitats in the Maumelle River study area. Examples include wood thrush (*Hylocichla mustelina*), prothonotary warbler (*Protonotaria citrea*), hooded warbler (Wilsonia citrina), cerulean warbler (Setophaga cerulea), piping plover, red knot, and many other riparian and/or wetland dependent species.

- Partners in Flight (PIF) - PIF is a cooperative partnership between federal, state, and local government agencies, philanthropic foundations, professional organizations,

conservation groups, industry, academia, and private individuals. In an effort to prioritize conservation needs, PIF assessed the conservation vulnerability for land bird species based on biological criteria such as population size, breeding distribution, non-breeding distribution, threats to breeding habitats, threats to non-breeding areas, and population trends. The PIF "declining" Yellow Watch List include many species have lost 50%-90% of their population in the past 40 years, declines that are representative of deteriorating conditions in virtually every terrestrial habitat and region in the United States. Species on this list that may occur in the Maumelle River study area include the prothonotary warbler, cerulean warbler, wood thrush, and other riparian and/or wetland dependent species.

- North American Waterfowl Management Plan (NAWMP) - Established in 1986, the NAWMP is an international plan to reverse the downward trend in waterfowl populations. The goal of the plan is to protect, restore, and enhance wetland habitat and increase waterfowl population numbers. Restoration of forested wetlands proposed in the Maumelle River study will directly benefit migratory waterfowl that utilize forested wetlands during part of their lifecycle.

- North American Bird Conservation Initiative (NABCI) - The NABCI is a tri-national declaration of intent between the U.S., Canada, and Mexico to strengthen cooperation on the conservation of North American birds throughout their ranges and habitats. The Maumelle River study area is located West Gulf Coastal Plain / Ouachita Bird Conservation Region.

- North American Waterbird Conservation Plan (NAWCP) - The goal of the Waterbird Conservation of the Americas is to sustain and restore waterbird populations and breeding, migratory, and nonbreeding habitats in North America, Central America, and the Caribbean. Waterbirds will benefit from the measures proposed for the Maumelle River study. Increased quality of riverine and riparian habitats will attract waterbirds and supplement their food and cover resources.

- USFWS Birds of Conservation Concern (BCC) – Restoration proposed in the Maumelle River study will directly benefit BCC species. By restoring riparian corridors and forested wetlands, the study area's biodiversity will be improved which will effectively improve foraging and nesting sites for birds.

- Arkansas Wildlife Action Plan - The Arkansas Wildlife Action Plan identifies Species of Greatest Conservation Need (SGCN) for ecoregions throughout the state. The Maumelle River study area is located in the Ouachita Mountains ecoregion, near its confluence with the Arkansas River ecoregion, thus some species possibly occurring in the study area are included on both ecoregion lists. There are nine species of SGCN that would directly benefit from the implementation of the proposed aquatic and riparian ecosystem restoration measures.

Further support for the Institutional Recognition of resources in the Maumelle River study area is documented in Appendix C-1 Environmental Resources.

2.3.3 Public Recognition

Significance based on public recognition means that some segment of the public recognizes the importance of an environmental resource. Public recognition is evidenced by people engaged in activities that reflect an interest in or concern for a particular resource.

The U.S. Fish and Wildlife Service (USFWS), Arkansas Game and Fish Commission (AGFC), Arkansas Department of Environmental Quality (ADEQ) and CAW recently utilized federal, state, and private funds to remove River Crossing 4 (RC4) on Maumelle River to provide unimpeded riverine access by numerous aquatic organisms from Lake Maumelle to RC2. The efforts by this consortium of conservation groups are evidence of the Public Significance of the Maumelle River.

2.3.4 Technical Recognition

Significance based on technical recognition requires identification of critical resource characteristics such as scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity. Therefore, technical recognition of resources varies across geographic areas and spatial scale. The significant resources in the study area, specifically riverine and riparian habitat continue to be degraded throughout the contiguous U.S. These habitats have steadily declined due to channelization, impoundments, agriculture, and urbanization. The study area provides desirable stopover habitat for migratory species, as well as nesting and den sites for local fauna. The riverine and riparian habitat within the study area represent a larger faction of declining habitat throughout North America and are representative of the environmental effects of human impacts and disturbance.

A detailed discussion of Resource Significance is included in Appendix C-1 Environmental Resources.

2.3.5 Climate and Climate Change

Central Arkansas has a humid subtropical climate with hot, usually humid summers, but subject to drought, primarily in late summer. Summers are usually hot, occasionally extremely hot; winters are short and cool, but with marked temperature variations, as the area is subject to alternating incursions of warm, moist air from the Gulf of Mexico, and cold, dry air from Canada. The average temperature for the year in Little Rock is 62.7°F (17.1°C). The warmest month, on average, is July with an average temperature of 82.8°F (28.2°C). The coolest month on average is January, with an average temperature of 40.8°F (4.9°C). The highest recorded temperature in Little Rock is 114.0°F (45.6°C), which was recorded in August. The lowest recorded temperature in Little Rock is -5.0°F (-20.6°C), which was recorded in February (Weatherbase 2021).

The average amount of precipitation for the year in Little Rock is 49.8", with November averaging the most (5.3") precipitation. August averages the least amount of precipitation (2.6"). In terms of liquid precipitation, there are an average of 105.0 days of rain, with the most rain occurring in January with ten days of rain, and the least rain occurring in August with seven days. The Little Rock area averages 3.5” of snow annually, with 1.6” occurring in January (Weatherbase 2021).

In regard to climate change, it is important to understand the distinction between climate and weather. Weather is a set of the meteorological conditions for a given point in time in one particular place, while climate is the average, long-term (30 years or more) meteorological conditions and patterns for a geographic area (Brandt and others 2014). Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2014).

While there is no clear overall trend in average annual temperature for Arkansas, the National Oceanographic Atmospheric Administration Arkansas State Climate Summary reports that under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st century. Even under a pathway of lower greenhouse gas emissions, average annual temperatures are projected to exceed historical record levels most likely by the middle of the 21st century. Heat wave intensity is projected to increase, while cold waves are projected to be less severe.

According to “Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Arkansas, White and Red Rivers Region 11” the general consensus for this region is a mild upward trending for average precipitation and extreme precipitation events as well as an upward trending for average streamflow (CWTS 2015).

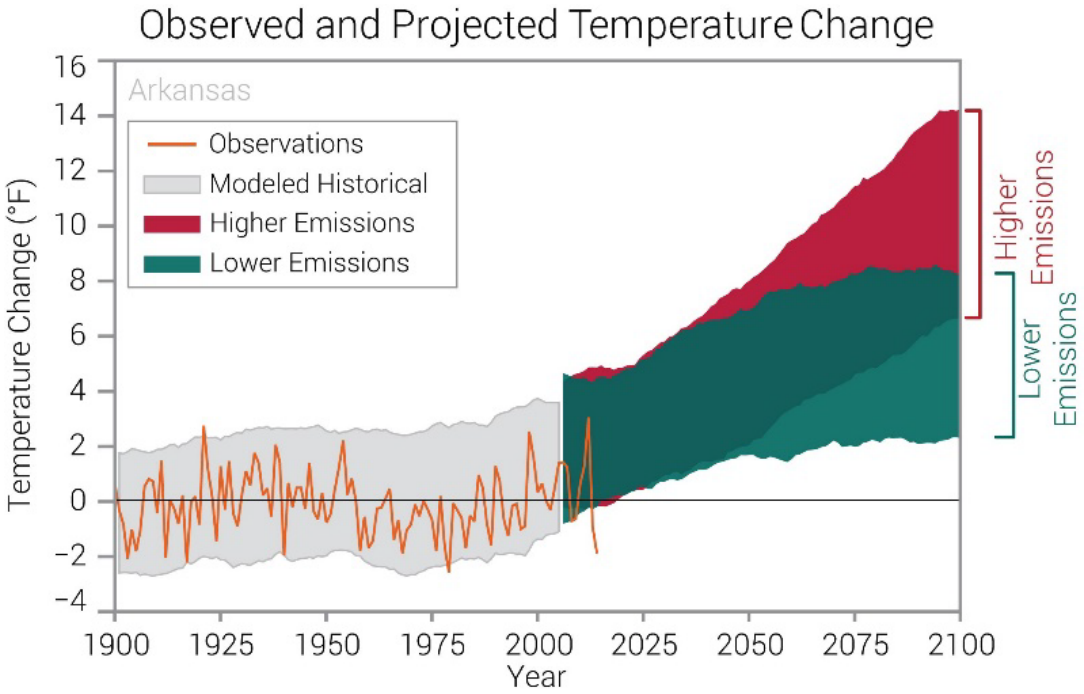

Figure 2.1. Observed and Projected Temperature Change

Future Without-Project Conditions

The trend of rising temperatures is predicted to continue into the future. Higher temps will increase the rate the loss of soil moisture during dry spells. As a result, naturally occurring droughts are projected to me more intense. Average annual precipitation amounts will continue

to fluctuate in the future, with no clear trend. Winter precipitation is projected to increase in Arkansas by mid-century. (Runkle et.al. 2017).

2.3.6 Geology, Topology, and Soils

The geology of an area includes bedrock materials and mineral deposits. The principal geologic factors influencing the stability of structures are soil stability, depth to bedrock, and seismic properties. Topography describes the physical characteristics of the land such as slope, elevation, and general surface features.

The topography of the study area is characterized by relatively flat to gently sloping terrain, with an elevation of ~ 100' above mean sea level (msl). Beyond the study area, the topography becomes relatively steep with elevations rising quickly to around 1000' msl. Geologic formations in the study area are Early Pennsylvanian-Morrowan in age. The dominant formation within the study area is Jackfork Sandstone, which is thin- to massive-bedded, fine- to coarse-grained, brown, tan, or bluish-gray quartzitic sandstones with subordinate brown, silty sandstones and gray-black shales. Toward the north of its outcrop area the shale units of the lower and middle Jackfork Sandstone take up more of the section and the sandstones are more lenticular, often occurring as chaotic masses in the shale. Minor conglomerates composed of quartz, chert, and metaquartzite occur notably in the southern exposures of the formation. A few poorly preserved invertebrate and plant fossils have been recovered from the Jackfork Formation. The Jackfork Sandstone rests conformably on the Stanley Shale and varies between 3,500 to 6,000 feet in thickness. Lithologic constituents include primarily sandstone and shale.

The Farmland Protection Policy Act (FPPA) (Public Law 97-98, Title XV, Subtitle I, Section (1539-1549) requires federal actions to minimize unnecessary and irreversible conversion of farmland to nonagricultural uses, specifically prime farmlands. The Act defines prime farmlands as "…land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion…" The act also exempts prime farmlands located within existing urban areas or areas that have been committed to urban development or water storage. Since bottomland hardwood forest is the historic condition, the restoration of the sod farm fields is exempt from the FPPA requirements. There are four soil types that occur within the sod farm fields (NRCS 2021), which can be found in Table 2.2 and Figure 2.2.

Table 2.2. Maumelle River – Sod Farm Soil Types

Map Unit Symbol	Map Unit Name	Acres in Area of Interest (AOI)	Percent of AOI
Am	Amy silt loam, 0 to 1 percent slopes	51.6	37.3%
CMF	Carnasaw-Mountainburg association, steep	0.1	0.1%
Re	Rexor silt loam, frequently flooded	74.9	53.3%
SgC	Sallisaw gravelly silt loam 3 to 8 percent slopes	13.4	9.3%
Totals for Area of Interest		140.0	100.0%

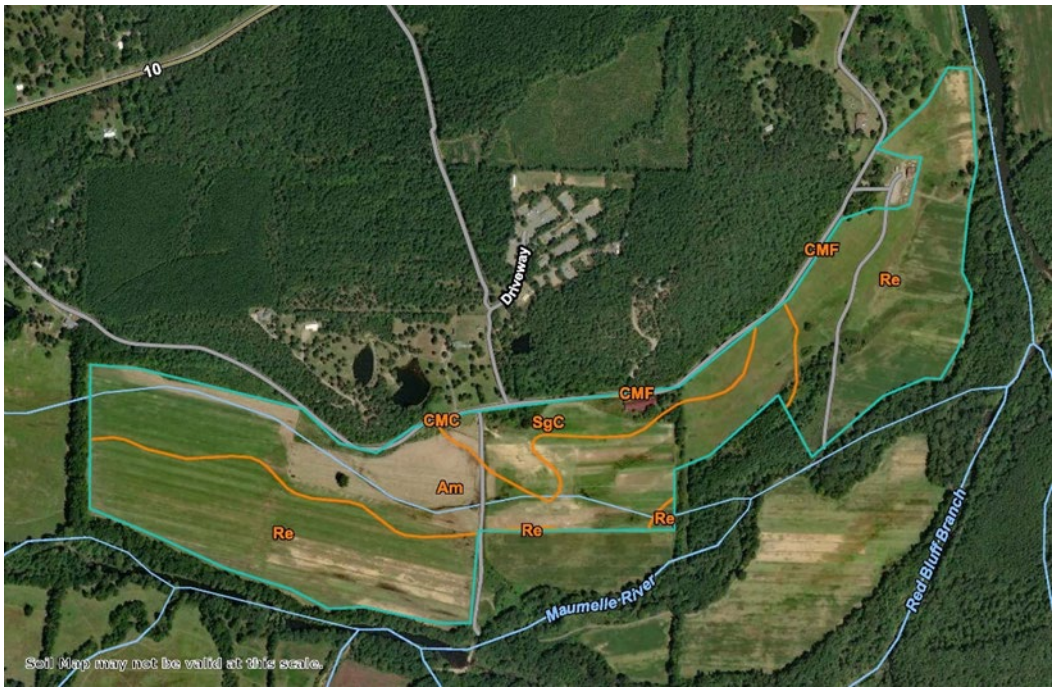

Figure 2.2. Sod Farm Soils Map

Future Without-Project Condition

Soil erosion is a major concern and a significant adverse impact on water quality in the study area. The conversion of bottomland hardwood forests to agricultural fields, coupled with the channelization of the historic hydrology that once existed, is causing significant sedimentation and embeddedness of benthic habitats in the Side Channel 1 and in the Maumelle River. Although geology and topography are not expected to radically change in the study area, soil will be impacted by the effects of erosion through extreme storm events and human disturbance (commercial sod production).

The nonfederal sponsor has indicated that in the absence of federal action to restore the fields, they will continue to be leased for agricultural purposes, thus the existing sedimentation issues are expected to continue in the FWOP condition.

2.3.7 Land Use

The latest land cover imagery for the study area shows a mix of forested areas (49%), pasture/bare ground (i.e., sod fields; 48%), and water features (i.e., ponds, streams, wetlands; 2%). Low density developed land and open or barren lands make up the remaining 1% (Table 2.3). Figure 2.3 provides a visual representation of this information.

Table 2.3. Maumelle River Study Area Land Cover (2016)

Land Cover	Acres	Percent of Site
Deciduous Forest	240.7	25.7
Mixed Forest	954	10.2
Evergreen Forest	121.7	13.0
Pasture/Hay Ground	443.6	47.4

Grasslands/Herbaceous	3.6	0.4
Shrub/Scrub	2.1	0.2
Open Water	14.0	1.5
Woody Wetlands	3.3	0.4
Developed, Low	1.4	0.1
Developed, Open	8.0	0.9
Barren Land (Rock/Sand/Clay)	2.0	0.2
Total	**935.8**	**100.0**

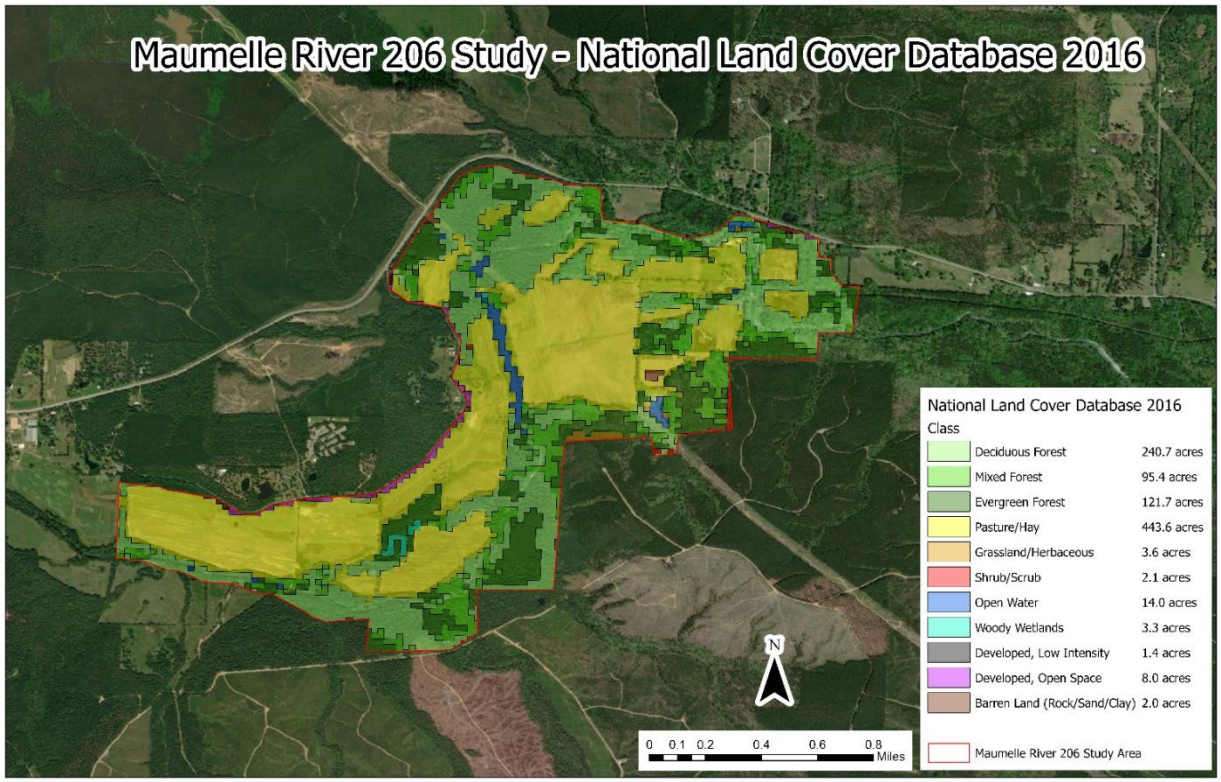

Figure 2.3. Maumelle River Study Area 2016 Land Cover

The Ouachita National Forest manages most of the upper one-third of the watershed as forest land. The remainder of the watershed is primarily forest with some pasture and agriculture existing in the lowland area of the Big Maumelle River above the lake. Turf (sod) farming is practiced in the floodplain of the basin. Many of the forest areas, apart from those that are protected by CAW and the Forest Service (such as wilderness areas), are subjected to timber harvesting on a periodic basis.

In summary, Lake Maumelle is used for multiple purposes consistent with maintaining good water quality. The land in the watershed is subject to a variety of uses, and is primarily forested, with some areas subject to periodic timber harvesting.

Future Without-Project Condition

Land use in the study area is managed for a mixture of wildlife conservation and water quality (~52%) and commercial monoculture sod production (~48%). It is expected that this trend will continue into the Future Without-Project.

2.3.8 Air Quality

The U.S. Environmental Protection Agency (EPA) has the primary responsibility for regulating air quality nationwide. The Clean Air Act (42 U.S.C. 7401 et seq.), as amended, requires the EPA to set National Ambient Air Quality Standards (NAAQS) for wide-spread pollutants from numerous and diverse sources considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards classified as either "primary" or "secondary." Primary standards set limits to protect public health, including the health of at-risk populations such as people with pre-existing heart or lung diseases (such as asthma), children, and older adults. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants. These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), particulate matter less than 10 microns (PM10), particulate matter less than 2.5 microns (PM2.5), sulfur dioxide (SO2) and lead (Pb). If the concentration of one or more criteria pollutant in a geographic area is found to exceed the regulated "threshold" level for one or more of the NAAQS, the area may be classified as a non-attainment area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either attainment or unclassifiable areas.

Existing emission sources occurring within the study area consist mainly of mobile sources. These would include, but are not limited to, combustion engines (such as those found in motor vehicles); dust from unpaved surfaces; smoke from prescribed burning; and other rural activities.

The entire state of Arkansas is in attainment for all criteria air pollutants.

Future Without-Project Condition

The Maumelle River study area sits in a rural landscape with minimal sources of emissions. The FWOP air quality is expected to remain similar to the existing condition.

2.3.9 Noise

The headwaters of the Maumelle River originate on the Ouachita National Forest (ONF) that is managed primarily for wildlife purpose. Below the ONF and above the study area, the watershed is sparsely populated, with small farms located in the wide portions of the floodplain and forested areas on the surrounding slopes which are also in small private ownership, or in commercial timber production. The nonfederal sponsor and AGFC own the majority of the watershed property from the study area to Lake Maumelle.

Noise levels in the study area are considered low, with only the occasional passing vehicle on the adjacent Highway 10, or from distant timber harvest activity on adjacent commercial timber land.

Future-Without Project Condition

Due to the large expanse of private property in farms or commercial timber production, coupled with the conservation efforts of CAW, the current noise levels in the study area are expected to remain the same in the FWOP condition.

2.3.10 Transportation

Transportation refers to the movement of people, goods, and/or equipment on a surface transportation network that can include many different types of facilities serving a variety of transportation modes, such as vehicular traffic, public transit, and non-motorized travel (e.g., pedestrians and bicycles). The relative importance of various transportation modes is influenced by development patterns and the characteristics of transportation facilities. In general, urban areas tend to encourage greater use of public transit and/or non-motorized modes of transportation, especially if pedestrian, bicycle, and transit facilities provide desired connections and are well operated and well maintained.

The Maumelle River study area is located in a rural area, approximately 30 miles west of Little Rock. The main paved road is U.S. Highway 10, which runs in an east-west direction on the north side of the study area. Other roads in the area consist of paved and gravel roads maintained by Pulaski County. A few small dirt roads in the study area are maintained by the non-federal sponsor.

Future Without-Project Condition

There is no anticipated significant growth in modes of transportation in or near the study area. Highway 10 will continue to receive periodic maintenance by the Arkansas Highway Department as needed for local transportation, but there are no plans for future expansion (personal communication with Arkansas Highway Transportation Department [AHTD] official). Dirt roads in the study area will be maintained by CAW as needed to maintain periodic access.

2.3.11 Light

The study area is located in a rural area approximately 30 miles west of Little Rock, Arkansas. The only light that can be seen from the study area comes from a few adjacent farmhouses. Traffic on highway 10 may contribute a small amount of light, but the majority of traffic is during daylight hours.

Future Without-Project Condition

Light sources are expected to remain similar to the existing condition for the duration of the FWOP condition.

2.3.12 Water Resources

Water resources include both surface water and groundwater resources; associated water quality; and floodplains. Surface water includes all lakes, ponds, rivers, streams, impoundments, and wetlands within a defined area or watershed. Subsurface water, commonly referred to as groundwater, is typically found in certain areas known as aquifers. Aquifers are areas with high porosity rock where water can be stored within pore spaces. Water quality describes the chemical and physical composition of water as affected by natural conditions and human activities.

