US Army Corps of Engineers

Lower Missouri Jefferson City L-142 Flood Risk Management Study

Draft Integrated Feasibility Report and Environmental Assessment

November 2024

MISSOURI DEPARTMENT OF NATURAL RESOURCES

TABLE OF CONTENTS*

APPENDICES

INDEX OF FIGURES

INDEX OF TABLES

*The sections of this report that are part of the integrated Environmental Assessment are denoted with an asterisk in the section header.

LIST OF ACRONYMS

1D	One Dimensional
2D	Two Dimensional
AAHU	Average Annual Habitat Unit
ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act
ADM	Agency Decision Milestone
AEP	Annual Exceedance Probability
AMM	Alternatives Milestone Meeting
BCC	Birds of Conservation Concern
BCSD	Bias Corrected, Spatially Disaggregated
BA	Biological Assessment
BGEPA	Bald and Golden Eagle Protection Act
BGS	Below Ground Surface
BMPs	Best Management Practices
BO	Biological Opinion
BSNP	Bank Stabilization and Navigation Project
CA	Combined Alternatives
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CHAT	Climate Hydrology Assessment Tool
CMIP5	Coupled Model Intercomparison Project Phase 5
CONUS	Continental United States
CST	Central Standard Time
CSRA	Cost and Schedule Risk Analysis
CSVR	Content to Structure Value Ratios
CV	Capital View
CWMS	Corps Water Management System
DDT	Dichlorodiphenyltrichloroethane
EA	Environmental Assessment
EAD	Equivalent Annual Damages
EC	Engineering Circular
ECB	Engineering and Construction Bulletin
EGM	Economic Guidance Memorandum
EJ	Environmental Justice
EM	Engineering Manual
EO	Executive Order
EOP	Environmental Operating Principals
ER	Engineering Regulation
ESA	Endangered Species Act
ESM	Earth Systems Model
ETL	Engineering Technical Letter
EQ	Environmental Quality
FAA	Federal Aviation Administration
FCSA	Federal Cost Share Agreement
FDA	Flood Damage Analysis
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FR	Feasibility Report
FRM	Flood Risk Management

ft	Feet
FS	Feasibility Study
FWOP	Future without Project
FWP	Future with Project
FY	Fiscal Year
GI	General Investigation
GCM	Global Climate Model
GPS	Global Positioning System
GRR	General Re-evaluation Report
HEC	Hydrologic Engineering Center
HEC-FDA	Hydrologic Engineering Center Flood Damage Reduction Analysis software
HEC-RAS	Hydrologic Engineering Center River Analysis System software
HTRW	Hazardous, Toxic, and Radioactive Waste
HUC	Hydrologic Unit Code
HWM	High Water Marks
I&A	Interest and Amortization
IDC	Interest During Construction
in	Inches
IPAC	Information for Planning and Consultation
IPR	In Progress Review
IWR	Institute of Water Resources
kcfs	Thousand Cubic Feet per Second
LEDPA	Least Environmentally Damaging Practical Alternative
LOCA	Localized Constructed Analogs
LOMO	Lower Missouri River
LERRD	Lands, Easements, Rights-of-Way, Relocations, and Disposal
LPP	Locally Preferred Plan
MBTA	Migratory Bird Treaty Act
MCACES	Micro-Computer Aided Cost Estimating System
MDC	Missouri Department of Conservation
MoDNR	Missouri Department of Natural Resources
MFA	Missouri Farmers Association
MGS	Missouri Geologic Survey
MO	Missouri
MOA	Memorandum of Understanding
MoDOT	Missouri Department of Transportation
MRBCA	Missouri Risk-Based Corrective Action
MRFFS	Missouri River Flow Frequency Study 2023
MRLS	Missouri River Levee System
NAA	No Action Alternative
NAVD88	National American Vertical Datum of 1988
NCA	National Climate Assessment
NED	National Economic Development
NEPA	National Environmental Policy Act
NFS	Non-federal Sponsor
NFIP	National Flood Insurance Program
NGVD 29	National Geodetic Vertical Datum of 1929
NLCD	National Land Cover Dataset
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NRHP	National Registry of Historic Places
NSI	National Structure Inventory
NWD	U.S. Army Corps of Engineers, Northwest Division
NWK	U.S. Army Corps of Engineers, Northwest Division, Kansas City District
NWS	National Weather Service

OMRR&R	Operate, Maintain, Repair, Rehabilitate and Replace
OSE	Other Social Effects
PAS	Planning Assistance to States
PCBs	Chlordane and Polychlorinated Biphenyls
PDT	Project Delivery Team
PED	Pre-construction Engineering and Design
PL	Public Law
P&Gs	Principals & Guidelines
RCB	Reinforced Concrete Barrell
RCP	Reinforced Concrete Pipe
RCP	Representative Concentration Pathway
RED	Regional Economic Development
RIP	Rehabilitation and Inspection Program
RM	River Mile
ROW	Right(s)-of-Way
RTK	Real Time Kinematic
S&A	Supervision and Administration
SEMS	Superfund Enterprise Management System
SHPO	State Historic Preservation Office
SSP	Shared Economic Pathway
TMDL	Total Maximum Daily Load
TRG	Tolerable Risk Guideline
TSP	Tentatively Selected Plan
TST	Time Series Toolbox
UMRSFFS	Upper Mississippi River System Flow Frequency Study 2003
US	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USCS	Unified Soils Classification System
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
UTC	Coordinated Universal Time
VA	Vulnerability Assessment
VIC	Variable Infiltration Capacity
WRDA	Water Resources Development Act
WSP	Water Surface Profile
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY*

Introduction

This integrated Feasibility Report and Environmental Assessment (FR/EA) presents the results of a U.S. Army Corps of Engineers (USACE) Flood Risk Management (FRM) feasibility study undertaken to identify and evaluate alternatives to improve life safety and reduce damage to property in Jefferson City on the north bank of the Missouri River. USACE is undertaking the action in partnership with the Missouri Department of Natural Resources (MoDNR), the study's non-federal sponsor (NFS). The report provides documentation on the plan formulation process to select a Tentatively Selected Plan (TSP) for flood risk management improvement, along with environmental, engineering, and cost details of the TSP, which would allow additional design and construction to proceed following the approval of this report.

Authority

The proposed levee is an unconstructed unit of the Missouri River Levee System (MRLS) authorized by the 1941 (Public Law 228, 77th Congress, 1st Session) and 1944 Flood Control Acts (Public Law 534, 78th Congress, 2nd Session). In December 1973, Unit L-142 was classified "inactive" because the 1960's restudy indicated it was not economically justified. The current study was authorized by Section 216 of the Water Resources Development Act (WRDA) of 2020. The authorization stated:

> *"…the Secretary shall expand the scope of such study to investigate and provide recommendations relating to modifications to projects in Iowa, Kansas, Nebraska, and Missouri authorized under the Pick-Sloan Missouri River Basin Program….and the Missouri River Bank Stabilization and Navigation project…. including modifications to the authorized purposes of such projects to further flood risk management and resiliency…".*

Purpose

Flooding has been a recurring problem for many years within the study area. The purpose of this study is to explore opportunities to reduce flood damages to properties and businesses along the left bank of the Missouri River near River Mile (RM) 142. At this location, the existing Capital View levee has a 17% Annual Exceedance probability (AEP) of overtopping. Each alternative is evaluated against the project objectives and four principles and guidelines (P&Gs) criteria of effectiveness, efficiency, completeness, and acceptability. This report identifies the preferred alternative for reducing recurring flood damages in the project area and the federal interest in constructing that alternative. It also documents the formulation and selection process for the TSP as well as similar information for the final array of alternatives to the TSP.

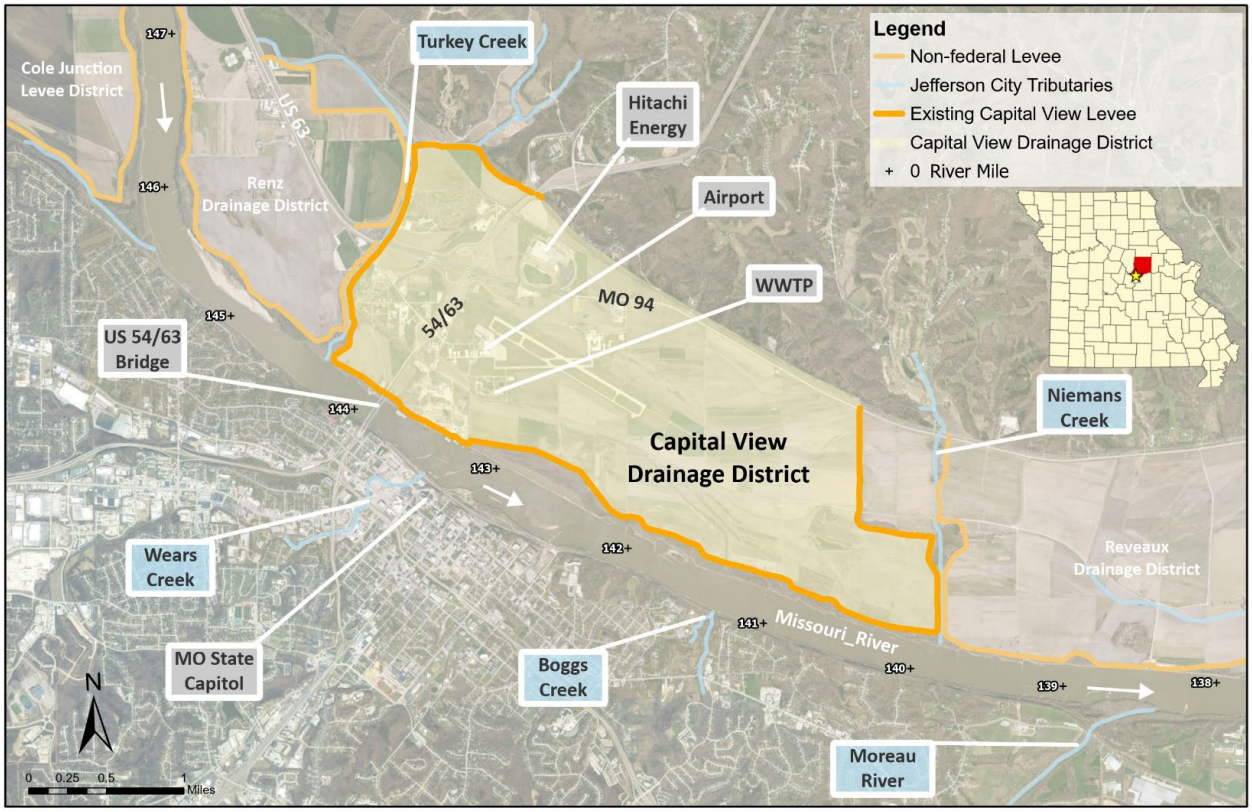
Study Area

The study area lies along the Missouri River near River Mile (RM) 142, in Jefferson City and Callaway County in central Missouri. The study area is the existing leveed area of the Capital View Drainage District on the left descending bank of the Missouri River and extends from the upstream tieback at Turkey Creek (approximately 1/2 mile upstream of the U.S. Highway 54/U.S. Highway 63 bridge) to the downstream tieback (approximately 4 miles downstream of the U.S. Highway 54/U.S. Highway 63 bridge). Jefferson City is the capital of Missouri and has a population of 43,228 according to the 2020 census, making it the 16th most populous city in the state. All these residents depend on critical infrastructure in the Capital View leveed area. While the study area does not include a full flood risk management study of the Missouri River right bank opposite of the Capital View Drainage District it does consider potential impacts of study alternatives to adjacent drainage areas, such as Wears Creek.

The Capital View levee, constructed prior to 1970 to alleviate recurring flood damages, is a 8.8-mile earthen, non-federal levee currently active in the USACE Rehabilitation and Inspection Program (RIP), authorized under Public Law 84-99 (P.L. 84-99). Currently, within the 3,300 acres of leveed area, there is

agricultural production, numerous businesses, the Jefferson City Memorial Airport, the Jefferson City Regional Wastewater Treatment Plant, and major transportation corridors. The leveed area has a daytime population at risk of 809 and a nighttime population at risk of 112. Population at risk is defined as the people in an area that would be subject to inundation in a flood event. Immediately upstream of Capital View on the left bank is the Renz levee and immediately downstream on the left bank is the Reveaux levee. These are both also non-federal levees active in the RIP. Other active RIP levees in the area evaluated for potential impacts include the upstream systems of Hartsburg (left bank) and Cole Junction (right bank), and the downstream systems including Wainwright (left bank), Jacobs (left bank), and Tebbetts East (left bank). Privately constructed levees, not active in the RIP were also evaluated for impact. Tributaries to the Missouri River in, or directly adjacent to, the project area are Turkey Creek, Wears Creek, Boggs Creek, Niemans Creek, and the Moreau River. The Missouri River is the predominate flood source at the study area. **Figure 1** shows the levee districts, tributaries, and other features in the study area.
The study area is within Northwestern Division, Kansas City District (NWK). Policy review and approval will be conducted by the Northwestern Division (NWD). The study area falls within the 3rd Congressional district of Missouri.

Figure 1 Jefferson City L-142 Study Area Location



Objectives

The impacts of levee failure have resulted in local, regional, and statewide disruptions. During the 1993 flood, the Capital View levee was overtopped and subsequently breached in 13 locations. In 1998, 2001 and 2013 the levee was fully loaded. Most recently, the 2019 flood caused extensive damages to agriculture and infrastructure in communities in the states of Iowa, Nebraska, Kansas, and Missouri. At Jefferson City, the Capital View levee overtopped and breached in seven locations and the leveed area was inundated. In the aftermath of the flood, the four states formed the Flood Recovery Advisory Working Group to identify actions that could reduce systemwide flood risk, reduce reoccurring damages, and improve system resiliency. In addition to the system-wide evaluations as described in Section 1.4,

Jefferson City was identified as a priority area for flood risk evaluation, prompting this site-specific feasibility study. Specific planning objectives are documented in the main report, focusing on flood risk, life safety, resiliency, and overall synergy with the ongoing Lower Missouri River Flood Risk and Resiliency Study (System Plan).

Plan Formulation

Development of the future without-project (FWOP) condition included detailed engineering and economic evaluations to quantify flood risk and prepare for the comparison of alternatives. In the Capital View leveed area, the analysis of National Economic Development (NED) flood risk damages estimated $20M in annual expected damages. The plan formulation process identified 37 initial measures for consideration. These measures were then organized into seven Alternative Themes (not including the No Action Alternative): Nonstructural, Natural & Nature Based, Channel Modification, Infrastructure Improvement, Improved Resiliency, Existing Levee Modifications, and New Structural Measures. The 37 measures were screened against the project objectives and four principles and guidelines (P&Gs) criteria of effectiveness, efficiency, completeness, and acceptability. Additionally, measures were evaluated against the project constraint, or the degree to which the measure avoids or minimizes disproportionate impacts to the economically disadvantaged and socially vulnerable populations in the study area and screened accordingly. The remaining measures were combined into 13 Combined Alternatives (CA1 through CA13). These Combined Alternatives were further screened down to a final array of three plans:

CA0: No Action

CA11: Nonstructural

CA13: Hybrid Alignment, 41-ft Stage, Partial Capital View Removal

Identification of the Tentatively Selected Plan

The NED costs and benefits of each alternative as they appeared during the plan selection process are summarized in Table 1. Only one of the 13 combined alternatives had positive net benefits, CA13. CA11, the nonstructural alternative, was not selected as the TSP. The nonstructural benefits were initially being driven by floodproofing of Hitachi Energy, a large manufacturing facility within the leveed area. This floodproofing measure would involve adding a waterproof veneer to the structure and reinforcing the doors to prevent water from getting into the building up to a certain height. Further evaluation of this alternative lead to the removal of Hitachi Energy as a candidate for floodproofing due to the large number of overhead door openings and daily deliveries that make dry floodproofing not a viable option. A reevaluation of the remaining nonstructural measures applied to other structures utilized an aggregation method to develop CA11.

Table 1 NED Costs and Benefits

Item Description	Combined Alternative 0	Combined Alternative 11	Combined Alternative 13
Total Annualized Investment Cost ($1,000s)	$0	$497.5	$13,400.3
Annual Benefits ($1,000s)	$0	$306.2	$15,774.6
Annual Net Benefits ($1,000s)	$0	-$191.3	$2,374.3
Benefit-Cost Ratio	0	0.6	1.2

Notes: Cost figures shown at an Oct 2024 Price Level. All figures are in $1,000s. Total Annualized Investment Cost reflects total economic project cost, including interest during construction and operation and maintenance, and reflects the FY 2025 Federal Discount Rate of 3% and a 50-year period of analysis. Discrepancies in totals due to rounding. It does not include escalation and therefore should not be used for programming funds.

Details of CA0 and CA13 Combined Alternatives and the TSP are listed below:

Combined Alternative 0: No Action

CA0 is the No Action Alternative (NAA). USACE planning policy (Engineering Regulation 1105-2-103) and the National Environmental Policy Act (NEPA) require consideration of a NAA. The NAA is the basis for the FWOP condition and assumes no measures would be implemented by the federal government to achieve the planning objectives. The NAA is the base condition to measure action alternatives.

The NAA would not reduce flood risk within the study area, including economic damages caused by inundation of structures, agricultural lands, and impacts to the businesses and critical infrastructure. No action would result in continued, recurring flooding which causes major impacts to transportation, regional supply chains, and community stress. The existing non-federal levee, Capital View, would remain in its current condition performing at 17.0% AEP of overtopping. As previously stated, the study area would expect to receive $18.8M in annualized flood damages each year through the period of analysis, causing local, regional, and state impacts. The Justice40 community would not receive any additional flood risk benefits from this alternative. According to the Implementation Guidance for Section 160 of the Water Resources Development Act (WRDA) of 2020, communities are identified as Justice40 communities for the purposes of the WRDA and all amendments made by the act by meeting one or more of the following criteria:

a) The area has a per capita income of 80% or less of the national average.

b) The area has an unemployment rate that is, for the most recent 24-month period for which data are available, at least 1 percent greater than the national average unemployment rate.

c) The area is Indian country as defined in 18 U.S.C. 1151 or in the proximity of an Alaska Native Village.

d) The area is a U.S. territory.

e) The area contains one or more communities identified as disadvantaged by the Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST).[1]

Due to criteria (a) above, the project area is disadvantaged due to its per capita income being less than 75% of the national average. The study area does not meet the requirements of criteria (b) through (e) above, but nevertheless is considered a disadvantaged community because only one of the above criteria needs to be met. A disadvantaged community may also be referred to as a Justice40 community. The terms are interchangeable.

Combined Alternative 13: Hybrid Alignment, 41-ft Stage, Partial Capital View Removal

The structural alternative carried forward for this project area is a federal levee system that was evaluated to have a 1% AEP of overtopping. CA13 includes constructing 31,400 linear feet of new earthen levee set back approximately 1,500 to 3,000 feet from the Missouri River, increasing conveyance of the river for the most frequent overbank flow scenarios, and decreasing the frequency in which the levee would get loaded compared to the existing Capital View levee. The new L-142 federal levee would have an overtopping AEP of 1% making it more in line with other levees that reduce flood risk in urban areas with similar infrastructure (major manufacturing, airport, critical facilities, major roadways). A federal levee system would have the added benefit to stakeholders of being a predictable, engineered system designed

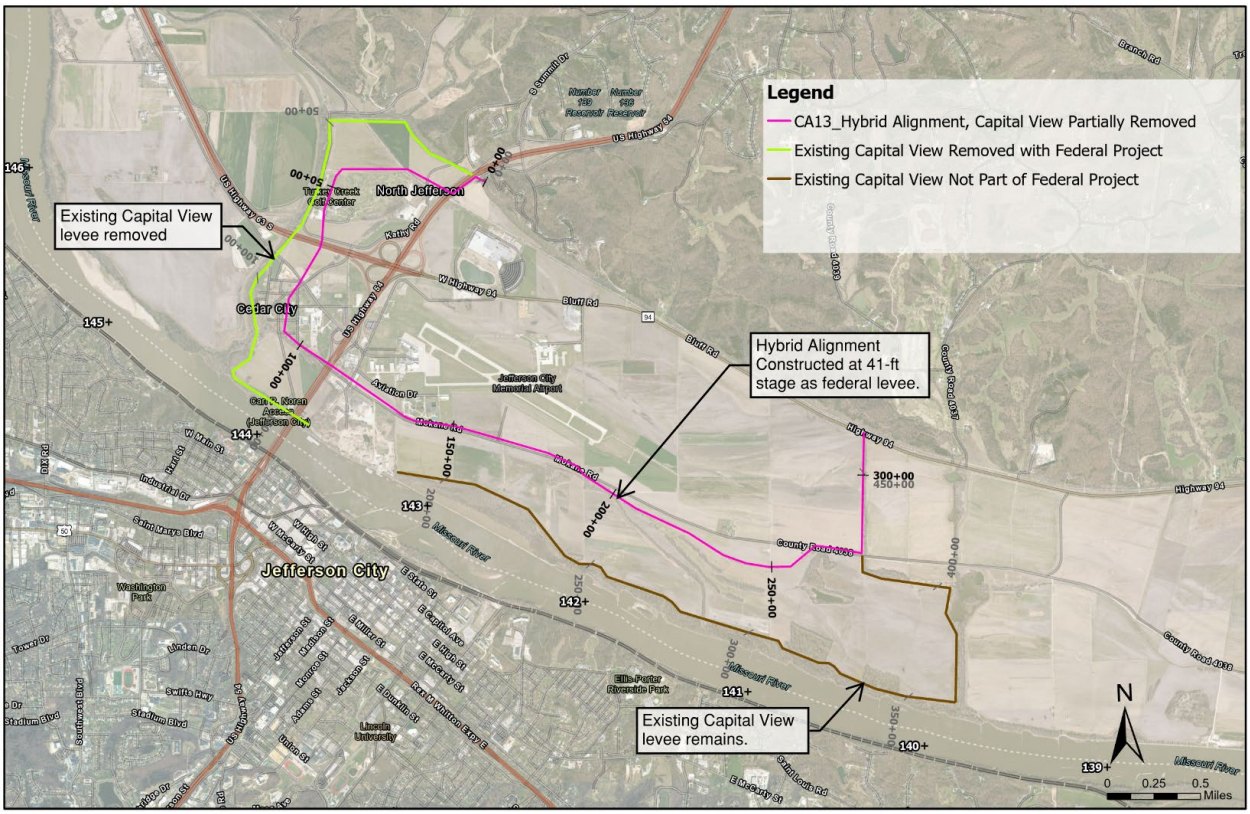
[1] https://screeningtool.geoplatform.gov

and constructed to the USACE design requirements as listed in the Appendix A3 reference list. The alignment seeks to maximize public right-of-way (ROW) and property for levee footprint in light of real estate considerations, while providing setbacks at hydraulically critical locations and protecting access to critical infrastructure and vital transportation corridors. The alignment and overtopping event of the levee was iterated multiple times by the project delivery team (PDT), local stakeholders, and the non-federal sponsor. The alternative would not seek a levee design to meet minimum National Flood Insurance Program (NFIP) regulatory standards, which would require an additional three feet of levee height above CA13. Therefore, this project would not result in a request to reduce the leveed area's flood risks associated with the 1-percent-annual-chance flood as delineated by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM).

CA13 also includes removal of the portion of the Capital View levee west of U.S. Highway 54/U.S. Highway 63 to decrease hydraulic impacts from Turkey Creek on adjacent levee systems and the federal levee tiebacks and to provide environmental benefits to the area. The federal project would leave the Capital View levee east of U.S. Highway 54/U.S. Highway 63 in place. With the construction of a federal levee system within the same drainage district, the existing Capital View levee that remains would no longer be eligible for federal assistance for repair under P.L. 84-99. However, the new federal levee would be eligible for repairs of flood damages through the P.L. 84-99 program without a local cost share.

As anticipated with any project modifying drainage patterns within the floodplain, hydraulic pattern changes are anticipated with construction of a new federal levee. A Real Estate Plan has been prepared that addresses the fee acquisition, easements and other necessary components required for implementation of the plan. Not all parcels riverward or outside of a new levee would need to modify land use in the same manner – some landowners may sell, retain ownership and continue farming, enroll in a Natural Resource Conservation Service (NRCS) program, or pursue other options. Those conversations would occur after the TSP milestone. A map of the proposed CA 13 is shown below in **Figure 2**.

Figure 2 Proposed CA 13 Levee Alignment



Other Local Plan Considerations

This study did evaluate raising the existing Capital View levee to a flood stage of 34 feet as CA1. The existing levee currently overtops at a 30.5-foot stage on the Jefferson City gage. This alternative had some local support. However, CA1 would result in increased maximum water surface elevations at both upstream and downstream levees and also worsens the Missouri River backwater condition for Wears Creek in Jefferson City on the south side of the river. Additionally, the cost of rebuilding Capital View to federal levee design requirements would only result in an increase from a 1/6-year level of performance to a 1/12 year level of performance. CA1 does not have a positive benefit cost ratio, or the potential to provide benefits in the four comprehensive benefits accounts, and therefore is not an efficient alternative for reducing flood risk. The PDT concluded there is no federal interest in this alternative. The public, including affected landowners, was informed of these results in April 2024 at the public meeting. They were informed that USACE would not continue evaluation of this levee raise alternative. Any revisions to the existing Capital View levee, beyond removal, are outside the federal interest for the study. The existing Capital View levee footprint is within both Jefferson City and Callaway County floodplain management jurisdictions, generally within the adopted FEMA Floodway. Any revision to volume and/or changes in hydraulics within a floodway, including raising the existing Capital View levee to the current highest elevation point, would have impacts to adjacent properties. These impacts could be substantial to many stakeholders within Jefferson City, and could impact development in the downtown Government district, as has been observed in recent years.

Baseline Cost for CA13 Structural Plan

Cost estimates were completed for nine of the thirteen combined alternatives, and a feasibility cost estimate was completed for CA13. **Table 2** below provides the fully funded total project cost for CA13 by associated cost items. A risk-based contingency at the 80% confidence level in the amount of $118,500,000 (46%) and has been applied to the cost estimate. The total Estimated First Cost of CA13 is $313.9 M (FY 2025 price level). Escalated to the expected mid-point of construction and/or design, the Total Project Cost (fully funded) is $381,600,000. **Table 3** below shows the economic summary for CA13.

Table 2 Cost Item Summary with Fully Funded Total Project Cost

Cost Item	Cost (FY 2032) in $1,000s
Construction Costs	$216,600
Relocations	$82,100
Planning, Engineering, and Design (PED)	$35,800
Construction Management (EDC, S&A)	$38,800
Real Estate (LERDs)	$8,300
Fully Funded Total Project Cost*	**$381,600**

**Discrepancies in totals due to rounding.*
***Effective Price Level is 1 Oct 2024. The Fully Funded Cost is the estimate at the effective price level escalated to the midpoint of construction and/or design.*

Table 3 CA13 Economic Summary

CA13 Economic Summary	Cost (FY 2025) in $1,000s
Annual Benefits	$15,774.6
Total Annualized Investment Cost	$13,421.7
Annual Net Benefits	$2,352.9

CA13 Economic Summary	Cost (FY 2025) in $1,000s
Benefit-Cost Ratio	1.2

**Discrepancies in totals due to rounding. Oct 2024 (FY25) price level*

Tentatively Selected Plan (TSP)

CA13 (Hybrid Alignment, 41-ft Stage, Partial Capital View Removal) is the structural plan most likely to become the TSP. This plan provides not only NED benefits, but also the most comprehensive benefits across all four accounts. It has federal interest, aligns with the overall goals of the system plan, increases conveyance at Jefferson City, relieves localized flooding impacts from the Turkey Creek tributary, and maximizes the amount of critical infrastructure protected by the proposed levee. As part of the greater Lower Missouri River System, this alternative meets the consideration to plan for system conveyance and flood risk planning in the future by providing a setback from the bank of the Missouri River channel.

However, the non-federal Sponsor (NFS) MoDNR has indicated they do not fully support CA13 as the TSP at this time due to not having full community support among affected parties to move the study into the next phase. They are looking for more input from landowners, stakeholders, and others in the community once this draft report has been released to the public. **Therefore, the TSP has not been selected at this time.**

1.0 Introduction

This Feasibility Report and Integrated Environmental Assessment (FR/EA) presents the results of the Lower Missouri River Jefferson City L-142 flood risk management study, completed by the U.S. Army Corps of Engineers (USACE) Kansas City District (NWK) in partnership with the Missouri Department of Natural Resources (MoDNR) who is the non-federal study sponsor. The NWK-prepared FR/EA integrates plan formulation with documentation of environmental effects, provides potential alternatives for flood risk management within the Jefferson City study area, outlines the process used for selecting the Tentatively Selected Plan (TSP), and concludes with recommendations for project implementation. This report facilitates acceptance of the study conclusions and recommendations by the sponsor, public, state and local agencies, Tribes, and the federal government.

1.1 USACE PLANNING PROCESS

The USACE planning process follows Risk Informed Planning, which uses a six-step process as defined in Engineering Regulation (ER) 1105-2-103 Policy for Conducting Civil Works Planning Studies. This process is a structured approach to problem solving which provides a rational framework for sound risk informed decision making while strategically reducing uncertainty. This process is usually expressed in a sequential manner. However, it can also be iterative in practice. This report will mirror the sequential manner of the process. These steps start with scoping which includes identifying problems, opportunities, inventorying, and forecasting conditions as identified in the first two chapters. Chapter 3 starts with the formulation of ways to solve the water resource problem and contains portions of how to evaluate these solutions. Evaluation cannot be completed without fully understanding the effects and consequences of these solutions as described in Chapter 4. Plan comparison and selection within Chapter 5 comprises steps 5 and 6. The remaining chapters of this report describe the TSP, the plan's environmental compliance, the district engineer's recommendation, a list of those involved in report preparation, and literature cited.

This report integrates the Environmental Assessment (EA) in order to document compliance with the National Environmental Policy Act (NEPA) of 1969. Sections of the FR/EA that are required by NEPA are indicated by an asterisk and those sections count towards NEPA page limits.

1.2 STUDY AUTHORITY

Section 216 of the Water Resources Development Act (WRDA) of 2020 authorizes modifications to projects in Iowa, Kansas, Nebraska, and Missouri authorized under the Pick-Sloan Missouri River Basin Program and the Missouri River Bank Stabilization and Navigation Project, including modifications to the authorized purposes of such projects to further flood risk management and resiliency. The authorization states:

> *"…the Secretary shall expand the scope of such study to investigate and provide recommendations relating to modifications to projects in Iowa, Kansas, Nebraska, and Missouri authorized under the Pick-Sloan Missouri River Basin Program….*
>
> *and the Missouri River Bank Stabilization and Navigation project…. including modifications to the authorized purposes of such projects to further flood risk management and resiliency…".*

The L-142 Unit in Jefferson City is within the authorized scope of WRDA 2020. Additionally, Jefferson City was identified within the Memorandum for Commanding General, U.S. Army Corps of Engineers (USACE) Subject: Implementation Guidance for Section 216 of WRDA 2020, Lower and Upper Missouri River Comprehensive Flood Protection as a spin-off study that was coordinated with the non-federal sponsor for consideration for implementation.

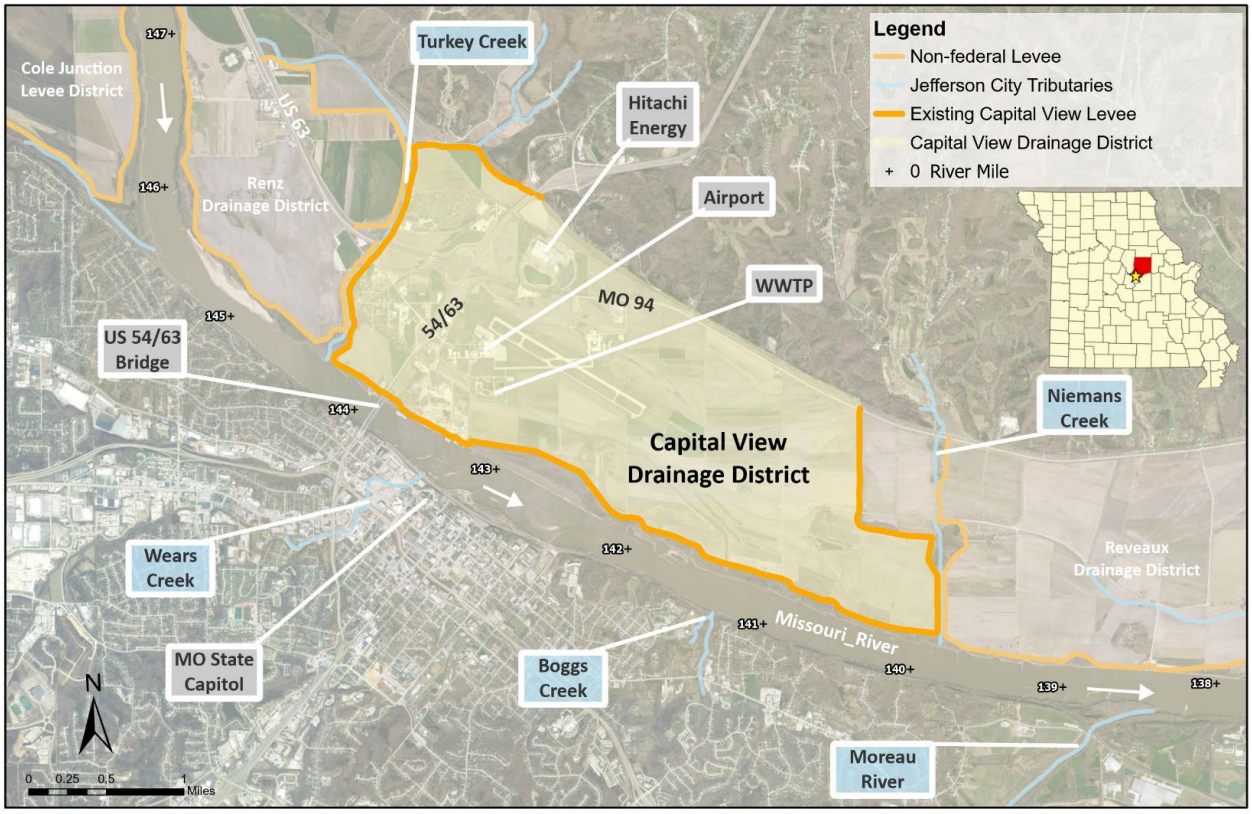
1.3 STUDY AREA (PLANNING AREA)

The Jefferson City levee study area is at the southern edge of Callaway County, Missouri, along the left bank of the Missouri River from Turkey Creek (river mile 144.5) on the west to the approximate area of Niemans Creek (river mile 140.5) on the east.

