



**US Army Corps  
of Engineers**®  
Kansas City District

## **MISSOURI RIVER RECOVERY PROGRAM**

### **Searcys Bend Interception-rearing-complex Habitat Project**



**Moniteau County, Missouri  
Environmental Assessment  
&  
Section 404(b)(1) Evaluation**

**May 2016**

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**FINDING OF NO SIGNIFICANT IMPACT**

**Missouri River Recovery Program - Environmental Assessment & Section  
404(b)(1) Evaluation**

**Searcys Bend Interception-rearing-complex Habitat Project**

**Project Summary**

The U.S. Army Corps of Engineers, (USACE) Kansas City District is proposing an interception-rearing-complex habitat project in the Missouri River at Searcys Bend (Moniteau County, Missouri). The goal of this project is to determine if increasing interception-rearing-complex habitat increases the population of federally endangered pallid sturgeon within the lower Missouri River. This project will help test the hypothesis that mostly passive free-floating pallid sturgeon embryos and larvae are entrained in the thalweg, the deepest fastest flowing portion of the channel, and are unable to move to the channel margins where environmental conditions may be more suitable for their growth and survival. This hypothesis is one of several that has recently been described in the U.S. Geological Survey's (USGS) *Missouri River Pallid Sturgeon Effects Analysis, Integrative Draft Report 2015* as a potential reason pallid sturgeon populations have declined. The specific objective of this project is to create hydraulic conditions to intercept free drifting embryos and larval sturgeon from the channel thalweg to the (interception) channel margins (food producing and foraging habitats) where water depths are one to three meters and velocities are 0.5 to 0.7 meters per second.

This project is being conducted as part of the Missouri River Recovery Program (MRRP). The current focus of MRRP is to avoid jeopardy to threatened and endangered species, including pallid sturgeon, resulting from the operation and maintenance of USACE projects on the Missouri River in accordance with the *U.S. Fish and Wildlife Service (USFWS) 2003 Amendment to the 2000 Biological opinion on the operation and maintenance of the Missouri River Main Stem Reservoir System, operation and maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP), and operation of the Kansas River Reservoir System (USFWS, 2003)*, hereafter referred to as the 2003 Amendment to the Biological Opinion. The biological opinion was prepared in accordance with the Endangered Species Act (ESA). It is expected that this project would be constructed during the 2016 to 2017 timeframe pending available funding.

## **Alternatives**

Combinations of the measures were used to develop an initial array of alternatives. These measures included:

- 1) Construct a series of rootless dikes,
- 2) Remove portions of existing dikes,
- 3) Extend portions of existing dikes, and
- 4) Remove sand from the existing sandbar.

The measures of constructing rootless dikes, removing portions of existing dikes, and extending portions of existing dikes were combined with various degrees of removing sand from the existing sandbar to develop an array of alternatives. Including sub-alternatives, a total of twelve alternatives were developed for the initial array of alternatives, including the no-action (future without-project condition) alternative.

Habitat benefits were determined by multiplying the estimated percentage of free-floating particulates that would be intercepted from the thalweg of the river and transported to the channel margin by the area of suitable foraging habitat to provide interception-rearing-complex habitat units. Net average annual habitat units (AAHUs) of interception-rearing-complex habitat were then determined over a 50-year period of analysis. Average annual costs over the period of analysis were also determined. Each of the alternatives was then evaluated using a cost effectiveness/incremental cost analysis (CE/ICA) procedure. From this, five best buy plans were identified and were evaluated in detail. With information from the CE/ICA analysis and following an evaluation of potential impacts to environmental, socioeconomic, and cultural resources, Best Buy Plan 2 – Modify Existing Dikes and Construct One New Rootless Dike was identified as the Recommended Plan.

### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

For the No-Action/Future Without-Project Condition, no new measures would be implemented to increase the amount of interception-rearing-complex habitat. It was assumed that the existing conditions would be maintained over the 50-year period of analysis because the Missouri River BSNP generally maintains the channel in a fixed location. The existing conditions have an interception ratio of 0.25 and 21.3 acres of foraging habitat, which equates to 5.8 AAHUs of interception-rearing-complex. This alternative serves as the baseline condition in which the other alternatives were compared.

**Best Buy Plan 2 – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan consists of removing portions of four existing dikes, the extension of two existing dikes, and constructing two new dikes, one of which would be rootless. This alternative would result in an interception ratio of 0.37 and 41.6 acres and foraging habitat when fully developed after a four-year period. It would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$122,000. The average annual cost per AAHU is \$13,400.

**Best Buy Plan 3 – Modify Existing Structures and Construct Two New Rootless Dikes**

This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. Best Buy Plan 3 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a four-year period. It would result in an additional 10.0 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$162,000. Compared to Best Buy Plan 2, the incremental average annual cost per AAHU for Best Buy Plan 3 is \$44,600.

**Best Buy Plan 4 – Modify Existing Structures, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar**

This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. It includes partial dredging of the sandbar to increase the rate at which foraging habitat will develop. Best Buy Plan 4 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a two-year period. It would result in an additional 10.2 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$209,000. Compared to Best Buy Plan 3, the incremental average annual cost per AAHU for Best Buy Plan 4 is \$235,000.

### **Best Buy Plan 5 – Modify Existing Structures, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. It includes full dredging of the sandbar so that the foraging habitat will be fully developed following project construction. Best Buy Plan 5 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed immediately following construction. It would result in an additional 10.4 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$302,000. Compared to Best Buy Plan 4, the incremental average annual cost per AAHU for Best Buy Plan 5 is \$465,800.

#### **Summary of Environmental Impacts**

The Recommended Plan would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. This would result in a minor long-term benefit to fish and wildlife that potentially includes the federally endangered pallid sturgeon. The project would result in minor short-term impacts to water quality resulting from localized increases in turbidity during construction. It would result in temporary avoidance by fish; disturbance in the project footprint to benthic community; and, temporary construction-related noise and air pollution. There may be minor beneficial impacts to local income as a result of construction activities. The Recommended Plan would result in a minor long-term impacts to recreation because a sandbar that is occasionally used for recreation would be removed. It would not contribute to the spread of invasive species. It would not result in any impacts to wetlands, cultural resources, navigation, or flood risk management.

#### **Mitigation Measures**

The Recommended Plan would not impact any resources that would require mitigation. Therefore, no mitigation efforts are proposed.

#### **Public Availability**

The proposed project is being circulated to the public and resource agencies through a joint Public Notice with the Missouri Department of Natural Resources. The Public Notice, Number 2016-00334, dated May 3, 2016, will provide a 30-day comment period ending on June 2, 2016. Information concerning the availability of the Public Notice and draft documents is being e-mailed to entities on the USACE Regulatory Branch email distribution list. During the public comment period, the Public Notice and draft documents are available on the USACE Public Notice website at:

<http://www.nwk.usace.army.mil/Media/PublicNotices/PlanningPublicNotices.aspx>. Hard copies were available on request. A public meeting is scheduled on May 24, 2016 from 5:00-7:00 p.m. at Marshall City Hall, 214 North Lafayette, Marshall, Missouri 65340.