Surface Water

A Comprehensive Land Use and Development Plan (hereafter – CAW Plan) was developed in 2013 by Geosyntec Consultants for a 915-acre tract of property that had been acquired by CAW (former Winrock Grass Farm). The current Maumelle River study area covers the area investigated in that plan. Excerpts from the CAW Plan are provided below to describe the existing condition in the study area.

There are several small streams that transport surface waters across and through the property. The Maumelle River traverses the study area flowing from the southwest corner in an easterly direction towards the northeastern side of the area. Once a free-flowing river, the channel was altered to accommodate farming activities within its floodplains. Most of these small streams have been channelized or filled to create additional farmable lands. Based on U.S. Fish and Wildlife (FWS) National Wetlands Inventory website, the largest of these streams that historically existed is Tributary A, which is one of the restoration features of the TSP.

The Maumelle River is a fourth order stream with a drainage area of 55 square miles (mi2) at the upstream end of the study area (west end). The channel is composed of a gravel substrate in most locations with occasional exposed bedrock. The river has a variable sinuosity as it traverses the property, with a relatively low sinuosity of 1.1 in the upper two-thirds portion of the river and moderate sinuosity of 1.4 in the lower third of the river. The average sinuosity is 1.3. The water surface slope is approximately 0.0024 ft/ft and the main channel width, estimated based on aerial photography, ranges from 100 to 200 feet with an average width of 160 feet (CAW 2013).

The CAW Plan compared the present-day Maumelle River in the study area to Government Land Office (GLO) survey notes collected in 1821 and aerial photographs from 1940 – 2009. This comparison indicated that some of the Maumelle River has remained similar in form and size, such as the estimated sinuosity in 1821 was 1.2, compared to 1.3 today. Conversely, some areas along the river have maintained an average 80-foot width as measured in 1821, while other areas have widened to ~160 feet, based on 2009 aerial imagery.

Undoubtedly, anthropogenic changes to the river corridor that have occurred over several decades have and continue to adversely impact the natural function of the river and adjacent floodplain. A review of aerial photography of the site beginning with the earliest photograph taken in 1940 shows the river and its corridor have been altered. Levees along the North side of the river on the west side of the study area (upstream) can be seen in the 1940 aerial photography. Between 1940 and 1950, a buried gas and oil pipeline had been installed through the property. The pipeline crosses the Maumelle River three times, once on the upstream end, once in the middle of the property and once on the eastern side of the property. Other alterations to the main channel included channelization, disconnecting side channels, construction of four hardened river crossings that created artificial impoundments.

Of the four original river crossings, two remain in place that are a central focus of this study. The crossings have altered the natural hydrology of the Maumelle River in the study area and are adversely impacting water quality. Temperature regimes above the crossings and dissolved oxygen concentrations below them have been altered from historic conditions. The crossings are also creating shear stress to downstream banks during high water events, which increases suspended sediments in the river and Lake Maumelle.

Frequent soil disturbance from the sod operation and use of herbicides is undoubtably impacting water quality. Runoff from the operation is funneled directly into the Maumelle River and an isolated side channel via channelized ditches.

A desktop survey was performed to determine the location of wetlands within the study area using the USFWS National Wetlands Inventory mapping system. Approximately 96 acres of wetlands currently exist in the study area (Table 2.4 and Figure 2.4).

Table 2.4. Maumelle River Study Area Wetlands (2021)

Wetland Type	Acres
Freshwater Emergent Wetland	2.2
Freshwater Forested/Shrub Wetland	37.9
Freshwater Pond	5.4
Riverine	95.9
Total	141.4

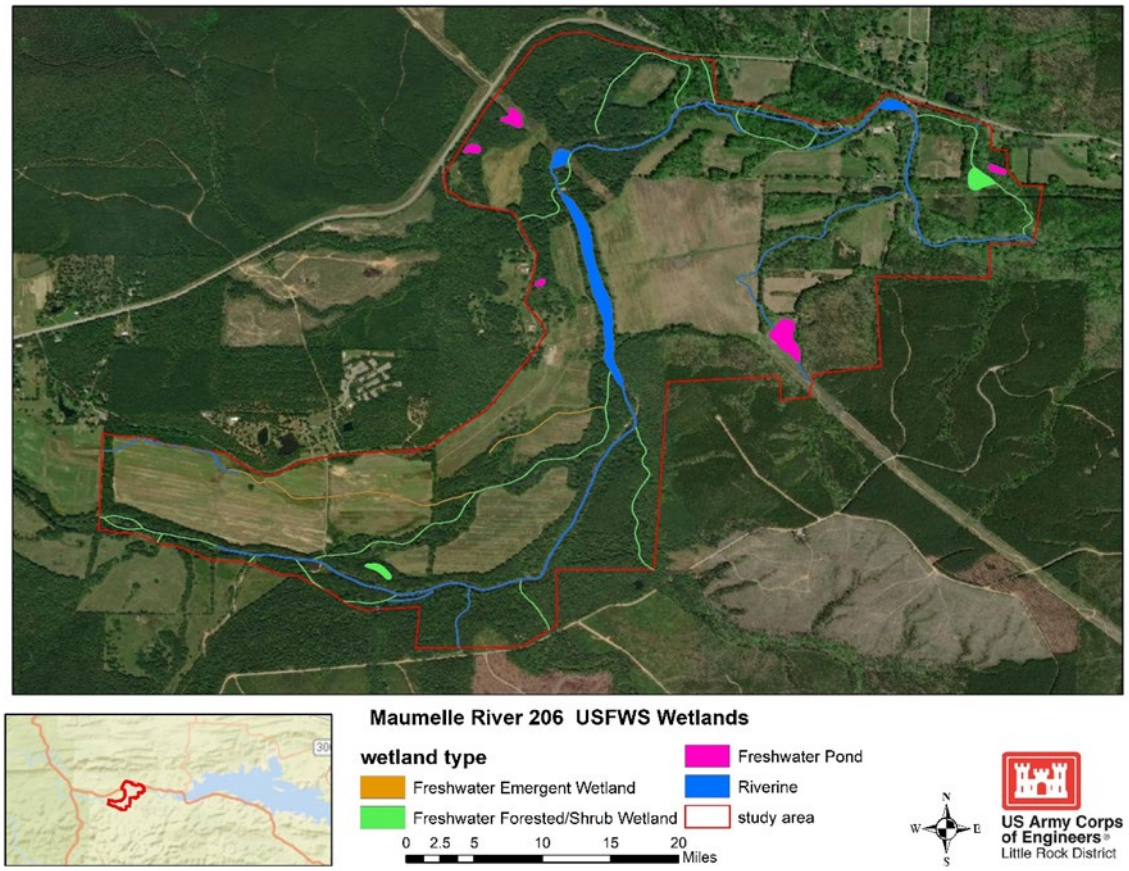

Figure 2.4. Maumelle River Wetland Types

Based on the NRCS soil survey information, the Amy silt loam soil is classified as a hydric soil type. This soil type is the approximate location of the tributary stream that historically existed on the sod farm. The USFWS Wetland Mapper identifies the location as a Freshwater Emergent Wetland based on soils (prior to conversion). The other large soil type present in the sod farm fields is the Rexor silt loam, frequently flooded. This soil type lies between the man-made levee on the north bank of the Maumelle River and the Amy silt loam type previously discussed. While not classified as a hydric soil, this area undoubtably flooded periodically when the Maumelle River reached significant flood stages. Based on nearby reference sites, the historic vegetation would have been flood tolerant bottomland hardwood species, thus would have functioned as a Freshwater Forested/Shrub Wetland. Together, these two areas historically supported approximately 130 acres of wetlands.

Future Without-Project Condition

Surface water in the Maumelle River study area is being adversely impacted by numerous human disturbances that will continue in the FWOP condition. Existing wetlands will likely remain in the same condition as they are now. Those emergent and forested wetlands converted to agriculture fields will not be restored in the FWOP planning horizon, rather the acres will continue to be used for sod production or some other agricultural use.

2.3.13 Groundwater

The Maumelle River study area sits above the Ouachita Mountains aquifer which is part of the Interior Highlands Physiographic Region of Arkansas. The Ouachita Mountains aquifer includes all formations extending north to the Arkansas River (and associated alluvial deposits), west to the State line, and south and east to the boundary with the Coastal Plain. A thick sequence of Paleozoic rock formations in the Ouachita Mountains serves as an important source of groundwater supply for domestic users, in addition to a limited number of small commercial- and community-supply systems.

Future Without-Project Condition

Groundwater is expected to remain the same as the existing conditions.

2.3.14 Water Quality

Information contained in the 2014 Arkansas Water Plan Update, West-Central Arkansas Water Resources Planning Region Report (WAWRPR), water quality in the Fourche Mountains surface waters tends to be exceptional, with low mineral, nutrient, and biochemical parameter concentrations (AWP 2014).

The Arkansas Integrated Water Quality Monitoring and Assessment Report (AIWQMAP 2018), which is a requirement of the CWA Sections 305(b) and 303(d), evaluates the quality of waters in Arkansas and identifies those that do not meet uses and criteria defined in the Arkansas Surface Water Quality Standards (ASWQS). The Arkansas Integrated Report describes the status of Arkansas' natural waters based on historical data and assigns waterways to various categories depending on the extent to which they attain the ASWQS. A review of the 2018 Arkansas Integrated Report indicated that the Maumelle River and Lake Maumelle are within attainment for all water quality standards.

Water quality of the Ouachita Mountains aquifer is generally considered good throughout the region. It is primarily a mixed calcium- and sodium-bicarbonate type and chemically is suitable for most domestic and farm uses. Yields from wells completed in the Ouachita Mountains aquifer have a fairly large range depending on individual formations and lithology but are typically low throughout the aquifer. Most wells are less than 100 feet deep but can range up to approximately 700 feet deep. Static water levels are generally less than 20 feet below land surface and flowing-artesian wells are common throughout the region, however pumping water levels may be as much as 150 feet below land surface in deeper wells. Seasonal water-level fluctuations in wells generally are less than 10 feet; however, larger fluctuations are common in abnormally wet or dry years because the groundwater reservoirs generally have small storage capacities and are recharged by rapid infiltration of local precipitation.

Future Without-Project Condition

Water quality in the Maumelle River and side channels will continue to be adversely impacted over the 50-year study horizon.

2.3.15 Visual Aesthetics

Visual resources are defined as the natural and manufactured features that comprise the aesthetic qualities of an area. These features form the overall impressions that an observer receives of an area or its landscape character. Landforms, water surfaces, vegetation, and manufactured features are considered characteristic of an area if they are inherent to the structure and function of a landscape.

The Maumelle River study area is situated in a rural landscape. Ridgetops and slopes are largely forested with upland hardwoods (on private property), or evergreen forests dominated by loblolly pine (commercial timber companies). Much of the broad valley is privately owned and has been converted to pasture or other agriculture practices.

Within the study area, the landscape is a mosaic of bottomland hardwood forests interspersed with old sod farm fields, some of which have been converted to bottomland hardwood forests by the nonfederal sponsor (mostly on eastern side of study area). The north side of the study area is bordered by Arkansas Highway 10, while the southern border is largely forested. The western part of the study area north of the Maumelle River was historically forested with native bottomland hardwood tree species prior to their conversion to agricultural fields. Today only remnants of those forests still exist, and only as a very narrow corridor along the Maumelle River. Most of the area consists of open fields that are used for commercial sod production. As these fields are continually disturbed for the production of sod (primarily zoysia), they provide a prime opportunity for invasive species to encroach and become established (particularly along the edges of the fields). Invasive species will continue to be a growing problem in the study area unless aggressively managed or replaced by native vegetation.

Future Without-Project Condition

The current landscape condition in the Maumelle River study area is expected to remain the same over the planning horizon.

2.3.16 Recreation

The Maumelle River study area is owned by the nonfederal sponsor CAW. In the interest of watershed protection for Lake Maumelle, access to the property is currently restricted to CAW employees and partners. The presence of the low water crossings in the river currently limit any canoe or kayaking opportunities.

While recreation opportunities are limited in the study area, there is ample access to public recreational opportunism in the watershed. The Ouachita National Recreation Trail runs along the south perimeter of the study area for roughly 2.5 miles. The Ouachita Trail is a 223-mile trail that runs through the Ouachita Mountains of Arkansas and Oklahoma. The trail connects the Talimena State Park in Oklahoma to Pinnacle Mountain State Park near Little Rock. The trail is used by hikers, backpackers, hunters, and mountain bikers. Shelters for overnight camping are located along the trail.

The eastern boundary of the Ouachita National Forest is approximately 1.5 miles west of the study area. The Ouachita National Forest covers 1.8 million acres in central Arkansas and southeastern Oklahoma and is managed for multiple uses, including timber and wood production, watershed protection and improvement, habitat for wildlife and fish (including

threatened and endangered species), wilderness area management, minerals leasing, and outdoor recreation.

Future Without-Project Condition

Recreational opportunities within the Maumelle River study area and watershed are expected to remain the same in the FWOP condition.

2.3.17 Vegetation

The Maumelle River is located in the Fouche Mountains Level IV Ecoregion (EPA 2013). Steep east to west trending ridges are present, resulting in primarily north and south-facing slopes. Differences in temperature and moisture on these slopes influence the plant communities present. Overall, oak-hickory-pine forest is the dominant natural vegetation on these slopes and in narrow valleys. Many of the broader valleys on private land have been converted to pasture or other agriculture practices.

GLO notes recorded in 1821 on the Maumelle River study area indicated the entire area was forested with a variety of tree species including ash (possibly green ash, Fraxinus pennsylvanica), bald cypress (Taxoidium distichum), dogwood (Cornus florida), elm (Ulmus spp.), gum (possibly tupelo gum Nyssa sylvatica or sweetgum Liquidambar styraciflua), hickory (Carya spp.), several oak species including black (Quercus velutina), post oak (Q. stellate), red and white oaks (Quercus spp.), and shortleaf pine (Pinus echinata).

By 2013, 47% of the forest had been removed, leaving only riparian corridors along the Maumelle River and some tributaries – many of which were too narrow to support the diversity of native wildlife that historically existed in the area. In the broader valley areas, including larger tributary streams, hardwood forests were converted to open fields for agricultural production and eventually sod production.

Remaining forested acres in the study area include a similar mosaic of hardwoods and pines as recorded in 1821, particularly along smaller tributary streams where some old growth trees remain. In addition to the species recorded by the GLO, cottonwood (Populus deltoides), sycamore (Platanus occidentalis), pecan (Carya illinoensis), box elder (Acer negundo), river birch (Betula nigra), black willow (Salix nigra), sugarberry (Celtis laevigata), red maple (Acer rubrum), overcup oak (Quercus lyrata), water oak (Q. nigra), and willow oak (Q. phellos) are found in the study area.

Typical old field vegetation found along the edges of roads, fields, etc., includes blackberry (Rubus spp.), sumac (Rhus spp.), eastern red cedar (Juniperus virginiana), persimmon (Diospyros virginiana), and sassafras (Sassafras albidium), among others.

Since CAW began acquisition of the lands included in and surrounding the study area, they have been reforesting many of the old sod farm fields that were no longer in production. Planting plans for those fields included many native bottomland hardwood species including willow oak, water oak, cherrybark oak (Q. pagoda), pin oak (Q. palustris), southern red oak (Q. falcata), sugarberry, black walnut (Julgans nigra), redbud (Cercis canadensis), and red mulberry (Morus rubra). Other species, such as persimmon, red maple, sycamore, and cottonwood are common volunteer species in the reforestation areas.

Future Without-Project Condition

Based on information from the nonfederal sponsor, in the absence of USACE involvement, the current sod farm acres will continue to be operated as an agricultural lease. Adverse impacts to riparian and aquatic habitats discussed elsewhere will continue to occur. The lack of forested cover and native vegetation will continue to allow invasive species to encroach the area and have a higher likelihood of establishment.

2.3.18 Wildlife

Wildlife inhabiting the study area include species typical of the Ouachita Mountains and Arkansas River ecoregions. These include white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), eastern mole (*Scalopus aquaticus*), gray squirrel (*Sciurus carolinensis*), eastern fox squirrel (*Sciurus niger*), eastern cottontail rabbit (*Sylvilagus floridanus*), beaver (*Castor canadensis*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), mink (*Mustela vison*), nine-banded armadillo (*Dasypus novemcinctus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*). Species of amphibians and reptiles common to the study area, including red-ear slider (*Trachemys scripta*), Ouachita map turtle (*Graptemys ouachitensis*), spring peeper (*Pseudacris crucifer*), and several other species of frogs, toads, snakes, lizards, and salamanders.

Similar to Ouachita Mountain ecoregion reference streams, macroinvertebrate feeding fishes dominate the trophic structure in the Maumelle River. However, while reference stream fish populations are dominated by species in the family Cypriidae (minnows), including the bigeye shiner (*Notropis boops*), and central stoneroller (*Campostoma anomalum*),followed by Centrarchidae (sunfishes), the majority of species collected in the Maumelle River study area belong to the Percidae family (perches [10 species]). Percid species present in the Maumelle River (within the study area) include fantail darter (*Etheostoma flabellare*), redfin darter (*Etheostoma whipplei*), and the Johnnie darter (*Etheostoma nigrum* {considered vulnerable in Arkansas}). Two species of catfish, yellow bullhead (*Ameiurus natalis*) and slender madtom (*Noturus exilis*), are commonly found in the Maumelle River. Eight species of Centrarcharids have been collected from the study area, including longear sunfish (*Lepomis meglaotis*) and orangespotted sunfish (*Lepomis humilis*). Largemouth bass (Micropterus salmoides) and black crappie (*Pomoxis nigromaculatus*) were both collected in the pool above RC-1. While both species would be expected to (and do) occur in Lake Maumelle, their presence in the study area is indicative of the altered stream conditions created by the low water crossings. A list of fish species collected from the Maumelle River can be found in Appendix C-1.

The Arkansas Wildlife Action Plan identifies wildlife “species of greatest conservation need” (SGCN). There are several invertebrate and fish species recorded for the Ouachita Mountains ecoregion, however the majority of them are only known from very specific locations within the ecoregion. No SGCN wildlife species are known to occur in the Maumelle River watershed.

While not currently listed as federally endangered or threatened, or as a SGCN, recent communications with USFWS biologists have revealed the possibility that the Alligator Snapping Turtle (*Macrochelys temminckii*) and Monarch Butterfly (*Danaus plexippus*) may become federally listed species within five years. Both species are known to occur in the Maumelle River study area.

Future Without-Project Condition

Wildlife species found in the study area are typical of those found throughout the Maumelle River watershed and much of the Ouachita Mountains ecoregion. Populations were undoubtably impacted with the conversion of hardwood forests that occurred decades ago. In the absence of USACE involvement, the 140 acres of agriculture fields in the western part of the study area will continue to adversely impact native wildlife species. The lack of cover and food will limit the species that utilize the area.

Unless stated otherwise, it is assumed some of the existing conditions will continue to degrade in the FWOP.

2.3.19 Migratory Birds

The MBTA (16 U.S.C. 703-712) prohibits the take, possession, importation, exportation, transportation, selling, purchasing, bartering, or offer to sell, purchase, or barter any migratory bird, or parts, nests, or eggs of such a bird except under terms of a valid Federal permit. The MBTA applies to native birds migrating or residing within the U.S., Mexico, Russia, and Japan. Additional protections for eagles are provided under the Bald and Golden Eagle Protection Act.

The past several decades have seen a decline in NTMB numbers. Recently, it has been recognized that the loss, fragmentation, and degradation of migratory stop-over habitat is potentially the greatest threat to the survival and conservation of Neotropical birds. The USFWS maintains a list of Birds of Conservation Concern (BCC) that identifies migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent their highest conservation priorities. The list is based on an assortment of several factors, including population abundance and trends, threats on breeding and nonbreeding grounds, and size of breeding and nonbreeding ranges. Table 2.5 provides a partial list of those BCC species that are known to occur in the study area. Section 2.1.16 in Appendix C-1 provides additional information on USFWS BCC species.

Table 2.5. Migratory Birds with the Potential to Occur within the Study Area

Name	Scientific Name	Breeding Season
American Kestrel	*Falco sparverius paulus*	Breeds Aug 1 to Aug 31
Bald Eagle	*Haliaeetus leucocephalus*	Breeds Sep 1 to July 31
Kentucky Warbler	*Oporornis formosus*	Breeds Apr 20 to Aug 20
Prairie Warbler	*Dendroica discolor*	Breeds May 1 to Jul 31
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Breeds May 10 – Sep 10

A wide variety of birds are known to occur within the study area due to the geographic location and the diversity of habitats present. Bird surveys conducted by the Arkansas Audubon Society during the period of March 16, 2013 – June 11, 2015, documented 135 species occurring in the project area, including several species of conservation concern. Given the sample period included the fall thru early spring, it's likely that many of the birds recorded were using the area for migration, wintering, breeding, and/or foraging habitats. A list of bird species observed during these surveys is located in Appendix C-1 Environmental Resources.

Future Without-Project Condition

Migratory birds will continue to utilize the study area for resting, foraging, and nesting. The existing sod farm creates a significant amount of “edge habitat” that is detrimental to many NTMB species. This edge habitat attracts many nest predators like black rat snakes (Elaphe obsoleta) and several mammal species. Some bird species also prey on nests of other birds, including the American crow (Corvus brachyrhynchos) that raid nests and steal eggs or even young birds, and the well-known brown-headed cowbird (Molothrus ater) that lays its’ eggs in the nests of other bird species. Existing habitat use and nesting success by resident and NTMB species is expected to remain the same over the planning horizon.

2.3.20 Threatened and Endangered Species

Wildlife species may be classified as threatened or endangered under the ESA of 1973. The ESA protects threatened and endangered species and their habitats by prohibiting the “take of listed animals and the interstate or international trade in listed plants and animals, including their parts and products, except under federal permit.” Take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct.” The term harm is defined as “an act which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.”

The USFWS is responsible for the implementation of the ESA. Section 7 of the ESA ensures that federal agencies use their authorities to address the impacts of federal actions on listed species and ensure that those actions would not jeopardize the continued existence of listed species or their critical habitat.

There are four federally listed species and one candidate species that are known to or could possibly occur in the study area (Table 2.6). No critical habitat is designated within the study area. See Appendix C-2 Environmental Compliance for a complete list of the Federally listed threatened and endangered species with the potential to occur within the study area.

Table 2.6. Federally Listed Threatened and Endangered Species with the Potential to Occur in the Study Area (USFWS 2022A)

Common Name	Scientific Name	Federal Listing	Habitat Present
Mammals			
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	Yes
Birds			
Eastern Black Rail	*Laterallus jamaicensis spp. Jamaicensis*	Threatened	No
Piping Plover	*Charadrius melodus*	Threatened	No
Red Knot	*Calidris canutus rufa*	Threatened	No
Invertebrates			
Monarch Butterfly	*Danaus plexippus*	Candidate	Yes

Acoustic surveys conducted in December of 2017 documented the “possible” presence of a northern long-eared bat near the Maumelle River in the study area. These surveys also recorded the possible presence of one gray bat (Myotis grisescens). The gray bat is a federally listed species (endangered), but at the present time is not listed by the USFWS as occurring in Pulaski County (IPaC 2021). GPS tracking surveys recently conducted by the USFWS has revealed an expanded summer range for both the gray bat and the federally endangered Indiana bat (Myotis sodalis), thus it is possible that both species will soon be listed on the IPaC

website for the study area (USFWS personal communication). While the gray bat roosts in caves year-round, both the northern long-eared bat and Indiana bat utilize trees with loose bark for summer roosts and maternity sites.