Much of the area has been incorporated into the city limits of Jefferson City and is known informally as north Jefferson City.

There are no federal flood risk management projects in or near the study area. The Missouri River upstream and downstream of Jefferson City, MO is lined with a patchwork of non-federal levee systems including some that are active in the USACE Rehabilitation and Inspection Program (RIP), authorized under Public Law 84-99 (P.L. 84-99); privately constructed levees that have no USACE affiliation; and areas with no structural flood risk management features. The RIP is commonly referred to as the P.L. 84-99 program, which is the terminology adopted in this report. The current study area is within the leveed area of Capital View levee (**Figure 3**). The Capital View levee is operated and maintained by the Capital View Drainage District and is active in the RIP. Immediately upstream of Capital View on the left bank is the Renz levee and immediately downstream on the left bank is the Reveaux levee. These are both also non-federal levees active in the RIP. Critical infrastructure within the existing leveed area includes the Jefferson City Memorial Airport and the city's regional wastewater treatment plant.

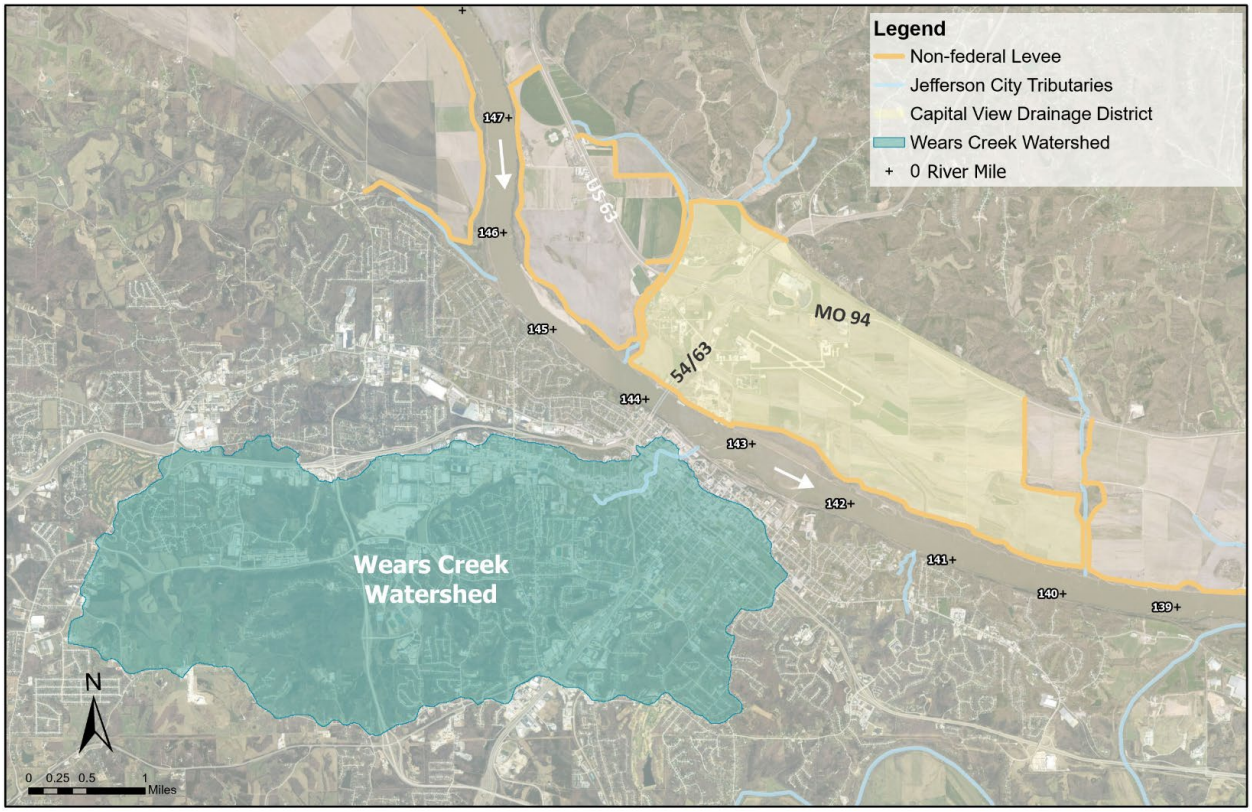
Figure 3 Jefferson City L-142 Study Area Location



Jefferson City, Missouri is located across the river from the study area on the right bank. It sits high on a bluff with much of the city at little to no risk of Missouri River flooding. However, a tributary of the Missouri River, Wears Creek, can be impacted by Missouri River water surface elevations. Wears Creek is a right bank tributary of the Missouri River, entering the river at mile 143.4 and draining 14.1 square miles as outlined in **Figure 4**. The Wears Creek drainage area is subject to flooding incurred from both shorter duration storms overwhelming the City's stormwater infrastructure from Wears Creek watershed runoff

and slower backwater floods of a longer duration from the Missouri River. Wears Creek basin flooding has been analyzed separately from the Lower Missouri Jefferson City L-142 Flood Risk Management Study by both the USACE and the State of Missouri with recommendations that have not been implemented to date. A summary of past Wears Creek studies is included in Section 1.4. Due the complexity of the Wears Creek basin, the Jefferson City feasibility study assesses, and documents impacts to Wears Creek in relation to the change of water surface elevation in the Missouri River profile at the Wears Creek confluence.

Figure 4 Wears Creek Watershed



1.4 BACKGROUND AND HISTORY

Unit L-142 is an unconstructed unit of the Missouri River Levee System (MRLS) authorized by the 1941 and 1944 Flood Control Acts (Public Law 228, 77th Congress, 1st Session, and Public Law 534, 78th Congress, 2d Session) on the left bank of the Missouri River at Jefferson City. In December 1973, Unit L-142 was classified "inactive" because the 1960's restudy indicated it was not economically justified. The area that would have been behind Unit L-142, now sits behind the Capital View non-federal levee.

Flooding has been a recurring problem for many years within the study area. The Capital View levee was constructed prior to 1970 to alleviate the recurring flood damages. The Capital View levee is on the left descending bank of the Missouri River and extends from the upstream tieback at Turkey Creek (approximately 1/2 mile upstream of the U.S. Highway 54/U.S. Highway 63 bridge) to the downstream tieback (approximately 4 miles downstream of the U.S. Highway 54/U.S. Highway 63 bridge). During the 1993 flood, the Capital View levee was overtopped and subsequently breached in 13 locations. Capital View also overtopped and breached in 13 locations in 1995 and in 7 locations in 2019. In 1998, 2001 and 2013 the levee was fully loaded but did not breach.

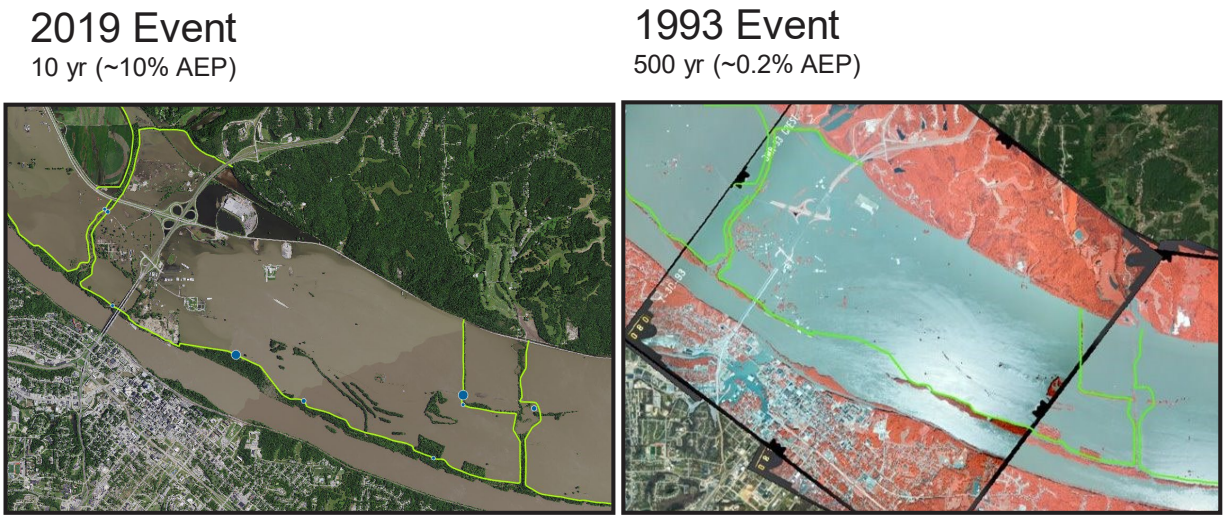
As a result of the 1993 and 1995 floods, a General Re-Evaluation was initiated on Unit L-142. The General Re-Evaluation Report (GRR) was complete in 2001 with a recommendation to construct a federal

levee on the left bank to an elevation of 564.0 feet National Geodetic Vertical Datum of 1929 (NGVD29). At the time, this correlated to approximately a 0.1-percent-chance (1/1000 year) annual exceedance probability (AEP) of overtopping. This levee would be slightly landward of and shorter in length than the existing Capital View levee. The project moved forward to design but was paused in 2007 when the sponsor declined to sign the Project Partnership Agreement.

Most recently, the 2019 flood caused extensive damages to agriculture and infrastructure in communities in the states of Iowa, Nebraska, Kansas, and Missouri. Specifically at Jefferson City, the Capital View levee overtopped and breached in numerous locations and the leveed area was inundated. In the aftermath of the flood, the four states formed the Flood Recovery Advisory Working Group to identify actions that could reduce systemwide flood risk, reduce reoccurring damages, and improve system resiliency. In addition to the system-wide evaluations as described below, Jefferson City was identified as a priority area for flood risk evaluation, prompting this site-specific feasibility study.

The Flood of 1993 remains the flood of record at Jefferson City, with a recorded maximum stage of 38.7 feet and discharge of 750,000 cfs at the Jefferson City Missouri River gage, corresponding to a roughly 0.2% (1/500 yr) AEP flow. The 2019 flood recorded a maximum river stage of 33.4 feet and discharge of 366,000 cfs, an approximate 10% (1/10 yr) AEP flow. **Figure 5** shows the difference in inundation between the 2019 and 1993 flood events at the Capital View Drainage District leveed area.

Figure 5 Inundation Extent Comparison at Capital View levee for 2019 and 1993 flood events.



In addition to this study, several other studies of the project area have been recently completed or are in progress. A summary of studies most relevant to the study area follows. Additional project history is included in the Hydrology and Existing Conditions appendix, Appendix A1 – Part 1.

Missouri River Levee System Definite Project Report (1947)

The Missouri River Levee System Definite Project Report, also known as **the Pick-Sloan Plan, is the original authorization for many agricultural levee systems on the Missouri River and proposed a minimum floodway width of 4,500 feet for the Missouri River from the Grand River to Osage River confluences. This plan was not fully constructed.**

General Reevaluation Report & Environmental Assessment (2001)

The Jefferson City L**-142 study area previously underwent analysis resulting in a recommendation for construction of a federal levee. The project moved forward to design but was paused in 2007 when the sponsor declined to sign the Project Partnership Agreement.**

Lower Missouri River Flood Risk Resiliency Plan Section 22 PAS (2022)

The *Considerations and Analysis for Flood Risk Resiliency for the Lower Missouri River (Nebraska, Iowa, Kansas, and Missouri) Section 22 Planning Assistance to States* (PAS) study investigated conceptual measures and strategies to lessen flood risk vulnerability and improve flood risk resilience throughout the Lower Missouri River Basin. The four state partners assisted in prioritizing areas between Sioux City, Iowa and St. Louis, Missouri for potential action. The PAS study analyzed vulnerable locations on the Lower Missouri River and conducted stakeholder outreach to better understand recurrent problem areas and impacts. Jefferson City was identified as one of the critical areas to be considered for feasibility-level study with this analysis.

Lower Missouri River Flow Frequency Study (2023)

The *Missouri River Flow Frequency Study–Yankton, South Dakota to Hermann, Missouri* was completed in June 2023 and incorporates new data and statistical analysis and applies state of the practice methodologies to update the Lower Missouri River flow frequencies, including flow and annual exceedance probabilities, at 10 gages. This study extends the period of record and replaces the Missouri River flow frequencies developed with the 2003 Upper Mississippi River System Flow Frequency Study.

Lower Missouri River Stage Frequency Analysis (Expected in 2025)

The Lower Missouri River Stage Frequency analysis will update hydraulic modeling and associate 2023 Flow Frequency study flows to determine stage frequencies at select river locations. The stage analysis of the Lower Missouri River was not complete at the time of this study and is anticipated to be complete in 2025.

Lower Missouri River Flood Risk & Resiliency Study (Expected in 2027)

This feasibility study will evaluate the Lower Missouri River system over 735 river miles from Sioux City, Iowa to the mouth near St. Louis, Missouri. In partnership with Missouri, Kansas, Iowa, and Nebraska the study will create a vision for a more resilient future for the Lower Missouri River, with a focus on flood risk management. Outcomes of the study will include system analysis providing context to the initial studies, identify and recommend any additional spin-off feasibility studies and their locations, and identify potential policy recommendations that would support the system and potential actions for local stakeholders. The study is scheduled to be complete in March 2027. The Jefferson City study is not directly tied to the findings of the system plan, but many of the same resources will be used in the development of both analyses.

Wears Creek Studies (1953, 1974, 1980, 1986, 2003)

Wears Creek is a right-bank tributary to the Missouri River with a confluence located 0.5-mile downstream of the U.S. Highway 54/63 bridge, directly across the river from the existing Capital View levee. The drainage area encompasses 14.1 square miles, delineated in **Figure 4**, and is routed through the city of Jefferson City as an open channel, with many bridges and a couple enclosed sections. The Wears Creek system is subject to two very different types of flooding including flash runoff floods from the upstream watershed and backwater floods from the Missouri River (USACE 1974). The scope of the current Jefferson City study does not extend to the right bank of the Missouri River but will document the effects of proposed left-bank alternatives.

Many studies, conducted by both USACE and the State of Missouri, have been produced to assess feasibility of reducing flooding in the Wears Creek basin since 1928. The most recent USACE findings are documented in a General Design Memorandum issued in 1986 by USACE, Kansas City District. The report concluded that feasible alternatives for the reduction or elimination of flood damages in the developed Wears Creek basin do not exist. Considered alternatives for past USACE studies are summarized in Table 4.

Table 4: Summary of USACE Wears Creek Flood Risk Management Study Efforts

Date	Recommendation	Outcome
January 1953	Interception and diversion of Wears Creek North and East Branches to the Missouri River and provision of a gated outlet at the mouth of Wears Creek.	Not submitted to Congress for authorization due to lack of local support
September 1974	Series of closed conduits for Wears Creek and portions of the Frog Hollow and East and North Branch tributaries to pass the 100-year Wears Creek flood. Filling the floodplain downstream of the Whitten Expressway to the Missouri River Urban Design Flood elevation and filling the floodplain between the Witten Expressway and U.S. Highway 54 to above the 100-year flood elevation. Other considered alternatives included Zoning and Building Code Requirements, Floodproofing, Evacuation of the Floodplain, Pressurized Conduit, Upstream Impoundments, and Open channel alternatives ($48M 1979 cost).	Plan was not economically justified using standard USACE benefit/cost analysis due to removal of existing infrastructure to make way for new. Project defined as an urban renewal effort and authorized for further evaluation for federal interest instead of construction.
March 1980	Recommendation of a closed conduit.	Project not economically justifiable due to land use changes in the floodplain. Jefferson City action to convert floodplain to compatible uses.
January 1986	Study to determine if federal interest could be found for targeted flood protection measures for the most developed reach of Wears Creek including Closed Conduit, Earthen Levees, Channel Improvements, Floodwall, and Floodproofing.	The only alternative that would meet project goals of flood risk management for both Wears Creek and Missouri River flooding was the floodwall alternative, which would be cost prohibitive in relation to the flood damages reduced. The city removed much of the flood-prone development prior to the study, and USACE recommendation is to continue flood damage reduction efforts.

The most recent report lead by the State of Missouri was completed by HDR, Inc. in 2003, titled Wears Creek flood Mitigation Study Phase II Project No. 00025-01. This study considered alternatives for providing flood protection to key infrastructure within the Capital Complex area and performed hydrologic and hydraulic evaluations to define risk of flooding from Missouri River backwater, Wears Creek runoff, and coincidental flooding. Two conceptual designs were considered to provide a 1-ft freeboard above the 0.2% AEP (1/500 year) Missouri River flood event and 1% AEP (1/100 year) interior pumping facility for the Wears Creek drainage area. Conceptual designs included an alternative for a levee, flood gate, and pumping facilities at the mouth of Wears Creek totaling $76 Million or an alternative consisting of site-specific floodwalls, gates, and pumping facilities at the Truman Building, State Health Laboratory, and Capital Plaza Hotel totaling $5 Million. Neither alternative was implemented.

1.5 PURPOSE AND NEED*

Flooding has frequently damaged the area on the left bank of the Missouri River near Jefferson City. The purpose of the proposed federal action is to reduce the potential risk for loss of life as well as reduce economic damages due to flooding. This area has seen repeated flood events that overtop and breach the existing Capital View non-federal levee. Although life loss has not been recorded to date, there is still life loss potential. While overtopping events of the levee generally have days of warning time, breaches

prior to overtopping can happen suddenly. Once the Capital View levee overtops (or breaches), those in the immediate vicinity of the airport have only about 2 hours to safely complete any evacuations. In addition to property and structures in the leveed area, U.S. Highway 54 is a major thoroughfare for the region. The highway closes when the water surface reaches an elevation of 557.9 feet NGVD29, an approximate 37-foot flood stage at Jefferson City.

The existing Capital View levee protects important infrastructure that provides local, regional, and statewide benefits. Some of the negative impacts during flood events include:

- Hitachi Energy is a manufacturer of electrical transformer components that employs 1200 people, many of which are not paid their hourly wage when they are unable to get to work.
- Capital Sand provides materials for construction for the region, including for sites as far as Springfield, MO, one of the fastest growing areas in the state of Missouri. Lack of material impacts construction and maintenance of public goods in this service area.
- The Jefferson City Memorial Airport serves not only private and contract aviation, but also essential state government services. These services are suspending during flood events.
- The Missouri Air National Guard has an Army Aviation Support Facility affected by the recurring flooding, which is unable to operate once Capital View levee overtops.
- Regional transportation routes supporting the economy, agricultural production, and emergency services routes are impacted by flooding, resulting in costly detours and delays.
- Loss of access to the Jefferson City Regional Wastewater Treatment Plant can impact basic public services such as clean water and sanitary sewer operations.
- Businesses and public enterprises in the area continue to suffer structural deterioration and loss of market value due to flooding.

The USACE Kansas City District is the lead federal agency for this study. The non-federal sponsor (NFS) of this study is the Missouri Department of Natural Resources (MoDNR). However, MoDNR has indicated they will not be the implementation sponsor for the study. Therefore, several key stakeholder groups have been involved and engaged with the study progress including the Capital View Drainage District, Corn Growers, Farm Bureau, Jefferson City Memorial Airport, City of Jefferson City, and the Jefferson City Regional Economic Partnership. Landowners, businesses, and residents in Jefferson City proper are also providing feedback to the PDT. Public Involvement conducted as part of the study is detailed in Appendix F.

The Osage Nation is a cooperating agency for this study.

1.6 PROBLEMS AND OPPORTUNITIES

The problems for the study include the following:

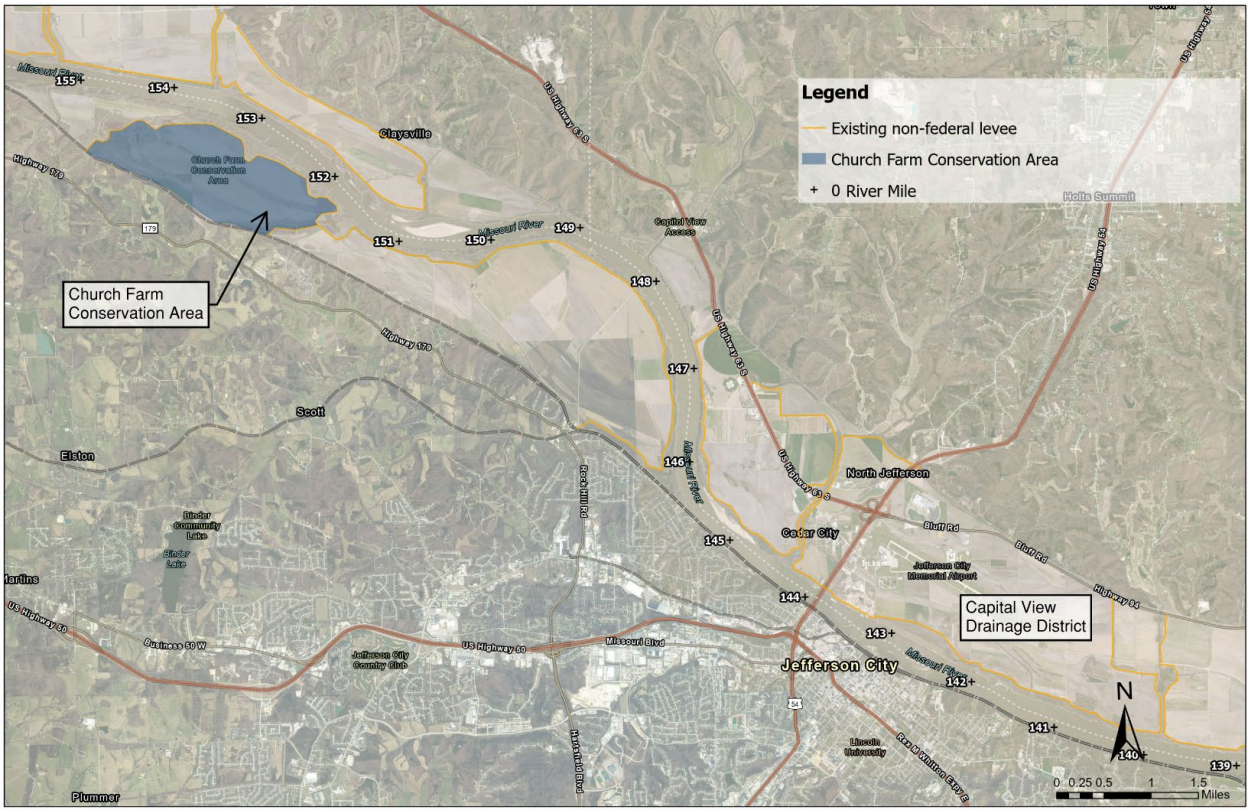
- There are frequent and reoccurring economic and infrastructure damages on the north bank of the Missouri River in Jefferson City, Missouri due to repetitive flooding, including damage to an airport, Air National Guard facility, major roadways, wastewater treatment facilities, businesses, and ~2,100 acres of agriculture production land.
- The existing non-federal levee, the Capital View levee, has repeated resiliency concerns, which include overtopping, interior drainage, under seepage, slope and crown erosion and stability, and **does not provide adequate flood risk reduction** for the area.

While addressing the identified problems, there are opportunities to achieve the following:

- To provide recreational opportunities that connect the surrounding communities to the environment such as Katy Trail connectivity.
- To preserve, restore, or enhance the aesthetic and environmental qualities of the study area.

- Allow greater floodplain connectivity. Wetlands located riverward of Mokane Road may be enhanced as they derive hydrology from the Missouri River and have the potential to support fair to minimal benefits to area wildlife.
- To sustain and improve community cohesion through measures to better protect existing critical infrastructure in leveed area (wastewater treatment facility, airport).
- Identify other opportunities and actions for other agencies, local entities, or sponsor to implement independently to provide flood risk resiliency for the area.
- Potential addition of Church Farm Conservation Area (**Figure 6)** as upstream retention. The Church Farm Conservation area, owned by the State of Missouri and leased by the Missouri Department of Conservation since 2016, is 1,277 acres of bottomland along the Missouri River's right bank. MDC maintains the 3.75-mile-long Prison Farm levee (also referred to as Church Farm levee). Numerous scour holes due to past flooding, along with a natural slough that hold water seasonally, provide bird habitat that could be enhanced with additional water retention to benefit the project.

Figure 6 Church Farm Conservation Area Map



1.7 OBJECTIVES AND CONSTRAINTS

The study objectives, listed below, will be used to compare each alternative and select a plan partially based on its effectiveness in meeting these objectives. They are:

- Reduce the risk of flood damage and/or improve resiliency for property, businesses, agriculture, and infrastructure (including critical facilities) near Jefferson City for the 50-year period of analysis beginning in 2026.

- Reduce the risk of flooding on human life and safety for the 50-year period of analysis beginning in 2026.
- Consider the project as part of the overall Lower Missouri River Flood Risk and Resiliency study (System Plan) planning objectives for system conveyance and flood risk planning in the future.

Constraints are substantial barriers or restrictions that limit the extent of the planning process. Plans are formulated to meet the planning objectives to avoid violating the constraints. Considerations are those issues or matters that should be considered during the planning process, but do not necessarily limit the extent of the process as do constraints. Only one true constraint was identified during the planning process:

- Avoid increasing bird/wildlife air strike hazard in accordance with the USACE Memorandum of Agreement with the Federal Aviation Administration (FAA).

This constraint was discussed at length with both the airport's local leadership, as well as the FAA Regional Administrator to determine the proper consideration of this constraint. The following decision criteria were used when planning around this constraint:

- Limit all borrow activities within five miles of the airport to the extent practicable. In particular, borrow sites located in-line with runways are to be avoided if possible.
- If the project delivery team (PDT) determines that it is necessary to collect borrow material within five miles of the airport, the USACE would coordinate with the FAA to minimize bird attractants. Preventing the formation of pools of water is particularly important to avoid attracting large flocks of waterfowl.
- Any restored habitat within five miles of the airport should be wooded. Habitat characterized by open water or herbaceous vegetation may attract flocks of geese which are especially problematic for airports.
- Borrow activities or land use changes more than five miles away from the airport are considered to have no meaningful impact on airport operations.

Other considerations for the study include:

- Avoid impacts to the authorized purposes of the Bank Stabilization and Navigation Project (BSNP).
- Avoid, minimize, or mitigate impacts to cultural sites in the project area.
- Avoid, minimize, or mitigate impacts to jurisdictional wetlands in the project area.
- Consider the status of Capital View levee in the P.L. 84-99 program (ER 500-1-1).
- Avoid, minimize, or mitigate increased flood profiles upstream/downstream or induced substantial damages on opposite bank of project site unless mitigation as appropriate is included to offset.

1.8 STUDY SCOPE

The Lower Missouri River Jefferson City L-142 Flood Risk Management General Investigation Feasibility Study will identify the problems, opportunities, objectives, and constraints related to the flooding concerns in the Jefferson City area, specifically the Capital View non-federal leveed area. For the purpose of analysis, a 50-year time horizon is used to develop water management policies and adaptation strategies. The study will also identify and evaluate potential alternatives for flood risk management that would reduce property damage and economic loss for government, local businesses, agricultural producers, and residents. The No Action Alternative (NAA) is included in the array of potential alternatives for comparison purposes.

2.0 Existing and Future Without Project Conditions*

This chapter provides both the existing conditions (a baseline), as well as a forecast of the FWOP conditions, which together provide the basis for a 50-year plan formulation. The existing conditions presented in this chapter also represents the affected environment as required for NEPA purposes. The affected environment includes the human environment, which is subdivided into the natural, physical, economic, and built environments.

The FWOP condition is a forecast of future conditions of the No Action Alternative for the life of the planning project; it is forecasted over the 50-year planning period of analysis.

2.1 PERIOD OF ANALYSIS

The period of analysis for this study, beginning in 2027, is 50 years, which is the standard length for USACE feasibility studies.

2.2 GENERAL SETTING

The study area's general setting is largely comprised of Missouri River floodplain around Jefferson City, Missouri (see **Figure 1**). The two areas of particular focus are the locations in and around the Capital View levee and Church Farm levee. The study area features a variety of land uses and developments. Most of the study area is developed for row crop agriculture, though more intensive developments (e.g., Jefferson City Memorial Airport, Hitachi Energy manufacturing plant, Capital Sand Company quarry) can be found around the western side of the Capital View levee area. This part of the study area also contains some residences and much of the area's recreational development. The few undeveloped places in the study area are generally represented by forested lands on the riverward side of levees.

2.3 NATURAL ENVIRONMENT

Aquatic Habitat and Resources

The Missouri River is the longest river in the United States, with a watershed that encompasses one-sixth of the country. Historically, the channel geometry of the Missouri River and flows across the riverbed varied widely. The width of the main channel ranged from roughly 1,000 to 10,000 feet during normal flow periods and 25,000 to 35,000 feet during floods (Schneiders 1999), resulting in a wide floodplain. The channel geometry continuously changed as varying flows and sediment loads in the river resulted in frequent erosion, deposition, degradation (i.e., lowering of the channel bed), and aggradation (i.e., raising of the channel bed); the formation of sandbars, mudflats, chutes, pools, log jams, whirlpools, and backwaters; and the development of meanders and cut-off channels (Skalak et al. 2013). The thalweg (i.e., primary flow channel) was narrow and highly variable in both location and depth. Most of these changes occurred during flood events.

The present-day Missouri River has been heavily modified from these historic conditions. USACE has been modifying the Missouri River to facilitate navigation since the 1800s, in part by removing snags or other obstructing habitat features in the river. The major modification to the Missouri River within Missouri is the Bank Stabilization and Navigation Project (BSNP). The BSNP consists mainly of rock pile structures and revetments along the outsides of bends and transverse dikes along the insides of bends to force the river into a channel alignment that is self-maintaining or self-scouring. This is different from most inland navigation systems, which are managed through the use of locks with some associated dredging. Training structures permit an open condition for the entire length of the project with no dredging required under normal flow conditions. Other impacts of the BSNP on the Missouri River include increased flow velocities, degradation of the riverbed, and a reduction of the size of the floodplain.

The Missouri River has a vast number of tributary streams. The Capital View levee area is bordered on the upstream end by Turkey Creek and on the downstream end by Niemans Creek. Like the Missouri River, these two tributaries have also been altered from their historic condition. In particular, these streams have been channelized and, because they are generally bounded on either side by levees, have lost most of their access to the historic floodplain. Workman Creek, which is a Missouri River tributary located in the Church Farm area, also has been degraded by channelization and disconnection from most of its floodplain.

None of the surface water features located in or along the study area are listed as impaired waters in the 2022 Section 303(d) List for Missouri (MoDNR, 2022). The Missouri River is subject to a Total Maximum Daily Load (TMDL) for chlordane and polychlorinated biphenyls (PCBs) in fish tissue.

The L-142 Area and Church Farm Conservation Area are both located within the Missouri River's 100-year floodplain. Flooding in the L-142 Area has caused greater economic and infrastructure damage than flooding in the Church Farm Conservation Area because the former has been developed to a far greater degree. The L-142 Area has been impacted by flooding in 1993, 1995, 2007, and 2019. Floodplain infrastructure at this location is protected by the non-federal Capital View levee District, which is a 8.8-mile-long earthen levee that reduces flood risk to approximately 3,300 acres (USACE, 2023). This levee has repeated resiliency concerns which include overtopping, interior drainage, under seepage, slope and crown erosion and stability. The Church Farm Conservation Area is protected by the non-federal Prison Farm levee, which is a 3.8-mile-long earthen levee that reduces flood risk to approximately 998 acres (USACE, 2022).

In the absence of a flood risk management project, no substantial changes to aquatic habitat or related resources would be expected under the FWOP condition. The BSNP and Capital View levee would remain in place and the altered condition of the study area's aquatic resources would be maintained. It is reasonable to expect additional levee breaches in the next fifty years under the FWOP, and the assumption is that those breaches would continue to be repaired.

Wetlands

Historically, the Missouri River floodplain exhibited a substantial amount of wetlands of various kinds, such as riparian bottomland forests, oxbows, and emergent marshes. Large swathes of these wetlands have been eliminated or degraded by development and other land use practices, and the study area is no exception. Nevertheless, the modern-day study area still features wetlands, though at a reduced quantity and quality compared to historic conditions. Much of the land capable of supporting wetland species within the study area is currently used for farmland.