## Conclusion

After evaluating the anticipated environmental, economic, and social effects of the proposed project, it is my determination that the Recommended Plan (Best Buy Plan 2) does not constitute a major federal action that significantly affects the quality of the human environment. Therefore, preparation of an environmental impact statement is not required. In addition, I have determined that the Recommended Plan is in full compliance with the requirements of the Clean Water Act Section 404(b)(1) Guidelines.

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Date

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Andrew D. Sexton  
Colonel, Corps of Engineers  
District Commander

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- APPENDIX C – Hydrodynamic Modeling
- APPENDIX D – Draft Clean Water Act Section 404(b)(1) Evaluation
- APPENDIX E – Clean Water Act Section 401 Water Quality Certification (Pending)
- APPENDIX F – Cultural Resources Coordination (Pending)

## 1.0 Introduction

The U.S. Army Corps of Engineers, (USACE) Kansas City District is proposing an interception-rearing-complex habitat project in the Missouri River at Searcys Bend. Searcys Bend is located in Moniteau County, Missouri. The goal of this project is to determine if increasing interception-rearing-complex habitat increases the catch rate of age-0 sturgeon within the lower Missouri River. This project will help test the hypothesis that mostly passive free-floating pallid sturgeon embryos and larvae are entrained in the thalweg, the deepest fastest flowing portion of the channel, and are unable to move to the channel margins where environmental conditions may be more suitable for their growth and survival. This hypothesis is one of several that has recently been described in the U.S. Geological Survey's (USGS) *Missouri River Pallid Sturgeon Effects Analysis, Integrative Draft Report 2015* (Effects Analysis) as a potential reason pallid sturgeon populations have declined (In review).

This project is being conducted as part of the Missouri River Recovery Program (MRRP). The purpose of MRRP is to avoid jeopardy to threatened and endangered species, including pallid sturgeon, resulting from the operation and maintenance of USACE projects on the Missouri River in accordance with the *U.S. Fish and Wildlife Service 2003 Amendment to the 2000 Biological opinion on the operation and maintenance of the Missouri River Main Stem Reservoir System, operation and maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP), and operation of the Kansas River Reservoir System* (USFWS, 2003), hereafter referred to as the 2003 Amendment to the Biological Opinion. The biological opinion was prepared in accordance with the Endangered Species Act (ESA). It is expected that this project would be constructed during the 2016 to 2017 timeframe pending available funding.

This Environmental Assessment (EA) is tiered from of the *Final Supplemental Environmental Impact Statement for the Missouri River Fish and Wildlife Mitigation Project* (USACE, 2003) following the President's Council on Environmental Quality (CEQ) guidelines for Effective Use of Programmatic National Environmental Policy Act (NEPA) Reviews (CEQ, 2014). It meets the requirements of NEPA of 1969, as amended (42 U.S. Code [USC] 4321 et seq.); CEQ Regulations (40 Code of Federal Regulations [CFR] 1500 – 1508); and USACE ER 200-2-2 (33 CFR 230). It also is compliant with the National Historic Preservation Act, Section 404 of the Clean Water Act, the ESA and other laws and regulations listed in Section 6.

### 1.1 Project Authority

The project would be completed under the authority of MRRP as derived from Water Resource Development Acts (WRDA) of 1986 (Section 601), 1999 (Section 334), and 2007 (Section 3176). This project would fit the description of the reasonable and prudent alternative for pallid sturgeon starting on page 219 of the 2003 Amendment to the Biological Opinion (USFWS, 2003). It would contribute to avoiding jeopardy to pallid sturgeon.

## 1.2 Project Location

Searcys Bend is located in the Missouri River approximately 9 miles southwest of Columbia, Missouri (Figure 1). The bend is 10,560 feet long and extends from about Missouri River mile 178.2 to 180.2 (Figure 2). The project area is primarily within the banks of the Missouri River. It is adjacent to Tadpole Island which is owned by USACE and managed by USFWS as part of the Big Muddy National Fish and Wildlife Refuge. Tadpole Island is created by a side channel that was constructed as a part of the MRRP shallow water habitat program in 2006.

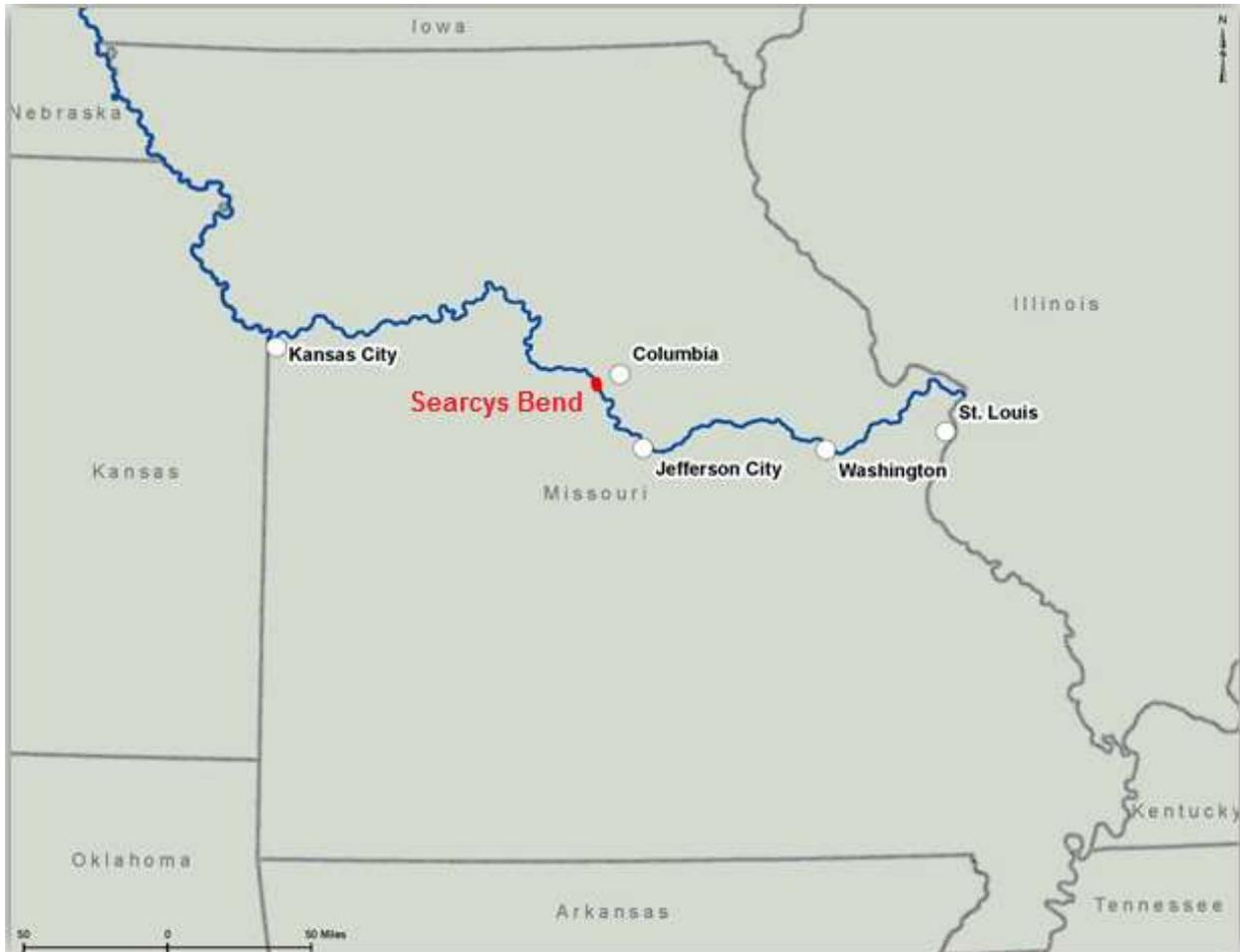


Figure 1: Searcys Bend is located southwest of Columbia, Missouri.