Quality foraging habitat for the eastern black rail, piping plover, and red knot does not exist in the study area. These migratory birds are more likely to use exposed mud flats around Lake Maumelle during any migratory stops.

Monarch Butterfly (*Danaus plexippus*) is listed as a candidate species wherever it is found (USFWS, 2021B). Breeding habitat consists primarily of milkweed species (*Asclepias sp.*), which is the only species of plant that their larvae feeds on. While migrating throughout North America, the butterfly is a common occurrence wherever concentrations of flowering plants and milkweed occur. Monarch butterflies are a common sight in and near the project area during fall migrations.

Future Without-Project Condition

Habitat conditions for the current list of federally threatened and endangered species in the study area are expected to remain the same over a 50-year period.

2.3.21 Invasive Species

Invasive species are non-native species whose populations tend to outcompete native species and decrease the diversity of the native vegetation communities. Invasive species are one of the most pervasive, widespread threats to indigenous biota and often a major driver in the listing of threatened and endangered species. The introduction and establishment of invasive species can have substantial impacts on native species and ecosystems. Invasive species capable of spreading and invading into new areas are typically generalists that can easily adapt to new environments, are highly prolific and superior competitors and/or predators and lack the natural predators that keep the species in check in the native habitats. Some are very specialized and more efficient and effective than their native competitors at filling a particular niche. They compete for resources, alter community structure, displace native species, and may cause extirpations or extinctions. Invasive species often benefit from altered and declining natural ecosystems by filling niches of more specialized and displaced species with limited adaptability to changing environments.

Aquatic and riparian habitats in the study area are impacted by exotic plant species including privet (Ligustrum sp.), Japanese honeysuckle (Lonicera japonica), kudzu (Pueraria montana), tree of heaven (Ailanthus altissima) and Johnson grass (Sorghum halepense).

Future Without-Project Condition

Non-native invasive species are expected to increase in abundance within the study area without proper management (chemical control and/or habitat restoration).

2.3.22 Hazardous and Toxic Materials

As part of the purchase process when the nonfederal sponsor purchased the property in the Maumelle River study area, they contracted with Pollution Management, Inc. (PMI), of Little

Rock, Arkansas to perform a Phase 1 Environmental Site Assessment. The results of the assessment state that “No recognized environmental conditions (RECs) and three (3) business environmental risks (BERs) were documented on the property”. The three BERs included:

- A concrete pad occasionally used to clean equipment, with the potential for oil and grease to penetrate the ground surface.
- A 1,000-gallon AST and a 500-gallon AST containing diesel fuel were located on the southwestern portion of the property. Additionally, three irrigation pumps with fuel storage tanks were located throughout the property.
- The presence of a shooting range/dumping area on the southeastern portion of the property. This was considered a BER due to the potential for lead shot and lead bullets to be located throughout the shooting range/dumping area.

Since acquiring the property, CAW has phased out the commercial sod farm operation that existed there, with the exception of the 140 acres on the western side of the study area (area proposed for restoration). All irrigation pumps and diesel tanks have been removed from the study area and the sites cleaned. The tanks and pumps were not located near any of the proposed restoration sites in the Maumelle River TSP. There are presently no known HTRW materials known to occur in the study area. A copy of the PMI assessment is included in Appendix C-2.

Future Without-Project Condition

With CAW’s focus on watershed protection for Lake Maumelle, no new HTRW materials are likely to be placed within the study area. The current HTRW condition is expected to remain the same over a 50-year period.

2.3.23 Cultural Resources

Federal agencies are required under Section 106 of the National Historic Preservation Act to “take into account the effects of their undertakings on historic properties” and consider alternatives “to avoid, minimize or mitigate the undertaking’s adverse effects on historic properties” [(36 CFR 800.1(a-c)] in consultation with the State Historic Preservation Officer (SHPO) and appropriate federally recognized Indian Tribes (Tribal Historic Preservation Officers - THPO) [(36 CFR 800.2(c)]. In accordance with this and other applicable regulations, including the National Environmental Policy Act of 1969 (NEPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and Engineer Regulation (ER) 1105-2-100, USACE has reviewed of the Arkansas Archeological Survey’s Automated Management of Archeological Sites Data in Arkansas (AMASDA) database to better determine the existing conditions and potential risks of encountering cultural resources.

The review of the AMASDA database revealed that one archeological site has been identified in the study area and one adjacent to the study area, but only very minimal cultural resource survey work has been performed in the study area. In addition, a review of the Arkansas Historic Preservation Program’s Structure Database was performed and did not indicate any previously recorded historic buildings, structures, or objects. As this study moves forward and the Area of Potential Effects (APE), as defined by 36 CFR § 800.16(d), becomes clearly defined, this federal undertaking will be assessed for potential effects, as defined by 36 CFR § 800.3, in consultation with the SHPO, and appropriate Tribal Nations.

2.3.24 Archaeological Sites

3PU852

Archeological Site 3PU852 was recorded within the current study area by Flat Earth Archeology, LLC during a 2013 survey for the Maumelle Riverbank Stabilization Project conducted for Central Arkansas Water. It was described as a large lithic scatter with no diagnostic artifacts observed. The site was recorded as extensively disturbed from sod cultivation practices. The site was recorded as having an unknown eligibility for listing on the National Register of Historic Places.

3PU1005

Archeological Site 3PU1005 was recorded directly adjacent to the current study area by the Arkansas Department of Transportation.

2.3.25 Tribal Consultation

The USACE consulted with the Alabama-Quassarte Tribal Town, The Choctaw Nation of Oklahoma, the Coushatta Tribe of Louisiana, the Mississippi Band of Choctaw Indians, the Muscogee (Creek) Nation, the Osage Nation, and the Quapaw Nation in 2019, as the Maumelle River study area was believed to be in these Federally recognized Tribes' areas of interest, and for which historic properties within the focused study area of the undertaking are believed to have religious and cultural significance to these Federally-recognized Tribes. As a result of this consultation, a Programmatic Agreement (PA) was executed between the USACE, the Arkansas Historic Preservation Officer, CAW, and the Muscogee (Creek) Nation, the Osage Nation, and the Quapaw Nation (Consulting Tribes) to ensure that implementation of the TSP will take into account the effects of the undertaking on historic properties. For detailed information regarding the PA, it is located in Appendix C-2.

Future Without-Project Conditions

The review of the AMASDA database revealed that one archeological site has been identified, but only very minimal cultural resource survey work has been performed in the study area. In addition, a review of the Arkansas Historic Preservation Program's Structure Database was performed and did not indicate any previously recorded historic buildings, structures, or objects. The current condition of cultural resources is expected to remain the same for the FWOP horizon of 50 years.

2.4 Socioeconomics

The study area lies completely within Pulaski County, Arkansas, approximately 30 miles west of the city of Little Rock on the Maumelle River. The area immediately around the study area is rural and agricultural. The study area is within the Little Rock-North Little Rock-Conway Metropolitan Statistical Area (MSA), which is comprised of six counties: Faulkner, Grant, Lonoke, Perry, Pulaski, and Saline. The study area is also located in Central Arkansas, one of the six regions of Arkansas. Central Arkansas encompasses eight counties: Conway, Faulkner, Grant, Lonoke, Perry, Pulaski, Saline and White. The city of Little Rock is the most populous city

(197,312 as of 2019) in Arkansas and is both the state capital and the Pulaski County seat. While the study area lies within these larger political boundaries, given the small scale of the project, the description of the demographic setting will focus on Pulaski County. Unless otherwise noted demographic data come from the U.S. Census Bureau's American Community Survey (2019 Year Estimate).

2.4.1 Population

Currently, the population of Pulaski County is estimated to be 392,967, approximately 13 percent of the population of Arkansas. The county's population has seen continuous growth from 2000 to 2019, as shown in Table 2.7. The county's population is projected to continue to increase through 2065 to 551,833, an annual rate of 0.74 percent. This is just slightly slower than the overall state's projected growth rate of 0.86 percent.

Table 2.7. Population Estimates and Projections

Geography	2000	2010	2019	2065
Arkansas	2,763,400	2,915,919	2,990,370	4,437,622
Pulaski County	361,474	382,748	392,967	551,833

Sources:
2000 Decennial Census, U.S. Census Bureau
2010 Decennial Census, U.S. Census Bureau
2019 – American Community Survey, 5 Year Estimates, U.S. Census Bureau
2065 – Arkansas Economic Development Institute

Approximately 49.1 percent of the county's population is male, and 50.9 percent is female, which is similar to the state's distribution of 47.8 percent male and 52.2 percent female.

2.4.2 Race and Ethnicity

Approximately 52 percent of the population in Pulaski County is White, 37 percent is Black, and 6 percent is Hispanic. Asian and persons of two or more races make up approximately 2 percent each of the total population, with Native American and Alaskan and Some other race making up less than 1 percent each. By comparison, the state overall is approximately 72 percent White, 15 percent Black, and 8 percent Hispanic, with the remaining population distribution similar to that of the county.

2.4.3 Age

As shown in Figure 2.5, the general distribution of the population by age groups is very similar for Pulaski County and Arkansas, with Pulaski County only slightly younger overall. About 40 percent of the population of Pulaski County is between 25 and 54 years old, 14 percent is under 10 years of age, and 15 percent is 65 years of age or older.

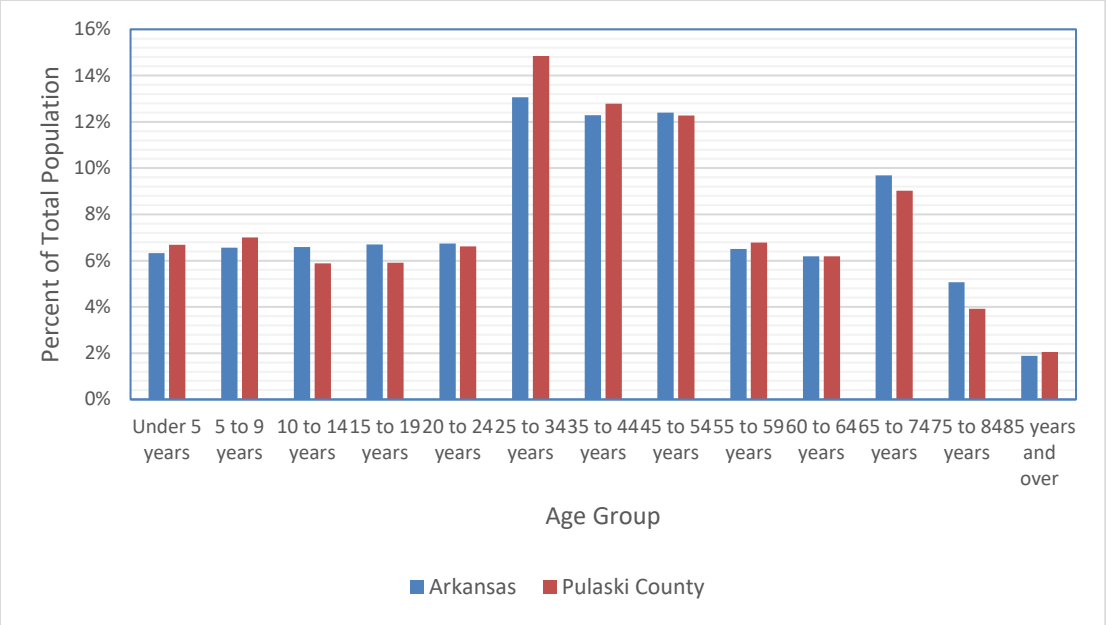

Figure 2.5. Age Group Distribution

2.4.4 Employment

In Pulaski County, the about 184,202 persons in the civilian labor force are employed. The largest employment sector is Educational, Health Care and Social Services, with 27 percent of the employment. Retail trade makes up about 12 percent of total employment and professional, scientific and management makes up approximately 10 percent. Approximately 9 percent are employed in the Arts, Entertainment, Recreation, Accommodation and Food Services sector. The Manufacturing, Finance/Insurance/Real Estate, and Public Administration sectors make up about 7 percent each of the employment. The remaining sectors make up 5 percent or less each, of total employment.

2.4.5 Income and Poverty

Based on the 2019 American Community Survey (5-year estimate), the median household income for Pulaski County is approximately $51,749, slightly higher than for the state of Arkansas overall, at $41,229. Similarly, the per capital income for Pulaski County ($32,692) is greater than the state overall ($26,577).

Although the two income measures are greater for Pulaski County than for the state, the proportion of the two populations below the poverty level are similar, with 16.8 percent of all persons in Pulaski County below the poverty level compared to 17.0 percent for Arkansas. This is higher than the national level, which is 13.4 percent.

Future Without-Project Condition

Under the no action alternative, there would be no change in the population or other demographics compared to the existing conditions.

3 Plan Formulation

3.1 Management Measures

Plan formulation is the process of building alternative plans that meet the planning objectives of the study within the planning constraints. First, management measures are formulated. These measures are features that can be implemented at a specific geographic site to address the planning objective(s). A measure can be a structural element that requires construction or a nonstructural action. Then alternative plans are developed, comprising a set of one or more management measures functioning together to address the planning objective.

Preliminary plans are formulated by combining management measures. Each plan must be formulated in consideration of the following four criteria described in the 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (referred to as Principles and Guidelines or P&G):

- Completeness: Extent to which the plan provides and accounts for all necessary investments or actions to ensure realization of the planning objective

- Effectiveness: Extent to which the plan contributes to achieving the planning objective

- Efficiency: Extent to which the plan is the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment

- Acceptability: Workability and viability of the alternative plan with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies

The four criteria were used in different steps in the plan formulation process. Completeness was used through the alternative formulation process and was evaluated for each alternative plan by meeting the planning objectives (Section 3.6). Effectiveness was evaluated by determining the habitat units for each alternative to determine alternative benefits (Section 3.3). Efficiency was evaluated by determining the incremental cost per output for each alternative (Section 3.4). Acceptability was used throughout the formulation process. This was a key focus during the resource agency meetings, public meetings, and involvement with the NFS.

Initial study efforts involved a determination of the magnitude and extent of the problems along the project area in order to develop and evaluate an array of alternative solutions that meet the existing and long-range future needs of the NFS and the public. At the initiation of the feasibility phase of the project, lines of communication were opened with Federal, state, and local agencies, private groups, and the affected public.

A Resource Agency Charette was held on February 18, 2020. A project overview was given, followed by the development of a conceptual model and an initial array of measures. The Resource Agencies were invited to conduct initial field work for the environmental models with the PDT.

The PDT met at the CAW office at their Clearwater Facility in February 2020 for a charette to develop the conceptual ecological model, a list of environmental metrics, identification of appropriate habitat

models, and to develop a suite of measures for the initial array to be considered. The PDT team consisted of representatives from Arkansas Game and Fish Commission (AGFC), CAW, and USACE. Restoration areas were generally identified as locations where appropriate measures could be applied, and where CAW currently owns the property in fee. The restoration measures will specifically benefit the Maumelle River and its adjacent riparian wetlands and floodplain by restoring the structure and function of important habitats that will result in increased habitat diversity and improve the biodiversity of native fish and wildlife species.

The eight initial measures identified for Maumelle River, shown in Figure 3.1 are:

- Notching River Crossings (RC) [non-structural]
- Removal of River Crossings (RC) [non-structural]
- Restoration of Side Channels (SC)
- Restoration of Patterson Branch
- Restoration of Tributary A
- Restore forest on Sod Farm
- Repair and Stabilize River Crossing 3 (RC3)
- River Crossing (RC) repair for recreation access

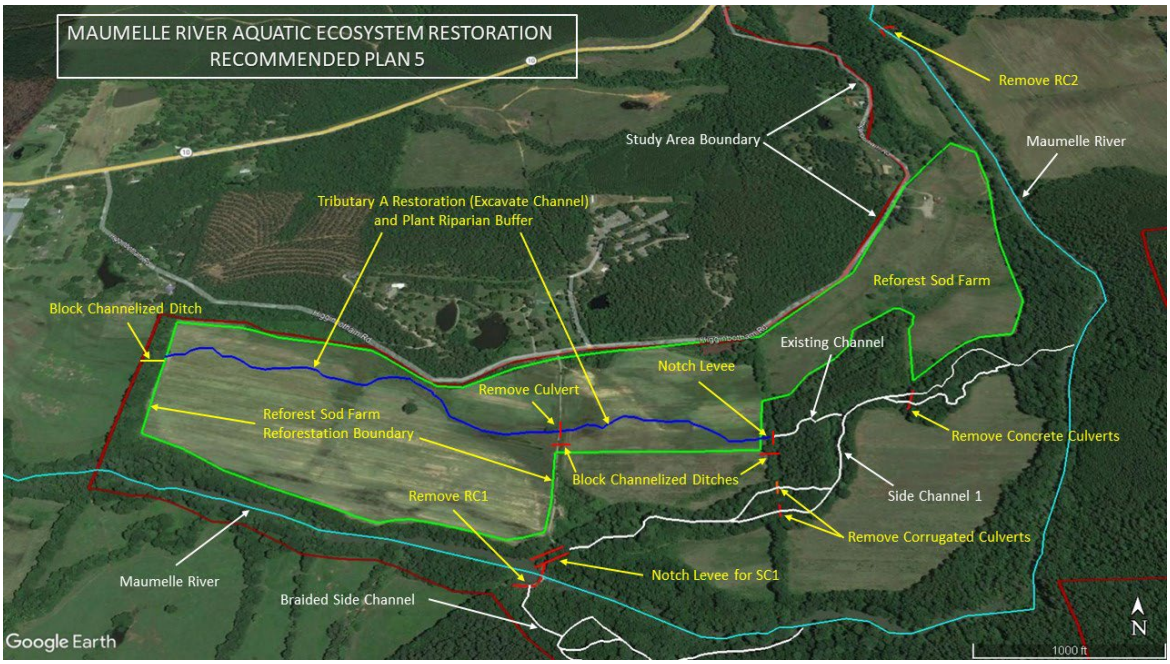

Figure 3.1. Location of Management Measures

3.1.1 Screening of Measures

The measures identified in the charette were first screened for applicability to the stated objectives of the project. During the charette, some measures were identified that were meant to address recreation objectives. It was later determined that any recreation benefits derived from the project would be considered ancillary to the primary objectives of restoring connectivity to historic riparian wetlands and floodplains and improving habitat for native fish and wildlife species.

The non-Federal sponsor owns most of the land adjacent to the project area. Patterson Branch, a parcel in private ownership, was briefly considered for erosion control and potential relocation of the stream within the floodplain because it could provide additional connectivity of riparian habitat and floodplains if it was included in the ecosystem restoration plan. It was later determined that the cost of acquiring this parcel to include in the project was too expensive and the process too complex for a CAP project. This parcel was removed from consideration by the project and no benefits were calculated for this land. This was the only measure screened out, with the remaining measures carried forward.

Seven measures that primarily provided ecosystem restoration were carried forward.

3.1.2 Alternative Formulation

The seven management measures carried forward are able to be stand-alone alternatives, as well as combined to create additional alternatives. The measures considered for this study, including removal of low water river crossings, notching of low water river crossings, channel modification, planting of riparian vegetation and bottom-land hardwoods, were applicable to multiple areas within the study area. Because there were multiple areas within the study area for ecosystem restoration, these measures were combined to create ten alternatives, with each alternative addressing a different area or two different alternatives addressing the same area. The ten alternatives would be combined to create alternative plans for evaluation and comparison. Because the environmental lift for combinations of notching and removing the river crossings were not additive, metrics for the combinations were developed separately, allowing the combinations to be evaluated. The alternatives are shown in Table 3.1.

Table 3.1. List and Description of Alternatives

Alternative Label	Alternative Name	Description
A	Remove River Crossing 1 (RC1)	Remove all concrete and dispose of off CAW property
B	Notch RC1	Notch in main channel; width should be same as width of Maumelle River above the impounded pool. Concrete removed from notch to be disposed of off CAW property.
C	Remove River Crossing 2 (RC2)	Remove all concrete and dispose of off CAW property.
D	Notch RC2	Notch in main channel; width should be same as width of Maumelle River above the impounded pool. All concrete to be disposed of off CAW property.
E	Open Side Channel 1 (SC1)	Notch levee adjacent to RC1. Material can be used to create microtopography across sod farm (PFP H) or disposed of off CAW property. Remove culverts (metal) in old road (road not needed). Dispose of off CAW Property. Remove culverts (concrete) in old road (road not needed). Dispose of off CAW Property.
F	Open Side Channel 2 (SC2)	Notch levee between Maumelle River and SC2. Width of opening should be approximately equal to average width of

Alternative Label	Alternative Name	Description
		SC2. Material can be used for microtopography across sod farm or disposed of off CAW property. Remove road crossing on SC2.
G	Restore Tributary A	Block channelized ditch on west end of field. Excavate/Restore Tributary A. Dirt can spread across fields in low level mounds (pimple mounds) and/or elongated ridges (goal is to create microtopography across field). Remove culvert from road (leave gravel low water crossing for CAW access to river). Block channelized ditch. Notch levee (to reconnect Tributary. A to existing channel). Plug ditch to direct Tributary A flow into existing channel through woods). Plant riparian area with native bottomland hardwood tree species (for riparian restoration).
H	Sod Farm Reforestation	Plant sod fields to bottomland hardwood tree species. (For terrestrial reforestation).
I	Repair River Crossing 3 (RC3)	Construct rock vanes at a 20^{o} angle upstream
R	Combinations of River Crossings	This alternative consists of combining the removal and notching of the river crossing alternatives (RC1 and RC2). Because the AAHUs were not additive, requiring separate AAHU calculations to be developed when they were combined. The combinations were treated as four scales: R1 – Notch RC1 and Remove RC2 R2 – Notch RC1 and Notch RC2 R3 – Remove RC1 and Notch RC2 R4 – Remove RC1 and Remove RC2

3.1.3 Alternative Analysis – Environmental Models

To evaluate ecosystem restoration alternatives, both monetary and non-monetary benefits are used for comparison. Non-monetary benefits are derived by using environmental models to determine habitat values for each alternative.

Two habitat types were assessed for the Maumelle River Study: Riparian Forest and Riverine. These assessments were based on the historical conditions of the Maumelle River and riparian area, and the ecosystem restoration goals for the feasibility study.

To evaluate terrestrial habitat, the team used the USFWS Habitat Evaluation Procedure (HEP (USFWS 1980]), which is a method that can be used to document the quality and quantity of available habitat for selected wildlife species. HEP assumes that habitat for selected wildlife species can be described by a Habitat Suitability Index (HSI). The Barred Owl, Gray Squirrel, and Downy Woodpecker HSIs were utilized to assess the ecological integrity and habitat conditions of existing and future forested habitats. All three HSI models have been certified by the USACE Ecosystem Restoration Planning Center of Expertise (EcoPCX) for regional use, which includes Arkansas.