Missouri River floodplain wetlands dominated by herbaceous plant species have historically corresponded with the Eastern North American Marsh, Wet Meadow, and Shrubland ecological system (NatureServe, 2024b). The hydrology of these areas is generally characterized by seasonal flooding, though the length of time that these areas stay wet over the year can vary. Certain topographical features (e.g., depressional basins) can prolong the length of time a particular wetland maintains standing water, for example. Water depth in these wetlands can vary considerably as well. The vegetation in these areas is generally dominated by graminoids such as sedges (*Carex* spp.) and cattails (*Typha* spp.) as well as forbs.

Historically, most of the wetlands in the study area would have been dominated by woody species, as ecological succession would cause the dominance of herbaceous species to be supplanted by shrubs and saplings and then trees over a relatively short timeframe. These wooded areas are discussed further in Section 2.3.3 as part of a broader discussion on floodplain forest habitat.

Large swathes of wetlands within the study area have been eliminated or degraded by development and other land use practices. The presence of levees greatly restrict the natural flow of surface water from the main channel of the Missouri River to potential floodplain wetlands. Most of the study area has been developed for row crop agriculture, and so many of the historical wetlands in the area have been drained by ditches and other features. While degraded, many of these farmed wetlands have not entirely lost their

hydrological character due to topography (e.g., depressional basins) and other factors. On the other hand, areas that have experienced intensive development (e.g., industrial areas) have generally lost their historic wetlands altogether. Some herbaceous wetlands are currently maintained as roadside ditches, which exhibit weedy species and are prevented from developing into wooded habitat by regular road maintenance and mowing activities.

In the absence of a flood risk management project, no substantial changes to wetlands would be expected under the FWOP condition. No substantial developments or changes to general land use practices that would further alter the already degraded nature of the study area's hydrology are expected. The USACE expects that wetlands in the study area would be maintained in their current, degraded condition.

Terrestrial Habitat

Floodplain forest habitat in the study area generally corresponds with the Central Hardwood Floodplain Forest ecological system (NatureServe, 2024a). Vegetation in this kind of forest can be quite variable, but common tree species include box elder (*Acer negundo*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), American sycamore (*Platanus occidentalis*), and American elm (*Ulmus americana*). The trees that dominate these kinds of forest are frequently early to mid-successional species that are effective at spreading to new locations. The shrub layer can vary considerably, though oftentimes it is sparse. Shrub species commonly include pawpaw (*Asimina triloba*) and silky dogwood (*Cornus amomum*). Vines, such as poison ivy (*Toxicodendron radicans*) are frequently abundant. The understory often features abundant spring ephemerals, though a combination of ferns and forbs may be more characteristic for this layer by mid-summer.

However, the substantial amounts of human disturbance that the study area has been subjected to has resulted in the spread of invasive species. The Missouri Invasive Plant Council has identified the most harmful invasive plant species for each region of Missouri (Missouri Invasive Plan Council, 2021). Particularly noteworthy invasive plant species for the study area include reed canary grass (*Phalaris arundinacea*), Japanese hops (*Humulus japonicus*), bush honeysuckle (*Lonicera* spp.), common reed (*Phragmites australis*), and Johnson grass (*Sorghum halepense*), among others. In addition to these invasive plants, invasive insects have also reduced habitat quality in this area. The emerald ash borer (*Agrilus planipennis*) has been particularly impactful by devasting ash tree populations wherever an infestation takes hold. USDA records for the species indicate that it was first reported in Callaway County in 2018 (USDA, 2023). Thus, while the study area's terrestrial habitat has not been entirely eliminated, the current habitat is degraded when compared to its historic ecological conditions.

In the absence of a flood risk management project, no substantial changes to the terrestrial habitat of the study area would be expected under the FWOP condition. The overall quality of the habitat would continue to be degraded by a combination of invasive species and direct disturbance by human activities.

Fish and Wildlife

The Missouri River is home to a diverse array of fish species. The species that inhabit this river frequently contend with continuous high turbidity, swift currents, a scarcity of backwater habitat, and an unstable sand-silt bottom (Pflieger, 1971). Noteworthy Missouri River fish include paddlefish (*Polyodon spathula*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), longnose gar (*Lepisosteus oculatus*), blue catfish (*Ictalurus furcatus*), and flathead catfish (*Pylodictis olivaris*; Galat et al., 2005). Additional species can be found along the border of the main Missouri River channel or in floodplain waters such as oxbows. Some such species include black bullhead (*Ameiurus melas*), tadpole madtom (*Noturus gyrinus*), green sunfish (*Lepomis cyanellus*), and bluegill (*Lepomis macrochirus*).

Due to the substantial development that has occurred in the study area, much of the fauna that inhabit this location are edge and urban-adaptive species that can tolerate these disturbances. Wildlife that can be found in this area include small mammals such as eastern cottontail rabbit (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), Virginia opossum (*Didelphis virginiana*), and raccoon (*Procyon lotor*), among others. Larger mammals include whitetail deer (*Odocoileus virginianus*),

red fox (*Vulpes vulpes*), and coyote (*Canis latrans*). Various species of birds, reptiles, amphibians, and invertebrates also inhabit this area.

In the absence of a flood risk management project, meaningful changes to the local habitat are not anticipated and therefore fish and wildlife resources within the study area would not be expected to change under the FWOP condition.

Threatened and Endangered Species

Federally Listed Species

An official list of federally protected species was generated using the US Fish and Wildlife Service (USFWS) automated Information for Planning and Consultation (IPaC) website. The list generated by the IPaC website included six federally listed species that could potentially be affected by activities near the study area. These are listed in **Table 5**. However, the presence of a species on the list does not necessarily indicate presence within the study area.

Table 5 Federally Listed Species Potentially Present in the Study Area

Taxa	Scientific Name	Common Name	Federal Status	Federal critical habitat w/n study area
Fish	*Scaphirhynchus albus*	Pallid Sturgeon	Endangered	No
Insect	*Argynnis idalia occidentalis*	Western Regal Fritillary	Proposed Threatened	No
Insect	*Danaus plexippus*	Monarch Butterfly	Candidate	No
Mammal	*Myotis grisescens*	Gray Bat	Endangered	No
Mammal	*Myotis septentrionalis*	Northern Long-eared Bat	Endangered	No
Mammal	*Myotis sodalis*	Indiana Bat	Endangered	No
Mammal	*Perimyotis subflavus*	Tricolored Bat	Proposed Endangered	No

Pallid sturgeon are large, long-lived fish that inhabit large, deep turbid river channels, usually in strong current over firm sand or gravel (USFWS, 2023f). This species is adapted to murky waters such as the Missouri River and is known to migrate throughout the Missouri and Mississippi river systems. This species is imperiled by a variety of factors, perhaps the most notable of which are river channelization, bank stabilization, impoundment, and altered flow regimes. USFWS data indicates that pallid sturgeon may inhabit the Missouri River along the entirety of the study area and may also utilize the lower portions of local tributaries such as Turkey Creek as well (USFWS, 2023f). Missouri Department of Conservation (MDC) records also indicate that the species may be present in this general area (see Appendix F).

Gray bats live in caves year-round. During the winter, gray bats hibernate in deep, vertical caves. In the summer, they roost in caves which are scattered along rivers. These caves are in limestone karst areas of the southeastern United States. The gray bat habit of roosting in large numbers in only a limited number of caves makes them highly vulnerable to human disturbance. Gray bats are also imperiled by habitat loss, as caves important for roosting have been flooded and submerged by reservoirs (USFWS, 2022b). Roosting caves for this species are not known within the study area, though many caves have been identified in the general region around this location (MoDNR, 2023). MDC has records of gray bats within one mile of the study area (see Appendix F), and some gray bats may visit the study area during their nightly foraging.

The northern long-eared bat was listed as a threatened species in 2015 and then reclassified as an endangered species in 2023 due to declines mostly associated with white-nose syndrome. The bats spend winter hibernating in caves and mines. During the summer, the bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live trees and snags. Males and non-reproductive females may also roost in cooler places, like caves and mines. Like other listed bat species, northern long-eared bats have experienced a population decline resulting from white-nose syndrome and human disturbance (USFWS, 2023e). Site visits by USACE biologists confirmed the presence of multiple living and dead trees with the sufficient size (three inches diameter at breast height or greater) and characteristics (exfoliating bark, crevasses, etc.) to make them suitable for summer roosting by northern long-eared bat.

In the spring, Indiana bats emerge from hibernation and migrate to summer roost sites. During the summer months, female Indiana bats establish maternity colonies of up to 100 bats under the loose bark of trees and in tree cavities. Loss and fragmentation of forest habitat are among the major threats to Indiana bat populations. Other threats include white-nose syndrome, winter disturbance, and environmental contaminants (USFWS, 2022c). While there are no known Indiana bat roosts within the study area or its immediate vicinity, some trees within the study area have characteristics that make them suitable for roosting.

During the spring, summer and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves. During the winter, tricolored bats are found in caves and mines. White-nose syndrome has led to 90 to 100% declines in tricolored bat winter colony abundance at sites impacted by the disease (USFWS, 2022g). Other threats to this species include collisions with wind-energy turbines and habitat loss. Some trees within the study area may provide suitable roosting for this species.

Monarch butterfly is a migratory insect that depends on milkweed plants for reproduction (USFWS, 2023d). This species may use fields, roadside areas, wetlands, urban gardens, or any other areas with milkweed plants as habitat. Because the study area has ample open (i.e., not forested) land likely suitable for milkweed, monarch butterfly is likely present. However, monarch butterfly is currently listed as a candidate species under the Endangered Species Act (ESA) and thus does not receive formal protection under this law.

The western regal fritillary is a large, non-migratory butterfly subspecies that specializes on grassland habitats (USFWS, 2024). Larvae overwinter in nearby grassland vegetation before emerging in early spring to search for violets (Viola spp.), which is their only food source at this life stage. Adults can drink nectar from a variety of sources. This insect depends on large, well-connected, and diverse grasslands, and is threatened by habitat fragmentation due to development, herbicides, and invasive species.

No federally designated critical habitat is identified within the study area.

State Listed Species

In 1972, the Missouri General Assembly passed an Act (Section 252.240 RSMo.) charging the MDC with establishing a list of endangered species and providing protection for them. USACE coordinates with MDC through the Missouri Natural Heritage Program (MONHP) to identify species and natural communities of conservation concern near areas of interest, such as the study area. State listed species with records near these areas are listed in **Table 6** and described below. Records of state ranked species are provided in Appendix F.

Table 6 State-listed Species Identified within the Study Area

Taxa	Scientific Name	Common Name	State Status
Fish	*Acipenser fulvescens*	Lake sturgeon	Endangered

Taxa	Scientific Name	Common Name	State Status
Fish	*Platygobio gracilis*	Flathead chub	Endangered

In the absence of a flood risk management project, the presence and condition of listed species within the study area would not be expected to change.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act (BGEPA). The USACE used the USFWS IPaC website to determine which species protected by these regulations may be present within the study area. These are listed in **Table 7**. The 1988 amendment to the Fish and Wildlife Conservation Act mandates the USFWS to identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA. Pursuant to this effort, some migratory birds have been identified as Birds of Conservation Concern (BCC). This BCC status may be applicable across a species' entire range or only applicable in particular Bird Conservation Regions.

Table *7* Migratory Birds Potentially Present within Study Area

Common Name	Scientific Name	Birds of Conservation Concern (BCC) Status	Breeding Season within Study Area
Grasshopper Sparrow	*Ammodramus savannarum perpallidus*	BCC – Bird Conservation Region	June through August
Eastern Whip-poor-will	*Antrostomus vociferus*	BCC range-wide	May through August
Golden Eagle	*Aquila chrysaetos*	Not BCC in this area, but subject to BGEPA	Breeding not known within study area.
Semipalmated Sandpiper	*Calidris pusilla*	BCC – Bird Conservation Region	Breeding not known within study area.
Henslow's Sparrow	*Centronyx henslowii*	BCC range-wide	May through August
Chimney Swift	*Chaetura pelagica*	BCC range-wide	March through August
Black-billed Cuckoo	*Coccyzus erythropthalmus*	BCC range-wide	May through October
Bobolink	*Dolichonyx oryzivorus*	BCC range-wide	May through July
Rusty Blackbird	*Euphagus carolinus*	BCC – Bird Conservation Region	Breeding not known within study area.
Kentucky Warbler	*Geothlypis formosa*	BCC range-wide	April through August
Bald Eagle	*Haliaeetus leucocephalus*	Not BCC in this area, but subject to BGEPA	September through July
Wood Thrush	*Hylocichla mustelina*	BCC range-wide	May through August
Red-headed Woodpecker	*Melanerpes erythrocephalus*	BCC range-wide	May through September
Prothonotary Warbler	*Protonotaria citrea*	BCC range-wide	April through July
Cerulean Warbler	*Setophaga cerulea*	BCC range-wide	April through July

Common Name	Scientific Name	Birds of Conservation Concern (BCC) Status	Breeding Season within Study Area
Prairie Warbler	*Setophaga discolor*	BCC range-wide	May through July
Field Sparrow	*Spizella pusilla*	BCC – Bird Conservation Region	March through August
Least Tern	*Sternula antillarum antillarum*	BCC range-wide	April through September
Lesser Yellowlegs	*Tringa flavipes*	BCC range-wide	Breeding not known within study area.

Bald eagles were historically in danger of extinction throughout most of their range (USFWS, 2023a). This was due to a variety of factors, such as habitat destruction or degradation, illegal shooting, and contamination of their food source by the insecticide Dichlorodiphenyltrichloroethane, commonly known as DDT. The species was listed as endangered in most states under the ESA in 1978 and, thanks to the protections afforded by this law and other environmental regulations, the bald eagle population recovered. While bald eagles were delisted under the ESA in 2007, the species is still protected by the MBTA and the BGEPA. Both laws prohibit killing, selling, or otherwise harming eagles, their nests, or their eggs. A bald eagle nest has been identified within the vicinity of the Church Farm Conservation Area (see Appendix F). In the absence of a flood risk management project, the presence and condition of migratory birds within the study area would not be expected to change.

2.4 PHYSICAL ENVIRONMENT

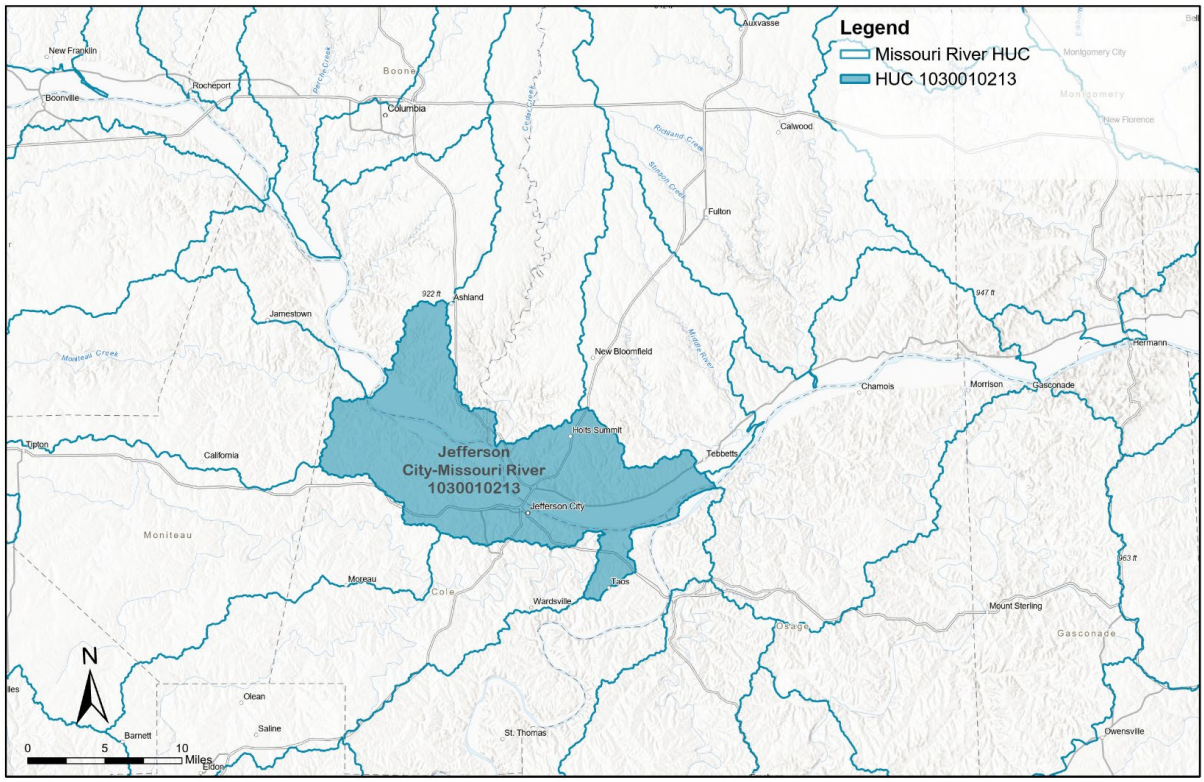
Hydrology and Hydraulics

Flooding on the left-bank of the Missouri River through Jefferson City is driven by Missouri River events. These events originate upstream of the study site, typically with ample predicted warning of a predicted Missouri River flood condition, due to the numerous large tributaries well upstream of the site. The Missouri River floodplain through Jefferson City is uniquely situated where limestone bluffs parallel the channel overbanks, binding the floodplain to a consistent footprint for most flood conditions once overtopping low-lying levees, with depths increasing as flows increase.

Hydrologic Analysis

The drainage area of the Missouri River at Jefferson City is approximately 507,500 square miles. The immediate study area is located within the Hydrologic Unit Code 10 (HUC-10) Jefferson City - Missouri River watershed 1030010213, outlined in **Figure 7**. The Missouri River watershed above Jefferson City is generally rural and used for agriculture. The Missouri River overbank through central Missouri is protected by locally constructed and operated agricultural levees. The Moreau River and Osage River confluences with the Missouri River are six and fourteen miles downstream of the Jefferson City United States Geological Survey (USGS) gage, respectively. The Osage River is regulated by multiple mainstem dams including Bagnell Dam, privately owned by Ameren, and the Harry S. Truman Dam, a USACE operated structure utilized for flood control.

Figure 7 Jefferson City - Missouri River Watershed (HUC 1030010213)



Primary data sources for the hydrologic analysis include observed gage data and developed period of records. The hydrologic inflow data used in the hydraulic model was developed from the Missouri River Flow Frequency Study (MRFFS 2023). The Missouri River Flow Frequency Study did not include Jefferson City as a calculated gage location, however the upstream and downstream hydraulic model boundaries at Boonville and Hermann were included. Peak regulated frequency flows for events spanning 99% to 0.2% annual exceedance probabilities (AEP) were adopted as target flows for the Boonville and Hermann gage locations. Jefferson City target flows, as summarized in **Table 8,** were developed by scaling the flows using factors informed by ratio targets of the 2003 flow frequency hydraulic routing and major tributary frequency flows.

Table 8 Summary of MRFFS Target Flows and Derived Jefferson City Flow Frequencies

AEP (%)	Boonville (MRFFS 2023 Flow) (cfs)	Jefferson City Feasibility Study Flow Target (cfs)	Hermann (MRFFS 2023 Flow) (cfs)
0.2	731,000	748,000	933,000
0.5	672,000	689,000	722,000
1	572,000	588,000	666,000
2	531,000	546,000	571,000
4	417,000	431,000	506,000
10	334,000	346,000	416,000

AEP (%)	Boonville (MRFFS 2023 Flow) (cfs)	Jefferson City Feasibility Study Flow Target (cfs)	Hermann (MRFFS 2023 Flow) (cfs)
20	280,000	290,000	345,000
50	204,000	212,000	262,000
99	78,000	81,000	100,000

The Missouri River is the source of flooding for the existing Capital View Drainage District. The targeted peak flow frequencies were utilized to create input hydrographs for the hydraulic model. Input hydrographs were developed by scaling 2018 flood hydrographs. The mainstem hydrograph included the Boonville gage, and tributary hydrographs were scaled to best meet frequency flow targets. As each storm is different, tributary scaling factors were assessed for feasibility by comparing peak flows to a range of historical storm events. A detailed summary of hydrologic considerations for this site are in Appendix A1 (Hydrology and Hydraulics).

Hydraulic Model

The modeled area for this study includes the Missouri River from Boonville to Hermann, spanning river miles 197 to 98, through central Missouri. The existing conditions and FWOP models are equivalent, with no watershed land use changes or terrain features within the area of alternative comparison anticipated to be substantially modified within the study timeframe. The hydraulic analysis was performed to estimate depth, durations, and velocities of flow frequency events routed through the study area. A total of eight recurrence intervals were modeled for the HEC-FDA analysis of each alternative and FWOP condition.

Hydraulic modeling was performed using HEC-RAS Version 6.4.1. Two reference models, including the 2022 CWMS model and Lower Missouri River System Plan draft model, were utilized to construct the greater Missouri River routing for the Jefferson City feasibility study. Additional refinements to the Jefferson City left bank were incorporated into a 2D flow area to accurately depict updated data for the project area and create a terrain for the existing Capital View levee and adjacent left bank levees with a smaller terrain grid sample. Hydrologic inputs included an upstream boundary condition at the Boonville gage and three major tributaries (Gasconade, Moreau, and Osage Rivers) as well as lateral inflows along the Missouri River mainstem to account for watershed runoff independent of major tributaries. For the feasibility-level of study, calibration of the hydraulic model prioritized routing peak flows and resulting conservative maximum water surface elevations through Jefferson City. Additional information regarding the development of the HEC-RAS model is included in Appendix A1 (Hydrology and Hydraulics).

Geology and Soils

This project is located within the alluvial valley of the Missouri River. The study area is relatively flat with elevations that range between 535 and 570 feet NAVD88. The Missouri River Valley at the site of the study area is filled with alluvial deposits generally consisting of coarser sands and gravels overlaid by finer silts and clays. The 1999 GRR states that the finer soils, also referred to as the blanket, range in thickness between 5 and 15 feet. Below the blanket is highly permeable sand and gravel with a thickness that varies between 75 and 80 feet. Below the sand and gravel is dolomite bedrock of the Roubidoux or Gasconade Formation. Additional soil details can be found in Appendix A3.

The USACE used the Natural Resource Conservation Service's (NRCS) Web Soil Survey website to help identify the presence of hydric or prime farmland soils. This NRCS soil data is summarized below in **Table 9**. The L-142 Area and Church Farm Conservation Area exhibit very similar soils and share several kinds of soil series between them. Because both areas are located within the Missouri River floodplain, soils in these areas are very deep, relatively flat, and were formed in Missouri River alluvium. Many of these soils

are also well suited for agriculture, though often need protection from flooding to fully achieve this use. Both areas exhibit soils that vary considerably in terms of their hydric qualities.

Table 9 Major Soil Associations within the Study Area

Soil Series	Slope	Hydric?	L-142 Presence	CFCA Presence	Description
Lowmo	0–2%	No	Commonly Present	Commonly Present	Very deep, well drained soils formed in Missouri River alluvium. Occurs on floodplains. These soils are prime farmland.
SansDessein	0–2%	Yes	Commonly Present	Commonly Present	Very deep, poorly drained soils formed in alluvium. Occur on floodplains and floodplain steps of the Missouri River. These soils are prime farmland if drained, though are not considered prime farmland when flooded frequently.
Booker	0–2%	Yes	Commonly Present	Absent	Very deep, poorly to very poorly drained, very slowly permeable soils formed in clayey alluvium on floodplains or clayey lacustrine sediments on glacial lake plains. These soils are not prime farmland.
Blencoe	0–2%	No	Commonly Present	Commonly Present	Very deep, somewhat poorly drained soils on floodplains and floodplain steps. Formed in 51 to 102 centimeters of clayey alluvium and underlying loamy alluvium. These soils are prime farmland if drained.
Peers	0-2%	No	Absent	Commonly Present	Very deep, somewhat poorly drained soils formed in Missouri River alluvium. Occur on floodplains and floodplain steps. These soils are prime farmland.
Haynie	0-2%	Yes	Absent	Commonly Present	Very deep, moderately well drained soils on floodplains. Formed in calcareous alluvium. These soils are not prime farmland.

In the absence of a flood risk management project, the geology within the study area would not change substantially. However, continued flooding of the study area would result in continued deposition and erosion of soils under the FWOP condition.

Climate

The climate of the study area is typical for Missouri: summers are generally warm and humid, and winters are relatively mild. Missouri's location in the interior of North America and the lack of mountain barriers to the north and south expose the state to incursions of cold arctic air masses in the winter and warm, moist air masses from the Gulf of Mexico in the summer (Frankson et al., 2022). Due to the interaction of these two kinds of air masses, severe thunderstorms are common in Missouri. Precipitation in the study area is generally greatest in spring and summer.

The climate change assessment conducted for this study assessed historic hydrometeorological data and projected future hydrometeorological data to gain insight on the projection of future risk at this site. The main climatic risk factor for the L-142 levee is increased Missouri River streamflows, especially during flood-prone seasons including spring and early summer.

Available literature suggests observed warming trends in the Lower Missouri River Basin are projected to carry into the future. Additionally, precipitation and streamflow models suggest upward trends, but with no substantial developed consensus across sources. Generally, precipitation increases are most anticipated in the spring months and late winter.

Evaluations of future extreme precipitation and streamflow generated using the Climate Hydrology Assessment Tool (CHAT) suggest future increases in both 3-day maximum precipitation and annual maximum mean monthly precipitation when Representative Concentration Pathway (RCP) 8.5 is assumed, with the most robust evidence of increased monthly mean streamflow in the end-of-century (2070 – 2099) epoch. This is supported by the likely increases in spring precipitation and runoff. The Vulnerability Assessment (VA) Tool indicates that flood magnification drives the vulnerability score for the Lower Missouri River watershed (HUC 1030). Relative to the rest of the country, flood vulnerability in the Lower Missouri Basin is particularly impacted by climate change.

Table 11 indicates potential residual risks for flood risk management project features due to climate change. The table also includes a qualitative rating of how likely those residual risks are to materialize and undermine project features resulting in adverse effects to the study area. Examples of building resilience into flood risk management project features includes designing top elevations of levees to protect against extreme events, providing designed overtopping at predetermined locations to reduce the risk of uncontrolled failures, and robust erosion protection designs.

Table 10: Residual Risk due to Climate Change

Project Feature	Trigger	Hazard	Harm	Qualitative Likelihood
Levees & Berms	Increased seasonal precipitation	Future flows may be larger than present. Large flood volumes may occur more frequently.	Levees could overtop more frequently or be loaded for longer durations, resulting in increased flood-fighting and O&M costs.	Likely
Internal Drainage	Increased seasonal precipitation	Increased flows behind the leveed area. Longer drawn down times along the Missouri River.	Flow volume internal to the leveed area could increase, requiring additional pumps or an extended time to relieve. Longer river draw down times could result in longer internal drainage ponding conditions.	Likely
Riprap Bank Stabilization	Increased seasonal precipitation	Future flows may be larger than present. Large flood volumes may occur more frequently.	Higher flows and velocities would result in increased O&M costs.	Likely
Floodproofing measures	Increased seasonal precipitation	Future flows may be larger than present. Large flood volumes may occur more frequently.	Floodproofing measures could overtop during more frequent storm events, leading to additional repair costs.	Likely

Climate change forecasts indicate the potential for larger and more frequent storms which would exacerbate flooding in the future. However, projected changes in flows are assumed to be gradual and to occur within the uncertainty of existing flow frequencies. As a result, flow frequencies were assumed to be stationary. More frequent extremes in drought conditions are also expected for the study area. Additional information regarding climate change patterns for the Lower Missouri River Basin can be found in Appendix A2.

Cultural Resources

The Lower Missouri River floodplain has potential to hold cultural resources dating from historic times back at least 12,000 years. Cultural resources include but are not limited to pre- and post-contact archeological sites (habitation sites, human burial sites, farmsteads, resource processing areas, and shipwrecks) buildings, bridges, landscapes, and trails. A desktop review of cultural resources was conducted for the Jefferson City L-142 Study area. This review consisted of an examination of the records in the MoDNR online archeology database, the National Register of Historic Places (NRHP) database, and USACE records.

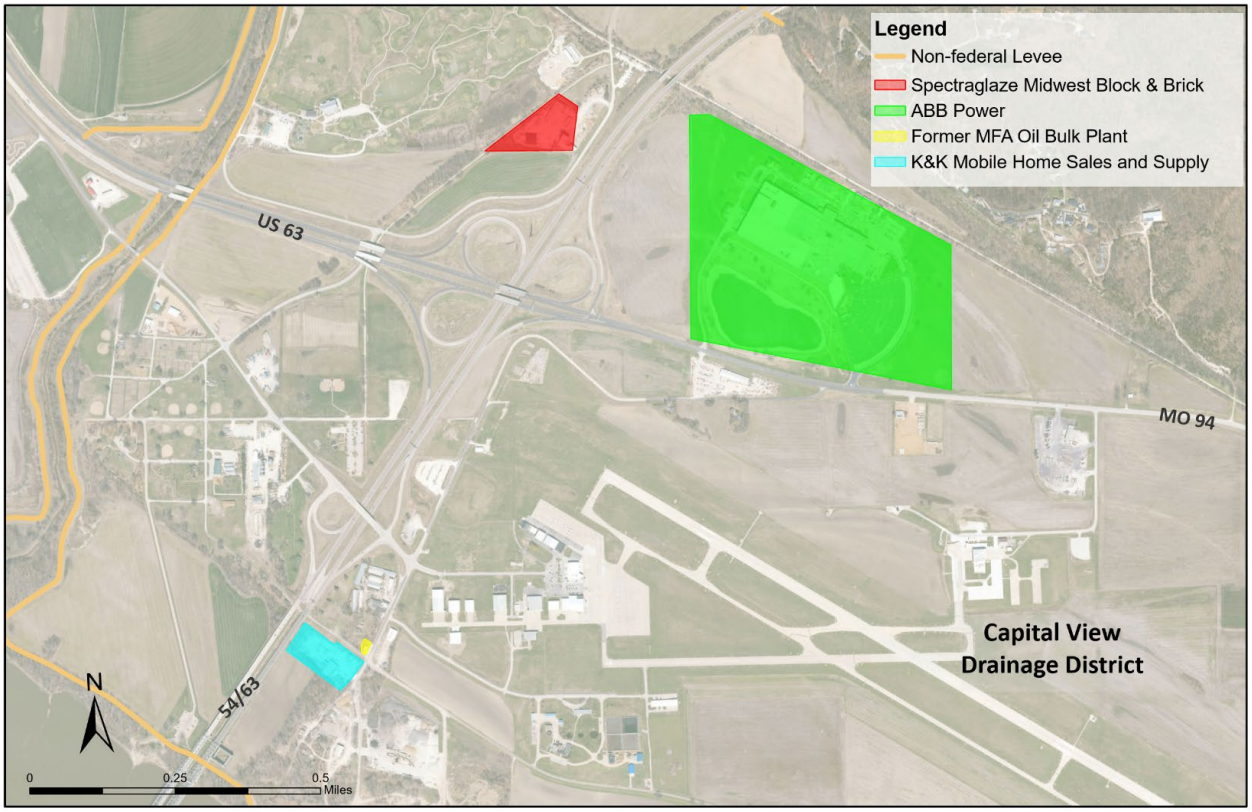
The review found no sites listed on or determined eligible for listing on the National Register of Historic Places. A patchwork of archeological surveys is recorded in the study area with most conducted within the floodplain. These surveys are of varying size and associated with actions requiring compliance with the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470). The surveys would need to be reviewed on a case-by-case basis to determine whether they meet modern standards to identify historic properties.

A total of 17 recorded cultural sites are mapped within or on the edge of the study area. Twelve of the sites are precontact Native American sites; two of these sites recorded in the Missouri River floodplain and the remaining 10 precontact sites are located on the bluff edge immediately adjacent to the floodplain or on terraces of tributary streams near where these streams enter the floodplain. Six of the sites were recorded in the 1960's as Native American burial mounds or cairns along the bluff edge. The records and maps of these locations are rough and can only be considered approximate locations. The two prehistoric sites in the flood plain were recorded as habitation sites. Five historic post American settlement sites are recorded in the floodplain; two are habitation sites, two are mapped shipwreck locations, and one is a cemetery. The locations of the shipwrecks are based on captains' logs and have not been field confirmed. The cemetery was damaged by 1993 flooding and human remains were exposed. The NRHP eligibility for all seventeen sites is either unreported or undetermined.

Hazardous, Toxic, and Radioactive Waste

USACE performed a Hazardous, Toxic, and Radioactive Waste (HTRW) assessment to determine the environmental conditions of the study area. The assessment identifies potential hazards via soil, surface water, and groundwater contaminant pathway interactions that may occur during project implementation. This assessment identified four sites within the study area that may be contaminated with HTRW materials (see **Figure *8***). Any proposed construction should avoid these locations if possible. The full HTRW assessment is available in Appendix C2. HTRW contamination is not known within the Church Farm Conservation Area.

Figure 8 Locations of Potential HTRW Concern



The assessment identified eighteen contaminations or potential contaminations located at seventeen properties. Of these properties, fourteen are not expected to have resulted in potential HTRW hazards. This is due to No Further Action Letters being issued at these locations or because the nature of the potential contaminations does not indicate substantial likelihood of HTRW hazards (e.g., the presence of underground storage tanks with no known releases to the environment). Potential to encounter contaminated soils at these locations is limited.

The former Spectraglaze facility was an operation where glazing was applied to concrete blocks for use in architectural landscaping applications. Heat from a fire at the plant in 1999 caused a release of trichloroethene into the soil on the south side of the plant. While remedial action was taken, the chlorinated solvents were not adequately addressed. There is currently a prohibition of the use of groundwater and drilling at the site. Potential HTRW hazards are expected at the site.