Figure 2: The Searcys Bend Interception-rearing-complex project area is located approximately between Missouri River miles 178 to 180.

### **1.3 Existing Project Conditions**

The Missouri River at Searcys Bend ranges in width from approximately 1,200 feet to 1,650 feet. The navigation channel is approximately 700 to 800 feet in width at the bend. The inside of the bend is dominated by a large sandbar that is nearly 70 acres in size during periods of low flow. During periods of high flow, the sandbar is submerged. The banks of the Missouri River in the project area are nearly vertical and range in height from 10 to 30 feet. The outside bend of the river is dominated by revetments and L-dikes that are part of the Missouri River BSNP. There are four dikes on the inside of the bend that are also part of the BSNP. Immediately adjacent to the sandbar is Tadpole Island. This island was formed when a side channel, Tadpole Chute, was constructed in 2006 to increase the amount of shallow water habitat in the Missouri River. Modifications to increase meandering of the side channel are currently underway (USACE, 2015). These modifications are expected to be completed sometime in 2016. The modifications to the side channel are for purposes separate from the project that is currently being proposed. A 2,000-foot portion of the McBaine Levee District is located immediately adjacent to the outside bend of the river. Levee District No. 1 of Cooper County is located approximately 3,000 feet landward of the inside bend of the river.

### **1.4 Purpose and Need/Problem and Opportunities**

Since 2004, USACE has been taking numerous actions to avoid jeopardy to pallid sturgeon on the lower Missouri River that were included in the recommended and prudent alternative from the 2003 Amendment to the Biological Opinion. These actions have included maintaining a stocking (propagation) program for pallid sturgeon, limited testing of flow modifications, and construction of shallow water habitat. Shallow water habitat construction has primarily consisted of notching select BSNP dikes along the river and constructing side channels across inside bends of the Missouri River in locations where the federal government owned sufficient land to construct such features. To date, there has not been strong evidence that pallid sturgeon are successfully reproducing naturally in the lower Missouri River. When the 2003 Amendment to the Biological Opinion was prepared, there was limited scientific knowledge about the ecological needs of pallid sturgeon. Today, knowledge about the ecologic needs of this species is still not complete. However, much has been learned since the 2003 Amendment to the Biological Opinion was prepared.

In 2013, the Missouri River Recovery Implementation Committee (MRRIC) provided a recommendation to USACE and USFWS to conduct an effects analysis of its actions to avoid jeopardy to pallid sturgeon, piping plover, and interior least turn, the three federally listed threatened and endangered species included in the 2003 Amendment to the Biological Opinion. The MRRIC, established by Section 5018 of WRDA 2007, consists of an assemblage of stakeholders who have an interest in the management of the Missouri River. The recommendation to conduct an effects analysis was based on input provided to MRRIC through an Independent Science Advisory Panel that was established in 2011, with oversight by a third party science neutral entity, to provide advice on specific topics.

The concept of an effects analysis for federal actions on the Missouri River to avoid jeopardy to the three federally listed threatened and endangered species was based on modifications to the effects analysis concept provided by Murphy and Weiland (2011). The purpose of the Missouri River effects analysis is to conceptually and quantifiably make explicit the effects of operations and actions on the listed species by specifically evaluating the effects of hydrologic and fluvial processes on the Missouri River, as well as ongoing management actions to the status and trends of the listed species and their habitats.

Numerous testable hypothesis have been developed as part of the effects analysis to better focus actions that may be undertaken as part of an adaptive management strategy to benefit pallid sturgeon populations and avoid jeopardy to this species. On the lower Missouri River, these hypothesis are related to the impact of spawning cues, food and foraging habitat, free drifting embryos and larval drift dynamics, spawning habitat, and population augmentation (stocking) have on recovery of pallid sturgeon. USACE and USFWS are currently working on a Missouri River wide programmatic plan to incorporate information from the effects analysis into a set of management actions to benefit populations of threatened and endangered species. This plan is being developed with an adaptive management paradigm as identified in the 2003 Amended Biological Opinion because of the amount of uncertainty associated with the benefits of various management actions to benefit these species. There is a particularly high amount of uncertainty associated with various management actions to benefit pallid sturgeon on the lower Missouri River. However, this plan is not yet completed. In the interim, there is a need to continue and take actions to avoid jeopardy to pallid sturgeon and to begin testing hypothesis that are included in the effects analysis.

One action that can be undertaken within the existing framework of the MRRP is related to free drifting embryos and larval pallid sturgeon drift dynamics. It has been postulated that free drifting embryos and larval pallid sturgeon do not survive because they are unable to move from the thalweg of the river to the channel margins where conditions are believed to be more suitable for growth and survival. The purpose of this project is to test the hypothesis that re-engineering the Missouri River channel morphology in select reaches will increase channel complexity and serve specifically to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage. Testing this hypothesis in the field will reduce the amount of uncertainty associated with the effectiveness of implementing management actions to intercept free drifting embryos and larval sturgeon on a larger scale to potentially benefit pallid sturgeon population size.

Foraging habitat is defined as locations in which the water depth is between one to three meters and bottom water velocities are between 0.5 to 0.7 meters per second. This project would be designed to intercept free flowing, larval pallid sturgeon-sized particles into the channel margins while creating habitat for larval pallid sturgeons to freely move, forage, and evade predators.

## 1.5 Project Goals and Objectives

The goal of this project is to determine if increasing interception-rearing-complex habitat increases the population of federally endangered pallid sturgeon within the lower Missouri River.

The objective of the project is to create hydraulic conditions to intercept free drifting embryos and larval sturgeon from the channel thalweg to the channel margins where water depths are one to three meters and velocities are 0.5 to 0.7 meters per second.

Hydraulic modeling will be used to estimate the amount of interception-rearing-complex habitat that is expected to develop from alternative plans. Interception-rearing-complex habitat will be determined by multiplying the interception ratio of surrogate particles in the hydraulic model that are intercepted from the channel thalweg (habitat quality) by the number of acres of foraging habitat, water depths of one to three meters and velocities of 0.5 to 0.7 meters per second, available in the channel margins (habitat quantity).

Post-construction monitoring would be conducted to measure actual changes in channel morphology and changes in catch rates of free drifting embryos and larval sturgeon. Because of the limited population size of pallid sturgeon in the Missouri River, free drifting embryos and larval shovelnose sturgeon, a species with a much larger population size, will be used as a surrogate for pallid sturgeon to determine the success of the project. It is assumed that any measures that would result in increases of interception of larval shovelnose sturgeon would also result in increases of interception of larval pallid sturgeon. Information learned from post-construction monitoring of this project may be used to further modify Searcy Bend as part of an adaptive management process, or used in the design of other interception-rearing-complex habitats that may be constructed in the future.