To evaluate habitat conditions that would result from alternative plans, first a suitability index (SI) value is determined based on field measurements for existing conditions and on professional judgment for future conditions under alternative plans. The index ranges from 0 to 1.0, with 1.0 representing the highest habitat quality possible. The SI values are aggregated to derive a habitat suitability index (HSI) value for the indicator species. Existing condition data used in the three HSI models involved measuring existing forest conditions. One critical

assumption made for using the three HSI models for the existing condition was that since the existing condition of the proposed reforestation area is a sod farm, field measurements were not necessary. Thus, the existing condition index for all three HSI models was zero.

A habitat unit (HU) is the product of the HSI value multiplied by an area (in acres) of available habitat. HSIs and HUs were developed for different times during the period of analysis (at years 1, 5, 10, 15, 25, and 50). The HUs were annualized to estimate an Average Annual Habitat Unit (AAHU).

This methodology allows future habitat conditions to be estimated for both baseline (without-project) and design (with-project) conditions. Projected long-term effects of a project can be predicted using AAHU values. Based on the AAHU outcomes, alternative designs can be formulated, and trade-off analyses can be simulated to promote environmental optimization.

Aquatic habitat was evaluated using the Qualitative Habitat Evaluation Index model (QHEI) to assess the ecological integrity and habitat conditions of the riverine habitats. This model was chosen based on existing aquatic habitat conditions and professional judgment. The QHEI model has been certified by USACE EcoPCX for use. The QHEI is based on five general classes of landscape characteristics: land use, riparian zone, substrate, cover, and channel morphology (Rankin 1989). To evaluate the existing habitat conditions in the Maumelle River and tributaries within the study area, data was collected for 16 metrics using visual observations of stream habitat within the study area as well as both upstream to a low-water crossing on private land, and downstream to Lake Maumelle. Professional judgment was used to estimate individual metric values for future conditions. Within each class of characteristics, metrics are rated, and the sum of the metric ratings yield a score for that class. Undisturbed or least-disturbed sites are reference locations and receive the highest possible scores. Heavily disturbed systems receive low scores. When the scores of the metrics from all five classes are summed, they can yield a maximum possible QHEI score of 100. For analysis purposes, it was assumed that habitat conditions up- and downstream of the study area would not change over the 50-year study horizon.

Similar to the evaluation of terrestrial habitats, HSIs and HUs were developed for different times during the period of analysis (at years 1, 3, 5, 10, 25, and 50). The HUs were annualized to estimate an Average Annual Habitat Unit (AAHU). The use of annualized values allows for comparison of impacts of land and water use changes on fish and wildlife habitat over time.

3.2 Cost Effective and Incremental Cost Analysis

Comparing benefits and costs for ecosystem restoration provides a challenge to planners and decision makers because benefits and costs are not measured in the same units. Environmental restoration outputs can be measured in habitat units or some other physical unit, while costs are measured in dollars. Therefore, benefits and costs cannot be directly compared. Two analyses are conducted to help planners and decision makers identify plans for implementation, though the analyses themselves do not identify a single ideal plan. These two techniques are cost effectiveness and incremental cost analysis. Use of these techniques are described in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies* (U.S. Water Resources Council 1983).

Cost effectiveness compares the average annual costs and environmental outputs of plans under consideration to identify the least cost plan for each possible level of environmental output, and for any level of investment, the maximum level of output is identified.

Incremental cost analysis of the cost-effective plans is then conducted to reveal changes in costs as output levels are increased. Results from both analyses are presented graphically to help planners and decision makers select plans. For each of the best buy plans identified through incremental cost analysis, an “is it worth it?” analysis is then conducted for each incremental measure or plan to justify the incremental cost per unit of output to arrive at a recommended plan.

For this study, the environmental output is the average annual habitat unit (AAHU). The development of the AAHU is discussed in detail in the environmental technical appendix.

3.2.1 Environmental Outputs

The following tables present the derivation of inputs for the CEICA analysis. To measure the output of the environmental plan, the future without (FWOP) and future with-project (FWP) average annual habitat units (AAHU) were calculated from environmental models. The difference between them, net AAHU, then represents the output or gain for that measure. A summary of the AAHUs is shown in Table 3.2. A full discussion of the underlying modeling and calculations made to derive the AAHUs is presented in the environmental technical appendices.

Table 3.2. FWOP, FWP and Net Average Annual Habitat Units (AAHUs)s for Alternatives

Alternatives	Description	Future Without Project AAHU	Future With-Project AAHU	Net AAHU	Acres
[1]A	Remove RC 1	231	241	10	290
[1]B	Notch RC 1	231	233	2	290
[1]C	Remove RC 2	231	239	8	290
[1]D	Notch RC 2	231	236	5	290
[2]E	Open SC1	21	33	12	40
[2]F	Open SC2	10	16	6	20
[2]G	Restore Tributary A	3	83	80	66
[3]H	Sod Farm Reforestation	0	43	43	74
[1]I	Repair RC3 Bank Erosion	7	8	1	11
[1]R1	Notch RC1 and Notch RC2	231	243	12	290
[1]R2	Notch RC1 and Remove RC2	231	245	14	290
[1]R3	Remove RC1 and Notch RC2	231	251	20	290
[1]R4	Remove RC1 and Remove RC2	231	253	22	290

[1] – AAHU values represent QHEI model outputs
[2] – AAHU values represent sum of QHEI and HSI model outputs
[3] – AAHU values represent HSI model outputs

3.2.2 Costs

The second input for CEICA is the average annual cost for each alternative. First costs, including monitoring and adaptive management, were developed. And though the sponsor currently owns all of the needed real estate, and no additional acquisition is required, economic cost for the use of those lands were developed and included as part of first cost. Interest during construction, based on the estimated construction time, for each measure was calculated, and added to the first cost to derive the investment cost for each plan. The investment cost was then amortized over a 50-year period of analysis using the FY 2021 federal discount rate of 2.5%, to get an average annual investment cost and then added to the estimate of average annual operating, maintenance, repair, replacement, and rehabilitation (OMRRR) costs to derive the average annual cost for each alternative. These costs are shown in Table 3.3. The derivation of the average annual OMRRR costs is presented in the Appendix B.

Table 3.3. First Cost and Derivation of Average Annual Cost by Alternative (October 2020 Prices, 2.5% Federal Interest Rate, 50 Year Period of Analysis)

Partially Formed Plan	Description	First Cost	Con-struction Time (months)	Interest During Construction	Investment Cost	Amortized Investment Cost	Interest	Annual OMRRR	Average Annual Cost
A	Remove RC1	$173,000	1	$178	$173,178	$1,776	$4,329	$0	$6,106
B	Notch RC1	104,000	1.5	161	104,161	1,068	2,604	1,141	4,814
C	Remove RC2	202,000	1	208	202,208	2,074	5,055	0	7,129
D	Notch RC2	232,000	1.5	358	232,358	2,384	5,809	1,141	9,334
E	Open SC1	139,000	3	430	139,430	1,430	3,486	0	4,916
F	Open SC2	180,000	3	557	180,557	1,852	4,514	0	6,366
G	Restore Tributary A Sod Farm	685,000	6	4,246	689,246	7,070	17,231	5,434	29,736
H	Reforestation	519,000	6	3,217	522,217	5,357	13,055	6,210	24,622
I	Repair RC3 Bank Erosion	130,000	1	134	130,134	1,335	3,253	0	4,588
R1*	Notch RC1 and Notch RC2	336,000							14,147
R2*	Notch RC1 and Remove RC2	306,000							11,943
R3*	Remove RC1 and Notch RC2	405,000							15,439
R4*	Remove RC1 and Remove RC2	375,000							13,235

*Note: The costs for the four combination scales are additive. The first cost and average annual cost for R1, R2, R3, and R3 are the sums of their respective components.

3.2.3 Cost Effective Analysis

Table 3.4 shows the summary of average annual costs and net AAHUs used as inputs in the CEICA analysis. Each of the alternatives were allowed to be combined to create alternative plans, with the exception of the river crossing alternatives.

Table 3.4. Summary of CEICA Inputs
(October 2020 Prices, 2.5% Federal Interest Rate, 50 Year Period of Analysis)

Alternative	Description	Average Annual Cost ($1,000)	Net AAHU
A	Remove RC1	$6	10
B	Notch RC1	5	2
C	Remove RC2	7	8
D	Notch RC2	9	5
E	Open SC1	5	12
F	Open SC2	6	6
G	Restore Trib A	30	80
H	Sod Farm Reforestation	25	43
I	Repair RC3 Bank Erosion	5	1
R1	Notch RC1 and Notch RC2	14	12
R2	Notch RC1 and Remove RC2	12	14
R3	Remove RC1 and Notch RC2	15	20
R4	Remove RC1 and Remove RC2	13	22

To conduct the CEICA analysis, environmental restoration outputs (net AAHUs) and annual costs (expressed in thousands of dollars) were entered into IWR Planning Suite II software, v. 2.0.9.1. The analysis is in two parts, cost effective analysis and incremental cost analysis. Cost effective analysis identifies all cost-effective plans. The cost-effective plans are incrementally evaluated on incremental cost per incremental output to identify the best buy plans. In combining the alternatives, the two options of addressing the river crossings (removal and notching) were defined as mutually exclusive, which prevents any plan from having both removal and notching of the same river crossing. Additionally, stand-alone river crossing alternatives were configured as not combinable with the other river crossing combinations. River crossing combinations were treated as scales of the combination measure, and by default, are not combinable with one another.

Using the IWR Planning Suite plan generator, the various combinations of alternatives resulted in 416 possible plan combinations. Thirty-two of the plans were determined cost effective, with 7 of those being best buys (inclusive of No Action). A scatter plot of the plans is shown in Figure 3.1. The cost-effective plans are shown as the red triangles, on the leading edge of the plot, and the subset of cost-effective plans determined to be best buys are showing as green squares. The best buy plans are:

- No Action
- Restore Tributary A
- Restore Tributary A, Open SC1
- Restore Tributary A, Open SC1, Sod Farm Reforestation

- Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and Remove RC2
- Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and Remove RC2, Open SC2
- Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and Remove RC2, Open SC2, Repair RC3 Bank Erosion

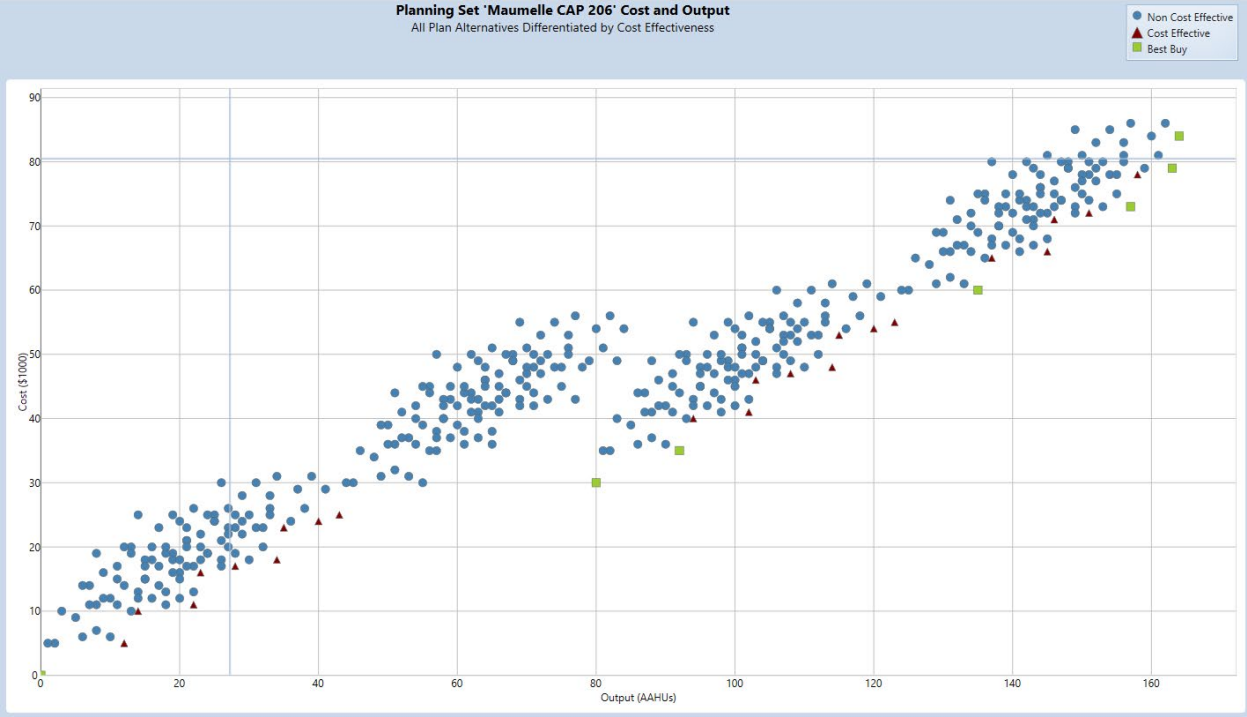

Figure 3.2. Plot of Pans Showing Cost Effective and Best Buy Plans

3.2.4 Incremental Cost Analysis

The next step in the CEICA analysis is to perform an incremental cost analysis (ICA) on the cost-effective plans. ICA compares the incremental cost per incremental benefit (output or lift in environmental output) among the plans to identify plans that maximize the last dollar spent. Starting with the no action plan, the incremental cost per incremental benefit is calculated from the no action for each cost-effective plan. The plan with the least incremental cost per incremental output is identified as the first of the “with-project” best buy plans. Then starting with that plan, the incremental cost per incremental benefit is calculated between that plan and each remaining cost-effective plan, and the one with the least incremental cost per incremental benefit is identified as the next plan in the array of best buy plans. This iteration continues until there are there are no remaining plans. The last plan in the best buy array, is typically the “kitchen sink” plan, or the plan that contains all the management measures being analyzed.

The array of best buy plans, ordered by ascending incremental cost per incremental output is shown graphically in Figure 3.2 with the numerical data shown in Table 3.5.

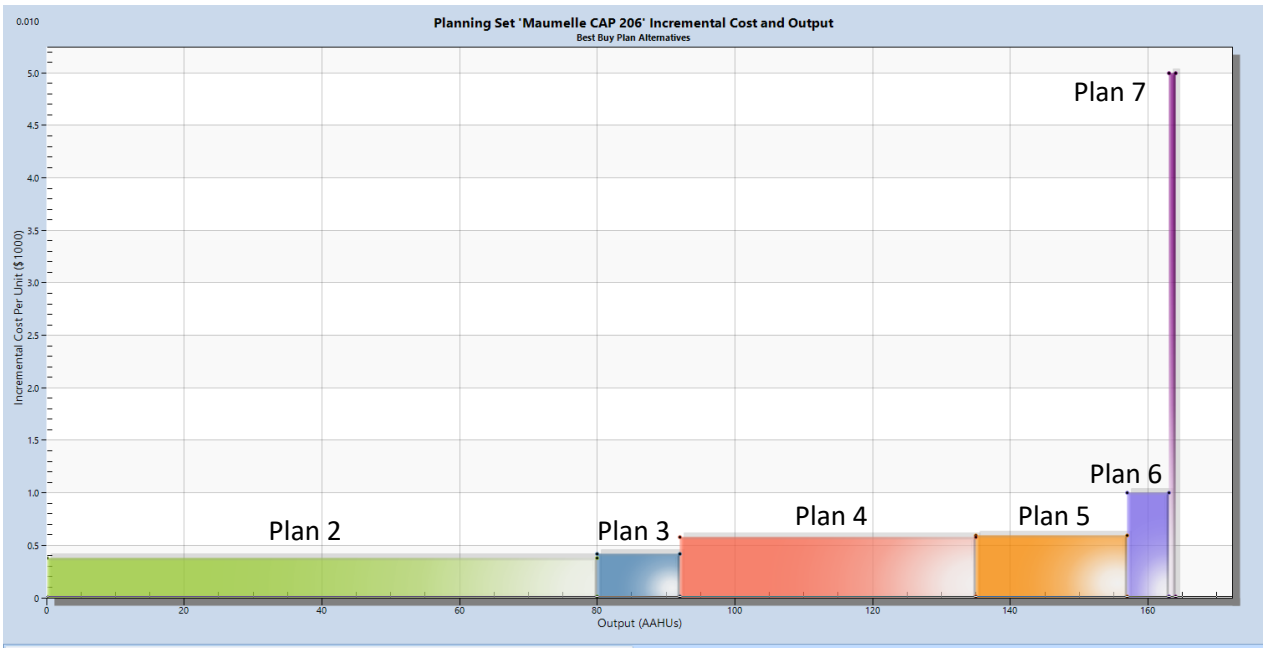

Figure 3.3 Best Buy Array

Table 3.5. Results of Incremental Analysis of Best Buy Alternatives (October 2020 Prices)

Plan	Description	Output (AAHU)	Average Annual Cost ($1,000)	Average Cost Per AAHU ($1,000)	Incremental Cost ($1,000)	Incremental Output (AAHU)	Incremental Cost per Incremental Output ($1,000)	First Cost
1	No Action	0	0					
2	Restore Tributary A	[1]80	$30	$0.38	$30	80	$0.375	$685,000
3	Restore Tributary A, Open SC1	[2]92	35	0.38	5	12	0.417	824,000
4	Restore Tributary A, Open SC1, Sod Farm Reforestation	[2]135	60	0.44	25	43	0.581	1,343,000
5	Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and RC2	[2]157	73	0.46	13	22	0.591	1,718,000
6	Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and RC2, Open SC2	[2]163	79	0.48	6	6	1.000	1,898,000
7	Restore Tributary A, Open SC1, Sod Farm Reforestation, Remove RC1 and RC2, Open SC2, Repair RC3 Bank Erosion	[2]164	84	0.51	5	1	5.000	2,028,000

[1] – AAHU values represent QHEI model outputs

[2] – AAHU values represent sum of QHEI and HSI model outputs

3.3 Best Buy Array and "Is It Worth It?" Analysis

The Cost Effective—Incremental Cost Analysis presented in the previous section does not lead to a definitive plan for choosing the recommended plan, but rather serves to inform the selection process. Using the results of the CEICA analysis, the benefits associated with the environmental incremental outputs have to be evaluated against the incremental increase in costs. This analysis, called the "Is It Worth It?" analysis evaluates each plan, its incremental outputs and costs, and the benefits provided by the plan to make a case that the plan is worth the Federal investment to achieve those benefits.

3.3.1 Plan 1 - No Action

The no action plan represents no federal action to address the degraded aquatic/riparian ecosystem, and the degradation would continue and increase over the 50-year period of analysis.

This plan does not address the identified resource need to remove two low water crossings on the Maumelle River that would restore stream connectivity in the main channel of the river for fish/aquatic organism passage, as well as restore flows through a braided side channel that would flush years of sediment that have destroyed important benthic habitats historically used for spawning and nursery areas. Aquatic biodiversity will continue to be adversely impacted by not allowing populations to mix freely, and the continued degradation of benthic habitats. The natural hydrology will continue to be drastically altered and seasonal variation in river flow below the two river crossings will continue to be diminished. Native plant species will continue to be harmed by the lack of seasonal fluctuations that provide regular depositions of sediment and nutrients, including species of national and regional conservation concern.

This plan does not address the identified resource need to restore floodplain connectivity to provide important spawning and nursery habitat for several aquatic organisms, nor restore flow through side channel riparian habitat important to many riparian dependent species, including neotropical migratory birds.

This plan does not address the identified resource need to restore riparian forest and forested wetland habitat that will restore historic vegetation, provide migration and breeding habitat for several neotropical migratory bird species, reduce “edge” habitat that is detrimental to forest interior breeding birds, provide terrestrial habitat for numerous riparian and forest dependent species, and reduce nutrient and sediment transport into the Maumelle River.

While there is no cost associated with this plan, the PDT does not believe the action is worth the lack of investment, as it does not address any of the planning objectives and leaves the study area in its degraded state

3.3.2 Plan 2 - Restore Tributary A

Plan 2 will partially restore the natural hydrology and riparian forest habitat that historically existed in the study area. This is accomplished through restoring the natural watershed drainage by reconstructing the tributary stream across the sod farm field that historically existed and planting a riparian corridor along the tributary with native bottomland hardwood species. This restoration will significantly reduce or eliminate the conduit of sediment and nutrients flowing into the Maumelle River and Side Channel 1 (SC1) by blocking channelized ditches that replaced the natural stream. It will also reduce the loss of water supply storage in Lake Maumelle due to sedimentation.

Plan 2 restores important spawning and nursery habitat for many native fish species that require small, shallow, intermittent streams for spawning and nursery habitat (e.g., Orangethroat darter *Etheostoma spectabile*, Pugnose minnow, *Opsopoeodus emiliae*). Many species of salamanders, frogs and toads will likely utilize intermittent pools for reproduction or as summer refugia depending on flow conditions.

The restoration of Tributary A partially restores a Freshwater Forested Wetland that historically existed on the site. Material excavated for this restoration will be used to recreate ridges, swales, small mounds, and alluvial depressions across the sod farm field. LiDAR imagery of reference watersheds will be used to approximate historic topography conditions.

Planting native riparian vegetation as a buffer for Tributary A will provide significant beneficial effects. Appropriate native vegetation (native bottomland hardwood species) will improve water quality by filtering out sediments and chemical constituents. The restored riparian forest corridor will provide forage, cover, and organic inputs to the Maumelle River ecosystem, developing the lower trophic levels utilized by fish and wildlife species. The restored riparian corridor will increase the organic allochthonous material to the aquatic system and provide the energy to the lower trophic organisms that drive and support the Maumelle River ecosystem and reduce the occurrence of invasive species in the study area. The restored riparian corridor will also partially increase habitat diversity for numerous forest-dependent wildlife species, including species of conservation concern (forest interior birds, reptiles and amphibians, and bats [including the federally endangered Northern Long-eared Bat, *Myotis septentrionalis*]), as well as for relatively stable native wildlife species.

While this plan is an improvement over the No Action Plan, it does not fully address all of the planning objectives or capture all of the potential benefits of other plans. The Maumelle River will remain isolated from its floodplain by the manmade levee along the north bank and several important side channels (forested wetlands) will remain isolated from necessary headwater flows that would flush excessive amounts of sediment that have been deposited in them over several decades since levee construction. These side channels historically provided important spawning and foraging habitat for native aquatic

species, as well as serve as refugia during flood events. The two river crossings (RC1 and RC2) will remain in place and to disrupt the natural hydrology in the Maumelle River as well as continue to create artificial pool habitat that has replaced natural riffle-pool-run habitats. In addition to the alteration of riverine habitat, the crossings are causing an increase in sedimentation and embeddedness above each of them, thereby degrading benthic habitats (i.e., cobble and gravel substrates) used by many aquatic species.

The restoration of the Tributary A, while requiring no real estate acquisition, does require an economic cost to be associated to the use of sponsor owned lands to achieve the environmental benefits. The economic cost for real estate makes up a large portion of the first cost for this plan.

This plan increases the output by 80 AAHUs at an incremental cost per incremental AAHU of $375. It partially restores 66 acres at a first cost of $685,500. Although the plan only partially addresses one Planning Objective (Restore the Structure and Function of Riparian Wetlands), it is preferred over the no action plan and therefore is worth the Federal Investment.