The ABB Power site was found to have at least one storage tank that leaked a petroleum substance sometime around 1990. The incident had been closed by the Missouri Department of Natural Resources (MoDNR) tanks section with a No Further Action Letter, but that letter was rescinded as contamination was found in 2000 after sampling the area. The site contamination is likely being addressed by another program such as the Hazardous Waste Program or the Water Pollution Control Program. Potential HTRW hazards are expected at the site.

A petroleum or hazardous substance storage tank or regulated release at the Former MFA Oil Bulk Plant was addressed under the MRBCA Guidance for Petroleum Storage Tanks. Evaluation of environmental media found that concentrations of any remaining contaminants, if present, do not pose an unacceptable risk to human health or the environment provided that Activity and Use Limitations applied to this property

remain in place. These limitations require that this site must remain non-residential with no domestic consumption of drinking water.

A petroleum or hazardous substance release at the K & K Mobile Home Sales and Supply site is currently being addressed under the MRBCA Guidance for Petroleum Storage Tanks. While information regarding this facility was limited during the HTRW assessment's records review, there is a potential for HTRW hazards at this site.

In the absence of a flood risk management project, the presence and condition of HTRW materials within the study area would not be expected to change under the FWOP condition.

2.5 BUILT ENVIRONMENT

The built environment of the L-142 area includes a number of noteworthy developments. This includes the Capital View levee, which is an 8.8-mile-long non-federal levee that reduces flood risk to approximately 3,300 acres. This levee was overtopped by floods in 1993, 1995, and 2019. The L-142 area also includes important transportation infrastructure. The Jefferson City Memorial Airport is one of the busiest airports in Missouri, has more than 60 based aircraft, and is home to several corporate and state government flight departments (Jefferson City, 2023). The most noteworthy roadways in the L-142 area are U.S. Highway 63 and U.S. Highway 54, which cross the Missouri River over a bridge into the rest of Jefferson City. This bridge is highly important to local traffic, as the next closest bridges across the Missouri River are the Interstate 70 bridge approximately 32.5 miles northwest and the Missouri Route 19 bridge approximately 41 miles northeast.

Many of the developments in the built environment are important local employers. In addition to the airport, economic developments include the Hitachi Energy manufacturing plant, Capital Sand quarry, wastewater treatment plant, and a number of other businesses. The L-142 area also includes some noteworthy recreational developments, though primarily on the western end. Such developments include a golf course, event center, community garden, ball fields, dog park, and Missouri River boat ramp. There is also a trailhead for the Katy Trail on the northern side of the L-142 area.

The built environment of the Church Farm Conservation Area is considerably less developed. The primary feature located there is the Prison Farm levee, which is a 3.8-mile-long earthen levee that reduces flood risk to approximately 998 acres. This location is primarily developed for row crop agriculture.

The USACE is unaware of any current proposals that would substantially alter the built environment of the study area. Activities in the study area that would impact the built environment generally appear to be limited to maintenance activities and modifications to already existing infrastructure. The Jefferson City Memorial Airport Master Plan makes a number of recommendations regarding the facility. These recommendations include the partial relocation of one runway; the extension and widening of another runway; the expansion of the terminal area with box/corporate hangars; improvements to perimeter fencing, the gate, and overall security; and a new location for the air traffic control tower.

The Missouri Department of Transportation (MODOT) has a number of planned or ongoing projects in and around the L-142 area, such as pavement resurfacing, guardrail replacement, bridge maintenance and rehabilitation, and highway widening. Such actions are typical for roadway maintenance, and it can be safely assumed that activities such as these would occur throughout the period of analysis. Overall, the FWOP conditions of the built environment are likely very similar to the existing conditions.

2.6 SOCIOECONOMIC ENVIRONMENT

According to the Implementation Guidance for Section 160 of the WRDA of 2020, communities are identified as Justice40 communities for the purposes of the WRDA and all amendments made by the act by meeting one or more of the following criteria:

a) The area has a per capita income of 80% or less of the national average.

b) The area has an unemployment rate that is, for the most recent 24-month period for which data

are available, at least 1 percent greater than the national average unemployment rate.

c) The area is Indian country as defined in 18 U.S.C. 1151 or in the proximity of an Alaska Native Village.

d) The area is a U.S. territory.

e) The area contains one or more communities identified as disadvantaged by the Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST) (https://screeningtool.geoplatform.gov).

With regards to criteria (a) above, the community within the project area is considered a Justice40 community due to its per capita income being less than 75% of the national average.

Additionally, there are two census tracts within one mile of the L-142 area (US Census tracts 29051020700 and 29051010600) on the other side of the Missouri River that are Justice40 communities because they are identified as disadvantaged by the CEJST tool. **Table 11** below describes the specific disadvantages that have been identified for these tracts.

Table 11 Climate and Economic Justice Screening Tool Results

Category	Disadvantage	Description	Number of Tracts
Climate Change	Expected population loss rate	Fatalities and injuries resulting from natural hazards each year	2
Energy	Energy cost	Average annual energy costs divided by household income	1
Health	Asthma	Share of people who have been told they have asthma	1
Health	Low life expectancy	Average number of years a person can expect to live	2
Housing	Lack of indoor plumbing	Share of homes without indoor kitchens or plumbing	1
Workforce Development	Low median income	Comparison of median income in the tract to median incomes in the area	1
Workforce Development	Poverty	Share of people in households where income is at or below 100% of the federal poverty level	1

The USEPA EJScreen tool was used to evaluate the demographics for the community within one mile of the L-142 area. **Table 12** shows the demographic indicators for this area ("Value" column), and how those indicators compare to the state and national averages.

Table 12 Socioeconomic Indicators of the Community within One Mile of the Study Area

Socioeconomic Indicators	Value	State Average	Percentile in State	USA Average	Percentile in USA
Demographic Index	31%	28%	67	35%	53
Supplemental Demographic Index	15%	14%	59	14%	59
People of Color	24%	23%	69	39%	43
Low Income	38%	33%	62	31%	67

Socioeconomic Indicators	Value	State Average	Percentile in State	USA Average	Percentile in USA
Unemployment Rate	4%	5%	63	6%	54
Limited English-Speaking Households	0%	1%	0	5%	0
Less Than High School Education	9%	10%	54	12%	53
Under Age 5	5%	6%	51	6%	54
Over Age 64	14%	18%	40	17%	45
Low Life Expectancy	22%	21%	61	20%	74

The percentage of low income and low life expectancy populations in the community around the L-142 area is higher than that the state and national averages, and the percentage of people of color is higher than the state average. However, the socioeconomic indicators for this community are all around or below the state and national medians.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs federal agencies to identify and address, as appropriate, disproportionately high, and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. When conducting NEPA evaluations, the USACE incorporates Environmental Justice (EJ) considerations into both the technical analyses and the public involvement in accordance with the USEPA and the Council on Environmental Quality guidance (CEQ, 1997). The CEQ guidance defines “minority” as individual(s) who are members of the following population groups: American Indian or Alaskan native, Asian or Pacific Islander, Black, not of Hispanic origin, and Hispanic. The Council defines these groups as minority populations when either the minority population of the affected area exceeds 50-percent of the total population, or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis.

Table 13 shows how EJ indexes for the community around the L-142 area compare to the State of Missouri and the United States. Each EJ index shown in this table uses environmental and demographic data to represent how low-income populations and people of color populations in and around the L-142 area are impacted by various sources of pollution. The supplemental indexes are similar, but also include data on linguistically isolated populations, population with less than a high school education, unemployed population, population with low life expectancy. The higher the value shown, the more impacted these communities are by a given source of pollution. These values are given as percentiles in order to put them in a clearer context at the state and national levels. For example, values lower than 50 indicate that low-income populations and people of color populations in that area are less impacted by that particular source of pollution than they are in most other places in the state or country. Values higher than 50 indicate that these communities are more impacted by that particular source of pollution in that area compared to the rest of the state or country. Because the 50th percentile represents the median, half of all areas in the state or country will have a percentile value higher than 50 even if the impact in most of those places is still minor in absolute terms. The data indicate that the EJ indexes for toxic releases to air and lead paint are notably above the state and national medians. EJ indexes for air toxics respiratory hazard index, traffic proximity, hazardous waste proximity, and underground storage tanks are notably above the state medians. At this time, the USACE does not anticipate any substantial changes to these existing socioeconomic FWOP conditions within the period of analysis.

Table 13 Comparison of Percentile Ranks for Various Environmental Justice Indexes for the Community within One Mile of the Study Area among Missouri and the USA

Selected Variable	State Percentile	Supplemental State Percentile	USA Percentile	Supplemental USA Percentile
EJ Index for Particulate Matter 2.5	54	47	48	48
EJ Index for Ozone	12	7	16	12
EJ Index for Diesel Particulate Matter	70	68	62	68
EJ Index for Air Toxics Cancer Risk	72	69	66	68
EJ Index for Air Toxics Respiratory Hazard Index	79	76	62	66
EJ Index for Toxic Releases to Air	82	86	80	86
EJ Index for Traffic Proximity	76	77	64	70
EJ Index for Lead Paint	81	79	76	79
EJ Index for Superfund Proximity	44	32	30	27
EJ Index for RMP Facility Proximity	45	37	35	35
EJ Index for Hazardous Waste Proximity	75	77	66	73
EJ Index for Underground Storage Tanks	75	74	65	69
EJ Index for Wastewater Discharge	63	56	61	65

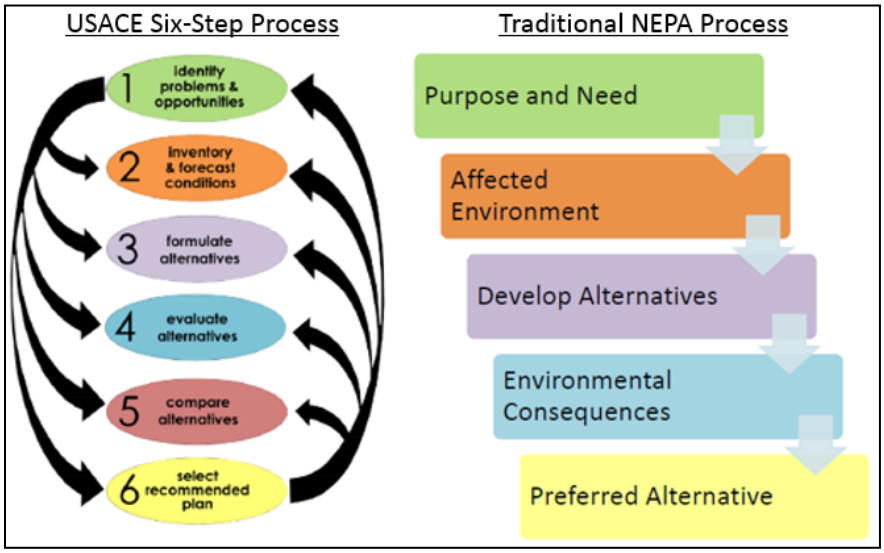
3.0 Plan Formulation and Evaluation

3.1 PLANNING FRAMEWORK

The USACE uses a six-step planning process to guide project studies, as detailed in Engineer Regulation (ER) 1105-2-103 "Policy for Conducting Civil Works Planning Studies." This process is a structured approach to problem solving which provides a rational framework for federal project decision making. The six steps are outlined in **Figure 9**:

1. Specify water and related land resource problems and opportunities (relevant to the planning setting) associated with the federal objective and specific state and local concerns.
2. Inventory, forecast, and analyze water and related land resource conditions within the planning area relevant to the identified problems and opportunities.
3. Formulate alternative plans.
4. Evaluate effects of the alternative plans.
5. Compare alternative plans.
6. Select recommended plan based upon the comparison of alternative plans.

Figure 9 USACE Six-Step Process



Plan formulation is the process of evaluating existing conditions and building alternative plans that meet planning objectives and avoid planning constraints. This study examines and addresses the federal criteria of completeness, efficiency, effectiveness, and acceptability. To adequately address these criteria, the development and early screening of potential alternatives considered a number of evaluation factors. Primary among those factors are the following:

- Engineering and flood risk management adequacy (effectiveness/completeness)
- Ability to contribute to meeting the planning objectives (effectiveness/completeness)
- Consistency with planning constraints and authorities
- Acceptability (includes law and policy, sponsor, environmental, cultural and public aspects)
- Early cost indicators (early efficiency indicators for screening purposes)

- Construction site constraints and real estate requirements (topography, location conflicts, adjacent development, etc.)

The guidance for conducting civil works planning studies, ER 1105-2-103, Policy for Conducting Civil Works Planning Studies, requires the systematic formulation of alternative plans that contribute to the federal objective. To ensure sound decisions are made with respect to development of alternatives and ultimately with respect to plan selection, the plan formulation process requires a systematic and repeatable approach. This chapter presents the results of the plan formulation process for the Jefferson City Feasibility Study. Alternatives were developed in consideration of study area problems and opportunities as well as study objectives and constraints. Measures and alternatives were evaluated against the four Principles and Guidelines evaluation criteria: completeness, effectiveness, efficiency, and acceptability.

Alternative plans are a set of one or more flood risk management measures functioning together to address one or more planning objectives. A measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Throughout this study, iterations of alternative plans throughout the watershed have been performed, outlined later in section 3.4.

Economic and Environmental Principals (Principals & Guidelines colloquially “P&Gs”) for Water and Related Land Resources Implementation Studies were established pursuant to the Water Resources Planning Act of 1965 (PL 89-80), as amended (42 U.S.C. 1962a-2 and d-1) with the intent to ensure consistent planning by federal agencies for plan formulation. In accordance with the P&Gs, four accounts were established to facilitate evaluation and display of impact from alternative plans. The four accounts are 1) National Economic Development (NED); 2) Environmental Quality (EQ); 3) Regional Economic Development (RED); and 4) Other Social Effects (OSE).

The NED displays changes in economic value of national output of goods and services while the EQ displays non-monetary effects on significant natural and cultural resources. The RED account notes change in distribution of regional economic activity and OSE registers plan effects from perspectives relevant to plan formulation, but not reflected in the other three accounts. The four accounts were considered during alternative formulation and ultimately selection of the TSP. Together, the four accounts assess the comprehensive benefits of proposed alternatives within the study area.

3.2 ASSUMPTIONS

Key assumptions for this study include:

- The study area is expected to remain at risk of recurring and devastating flooding and subject to similar flood related effects.
- Land use within the study area is not anticipated to change substantially over the next 50 years. Even with a new federal levee, there is no local interest in gaining accreditation through FEMA.
- Other non-federal levees adjacent to the study area will remain in place at current levels of performance.
- Climate change forecasts indicate the potential for larger and more frequent storms which would exacerbate flooding in the future. However, projected changes in flows are assumed to be gradual and to occur within the uncertainty of existing flow frequencies. As a result, flow frequencies were assumed to be stationary. More frequent extremes in drought conditions are also expected for the study area.

3.3 MANAGEMENT MEASURES

Measures are the building blocks of alternatives. Structural and nonstructural measures were considered, consistent with USACE planning guidance. USACE held an initial site visit on 9 March 2023 with local sponsors and stakeholders. An initial planning charette was held with the PDT, local sponsor, and

stakeholders on 3 May 2023. During the charette, an initial list of measures was identified for consideration in development of plan alternatives. In total, the PDT and local partners developed 37 initial management measures for consideration. These measures were then organized into seven Alternative Themes (not including the No Action Alternative): Nonstructural, Natural & Nature Based, Channel Modification, Infrastructure Improvement, Improved Resiliency, Existing Levee Modifications, and New Structural Measures. The alternative themes were developed to help the PDT think about various ways to combine measures to solve the identified problems in the study area.

Nonstructural measures considered included floodproofing (i.e. modifying structures), buy-outs/relocations, and a flood warning system. Structural measures considered included levee setbacks, detention basins, raising critical infrastructure, and modification to the U.S. Highway 54/63 bridge piers. Resiliency improvements included levee reinforcement, designated overtopping, designated breach locations, reverse loading design, seepage berms, and stability berms. Environmental enhancements such as wetlands could be stand alone or included with off-channel detention measures to provide nature-based solutions that reduce flood risk and restore the environment. While measures can be “stand alone” alternatives, most plan alternatives included a combination of measures. These measures were presented at the Alternatives Milestone Meeting (AMM) held on 5 June 2023.

Measure Theme 1 – No Action

- Required plan, provides baseline condition.

Measure Theme 2 – Nonstructural Measures

- Floodproofing: dry floodproofing by adding an exterior protective barrier around specific structures, and wet floodproofing by renovating to remove expensive utilities or equipment from flood-prone areas and allowing flood waters to pass through without causing structural damage.
- Elevating: elevating structures where they are built so they receive less damage from water inundation.
- Buyouts/Relocation: buying structures or moving structures to new locations.
- Flood Warning System: flood sensors/gages and warning devices incorporated into existing local planning framework to boost effectiveness of flood warnings and evacuations.

Measure Theme 3 – Natural & Nature Based Solutions

- Levee Setback: install setback levees and allow some areas to flood to increase floodplain capacity and connectivity.
- Detention Basins and Wetland Restoration: restoration or creation of wetlands to serve as temporary storage of excess water volume.

Measure Theme 4 – Channel Modifications

- In-stream Retention: Mainstem Missouri River reservoir, stays in channel.
- Deepening of Missouri River Channel: one-time deepening of river channel to allow for more flow.
- Widening of Missouri River Channel: cutting back riverbanks to allow for more flow.
- Dredging of Missouri River Channel and use of dredged material: ongoing dredging operation to deepen channel to allow for more flow.

Measure Theme 5 – Infrastructure Improvements

- Raise Critical Infrastructure: increase access to critical facilities during flood events and raise critical infrastructure including, but not limited to, public utilities and critical material suppliers.
- Submersible Pumps: pumps for moving interior water past a flood barrier, which operate when inundated.
- US Highway 54/63 Bridge Pier Modification: increase conveyance of water through narrow point created by the bridge infrastructure.

Measure Theme 6 – Resiliency Improvements

- Reinforce levee: provide additional reinforcement through riprap and other means in areas where erosion may be an issue.
- Designated Overtopping: managed overtopping in order for areas to fill more slowly and within predictable inundation limits in the event of a flood.
- Designated Breach Locations: managed breach locations to aid in predictability of inundation in the event of a flood.
- Reverse Loading Design: engineered levee system to withstand riverward and landward loading of flood water.
- Add Seepage Berms: additional reinforcement to control underseepage.
- Add Stability Berms: additional reinforcement to prevent stability issues such as sloughing and failure during a flood event.

Measure Theme 7 – Existing Levee Modifications

- Raise Existing (Capital View) Levee: provide a higher level of risk reduction from over-topping by increasing the height of the existing levee.
- Setback Existing (Capital View) Levee: setback existing levee to allow for additional conveyance riverward of the levee and less frequent inundation of the levee toe.

Measure Theme 8 – New Structural Measures

- New Federal Levee Construction: compacted earthen berm to decrease the initial overtopping frequency.
- Floodwall: concrete floodwall barrier.

The feasibility study process involves successive iterations of alternative solutions to the defined problems. These solutions are based upon the study objectives and constraints, and address problems and opportunities that have been previously defined. **Figure 10** shows the major steps taken in the process from the initial development of measures at a planning charrette though identification of the TSP. The following section describes the process and decisions during the processes. The iterative process of developing, evaluating, and refining alternatives is described in **Figure 10**.

Figure 10 Alternative Development Screening Diagram

Initially, the measures were screened against the project objectives and four P&G criteria of effectiveness, efficiency, completeness, and acceptability. Additionally, measures were evaluated against

the project constraint, or the degree to which the measure avoids or minimizes disproportionate impacts to the economically disadvantaged and socially vulnerable populations in the study area. Specific questions included:

- Does the measure meet the planning objectives?
- Does the measure avoid the planning constraints?
- Is the measure technically feasible?
- Does the measure meet the overall goals of the System Plan?
- Does the measure have disproportionate impacts to EJ Communities?

Table 14 describes the measures that were eliminated during the charette screening, and the rationale for their elimination.

Table 14 Eliminated Measures

No.	Measure	Rationale for Elimination
M 3	Flood Warning System	No tributary contributing to flash flooding, Missouri River provides substantial warning prior to flooding.
M 4	Missouri River Reservoir	Not effective at meeting study objectives. High level of environmental impacts, cost.
M 5	Channel Widening	Not effective at meeting study objectives. Impacts to existing dredging operation would be unacceptable to stakeholder.
M 6	Channel Deepening	Not effective at meeting study objectives due to ineffective hydraulic results. Impacts to existing dredging operation would be unacceptable to stakeholder. Potential for high environmental impacts.
M 7	Channel Dredging for capacity, material	Not effective at meeting study objectives due to ineffective hydraulic results. Impacts to existing dredging operation would be unacceptable to stakeholder. Potential for high environmental impacts.
M 8	Capital View Levee Setback	Does not decrease initial overtopping frequency to meet economically justified project.
M 9.2	Capital View Levee Raise to 33’	Does not decrease initial overtopping frequency to meet economically justified project.
M 9.3	Capital View Levee Raise to 32’	Does not decrease initial overtopping frequency to meet economically justified project.
M 9.4	Capital View Levee Raise to 1% AEP	Substantial hydraulic impact to Wears Creek and adjacent levee systems with low likelihood of feasible mitigation.
M 12	Designated Overtopping of Capital View Levee	Intentional overtopping would not provide additional protection to property, infrastructure, etc. Terrain does not allow for keeping water away from critical infrastructure.
M 13	Designated Breach Location of Capital View Levee	Intentional breaches would not eliminate additional breaching, would not provide additional protection to property, infrastructure, etc. Terrain does not allow for keeping water away from critical infrastructure.
M 14	Reverse Loading of Capital View Levee	Does not meet study objective of decreasing flood risk, does not decrease initial overtopping frequency.

No.	Measure	Rationale for Elimination
M 17.4	New Levee, floodwall included	Space limitations do not exist between critical infrastructure, transportation, public goods, etc. that would require use of floodwall vs. levee.
M 18	Add additional drainage structures	Does not meet objectives, internal drainage concerns were not expressed by community
M 20	Add pump station	Existing inundation is so low it would not be feasible on its own. Leveed area is not suitable for centralized internal drainage via pumping.
M 22	Wetlands	Violates FAA study constraint, not a viable measure to reduce flood risk.
M 23	Off-Channel Detention Basin	Violates FAA study constraint.
M 27	US Highway 54/63 Bridge Pier Modification	Initial analysis and descriptions of past floods revealed the piers do not appear to trap debris or cause conveyance restrictions at this site. Therefore, modifications to increase capacity of water under the bridge wouldn't provide benefit.

Measures retained after the initial formulation and screening are listed in **Table 15**. These include nonstructural and structural measures.

Table 15 Measures Retained

Structural Measures	Nonstructural Measures
M 9.1 – Capital View Levee Raise 34'	M 1 – Floodproofing existing structures
M 10 – Remove Capital View Levee	M 2 – Buy-outs and/or relocation of existing structures
M 11 – Armorment of Capital View Levee	M 2.1 – Elevate in Place
M 15 – Addition of Seepage Berms at Capital View Levee	
M 16 – Addition of Stability Berms at Capital View Levee	
M 17.1 – New Levee Historic L-142 Alignment	
M 17.2 – New Levee Optimization Alignment	
M 17.3 – New Levee Highway Alignment	
M 19 – Replace Existing Drainage Structures	
M 21 – Submersible or Portable Pumps	
M 24 – Remove Prison/Church Farm Levee	
M 25 – Raise Critical Infrastructure	
M 28 – North Renz Levee Modification/Incorporation into P.L. 84-99	
M 29 – Cedar Creek, Sec. 2 Levee Modification/Incorporation into P.L. 84-99	
M 30 – Renz Farm Road Crossing Closure Structure	
M 31 – New Levee: Turkey Creek Setback	

3.4 ARRAY OF ALTERNATIVES*

Carrying forward the Measures listed in **Table 15**, the PDT held an additional Charette on 14-15 March 2024 to combine the measures into alternatives. The team used existing economic and engineering data, design criteria, and feedback received during the public involvement process to create combined alternatives. Sixteen of the Measures were incorporated and combined into 13 Combined Alternatives listed in **Table 16**. The PDT assumed nonstructural measures could be considered in all alternatives and applied where technically feasible. The 13 combined alternatives made up the Initial Array of Alternatives for further assessment. This initial array is shown in **Table 16 Initial Array of Combined Alternatives**, which also shows the measures included in each of these alternatives. These alternatives were presented to the Vertical Team during an In-Progress Review (IPR) on 2 May 2024 for consideration and discussion. Through the alternative development process, it became apparent that options for flood risk reduction are really limited to two categories: remaining nonstructural measures that can be undertaken in the study area, and a structural solution of a levee. Most of the alternatives are variations of the structural solution of modifications to the existing levee or the construction of a new levee setback from the Missouri River.

Multiple iterations of structural levee alternatives were considered varying both levee height and levee setback alignments. Iterations of both these factors were considered early in identifying alternatives to determine the most economic alternative relative to levee overtopping frequency and reduced flood area behind the proposed levee. Iterations began along the existing Capital View levee footprint as requested by public input, then iterated with setbacks to reduce induced impacts observed with levee raises within the floodplain.

Table 16 Initial Array of Combined Alternatives

Combined Alternative	Description	M 9.1	M 10	M 11	M 15	M 16	M 17.1	M 17.2	M 17.3	M 21	M24	M 28	M 29	M 30	M 31	M 1	M 2	M 2.1
CA0	No Action																	
CA1	Existing Capital View Alignment, 34-ft Stage	X								X						X	X	X
CA2	Turkey Creek & Riverside Setback, 34-ft Stage, Capital View Removed	X								X						X	X	X
CA3	Existing Capital View Alignment with Resiliency			X	X	X				X						X	X	X
CA4	Optimization Alignment, 37-ft Stage, Capital View Remains							X		X						X	X	X
CA5	Optimization Alignment, 37-ft Stage, Capital View Removed		X					X		X						X	X	X
CA6	Historic L-142 Alignment, 45-ft Stage, Capital View Remains						X			X						X	X	X
CA7	Historic L-142 Alignment, 45-ft Stage, Capital View Removed		X				X			X						X	X	X
CA8	Highway Alignment, 37-ft Stage, Capital View Remains								X	X						X	X	X

Combined Alternative	Description	M 9.1	M 10	M 11	M 15	M 16	M 17.1	M 17.2	M 17.3	M 21	M24	M 28	M 29	M 30	M 31	M 1	M 2	M 2.1
CA9	Highway Alignment, 37-ft Stage, Capital View Removed		X						X	X						X	X	X
CA10	Limited Resiliency Measures Outside of Capital View Footprint											X	X	X		X	X	X
CA11	Nonstructural															X	X	X
CA12	Remove Church Farm Levee										X							
CA13	Hybrid Alignment, 41-ft Stage, Partial Capital View Removal									X					X	X	X	X

3.4.1 CA0 No Action

Under the No Action alternative, no federal action would be taken. NEPA requires Federal agencies to consider the no action alternative. It serves as a baseline against which action alternatives are measured. The projection of the No Action alternative into the future is the FWOP Condition. This alternative is the baseline condition used to identify potential impacts and benefits of proposed Future With Project (FWP) alternatives. If a FWP alternative is not identified to have Federal Interest, then the No Action Alternative can be selected by default.

3.4.2 CA1 Existing Capital View Alignment, 34-ft Stage

CA1 evaluates increasing the height of the levee along the existing Capital View Alignment to an overtopping stage of 34 feet on the Jefferson City gage. The existing Capital View levee would be removed and rebuilt to USACE design requirements in the same location. The new levee would be 46,423 feet long and be an average of 3.1 feet above the existing Capital View levee and a max height increase of 6.4 feet. This would lower the overtopping AEP from the current condition of 17% AEP to 8.0% AEP. The levee would become a federal levee system, renamed L-142.

3.4.3 CA2 Turkey Creek and Riverside Setback, 34-ft Stage, Capital View Removed

CA2 evaluates construction of a new levee setback approximately 1000 feet along the Missouri River and Turkey Creek reach. The setback levee is located at the Northeast side along an existing farm field and along the Western edge of a golf course. The levee then crosses U.S. Highway 54 at a high ground location and cuts South through Old Cedar City, where there are a few residences and City owned community gardens and practice baseball fields. The proposed alignment follows along Sandstone Drive to the South, around to the East and ties into the existing embankment of southbound U.S. Highway 54. The alignment continues from the northbound U.S. Highway 54 embankment and follows along to the East approximately 1000 feet setback from the bank of the Missouri River. It then connects to high ground at the Bluff by turning north along a tributary that feeds to Nieman's Creek. The 34-foot flood stage would lower the overtopping AEP to 6.5% and provide an expected levee performance of 1/15 year.

3.4.4 CA3 Existing Capital View Alignment with Resiliency

CA3 evaluates the existing Capital View alignment with added resiliency measures. See the discussion in 3.4.2 for the site description of the existing Capital View levee. The levee would retain its current elevation of an overtopping stage of 30.5 feet, 17% AEP (1/6 yr). The levee would be rebuilt to federal standards for material composition and compaction. The alternative includes resiliency measures such as armament, designated overtopping, and closure structures at key locations of previously identified weak points.

3.4.5 CA4 Optimization Alignment, 37-ft Stage, Capital View Remains

CA4 evaluates construction of a new levee built to the elevation that correlates to a 37-foot stage which corresponds to an AEP of 3.5% (1/28 yr). A version of this alignment was brought forward and recommended for consideration by the public to minimize real estate impacts by utilizing existing property owned by the City of Jefferson and existing Rights of Way. The alignment follows along the existing Capital View levee from station 0+00 to 113+00. The levee then turns and follows along the Missouri River at an offset that utilizes the existing Right of Ways and property owned by the City of Jefferson and along Sandstone Drive and Mokane Road. The levee connects to high ground at the bluff by turning north along the existing Capital View levee station 430+00 to 464+22.

The optimization alignment levee would be constructed from station 0+00 to 337+05 meeting federal standards for material composition and compaction. The portions of the existing Capital View levee that overlap the proposed alignment for this alternative would be reduced to base elevations and reconstructed meeting federal standards to the proposed elevations. The remaining existing Capital View levee would not be modified. Borrow material would be required to complete the proposed alternative.

The proposed alignment for CA4 is a levee that would reduce occurrence of flooding for approximately 2,200 acres of Missouri River floodplain in Callaway County, Missouri. The Capital View levee would remain with 1,100 acres between the existing levee and the proposed federal levee footprint.

3.4.6 CA5 Optimization Alignment, 37-ft Stage, Capital View Removed

CA5 evaluates construction of a new levee built to the elevation that correlates to a 37-foot stage which corresponds to an AEP of 3.5% (1/28 yr). A version of this alignment was brought forward and recommended for consideration by the public to minimize real estate impacts by utilizing existing property owned by the City of Jefferson and existing Rights of Way. The alignment follows along the existing Capital View levee from station 0+00 to 113+00. The levee then turns and is follows along the Missouri River at an offset that utilizes the existing Right of Ways and property owned by the City of Jefferson and along Sandstone Drive and Mokane Road. It connects to high ground at the bluff by turning north along the existing Capital View levee station 430+00 to 464+22.

The optimization alignment levee would be constructed from station 0+00 to 337+05 meeting federal standards for material composition and compaction. The portions of the existing Capital View levee that overlap the proposed alignment for this alternative would be reduced to base elevations and reconstructed meeting federal standards to the proposed elevations. The remaining existing Capital View levee would be fully removed and used for borrow material to construct the setback levee. Additional borrow material would be required to complete the proposed alternative.

The proposed alignment for CA5 is a levee that would reduce occurrence of flooding for approximately 2,200 acres of Missouri River floodplain in Callaway County, Missouri.

3.4.7 CA6 Historic L-142 Alignment, 45-ft Stage, Capital View Remains

CA6 was developed as a new levee built to the elevation that correlates to a 45-foot stage, which corresponds to an AEP of 0.2% (1/500 yr). This alignment was previously developed and designed to 95% completeness and was never constructed. The proposed alignment begins at high ground along the South U.S. Highway 54 embankment and continues along the east side of the golf course and crosses U.S. Highway 63 at a high point west of the U.S. Highway 63/54 interchange. The alignment continues through old Cedar City, tying into the bridge abutment along Sandstone Drive at U.S. Highway 54. The levee then continues to follow Mokane Road to the East then turns north just east of the airport.

The historic L-142 alignment levee would be constructed from station 0+00 to 247+27 meeting federal standards for material composition and compaction. The remaining existing Capital View levee would not be modified or removed. Borrow material is required to complete the proposed alternative.

CA6 would reduce occurrence of flooding for approximately 1,500 acres of Missouri River floodplain in Callaway County, Missouri. The Capital View levee would remain protecting 1,700 acres between the existing levee and the proposed federal levee footprint, though at a lower level of protection than the new federal levee.

CA6 and CA7 have the smallest leveed area and would conflict with the Jefferson City Memorial Airport master plan.

3.4.8 CA7 Historic L-142 Alignment, 45-ft Stage, Capital View Removed

CA7 was developed as a new levee built to the elevation that correlates to a 45-foot stage which corresponds to an AEP of 0.2% (1/500 yr). This alignment was previously developed and designed to 95% completeness and was never constructed. The proposed alignment begins at high ground along the South U.S. Highway 54 embankment and continues along the east side of the golf course and crosses U.S. Highway 63 at a high point west of the U.S. Highway 63/54 interchange. The alignment continues through old Cedar City, tying into the bridge abutment along Sandstone Drive at U.S. Highway 54. The levee then continues to follow Mokane Road to the East then turns north just east of the Jefferson City Memorial Airport.