## 1.6 Project Constraints

Constraints are things that must be avoided during the planning and development of a project. There were numerous program level and site-specific constraints that have been identified for the project. These constraints include:

**Missouri River Authorized Purposes:** The project must not adversely impact the authorized purposes of the Missouri River Mainstem Reservoir System and the BSNP. For the Mainstem Reservoir System these include: flood control, hydropower, navigation, water supply, water quality, irrigation, recreation, and fish and wildlife. For the BSNP these include: bank stabilization and navigation.

**Avoid Unacceptable Impacts to the Environment:** The project must not adversely affect any threatened and endangered species or the habitat upon which they rely. Negative impacts to wetlands should be avoided, minimized, or mitigated. Significant adverse impacts to water quality and fish and wildlife should be avoided. The project

should not negatively impact any existing habitat that has been constructed as part of MRRP.

**Cultural/Tribal Resources:** The BSNP resulted in the preservation in place of hundreds of historic shipwrecks along the Missouri River. Project features must avoid impacts to historic shipwrecks and other cultural or tribal resources. Measures must be taken to avoid and/or preserve in place cultural or tribal resources, including shipwrecks, if they are inadvertently discovered during construction.

**Private Property:** Project alternatives minimize or avoid any foreseeable effects to adjacent private property.

**Public Infrastructure:** The project must not adversely impact public roads, bridges, levee and drainage systems, sewer lines, drinking water intakes, or other components of public infrastructure.

**Project Construction Costs:** Only measures that are cost effective will be considered for implementation.

**Operation and Maintenance Costs:** Such habitat creation projects are intended to be self-sustaining. In addition, limited funding is available for long-term operation and maintenance.

**Laws and Regulations:** The project must be designed and constructed in a manner consistent with federal, state, and local laws and regulations.

## **1.7 Agency and Public Coordination**

Due to the technical nature of the hydraulic conditions included as part of the project objectives, alternatives were developed by USACE with input from U.S. Geological Service (USGS) staff who were involved in preparation of the draft effect analysis report. Both USACE and USGS have expertise in hydraulic modeling. The alternatives were shared with USFWS, Missouri Department of Conservation (MDC), U.S. Environmental Protection Agency (USEPA), and Natural Resources Conservation Service (NRCS) during a meeting on December 8, 2015.

On May 3, 2016, Public Notice No. 2016-00334 was issued jointly by the USACE and the Missouri Department of Natural Resource (MDNR) announcing the availability of this draft EA and draft Section 404(b)(1) Evaluation for a 30-day public comment period. Information concerning the availability of the Public Notice and draft documents has been e-mailed to entities on the USACE Regulatory Branch distribution lists. During the public comment period, the Public Notice and draft documents are available on the USACE Public Notice website at: <http://www.nwk.usace.army.mil/Media/PublicNotices/PlanningPublicNotices.aspx>. Hard copies are available on request. A copy of the Public Notice is included as Appendix A.

In addition, a public meeting is being held on May 24, 2016, from 5:00 p.m. to 7:00 p.m. at Marshall City Hall in Marshall, Missouri to provide the public information on the project and to solicit comments. A copy of all public and agency comments received during the public review process will be located in Appendix B of the final environmental assessment.

## **2.0 Alternatives**

This chapter describes the alternative formulation process and presents the final array of alternatives considered in detail for the Searcys Bend Interception-rearing-complex Project. Cost effectiveness and incremental cost analysis were used in conjunction with an evaluation of potential environmental impacts (Section 4) to identify the Recommended Plan.

An initial array of alternative plans was developed by combining various measures that were expected to meet the primary project objective. For purposes of this project, a measure is a feature, a structural element that requires construction or assembly on-site, an activity, or a non-structural action. Measures that did not meet the project objectives, project constraints, or meet the completeness, effectiveness, efficiency, and acceptability criteria described in the United States Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G)* were removed from further consideration.

### **2.1 Habitat creation Measures**

Seven management measures were initially considered to develop alternative plans. These included: 1) Construct a series of rootless dikes, 2) Remove portions of existing dikes, 3) Extend portions of existing dikes, 4) Remove sand from the existing sandbar, 5) Top-width widening, 6) Construct a side channel, and 7) Construct a backwater area. These are further described.

#### **2.1.1 Construct a Series of Rootless Dikes**

This measure would consist of constructing a series of rootless dikes to direct more water flow towards the sandbar. A rootless dike is a wing dike that is not "rooted" into the bank. A rootless dike maintains the ability of a traditional "rooted" wing dike to consolidate flow into the navigation channel while also allowing some flow landward of the dike to develop beneficial habitat. It is believed this would both intercept free drifting embryos and larval sturgeon from the channel thalweg to the channel margins and, over time, result in the development of food producing and foraging habitat. Depending on the configuration of the rootless dikes, this measure would meet the project objectives, avoid project constraints, and is technically feasible.

### **2.1.2 Remove Portions of Existing Dikes**

This measure would remove portions of existing dikes along the inside bend of the river and allow more flow within and behind the sandbar. It is believed this would both intercept free drifting embryos and larval sturgeon from the channel thalweg to the channel margins and, over time, result in the development of food producing and foraging habitat. Depending on the configuration in which portions of the dikes were removed, this measure would meet the project objectives, avoid project constraints, and is technically feasible.

### **2.1.3 Extend Portions of Existing Dikes**

This measure would extend portions of existing dikes along the inside bend of the river to create zones of flow expansion downstream of the structures. It is believed this would both intercept free drifting embryos and larval sturgeon from the channel thalweg to the channel margins and, over time, result in the development of food producing and foraging habitat. It is expected that this measure would be used in combination with other measures in order to be most effective. Depending on the configuration in which portions of the dikes were extended, this measure would meet the project objectives, avoid project constraints, and is technically feasible.

### **2.1.4 Remove Sand from the Existing Sandbar**

This measure would involve actively removing material from the sandbar using a dredge. This would increase the rate at which interception-rearing-complexes would develop. In order for this measure to be sustainable, it would be dependent on other measures that would construct a series of rootless dikes and/or remove portions of the existing dikes. Otherwise, new sand would be deposited on the sandbar and it would return to its current condition. In combination with other measures, this measure would meet the project objectives, avoid project constraints, and is technically feasible.

### **2.1.5 Top-Width Widening**

This measure would involve widening the top-width of the river channel and create marginal areas for pallid sturgeon foraging. In combination with other measures such as removing portions of existing dikes and constructing a series of rootless dikes this alternative would meet project objectives and is technically feasible. However, this measure is not reasonably expected to be cost effective in meeting the project objectives when compared to other measures being considered. This measure may also negatively impact the navigation channel within the project area. For these reasons, it was not carried forward for further consideration.

### **2.1.6 Construct a Side Channel**

This measure would involve construction of a side channel to the main river channel. Numerous side channels have already been constructed on the Missouri River,

including one immediately adjacent to the project area, Tadpole Chute. To date, Tadpole Chute has not been effective in intercepting free drifting embryos and larval sturgeon. The side channel is currently being modified to increase meandering to diversify water velocities and depths to improve the overall quality of the aquatic habitat within the side channel. However, these modifications are not being made in a way that will allow testing of the hypothesis that mostly passive free-floating pallid sturgeon embryos and larvae are entrained in the thalweg, the deepest fastest flowing portion of the channel, and are unable to move to the channel margins where environmental conditions may be more suitable for their growth and survival. Additionally, there is a lack of physical space to construct a second side channel. For these reasons, this measure was removed from further consideration.