3.3.3 Plan 3 – Restore Tributary A, Open Side Channel 1

Plan 3 builds upon Plan 2 by incrementally adding the Opening of Side Channel 1 (SC1). This restores headwater flow through a Freshwater Forested Wetland. Reduced water elevations from culvert removals will expose the riffle-run habitat currently flooded by artificially impounded pools. The restored headwater flows will flush sediments and reduce embeddedness in the channel.

Opening SC1 restores the flood storage capability of the floodplain, thereby reducing bank erosion and adverse impacts to aquatic habitats caused by restricting high flows to the main river channel. Floodplain connectivity is significantly improved with reconnecting SC1 and the Maumelle River. This connection restores flood frequencies to an average of once every 18 months, from the current condition of once every 15 years (average).

The restored flood frequency, coupled with the restoration of headwater flows through SC1 will significantly increase the quantity, quality, and diversity of aquatic and riparian habitats. Many native fish species utilize tributary streams for spawning and nursery habitat, or as refugia during flood conditions. Similarly, many species of salamanders, frogs, and toads will likely use intermittent pools during the summer as refugia. The increased aquatic biodiversity in the side channel will also benefit many riparian-dependent wildlife species. The reduced water surface elevation will also expose gravel banks/bars that have been inundated by the high water level caused by culverts. This newly exposed habitat is ideal for several state-sensitive plant species found in the Maumelle River drainage, including one possible new species (discussed in the Environmental Resources Section).

Plan 3 partially addresses a second Planning Objective (Restore Stream Connectivity) and continues to move towards completely addressing the problems and planning objectives and increase the diversity of aquatic and riparian habitat restoration.

This increases the environmental output by 12 AAHUs, for a total of 92 AAHUs. The incremental cost per incremental AAHU is $417, only slightly higher than Plan 2 ($375). It partially restores 106 acres at a first cost of $824,000. Plan 3 partially addresses a second Planning Objective (Restore Stream Connectivity). Given the increase in environmental outputs with only a small increase in incremental costs, this plan is worth the Federal investment.

3.3.4 Plan 4 – Restore Tributary A, Open Side Channel 1, Sod Farm Reforestation

Plan 4 builds on Plan 3 by incrementally adding reforestation of the land previously used as a sod farm. Restoring the historic Freshwater Forested Wetland (bottomland hardwood forest) will create significant

beneficial effects. It will restore a native floodplain bottomland hardwood forest that connects riparian forest communities to higher bottomlands (flood less than a 5-year frequency) and upland forested habitats. The restored forest habitat will reduce forest fragmentation and increase habitat diversity, availability, and connectivity important for numerous native forest-dependent wildlife species, including species of conservation concern (forest interior birds, reptiles and amphibians, and bats [including one federally listed species]), as well as for relatively stable native wildlife species. Reforestation of the sod farm with native hardwood tree species will help to reduce the spread of invasive species that threaten native habitats.

Plan 4 will maximize water quality benefits started in Plan 2 by filtering out sediments and chemical constituents caused by the commercial sod operation. It would further reduce the loss of water supply storage in Lake Maumelle due to sedimentation. It also maximizes the organic allochthonous material input to the aquatic system started in Plan 2, increasing the energy to the lower trophic organisms that drive and support the Maumelle River ecosystem.

Plan 4 provides a significant increase in ecosystem health in the study area by maximizing the restoration potential on the sod farm. Environmental outputs increase by 43 AAHUs over Plan 3, for a total of 135 AAHUs. The incremental cost per AAHU is $581. It partially restores 180 acres at a first cost of $1.3 million. While the incremental cost per incremental output is higher than Plan 3 ($581 compared to $417), Plan 4 provides a comparatively moderate lift in output. Plan 4 is the first to fully address one Planning Objective (Restore the Structure and Function of Riparian Wetlands) by completing the restoration of riparian bottomland hardwoods. Given this, this plan is worth the Federal investment.

3.3.5 Plan 5 - Restore Tributary A, Open Side Channel 1, Sod Farm Reforestation, Remove River Crossing 1 and River Crossing 2

The removal of both river crossings (RC1and RC2) maximizes the restoration of the main-stem Maumelle River to a free-flowing system downstream to Lake Maumelle, fully restores fish/aquatic organism passage in the Maumelle River within the study area to its natural state and restores the natural hydrology of the river. Channel sinuosity will be greatly improved by the lowered water levels above each crossing location. Sediment and energy transport will be restored to natural conditions. Dissolved oxygen concentrations will improve because of increased water flow. The removal of the impounded pools will improve water quality by restoring natural water temperature regimes and reduce suspended sediments.

Removal of RC1 and RC2 restores approximately 7.7 miles of stream connectivity and aquatic organism passage in the main-stem Maumelle River, from a partial barrier upstream of the study area, downstream to Lake Maumelle. Removal of the crossings will expose several riffle-run-pool habitat complexes (3+ above each crossing location based on USGS survey data) that have been inundated since construction of the crossings. This restoration of historic habitats and the increased connectivity will beneficially impact numerous native aquatic organisms by increasing access to quality habitat for foraging and reproduction. The increased connectivity will also improve aquatic biodiversity by allowing populations to mix freely.

Removal of RC1 and RC2 will stop the deposition of sediments and resultant embeddedness that occurred above them. The reestablished natural flow conditions will aid in flushing sediments out of the newly exposed riffle-run-pool habitat complexes and reduce embeddedness in the cobble/gravel substrate. Bank scouring caused by the crossings will be eliminated by their removal.

Removal of RC1 reconnects a 0.5-mile Freshwater Forested Wetland (braided side-channel) located downstream of the river crossing, restoring headwater flows that will flush excess sediment from heavily impacted riffle and pool habitat and reduce embeddedness, thereby increasing habitat diversity and productivity for native aquatic species.

The reduced water surface elevations will expose gravel banks/bars that have been inundated by the high water level created by the river crossings. This newly exposed habitat is ideal for several state-sensitive plant species found in the Maumelle River drainage, including one possible new species (discussed in the Environmental Resources Section).

Plan 5 increases environmental outputs by 22 AAHUs over Plan 4, for a total of 157 AAHUs. The incremental cost per incremental AAHU is $591. It partially restores 470 acres (290-acre increase over Plan 4) at a first cost of $1.7 million. Plan 5 is the first to fully address the majority of the Planning Objectives (fully addresses Restore Stream Connectivity and Restore the Structure and Function of Riparian Wetlands); and partially address the third (Restore Floodplain Connectivity in the Study Area). Given the added benefits associated with this plan and a full restoration of the mainstem of the Maumelle River, this plan is worth the Federal Investment.

3.3.6 Plan 6 - Restore Tributary A, Open Side Channel 1, Sod Farm Reforestation, Remove River Crossing 1 and River Crossing 2, Open Side Channel 2

This plan builds on Plan 5 by incrementally adding the Opening of Side Channel 2. This reconnection would restore headwater flow through a second Freshwater Forested Wetland. The headwater flows created by the opening would maximize aquatic and riparian habitat diversity and productivity by flushing years of sediment deposition that has accumulated and embedded in a natural gravel substrate that historically occurred in the channel. Environmental benefits will be similar to those gained with the opening of SC1 (Plan 3).

This plan increases the environmental output by 6 AAHUs, for a total of 163 AAHUs. The incremental cost per AAHU is $1,000. It partially restores 490 acres at a first cost of $1.9 million. While opening Side Channel 2 increases important side channel habitat for aquatic species (and maximizes all three Planning Objectives), it only provides an additional 6 AAHUs for a considerably large incremental cost per incremental output over Plan 5 ($1,000 compared to $591). The PDT feels that this alternative is not worth the investment of Federal dollars for the limited habitat gains.

3.3.7 Plan 7 - Restore Tributary A, Open Side Channel 1, Sod Farm Reforestation, Remove River Crossing 1 and River Crossing 2, Open Side Channel 2, Repair River Crossing Bank Erosion

This plan would incrementally add Bank Erosion Repair at River Crossing 3 (RC3) to Plan 6. The repair of bank erosion at RC3 (site of a former low water river crossing) will significantly reduce or eliminate active erosion occurring at the site. The bank restoration will reduce the amount of fine sediments entering the Maumelle River, thus improving benthic habitat diversity downstream. It would also assist in reducing the loss of water supply storage in Lake Maumelle due to sedimentation.

Plan 7 would increase the environmental output by only 1 AAHUs over Plan 6, for a total of 164 AAHUs. The incremental cost per incremental AAHU is $5,000, five times that of Plan 6 ($1,000). It partially restores 501 acres at a first cost of $2 million. While the repair of on-going bank erosion at River Crossing 3 would provide a reduction in sediments entering the river and lake, it results in an increase of only 1 AAHUs for a significantly large increase in incremental cost per incremental output. The PDT feels that this alternative is not worth the investment of Federal dollars for the limited habitat gain.

4 National Ecosystem Restoration Plan

Migratory birds, riparian and riverine systems, and aquatic wildlife are the resources of national significance identified within the study area. Based on historical descriptions and existing conditions of the Maumelle River, this portion of the river would have been extremely valuable stopover habitat for migrating birds, provided excellent connectivity between riparian systems, and would have been unobstructed for the movement of aquatic species, sediment, debris, and other natural materials. The re-creation of expanded riparian buffers, along with improved riverine habitat are critical to improving habitat for migratory birds, local wildlife, and aquatic species.

As outlined in ER-1105-2-100, an aquatic ecosystem restoration study must identify the National Ecosystem Restoration (NER) Plan. The NER plan is the justified alternative and scale having the maximum excess of monetary and non-monetary beneficial effects over monetary and non-monetary costs. It is the plan where the incremental beneficial effects are just equal to the incremental cost, or alternatively stated, where the extra environmental value is just worth the extra costs.

4.1 Selection of the NER/Recommended Plan

An incremental cost analysis was conducted on the nine best-buy plans and those incremental costs were compared against the incremental benefits through the “Is It Worth It Analysis?” (Section 3.3). Plan 5, which includes removal of two low water dams in the Maumelle River (RC1 and 2), notching a man-made levee to reconnect SC2 and re-establish floodplain connectivity, reconstructing a Freshwater Emergent Wetland/tributary stream, and restoring native riparian and bottomland hardwood forests, is the recommended National Ecosystem Restoration (NER) Plan, and as such, is the Recommended Plan. This plan creates 157 AAHUs, restores 470 acres at a first cost of $1,718,000 (prior to cost estimate refinement and abbreviated risk analysis). This plan achieves all three identified objectives, with Objective 3 (floodplain connectivity) being partially met by the reconnection of SC1 (SC2 would remain isolated). The selected NER Plan combines restoration features that will restore the structure and function of riverine and riparian ecosystems in the study area. Additionally, this plan provides:

- Two distinct habitat types (riparian and riverine) out of the two targeted habitat types.
- Resilient habitat for migratory birds.
- The restoration of complex pool/riffle/run features that will improve aquatic biodiversity.
- The restoration of the Maumelle River through improved channel flow, restored natural temperature regimes, improved dissolved oxygen concentrations, and sedimentation and erosion reduction.
- Restored floodplain connectivity.
- The restoration of Freshwater Emergent Wetlands and forested riparian areas.
- The restoration of bottomland hardwood forests.
- The restoration of 94.8% of the identified restoration opportunities in the study area.

4.2 Description of the NER/Recommended Plan

The Recommended Plan for the Maumelle River Aquatic Ecosystem Restoration Study incorporates several measures that will restore the structure and function of the aquatic and riparian ecosystem in the study area.

The Maumelle River reach in the study area is heavily degraded due in part to severe pooling and sedimentation. This pooling, caused by RCs 1 and 2, has decreased the efficiency of natural pool-riffle-run features that historically existed above the crossings and negatively impacting aquatic habitat. The Recommended Plan incorporates the removal of the low water crossings which will allow for open flow of the river, improve sediment transport, decrease erosion, and improve overall aquatic connectivity of the Maumelle River. Once the crossings have been removed, water will be allowed to flow unimpeded, including through a braided Freshwater Forested Wetland that has been isolated by one of the structures. A more natural river flow will allow for natural processes to return such as sediment transport and connectivity which have significant controls over habitat characteristics for flora and fauna. Animals that have evolved based on the natural processes of the river will greatly benefit through the implementation of this plan as well as native plant seed dispersal.

As part of the Recommended Plan, a portion of a man-made levee adjacent to the Maumelle River will be breached to restore floodplain connectivity in the study area, and to allow flows to once again nourish a side channel that has been isolated for decades. This side channel has received runoff from the adjacent sod farm for years, resulting in several inches of silt and muck covering what once was a pristine gravel substrate that provided important spawning areas for native aquatic species. The restored flows through the side channel will flush the sediments out of the side channel over time and once again expose the gravel substrate. The restored benthic habitat will not only benefit numerous aquatic species inhabiting the Maumelle River, but also increase the abundance of riparian-dependent wildlife that will once again utilize the area.

The removal of RC1 and 2, and reconnection of SC1, will result in an AAHU lift of 34, or 21.7% of the total project AAHUs (157). A significant benefit of these actions that isn't represented in the AAHU lift is the restoration of several miles of fish passage. In the FWOP condition, fish moving upstream from Lake Maumelle are restricted to the lower 2.4 miles of the Maumelle River (lake to RC2). With the barriers removed, an additional 5+ miles of river channel and connected side channels will become accessible for fish passage. This added benefit is discussed more in Section 4.4.3 – Environmental Quality (EQ) Account.

The Recommended Plan restores a historic Freshwater Emergent Wetland (Tributary A) that existed in the western part of the study area and plugging several channelized ditches that are currently serving as conduits for sediments, nutrients, and herbicides from a commercial sod farm operation in the study area. Runoff from the sod farm is being directed into the Maumelle River upstream of RC1 and into a side channel that was historically connected to the Maumelle River. Benthic habitats in these areas have been subjected to decades of excess sedimentation, resulting in gravel and cobble substrates being heavily embedded. Restoring Tributary A will provide important spawning and nursery habitat for native fish species that require small, shallow, intermittent streams for spawning and nursery habitat. Many species of salamanders, frogs and toads will likely utilize intermittent pools for reproduction or as summer refugia depending on flow conditions.

The Recommended Plan also restores 140 acres of native bottomland hardwood forest that once occurred in the study area. This reforestation will connect riparian forest communities to higher bottomlands (flood <5 year frequency) and upland forested habitats, thereby reducing forest fragmentation and increasing habitat diversity, availability, and connectivity important for numerous native forest-dependent wildlife species, including species of conservation concern (forest interior birds, reptiles and amphibians, and bats), as well as for relatively stable native wildlife species. Planting native riparian vegetation as a buffer for Tributary A will provide significant beneficial effects. Riparian species will assist ecosystem restoration

in several ways 1) roots of vegetation will hold in the soil and slow down runoff, decreasing the amount of erosion and effectively decreasing the amount of sedimentation buildup within the stream, 2) additional vegetation will provide shade within the stream, improving the temperature, 3) increase biodiversity of insects and microorganisms near the stream that improves foraging opportunities for aquatic and terrestrial wildlife, 4) provide a multitude of cover for aquatic and terrestrial wildlife through their various features, such as roots and limbs, 5) increase the organic allochthonous material to the aquatic system and provide the energy to the lower trophic organisms that drive and support the Maumelle River ecosystem, and 6) reduce the occurrence of invasive species in the study area.

4.3 NER Plan and the Four Criteria

As part of Federal guidelines for water resources projects, there are general feasibility criteria that must be met. According to the USACE ER 1105-2-100 for planning, any the USACE project must be analyzed with regard to the following four criteria:

Completeness: Extent to which the plan provides and accounts for all necessary investments or actions to ensure realization of the planning objective

- The alternatives fully analyzed will not completely restore the novel ecosystem; however, all of the alternatives included in the Selected Plan would achieve the benefits described below without other projects being completed. For all alternatives, this included determining the likelihood of natural resources that could benefit as part of a project's implementation.

Effectiveness: Extent to which the plan contributes to achieving the planning objective

- Plan 5 contributes to the achievement of the planning objectives and avoids all constraints. The Selected Plan is environmentally effective due to the varying measures that can be implemented

Efficiency: Extent to which the plan is the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment.

- Plan 5 is the most cost-effective means of achieving the objectives of all of this study's alternatives, plans, and scales of plans.

Acceptability: Workability and viability of the alternative plan with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies.

- Plan 5 is acceptable in terms of all known applicable laws, regulations, and public policies by the USACE and CAW.

4.4 Comprehensive Benefit Description

In accordance with the Assistant Secretary of the Army for Civil Works (ASA[CW]) policy directive dated 5 January 2021, each study mush include, at a minimum, the following plans in the final array of alternatives for evaluation:

- The "No Action" alternative
- A plan that maximizes net total benefits across all benefit categories, and

- A plan that maximizes net benefits consistent with the study purpose.

4.4.1 No Action Plan

Under this plan, the aquatic and riparian ecosystems in the study area would remain degraded and continue to adversely affect native aquatic and riparian-dependent species and their habitats. The natural hydrology will continue to be drastically altered and seasonal variation in river flow below the two river crossings will continue to be diminished. Native plant species will continue to be harmed by the lack of seasonal fluctuations that provide regular depositions of sediment and nutrients, including species of national and regional conservation concern.

This plan does not address the identified resource need to reestablish riparian forest and forested wetland habitat that will restore historic vegetation, provide migration and breeding habitat for several neotropical migratory bird species, including birds of conservation concern. The commercial sod farm would remain in production, or some other commercial agricultural activity would replace it, thereby continuing the present "edge" habitat that is detrimental to forest interior breeding birds and numerous riparian and forest dependent species. Water quality and aquatic habitats would remain degraded due to excess chemicals (e.g. fertilizer, herbicide) and sediments that will continue to be transported into the Maumelle River.

Section 3.3.1 provides a summary of the No Action, or Future Without Project Plan, while Section 2 for the report includes details for several environmental resources.

4.4.2 Maximum Net Benefits Plan – All Categories

Plan 7 was identified as the plan that would maximize net total benefits across all four accounts. This Plan includes all the restoration alternatives included in the Recommended Plan (Plan 5), plus the reconnection of SC2 and bank repairs at RC3. This plan was not selected as the Recommended Plan, as the CEICA analysis indicated that the environmental outputs (7 AAHUs) were not sufficient to justify an increase of approximately $300,000 in federal costs for implementation.

4.4.3 Maximum Net Benefits Plan Consistent with Study Purpose

The Economic and Environmental Principles, Requirements and Guidelines for Water and Related Land Resources Implementation Studies (PR&G) and ER 1105-2-100, Planning Guidance Notebook (PGN) states that for ecosystem restoration projects, an aquatic ecosystem restoration study must identify the National Ecosystem Restoration (NER) Plan. The NER plan is the justified alternative and scale having the maximum excess of monetary and non-monetary beneficial effects over monetary and non-monetary costs. It is the plan where the incremental beneficial effects are just equal to the incremental cost, or alternatively stated, where the extra environmental value is just worth the extra costs.

In addition, the PR&G identifies four accounts that must be considered in development of alternatives: National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ) and Other Social Effects (OSE). The following provides a description of these accounts and the potential effects of the Recommended Plan (Plan 5).

NED Account

While the Maumelle Ecosystem Restoration Study only quantified ecosystem restoration benefits, the National Economic Development (NED) benefits are discussed qualitatively. The project does not generate any reduction in flood damages or provide any navigation or hydropower benefits; however,

there are potential recreation benefits, considered as part of the NED benefits, that can be counted. Though no recreation features are constructed, the removal of the low water crossings open up the river which is anticipated to increase fish populations. The increased fish populations would have a positive impact on the recreation benefit enjoyed by angers along the river. Opening up the river would also make boating and canoeing more accessible and navigable over longer stretches, which would increase the recreation benefit enjoyed by those using watercraft. Additionally, the reforestation of the bottomland hardwoods will draw birds to the area for foraging and nesting. This would provide and increase benefits for birdwatchers and photographers, all adding to a net increase in NED benefits.

RED Account

Most of the Regional Economic Development (RED) benefits for the Maumelle project would be short term and related to the construction dollars spent in the local economy. The estimated $2,269,000 construction cost will contribute RED economic impact mostly directed to the local economy. Of the total expenditure, approximately $1.9 million is estimated to be spent locally. Through the multiplier effect, this would translate to approximately $3.4 million of new outputs produced in the local economy, 29 new jobs and approximately $1.9 million of new labor income. In addition to these short term construction related benefits, other RED benefits that could potentially be captured would be from dollars spent locally by any increased number of recreators brought to the area for fishing, boating/canoeing, or birdwatching. While recreation benefits tied to the recreation experience are captured as NED, the dollars they spend on items such as lodging, food, equipment rentals would be RED benefits. And though the project would not draw a large number of new recreators to the area, any increase would attribute, even if marginally, to the overall RED benefits created by the project.

EQ Account

This account considers effects of significant natural and cultural resources. EQ at the Maumelle River study area would be improved by restoring a more natural riverine and forested wetland system. This habitat restoration is expected to improve the environmental quality in the general area through the removal of aquatic barriers (dams, levees, culverts) that will restore floodplain and stream connectivity, as well as reconstruct a historic tributary that existed in the study area before being filled to expand a commercial sod farm. This restored connectivity will reestablish access to important spawning and nursery habitats for many aquatic organisms. The removal of these barriers will result in an AAHU lift of 34, as described elsewhere in this report and associated appendices. A significant benefit of these actions that isn't represented in the AAHU lift is the restoration of several miles of fish passage. In the FWOP condition, fish moving upstream from Lake Maumelle are restricted to the lower 2.4 miles of the Maumelle River (lake to RC2). With the barriers removed, an additional 5+ miles of river channel and connected side channels will become accessible for fish passage. Another qualitative benefit of the lower water dam removals will likely be a minor, but important reduction in downstream bank erosion created by the presence of the dams. This reduced erosion will lead to less sedimentation in the river and lake, thereby improving benthic aquatic habitat and water quality.

The study area is composed of a mixture of deciduous and evergreen forest, and open fields currently in commercial sod farm production. The Recommended Plan will reforest approximately 140 acres of those fields to native bottomland hardwood species. This restoration, combined with the surrounding native forest, will provide high quality forested habitat for a myriad number of riparian-dependent species, including native large and small mammals, amphibians, reptiles, and birds. Several species of neotropical migratory birds that utilize, or will likely utilize the area are listed as USFWS Birds of Conservation Concern (BCC). The suite of bird species utilizing the area will evolve over time as the reforested areas transition from open fields to mature bottomland and riparian forests. The restoration of the sod farm acreage will also provide significant benefits to aquatic habitats in the Maumelle River and tributaries as the forested acres will reduce erosion and the resulting sediments that are currently entering the river and

covering benthic habitats. Additionally, the restoration of the sod farm acreage will eliminate fertilizer and herbicides from entering the river and tributaries, thereby improving water quality and aquatic habitats.

The Recommended Plan will contribute 157 AAHUs and 470 acres of riverine, wetland, and riparian restoration to the Maumelle River study area.

OSE Account

This account displays plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts (e.g. community impacts, health and safety, displacement, and energy conservation).