The historic L-142 alignment levee would be constructed from station 0+00 to 247+27 meeting federal standards for material composition and compaction. The remaining existing Capital View levee would be fully deconstructed and used for borrow material to construct the setback levee. Additional borrow material would be required to complete the proposed alternative.

CA7 would reduce occurrence of flooding for approximately 1,500 acres of Missouri River floodplain in Callaway County, Missouri.

CA6 and CA7 have the smallest leveed area and would conflict with the Jefferson City Airport master plan.

3.4.9 CA8 Highway Alignment, 37-ft Stage, Capital View Remains

CA8 was developed as a new levee built to the elevation that correlates to a 37-foot stage which corresponds to an AEP of 2.5% (1/40 yr). The alignment utilizes the existing U.S. Highway 54 embankment as the line of protection. The levee then turns and follows along the existing ROW and property owned by the City of Jefferson along Mokane Road. It connects to high ground at the bluff by turning north along the existing Capital View levee station 430+00 to 464+22.

The highway embankment alignment levee would be constructed from station 0+00 to 272+30 meeting federal standards for material composition and compaction. The portions of the existing Capital View levee that overlap the proposed alignment for this alternative would be degraded and reconstructed meeting federal standards to the proposed elevations. The remaining existing Capital View levee would go on unchanged. Borrow material is required to complete the proposed alternative.

CA8 would reduce occurrence of flooding for approximately 1,700 acres of Missouri River floodplain in Callaway County, Missouri. The Capital View levee would remain protecting 1,500 acres between the existing levee and the proposed federal levee footprint, though a lower level of protection than the new federal levee.

3.4.10 CA9 Highway Alignment, 37-ft Stage, Capital View Removed

CA9 was developed as a new levee built to the elevation that correlates to a 37-foot stage which corresponds to an AEP of 2.5% (1/40 yr). The alignment utilizes the existing U.S. Highway 54 embankment as the line of protection. The levee then turns and follows along the existing ROW and property owned by the City of Jefferson along Mokane Road. It connects to high ground at the bluff by turning north along the existing Capital View levee station 430+00 to 464+22.

The highway embankment alignment levee would be constructed from station 0+00 to 272+00 meeting federal standards for material composition and compaction. The portions of the existing Capital View levee that overlap the proposed alignment for this alternative would be degraded and reconstructed meeting federal standards to the proposed elevations. The remaining existing Capital View levee would be fully deconstructed and used for borrow material to construct the setback levee. Additional borrow material would be required to complete the proposed alternative.

CA9 would reduce occurrence of flooding for approximately 1,700 acres of Missouri River floodplain in Callaway County, Missouri.

3.4.11 CA10 Limited Resiliency Measures Outside of Capital View Footprint

CA10 considers modification and incorporation of the North Renz levee into the P.L. 84-99 program. The North Renz levee is located along the left bank of the Missouri River between Cedar Creek (river mile 148.2) and 147.3. This alternative also considers the modification and incorporation of the Sod Farm levee into the P.L. 84-99 program. The Sod Farm levee is located along the left bank of the Missouri River between river mile 146.8 and Turkey Creek (river mile 144.5).

3.4.12 CA11 Nonstructural

CA11 includes consideration of incorporating various nonstructural measures such as floodproofing (wet or dry), elevate in place, and buyouts or relocations. These measures are considered within the area of the existing Capital View levee.

3.4.13 CA12 Remove Church Farm Levee

CA12 considers the removal of the existing Church Farm Conservation Area levee located along the right bank of the Missouri River upstream of the study area. The existing Church Farm levee is located between river mile 151.7 to 154.8. This alternative is evaluated to determine if there would be measurable benefit in the Missouri River water surface profile at Jefferson City by allowing floodwaters to inundate the conservation area and provide off-channel storage.

3.4.14 CA13 Hybrid Alignment, 41-ft Stage, Partial Capital View Removal

CA13 was developed as a new levee built to the elevation that correlates to a 41-foot stage (1% AEP). This alignment is a hybrid of CA2, CA4, and CA5. The alignment follows along the embankment for U.S. Highway 54, then continues along the north and west side of the golf course. The levee connects to high ground crossing over U.S. Highway 63 and continues through Old Cedar City tying into the U.S. Highway 54 embankment near the bridge abutment. The alignment follows East along Sandstone Dr and Mokane Road before a slight turn south to follow the natural drainage path along a farm levee. The levee connects to high ground at the bluff by turning north along the existing Capital View levee station 430+00 to 464+22.

The hybrid alignment levee would be constructed from station 0+00 to 313+32 meeting federal standards for material composition and compaction. The portions of the existing Capital View levee that overlaps the proposed alignment for this alternative would be degraded and reconstructed meeting federal standards to the proposed elevations. The portion of existing Capital View levee from station 0+00 to 160+00 would be deconstructed and used for borrow material to construct the setback levee. The remaining existing Capital View levee would not be modified. Additional borrow material would be required to complete the proposed alternative.

CA13 would reduce occurrence of flooding for approximately 2,100 acres of Missouri River floodplain in Callaway County, Missouri. The Capital View levee would remain with 1,000 acres between the existing levee and the proposed federal levee footprint.

3.5 PLAN EVALUATION*

Initial Array

The PDT reviewed the initial array of alternatives and conducted a new round of screening. Analysis of the alternatives and associated measures was conducted by considering qualitatively each alternative's ability to meet the project objectives and by applying criteria from USACE guidance and the P&G.

Screening based on the four P&G criteria eliminated three of the Combined Alternatives: CA3, CA10, and CA12. Explanation of the screening is presented in **Table 17**.

Table 17 Combined Alternatives Screened Out

Combined Alternative	Description	Screening Justification
CA3	Existing Capital View Alignment with Resiliency	All benefits are realized due to a reduction in breach potential. Does not increase flood risk benefits above the 17% AEP (1/6 yr). Screened due to a lack of efficiency associated with minimal flood risk benefits.
CA10	Limited Resiliency Measures Outside of Capital View Footprint	Does not meet project objective of reducing flooding. Does not meet effectiveness as a standalone alternative.
CA12	Remove Church Farm Levee	Had no measurable affects of reducing water surface elevation at Capital View as a standalone measure.

Additional screening of the remaining alternatives was conducted again using efficiency and effectiveness, specifically using the estimated annual costs of each alternative, the overtopping frequency the alternative would provide, and the annual benefits expected. The analysis is shown in **Table 18**.

Table 18 Alternative Cost and Benefit Analysis

Alternative	Description	Overtopping Frequency	Annual Cost	Annual Benefits	BCR	Net Benefits
CA0	No Action	17.0% AEP (1/6yr)	$0	$0	0	$0
CA1	Existing Capital View Alignment, 34-ft Stage	8.0% AEP (1/12yr)	$6,654,400	$4,742,600	0.7	-$1,911,800
CA2	Turkey Creek & Riverside Setback, 34-ft Stage, Capital View Removed	6.5% AEP (1/15yr)	$12,454,500	$991,400	0.1	-$11,463,100
CA4	Optimization Alignment, 37-ft Stage, Capital View Remains	3.5% AEP (1/28yr)	$13,573,300	$8,471,000	0.6	-$5,102,300
CA5	Optimization Alignment, 37-ft Stage, Capital View Removed	3.5% AEP (1/28yr)	$14,294,200	$9,027,300	0.6	-$5,266,900
CA6	Historic L-142 Alignment, 45-ft Stage, Capital View Remains	<0.2% AEP (>1/500yr)	$18,681,400	$17,113,800	0.92	-$1,567,600
CA7	Historic L-142 Alignment, 45-ft Stage, Capital View Removed	<0.2% AEP (>1/500yr)	$19,620,500	$16,975,500	0.87	-$2,645,000
CA8	Highway Alignment, 37-ft Stage, Capital View Remains	2.5% AEP (1/40yr)	$11,403,100	$8,009,400	0.7	-$3,393,700

Alternative	Description	Overtopping Frequency	Annual Cost	Annual Benefits	BCR	Net Benefits
CA9	Highway Alignment, 37-ft Stage, Capital View Removed	2.5% AEP (1/40yr)	$12,487,300	$8,328,600	0.7	-$4,158,700
CA11	Nonstructural	17.0% AEP (1/6yr)	$497,500	$306,200	0.6	-$191,300
CA13	Hybrid Alignment, 41-ft Stage, Partial Capital View Removal	1.0% AEP (1/100yr)	$13,421,700	$15,774,600	1.2	$2,352,900

**Discrepancies in totals due to rounding*
***Oct 2024 Price Levels*

Based on the anaylsis shown in **Table 18** Alternative Cost and Benefit Analysis, the PDT observed the low net benefits and high annual costs for many of the alternatives, resulting in BCRs less than one. Using this information, the PDT then considered the totality of comprehensive benefits in the four accounts as described in the *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies*, established by the Water Resources Council in 1983. In a memorandum dated 5 January 2021, the USACE headquarters issued further direction on the comprehensive assessment and documentation of benefits for USACE water resources development project planning.

- The NED account displays changes in the economic value of the national output of goods and services.
- The Environmental Quality (EQ) account displays non-monetary effects on significant natural and cultural resources.
- The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan.
- The Other Social Effects (OSE) account registers plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

The PDT determined the following criteria and characteristics to be relevant in the four accounts:

National Economic Development (NED):

- Total Investment Cost.
- BCR.
- Net Annual Benefits in flood damages reduced and detour and delay costs reduced.

Regional Economic Development (RED):

- Local Capture (RECONS), or the economic impacts to the region resulting from the proposed construction of the TSP.
- Allowing major employers to stay open and provide goods and services to the region, along with the employment benefits of those jobs.
- Agricultural Protection, specifically the average annual crop acreage inundated.

Other Social Effects (OSE):

- Life Safety.

- Adhering to Lower Missouri River System Plan goal of increased conveyance.
- Providing FRM benefits to a Justice40 community, maintaining access to goods, services, and transportation networks.
- Better access to free outdoor recreational opportunities via the Katy Trail.

EQ:

- Net AAHUs from restored acres.
- Cultural Resources.

A more detailed discussion of the four accounts and the metrics and screening criteria utilized can be found in Appendix E, Economics and Social Considerations.

Using the four accounts, CA1 (Existing Capital View Alignment, 34-ft Stage) was eliminated because of a low BCR and very little opportunity for benefits in the other three accounts. With the leveed area remaining unchanged, there would be no environmental benefit and the overtopping frequency would continue to be the most frequent of any of the structural alternatives. Additionally, the high overtopping frequency does not allow for substantial RED benefits or OSE benefits. Major employers are impacted in frequent storm events, agricultural production is inundated, and transportation networks become impassable. The alternative also does not adhere to the System Plan goal of increased conveyance, as the existing levee is immediately adjacent to the riverbank.

The Initial Array of Alternatives was presented to the sponsor and local stakeholders for consideration at a public meeting held in April 2024. Feedback was considered from the comments and questions from the public and interested stakeholders. Using this feedback, while a near positive BCR was met for CA6 (Historic L-142 Alignment, 45-ft Stage, Capital View Remains) and CA7 (Historic L-142 Alignment, 45-ft Stage, Capital View Removed), the sponsor and stakeholders found these alternatives unacceptable. With regards to screening using the four accounts criteria, this alignment eliminates businesses and community gathering centers from the leveed area, which was considered as a negative effect in the RED and OSE benefits categories. Therefore, the PDT eliminated CA6 and CA7 from further evaluation and consideration.

Additional sponsor and public feedback was received on CA8 (Highway Alignment, 37-ft Stage, Capital View Remains) and CA9 (Highway Alignment, 37-ft Stage, Capital View Removed). These alignments leave several of the benefits, especially those in the RED and OSE accounts, outside of the leveed area. The businesses and local stakeholders specifically excluded from the proposed leveed area were opposed to these alignments. The alignment also does not allow for the best utilization of the Katy Trail access, and diminishes the use of this important free outdoor recreation opportunity. Therefore, the PDT eliminated these alternatives from further evaluation.

To get to the final array, the PDT ultimately looked at the specific alignments and feasible overtopping frequencies they can achieve, while considering the potential for induced impacts to upstream and downstream levee systems. Additionally, the PDT considered impacts to the larger community of Jefferson City across the Missouri River, which includes economically vulnerable populations. Using these considerations, the PDT further screened CA2 (Turkey Creek & Riverside Setback, 34-ft Stage, Capital View Removed), CA4 (Optimization Alignment, 37-ft Stage, Capital View Remains) and CA5 (Optimization Alignment, 37-ft Stage, Capital View Removed). These three screened alternatives provided the lowest levels of levee performance and also fewer comprehensive benefits when compared to the remaining alternatives. Screening of the initial array of combined alternatives is summarized in **Table 19**.

Table 19 Initial Screening of Combined Alternatives

Combined Alternative	Description	Screened Out (Y/N)	Justification
CA0	No Action	N	Retained as the baseline alternative.
CA1	Existing Capital View Alignment, 34-ft Stage	Y	Negative net benefits, little to no opportunity for total net benefits across the four accounts. Does not meet overall goal of conveyance or resiliency in System Plan.
CA2	Turkey Creek & Riverside Setback, 34-ft Stage, Capital View Removed	Y	Negative net benefits, high overtopping frequency does not justify cost of federal levee segment, minimal total net benefits.
CA4	Optimization Alignment, 37-ft Stage, Capital View Remains	Y	Negative net benefits, moderate overtopping frequency does not justify cost of federal levee segment, minimal total net benefits.
CA5	Optimization Alignment, 37-ft Stage, Capital View Removed	Y	Negative net benefits, moderate overtopping frequency does not justify cost of federal levee segment, minimal total net benefits.
CA6	Historic L-142 Alignment, 45-ft Stage, Capital View Remains	Y	Negative net benefits, community and non-federal sponsor opposition.
CA7	Historic L-142 Alignment, 45-ft Stage, Capital View Removed	Y	Negative net benefits, community and non-federal sponsor opposition.
CA8	Highway Alignment, 37-ft Stage, Capital View Remains	Y	Negative net benefits, businesses and other stakeholders opposed, less RED and OSE benefits.
CA9	Highway Alignment, 37-ft Stage, Capital View Removed	Y	Negative net benefits, businesses and other stakeholders opposed, less RED and OSE benefits.
CA11	Nonstructural	N	Carried forward for further evaluation as required plan.
CA13	Hybrid Alignment, 41-ft Stage, Partial Capital View Removal	N	Carried forward for further evaluation with positive NED and total net benefits, level of protection significantly higher, structural alternative.

The PDT, in cooperation with the non-federal sponsor, determined the final array to be three alternatives:

- CA0 – No Action
- CA11 – Nonstructural
- CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal

4.0 Environmental Effects and Consequences*

4.1 AFFECTED ENVIRONMENT (40 CFR 1502.15) AND ENVIRONMENTAL CONSEQUENCES (40 CFR 1502.16)

This chapter discusses aspects of the environment that may potentially be impacted by the alternatives. It presents both the affected environment and environmental consequences, as required by NEPA. This chapter is organized by resource topic with the status of the affected environment and the impacts of each alternative described within each resource section. The affected environment sections provide a description of different aspects of the human environment that may be affected by the alternatives. The environmental consequences sections provide a description of the anticipated impacts.

All potentially relevant resource areas were initially considered for analysis in this EA. Some resource topics are not discussed, or the discussion is limited in scope, due to the lack of anticipated effect from the alternatives on the resource or because that resource is not located within the affected environment.

40 C.F.R. §1508.1(i) defines effects or impacts as changes to the human environment from the alternatives that are reasonably foreseeable, including direct effects that occur at the same time and place as the alternatives and may indirect effects that are later in time or farther removed in distance from the alternatives. The potential impacts of the alternatives are described in this EA using the following terms:

- Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
- Short-term: impacts generally occur during construction or for a limited time thereafter, generally less than two years, by the end of which the resources recover their pre-construction conditions.
- Long-term: impacts last beyond the construction period, and the resources may not regain their preconstruction conditions for a longer period of time.

When evaluating CA13, the USACE assumes that approximately 61.5 acres of publicly owned land located between the current Capital View levee and the new levee that would be constructed under CA13 would be allowed to naturally regenerate native floodplain habitat. This publicly owned area would be hydrologically reconnected to the Missouri River by removing part of the Capital View levee. This 61.5-acre area is currently used for row crop agriculture or is occupied by the Capital View levee. Because the currently existing levee would be removed in this location and because this area would be made less suitable for row crop agriculture due to floodplain hydrology being restored, the USACE assumes that this area would be allowed to regenerate habitat.

The USACE assumes that borrow material needed for the construction of the levee under CA13 would come from the Church Farm Conservation Area. The USACE also assumes that the borrow material site located at the Church Farm Conservation Area would also be allowed to naturally regenerate native floodplain habitat. This location is used for row crop agriculture, and the USACE assumes that borrow material collection would make the site less suitable for this kind of agriculture. The USACE assumes that borrow material would be removed in a manner that would restore natural floodplain topographic variability which would promote wetland and riparian habitat.

Climate and Greenhouse Gases

This section describes the possible impacts of the alternatives relating to greenhouse gas emissions and their potential effect on climate trends. The greenhouse gas emissions analysis is largely focused on actions within the study area. Climate considerations are made on a larger, regional scale.

CA0 – No Action. Under CA0, no federal action would be undertaken. Because the implementation of this alternative would not result in any greenhouse gas emissions, there would be no impact to climate or greenhouse gas emissions trends.

CA11 – Nonstructural. No construction activities would be undertaken by the implementation of this alternative. This alternative entails building elevation, floodproofing, and/or buying out flood prone properties. Fuel consumption associated with these actions would be minimal, particularly when compared to the amount of fuel used in CA13. Thus, this alternative would result in negligible emissions of greenhouse gases and would have a negligible impact on climate.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Construction activities under CA13 would require the use of equipment that emit greenhouse gases. In order to estimate the amount of greenhouse gases that would be emitted under this alternative, a list of the necessary equipment and the amount of fuel each piece of equipment would require was generated (see Appendix C1). By using 2024 greenhouse gas emission factors from the EPA and fuel economy data from the Department of Energy, the USACE was able to make a quantitative estimate of the gross emissions of greenhouse gases. Then, the USACE used the Net Emissions Analysis Tool to incorporate carbon sequestration associated with habitat restoration in the borrow areas. This allowed the USACE to estimate the net emissions of greenhouse gases. This analysis is provided in full in Appendix C1 and is summarized in **Table 20**.

Table 20 Greenhouse Gas Emissions Summary

Alternative	Gross Emissions of Carbon Dioxide Equivalent (in US Tons)	Net Emissions of Carbon Dioxide Equivalent (in US Tons)
CA0	0	0
CA11	0	0
CA13	14,095.4	9,776

The implementation of CA13 would be expected to result in the emission of 9,776 tons of carbon dioxide equivalent. According to the EPA Greenhouse Gas Equivalencies Calculator (EPA, 2024b), 9776 US tons of carbon dioxide equivalent is roughly the equivalent of the emissions of 2,111 gasoline-powered passenger vehicles driven for one year. This amount of carbon is sequestered by approximately 10,354 acres of forests in one year (EPA, 2024b). In 2022, the US had a total net emission of approximately 6,051 million US tons of carbon dioxide equivalents (EPA, 2024c). The emissions of CA13 would represent approximately 0.000016% of this amount.

The greenhouse gas emissions associated with CA13 are limited to the construction activities needed to implement it. In other words, this alternative would not result in the long-term increase in US emissions. The implementation of CA13 would not meaningfully interfere with achieving the goal of net-zero greenhouse gas emissions by 2050.

Geology and Soils

This section describes the possible impacts of the alternatives on the study area's geology and soil. Potential agricultural impacts are considered as part of the overall evaluate of potential soil impacts. The physical scope of this analysis is generally restricted to the study area.

CA0 – No Action. Under CA0, no federal action would be undertaken. There would be no impacts to the study area's geology or soils.

CA11 – Nonstructural. None of the activities that would be undertaken as part of CA11 would impact the study area's geology or soils.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. None of the construction activities that would occur under CA13 would be anticipated to impact the study area's bedrock, as project activities would be limited to area's with relatively deep soils. Because the L-142 Area and Church Farm Conservation Area have such similar soils, the transfer of soils from the latter area to the former would not meaningfully alter the character of the soils present in the L-142 Area. The construction of the setback levee would remove some areas from agriculture. According to the NRCS Web Soil Survey website, the proposed levee alignment would cover 139.56 acres of prime farmland, and 97.44 acres of land that is prime farmland if drained. In addition, there is 34.2 acres of land that is prime farmland if drained located on the riverward side of the proposed levee alignment that would experience restored floodplain hydrology. Thus, CA13 could result in the effective conversion of 271.2 acres of prime farmland. Under this alternative, the USACE would coordinate these impacts with the NRCS. Because these adverse effects would be coordinated with the NRCS and are relatively small in scale, the implementation of CA13 would have a negligible impact on soil resources.

Land Use

This section describes the possible impacts of the alternatives on land uses. The land use area of analysis is generally restricted to the study area and any easements that could be needed for alternatives.

CA0 – No Action. There would be no short-term impacts to the study area's land use. The anticipated changes to the L-142 area's built environment that were discussed in Section 2.5, such as runway expansion at the airport and highway modification projects, would be expected to continue. However, because the area's flooding concerns would not be addressed, there is a long-term risk that some businesses may relocate out of the area to avoid flood damages.

CA11 – Nonstructural. CA11 would have negligible to beneficial effects on the study area's land use. Elevation and floodproofing would allow some properties to continue their current use. Buyouts would remove some properties from the floodplain, which would reduce flood damages and result in land use that is more compatible with the area's natural tendency to flood. However, some facilities may not be able to implement any of these measures. For example, facilities that are unable to implement the floodproofing or elevation measures may relocate out of the study area in the long-term to avoid flood damages, as under CA0.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. CA13 would largely maintain the current land use in the study area. Most locations in the study area would either experience a greater protection from flooding impacts or would maintain their current level of protection. Locations along Turkey Creek in the L-142 area would experience a restoration of floodplain hydrology. Farmland that is owned by Jefferson City within this hydrologically restored area would generally be converted to native floodplain forest habitat. Other locations within the L-142 area would be expected to maintain their current land use. Approximately 214 acres of farmland in the Church Farm Conservation Area would be converted to native forested wetland habitat, though land use in this location would otherwise be unaltered.

Surface Water and Other Aquatic Resources

This section describes the possible impacts of the alternatives on aquatic resources. These resources include surface waters such as streams, groundwater resources such as aquifers, and other aquatic sites such as wetlands. The USACE used hydrologic and hydraulic modeling approximately 50 Missouri River miles upstream and downstream of the study area to determine the scope of potential impacts associated

with water surface elevation. Analysis of other aquatic resources, such as wetlands, are generally contained within the study area.

CA0 – No Action. Under CA0, no actions would be undertaken that would impact surface water or other aquatic resources.

CA11 – Nonstructural. None of the measures included in CA11 would affect surface water or other aquatic resources.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Appendix C1 contains the Section 404(b)(1) analysis conducted on CA13, which is summarized here. The Missouri River and its tributaries would not experience adverse impacts to any meaningful degree. The proposed levee alignment is located landward of the existing Capital View levee. Thus, there would be no fill activities in these waterbodies. Best management practices such as silt fences would be used in order to minimize the siltation of these waterbodies via runoff. In the event that CA13 is carried forward for implementation, the USACE would require the construction contractor to obtain an NPDES stormwater runoff permit from the MoDNR. The USACE would require the contractor to comply with all conditions of the permit.

Along Turkey Creek in the western portion of the L-142 area and along the Missouri River from the Turkey Creek confluence downstream to the Capital Sand quarry, the Capital View levee would be removed. This would restore the natural floodplain hydrology of the Missouri River and Turkey Creek in the area between the Capital View area and the proposed levee alignment. Water from these streams would be allowed to spread out over a larger area during flood events, which is anticipated to be beneficial to floodplain hydrology. In addition, the regeneration of natural habitat in the borrow areas would be expected to indirectly benefit water quality in the Missouri River and Turkey Creek. While neither of these waterbodies are currently listed on the Missouri 303(d) list of impaired waters, the increase in native habitat land cover would offer additional filtration of runoff and would be beneficial for water quality. This can be especially beneficial in agricultural settings such as the study area, as fertilizers are widely in use and can easily enter streams and other waterbodies via runoff. Thus, the long-term impact to the Missouri River and Turkey Creek would be anticipated to be beneficial.

Appendix A documents hydrologic and hydraulic assumptions, modeling, and anticipated changes in inundation patterns regarding CA13 and is summarized here. The modeled area extends from Boonville, MO near Missouri River Mile 197 to Hermann, MO near Missouri River Mile 98. This modeled area extends roughly 50 Missouri River miles upstream and downstream of the study area. While CA13 would set levee coverage back for part of the study area, the newly constructed levee would be taller than the currently existing Capital View levee. This would be necessary to improve flood protection in the area behind the new levee, which would be overtopped during the 1% AEP instead of the 17% AEP in FWOP conditions. As a consequence, water surface elevation around the study area would be expected to slightly increase during select flood events greater than the existing Capital View levee height. The increases in inundation depth would be most applicable for storms greater than the 10% AEP. In these conditions, flows are bluff-to-bluff through the low-lying levees through the study area and increases in depth are added to areas that would be inundated under FWOP conditions regardless.

Modeling indicates adjacent levees would not experience a detectable change in AEP of overtopping with implementation of CA13. Hydraulic modeling also indicates that any changes to river velocities in the channel and at the existing port location are within velocity parameters observed in existing flow conditions.

Impacts to Wears Creek, which is located on the right bank of the Missouri River across from the study area, are expressed as differences in maximum water surface elevation of the Missouri River at the confluence of Wears Creek. CA13 would cause no meaningful change in water surface elevation at the confluence of Wears Creek during the most frequent flow events at the 50% and 20% AEP. At more infrequent flow events, starting at 10% AEP, CA13 would cause a minor increase in water surface elevation. In existing conditions, road closures in the Wears Creek floodplain due to Missouri River flooding begin at the 26-foot river stage, corresponding to a storm probability frequency between 50% and 20% AEP. The U.S. Highway 63 / 50 corridor through the Wears Creek floodplain is closed at a 34-foot

Missouri River stage, corresponding to a storm probability frequency of roughly 2% AEP. The current Jefferson City flood action plan would remain applicable with CA13 due to the relatively small scale of the water surface elevation increases and impacts regarding Wears Creek occurring during less frequent flood events. Thus, the USACE does not anticipate that CA13 would cause substantial adverse impacts relating to water surface elevation.

CA13 would result in short-term adverse impacts to wetlands within the study area. Because wetland areas are located throughout the study area, it is impractical for any proposed levee alignment to avoid them entirely. Instead, the USACE has sought to avoid these areas to the extent practicable and to prioritize avoiding higher quality areas over lower quality areas. In the study area, the lowest quality areas are farmed wetlands, which are areas that could likely support wetland ecology but are currently developed for row crop agriculture. The construction of the levee would impact wetlands along the alignment by filling them in and removing vegetation. Best management practices would be used to minimize impacts to wetlands outside of the levee alignment, such as silt fences to minimize sediment runoff.

Wetlands would be restored in the borrow area located at the Church Farm Conservation Area. The Church Farm Conservation Area appears to have a number of farmed wetlands, and the excavation associated with borrow taking would further enhance wetland hydrology by creating topographic depressions that would hold water and support the growth of hydrophytic vegetation. The USACE would manage invasive species at the borrow site to prevent the area from being overrun by invasive plants, and the process of ecological succession would eventually develop the area into a forested wetland. In addition to this, restored floodplain hydrology in the western part of the L-142 area would enhance the wetlands located there, raising habitat lift further. Habitat modeling provided in Appendix C1 indicates the net effect of this habitat regeneration and enhancement would be an increase in habitat units, which is a representation of the quantity and quality of available habitat. Thus, CA13 would have long-term beneficial effects to wetlands.

Excavation associated with the collection of borrow material would not be anticipated to result in any alternation of the quality, character, or amount of groundwater resources within the study area. Thus, no effect to groundwater would be expected under CA13.

The topics covered in this section are discussed in greater detail in the 404(b)(1) analysis and habitat modeling analysis provided in Appendix C1. Based on this analysis, the USACE has identified CA13 as the Least Environmental Damaging Practicable Alternative (LEDPA). While CA13 does cause short-term adverse impacts that CA0 and CA11 do not, CA13 also restores floodplain hydrology to some areas and results in habitat regeneration of wetland habitat in part of the borrow area. Habitat modeling indicates that this habitat regeneration would ultimately exceed the short-term impacts over the course of the 50-year period of analysis. CA13 would therefore be the LEDPA because it is the only alternative to cause beneficial effects in the long-term. The implementation of CA13 would require the USACE to acquire a 401 Water Quality Certification from the MoDNR. USACE would anticipate obtaining the 401 WQC prior to construction, during the Pre-Construction Engineering and Design (PED) phase.

Floodplains

This section describes possible impacts of the alternatives on the floodplain. As part of the evaluation of potential indirect effects, this section analyzes the potential of the alternatives to promote future development within the floodplain. The section summarizes the eight-step evaluation process under Executive Order 11988, the full documentation of which is provided in Appendix C1. The scope of this analysis is generally focused on the floodplain.

CA0 – No Action. Under CA0, no actions would be undertaken that would impact the floodplain. The current risk of life loss and economic damages due to flood events would be maintained.

CA11 – Nonstructural. None of the measures included in CA11 would affect the floodplain. Floodproofing and structure elevation would make some structures in the floodplain more resilient to flooding impacts. Buyouts and relocations would result in the removal of some structures from the floodplain. Because this

alternative would not alter hydrology or flooding frequency of the study area, CA11 would not promote new developments within the floodplain.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. This alternative would construct a new levee within the Missouri River floodplain. This new levee would reduce the likelihood of flooding impacts for the land behind it because the existing levee has a 17% AEP of overtopping, while the newly constructed levee would have a 1% AEP of overtopping. The portion of the floodplain behind the newly constructed levee would include the Jefferson City Memorial Airport, the Hitachi Energy plant, a wastewater treatment plan, various other businesses, various residences, and some agricultural land (see **Figure 16**). While this area would experience less frequent flooding, the USACE does not anticipate CA13 would promote development in the floodplain. This is because the newly constructed levee would not be designed to FEMA accreditation standards and flood risk would still be associated with the 1% AEP as delineated by the FEMA Flood Insurance Rate Map. The left bank of the Missouri River is specifically outlined in the City's future land use map as a "River Transition Overlay Annexation" which is defined as "areas that need additional scrutiny in regard to development in and around the floodplain, flood prone areas, or environmentally sensitive features." There is added interest for the City to maintain the area east of the airport as undeveloped because it is their sludge disposal location for the adjacent wastewater treatment facility. During floods, there is considerable cost incurred by the City to find an alternative disposal location. The eastern boundary of the existing Capital View Drainage District is maintained in the CA13 footprint due to real estate concerns and to ensure a proposed levee would not impact airport runway operations or height restrictions. Thus, the implementation of CA13 would not promote development in the floodplain due to these unique site conditions.

In addition to the newly constructed levee, CA13 would also remove the existing Capital View levee west of U.S. Highway 54. This would restore floodplain hydrology to approximately 300 acres of land between the new and removed levees. Because CA13 would partially restore the hydrological connectivity of the Missouri River and Turkey without promoting the new development in the floodplain, the long-term effect of this alternative would be beneficial to floodplains. Compliance with each step of the eight-step decision-making process for Executive Order 11988 is fully documented in Appendix C1.

Terrestrial Habitat

This section describes possible impacts of the alternatives on terrestrial habitat. In the context of this study, terrestrial habitat refers to land-based habitat such as riparian forests. The geographic scope of this analysis is restricted to the study area.

CA0 – No Action. Under CA0, no actions would be undertaken that would impact terrestrial habitat.

CA11 – Nonstructural. None of the measures included in CA11 would affect terrestrial habitat.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. In addition to the aforementioned habitat impacts, CA13 would also remove some amount of floodplain forest. Invasive species would be controlled in disturbed areas to prevent their spread. Habitat would be allowed to regenerate in the borrow areas. While floodplain forest habitat may not generally be considered synonymous with wetland habitat, it is still characterized by floodplain hydrology and would thus also be enhanced by the restoration of floodplain hydrology in part of the L-142 area. Habitat modeling provided in Appendix C1 indicates that the long-term effect of this habitat regeneration would be a net increase in habitat units. Thus, while CA13 would cause adverse impacts to terrestrial habitat in the short-term, the long-term effects would be beneficial.

Fish and Wildlife

This section describes possible impacts of the alternatives to fish and wildlife. The analysis in this section evaluates potential effects to animal species that inhabit the area in or around the study area.

CA0 – No Action. Because no action would be undertaken with CA0, there would be no impact to the study area's fish and wildlife.

CA11 – Nonstructural. The measures included in CA11 would have no impact to fish and wildlife.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Short-term impacts to fish and wildlife under CA13 would be negligible. Most of the land impacted by construction activities would be farmland or other areas where native habitat has effectively been lost. The forests and wetlands that would be impacted are all characterized by moderate to severe disturbance by human activities. Thus, the fish and wildlife that are present are generally edge and urban adaptive species that are able to tolerate these disturbances. While construction activities would add to these disturbances in the short-term, these activities would not occur around the clock and would not cause the study area to become unusable for the species that inhabit it currently. By restoring habitat in the borrow areas and restoring floodplain hydrology to some of the habitat in the L-142 area, CA13 would have beneficial effects to fish and wildlife in the long-term.