### 2.1.7 Construct a Backwater Area

This measure would be similar to constructing a side channel, except that it would be closed off on one end. This measure was removed from further consideration for several reasons. These reasons include: 1) This feature would not be effective in intercepting free drifting embryos and larval sturgeon from the thalweg of the main channel, and therefore does not meet the primary objective of the project; 2) There is a lack of physical space to construct this feature without negatively impacting the existing side channel; and 3) Several back water areas have been constructed along the Missouri River within the Omaha District and they have not been sustainable over the long-term because of sediment deposition.

### 2.1.8 Summary of Habitat Creation Measure Screening

The initial screening of management measures considered is summarized in Table 1. Four measures were carried forward to develop an initial array of alternatives.

Table 1: Summary of the evaluation of management measures.

<b>Measure</b>	<b>Meets Project Objectives</b>	<b>Meets Project Constraints</b>	<b>Technically Feasible</b>	<b>Carried Forward</b>
Construct a Series of Rootless Dikes	Potentially	Yes	Yes	Yes
Remove Portions of Existing Dikes	Potentially	Yes	Yes	Yes
Extend Portions of Existing Dikes	Potentially	Yes	Yes	Yes
Remove Sand from the Existing Sandbar	Potentially	Yes	Yes	Yes

Top-Width Widening	Potentially	No	Yes	No
Construct a Side Channel	No	No	No	No
Construct Backwater Areas	No	No	No	No

## 2.2 Initial Array of Alternatives

Various combinations of the measures that were carried forward were used to develop an initial array of alternatives using best professional judgment. Four distinct plans for dike modifications were developed with measures that consisted of constructing rootless dikes, removing portions of existing dikes, and extending portions of existing dikes. These plans were combined with various degrees of removing sand from the existing sandbar. Including sub-alternatives, a total of twelve alternatives were developed for the initial array of alternatives, including the no-action (future without-project condition) alternative. Elevations of the dikes are described as feet above or below the construction reference plane. The construction reference plane is used as a baseline elevation used to construct dikes and revetments on the Missouri River. It is an imaginary plane that extends the length of the river. It is technically defined as the sloping water surface elevation of a discharge that is exceeded 75 percent of the time during the navigation season.

### 2.2.1 No-Action/Future Without-Project Condition

The No-Action alternative would not result in any changes to Searcys Bend to meet the project objectives. It was assumed that there would be no difference between the existing condition and the future without-project condition with regard to interception-rearing-complex habitat because of the river channel is stabilized by the BSNP. Climate change is expected to cause more frequent large events, however it is not anticipated that would have a positive effect on embryos being able to escape the channel thalweg into suitable foraging habitat. See Figure 3.



Figure 3: The No-Action/Future Without-Project Condition of the initial array of alternatives.

### 2.2.2 Alternative Concept 1

Alternative Concept 1 consists of new rootless rock dike structures. These structures include a 250-foot portion perpendicular to flow at an elevation +two feet above the construction reference plane with the intent to maintain the navigation channel and an angled portion of dike at -four feet below the construction reference plane for 100 feet and -two feet below the construction reference plane for 200 feet. The purpose of the angled dike is to direct water perpendicularly across the top of the structure towards the sand bar with the intent to create additional food and foraging habitat.

**Alternative 1a of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. It includes partial dredging of the sandbar to increase the rate at which foraging habitat will develop. See Figure 4.

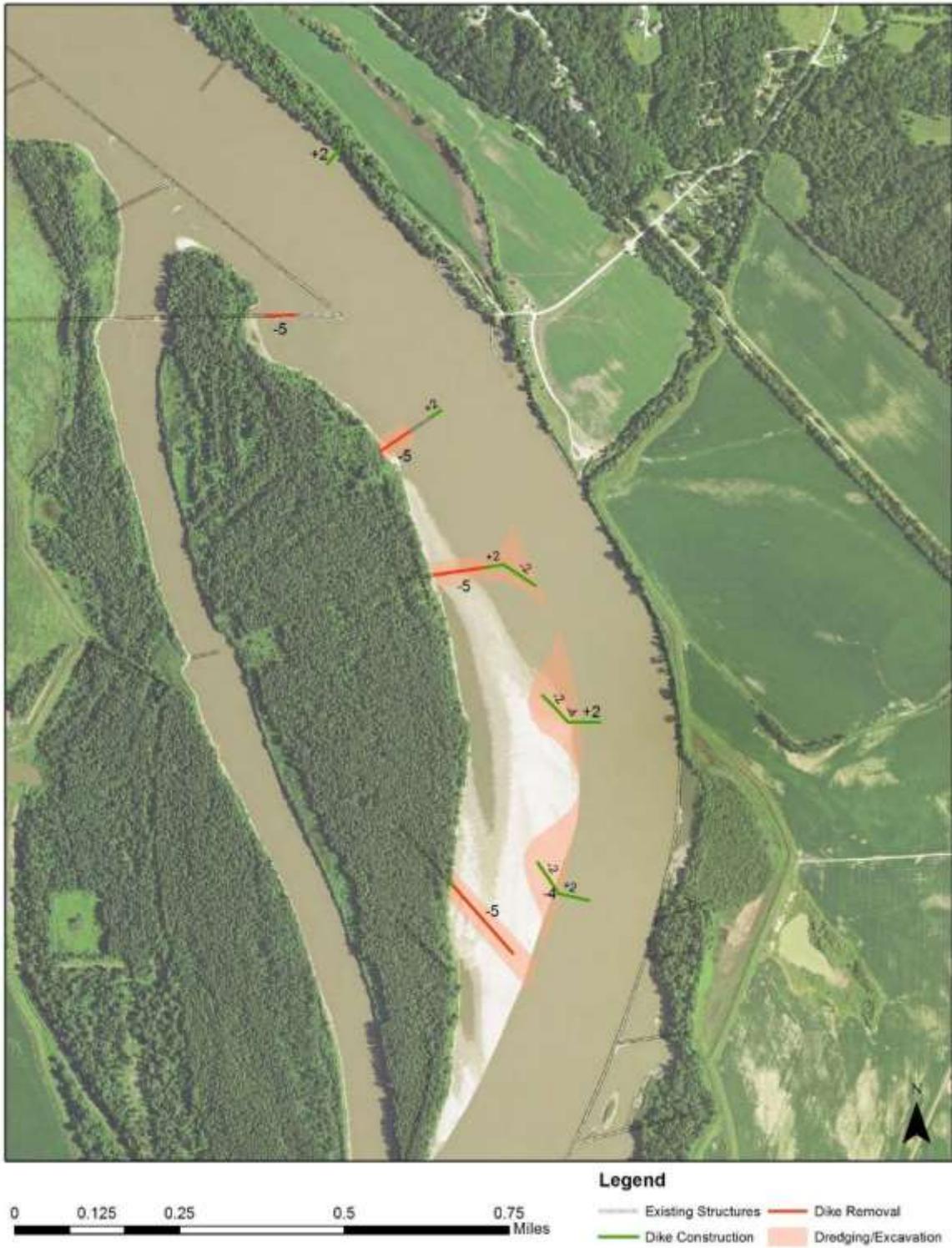


Figure 4: Alternative 1a of the initial array of alternatives.