The Recommended Plan provides habitat restoration to support recreational and educational opportunities in a way that minimizes the risk to the restored environment. The non-federal sponsor has expressed a desire to develop the study area into an outdoor education center in the future. Such as center could provide examples of restoration opportunities and results to neighboring landowners, which could then contribute to increased restoration throughout the Maumelle River watershed. An outdoor education center in such close proximity to Arkansas' largest metropolitan area would likely draw interest from numerous primary and secondary public schools as a "real-life" example of ecosystem restoration and water quality protection.

An added benefit of an outdoor education center would be the development of low-impact hiking trails located in portions of the study area, as well as surrounding CAW-owned properties. Such trails would provide health benefits to the public that choose to recreate in the area.

The removal of two low-water dams on the Maumelle River will improve safety conditions for kayakers and canoeists that use the river. In its present condition, these dams create hazards to floaters and anglers.

The restoration of 140 acres of native bottomland and riparian forests will improve air quality in the area in four main ways:

- Absorbing gaseous pollutants (ozone, nitrogen dioxide) through leaf surfaces
- Intercepting particulate matter (e.g., dust, ash, dirt, pollen, smoke)
- Releasing oxygen through photosynthesis
- Transpiring water and shading surfaces, resulting in lower local air temperatures, thereby reducing ozone levels

The reforestation proposed in the Recommended Plan will help reduce atmospheric carbon dioxide (CO2) by directly sequestering CO2 as woody and foliar biomass as they grow. One study by Paula Peper, et. al. (2007) calculated the benefit of reducing atmospheric CO2 at approximately $1.29 per tree. Based on a planting regime of 302 stems of riparian woody vegetation per acre (12" x 12" spacing), the improved water quality value is approximately $390 per acre annually. Since the Recommended Plan proposes 140 acres of riparian woody vegetation, the CO2 sequestering benefit is valued at approximately $54,500 annually.

In addition to the health benefits that the proposed reforestation provides, there is also a benefit to the aesthetic value of the property. While the study area is situated in a rural landscape surrounded by ridgetops and slopes are largely forested with upland hardwoods (on private property), or evergreen forests dominated by loblolly pine (commercial timber companies), much of the broad valley is privately owned and has been converted to pasture or other agriculture practices. Within the study area, the

landscape is a mosaic of bottomland hardwood forests interspersed with sod farm fields that detract from the natural landscape. The reforestation of 140 acres to native bottomland and riparian hardwoods will provide a benefit to the visual aesthetics of the area, as well as reduce the opportunity for the encroachment of invasive species, which can detract from the visual quality.

4.5 Monitoring and Adaptive Management

To ensure the success of the Selected Plan, the restoration measures will be periodically surveyed to provide feedback on the response of the ecosystem and its resources to the management measures taken. By connecting the ecosystem response to the restoration as well as the management measures, potential beneficial adaptations and adjustments to the project or management plan can be identified to ensure continued success of the project. The Monitoring and Adaptive Management Plan is in Appendix C-4 – Monitoring and Adaptive Management**.** Some ecosystem responses to climate change may occur over a longer time scale than the monitoring plan will cover, however near-term adaptations may consider short-term observed values in temperature and streamflow. Long-term adaptations can be considered as climate trends become clearer over time.

4.6 Real Estate

All project areas fall within lands already owned by the NFS. All the project LERRD is within the 100-year floodplain, and as such, all the project areas are vacant, floodplain, open space properties. Information on LERRD requirements for the Recommended Plan can be found in Appendix G.

4.7 Relocations

No facility or utility relocations are anticipated; however, the Government will make a final determination of the relocations necessary for the construction, operation, or maintenance of the project after further analysis and completion and approval of the Final Attorney's Opinions of Compensability for each of the impacted utilities and facilities. Cost estimates for the relocation of water lines, sanitary lines, gas lines, telephone lines, and electric lines can be found in Appendix G. There does not appear to be any relocation of utility and facilities.

4.8 Cost

Upon the determination of the recommended plan, costs were refined and an abbreviated risk assessment was made on the risk to cost and scope, which result in a more risk informed estimate of the project first costs. The estimated first cost for the recommended plan is $2,464,000, as shown in Table 4.1. This includes $1,354,000 for construction, including monitoring and adaptive management, $547,000 for land and damages, and $462,000 for pre-engineering design and $101,000 for construction management.

Table 4.1. Project First Costs (October 20221 Prices)

Feature	First Cost
Construction	$1,354,000
Lands and Damages	547,000
PED	462,000
Construction Management	101,000

Total	$2,464,000

Table 4.2 shows the derivation of average annual costs, based on a 2.50% Federal interest rate and a 50-year period of analysis. The average annual cost of the recommended pan is $99,000, which provides a total lift of 157 average annual habitat units.

Table 4.2. Derivation of Average Annual Costs
(October 2022 Prices, 2.50% Federal Interest Rate, 50 Year Period of Analysis)

Cost Element	Cost
Project First Cost	$2,269,000
Interest During Construction	15,000
Investment Cost	2,479,000
Amortization	25,000
Interest	62,000
Annual OMRRR	12,000
Average Annual Cost	**$99,000**
Average Annual Habitat Units	**157**
Acres	**470**

Table 4.3 shows the cost share allocation between the Federal government and the Non-Federal sponsor. Ecosystem restoration is cost shared 65% Federal and 35% Non-Federal, with the Non-Federal sponsor responsible for all lands and damages costs. With an estimated $547,000 for lands and damages, a $315,400 cash contribution would be required by the sponsor to achieve a 35% contribution of $862,400. The 65% Federal share would be $1,601,600.

Table 4.3 Cost Share Allocation

Feature	Federal	Non-Federal Sponsor	Total
Construction	$1,354,000		$1,354,000
Lands and Damages		547,000	547,000
PED	462,000		462,000
Construction Management	101,000		101,00
Subtotal	1,917,000	547,000	2,464,000
Non-Federal Sponsor Cash		315,400	
Adjustment to achieve 65/35	-315,400		
Total	$1,601,600	$862,400	$2,464,000
Cost Share Percentage	65%	35%	

5 Expected Future With-Project Condition for the Recommended Plan

This section describes the likely future conditions in the study area over the 50-year period of analysis. Because this is an ecosystem restoration project, the FWP is assumed to provide habitat benefits to all areas. Habitat benefits will be gained by native riparian and aquatic plantings, invasive species management, and open flow of the riverine system.

Alternative impacts were assessed primarily through habitat surveys of existing conditions, alongside expected improvements or degradations projections developed by USACE, the NFS, and state and Federal resources agencies. Details of the habitat analysis and expected future conditions regarding AAHUs are described in detail in Appendix C-3 – Habitat Modeling.

Under NEPA, the significance of project impacts is a function of context and intensity. For biological resources, context refers to the importance (ecological, commercial, scientific, recreational, etc.) or regulatory (i.e., legally protected) status of the resource, and intensity refers to the magnitude – scale and duration – of the impact. Both beneficial and adverse impacts are recognized; either can be significant. In the project area, the habitats of greatest importance are riverine and riparian habitat. Substantial long-term net changes in the acreage and/or value of these habitats would likely result in significant impacts.

Losses or gains of population and habitat for special status species may also be significant, depending on the magnitude of the impact relative to the population size and distribution of the species in the region.

Finally, an impact that led to new introductions or the expansion of invasive species in the study area would also be considered significant in terms of potential far-reaching effects on the ecosystem as a whole.

5.1 Direct vs. Indirect Impacts

The terms “effect” and “impact” are synonymous as used in this analysis. Both short- and long-term effects are relevant in considering the significance of an impact. Effects are also expressed in terms of duration. The duration of short-term impacts is considered to be one year or less. Long-term impacts are described as lasting beyond 1 year. They can potentially continue in perpetuity; in which case they would also be described as permanent. Effects may be beneficial or adverse and may apply to the full range of natural, aesthetic, historic, cultural, and economic resources of the project area and the surrounding area. Definitions and examples of direct and indirect impacts as used in this document are as follows:

- Direct Impact - A direct impact is one that would be caused directly by implementing one of the two plans and that would occur at the same time and place.

- Indirect Impact - An indirect impact is one that would be caused by implementing a plan that would occur later in time or farther removed in distance but would still be a reasonably foreseeable outcome of the action. Indirect impacts may include induced changes in the pattern of land use, population density, growth rate, air, water, and other natural resources and social systems.

5.1.1 Significance Criteria and Impact Characterization Scale

In accordance with CEQ regulations and implementation guidance, impacts are evaluated in terms of their significance. The term “significant,” as defined in 40 CFR 1508.27, part of the CEQ regulations for implementing NEPA, requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several settings, such as society as a whole (human, national); the affected region; the affected interests; and the locality. Significance varies with the setting of the Proposed Action. For instance, in the case of a site-specific action, significance would usually depend on the effects on the locale rather than on the world as a whole.

Impacts are characterized by their relative magnitude. Significant adverse or beneficial impacts are the highest levels of impacts. Conversely, negligible adverse or negligible beneficial effects are the lowest level of impacts. In this document, nine descriptions are used to characterize the level of impacts. In order of degree of increasing impact, they are:

- Significant Adverse Impact
- Moderate Adverse Impact
- Minor Adverse Impact
- Negligible Adverse Impact
- No Measurable Impact
- Negligible Beneficial Impact
- Minor Beneficial Impact
- Moderate Beneficial Impact
- Significant Beneficial Impact

Intensity refers to the severity of impact with regard to the above ratings (minor through significant). Factors contributing to the evaluation of the intensity of an impact include, but are not limited to, the following:

- The balance of beneficial and adverse impacts, in a situation where an action has both;
- The degree to which the action affects public health or safety;
- The unique characteristics of the geographic area where the action is proposed, such as proximity to parklands, historic or cultural resources, wetlands, prime farmlands, wild and scenic rivers, and ecologically critical areas;
- The degree to which the effects on the quality of the human environment are likely to be controversial;
- The degree to which the effects of the action on the quality of the human environment are likely to be highly uncertain or involve unique or unknown risks;
- The degree to which the action might establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action “temporary” or by breaking it down into small component parts;
- The degree to which the action might adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the NRHP or might cause loss or destruction of significant scientific, cultural, or historic resources;
- The degree to which the action might adversely affect an endangered or threatened species or habitat that has been determined to be critical under the ESA; and;

- Whether the action threatens a violation of Federal, state, or local law or requirements imposed for the protection of the environment.

5.1.2 No Action Alternative Comparison

The No Action Alternative can be interchanged with the FWOP conditions for the NEPA analysis in this section. See Section 2 Existing Conditions and FWOP conditions for a full description of the expected impacts to the study area over a 50-year period without the implementation of a project

5.2 Environmental Resources

5.2.1 Climate and Climate Change

Proposed Action

The FWP project condition is expected to be the same as that discussed for the FWOP. The trend of rising temperatures is predicted to continue into the future. Higher temps will increase the rate the loss of soil moisture during dry spells. As a result, naturally occurring droughts are projected to be more intense. Average annual precipitation amounts are also projected to increase in the future (CWTS 2015). Appendix D – Climate Assessment provides detailed information on climate change in Arkansas.

The proposed project would utilize native plant species that have evolved to cyclical drought patterns. The composition of the native vegetative community would be better adapted to weather extremes anticipated as the result of climate change. According to “Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Arkansas, White and Red Rivers Region 11” the general consensus for this region is a mild upward trending for average precipitation and extreme precipitation events as well as an upward trending for average streamflow (CWTS 2015). As such, sufficient water flows should maintain and ensure the survival of aquatic native plant species within the river, avoiding adverse impacts from climate change. The TSP will also incorporate the removal of two low water crossings that are artificially impounding water in the river channel and adversely impacting water temperatures above the crossings and dissolved oxygen and flow conditions below them. By removing the crossings plus implementing 140 acres of native species plantings, it is assumed that the overall temperature of the study area would decrease, thereby, improving the effects of Climate and Climate Change.

There will be short-term minor adverse impacts from emissions due to the use of heavy machinery such as back hoes and bulldozers within the study area during construction. Increased emission of Greenhouse Gases can cause temperature increases, which in turn have an adverse impact on the study area. However, the adverse impacts caused by the Proposed Action will expire once the project has been completed (expected to be less than two years). Long-term minor beneficial impacts from the Proposed Action will occur through the restoration of approximately 140 acres of riparian habitat, contributing to the collective sequestration of carbon.

Risks and Uncertainties

While there are concerns related to climate change with the Maumelle Ecosystem Restoration, overall the project will increase resiliency of the Maumelle River Ecosystem. This project cannot prevent a shift in average temperature in the area. But by restoring the sod farm and removing the low head dams, the area

will become better fish habitat. Restoring the riparian zones will provide shade to reduce stream water temperatures. It will filter sediment and pollution which can also cause an increase in water temperature. The reforestation of the overbanks will provide storing of flood water and will help in decreasing erosion and increase bank stabilization. Increased vegetation will work to support the animals most threatened by climate change.

The ecosystem restoration project is itself potentially vulnerable to climate change, though those same vulnerabilities are present without the project, and considerations should be made for increasing temperatures and increased extreme precipitation. Considerations should be taken when planting to make sure that vegetation are adapted for wet climatic conditions and increased temperature. For example, bald cypress and tupelo gum could be planted in the lower elevations. Species will vary as elevation increases. As for increasing temperature, hardwood seedlings from regional sources would be well adapted for climatic variations as the surrounding native vegetation. Overall, the project will increase the resilience of the Maumelle River's ecosystem to climate change.

Table 5-1 Residual Climate Risks to Project Features

Project Feature	Trigger	Hazard	Harm	Qualitative Likelihood (Low, Moderate, High)	Qualitative Justification for Likelihood Rating
Shoreline Stabilization	Increased precipitation from more intense, frequent storm events and increases in winter and spring precipitation	Potential for larger future flood volumes and peak discharges Higher flood stages resulting from larger amounts of runoff	Floods may more frequently reach higher elevations than what the riverbanks can stabilize, which could erode shorelines.	Low	Existing trends on the Maumelle indicate an upward trend in peak flood flow. General consensus for this region is a mild upward trend for average precipitation and extreme precipitation events as well as an upward trend for average streamflow. Climate model projections indicate that projected mean annual maximum monthly flows could increase though it is outside the threshold of statistical significance. Increases in temperature are also expected which could potentially increase evapotranspiration and offset increases in flood flow, which make future projections of hydrology uncertain.
Natural Wetland Restoration	Increased precipitation from more intense, frequent storm events and increases in winter and spring precipitation	Potential for larger future flood volumes and peak discharges Higher flood stages resulting from larger amounts of runoff	Flood volume may be greater than what was experienced in the past, exceeding available storage volume. This can result in loss of riparian and aquatic habitat due to longer periods of inundation.	Low	Existing trends on the Maumelle indicate an upward trend in peak flood flow. General consensus for this region is a mild upward trend for average precipitation and extreme precipitation events as well as an upward trend for average streamflow. Climate model projections indicate that projected mean annual maximum monthly flows could increase though it is outside the threshold of statistical significance. Increases in temperature are also expected which could potentially increase evapotranspiration and offset increases in flood flow, which make future projections of hydrology uncertain

5.2.2 Geology, Topography, and Soils

Proposed Action

The removal of the low water crossings would have negligible to minor, long-term, beneficial impacts on topography, geology, and soils within the study area. The beneficial impacts come from the restoration of a more natural sediment and water regime in the Maumelle River. The lower water surface profile may cause temporary bank sloughing that would naturally stabilize and re-vegetate, further stabilizing riverbanks from future floods. However, the planting of approximately 140 acres of native riparian species will negate some of these effects and provide stabilization of soils from larger storm events or flooding.

The restoration of a historically occurring tributary stream may have negligible to minor, short-term, negative impacts on soils within the study area due to possible erosion. However, the restoration of the existing agriculture fields would have significant, long-term, beneficial impacts on soils by the elimination of ground-disturbing activities associated with commercial sod production, in addition to the elimination of the use of herbicides.

There will be short-term, minor, adverse impacts on the soil conditions where the man-made levee would be breached to reestablish floodplain connectivity, however erosion control prevention measures will be incorporated to minimize effects. Based on communications with the NRCS Soil Scientist for Arkansas, the Farmland Protection Policy Act (FPPA) is not applicable since the proposed actions retore the area to vegetation that would have historically occurred. The FPPA only applies to those actions that permanently convert land to a non-agricultural use in the forms of structures, roads, etc., where there is no possibility of it returning to agriculture use. A copy of this communication is included in Appendix C-2).

5.2.3 Land Use

Proposed Action

The removal of the low water crossings and reconnection of side channel 1 would have minor beneficial impacts on land use within the Maumelle River study area. The restoration of 140 acres of riparian hardwood forest will have significant long-term beneficial impacts on land use.

5.2.4 Air Quality

Proposed Action

The demolition of the low water crossings, breaching the man-made levee, and excavating Tributary A and associated tree planting would have short-term, minor, adverse impacts on air quality for the Maumelle River study area. The increase of construction activity would result in a temporary increase of air pollution in the immediate surrounding area as total construction time is expected to be less than two years.

The planting of up to approximately 140 acres of riparian hardwood species would have minor long-term benefits to air quality as the trees would absorb atmospheric carbon.

The operation of heavy equipment, support vehicles, and other motorized machinery for construction would result in combustion of fossil fuels and the release of volatile organic compounds (VOCs), nitrogen oxides (NOx), carbon monoxide (CO), ozone (O3), sulfur dioxide (SO2), and particulates (PM10 and PM2.5). Additionally, fugitive dust emitted to the atmosphere by heavy equipment and support vehicles

moving across unpaved, non-vegetated roadways or staging areas, wind blowing dust from disturbed areas and storage piles into the atmosphere could create a haze over the project area and increase ambient concentrations of particulate matter. Fugitive dust emissions would be greatest during the initial site preparation activities and would vary from day to day depending on the construction phase, level of activity, and prevailing weather conditions. The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of construction activity. Emissions would be temporary in nature. The use of BMPs during construction would minimize these emissions, including the use of cleaner burning fuels and energy efficient equipment.

Air emissions would be mobile in nature, temporary, and localized to the restoration unit(s) being worked at that time. Implementation of the following BMPs would further reduce air quality impacts and should be incorporated when developing contract specifications:

Mobile Source Controls:

- The use of heavy machinery should be fitted with approved muffling devices that reduce emissions;
- Plan construction scheduling to minimize vehicle trips;
- Limit idling of heavy equipment;
- Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, prevent tampering, and conduct inspections to ensure these measures are followed; and
- Consider alternative fuel and energy sources (e.g., natural gas, electricity, etc.) when and where appropriate.

Fugitive Dust Source Controls:

- Stabilize open storage piles and disturbed areas by covering and / or applying water or chemical/organic dust palliative where appropriate at active and inactive sites; and
- Install wind fencing and phase grading operations where appropriate and operate water trucks for stabilization of surfaces under windy conditions.

All air quality standards are in attainment for the region and no General Conformity analyses are required.

5.2.5 Noise

Proposed Action

The removal of the low water crossings and levee breaching would have short-term, adverse impacts on noise within the area. Heavy equipment, including excavators and dump trucks would be used to remove and haul away material, which will increase noise. Noise levels created by construction equipment would vary greatly depending on factors such as the type of equipment, the specific model, the operation being performed, and the condition of the equipment. The equivalent sound level of the construction activity also depends on the fraction of time that equipment is operated over the period of time of the construction. Construction would occur during daylight hours, thus reducing the day-night average sound levels and the chances of causing annoyances. Construction would also be in accordance with migratory bird nesting periods. The use of BMPs such as keeping equipment in good operating condition, proper training, and

providing appropriate health and safety equipment would minimize the potential noise impacts associated with the Proposed Action.

Long-term, there would be no change from the No Action Alternative in regard to construction noise. Construction will comply with Section 4(b) of the Noise Control Act of 1972 (42 USC §§ 4901-4918), which directs federal agencies to comply with applicable federal, state, and local noise requirements with respect to the control and abatement of environmental noise.

5.2.6 Transportation

Proposed Action

Under the Proposed Action, construction equipment and workers would travel along highway 10 to arrive to the work sites along the Maumelle River. Project-related trips would include construction worker commuting trips and truck trips for the delivery of construction related equipment and materials. These trips may contribute incrementally to existing and projected future queues and delays on nearby roadways. However, existing travel use of highway 10 adjacent is typically light during both day- and nighttime hours. The traffic increase would be temporary and, where possible, construction travel to the site would be scheduled to occur outside of the peak commuting hours. Therefore, the contribution to peak hour congestion is expected to be relatively minor. Any adverse transportation related impacts would be short-term and temporary.

5.2.7 Light

Proposed Action

There would be no change in impacts to or from light sources with implementation of the Proposed Action.

5.2.8 Water Resources

Proposed Action

The change in landscape due to the Proposed Action will assist in water conservation in addition to water quality improvement. Native species can increase soil’s capacity to store water and can conserve water resources more efficiently than non-native plants. Site-specific species will also be more sustainable and require less maintenance compared to non-native species in the long-term.

Surface Water and Wetlands

Once constructed and the low water crossings are removed the upstream portion of the river (above the crossing locations) will have a lower water elevation, however, any loss of open water habitat resulting from the removal of the low water crossings will be accomplished to compensate a natural stream channel. The loss of open water resulting in excessive pooling is marginal considering the benefits that historic riverine instream structures will provide for aquatic wildlife.

Groundwater

No impacts to the Ouachita Mountains aquifer are anticipated from the Proposed Action.

Water Quality

Implementation of the Proposed Action would directly impact surface waters in the study area through construction activities associated with demolition of low water crossings and opening side channels. During the construction period, these impacts are expected to temporarily degrade water quality as a result of ground disturbing activities. Erosion and sedimentation controls, such as silt fencing and sediment traps, the application of water sprays, and the prompt re-vegetation of disturbed areas would be required during construction to reduce and control siltation or erosion impacts. In addition, every construction project poses a potential contamination risk from petroleum or chemical spills. The contractor would be required to prepare and follow a site-specific Spill Prevention Plan during construction, which would include use of BMPs such as proper storage, handling, and emergency preparedness, reducing the risk of such contamination.

Impacts to surface waters following implementation of the Proposed Action would have major, long-term, beneficial impacts on water quality. The restoration of approximately 140 acres of riparian forested habitat associated with the project would increase the natural nutrient and pollutant filtering functions of the riparian zone. Reduced sedimentation will improve water temperatures, water clarity, and dissolved oxygen levels over time.

Water quality in the Ouachita Mountains aquifer is expected to remain the same as the existing and FWOP conditions.

A Clean Water Act Section 404(b)(1) Analysis was completed for the study with a determination that the proposed placement site for discharge of or fill material complies with the Section 404(b)(1) guidelines. A Short Term Activity Authorization (STAA) application was prepared and submitted to the Arkansas Department of Environmental Quality (ADEQ) for Section 401 water quality certification on 20 September 2021. Water quality certification (STAA) was provided in a letter dated 14 October 2021 (STAA # 20210339).

5.2.9 Visual Aesthetics

Proposed Action

Short-term impacts may occur where construction-related equipment, activities, and dust could be visible to observers. Impacts would be anticipated to be short-term and occur only in the years in which construction is implemented. Plans that do not include construction of structures, such as reforesting 140 acres of riparian forest, would realize only temporary aesthetic degradation until the disturbed area blends in with the surrounding environment, at which time, it would be anticipated that the aesthetic value of the area would be improved over the existing condition.