Threatened and Endangered Species

This section describes possible impacts of the alternatives to threatened and endangered species, or species that are proposed to be listed as threatened or endangered. The analysis in this section evaluates potential effects to species that inhabit the area in or around the study area.

CA0 – No Action. Because no action would be undertaken with CA0, there would be no impact to any threatened or endangered species present in the study area.

CA11 – Nonstructural. The measures included in CA11 would have no impact on threated or endangered species.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. CA13 would require the removal of approximately 20.6 acres of wooded habitat, and site investigations have indicated that much of this habitat contains trees suitable for roosting by Indiana bat, northern long-eared bat, and tricolored bat. However, tree removal activities would be timed to avoid the summer roosting season for these species in order to mitigate impacts. The USACE would complete ESA Section 7 consultation for these species prior to completion of a final report and signing of a FONSI. Because project activities would not meaningfully impact Missouri River in-channel habitat, no impact would occur to pallid sturgeon. Because caves and prairie habitat are absent from the study area, no impacts would occur to gray bat or western regal fritillary.

Migratory Birds

This section describes possible impacts of the alternatives to migratory bird species. The analysis in this section evaluates potential effects to species that are seasonally present or present year-round in the area in or around the study area.

CA0 – No Action. CA0 would have no effect on migratory birds, including bald eagles.

CA11 – Nonstructural. CA11 would have no effect on migratory birds, including bald eagles.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. While CA13 includes tree removal activities that could disturb migratory bird nests, these activities would be timed so that they would occur outside of the nesting season. The restoration of wetlands and floodplain forests at the borrow locations would provide additional habitat to migratory birds in the long-term. However, this is not expected to increase the risk of bird strikes at the airport. The conversion of farmland in the borrow area near the airport to native vegetation would likely decrease the presence of geese there because agricultural land offers better foraging for this animal (Fox & Abraham, 2017) According to a Memorandum of Agreement (MOA) between the FAA, the USACE, and other federal agencies, geese account for the second highest amount of aircraft-wildlife strikes that result in damage or adversely affect an aircraft's flight (see Appendix F). Because the Church Farm Conservation Area is more than five miles away from the airport, habitat restoration at that location is expected to have no meaningful effect on wildlife strike risk at the airport. While bald eagles are known to nest in the vicinity of the Church Farm Conservation Area, borrow

activities would occur more than 660 feet from the nest location, which would make any impacts to the eagles negligible.

Cultural Resources

This section describes potential impacts cultural resources in the study area. Cultural resources are any pre-contact or historic remains or indicators of past human activities, including artifacts, sites, structures, landscapes, and objects of importance to a culture or community for scientific, traditional, religious, or other reasons. Historic properties are cultural resource sites that are listed on or eligible for listing on the National Register of Historic Places.

CA0 – No Action. No federal action would result in no change of conditions to either currently known or unknown historic properties within the study area. Sites would be subject to the same adverse impacts from erosion, land development, or looting activity that they may currently be subject to at present.

CA11 – Nonstructural. CA11 would likely have no negative or positive impacts on historic properties. No known historic properties would be adversely impacted by the nonstructural measures. The effects to historic properties would likely be similar to Alternative CA0. Cultural resource investigations would need to be conducted to determine whether sites would be impacted or protected by the undertaking.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. CA13 could have either positive or negative impacts on historic properties. No known historic properties would be adversely impacted by the CA13 measures. However, currently unknown, or unrecorded historic properties could be affected by the levee setback and through borrow activity. Conversely, currently unknown sites could also be protected from flood damage. Cultural resource investigations would need to be conducted to determine whether sites would be impacted or protected by the undertaking.

Socioeconomics and Environmental Justice

This section describes potential impacts to socioeconomic conditions and Justice40 communities from the alternatives. This evaluation considers the communities and businesses in the study area or are potentially effected by activities within the study area.

CA0 – No Action. No federal action would be undertaken with CA0, and therefore no short-term impacts to socioeconomics or environmental justice would occur. However, flood damages would be expected to continue unabated. There is a long-term risk that businesses in the L-142 area may eventually relocate out of the study area to avoid flood events, and this could result in the local loss of employment opportunities. Justice40 communities and economically disadvantaged communities may be particularly vulnerable to the effects of this risk if it is realized. Thus, long-term adverse impacts to socioeconomics and environmental justice are possible under CA0.

CA11 – Nonstructural. CA11 would have beneficial effects on socioeconomics and environmental justice. The measures included in this alternative would reduce the damages experienced in the study area during flood events. Floodproofing would help make some local employers located within the study area more flood resilient.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. CA13 would have negligible impacts in the short-term. Construction activities would be small enough in scale and intensity that they wouldn’t substantially alter environmental justice factors such as particulate matter, ozone, and traffic proximity. For example, air quality impacts under CA13 would be minor, localized, and temporary. The local community may experience a small short-term socioeconomic benefit from the business and job opportunities associated with construction. CA13 is expected to have a long-term benefit to socioeconomics and environmental justice by making the study area, which supports a variety of local employers, more resilient to flooding events.

Hazardous, Toxic, and Radioactive Wastes (HTRW)

This section describes the potential impacts of the alternatives relating to HTRW materials and contamination. This evaluation is particularly focused on areas with a known history of HTRW contamination.

CA0 – No Action. No HTRW substances would be generated under CA0, and therefore no HTRW impacts would occur.

CA11 – Nonstructural. None of the measures included in CA11 would impact properties that have a known potential for HTRW contamination.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Known contamination sources within the study area would not be anticipated to prevent the implementation of this alternative. The proposed levee alignment under CA13 would intercept the Former MFA Oil Bulk Plant site. The non-federal sponsor would be required to address any HTRW concerns and ensure that lands necessary for the implementation of CA13 are clean. In the event that any HTRW materials are present in the lands necessary for CA13, these substances would be cleaned up and appropriately disposed of. The implementation of CA13 would include strict adherence to health and safety plans and project specifications to avoid potential HTRW impacts. HTRW substances would not be produced by this alternative in any substantial quantity, so there would be no potential for further contamination during construction.

Air Quality

This section describes the potential impacts of the alternatives on air quality. This evaluation considers the study area and other nearby locations because air quality emissions have the potential to effect areas beyond the location of their original source.

CA0 – No Action. There would be no emission of air quality pollutants under CA0.

CA11 – Nonstructural. None of the measures included in CA11 would result in the emission of CA11 in any meaningful quantity.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Construction activities under CA13 would require the use of heavy equipment that emit diesel fuel fumes and exhaust, and fugitive dust would be made airborne from construction activities. However, CA13 would not require nonstop construction and as such, equipment downtime would allow for dispersion of any fumes or fugitive dust generated during construction. In addition, dust control BMPs would be implemented to reduce the impact of fugitive dust, as required by National Pollutant Discharge Elimination System (NPDES) permits. Greenhouse gas emissions caused by this alternative are included in the discussion of climate impacts. As of 31 August 2024, Cole and Callaway Counties, Missouri are both in attainment for all criteria pollutants, and the implementation of CA13 would not cause attainment status to be lost.

Noise

This section describes the potential impacts of the alternatives relating to noise. This evaluation considers the study area and other nearby locations because noise-causing activities can have effects beyond the location of their original source.

CA0 – No Action. The implementation of CA0 would not result in any noise generation.

CA11 – Nonstructural. None of the measures included in CA11 would generate any substantial amount of noise.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Noise associated with this alternative would be limited to noise generated during construction activities. Construction noise would be similar to other machinery used in the local area. Common equipment used during construction generally

emit noise levels around 85 dBA at 45 feet. The noise associated with construction would only occur during daylight hours, thereby providing regular respite from noise-related impacts. CA13 would be expected to result in minor short-term noise impacts.

Aesthetics and Recreation

This section describes the possible impacts of the alternatives on aesthetics and recreational opportunities. Potential aesthetic and recreational impacts are evaluated in and around the study area.

CA0 – No Action. CA0 would not alter the study area's aesthetics or recreational opportunities.

CA11 – Nonstructural. Property buyouts would result in negligible alterations to the study area's aesthetics. Recreational opportunities would be unaffected by CA11.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Aesthetics would experience short-term adverse impacts due to construction activities, though these impacts are not expected to substantially differ from other short-term construction-related activities that have occurred in the past here. The long-term aesthetic impact may be beneficial, as habitat regeneration in the borrow areas would partially restore the area's natural appearance. Adverse recreational impacts would be minor. Impacted recreational features would likely include the Katy Trail, the local golf course, community gardens, and sports practice fields in the recreational area located in the western part of the L-142 area. Impacts would be lessened in the long-term. For example, while it may be necessary to close or detour the Katy Trail during construction activities, the trail could resume normal operation after CA13 was implemented. Some features would experience long-term impacts, such as a partial reduction of the community gardens where the proposed levee alignment overlaps with their current placement. Regardless, the implementation of CA13 would not be expected to substantially alter the character of the study area's recreational opportunities.

Traffic and Transportation

This section describes the possible impacts of the alternatives on traffic and transportation. This evaluation includes transportation by land, water, and air.

CA0 – No Action. CA0 would not impact traffic or transportation in the study area.

CA11 – Nonstructural. None of the measures included in CA11 would impact traffic or transportation in the study area.

CA13 – Hybrid Alignment, 41-ft Stage, Partial Capital View Removal. Construction activities under CA13 would likely result in short-term impacts to traffic. Some of the study area's roadways would need to be temporarily closed during the construction of the levee, which would restrict the movement of traffic. However, because there are a variety of roadways present within the study area, construction would be phased so that alternative routes would be available and minimize the adverse impact to traffic. CA13 would have the long-term benefit to transportation by providing an enhanced level of flood protection for the area it covers, which includes the local airport and a number of roadways. Water surface elevation modeling indicates that road closures in the Wears Creek floodplain would likely occur at about the same frequency under CA13.Detour routes would be comparable or improved upon in comparison to the FWOP conditions. The USACE does not anticipate that impacts to traffic and transportation would be substantial.

Cumulative Effects

The CEQ regulations for implementing NEPA require the assessment of cumulative impacts in the decision-making process. This section describes the methods for identification of cumulative actions and presents the results of the cumulative impact analysis. CEQ defines a cumulative impact as "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 (RFFAs) regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR § 1508.7).

Cumulative Effects Methodology

The cumulative action identification and analysis methods are based on the policy guidance and methodology originally developed by CEQ (1997) and an analysis of current case law. Cumulative impacts were determined by adding the impacts of the alternatives being considered with other past, present, and RFFAs. A process based on four primary steps was employed to assess the cumulative impacts of the alternatives.

Step 1: Identify Potentially Affected Resources

In this step, each resource adversely affected by the alternatives is identified. If there is no or negligible adverse impacts to a resource, by definition there is no cumulative impact and that resource should not be included in the cumulative impact assessment. Also, resources that had entirely beneficial impacts were not included in the cumulative impact assessment.

Step 2: Establish Boundaries (Geographic and Temporal)

In identifying past, present, and reasonably foreseeable actions to consider in the cumulative impact analysis, affected resource-specific spatial and temporal boundaries were identified. The spatial boundary is where impacts to the affected resource could occur from the proposed alternatives and therefore where is defined by the affected resource. The temporal boundary describes how far into the past and forward into the future actions should be considered in the impact analysis. The temporal boundary is guided by CEQ guidance on considering past action and a rule of reason for identifying future actions. For each resource topic, the geographic and temporal boundaries were identified. The geographic/spatial boundary was considered the study area, unless otherwise specified. For all resource topics, the consideration of past actions is reflected in the existing condition. A future temporal boundary of 50 years from the baseline condition was used consistent with the period of analysis identified for evaluation of plan benefits; however, the impacts are based on their likelihood of occurring and whether they can be reasonably predicted.

Step 3: Identify the Cumulative Action Scenario

In this step, past, present, and RFFAs (RFFAs) to be included in the impact analysis for each specific affected resource were identified. These actions fall within the spatial and temporal boundaries established in Step 2. **Table 21** summarizes the cumulative impacts scenario considered for each resource identified for evaluation.

Step 4: Analyze Cumulative Impacts

For each resource, the actions identified in Step 3 are analyzed in combination with the impacts of the alternatives being evaluated. This analysis describes the overall cumulative impact related to each resource and the contribution to this cumulative impact of alternatives being evaluated.

Past Present and Reasonably Foreseeable Future Actions

The study area has been impacted by a variety of past, present, and reasonably foreseeable future actions. Past and present actions that have contributed to the existing conditions of the study area include:

- Crop Production – The conversion of land from native habitat to crop production. Extensive acreage of floodplain habitat within the study area has been removed for agriculture. While some habitat is still present, it is generally disturbed and fragmented.
- Floodplain Development – The development of land for residential, commercial, and industrial purposes. Bridges, highways, local roadways, and utility lines have all been constructed in the study area as well. This has further contributed to the loss and fragmentation of native habitat.

- Levees – The placement, design, and management of structures intended to prevent or control floodplain inundation. In addition to removing habitat during construction, levees also degrade habitat on the landward side by interfering with natural floodplain hydrology that many floodplain species are adapted to. By constricting floodplain flows during high water events, these levees also have the effect of increasing water surface elevation on the riverward side.
- Missouri River Bank Stabilization and Navigation Project (BSNP) – The BSNP consists mainly of rock pile structures and revetments along the outsides of bends and transverse dikes along the insides of bends to force the river into a single active channel that is self-maintaining. As authorized, the BSNP provides a 9-foot-deep channel with a minimum width of 300 feet during the navigation season from April 1 to November 30 between Sioux City, Iowa, and the mouth near St. Louis, Missouri. The need for maintenance dredging dropped sharply in the early 1970s as a result of the structures' confining features. The navigation project is maintained by placing river training structures to confine and direct the channel.
- River Transition Overlay Annexation – Jefferson City, MO has designated the study area as the River Transition Overlay Annexation in response to the flood risk that the area is subject to. According to this designation, this area needs "additional scrutiny in regard to development in and around the floodplain, flood prone areas, or environmentally sensitive features." This regulates development within the study area.

The USACE assumes that the River Transition Overlay Annexation will be maintained throughout the period of analysis. The USACE assumes currently existing infrastructure within the study area will be maintained. The USACE is unaware of any current or planned proposals that would substantially alter the presence or operation of businesses and other facilities within the study area. Regardless, the USACE has identified several reasonably foreseeable future actions that may cause impacts in or around the study area.

- Lower Missouri River Flood Risk and Resiliency System Plan (System Plan) – The System Plan is a currently ongoing USACE study that seeks to improve resiliency to flood risk across the entire Missouri River floodplain from Sioux City, Iowa to St. Louis, Missouri. The System Plan will identify potential spin off studies that would have the objective to reduce public safety risk and economic damages due to flooding impacts along the Missouri River. The study documented in this FR/EA is one such spin off study, and the USACE is currently in progress with two other spin off studies. The System Plan itself will not contain any construction recommendations, though the USACE anticipates that it will identify potential themes for future spin off studies, such as increasing conveyance through levee setbacks. The goal of the System Plan is to identify potential future spin off studies and unify the studies undertaken to so that their recommendations are compatible and work synergistically to address flood risk across the entire lower Missouri River floodplain.
- Jefferson City Memorial Airport Master Plan – The Jefferson City Memorial Airport Master Plan makes a number of recommendations regarding the facility. These recommendations include the partial relocation of one runway; the extension and widening of another runway; the expansion of the terminal area with box/corporate hangars; improvements to perimeter fencing, the gate, and overall security; and a new location for the air traffic control tower. The USACE assumes that these recommendations would be carried forward for implementation of which alternative is recommended in this FR/EA.
- Highway and Roadway Projects – MODOT has a number of planned or ongoing projects in and around the L-142 area, such as pavement resurfacing, guardrail replacement, bridge maintenance and rehabilitation, and highway widening. Such actions are typical for roadway maintenance, and the USACE assumes that activities such as these would occur throughout the period of analysis.

Table 21. Cumulative Effects Scenario for Evaluated Resources.

Impact Topic	Spatial Boundary	Past Actions	Present or Ongoing Actions	Reasonably Foreseeable Future Actions
Geology and Soils	Study Area	Crop Production, Floodplain Development, Levees, River Transition Overlay Annexation	Crop Production, Floodplain Development, River Transition Overlay Annexation	Crop Production, Floodplain Development, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Construction Projects
Surface Water and Other Aquatic Resources	Hydrology: Missouri River Mile 98 – 197. Other Aquatic Resources: Study Area	Crop Production, Floodplain Development, Levees, River Transition Overlay Annexation, BSNP	Crop Production, Floodplain Development, Levees, River Transition Overlay Annexation, BSNP	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, System Plan, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Floodplains	Study Area	Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, System Plan, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Terrestrial Habitat	Study Area	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Fish and Wildlife	Study Area	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects

Impact Topic	Spatial Boundary	Past Actions	Present or Ongoing Actions	Reasonably Foreseeable Future Actions
Threatened and Endangered Species	Study Area	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Migratory Birds	Study Area	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Cultural Resources	Study Area	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Air Quality	Study Area	Floodplain Development, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Noise	Study Area	Floodplain Development, Levees, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects

Impact Topic	Spatial Boundary	Past Actions	Present or Ongoing Actions	Reasonably Foreseeable Future Actions
Aesthetics and Recreation	Study Area	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Crop Production, Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects
Traffic and Transportation	Study Area	Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Floodplain Development, Levees, BSNP, River Transition Overlay Annexation	Floodplain Development, Levees, BSNP, River Transition Overlay Annexation, Jefferson City Memorial Airport Master Plan, Highway and Roadway Projects

Cumulative Effects by Resource

Geology and Soils

Past actions in the study area have disturbed the natural soil conditions but have also made the area more suitable for agriculture. Present and ongoing actions have a comparatively smaller impact on soils since the study area is already developed. Minor soil disturbing activities are somewhat common and the USACE assumes that soil erosion in the agricultural fields is typical. CA0 would not disturb soils and CA11 would have a negligible impact on soils. The soil disturbance caused by CA13 would be a minor incremental increase to these disturbances. By removing levee coverage for part of the study area, CA13 could result in the effective conversion of 271.2 acres of prime farmland. Some actions proposed by the Jefferson City Memorial Airport Master Plan, such as runway extension, would also likely result in the loss of agricultural land. Highway and roadway projects may also disturb soils, though most likely only in the vicinity of currently existing highways and roads. Cumulatively, CA13 and the RFFAs would cause minor impacts to soils, though there would not be a substantial loss of soil resources. These actions would not cause the study area to become unsuitable for agriculture. Should CA13 be carried forward for implementation, the USACE would coordinate potential impacts with the NRCS. Geology does not appear to be meaningfully affected by the past, present, or reasonably foreseeable future actions, or by any of the alternatives.

Surface Water and Other Aquatic Resources

Past actions have substantially altered the surface water and other aquatic resources in and around the study area. The BSNP has engineered the Missouri River into a single-threaded channel, and the levees constructed along most of its floodplain have hydraulically constricted the river. By preventing floodwaters from spreading over the entire floodplain and by constructing hydraulic pinch points, water surface elevations during flood events have been restricted in footprint and made vertically more severe when compared to natural conditions. Developments that have altered the land use of the Missouri River floodplain have also resulted in the widespread loss of wetland habitat that was otherwise common historically. Present and ongoing actions are not substantially altering these aquatic resources further and instead have the effect of largely maintaining these disturbed conditions. However, soil disturbing activities and the use of fertilizers for agricultural and residential land do have adverse impacts on water quality. Jefferson City's adoption of a River Transition Overlay Annexation has had the beneficial effect of adding scrutiny for developments around environmentally sensitive features.

CA0 and CA11 would have no meaningful impact on surface water or other aquatic features. The levee constructed under CA13 would be one of many within the Missouri River floodplain. In order to evaluate the cumulative effect that the CA13 levee would have with these other currently existing levees, the USACE's hydraulic modeling evaluated the reach from Boonville, MO near Missouri River Mile 197 to Hermann, MO near Missouri River Mile 98, extending roughly 50 Missouri River miles upstream and downstream of the study area.

Of the RFFAs, the System Plan is the most noteworthy for aquatic resources. Actions proposed under the Jefferson City Memorial Master Plan and the various planned highway and roadway projects are expected to have negligible hydraulic impacts. Under the System Plan, the USACE anticipates that a variety of flood risk studies similar to the one documented in this report will be undertaken throughout the Missouri River floodplain between Sioux City, Iowa and St. Louis, Missouri. The USACE anticipates that these future studies will formulate potential measures to address flood risk similar to measures formulated in this study. At this early stage, it cannot be fully determined how many of these studies wouldbe undertaken, where precisely they would be located, what recommendations they would make, or how many recommendations would be carried forward for implementation. However, it can be assumed that these other studies would have the objective to reduce public safety risk and economic damages due to flooding impacts along the Missouri River.

The two other ongoing studies under the System Plan are located around Brunswick, Missouri and Holt and Doniphan Counties in Missouri and Kansas, respectively. These locations are beyond the hydraulic modeling extent of this study. Modeling done for CA13 indicates that this alternative would not meaningfully impact hydraulics at the locations of these other studies, as CA13's hydraulic effects attenuate into negligibility within the modeled extent. The USACE assumes that any recommendations made at these locations, if implemented, would be far enough removed from the area modeled in this study to have a negligible potential for adverse cumulative effects with CA13. Any ongoing or future studies conducted under the System Plan would also be evaluated for their potential to have hydraulic impacts, on both an individual scale and cumulatively with other past, present, and reasonably foreseeable future actions. Thus, based on the modeling results for CA13 and the assumptions that can be safely made about the System Plan and the studies that are and will be conducted under it, the USACE does not anticipate substantial adverse cumulative impacts. The intent of the System Plan is to organize these various studies and promote recommendations that are compatible such that they would have a cumulatively beneficial effect on flood risk resiliency.

CA13 would result in some disturbed wetlands being lost due to levee construction. While this would cause adverse effects in the short-term, CA13 would also allow floodplain wetland habitat to regenerate and recover from historical impacts from agriculture. Based on the habitat modeling provided in Appendix C1, the USACE anticipates that CA13 would result in the long-term increase of 66 average annual habitat units for wetland habitat. It is possible that the actions proposed under the Jefferson City Memorial Master Plan and the various planned highway and roadway projects would result in the loss or degradation of wetlands. Because wetland habitat is generally scarce or highly degraded in the vicinity of the airport, highways, and roadways, the USACE anticipates that these RFFAs would have a very minor effect on wetlands and does not anticipate that they would counteract the overall benefit of CA13.

Floodplains

The study area's floodplains have been substantially altered by past actions. The BSNP has engineered the Missouri River into a single channel that is largely fixed in place and no longer moves throughout the floodplain. Levees have cut the Missouri River off from a large portion of its natural floodplain, and various forms of development (residential, industrial, etc.) has occurred in the floodplain. Present actions in the floodplain do not substantially alter these conditions and no major developments are currently underway. RFFAs that impact the study area are limited to activities that would modify currently existing developments, such as the Jefferson City Memorial Airport Master Plan and the various planned highway and roadway projects. CA0 and CA11 would have no meaningful impact on floodplains. The CA13 levee would be one more development within the floodplain, but it would also remove part of the currently existing Capital View levee. The CA13 levee would not be designed to FEMA accreditation standards,

which means that the area behind this levee would still be associated with the 1% AEP as delineated by the FEMA Flood Insurance Rate Map. Consequently, CA13 would not promote further development of the floodplain that could otherwise have the potential to cumulatively impact the floodplain.

Terrestrial Habitat

Past actions in the study area have resulted in most of original terrestrial habitat being lost. Most of this habitat would have been removed when the study area was developed for agriculture, though subsequent developments for residential, commercial, and industrial land use would also have contributed to some degree. Present and ongoing actions have generally prevented this habitat from regenerating naturally, though the River Transition Overlay Annexation has had the beneficial effect of adding scrutiny for developments around environmentally sensitive features. CA0 and CA11 would have no meaningful impact on terrestrial habitat. CA13 would cause minor impacts in the short-term by removing some disturbed habitat but would benefit habitat by allowing it to regenerate in the L-142 Area and Church Farm Conservation Area. The areas around the Jefferson City Memorial Airport, highways, and roadways generally lack terrestrial habitat of meaningful quantity or quality, so the USACE anticipates that these RFFAs would have a very small effect on terrestrial habitat and does not anticipate that they would counteract the overall benefit of CA13.

Fish and Wildlife

Historically, the study area would have exhibited a wider diversity of fish and wildlife species, However, past actions have resulted in most of the original habitat being lost and left the surviving habitat degraded and fragmented. Thus, species in the study area are generally edge and urban adaptive species that can tolerate these kinds of conditions. This has blunted further impacts that could be caused by present actions, and most ongoing actions in the study area occur in locations that are already developed. The River Transition Overlay Annexation has had the beneficial effect of adding scrutiny for developments around environmentally sensitive features that might be used by fish and wildlife. CA0 and CA11 would have no meaningful impact on fish and wildlife. CA13 would have minor impacts to fish and wildlife in the short-term, though this resource would benefit from the regeneration of floodplain habitat in the long-term. Activities around the Jefferson City Memorial Airport, highways, and roadways would have little effect on the study area's fish and wildlife and would have a negligible potential to counteract CA13's benefits to fish and wildlife.

Threatened and Endangered Species

This discussion is focused on Indiana bat, northern long-eared bat, and tricolored bat because these are the only threatened or endangered species that are potentially affected by the alternatives. Past actions have removed much of the forested habitat that provides summer roosting locations for these tree-roosting bats. Present activities may remove trees from time to time, but forested habitat isn't generally removed in noteworthy quantities. CA0 and CA11 would have no impact on these species or their habitat. CA13 would remove approximately 20.6 acres of wooded habitat during construction, though tree removal activities would be timed to occur outside of the summer roosting season for these species. In contrast, approximately 275 acres of forested habitat would be allowed to naturally regenerate under CA13 which would benefit these species in the long-term. Tree removal may also be necessary for actions proposed in the Jefferson City Memorial Airport Master Plan and for planned projects involving the study area's highways and roadways. However, trees are generally sparse in the immediate vicinity of the airport, highways, and roadways, so the USACE does not anticipate substantial loss of summer roosting habitat for listed bats resulting from these RFFAs. Therefore, the USACE would not expect a substantial adverse cumulative impact to Indiana bat, northern long-eared bat, or tricolored bat.

Migratory Birds

The loss of most of the study area's original habitat due to land development and other past actions have adversely impacted migratory birds. Present and ongoing actions have had a comparatively smaller effect since these activities are usually focused on locations that have already lost suitable habitat for migratory birds, but these actions have also prevented this habitat from regenerating in the places it has been lost

in. CA0 and CA11 would have no impacts on these species or their habitats. CA13 would have some minor short-term impacts due to habitat removal during construction, but these activities would be timed to avoid the nesting seasons for these birds to minimize impacts. In contrast, approximately 275 acres of native floodplain habitat would be allowed to naturally regenerate under CA13, resulting in long-term benefits to migratory birds. Some habitat disturbance may be necessary for actions proposed in the Jefferson City Memorial Airport Master Plan and for planned projects involving the study area's highways and roadways. However, suitable habitat is generally sparse in the immediate vicinity of the airport, highways, and roadways, so the USACE does not anticipate substantial impacts to migratory birds resulting from these RFFAs. Thus, the USACE would not anticipate a substantial cumulative impact to migratory birds.

Cultural Resources

No known historic properties are recorded within the area of potential effect (APE) for any alternatives. However, the APE has only been partially inventoried for historic properties and there is a potential for currently unknown historic properties in the APE. Investigations and subsequent effect determinations would need to be made to determine if the undertakings would affect historic properties. It is unknown whether and to what degree the urban development in the study area from the Memorial Airport, highways, and roadways have impacted the potential for historic properties to remain in the APE. In general, Alternatives CA0 and CA11 are less likely to impact historic properties due to less ground disturbance and alternative C13 is more likely to have adverse effects given the increased ground disturbance in that alternative. All undertakings with the potential to affect historic properties will be subject to measures outlined in an NHPA Programmatic Agreement now being developed between the USACE, Missouri SHPO, Tribal Nations, and the ACHP. Due to this Programmatic Agreement and the nature of the RFFAs, the USACE does not anticipate cumulative adverse impacts to cultural resources.

Air Quality

Past actions in the study area involved the use of machinery and equipment that has the potential to affect air quality, but emissions dissipate over time. Present day activities in the study area do have associated emissions, particularly from the use of vehicles. However, the study area is currently in attainment for all criteria pollutants for air quality, so it can be surmised that these ongoing activities have a small effect on air quality. CA0 has no potential for air quality impacts. CA13 and the RFFAs would all involve the use of equipment that have some potential for emissions that affect air quality, such as diesel fumes. It is highly unlikely that active construction for these actions would occur around the clock, providing time for any emissions to dissipate. The USACE assumes that any air quality emissions associated with these actions would be typical for construction activities. Thus, the USACE does not anticipate a cumulative air quality impact.

Noise

Past actions in the study area have caused noise impacts, but this impact is fleeting by nature. Present day activities cause noise primarily by industrial activity and vehicles. CA0 would generate no noise, while CA11 and CA13 would generate noise to varying degrees. The USACE expects that noise generated by these alternatives would be within levels typically generated by construction activities. The actions proposed in the Jefferson City Memorial Airport Master Plan and for planned projects involving the study area's highways and roadways would also generate noise of presumably similar levels. Even in the unlikely event that CA11 or CA13 was implemented at the same time as these other RFFAs, these activities would be dispersed across the study area and would not be expected to require around-the-clock work. Thus, the USACE does not anticipate cumulative noise impacts.

Aesthetics and Recreation

The study area's original aesthetics have been substantially altered by past actions that have largely removed the native floodplain habitat. However, various recreational developments have occurred in the study area, such as the Katy Trail, a golf course, and other features. Present actions largely act to maintain these conditions. CA0 and CA11 would have no meaningful impact on aesthetics or recreation.

CA13 would cause minor short-term aesthetic impacts during construction activities and would temporarily inhibit access to some recreational features in the study area. This is likely also the case with the actions proposed in the Jefferson City Memorial Airport Master Plan and for planned projects involving the study area's highways and roadways. There would not be a substantial cumulative impact to aesthetics because construction-related disturbances are fairly common in the study area anyway, and CA13 would be beneficial in the long-term by allowing lost habitat to regenerate. The USACE does not anticipate that these actions would cumulatively cause a substantial loss of access to recreational resources and any adverse impact from these activities would be temporary.

Traffic and Transportation

Past actions have created the transportation infrastructure that exists today within the study area. This includes highways, roadways, bridges, the Jefferson City Memorial Airport, and river navigation via the BSNP. In the present day, maintenance activities occasionally require transportation along highways and roadways to be partially restricted, though the overall capacity for transportation is maintained. CA0 and CA11 would not meaningfully impact traffic or transportation. While CA13 has short-term and potential long-term impacts to traffic and transportation, the actions proposed in the Jefferson City Memorial Airport Master Plan and the planned projects involving the study area's highways and roadways would only be expected to have short-term impacts. All of these actions have the potential to temporarily close roads and therefore concentrate traffic onto alternate routes. The USACE would coordinate with MODOT to ensure that CA13 would be timed to ensure that these alternate routes would be available. The design of the levee under CA13 was developed with the Jefferson City Memorial Airport Master Plan in mind by allowing enough space around airport for runway extensions. Thus, CA13 would not interfere with the successful implementation of these RFFAs.

4.2 MITIGATION, MONITORING, AND ADAPTIVE MANAGEMENT

The implementation of CA13 would cause unavoidable impacts to wetland habitat. In particular, the proposed levee alignment crosses over a number of likely wetland sites which would need to be filled in. In order to maintain compliance with the Clean Water Act, the USACE would need to mitigate for these impacts after altering the design to minimize these impacts to the extent practicable. If CA13 is carried forward for implementation, the USACE would need to do a cost effectiveness analysis between different mitigation methods, such as mitigation in-kind by habitat restoration or mitigation through the use of a wetland credit mitigation bank. If the USACE identified in-kind mitigation as the most cost-effective method, the USACE would develop a monitoring and adaptive management plan for the mitigation activities.

The monitoring and adaptive management plan would outline the methods and requirements of wetland restoration activities. The location of restoration activities, species planted, and necessary actions to the environment to achieve restoration goals (e.g., earthwork to support wetland hydrology) would need to be identified. Because borrow activities in the Church Farm Conservation Area would be conducted in an area suitable for wetland restoration, the monitoring and adaptive management plan would detail how the borrow collection activities would need to be performed to make the site suitable for reestablishing wetland ecology. The plan would need to detail the monitoring regime that would evaluate the condition of the restoration site relative to defined ecological success criteria. These ecological success criteria would define the metrics by which restoration success is determined. The plan would also include adaptive management measures that would be employed if the monitoring activities indicated that there was a substantial risk that one or more ecological success criteria would not be met. Once all of the ecological success criteria would be achieved, the restoration would be deemed successful, and the management of the site would transition to long-term maintenance.

Any direct or indirect impacts to cultural resources would be addressed in the NHPA Programmatic Agreement now being developed between the USACE, Missouri SHPO, Tribal Nations, and the ACHP. A copy of the current draft of the Programmatic Agreement is included in Appendix C1.