**Alternative 1b of the Initial Array of Alternatives:** This alternative consists of extending two dikes and constructing three new dikes, two of which are rootless. It includes partial dredging of the sandbar to increase the rate at which foraging habitat will develop. See Figure 5.



Figure 5: Alternative 1b of the initial array of alternatives.

**Alternative 1c of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. It includes full dredging of the sandbar so that the foraging habitat will be fully developed following project construction. See Figure 6.

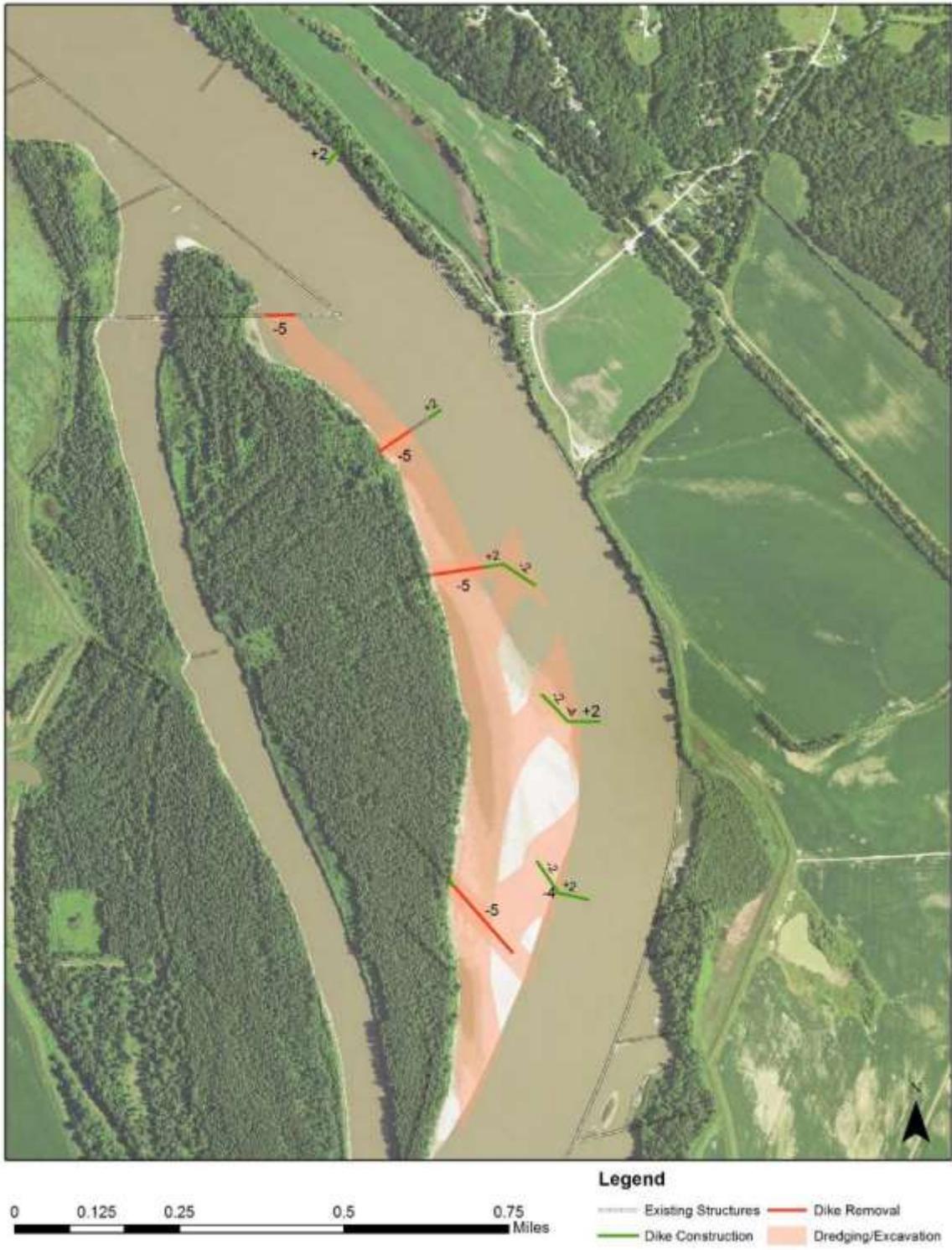


Figure 6: Alternative 1c of the initial array of alternatives.