Construction activities can introduce differing elements of form, line, color, and texture into the landscape through construction or placement of constructed features such as roads, structures, equipment, or manipulation of vegetation. Effects can also result when actions change scenic integrity or result in conditions that produce unattractive landscapes.

Impacts associated with the proposed plans regarding aesthetics include visibility of construction disturbances, constructed structures, and temporary roads. Vegetation clearing and/or placement of excavated material on upland sites before relocation would present an obvious contrast in color with the surrounding vegetation.

Temporary placement of staging areas and access roads would be visually obvious until use of these is discontinued, and the area naturally restores. Natural restoration would be expected to occur over a period

of 1-5 years. Aesthetic degradation would decrease as the disturbed surface begins to blend in color, form, and texture. In general, restoration measures would have significant beneficial impacts to the aesthetic value of the area and pleasing to visitors.

The removal of the low water crossings would have mixed adverse and beneficial impacts based on an individual's perception. The flat calm water immediately upstream of the crossings, along with the bare riverbank provide a picturesque scene for some of the public. The removal of the low water crossings would have permanent, major, adverse impacts to this aesthetic value.

However, those who prefer natural landscapes sans anthropogenic influences would find the return of flowing river and riffle complexes a permanent, major, and beneficial impact on aesthetic value. The trade-off would likely result in minor, beneficial impacts on aesthetics in the area. The removal of monocultures through invasive species management and the planting of native riparian species will bring about an attractive change that can produce a variety of striking colors and variation.

5.2.10 Recreation

Proposed Action

Recreational use of the study area is currently restricted by CAW. However, future plans include opportunities to increase public use of the area for education and limited recreation. The removal of the low water crossings and restoration of 140 acres of riparian forest would have minor long-term beneficial impacts on potential recreation use of the Maumelle River study area.

5.2.11 Vegetation

Proposed Action

There will be some temporary minor adverse impacts to vegetation as a result of construction. It is expected that the equipment utilized for construction and general human disturbance will cause the loss of some native vegetation in the project area. Mortality of species will be avoided as best as possible.

There would be significant long-term, beneficial effects from planting approximately 140 acres of native riparian vegetation. Appropriate native vegetation would improve water quality by filtering out sediments and chemical constituents. Additionally, it would provide forage, cover, and would increase the organic allochthonous material to the aquatic system and provide the energy to the lower-level trophic organisms that drive and support the Maumelle River ecosystem. Planting of appropriate vegetation within the study area would also provide connectivity of the aquatic and riparian habitats, more closely mimicking historical conditions. Table 4.1 includes a list of bottomland hardwood species recommended for reforestation efforts.

Table 4.2: Bottomland Hardwood Tree Species Recommended for Planting*.

Common Name	Scientific Name
Cherrybark Oak	Quercus pagoda
Pin Oak	Quercus palustris
Willow Oak	Quercus phellos
Nuttall Oak	Quercus texana
Southern Red Oak	Quercus falcata
Black Walnut	Juglans nigra
Redbud	Cercis canadensis
Red Mulberry	Morus rubra

Sugarberry	Celtis laevigata
Pecan	Carya illinoinensis
Hickory	Carya spp. (species dependent on availability)

*Species composition contingent on availability of seedlings

The appropriate use of BMPs such as erosion control practices and tree protection devices at construction sites would protect existing trees and large blocks of vegetation/habitat adjacent to the construction areas.

The restoration features of the Proposed Action will provide significant, long-term, beneficial impacts to forested riparian and wetland areas in the Maumelle River study area.

5.2.12 Wildlife

Proposed Action

Where construction or disposal is proposed, there would be an increased level of human disturbance, such as noise, vehicular traffic, and construction equipment, which could lead to temporary localized displacement of affected existing fish and wildlife populations. Mortality of fish or wildlife individuals is possible during the construction phase, but would be rare, as most species would avoid the areas of disturbance.

There would be major long-term beneficial impacts on fish and wildlife populations from the implementation of the proposed alternatives through geographic expansion and improved quality of their respective habitats. By removing the existing low water crossings and restoring the Maumelle River to a more natural condition, native fish populations could repopulate areas that have not been favorable for their existence or survival. The resulting water quality improvements would improve habitat conditions for intolerant native species and would restore balance to the native tolerant/native intolerant aquatic species over time.

Increased connectivity within the river will provide better habitat conditions for several native aquatic species by the restored riffle-pool habitats. Pool/riffle/run features acting in a more natural capacity assist ecosystem restoration in a variety of ways. Pools can protect smaller fish or provide shelter during dry conditions and also allow sediment and organic materials to settle within the streambed because the river moves more slowly. Riffles also assist in the protection of smaller species from predators while also acting as a unique food source. Riffles are a good source of habitat for caddisflies, stoneflies, and mayflies; indicator species for river health. Smaller fish, unable to adequately compete in pools, are more likely to utilize runs because of the quick moving water over shallower areas. Due to the complexity of pool/riffle/run features, each segment acts as its own micro habitat providing protection and forage for a variety of species.

The restoration of approximately 140 acres of riparian forest vegetative structure would provide additional wildlife habitat (food, shelter, and reproductive resources) for small mammals, amphibians, reptiles, and birds. The restoration measures would also connect riparian and upland habitats, thereby reducing the existing fragmentation.

Overall, the restoration features of the Proposed Action will provide significant, long-term, beneficial impacts to native terrestrial and aquatic species in the Maumelle River study area.

5.2.13 Federally Listed Threatened and Endangered Species

Proposed Action

While the Maumelle River Study Area is not included in the core habitat area for northern long-eared bat identified by the USFWS (IPaC 2022), summer habitat does exist in the area and the Proposed Action will create additional summer roost habitat through the restoration of 140 acres of riparian forest habitat, although this habitat will likely become available towards the end of the planning study period (50 years), or beyond, as bottomland hardwood species are typically slow-growing and take several decades to mature. As discussed in Section 2.1.16, foraging habitat for the eastern black rail, piping plover, and red knot does not exist in the study area due to the absence of large expanses of sand and/or mud flats. Monarch butterflies are a common visitor to the study area during fall migration. While mostly observed flying over the study area, there are species of milkweed scattered throughout the area that offer nourishment and possibly sites for egg laying. The non-federal sponsor manages areas in and near the Maumelle River Study Area for native herbaceous species, including milkweed, that may benefit the species. Should federally listed species change in the future, associated requirements will be reflected in construction efforts in coordination with the USFWS.

The Proposed Action will have no effect on any federally listed threatened, endangered, or candidate species in the Maumelle River Study Area.

5.2.14 Migratory Birds

Proposed Action

Many important habitats in the study area provide migratory bird shelter, nesting, feeding, and roosting habitat. Short-term, minor, and adverse impacts to migratory birds would occur during construction and cease post-construction. Significant, long-term, beneficial impacts to migratory birds would be expected from ecosystem restoration measures. Restoration of riparian and riverine areas would result in an overall net increase in functional value and ultimately support larger populations of species and potentially increase species diversity. There will be major beneficial impacts to migratory birds as a result of the TSP. The project area will provide crucial stopover habitat for migratory birds during migration.

During construction, there is a potential for harm and/or harassment of nesting migratory birds. Attempts would be made to conduct all restoration activities outside of the nesting season; however, this may not be possible, due to the extended length of some species nesting periods. USFWS guidelines should be followed to avoid adverse impacts to these species. Implementing these conservation measures, should result in no adverse effects to migratory birds.

Implementation of the Proposed Action would be in compliance with the Migratory Bird Treaty Act and EO 13186, Responsibility of Federal Agencies to Protect Migratory Birds.

5.2.15 Invasive Species

Proposed Action

EO 13112, Invasive Species, dated February 3, 1999, directs federal agencies to expand and coordinate their efforts to combat the introduction and spread of invasive species (i.e., noxious plants and animals not native to the U.S.). Implementation of BMPs such as cleaning equipment prior to entering restoration units

and monitoring post construction for invasive species would prevent further spread of invasive species. Implementation of any of the action plans would be in compliance with EO 13112. A healthy ecosystem with plentiful species diversity will help deter the spread and establishment of invasive species.

As with any ground-disturbance activity, the probability of introducing, spreading, and/or establishing new populations of invasive, non-native species, particularly plant species, exists. Contractors would be required to clean all equipment prior to entering the construction area to avoid the spread of invasive species into the project area.

Areas that are expected to have high rates of erosion, are susceptible to invasive species establishment, or where recruitment of a monoculture is anticipated, would be vegetated with native species. Post-construction and plantings, if needed, each restoration unit would be monitored for invasive species and action taken to prevent establishment of any species.

The reforestation of 140 acres of agriculture fields should reduce the occurrence of invasive species, as the native hardwood species should be able to out-compete invasive species for space.

With the implementation of restoration features of the TSP, coupled with the BMPs mentioned, should result in minor, long-term, beneficial impacts to the study area through the reduced number of invasive species.

5.2.16 Hazardous and Toxic Materials

Proposed Action

To minimize potential impacts from hazardous and regulated materials during construction, all fuels, waste oils, and solvents would be collected and stored in tanks or drums within a secondary containment system that consists of an impervious floored and bermed sidewalls capable of containing the volume of the largest container stored therein.

The refueling of machinery would be done following accepted guidelines, and all vehicles would have drip pans, when not in use, to contain minor spills and drips. Although it would be unlikely for a major spill to occur, any spill of five gallons or more would be contained immediately within an earthen dike, and the application of an absorbent (e.g., granular, pillow, sock, etc.) would be used to absorb and contain the spill. Any major spill of a hazardous or regulated substance would be reported immediately to SARA and USACE environmental personnel who would notify appropriate Federal and State agencies.

Additionally, all construction personnel would be briefed as to the correct procedures for preventing and responding to a spill. All waste oil and solvents would be recycled if practicable. All non-recyclable hazardous and regulated wastes would be collected, characterized, labeled, stored, transported, and disposed of in accordance with all Federal, State, and local regulations, including proper waste manifesting procedures. A Spill Prevention Plan would be in place prior to the start of construction, and all personnel shall be briefed on the implementation and responsibilities of this plan. Adoption and full implementation of the construction measures described above would reduce adverse hazardous/regulated substances impacts to insignificant levels.

With CAW's focus on watershed protection for Lake Maumelle, no new HTRW materials are likely to be placed within the study area. The current HTRW condition is expected to remain the same over a 50-year period.

5.2.17 Cultural Resources

Proposed Action

The Programmatic Agreement (PA) executed between the USACE, CAW, the Muscogee (Creek) Nation (Concurring Party), and the Osage Nation and the Quapaw Nation (Consulting Tribes) will ensure that implementation of the Proposed Action will take into account the effects of the undertaking on historic properties.

5.2.18 Socioeconomic and Environmental Justice

Proposed Action

With the rural location and the scale and nature of the recommended plan, there is no anticipated changes or impacts to the population or other demographic characteristics.

Executive Order (EO) 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low- Income Populations” dated February 11, 1994, requires all Federal agencies to identify and address disproportionately high and adverse effect of its programs, policies, and activities on minority and low-income populations. Data were compiled to assess the potential impacts to minority and low-income populations within the study area. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Minorities account for a large portion (48 percent) of the county’s total population and the low-income population is above the national level but comparable to the state level. However, because the project site is in a relatively isolated and rural area, construction of the proposed alternatives would not have a disproportionately high or adverse impact on these populations. No environmental justice concerns are anticipated, and the recommended plan would be consistent with EO 12898.

5.3 Cumulative Effects

Potentially, the most severe environmental degradation does not result from the direct effects of any particular action, but from the combination of effects of multiple, independent actions over time. As defined in the CFR, 40 CFR 1508.7 (CEQ Regulations), a cumulative effect is the “impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.” Some authorities contend that most environmental effects can be seen as cumulative because almost all systems have already been modified. Principles of cumulative effects analysis, as described in the CEQ guide Considering Cumulative Effects under NEPA, are:

- Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.
- Cumulative effects are the total effects, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions.
- Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected.

- It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.

- Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.

- Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.

- Cumulative effects may last for many years beyond the life of the action that caused the effects.

- Each affected resource, ecosystem, and human community must be analyzed in terms of the capacity to accommodate additional effects, based on its own time and space parameters.

The Recommended Plan has the potential for cumulative effects (with past, present, and reasonably foreseeable future projects) on water resources, visual aesthetics, recreation, and biological resources such as: vegetation, wildlife, migratory birds, and invasive species. The cumulative effects assessment is limited to projects reasonably foreseeable through 2025 within the study areas for various resources described in Section 5. The geographical boundaries for cumulative effects analysis are limited to the Maumelle River watershed.

5.3.1 Water Resources

Past impacts to the Maumelle River habitats are documented in Section 2.2.9 Water Resources. Past restoration efforts by the nonfederal sponsor include a bank stabilization project where a low water crossing had been washed out by a significant flood event. This bank stabilization project proved successful for several years, thus reducing excess sediment from impacting downstream riverine habitats and Lake Maumelle. The bank stabilization features employed with this initial restoration have begun to fail, causing an increase in sedimentation issues once again. A partially formed plan was developed during this study to address this issue but was determined not to be worth the investment of federal dollars.

The nonfederal sponsor and several federal and state partners funded the removal of the lowest low water crossing that occurred in the study area in 2019-20. The crossing was replaced with a bridge that restored stream connectivity in the Maumelle River from low water crossing RC-2 (proposed for removal in the Proposed Action) downstream to Lake Maumelle.

Implementation of the Proposed Action will remove the two remaining low water crossings left in the Maumelle River within the study area. These removals will result in the addition of several miles of stream connectivity and fish passage.

The cumulative impacts to water resources of past, present, or reasonably foreseeable projects when considered with the impacts of the Proposed Action, would provide significant, long-term, beneficial impacts to the Maumelle River aquatic ecosystem.

5.3.2 Visual Aesthetics

Restoration activities that improve the heterogeneity and complexity of the natural environment would have beneficial impacts to the aesthetics of the Maumelle River study area. The open-arch bridge discussed in the previous section provides a much more aesthetically pleasing view than the concrete river crossing that preceded it, particularly since the structure had become a patchwork of concrete repairs over the years. The removal of the two remaining low water crossings and opening a major side channel

to the Maumelle River will restore the structure and function of riffle-pool-run habitats, as well as the natural aquatic scenery that historically existed in the study area.

CAW has reforested several hundred acres of former sod farm fields to bottomland hardwood forest habitat since acquiring the property. The restoration of 140 acres of riparian hardwood forest included in the Proposed Acton will add to the landscape conversion of monoculture sod farms and provide a pleasing scenery to those visiting the study area. Additionally, the increase in native wildlife that will accompany the restored forests will increase opportunities for wildlife viewing.

Any impacts caused by the demolition of the low water crossings, breaching of the man-made levee, and reconstruction of a historically occurring tributary stream will have minor adverse impacts to the aesthetics within the Maumelle River study area, but they will be temporary.

The cumulative impacts to aesthetics of past, present, or reasonably foreseeable projects when considered with the impacts of the TSP would be moderately beneficial because of the restored native vegetation and removal of manmade structures.

5.3.3 Recreation

As discussed in previous sections, current recreational opportunities are limited in the study area. However, CAW has expressed interest in adding hiking trails and kiosks in the future to provide educational opportunities for schools and the public. Recent projects completed by CAW, together with those included in the Proposed Action, will restore the natural terrestrial and aquatic ecology in the study area, which will increase recreational opportunities in and around the Maumelle River study area.

The cumulative impacts to recreation from past, present, or reasonably foreseeable projects, when considered with the impacts of the TSP, would be moderately beneficial because of the restored native vegetation and removal of manmade structures.

5.3.4 Biological Resources including Vegetation, Wildlife, Migratory Birds, and Invasive Species

Fish and wildlife inhabiting the Maumelle River and surrounding areas would have consisted of a diverse community of native invertebrate, fish, amphibian, reptile, mammal, and bird species. As the habitat within the study area degraded, wildlife species intolerant of such impacts likely migrated out of the area over time and tolerant species such as raccoons, opossums, and brown-headed cow birds now thrive. The aquatic habitat that supported a diverse community of amphibians, aquatic invertebrates, and native fish species has been significantly diminished by anthropomorphic activities, further reducing wildlife diversity in the study area.

In the earlier discussion of direct impacts of the TSP, significant beneficial effects were recognized that improve habitat not only for migratory birds and other upper tier trophic species, but more importantly for lower trophic level organisms that support the more visible and mobile species.

As further discussed, these beneficial impacts are not limited to the Maumelle River study area but expand throughout the watershed. For migratory birds, the benefits of the proposed Maumelle River riparian habitat restoration might be realized several thousand miles away after the successful breeding and fledging of their young.

The TSP alone cannot ensure the continued survival and existence of migratory birds and other organisms depending on riverine and riparian resources. However, the TSP can contribute to the cumulative

conservation, preservation, and restoration efforts underway both locally, regionally, nationally, and internationally. Locally, previous restoration efforts in the Maumelle River study area will improve migratory bird habitats. Additional conservation efforts in the region, including conservation easements initiated by CAW and non-governmental conservation organizations, and international initiatives such as the PIF and Joint Ventures, will continue to provide pieces of the migratory bird habitat puzzle that will ensure migratory birds have the resources to complete migration and successfully breed and fledge young.

The cumulative habitat incorporated into these migratory bird conservation efforts are predicated on the establishment of the lower trophic levels by ensuring that aquatic and riparian habitats properly function ecologically.

The cumulative impacts to wildlife resources in the study area from past, present, or reasonably foreseeable projects, when considered with the impacts of the TSP, would provide significant, long-term, beneficial impacts because of the restored native vegetation, removal of low water crossings, and reestablishing riverine connectivity in the main river channel and important side channels.

5.4 Indirect Effects

Indirect effects, as defined by the CEQ's regulations, are "caused by the proposed action and occur later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). Indirect effects differ from direct impacts associated with the construction and operation of the proposed project and are caused by an action or actions that have an established relationship or connection to the proposed project. However, indirect effects can be linked to direct effects in a causal chain, which can be extended as indirect effects that produce further consequences.

As previously discussed, implementation of the TSP would directly result in a net beneficial impact to the Maumelle River study area and the associated vegetation and wildlife. In addition, the proposed Maumelle River ecosystem restoration measures would result in benefits that extend further outside the study area for several notable environmental resources. These benefits would increase over time as the riverine and riparian habitats develop and mature.

The removal of the two remaining low water crossings in the study area will restore stream connectivity for many native aquatic organisms, allowing them to move freely within the system. This increased access to additional aquatic habitat beyond the study area will provide long-term beneficial impacts to the native aquatic biodiversity in the Maumelle River.

5.5 Irreversible and Irretrievable Commitment of Resources

NEPA 40 CFR 1502.16 requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the Recommended Plan should it be implemented." Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable period. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored because of the action (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site).

The TSP would result in the direct and indirect commitment of resources. These would be related mainly to construction components. Energy typically associated with construction activities would be expended

and irretrievably lost under the TSP. Fuels used during the removal of the low water crossings, breaching the man-made levee and culverts, and restoration of a tributary stream and associated riparian hardwood habitat (e.g., bulldozers, backhoes, ATVs, etc.) and support vehicles would constitute an irretrievable commitment of fuel resources. Capital and labor resources would also be considered an irretrievable and irreversible commitment of resources. The use of such resources would not adversely affect the availability of such resources for other projects both now and in the future.

For the TSP, most resource commitments are neither irreversible nor irretrievable. Benthic communities immediately downstream of the low water crossings may be adversely impacted during demolition and removal actions. Slow moving or non-motile fish, wildlife, invertebrates, and plant (aquatic and terrestrial) species may be entrained in the materials during demolition. While these losses would be irretrievable, most impacts to the species' population, as a whole would be insignificant. These impacts would only occur during construction.

No other impacts, such as water resources, existing land uses, or visual resources, have been identified which could result in irreversible or irretrievable commitments of resources which would preclude implementation of the TSP.

6 Plan Implementation

Per Implementation Guidance for Section 1161 of the WRDA 2016, Completion of Ecosystem Restoration Projects, "Ten years after ecological success has been determined pursuant to paragraph 7.c, the responsibility of a non-federal sponsor to conduct O&M activities on nonstructural and non-mechanical elements of an ecosystem restoration project (or component of a project) will cease. Operation, maintenance, repair, replacement, and rehabilitation of structural and mechanical elements of an ecosystem restoration project (or component of a project) will continue as outlined in the operations manual for the project."

6.1 The USACE Campaign Plan

The USACE has developed a campaign plan with a mission to "deliver vital engineering solutions, in collaboration with our partners, to secure our Nation, energize our economy, and reduce risk from disaster". This Campaign Plan shapes the USACE command priorities, focuses transformation initiatives, measures and guides progress, and helps the USACE adapt to the needs of the future by improving the current practices and decision-making processes of USACE. The USACE Campaign Plan is available at the following address: http://www.usace.army.mil/about/campaignplan.aspx. The goals and objectives outlined in the latest USACE Campaign Plan (FY18-22) include:

1. Support National Security
2. Deliver Integrated Water Resource Solutions
3. Reduce Disaster Risk
4. Prepare for Tomorrow

This project supports Goals 2 and 4 of the USACE Campaign Plan by addressing:

- Campaign Plan Goal 2: Deliver enduring and essential water resource solutions using effective transformation strategies

  - Objective 2c: Deliver quality solutions and services
  - Objective 2d: Deliver reliable, resilient, and sustainable infrastructure systems
- Campaign Plan Goal 4: Build resilient people, teams, systems, and processes to sustain a diverse culture of collaboration, innovation, and participation to shape and deliver strategic solutions
  - Objective 4b: Restore trust and understanding with customers, stakeholders, teammates, and the public through strategic engagement and communication

6.2 Environmental Operation Principles

In 2002 and again in 2012, the USACE formalized a set of Environmental Operating Principles (EOP) applicable to decision-making in all programs. The seven EOPs are:

- Foster sustainability as a way of life throughout the organization
- Proactively consider environmental consequences of all the USACE activities and act accordingly
- Create mutually supporting economic and environmentally sustainable solutions
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may affect human and natural environments
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of the USACE actions in a collaborative manner
- Employ an open, transparent process that respects the views of individuals and groups who are interested in the USACE activities

These principles are available at the following address:

https://www.bing.com/newtabredir?url=https%3A%2F%2Fwww.usace.army.mil%2FMissions%2FEnvironmental%2FEnvironmental-Operating-Principles%2F

The principles are consistent with the NEPA, the Army Strategy for the Environment, other environmental statutes, and the WRDA of 2007. The EOPs are considered at all stages of the study process at the same level as economic issues. Environmental consequences, sustainability, risk management, and stakeholder involvement were integral parts of the study process.

7 Environmental Compliance

Environmental compliance for this project was initiated in the summer of 2019 and has been prepared to satisfy the requirements of all applicable environmental laws and regulations and has been prepared in accordance with the CEQ's implementing regulations for NEPA, 40 CFR Parts 1500 – 1508, and the USACE ER 200-2-2, Environmental Quality: Procedures for Implementing NEPA. An Environmental

Assessment has been prepared in accordance with the National Environmental Policy Act and is included within the Integrated Feasibility Report.

7.1 Migratory Bird Treaty Act

The MBTA makes it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid Federal permit.