5.0 Plan Comparison and Selection

5.1 PLAN COMPARISON

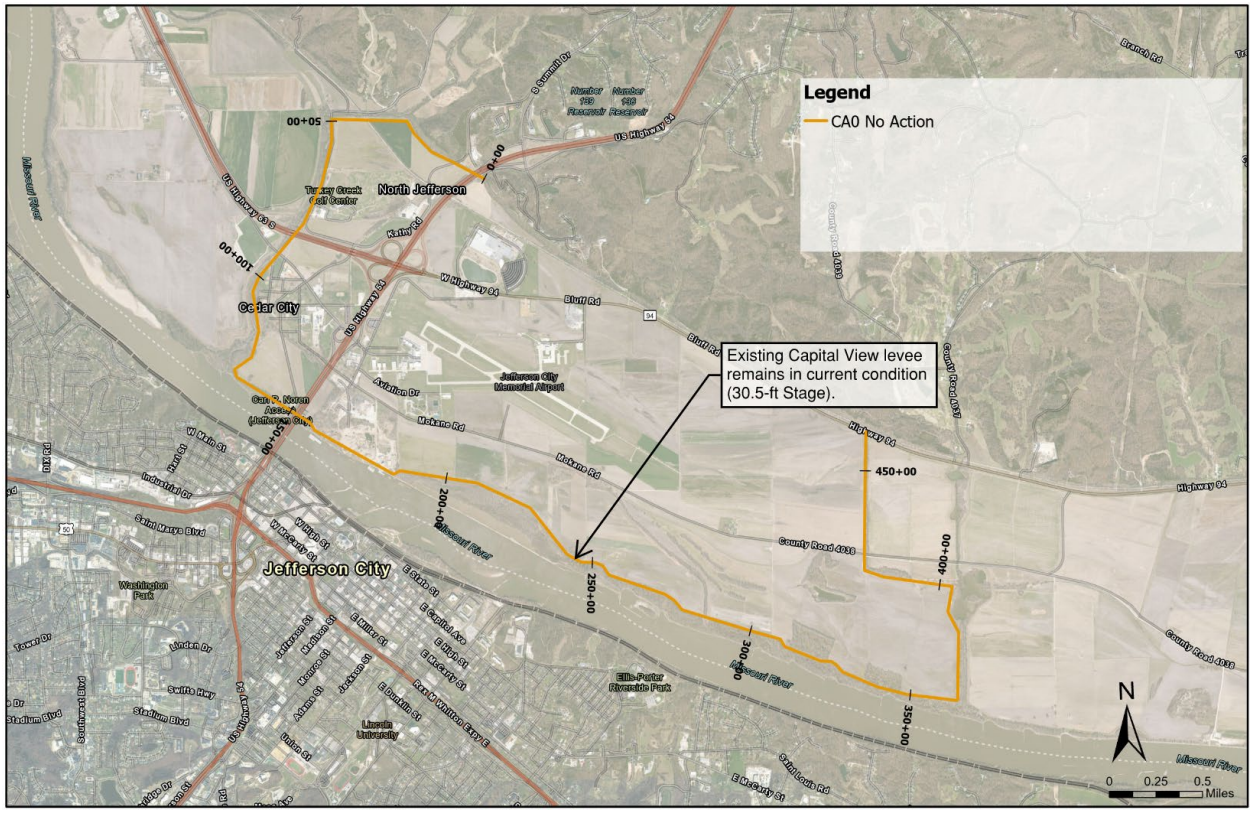
The PDT, in cooperation with the non-federal sponsor, determined the final array to be three alternatives. Descriptions of the final array of alternatives follow:

Combined Alternative 0 No Action

CA0 is the No Action Alternative (NAA). USACE planning policy (Engineering Regulation 1105-2-103) and NEPA require consideration of an NAA. The NAA is the basis for the FWOP Condition and assumes no measures would be implemented by the federal government to achieve the planning objectives. The NAA is the base condition to measure FWP alternatives.

The NAA would not reduce flood risk within the study area, including economic damages caused by inundation of structures, agricultural lands, and impacts to the businesses and critical infrastructure. No action would result in continued, recurring flooding which causes major impacts to transportation, regional supply chains, and community cohesion. The existing non-federal levee, Capital View, would remain in its current condition performing at 17.0% AEP of overtopping. The NAA is shown in **Figure 11**.

Figure 11 Map of CA0 No Action



Combined Alternative 11 Nonstructural

CA11 is the nonstructural alternative carried forward for consideration which includes elevating, dry floodproofing, wet floodproofing, and buyouts/relocations. Cost uncertainty exists with this alternative due to a lack of parametric costs. The PDT aggregated the nonstructural measures by floodplain and occupancy type. Multiple iterations of a nonstructural plan were formulated but ultimately the PDT decided to formulate a nonstructural plan based on commercial and public service cohesion, identity, and resilience. This plan entails nonresidential structures remaining in place and receiving elevation or

floodproofing where applicable. Residential structures, along with outbuildings on the same parcel, would be elevated or bought out/relocated to reduce damages and life safety risk. It should be noted that a substantial effort was made after the historic Flood of 1993 to implement nonstructural measures within the FEMA mapped floodplain. This was undertaken by the City of Jefferson City and resulted in hundreds of buyouts, relocations, updated zoning of the left-bank floodplain for development, and elevations of critical infrastructure. Therefore, the PDT was limited in structures left in the leveed area that would be eligible for nonstructural measures. **Figure 12** and **Table 22** detail the structures considered along with the measure identified for each.

Figure 12 Map of CA11 Nonstructural

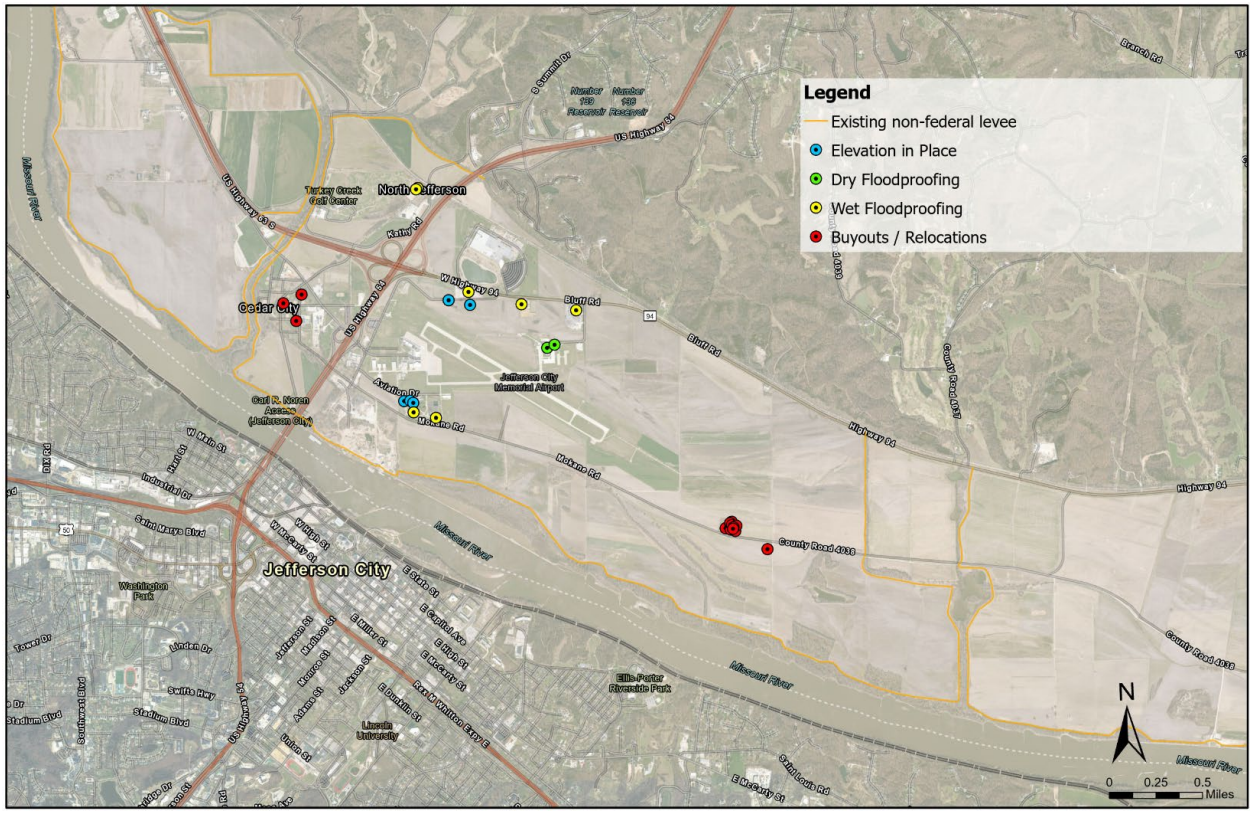


Table 22 CA11 Measure Breakout

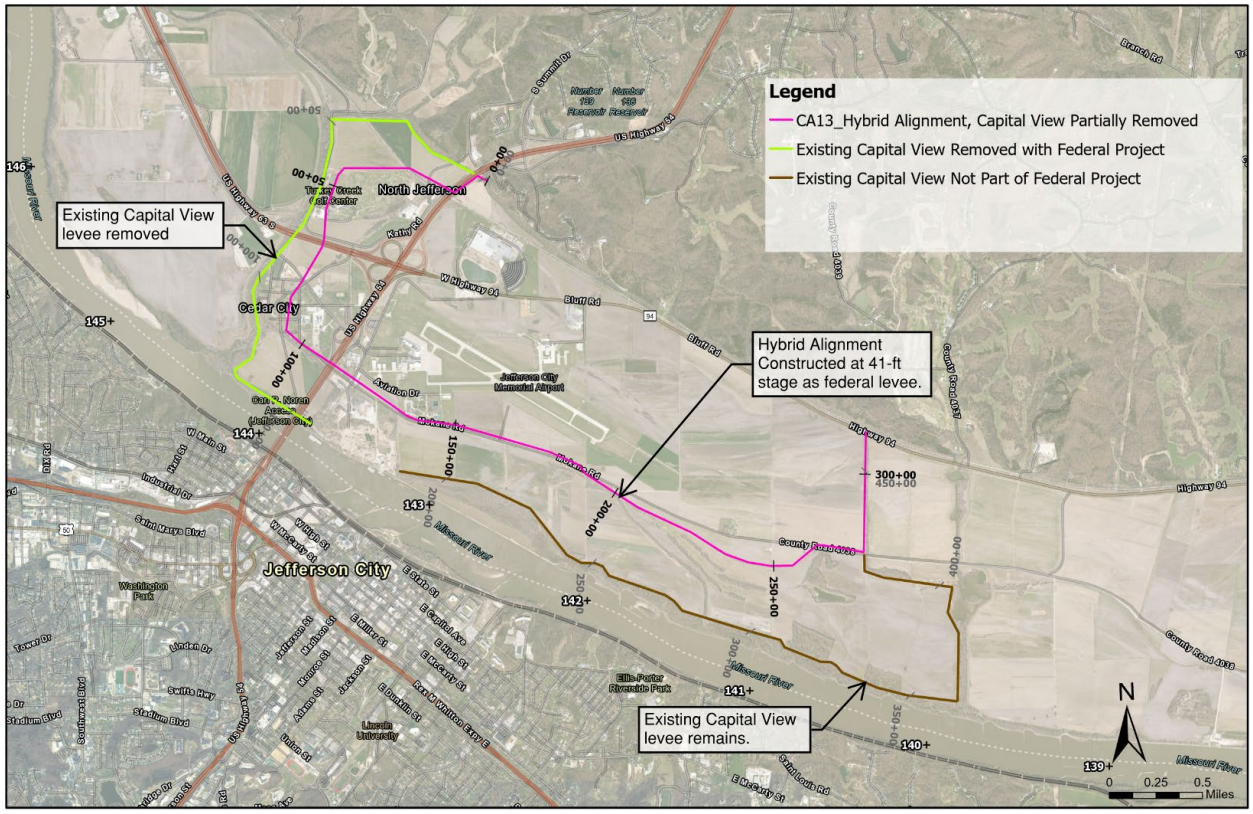
Total Structures Eligible in Plan	Structures Being Recommended for Elevation	Structures Being Recommended for Dry Floodproofing	Structures Being Recommended for Wet Floodproofing	Structures Being Recommended for Buyout/Relocation
28	5	2	7	14

Combined Alternative 13 Hybrid Alignment, 41-ft Stage, Partial Capital View Removal

The structural alternative carried forward for this project area is a federal levee system that was evaluated to have a 1% AEP of overtopping. The levee seeks to maximize public right-of-way and property for the levee footprint and protects access to critical infrastructure and vital transportation corridor. The alignment

of the levee was iterated multiple times by the PDT, local stakeholders, and the non-federal sponsor. The alignment is shown in **Figure 13**. This alignment assumes the bright green segment of the existing levee, Capital View, west of U.S. Highway 54/U.S. Highway 63 is removed as part of the federal project. The existing levee in brown is not considered for any modification or removal as part of the federal project. Any remaining Capital View levee would not be eligible for repair assistance under the P.L. 84-99 RIP. **Figure 13** shows the recommended alignment for CA13.

Figure 13 Map of CA13 Hybrid Alignment, 41-ft Stage, Partial Capital View Removal



Once CA13 was identified as the most feasible structural alternative, an abbreviated flood risk assessment was performed by the PDT. Under CA13, the annual probability of failure by overtopping was lowered by 1.5 orders of magnitude compared to the existing Capital View levee. The new CA13 levee would have an overtopping AEP of 0.01 (1/100 yr). The AEP for one foot of overtopping is approximately 0.002 (1/500 yr). That total Life-Safety Risk is driven primarily by overtopping, with all breaching prior to overtopping PFMs (probable failure modes – i.e. erosion, foundation/embankment seepage and piping, slope stability, closure structure failure) plotting at least 1.5 orders of magnitude less than the overtopping PFM.

Life loss consequences are estimated to be between 0.3 and 3 under the overtopping PFM according to a LifeSim analysis. The leveed area is not densely populated, and evacuation routes are short, less than two miles. The Missouri River is a slow rising system that would allow days to weeks of advanced notice before a large-scale flood loaded the system. Based on the updated LifeSim modeling, estimated daytime life loss is 3 and the nighttime incremental life loss is 0. The team determined the average annual life loss would be between 0.3 and 3, with an average annual life loss of 1. See Appendix G for more detail.

The following describes the way the final array criteria were evaluated:

<u>NED:</u>

- Total Investment Cost.
- BCR.
- Net Annual Benefits in flood damages reduced and detour and delay costs reduced.

RED:

- Local Capture (RECONS), or the economic impacts to the region resulting from the proposed construction of the TSP.
- Allowing major employers to stay open and provide goods and services to the region, along with the employment benefits of those jobs.
- Agricultural Protection, specifically the average annual crop acreage inundated.

OSE:

- Life Safety.
- Adhering to Lower Missouri River System Plan goal of increased conveyance.
- Providing FRM benefits to a Justice40 community, maintaining access to goods, services, and transportation networks.
- Better access to free outdoor recreational opportunities via the Katy Trail.

EQ:

- Net AAHUs from restored acres.
- Cultural Resources.

A more detailed discussion of the four accounts and the metrics and screening criteria utilized can be found in Appendix E, Economics and Social Considerations.

Initially, the PDT conducted an economic comparison of the final array, shown in **Table 23**.

Table 23 Final Array Plan Economic Comparison

Alt	Description	Level of Performance	Total Capital Cost	Annual Cost	Annual Benefits	Net Benefits	BCR
CA0	No Action	17.0% AEP (1/6yr)	$0	$0	$0	0	0
CA13*	Hybrid Alignment, 41-ft Stage, Partial Capital View Removal	1.0% AEP (1/100yr)	$310,282,300	$13,421,700	$15,774,600	$2,352,900	1.2

Alt	Description	Level of Performance	Total Capital Cost	Annual Cost	Annual Benefits	Net Benefits	BCR
CA11*	Nonstructural	17.0% AEP (1/6yr)	$11,291,000	$497,500	$306,200	$-191,300	0.6

**All dollar amounts in Oct 2024 $*

The USACE feasibility planning is guided by the Principles and Guidelines for Water and Land Related Resources Implementation Studies (Principles & Guidelines). The 1983 Principles & Guidelines define the Federal Objective of The USACE project planning, which is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements. A wide range of alternatives were investigated and the alternative with the greatest net economic benefit was identified as the NED Plan. The alternative plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment is defined as the NED plan, and in this study, CA13 is the NED Plan.

5.2 TOTAL NET BENEFITS EVALUATION

The final array was then considered across the four accounts (NED, RED, EQ, and OSE). The NED account displays changes in the economic value of the national output of goods and services. The EQ account displays non-monetary effects on significant natural and cultural resources. The RED account registers changes in the distribution of regional economic activity that result from each alternative plan. The OSE account registers plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

National Economic Development

The intent of comparing alternative plans in terms of NED is to evaluate the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects are considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED are expressed as the plan's economic benefits, and the adverse NED effects are the investment opportunities lost by committing funds to the implementation of a plan. In this case, NED benefits are the reduction in flood risk achieved by expending NED costs to implement a project, and net benefits are the difference between these NED benefits and NED costs. The HEC-FDA model and the detour/delay spreadsheet model were utilized to estimate FWOP and FWP NED benefits for each alternative. These benefits were then compared to cost. Analysis included flood damages to buildings and contents, road damage, traffic detours and delays, vehicle damage, displacement, and cleanup. A breakdown of expected annual damages is shown in **Table 24**, and additional details of the NED Account analysis can be found in Appendix E, Economics and Social Considerations.

Table 24 Annual Damages in NED Account for FWOP Condition

	Detour/Delay Annual Damages	FDA Damages (structures, roads, vehicles, displacement, cleanup)	Total Annual Damages
Future Without Project	$847	$17,904	**$18,751**

**Numbers in $1,000's, Oct 2024 Price Level*

The No Action alternative would not reduce these total annual damages. The Nonstructural Plan, CA11, would only reduce these damages to the 28 structures in the floodplain that would include a nonstructural measure. CA13 would benefit transportation systems, which are vulnerable to flooding, resulting in fewer delays and detours. These delays and detours are substantial, as there are not many places to cross the Missouri River, so it is not uncommon for detours to be 10-100 miles. It would also benefit the area with reductions in damage to structures, roads, vehicles, displacement of businesses and people, and the cleanup which must occur after a flood event. Therefore, CA13 has the greatest annual net benefits.

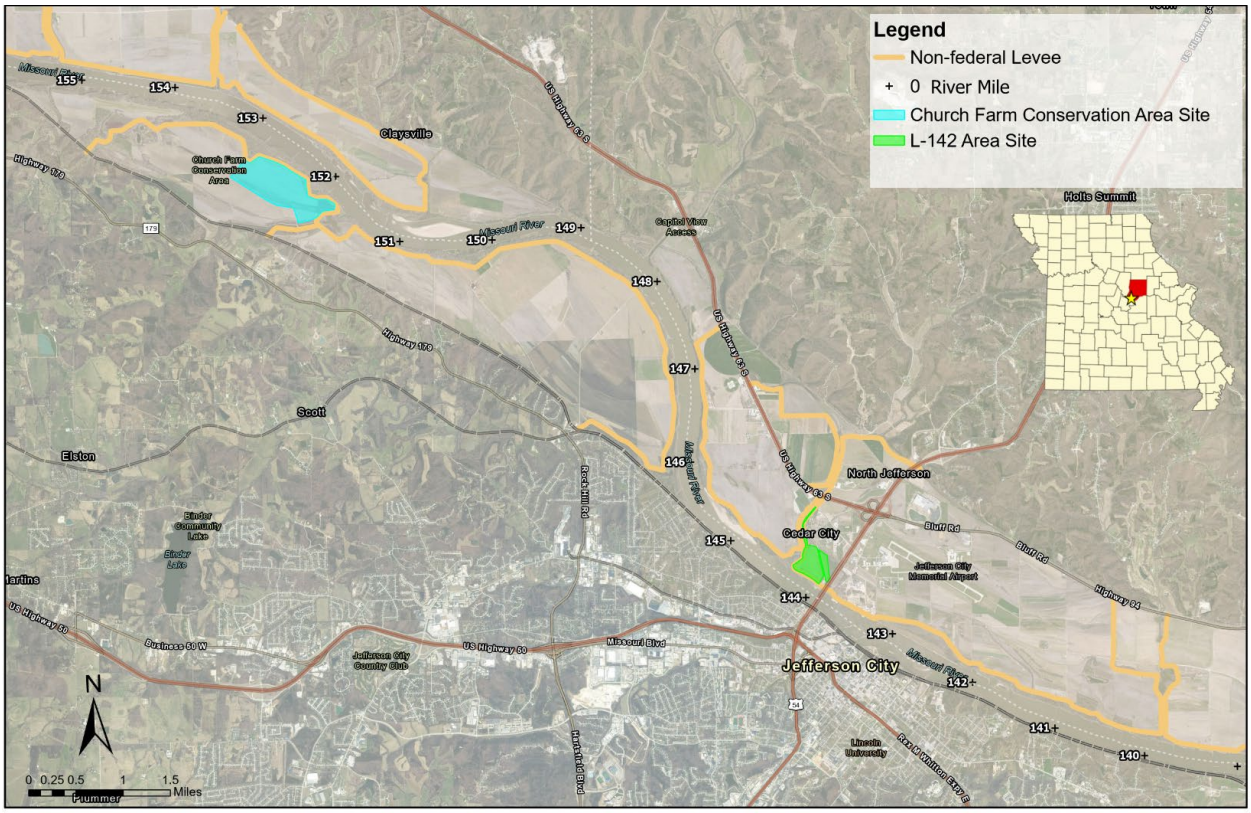
Environmental Quality

The EQ account is intended to indicate the long-term effects that the alternative plans may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural, and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. Significance is derived from institutional, public, or technical recognition that a resource or an effect is significant. All alternatives were formulated to first avoid impacts to significant resources, particularly species and critical habitat protected by the ESA. If avoidance was not possible then minimization was utilized in order to have the least impacts on regulated resources occurring in the system. Impacts to resources would continue to be considered, evaluated, and avoided or minimized to the extent possible.

In this study, the EQ benefits are greatly impacted by the land use that falls outside of the new leveed area. Much of this land is in private ownership and is currently in agricultural production. The conversion of private land into EQ lands would be a substantial issue for landowners, local stakeholders, and general public project support as well. Therefore, the PDT sought to maximize the EQ benefits that could be gained through publicly owned lands outside of the new leveed area. When looking at the final array of alternatives, the PDT determined that a benefits to the environment are only gained through CA13. CA0 (No Action) and CA11 (Nonstructural) result in zero restored acres. CA13 would restore floodplain hydrology by removing part of the Capital View levee, and the USACE assumes that approximately 61.5 acres of publicly owned land in this restored area would be allowed to naturally regenerate native floodplain habitat. The area of this restored habitat also has benefits of flood risk reduction, as it allows for conveyance of the Turkey Creek Tributary which is an issue during high water on the Missouri River. The USACE assumes that borrow activities in the Church Farm area would be done in a manner that would restore variable floodplain topography and that this area would be taken out of row crop agriculture and allowed to naturally regenerate native floodplain habitat. The total acreage of restorable, publicly owned land at the Jefferson City area and Church Farm area exceeds the estimated acreage necessary for mitigating impacts. The PDT used the FACWet model, which is a general ecological model for wetlands and riparian habitat, to determine the benefits in the EQ account. This approach is detailed in Appendix C1. A map of the areas contributing to the EQ benefits is in **Figure 14**.

Cultural resources were also considered as part of the EQ account. As discussed in Chapter 4, CA13 could have either positive or negative impacts on cultural resources. No known historic properties would be adversely impacted by the CA13 measures. However, currently unknown, or unrecorded historic properties could be affected by the levee setback and through borrow activity. Conversely, currently unknown sites could also be protected from flood damage. Cultural resource investigations would need to be conducted to determine whether sites would be impacted or protected. Potential adverse impacts to cultural resources caused by CA13 would be addressed in the NHPA Programmatic Agreement now being developed between the USACE, Missouri SHPO, Tribal Nations, and the ACHP. Because adverse impacts would be addressed by this programmatic agreement and because the USACE does not have the data to quantify any potential benefits, effects to cultural resources are considered negligible for the purposes of comprehensive benefits evaluation.

Figure 14 Potential Habitat Regeneration Areas



Regional Economic Development

The Regional Economic Development (RED) account is intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically regional income, and regional employment. As described in Appendix E (Economics and Social Considerations), the RED analysis considered three main components: allowing major regional employers to stay open and provide goods and services to the region, along with the employment benefits, agricultural protection (average annual crop acreage inundated), and potential beneficial effects of plan implementation as a function of construction and OMRR&R expenditures which would accrue to businesses within the regional economy.

The No Action alternative would not reduce the risk of regional economic impacts from business disruption. CA11 (Nonstructural) would have minor beneficial effects for allowing major regional employers to stay open and provide goods and services to the region.

Regional income and employment are commonly applied measures of regional economic activity. The positive effects of a plan on regional employment are directly parallel to the positive effects on regional income. The primary types of positive regional impacts associated with the final alternatives involve short term employment and income gains associated with project construction. The RECONS model is utilized to analyze the economic impacts of project construction and OMRR&R expenditures. RECONS is a USACE-certified regional economic impact modeling tool that was developed to provide estimates of regional economic impacts associated with USACE spending. The model presents results at the regional level (typically a county or metropolitan statistical area), the state level (may include multiple states), and the national level.

Depending on the alternative, construction expenditures would support between 749 and 1,358 local jobs, provide between $44,858,157 to $81,276,424 in local labor income, and provide between $53,482,981 to $96,903,344 in local capture for the regional impact area. Model results are found in Appendix E

(Economics and Social Considerations). With the largest construction cost, CA13 provides the greatest increase in RED benefits, including jobs and labor income.

Business interruption losses from flooding are substantial in the study area. CA13 is the alternative that provides the most benefits in these criteria. Hitachi Energy, an important employer of more than 1,200 employees, has gone to great lengths in previous flood events to continue operations. As a manufacturer of components of electric transmission systems, they were considered an essential business during COVID-19 pandemic lockdown restrictions. Their products and continued production are essential not only in the U.S., but in the global energy market. In the 2019 flood event, Hitachi Energy bussed and then boated employees to work, requiring a substantial number of resources, additional costs, workplace stress, and adding to the commuting times of many employees. Additionally, their hourly employees are not paid when they cannot work, causing substantial strain to a Justice40 community. A one-day closure costs at least $192,000 per day in lost wages[2].

Other employers, such as the Jefferson City Memorial Airport and Capital Sand and Gravel also see substantial losses as businesses, and to the community during flood events. The airport was responsible for 250 direct and indirect jobs and $21,849,000 (FY13 dollars) in economic output according to a study conducted by the Missouri Department of Transportation. In 2023, approximately 44,000 flights utilized the airport, including corporate flying, flight training, military exercises, air cargo, recreational flying, law enforcement operations, prisoner transports, government flights, and aerial inspections. The airport also provides critical emergency medical evacuation such as Angel Flight and Life Flight, as many in this Justice40 community must utilize lifesaving medical care outside of Jefferson City.

Capital Sand is the largest producer of sand and gravel on the Missouri River, serving communities as far south as Springfield, MO, which is 140 miles away. Springfield is a substantial area of growth in Missouri, with an 11 percent population growth over the past 10 years[3]. Its area of economic influence reaches 27 counties in Missouri and Arkansas and totals 1.1 million people. This growth requires the materials provided by Capital Sand. They provide nearly 1.2 million tons of production sales annually to the region. They also employ 34 people, with 32 of those being hourly employees. Similar to the Hitachi Energy employees, the inability to get to work means they are not paid, further burdening families in this community. Most employees live in the Jefferson City area, but some commute up to 1-hour in normal times, so flooding detours and delays cause even more stress and hardship on employees. Depending on the severity of future flooding, under FWOP conditions, some businesses may be forced to reduce employment, reduce (or not expand) operations, or even close permanently due to recurring losses and damages. CA13 substantially reduces flood risk and associated impacts for businesses in the study area under the FWP condition. Additional information on the RED account and comparison can be found in Appendix E.

Other Social Effects

The purpose of the OSE analysis is to show the beneficial and adverse effects of a flood-risk management alternative on the social wellbeing of the study area. The OSE account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic, and manmade and natural resources. The OSE account also integrates information into the planning process that is not reflected in the other three accounts used by USACE to evaluate projects and alternative plans.

Evaluation and comparison of alternatives in terms of OSE requires a qualitative and relative scoring of outputs by social factor and metric. There are a variety of potential social effects from flooding that if present in the study area under a given alternative, should be considered for assessment. Based on the measures included in each alternative and the PDT's assessment of the expected effects of the measures to OSE resources, the PDT assigned a score for each metric and alternative. Scoring used a 7-point scale from -3 to +3. Negative scores indicated adverse OSE impacts relative to the FWOP

[2] According to starting wage posted inside Hitachi Energy at $20 per hour, 1,200 people, 8-hour shift.
[3] Springfield Demographic Profile, springfieldregion.com, updated 2023.

condition, and positive scores indicated beneficial OSE impacts relative to the FWOP condition. **Figure 15** below includes the scoring rubric.

Figure 15 Scoring Rubric (Source: USACE 201 3a)

Score	In Relation to the Without Project Alternative, the With Project Alternative Has ...
-3	Significant negative effects (showstopper)
-2	Moderate negative effects
-1	Minor negative effects
0	Negligible effects (no impact)
1	Minor beneficial effects
2	Moderate beneficial effects
3	Significant beneficial effects

The first OSE criteria considered life safety implications for all the alternatives in the final array. Non-breach LifeSim results were completed and assumed USACE design criteria to the future top of levee with negligible probability of a breach. LifeSim results for all alternatives were within the same order of magnitude. They all have maximum life loss results between 1 and 4. There are only four remaining homes in the old Cedar City area that did not choose the buy-out option after the 1993 flood. The Incremental risk of breach and non-breach analysis was run for CA13 as part of a risk assessment. Implementing CA13 (the only structural option in the final array) introduces no substantial incremental risk to life loss. The screening level risk assessment (SLRA) resulted in a Levee Safety Action Classification (LSAC) of 4/Low. Because the AEP of overtopping is at 1 percent, overtopping is the primary risk driver. The prior to overtopping average life loss is 0.1 and the overtopping average life loss is 0.08, resulting in an incremental life loss of less than one.

The other three OSE comparison criteria deal with connectivity, community cohesion, and System Plan adherence. One area of community connectivity and cohesion that is greatly impacted by flood events is the traffic network in the area. Major highways (U.S. Highway 54 and U.S. Highway 63/Missouri Route 94) in the area have very large detours when they are inundated. Traffic Counts on these roadways are estimated at ~82,000 total vehicles per day. Failure of these systems, the inability to use them during the flood event, and the recovery and repair lengthening the time these roadways are closed causes additional, non-monetary impacts in the day-to-day lives of citizens not captured in the NED account. The Justice40 Community south of the river is not in the project area but also uses this critical infrastructure daily. The primary source of commuting and accessing public services such as healthcare, groceries, and other essential services in this area is by private vehicle. Employers in the area report that most of their employees utilize these transportation corridors to commute to work daily. A loss of these corridors would cease economic activity in the area. Flood damages to the transportation network alone in the area is estimated to be $847,000 annually under the FWOP condition. CA13 reduces this damage to an estimated $321,000 annually.

This community has also found a sense of identity in some of the businesses and services that are offered in the study area. The golf course and event center and the airport restaurant are locations that add to the quality of life in the broader community. They serve as gathering places, contribute to the local economy, provide recreational opportunities, and serve a Justice40 community. The Katy Trail is a nationally known outdoor recreation opportunity. All these benefits are severely damaged during flood events.

The System Plan study scope includes work with basin states, Tribes, stakeholders, other agencies, and the public to create a vision for a more flood risk resilient future for the Lower Missouri River. Resiliency is being defined in the study as the ability to recover more quickly from flood events. This recovery includes increasing conveyance on the riverside of the levees, increasing level of performance of the levees, or providing features like riprap and designed overtopping in order to cause less catastrophic damage to the leveed area. As part of the study, Jefferson City L-142 was looked at under the Spin-off authority, and considers localized solutions to the flooding problem. However, any local solution should fit within the conveyance goals and other measures considered for the future resilience. CA13 provides conveyance not only on the Missouri River, but also provides the conveyance on the Turkey Creek tributary. The final array comparison using the four accounts is detailed in **Table 25** below.

Table 25 Final Array Comparison, Four Accounts

Alternatives	NED			RED			OSE				EQ	
	Total Investment Cost	BCR	Net Annual Benefits (flood damages reduced + detour/delay costs reduced)	RED 1: Local Capture (RECONS)	RED 2: Allows major regional employers to stay open and provide goods and services to the region, along w/ employment	RED3: Agricultural Protection (average annual crop acreage inundated)	OSE 1: Life Safety	OSE 2: Adhering to LoMO System Plan Goals	OSE 3: Providing FRM benefits to a Justice40 community; maintaining access to goods, services, transportation networks	OSE 4: Better access to free outdoor recreational opportunities via the Katy Trail	EQ 1: Net AAHUs from restored acres	EQ 2: Cultural Resources
CA0	$0	0	-	$0	0	287	0.3 – 3	0	0	Tied Least	0	0
CA13	$310.3 mil	1.2	$2.4 mil	$96.9 mil	2	359	0.3 – 3	2	2	Most	98.4	0
CA11	$11.3 mil	0.6	-$191,3000	$4.5 mil	1	287	0.3 – 3	0	1	Tied Least	0	0

**Oct 2024 Price Level.*

The PDT determined that CA13 provides the most benefits and is therefore the Total Net Benefits Plan. Specifically,

- CA13 would result in $15.8M damages reduced per year, substantially reducing community impacts.