**Alternative 1d of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. See Figure 7.

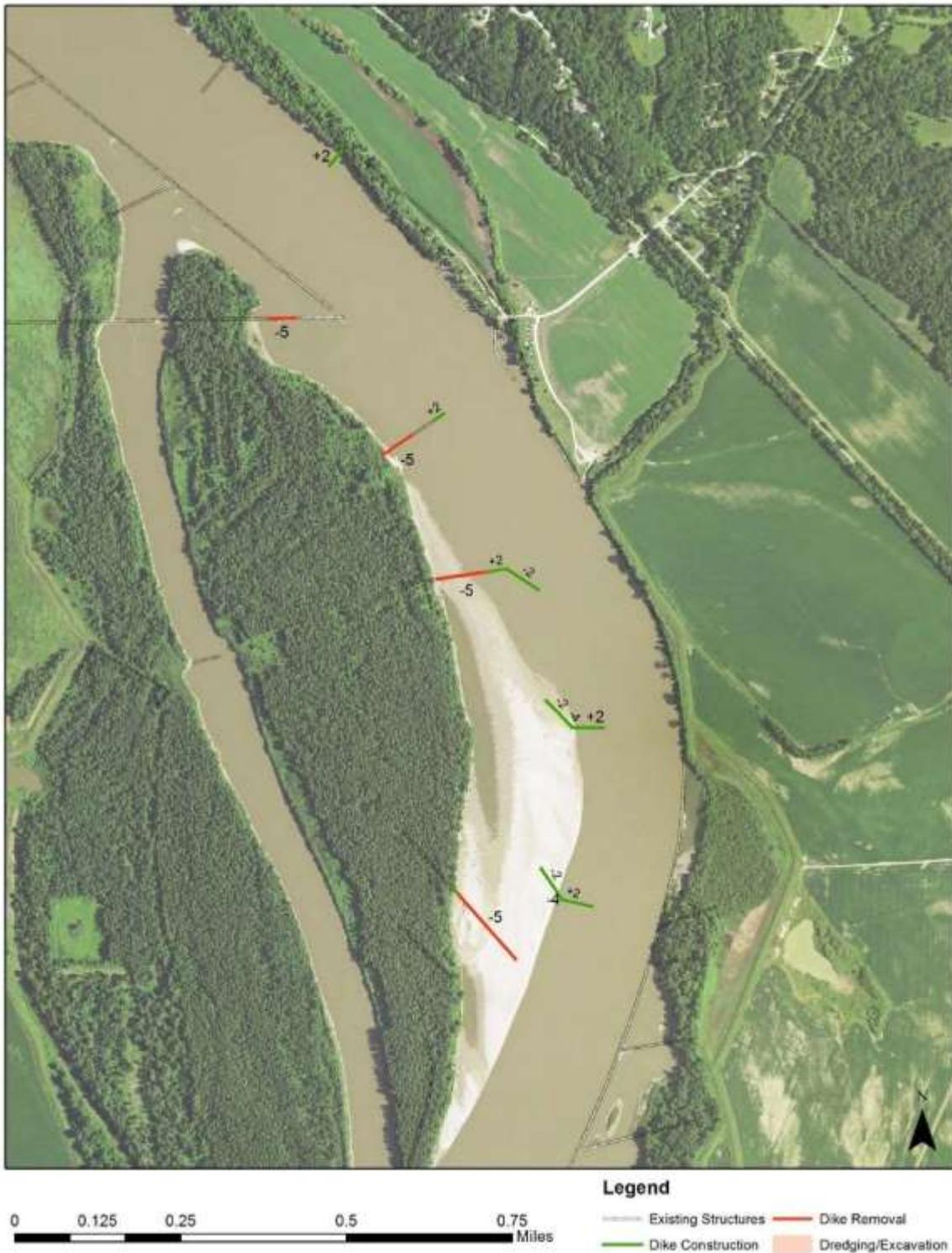


Figure 7: Alternative 1d of the initial array of alternatives.

### **2.2.3 Alternative Concept 2**

This concept includes the construction of new rootless rock dike structures similar to Plan 1 with the exception that the furthest downstream dike addition from Plan 1 is excluded in Plan 2. This configuration was introduced to provide a direct comparison with Plan 1, or more specifically test the relative increase or decrease in interception and habitat creation by excluding the furthest downstream dike addition. This plan includes one structure with a 250-foot portion perpendicular to flow at an elevation +two feet above the construction reference plane with the intent to maintain the navigation channel and an angled portion of dike at -four feet below the construction reference plane for 100 feet and -two feet below the construction reference plane for 200 feet. The purpose of the angled dike is to direct water perpendicularly across the top of the structure towards the sand bar with the intent to create additional aquatic area.

**Alternative 2a of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing two new dikes, one of which is rootless. It includes partial dredging of the sandbar to increase the rate at which foraging habitat will develop. See Figure 8.

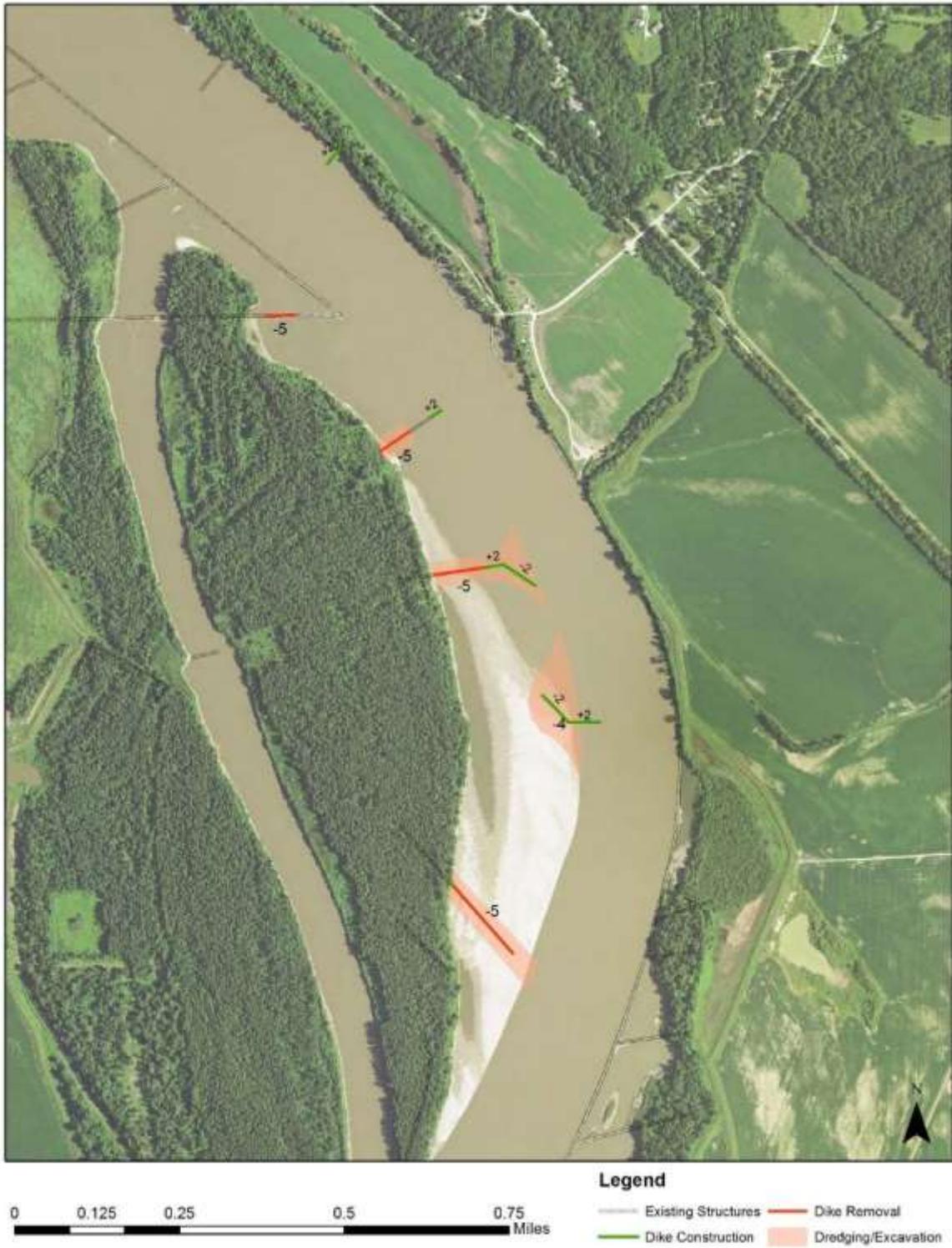


Figure 8: Alternative 2a of the initial array of alternatives.

**Alternative 2b of the Initial Array of Alternatives:** This alternative consists of extending two dikes and constructing two new dikes, one of which is rootless. It includes partial dredging of the sandbar to increase the rate at which foraging habitat will develop. See Figure 9.



Figure 9: Alternative 2b of the initial array of alternatives.

**Alternative 2c of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing two new dikes, one of which is rootless. It includes full dredging of the sandbar so that the foraging habitat will be fully developed following project construction. See Figure 10.