The Recommended Plan may require measures that remove native tree species for equipment access, which can also include trees that may house migratory bird nests. However, clearing and/or control of vegetation will be conducted outside of bird migration periods when possible. Any and all trees that have been found to contain migratory bird nests will be avoided and appropriate methods will be enacted to move forward with the study, such as implementing timing limitations based on the species affected or intensity of breeding activity, average nesting dates are May 15th to July 15th; inspect and clear an area for migratory bird nesting (should be performed by qualified personnel); and prioritize opportunities to habitat changes based on significant species needs.

7.2 Section 404 of the Clean Water Act

Although this is an aquatic ecosystem restoration project, there will be permanent and temporary impacts to the Maumelle River. However, the discharge of fill materials into the river will be limited to temporary impacts during the demolition of LWCs 1 and 2. These impacts will cease once removal of the crossings has been completed.

The USACE under direction of Congress regulates the discharge of dredged and fill material into all waters of the US, including wetlands. Although the USACE does not issue itself permits for construction activities that would affect waters of the U.S., the USACE must meet the legal requirement of the Act. A Clean Water Act Section 404(b)(1) Analysis was completed for the study with a determination that the proposed placement site for discharge of or fill material complies with the Section 404(b)(1) guidelines.

A Short Term Activity Authorization (STAA) application was prepared and submitted to the Arkansas Department of Environmental Quality (ADEQ) for Section 401 water quality certification on 20 September 2021. Water quality certification (STAA) was provided in a letter dated 14 October 2021 (STAA # 20210339).

Final documentation of CWA compliance is located in Appendix C-2 – Environmental Compliance Documentation.

7.3 Section 176(c) Clean Air Act

The General Conformity Rule (GCR) was promulgated by the EPA. The GCR rule mandates that the Federal government does not engage in, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved State Implementation Plan. In Arkansas, the applicable plan is the Arkansas State Implementation Plan (SIP), an EPA-approved plan for the regulation and enforcement of the National Ambient Air Quality Standards (NAAQS) in each air quality region within the state. The General Conformity Rule is applicable only to non-attainment and maintenance areas as described in 40 CFR Part 93.153.

The entire state of Arkansas is in attainment for all criteria air pollutants; thus the Proposed Action does not require a General Conformity Determination.

7.4 Executive Order 13112, Invasive Species

The Recommended Plan would comply with EO 13112 by restoring native aquatic and riparian vegetation species to the riverine system. The measures included in the Recommended Plan would restore native plant species, which are adapted to stie conditions and can out-compete non-native invasive species. Required operation and maintenance of the project area by the NFS after ecological success is determined will deter the influence of non-native invasive plants through mechanical and/or chemical methods, as needed.

7.5 Executive Order 11990, Protection of Wetlands

The purpose of EO 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands". To meet these objectives, the Order requires federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided.

The purpose of the Maumelle River Aquatic Ecosystem Restoration Feasibility Study is to restore the aquatic and associated riparian ecosystem of the Maumelle River within the study area. The Recommended Plan will have beneficial impacts to wetlands through the restoration of a Freshwater Emergent Wetland that was drained and channelized for agricultural purposes.

7.6 Executive Order 11988, Flood Plain Management

EO 11988 was enacted May 24, 1977, in furtherance of the National Environment Policy Act of 1969, as amended (42 USC. 4321 et seq.), the National Flood Insurance Act of 1968, as amended (42 USC. 4001 et seq.), and the Flood Disaster Protection Act of 1973 (PL 93-234, 87 Star. 975). The purpose of the EO was to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

The order states that each agency shall provide and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for:

- Acquiring, managing, and disposing of Federal lands and facilities;
- Providing Federally undertaken, financed, or assisted construction and improvements; and
- Conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

All alternatives were designed to ensure that the combination of all ecosystem restoration measures proposed would not result in a decrease in the floodplain capacity and an increase in flood risk to the study area. The Proposed Action is located in the floodplain due to its intent: aquatic ecosystem restoration. The aquatic ecosystem that has been evaluated is located within the floodplain, thus the goals of the project cannot be achieved without implementing the project within the floodplain. All of the

practicable alternatives would have occurred within the base flood plain and would have been unavoidable regardless of the selected plan. The agencies and organizations involved with this project include: USFWS, AGFC, ADEQ, ANHC, and CAW.

The Proposed Action increases the natural and beneficial values of the floodplain and reduce the hazard and risk associated with floods on existing infrastructure and minimize the impact of floods on human safety, health, and welfare. The reduction and minimization of flood risk will occur as a result of notching a man-made levee adjacent to the Maumelle River and the low water crossing removals included as part of the Recommended Plan. Notching the levee will restore floodplain connectivity in the study area that will significantly increase flood storage capacity. The low water crossings have acted as small-scale dams within the river. By removing these manmade features, the Recommended Plan will restore the natural and beneficial uses of the base flood plain.

The Recommended Plan would remain in compliance with EO 11988 by restoring and protecting the values of the Maumelle River study area floodplains.

7.7 Executive Order 13186, Migratory Birds

The proposed ecosystem restoration would contribute directly to the USFWS Migratory Bird Program goals to protect, conserve, and restore migratory bird habitats to ensure long-term sustainability of all migratory bird populations through the ecosystem restoration measures described for the Recommended Plan. Specifically, the reforestation of 140 acres of sod farm fields will create a diversity of nesting and resting habitat important to migratory birds as the forest grows over time.

7.8 Executive Order 12898, Environmental Justice

Executive Order (EO) 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low- Income Populations” dated February 11, 1994, requires all Federal agencies to identify and address disproportionately high and adverse effect of its programs, policies, and activities on minority and low-income populations. Data were compiled to assess the potential impacts to minority and low-income populations within the study area. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Minorities account for a large portion (48 percent) of the county’s total population and the low-income population is above the national level but comparable to the state level. However, because the project site is in a relatively isolated and rural area, construction of the proposed alternatives would not have a disproportionately high or adverse impact on these populations. No environmental justice concerns are anticipated, and the recommended plan would be consistent with EO 12898.

7.9 Executive Order 13045, Protection of Children – Environmental Health & Safety Risks

EO 13045 “Protection of Children from Environmental Health Risks” dated April 21, 1997, requires Federal agencies to identify and address the potential to generate disproportionately high environmental health and safety risks to children. This EO was prompted by the recognition that children, still undergoing physiological growth and development, are more sensitive to adverse environmental health and safety risks than adults.

Numerous types of construction equipment such as backhoes, bulldozers, graders, and dump trucks, and other large construction equipment would be used throughout the duration of construction of the Recommended Plan. Because construction sites and equipment can be enticing to children, construction activity could create an increased safety risk. During construction, safety measures would be followed to protect the health and safety of residents as well as construction workers. Barriers and “No Trespassing” signs would be placed around construction sites to deter children from playing in these areas, and construction vehicles and equipment would be secured when not in use. Since the construction area would be flagged or otherwise fenced, issues regarding Protection of Children are not anticipated.

7.10 Endangered Species Act of 1973

Current lists of Federally listed threatened or endangered species were compiled for the Maumelle River Feasibility Study. As the sole federal agency in this study, USACE has determined that the proposed action will have no effect on federally threatened or endangered species possibly occurring in the study area. Long-term beneficial impacts as a result of riparian forest habitat enhancement will occur as part of the Recommended Plan, however these benefits will likely occur beyond the 50-year lifespan of this study as the bottomland hardwood seedlings planted begin to reach maturity. The purpose of the assessment is to coordinate with the USFWS about the likelihood if impacting threatened and endangered species. A rating of “no effect” is assumed for the Recommended Plan and has been verified by the USFWS (Appendix C-2 – Environmental Compliance).

7.11 Fish and Wildlife Coordination Act

In accordance with the Fish and Wildlife Coordination Act of 1958, as amended, from the initial stages of this study the USFWS and AGFC have been involved in the planning process. All agencies have had an opportunity to provide comments throughout the planning process. The USFWS and the AGFC biologists provided input on the model selection, participated in fieldwork, and participated in the habitat benefit projection meetings for the FWP and FWOP conditions. The USACE initiated public involvement and agency scoping meetings to solicit input on the Maumelle River Feasibility Study process, as well as identify prospective measures, and identify significant issues related to the Recommended Plan. Information provided by the USFWS and the AGFC on fish and wildlife resources has been utilized in the development of the Recommended Plan.

The FWS provided a Planning Aid Letter on July 21, 2021 and Fish and Wildlife Coordination Act letter on March 17, 2022 in support of the Proposed Action (included in Appendix C-2). Receipt of these letters fulfilled compliance with the Fish and Wildlife Coordination Act of 1958.

7.12 Advisory Circular 150/5200-33A Hazardous Wildlife Attractants on Near Airports

The advisory circular provides guidance on locating certain land uses having the potential to attract hazardous wildlife to or near public-use airports. The circular provides guidance on ecosystem restoration projects in and around airports and establishes notification procedures if reasonably foreseeable projects either attract or may attract wildlife.

In response to the Advisory Circular, the U.S. Army as well as other Federal agencies, signed a Memorandum of Agreement with the Federal Aviation Administration (FAA) to address aircraft-wildlife strikes. The MOA establishes procedures necessary to coordinate their missions to address existing and future environmental conditions contributing more effectively to aircraft-wildlife strikes throughout the US.

The Maumelle River study area is situated in a narrow river valley surrounded by steep terrain and is located approximately 30 air-miles west of the Bill and Hillary Clinton National Airport (CNA). The CNA consists of two runways situated in a north-south direction for take-offs and landings. Given the landscape surrounding the study area and its distance and direction from CNA, implementation of the Proposed Action will not contribute to any hazardous wildlife attractants.

7.13 National Historic Preservation Act of 1966, as amended

Compliance with the NHPA of 1966, as amended, requires identification of all properties in the project area listed in, or eligible for listing in, the NRHP. Known sites are mapped and will be avoided.

The Programmatic Agreement (PA) executed between the USACE, CAW, the Muscogee (Creek) Nation (Concurring Party), and the Osage Nation and the Quapaw Nation (Consulting Tribes) will ensure that implementation of the Proposed Action will consider the effects of the undertaking on historic properties affected by the undertaking.

7.14 National Environmental Policy Act of 1969

The National Environmental Policy Act (NEPA) was signed into law on January 1, 1970. NEPA requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions. Section 102 in Title I of the Act requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. Specifically, all federal agencies are to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment.

Environmental information on the proposed action has been compiled and the IFR-EA has been prepared and coordinated for public, state, and Federal agency review. The Proposed Action is in compliance with NEPA through the analysis of environmental impacts proposed by USACE.

7.15 Farmland Policy Protection Act

As discussed in Sections 2.3.6 and 4.9.2, the Farmland Protection Policy Act (FPPA) is not applicable to this study since the proposed actions retore the area to vegetation that would have historically occurred. The FPPA only applies to those actions that permanently convert land to a non-agricultural use in the forms of structures, roads, etc., where there is no possibility of it returning to agriculture use. A copy of communication with the NRCS Soil Scientist for Arkansas reflecting this determination is included in Appendix C-2).

7.16 Additional Acts Considered

See below for all Acts that were considered, but not applicable to this study:

- Native American Graves Protection and Repatriation Act, 1990- No Native American burial sites are known to occur or anticipated within the study area.
- Wild and Scenic Rivers Act, as amended – the Maumelle River is not included under this Act.

- Magnuson Fisheries Conservation and Management Act – the project area is not located with a fishery zone.
- Coastal Zone Management Act 1972, as amended – the project area is not located within a coastal environment.
- Archaeological and Historic Preservation Act 1974, as amended – superseded by the NHPA.
- Archaeological Resources Protection Act 1979, as amended – only applicable on Federal and Tribal lands.
- Rivers and Harbors Act, 1899 – not applicable because of the study area's proximity to the Maumelle River headwaters.
- Marine Mammal Protection Act of 1972 – the project area is not located within a marine environment.
- Estuary Protection Act of 1968– the project area is not located within a coastal environment.
- Federal Water Project Recreation Act of 1965, as amended. Applies to federally-owned lands/waters – not applicable.
- Fishery Conservation and Management Act of 1976. The project area is not located within a marine environment.
- Submerged Lands Act of 1953. Land ownership is not an issue.
- Coastal Barrier Resources Act and Coastal Barrier Improvement Act of 1990. The project area is not located within a marine environment.
- Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646). No relocations are required for this project.
- Anadromous Fish Conservation Act. Not applicable to study area.
- Marine Protection, Research and Sanctuaries Act. The project is not located within a marine environment.

8 Summary of Coordination, Public Views and Comments

8.1 Participating and Cooperative Agencies

Copies of agency coordination letters are presented in Appendix C-2 – Environment Compliance. Formal and informal coordination has been and will continue to be conducted with the following resource agencies:

- EPA

- USFWS
- USDA NRCS
- AGFC
- ANHC
- ANRC
- AHTD
- ADEQ
- Arkansas SHPO

The AGFC, USFWS and ANHC, have been involved throughout the study process. These organizations participated in initial brainstorming and problem identification and provided comments throughout the Maumelle River Feasibility Study process.

An initial agency meeting was held August 1-2, 2017, with the nonfederal sponsor, USFWS, and several state agencies to review the study goals and objectives and develop a conceptual model for the study area.

A second agency meeting was held February 18, 2020, with the non-federal sponsor, USFWS, and several state agencies to review the study goals and objectives and begin development of restoration opportunities.

8.2 Public Coordination

In accordance with 40 CFR 1501.7, 1503, and 1506.6, the USACE Little Rock District (USACE-SWL) initiated National Environmental Protection Act (NEPA) agency scoping efforts on July 18, 2019 via scoping letters mailed to state and federal resource agencies, requesting information and comments that would assist in the preparation of the Maumelle River Aquatic Ecosystem Restoration Feasibility Study and accompanying Environmental Assessment (EA). This release initiated a 30-day public comment period on the proposed study (July 25 – August 30, 2019). The news release was also placed on the USACE webpage and social media. No public comments were received from this outreach.

A Notice of Availability of the Maumelle River Aquatic Ecosystem Restoration Integrated Feasibility Report and Environmental Assessment was released on February 17, 2022 for agency and public review. Agency comments are included in Section 1 following the Notice of Availability letter and under the FWCA Section (FWS response). No public comments were received on the Draft Report or EA.

In accordance with 40 CFR 1501.7, 1503, and 1506.6, the USACE Little Rock District (USACE-SWL) initiated National Environmental Protection Act (NEPA) agency scoping efforts on July 18, 2019 via scoping letters mailed to state and federal resource agencies, requesting information and comments that would assist in the preparation of the Maumelle River Aquatic Ecosystem Restoration Feasibility Study and accompanying Environmental Assessment (EA). USACE-SWL also invited each state and federal agency to become a Participating Agency or Cooperating Agency, respectively, to assist with the study. Federal and state NEPA scoping letter examples, Table 1 with list of agencies contacted, and resource agency responses, are included in Section 1 of this Appendix.

The USACE, Little Rock District, provided a Notice of Availability (NOA) of the Draft Maumelle River Aquatic Ecosystem Restoration Integrated Report and Environmental Assessment to interested parties on February 17, 2022. The NOA included a 30-day comment period (February 21 – March 24, 2022). Advertisements were placed on the USACE webpage and social media regarding the availability of the Draft Report and request for comments. A summary of public comments and USACE responses can be found in Appendix C-2 – Environmental Compliance.

9 List of Preparers

Name	Technical Specialty
Dana Coburn	Project Management
Natalie Garrett	Plan Formulation Lead
Katie Martin	Hydrology and Hydraulic Engineering
Norm Lewis	Economics
Craig Hilburn	Environmental Resources
Christopher Davies	Cultural Resources
Robert Sunta	Civil Engineering
Wayne Crawford	Real Estate

10 Conclusions

The findings of this study indicate that there is a need for aquatic ecosystem restoration in the Maumelle River study area. A failure to do so would result in a further degraded aquatic ecosystem and riparian corridor. The recommended plan would restore the structure and function of the aquatic and riparian ecosystems in the study area. This report with integrated EA discloses the potential environmental and cultural impacts associated with the proposed Continuing Authority Program Section 206 Aquatic Ecosystem Restoration project along the Maumelle River in Pulaski County, Arkansas.

The Recommended Plan creates 157 AAHUs and restores 470 acres. This plan achieves all three planning objectives identified in Section 1.9. Removal of the two low water dams will restore stream connectivity for numerous aquatic species inhabiting the Maumelle River and Lake Maumelle. Notching of the earthen levee adjacent to RC1 will reconnect the Maumelle River to side channel 1 which restores floodplain connectivity and important spawning and nursery habitat for many aquatic organisms. The restoration of Tributary A and riparian reforestation will restore the natural stream channel that once existed on the current sod farm. This restoration, together with the associated blockages of channelized ditches, will decrease sediment and nutrient movement into the Maumelle River and side channels. These reductions will result in a vast improvement of important habitat for many aquatic organisms.

There would be significant beneficial effects from restoring the freshwater forested wetland (bottomland hardwood forest) that historically existed in the study area. This plan restores a native floodplain bottomland hardwood forest that connects riparian forest communities to higher bottomlands (flood <5 year frequency) and upland forested habitats, thereby reducing forest fragmentation and increasing habitat diversity, availability, and connectivity important for numerous native forest-dependent wildlife species, including federally threatened and endangered species, species of conservation concern (forest interior birds, reptiles and amphibians, and bats), as well as for relatively stable native wildlife species. Reforestation of the sod farm results in the reduction of nutrients currently being transported into side channels. It will also help reduce the spread of invasive species that threaten native habitats. The restored freshwater forested wetland will maximize water quality benefits by filtering out sediments and chemical

constituents. In addition, the restored forest ecosystem will maximize the organic allochthonous material imported to the aquatic system, thereby increasing the energy to the lower trophic organisms that drive and support the Maumelle River ecosystem. This plan also reduces the loss of water supply storage in Lake Maumelle due to sedimentation.

Restoring aquatic habitats, freshwater forested wetlands, and reestablishing floodplain connectivity have regional and national significance based on the institutional, public, and technical recognition criteria described in Appendix C-1 Environmental Resources. The restoration of these native habitats meets the criteria for institutional significance by furthering the purposes of the Endangered Species Act, Migratory Bird Treaty Act, and Fish and Wildlife Coordination Act (among others), several nationally-important conservation partnerships, and Executive Orders. Technical significance of the Recommended Plan is met by restoring stream and floodplain connectivity, and forested wetland and riparian habitats, in the Maumelle River project area. Research has shown that approximately 95% of riparian habitat has been converted by river channelization, water impoundments, agricultural practices, and urbanization in the past 100 years. This loss of connectivity of riverine and forested riparian habitat has adversely impacted the biodiversity of many native species, including numerous neotropical migratory birds. The consortium of conservation groups described in Section 2.2 of Appendix C-1 is evidence of the public significance of restoration efforts in the Maumelle River watershed.

It is the finding of this assessment that implementation of the recommended plan would not constitute a major Federal action requiring the preparation of an Environmental Impact Statement.

11 District Engineer's Recommendation

I recommend that the restoration plan as generally described in the Final Maumelle River Aquatic Ecosystem Restoration Feasibility Report and Integrated Environmental Assessment be implemented under the authority of Section 206 of the WRDA of 1996, Public Law 104-303, with such modifications as in the discretion of the appropriate authority may be deemed advisable. The project first cost is currently estimated to be $2,464,000.

Prior to the commencement of construction, local interest must agree to meet the requirements of Local Sponsor responsibilities as outlined in this report and future legal documents. Central Arkansas Water has demonstrated that they have the authority and financial capability to provide all Local Sponsor requirements for the implementation, operation, and maintenance of the project. The recommendations contained herein reflect the information available at the time and current Department of the Army policies governing formulation, evaluation, and development of individual projects under the US Army Corps of Engineers Continuing Authorities Program.

DATE

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Damon M. Knarr
Colonel, U.S. Army
Commanding

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13 Acronyms and Abbreviations

~	Approximate or Approximately
°	Degree or Degrees
$	US Dollars
‘	Foot or Feet
>	Greater Than
≥	Greater Than or Equal To
“	Inch or Inches
<	Less Than
#	Number
AAHU	Average Annual Habitat Unit
AO	Administrative Order
AOI	Area of Interest
AM	Amy Silt Loam, 0 to 1 Percent Slopes
APE	Area of Potential Effect
ADEQ	Arkansas Department of Environmental Quality
AGFC	Arkansas Game and Fish Commission
AHTD	Arkansas Highway and Transportation Department
ANHC	Arkansas Natural Heritage Commission
ARNC	Arkansas Natural Resources Commission
ATR	Agency Technical Review
BCC	Birds of Conservation Concern
BMP	Best Management Practice
CAW	Central Arkansas Water
CE/ICA	Cost Effective–Incremental Cost Analysis
CEM	Conceptual Ecological Model

CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
Cm	Centimeter
CMF	Carnasaw-Mountainburg Association, Steep
CN	Curve Number
CNM	Curve Number Method
CO	Carbon Monoxide
CO2	Carbon Dioxide
cy	Cubic Yards
dbh	Diameter at Breast Height
DQC	District Quality Control Review
DO	Dissolved Oxygen
DoD	Department of Defense
EA	Environmental Assessment
EC	Engineering Circular
ECO-PCX	Ecosystem Restoration Planning Center of Expertise
e.g.	For example
EO	Executive Order
EOP	Environmental Operating Principle
EP	Engineering Pamphlet
EPA	Environmental Protection Agency
ER	Engineering Regulation
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act

FAA	Federal Aviation Administration
FPPA	Farmland Protection Policy Act
FWOP	Future Without-Project
FWP	Future With-Project
Gpm	Gallons per Minute
GRR	General Re-evaluation Report
HEC	Hydrologic Engineering Center
HEP	Habitat Evaluation Procedure
HMS	Hydrologic Modeling System
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Unit
IBI	Index of Biological Integrity
i.e.	Id Est or That Is
IFR-EA	Integrated Feasibility Report and Environmental Assessment
L	Liter
LRSI	Life Requisite Suitability Index
m	Meter
MBTA	Migratory Bird Treaty Act
Measures	Management Measures
PL	Public Law
n	Number of Observations or Measurements
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NAWCP	North American Waterbird Conservation Plan
NAWMP	North American Waterfowl Management Plan

NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NO2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
O3	Ozone
OMRR&R	Operation and Maintenance, Repair, Replacement and Rehabilitation
OSE	Other Social Effects
Pb	Lead
PIF	Partners in Flight
PL	Public Law
PM10	Particulate Matter Less Than 10 Microns
PM2.5	Particulate Matter Less Than 2.5 Microns
PMF	Probable Maximum Flood
QHEI	Qualitative Habitat Evaluation Index
Re	Rexor Silt Loam, Frequently Flooded
RPEC	Regional Planning and Environmental Center
RR	Railroad Commission
s	Second
SgC	Sallisaw Gravelly Silt Loam, 3 to 8 Percent Slopes
SO2	Sulfur Dioxide
SWL	Little Rock District
TDS	Total Dissolved Solids
TSP	Tentatively Selected Plan
TSS	Total Suspended Solids
TY	Target Year

USC	US Code
UDC	Unified Developed Code
US	United States
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service
WRDA	Water Resources Development Act
WWTP	Wastewater Treatment Plan

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