- Two Low income Justice40 Communities (both within the study area and across the river in Jefferson City) would gain income stability when access to places of employment and goods and services are protected to a higher level.
- Access to jobs, transportation, and emergency care during flood events remains for a much longer period than previous levee performance.
- Community businesses, which employ thousands, are all currently at risk of becoming inoperable for extended periods of time due to flooding, putting employees at risk of losing jobs and/or income. These businesses and/or their access are included within the new federal leveed area:
    - Hitachi Energy employs over 1,200 people. Important regional manufacturer in energy sector.
    - Capital Sand & Gravel is largest producer of sand and gravel on the MO River, serving communities as far south as Springfield, MO.
    - 44,000 flights (takeoffs and landings) annually at the Jefferson City Memorial Airport with 250 jobs either directly or indirectly supported.
- Other vital business including National Guard armory, which contributes to the military and national defense, and MFA AgriServices, an important resource for getting critical agricultural products to market, would gain substantial benefits in flood risk reduction.
- CA13 would contribute to community identity and cohesion by ensuring vital economic and communal centers remain accessible, including a restaurant, golf course and events center, and access to the nationally known Katy Trail. These are all important community gathering locations.
- The plan provides better opportunities to maintain infrastructure and quality of life during flood events and in the aftermath.
- CA13 would provide an increased level of performance for critical infrastructure such as the wastewater treatment plant, resulting in less clean-up costs for local governments.
- A higher level of levee performance would produce positive impacts to a strong regional economy as concerns of flooding is lessened.
- CA13 would improve the quality and quantity of natural habitat in the study area and is the only alternative to enhance hydrologic connectivity with the Missouri River.

5.3 IDENTIFICATION OF THE NED PLAN

NED Plan: Reasonably maximizes NED benefits.

CA13 is the NED Plan.

Nonstructural Plan: A primarily nonstructural alternative considered for FRM projects.

CA11 is the nonstructural plan.

Life Safety/Tolerable Risk Guidelines (TRG) Plan: An alternative that addresses life safety concerns and TRG1 and TRG4 (from PB 2019-04) for studies that involve existing or proposed dams and levees.

CA13 is the Life Safety Plan. See Appendix G for more detail.

Maximum Total Net Benefits Plan: The plan that maximizes total net benefits across all benefit categories.

CA13 is the Maximum Total Net Benefits Plan. It provides the most benefits to the NED, RED, OSE, and EQ accounts.

Least Damaging Environmentally Practicable Alternative (LEDPA): Consistent with Section 404 of the CWA.

CA13 is the LEDPA Plan. The USACE makes this determination based on the 404(b)(1) analysis provided in Appendix C1. While CA13 does cause short-term adverse impacts that CA0 and CA11 do not, CA13 also restores floodplain hydrology to some areas and results in habitat regeneration of wetland habitat in part of the borrow area. Habitat modeling indicates that this habitat regeneration would ultimately exceed the short-term impacts over the course of the 50-year period of analysis. CA13 would therefore be the LEDPA because it is the only alternative to cause beneficial effects in the long-term.

Locally Preferred Plan: If requested by the NFS, and not in one of the other listen plans in the guidance.

The NFS has not indicated support for any plan at this time.

5.4 PLAN SELECTION

At this time, there is not a TSP. The sponsor has indicated they would support CA13 as the TSP if they can achieve community concurrence, specifically from those property owners in the study area who would be impacted by the TSP. They do not currently have that. If they cannot get full concurrence, then the Locally Preferred Plan (LPP) would be CA0 No Action. MoDNR is continuing with outreach to the affected landowners and would determine the LPP after the public review period of this report.

There is also not a public sponsor for design, construction, and OMRR&R. The LPP could change if an implementation sponsor is identified.

5.5 DEVIATIONS FROM THE NED PLAN

Should a plan for action be undertaken as a result of this study, CA13 would be the selection plan and is also the NED Plan. Therefore, no deviation or policy waiver would be necessary.

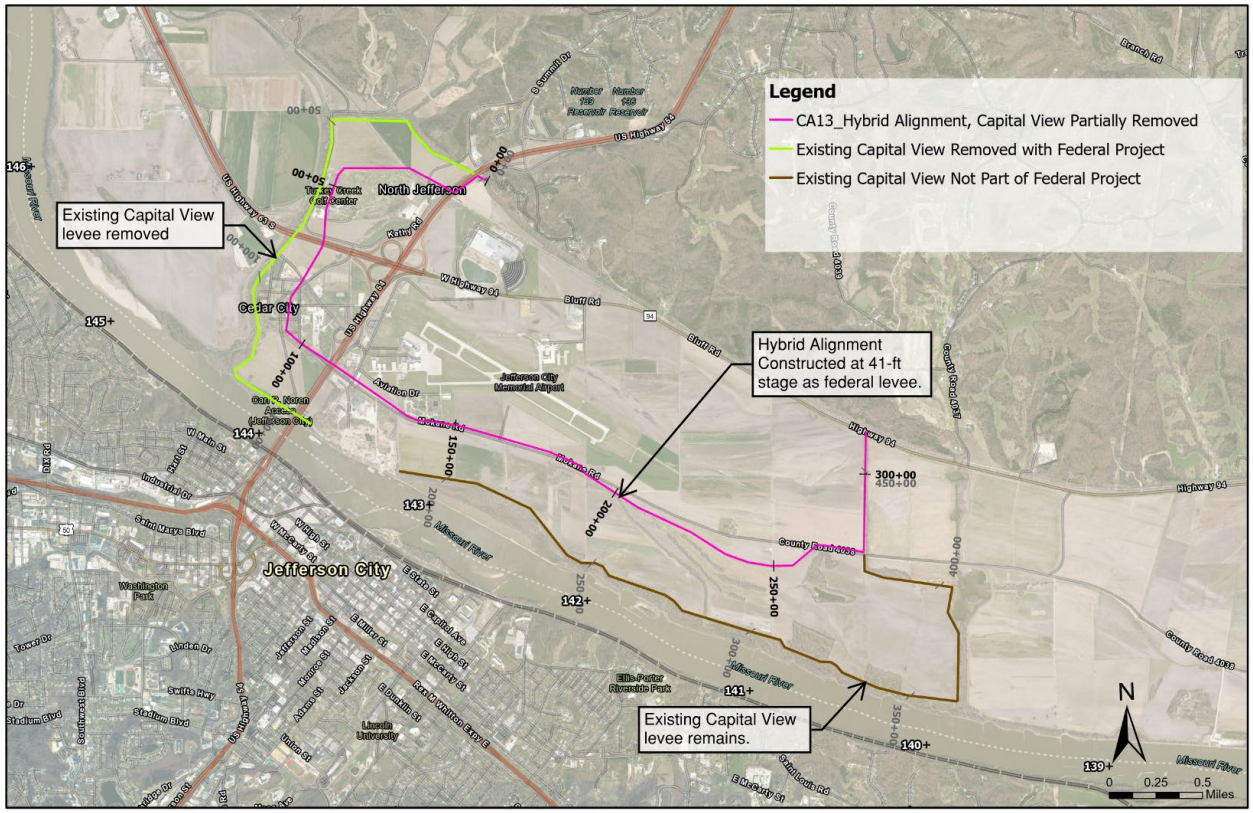
6.0 The Tentatively Selected Plan

6.1 PLAN ACCOMPLISHMENTS

The federally preferred TSP is the structural alternative, CA13 (Hybrid Alignment, 41-ft Stage, Partial Capital View Removal), see **Figure 16**. This plan provides not only NED benefits, but also the most comprehensive benefits across all four accounts. The earthen levee embankment would encompass 2,100 acres of area including critical infrastructure, transportation networks, and existing leveed area as feasible for the engineered design. With an initial overtopping annual exceedance probability of 1%, facilities located behind the federal levee would be able to withstand and recover from a much wider range of flood events than the existing Capital View levee is able to withstand at a 17% AEP of overtopping. The combination of a levee top elevation at the 1% AEP water surface elevation and the proposed setback, generally following the limits of the mapped floodway, minimizes overtopping of the proposed levee system for most historically frequent storms, while also minimizing impacts to water surface elevation for adjacent lands and the southern bank. A federal levee system would have the added benefit to stakeholders of being a predictable, engineered system designed and constructed to USACE design requirements. The additional reliability would aid not only in flood preparation and ability to access the Capital Sand supplier during a flood event, but also resiliency for major facilities including the airport, National Guard center, and wastewater treatment plant. The setback of the levee would not only improve conveyance for the Missouri River and Turkey Creek tributary but would also provide the potential for ecosystem habitat in areas where the existing levee is removed.

As part of the greater Lower Missouri River System, this alternative meets the consideration to plan for system conveyance and flood risk planning in the future by providing an offset from the bank of the Missouri River channel. This increased conveyance for the most frequently occurring overbank flows is needed system-wide, including the area around L-142 and Jefferson City.

Figure 16 Federal Tentatively Selected Plan CA13



The NWD Justice40 Screening Tool identifies both the census tract covering the project area and two census tracts directly across the river in Jefferson City as Justice40 communities. This TSP provides benefits directly to these communities through flood risk reduction of critical infrastructure, transportation routes, employment opportunities, open space, and recreational benefits (notably the Katy Trail), and the protection of critical goods and services. These areas are all identified as 'low income' and would immediately benefit from the implementation of CA13.

6.2 PLAN COMPONENTS

CA13 is comprised of a newly constructed levee from station 0+00 to 314+18 with a length of 31,018 feet (5.87 miles) of new earthen embankment. The average height of the embankment is 14.4 feet above ground surface. The embankment is zoned with impervious and random fill materials. The embankment would be a minimum of 10 feet wide surfaced with aggregate pavement to allow for operation and maintenance of the project. Seepage analysis was performed, requiring the project to include 20,618 linear feet of landside underseepage berms extending 150 feet from the landside levee toe with an average height of 3 feet. Underseepage berms are comprised of random material. In the area of the wastewater treatment plant, underseepage berms are not feasible. Three (3) relief wells, 12 inches in diameter, extending approximately 98 feet down to bedrock, would be constructed to relieve the underseepage pressures. Stability analysis was performed and would require construction of 6,200 linear feet of landside stability berms which extend 15 feet from the landside toe of the levee and have an average height of 10 feet. Stability berms are comprised of random material and are constructed to the same level of compaction as the levee embankment. The embankment and stability berms would be capped with 4 inches of topsoil and vegetated. The underseepage berms, where farmed, would be capped with 12 inches of topsoil and temporarily vegetated. Riverside armoring with riprap slope protection is required where high velocities pose a risk to embankment erosion. The riprap and bedding would be constructed along 18,500 linear feet along the reach facing the Missouri River. The existing

Capital View levee embankment and drainage pipes would be removed between Station 0+00 and 160+00. Approximately 16 new drainage structures would be constructed to maintain proper drainage within the protected area. It is estimated that 5-6 portable pumps are necessary for interior drainage. Drainage features would be evaluated and potentially combined to efficiently drain the interior.

Borrow material to construct the features would be hauled in from Church Farm levee upstream and from adjacent properties. Borrow sources are not finalized.

The proposed alignment for CA13 would impact the existing Mokane Road, which is heavily used by nearby businesses and residents. The road would be relocated to the landside of the levee embankment and constructed to meet state and local requirements. Up and over ramps would be installed to maintain access to properties and businesses along the project. Two stoplog closure structures would be necessary at Oilwell Road and Old U.S. Highway 63. The structures would be approximately 135 feet long and 15 feet high.

A substantial number of utilities would be required to be relocated with the proposed alignment. The alignment would extend through well developed areas and impact a variety of utility services. Relocations would include waterlines, overhead electric lines and power poles, sanitary sewer force mains, sanitary sewer gravity mains, gas lines, telephone lines, fiber lines, storm drainage utilities, and communication lines. Future refinement of the proposed alignment for CA13 would be adjusted for utility relocations.

The elements and features comprising CA13 would be constructed together and are not considered separate elements.

6.3 COST ESTIMATE

A detailed cost estimate for each site was developed using the USACE Micro-Computer Aided Cost Estimating System MII (MCACES 2nd generation) in accordance with guidance contained in ER 1110-2-1302, Civil Works Costs Engineering. In compliance with ER 1110-2-1302, a cost and schedule risk analysis (CSRA) was conducted on the initial array of alternatives.

The PDT, in collaboration with MoDNR, conducted a CSRA for the project to identify construction risk for project features. The purpose of this assessment was to establish a risk-based contingency for each alternative. Risks identified have an expected likelihood of occurrence and consequence (cost) should the risk come to fruition. Both cost increases and cost decreases are considered when evaluating the consequence. The risks are modeled using a Monte Carlo Simulation with likelihood and consequence taken into consideration. The result is a risk-based contingency at various confidence levels. The 80% confidence level resulted in a FY25 project first cost contingency of $90,077,001 (47%) for CA13. An 80% confidence level indicates the total project cost has an 80% chance the actual cost would be at or below the total cost plus contingency.

The Fully Funded Total Project Cost is $375,946,510. The Effective Price Level is 1 Oct 2023. The Fully Funded Cost is the estimate at the effective price level escalated to the midpoint of construction and/or design. The fully funded estimate includes construction costs (which includes environmental mitigation costs and associated monitoring and adaptive management activities), Relocations, Planning Engineering and Design (PED), Construction Management (CM) which includes Engineering During Construction (EDC) and Supervision and Administration (S&A) during construction, and Land, Easements, Rights-of-Way, and Disposal Areas (LERDs), a risk derived contingency, and escalation from the price level date to the midpoints of design and construction.

The cost estimate for the final structural alternative, CA13, is shown in **Table 26** and presents a breakdown of the estimated Fully Funded cost.

Table 26 Estimated Fully Funded Total Project Costs for Federal TSP, CA13

Cost Item	Cost (FY 2032) in $1,000s
Construction Costs	$216,600
Relocations	$82,100
Planning, Engineering, and Design (PED)	$35,800
Construction Management (EDC, S&A)	$38,800
Real Estate (LERDs)	$8,300
Fully Funded Total Project Cost*	$381,600

**FY32 Price Level*

***Fully funded cost includes a contingency of $116,100,000 (46%)*

6.4 LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS, AND DISPOSAL

The non-federal sponsor is required to provide any lands, easements, right of ways, relocations, and disposals (LERRDs) necessary for project construction and OMRR&R. A Real Estate Cost Estimate has been completed by a Certified General Review Appraiser. It includes the real estate acquisition values for the affected lands in Fee for mitigation, Fee for Billboard Sites, permanent easements for flood protection levee and roads, temporary work area easements for construction staging, and one business relocation under PL 91-646. Administrative costs associated with the land acquisition has been included in the overall LERRD cost. The total LERRD value and acreage amounts are detailed in Appendix D – Real Estate Plan.

Preliminary hydraulic modeling indicates that there may be a potential for project features to impact water surfaces at various flows, including the 1% Annual Exceedance Probability (AEP) flow. Additional modeling will be completed prior to the finalization of this feasibility report. Further analysis would be completed during PED phase. The outputs of those analyses would be used to determine the necessary property interests to be acquired. The acres of affected land, as stated above, are subject to change based on the additional water surface modelling to be conducted.

6.5 OPERATIONS, MAINTENANCE, REPAIR, REPLACEMENT AND REHABILITATION (OMRR&R)

An Operation and Maintenance Manual would be developed by the USACE at the completion of construction and all operation and maintenance responsibilities would be given to the non-federal sponsor in perpetuity after completion of construction. Once the project is turned over the non-federal sponsor is fully responsible for all OMRR&R costs of the project in accordance with the OMRR&R Manual and 33 C.F.R. § 208.10 and ER 1110-2-401. Some repairs may be eligible for federal assistance under the USACE Rehabilitation and Inspection Program. The non-federal sponsor should reserve enough funding to complete routine operations and maintenance activities as well as plan for long term rehabilitation and replacement. Routine O&M activities the sponsor would need to perform on this project include, but are not limited to: mowing, removal of unwanted vegetation, animal control, minor slope repair, crown repair, gate maintenance and operation, pipe inspections and cleaning, relief well testing and cleaning, and emergency planning. Non-routine O&M items, also referred to as RR&R, would include major slide or slope repairs, lining or replacement of drainage pipes and relief wells, gatewell repairs, gate replacements, and riprap replacement. Flood fight activities would include levee patrols, sandbagging, and ringing of sand boils.

The USACE Levee Cost Estimating Tool was used to estimate the OMRR&R cost for each alternative. This tool gives a broad range of costs to help sponsors estimate costs needed for common levee related activities. The tool gives a high and low range for Average Yearly Costs that includes routine O&M, non-routine RR&R, and flood fight activities. For all alternatives the lowest number was used as it was the

most appropriate based on knowledge of what local levee districts typically spend each year on maintenance. The Average Yearly Cost for OMRR&R of CA13 was estimated to be $156,170. Of this number, $105,720 was estimated for routine O&M, $33,450 is estimate for non-routine O&M and $17,000 for flood fighting.

6.6 PROJECT RISKS

All risks are recorded in the Risk Register. Those identified as High risk are detailed below:

1. **Public Input and Consensus**: The study area contains vocal stakeholders, large private landownership, and varying stakeholder expectations associated with past project, right bank, and prior litigation.

   Description and Potential Impacts: The NFS, MoDNR, has indicated that they will only support a plan with full consensus from all affected landowners. Currently they do not have that. Outreach is still ongoing with landowners that are opposed to CA13. If consensus is not reached the MoDNR will not move forward with this project. In addition, MoDNR is only the sponsor for the feasibility study. No local sponsor for design, construction and OMRR&R has been identified. If local consensus is obtained, the project would then be at risk of not having a local sponsor for implementation. This has the potential to delay schedule, increase study costs, and delay study completion.

   Risk Management Recommendation: Conduct initial sponsor and outreach events, clear communication of project location and scope, tie modeling back into the system plan model, and increase the real estate effort due to large private land ownership.

2. **Borrow Locations:** Local landowners will not identify local borrow sources. Borrow locations must also limit air strikes at the airport and need to be coordinated.

   Description and Potential Impacts: The study area is a frequent site for borrow due to levee repairs and flood fight efforts over the past 30 years. Local landowners have indicated they do not believe there is enough borrow material available within the leveed area to build a new levee system. Additionally, borrow locations must be constructed in a way that do not allow water to pond, attracting birds near the airport runway. The current assumed borrow location is approximately sixteen miles from the project, driving up costs.

   Risk Management Recommendation: Continue to encourage sponsor to coordinate with local landowners for borrow, and coordinate with FAA on borrow location designs within airport radius. Look for borrow sources on publicly owned lands.

3. **Tentatively Selected Plan Change**: Sponsor changes their support for CA13 and decides to move forward in agreement with CA13 for the TSP after the release of the draft report.

   Description and Potential Impacts: Portions of this report would need to be updated to accurately reflect the project and TSP milestone. Comments and public input may be robust, and additional outreach may need to occur. Impacts to schedule could lower the ability of the Chiefs Report to be authorized in the Water Resources Development Act expected in 2026.

   Risk Management Recommendation: Continue to encourage the NFS to gain

consensus or confirm that the No Action Alternative is also the LPP. The PDT continues to refine and include documentation of CA13 in all reports.

6.7 COST SHARING

The cost of the feasibility phase is shared (50/50) with the NFS pursuant to the terms of the FCSA executed by the USACE Kansas City District Commander and MoDNR on 28 November 2022. The cost share for the PED phase and the construction phase would be included in the Project Partnership Agreement and is expected to be 65/35 federal/non-federal. It is anticipated that MoDNR would not be the cost share sponsor for project implementation and would identify the implementation partner at the Agency Decision Milestone. Estimated cost shares based on model agreements are included in **Table 27** below. Estimated cost share is the fully funded cost escalated to midpoint of construction.

Table 27 Breakout of Study Cost Sharing & CA13 Implementation

	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	Future Funding
Feasibility Study Costs							
Fed Share	$200,000	$500,000	$517,000	$500,000	$283,000		
Non-Fed Share		$780,000	$517,000	$500,000	$203,000		
Design & Implementation Costs							
PED						$35,800,000	
S&A							$38,800,000
Construction							$216,600,000
Lands and Damages							$8,300,000
Relocations							$82,100,000
FED share (65%)							$242,645,000
Non-FED (35%)							$130,655,000
Non-FED LEERD							$8,300,000
Total Project Cost (Fully Funded)							$381,600,000

6.8 DESIGN AND CONSTRUCTION

Details related to design and construction would be added after the TSP is confirmed as the Recommended Plan at the Agency Decision Milestone, to be held in March 2025. Additional details on design and implementation are discussed in Appendix B.

6.9 ENVIRONMENTAL COMMITMENTS

The implementation of CA0 would not result in any environmental commitments. In the event that CA13

would be carried forward for implementation, there would be a variety of environmental commitments. The USACE would need to acquire a water quality certification and NPDES permit to comply with the Clean Water Act. These permits would outline further commitments, such as best management practices that would need to be used. Such practices would likely include silt fencing around construction activities to minimize siltation.

The USACE would need to mitigate for unavoidable impacts to wetlands within the study area. The USACE would need to perform a cost effectiveness analysis between different mitigation methods (i.e., in-kind mitigation via habitat restoration or an in-lieu fee credit bank) to determine which mitigation method was most cost effective. If habitat restoration would be identified as the most cost-effective method, then the USACE would need to complete a monitoring and adaptive management plan for those restoration activities. At a minimum, this plan would need to outline ecological success criteria that would be used to determine the success of restoration activities, as well as adaptive management measures that would be used in the event that initial restoration actions were not sufficiently effective.

In order to avoid impacts to federally listed tree roosting bats or federally protected migratory bird species, tree removal activities would need to abide by seasonal restrictions to avoid incidental take. The planning aid letters developed by USFWS make a number of recommendations that the USACE would follow to the extent practicable. CA13 would need to complete and submit Form AD-1006 to NRCS to coordinate the anticipated loss of prime farmland that would occur under CA13. The USACE would need to coordinate with MODOT to ensure that construction activities were scheduled so that alternative routes would be available for any potential road closures that would need to occur.

6.10 PROJECT-SPECIFIC CONSIDERATIONS

No project-specific considerations are known at this time.

6.11 ENVIRONMENTAL OPERATING PRINCIPLES (EOP)

The implementation of CA13 would meet the USACE Environmental Operating Principles. The USACE achievement of these principles is described in **Table 28**.

Table 28 Environmental Operating Principles

Environmental Operating Principle	Achievement of Principle
Foster sustainability as a way of life throughout the organization.	CA13 would represent a more sustainable future for the study area by using a levee setback design that is more compatible with natural floodplain functioning.
Proactively consider environmental consequences of all USACE activities and act accordingly.	The USACE has analyzed CA13 for the potential environmental consequences of its implementation and acted accordingly. The USACE has coordinated with agencies such as USFWS and FAA to ensure that potential environmental impacts are identified.
Create mutually supporting economic and environmentally sustainable solutions.	CA13 is economically sustainable by reducing the cost of flood damages. CA13 is environmentally sustainable because it would restore some of the lost hydrological functioning to the floodplain.
Continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments.	The USACE has endeavored to meet our corporate responsibility and accountability by remaining in compliance with the law and USACE policy.

Environmental Operating Principle	Achievement of Principle
Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.	The USACE has used a risk management and systems approach throughout the feasibility study. This has included environmental considerations, such as potential backwater effects associated with CA13 and other structural measures.
Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.	The USACE has leverage scientific, economic, and social knowledge in the formulation of CA13. The USACE has worked with agencies, local organizations, and knowledgeable individuals to collaborative understand the environmental context and effects that CA13 would be expected to have.
Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.	The USACE has employed an open and transparent process throughout the feasibility study by offering numerous opportunities to learn about the study and comment on it. Four public scoping meetings were held, and all individuals and groups interested in the study were invited to ask questions and provide comments.

6.12 VIEWS OF THE NON-FEDERAL SPONSOR

The non-federal sponsor, MoDNR, does not support a plan for implementation at this time. As the NFS of all spin-off studies as part of the larger System Plan, they are seeking community consensus before moving forward. In Jefferson City, there is still landowner and stakeholder opposition to the proposed structural alternative setback from the river. The NFS will not exercise their right to eminent domain and therefore specific private land holdings required for the project may not be acquired. The views in the study area are diverse, as was listed and addressed in the study background and study risks in this report and its appendices. Increased public outreach and coordination was done during the study process to educate the stakeholders on the USACE planning process and its intended results. There is still the possibility of consensus going forward, but additional time is needed. The NFS must continue to work with members of the community on their priority to meet the objectives set forth in this study.

7.0 Environmental Compliance*

7.1 ENVIRONMENTAL COMPLIANCE TABLE

Table 29 Environmental Compliance Status

Federal Law or Executive Order	Compliance*
Archeological Resources Protection Act, 16 U.S.C. 470, et seq.	Full Compliance
Bald and Golden Eagle Protection Act, 16 U.S.C. 668-668d, et seq.	Full Compliance
Clean Air Act, as amended, 42 U.S. C. 7401-7671g, et seq.	Full Compliance
Clean Water Act (Federal Water Pollution Control Act), 33 U.S.C. 1251, et seq.	In Progress
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not Applicable
Endangered Species Act, 16 U.S.C. 1531, et seq.	In Progress
Environmental Justice (Executive Order 12898)	Full Compliance
Estuary Protection Act, 16 U.S.C. 1221, et seq.	Not Applicable
Farmland Protection Policy Act, 7 U.S.C. 4201, et. seq.	In Progress
Federal Water Project Recreation Act, 16 U.S.C. 4601-12, et seq.	Full Compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 661, et seq.	In-Progress
Floodplain Management (Executive Order 11988)	Full Compliance
Invasive Species (Executive Order 13122)	Full Compliance
Land and Water Conservation Fund Act, 16 U.S.C. 4601-4, et seq.	Not Applicable
Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq.	Not Applicable
Migratory Bird Treaty Act, as amended, 16 U.S.C. 703-712, et seq.	Full Compliance
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	In-Progress
National Historic Preservation Act, as amended, 54 U.S.C. 300101, et seq.	In Progress
Protection & Enhancement of the Cultural Environment (Executive Order 11593)	Full Compliance
Protection of Wetlands (Executive Order 11990)	Full Compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full Compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full Compliance
Wild and Scenic River Act, 16 U.S.C. 1271, et seq.	Not Applicable

*NOTES: Not applicable. No requirements for the statute required: compliance for the current stage of planning.

Full compliance. Having met all requirements of the statute for the current stage of planning (either preauthorization or post authorization).

In-Progress. Not having met some of the requirements to be in full compliance but anticipated to be in full compliance upon final state of planning.

Noncompliance. Violation of a requirement of the statute.

7.1.1 CLEAN WATER ACT

CA13 would cause unavoidable impacts to wetlands that would need to be mitigated to comply with Clean Water Act. A monitoring and adaptive management plan would need to be developed for in-kind mitigation for wetland impacts, or a sufficient number of mitigation credits would need to be purchased from an in-lieu fee bank. The USACE would need to perform a cost effectiveness analysis to determine which method of mitigation would be more cost effective. In addition, the USACE would need to acquire a water quality certification and NPDES permit issued by MoDNR. The USACE would acquire these permits prior to start of construction activities.

7.1.2 NATIONAL HISTORIC PRESERVATION ACT

Alternatives C11 and C13 would need to be evaluated using the process laid out in the NHPA programmatic agreement being developed for the Study. The PA process would be followed to determine if there are historic properties within the areas of potential effect for these alternatives, the determination of effects to these properties, and treatment or avoidance measures as appropriate.

7.1.3 ENDANGERED SPECIES ACT

CA13 would remove habitat suitable for federally listed bats and protected migratory bird species. The USACE would need to seasonally restrict the timing of these activities and coordinate the anticipated effects on these species with USFWS. The USACE would complete ESA Section 7 consultation prior to completion of a final report and signing of a FONSI. The USACE would not anticipate any impacts to pallid sturgeon, gray bat, or western regal fritillary because there would not be meaningful impacts to the habitat for these species.

7.1.4 FISH AND WILDLIFE COORDINATION ACT

Pursuant to the Fish and Wildlife Coordination Act, USFWS has produced two planning aid letters for the Lower Missouri River System Plan study that are also applicable to the Jefferson City study. These letters are provided in Appendix F. In summary, these letters encourage the use of nature-based features and the expansion of the riparian corridor by creating terrestrial habitat. The USACE has sought to implement recommendations such as these where feasible and appropriate. CA13 would use recommendations made in these planning aid letters by hydrologically restoring part of the floodplain and allowing natural regeneration of floodplain habitat. In addition to these planning aid letters, USFWS is also producing a coordination act report for the Lower Missouri River System Plan study. USFWS has stated that they will submit comments specific to the Jefferson City study during the public review period of the draft report.

7.2 PUBLIC INVOLVEMENT

7.2.1 SCOPING

The USACE held four public scoping meetings during the development of this feasibility report in May 2023, November 2023, February 2024, and April 2024. These public meetings were all held in MoDNR offices located within Jefferson City, Missouri. These meetings were attended by representatives of the Capital View Drainage District, the City of Jefferson City, resource agencies, and businesses. Local landowners and other interested members of the public also attended these meetings.

7.2.2 AGENCY COORDINATION

The USACE has been in coordination with USFWS, the Environmental Protection Agency (EPA), the

Federal Emergency Management Agency (FEMA), FAA, Missouri NRCS, MoDNR, MDC, and MODOT. The USACE initiated agency coordination with these organizations with scoping letters. The USACE hosted two interagency meetings on 22 March 2023 and 23 March 2023 to brief these agencies on the study setting, key considerations, and its place within the broader Lower Missouri River System Plan. Agency representatives have also participated in the public scoping meetings.

The USACE has also conducted one-on-one coordination with agencies to discuss particular topics. The USACE met with FAA, MODOT, and representatives of the airport to discuss potential wildlife strike risks associated with project activities, which could result from changes to the local land use. The USACE and FAA discussed how habitat regeneration could be done in the vicinity of the airport without causing a substantial change in wildlife strike risk. The USACE has coordinated with USFWS pursuant to Fish and Wildlife Coordination Act (FWCA). USFWS has produced two planning aid letters for the Lower Missouri River System Plan study that are also applicable to the Jefferson City study. These letters are provided in Appendix F. USFWS has stated that they will submit comments specific to the Jefferson City study during the public review period of the draft report. In addition, the USACE and USFWS have coordinated regarding potential impacts to bald eagles to avoid the need for an incidental take permit. The Osage Nation is a cooperating agency in this study and assisted the USACE during alternative development by providing comments on the initial array. The Osage Nation also reviewed and commented on a draft of this feasibility report prior to the public comment period.

7.2.3 TRIBAL CONSULTATION

Consultation was initiated with 42 federally recognized Native American tribes (Tribes) by letter in March 2023. An Initial Tribal Nations briefing and listening session was held in August 2023. During the session The Osage Nation requested cooperating agency status for the Study. USACE agreed to this request and a memorandum of agreement (MOA) for this status was executed in December 2023. Since that time, The Osage Nation were briefed on project developments in May 2024 per terms of the MOA. Tribal Consultation on the development of a programmatic agreement for compliance with the National Historic Preservation Act has been ongoing with all consulting Tribes since 2023. A list of consulting Tribal Nations is included in Appendix F.

Appendix F includes a list of the agencies, organizations, and persons to whom the USACE sent copies of the draft report for review.

7.2.4 PUBLIC COMMENTS RECEIVED AND RESPONSES

The study stakeholders have shown a keen interest in the study and have provided feedback on a variety of subjects, such as suggestions for alternatives, the placement of proposed levee alignments, and requests for information regarding activities in the study area and the history of flood impacts. Stakeholders commonly voiced concerns for potential backwater effects across the river resulting from changes to levee coverage and for the potential future and status of the Capital View levee in the event that a structural alternative would move forward for implementation. Numerous engagements outside of public meetings were also held to help explain alternatives, get feedback, and gain the consensus desired by the NFS. This outreach is detailed in Appendix F, Public Involvement and Agency Coordination.

8.0 District Engineer Recommendation

The District Engineer Recommendation will be made once the study reaches completion and will be included in the Final Report.

9.0 List of Preparers*

Name	Role	Qualifications (Licensing and Years of experience)
Baker, George	Cost Engineer	Certified Cost Consultant, 7 years of experience
Colby-George, Noah	Economist	4 years of experience
Edkin, Rachel	Realty Specialist	Realty Specialist with 6 years of experience, serving as Team Lead for 2 years
Fernandez, Eduardo	Structural Engineer	Registered EIT, 22+ years of experience with structural engineering flood control design, inspection, and technical leadership.
Headlee, Max	Environmental Resources Specialist	4 years of experience
Meade, Timothy	Archeologist	Archologist and Tribal Liaison, 20+ years USACE experience
Mehnert, James	Geotechnical Engineer	Professional Engineer, 30+ years of experience
Niemann-Harper, Ginger	Plan Formulator	Community Planner, 5 years USACE water resources experience
Roberts, Colleen	Program Manager	Professional Engineer, 14 years of experience
Sciarra, Jennifer	Technical Lead, Civil Engineer	Professional Engineer, 15 years of experience
Spangler, Natalie	Civil Engineer	Professional Engineer, 11 years of experience
Swacker, Shelbi	Hydraulic Engineer	Professional Engineer, 8 years of experience
Wood, Jennifer	Geologist	Registered Geologist, 22 years of experience