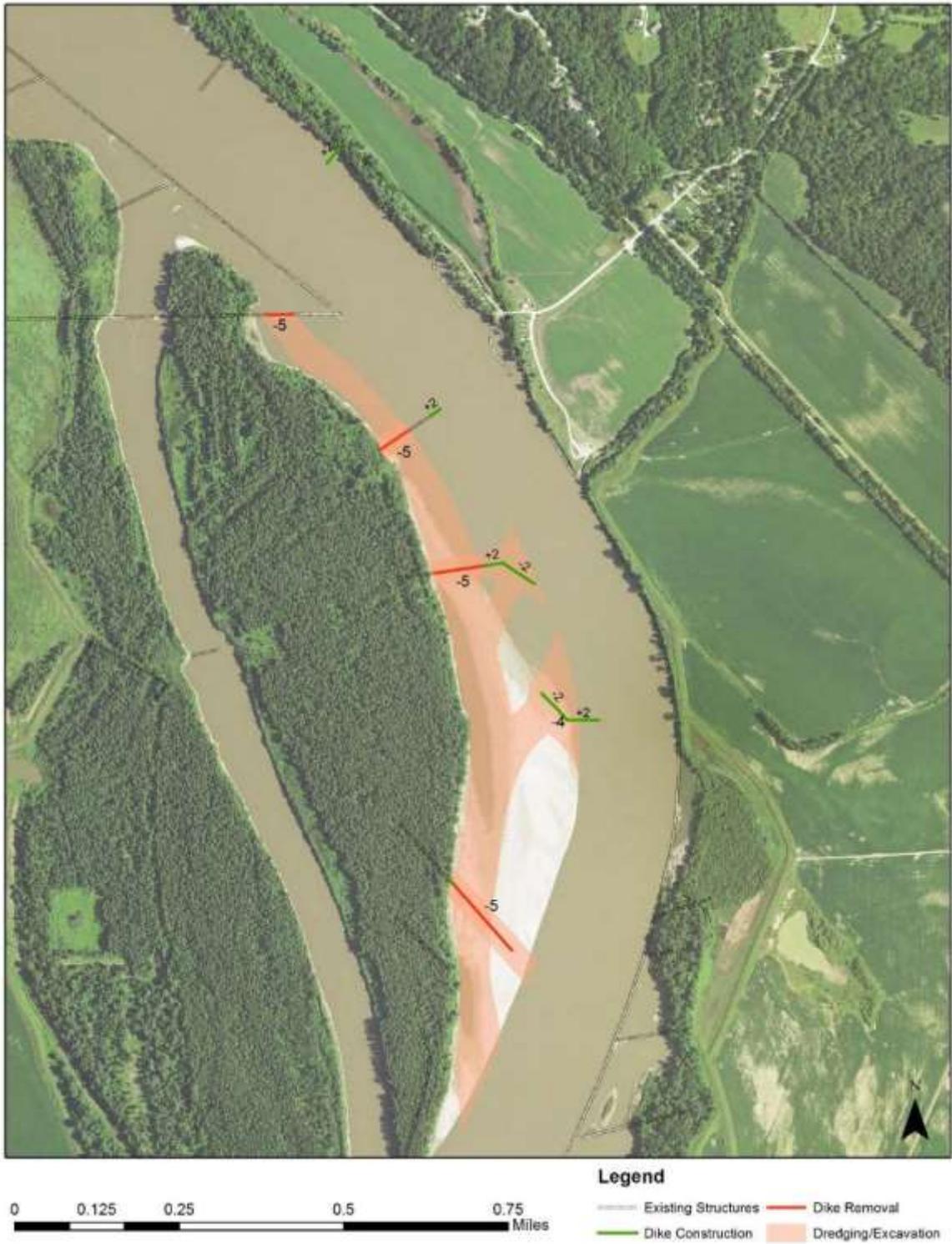


Figure 10: Alternative 2c of the initial array of alternatives.

**Alternative 2d of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing two new dikes, one of which is rootless. See Figure 11.

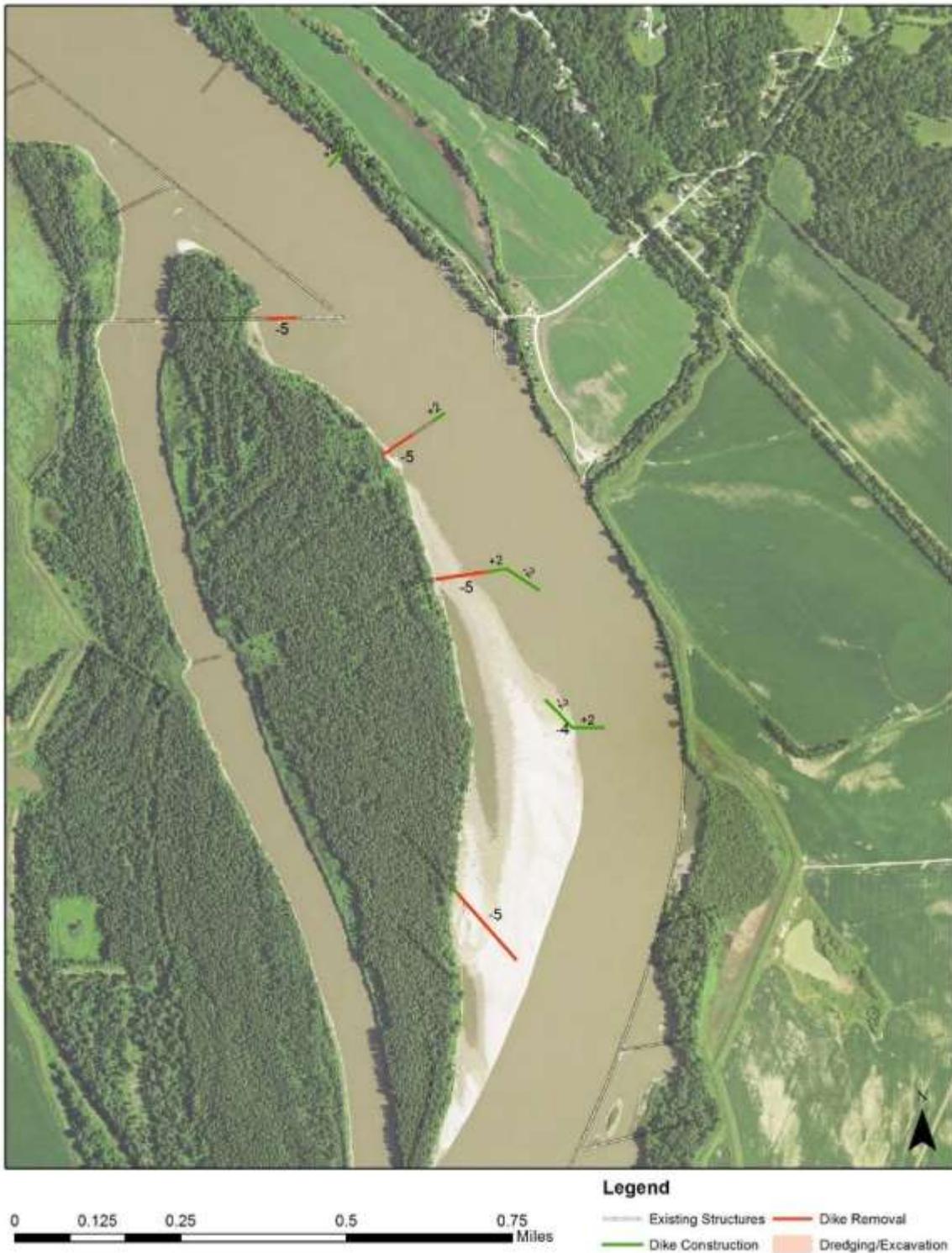


Figure 11: Alternative 2d of the initial array of alternatives.

**Alternative 2e of the Initial Array of Alternatives:** This alternative is identical to alternative 2d except that a shorter length of one of the dikes would be removed. See Figure 12.

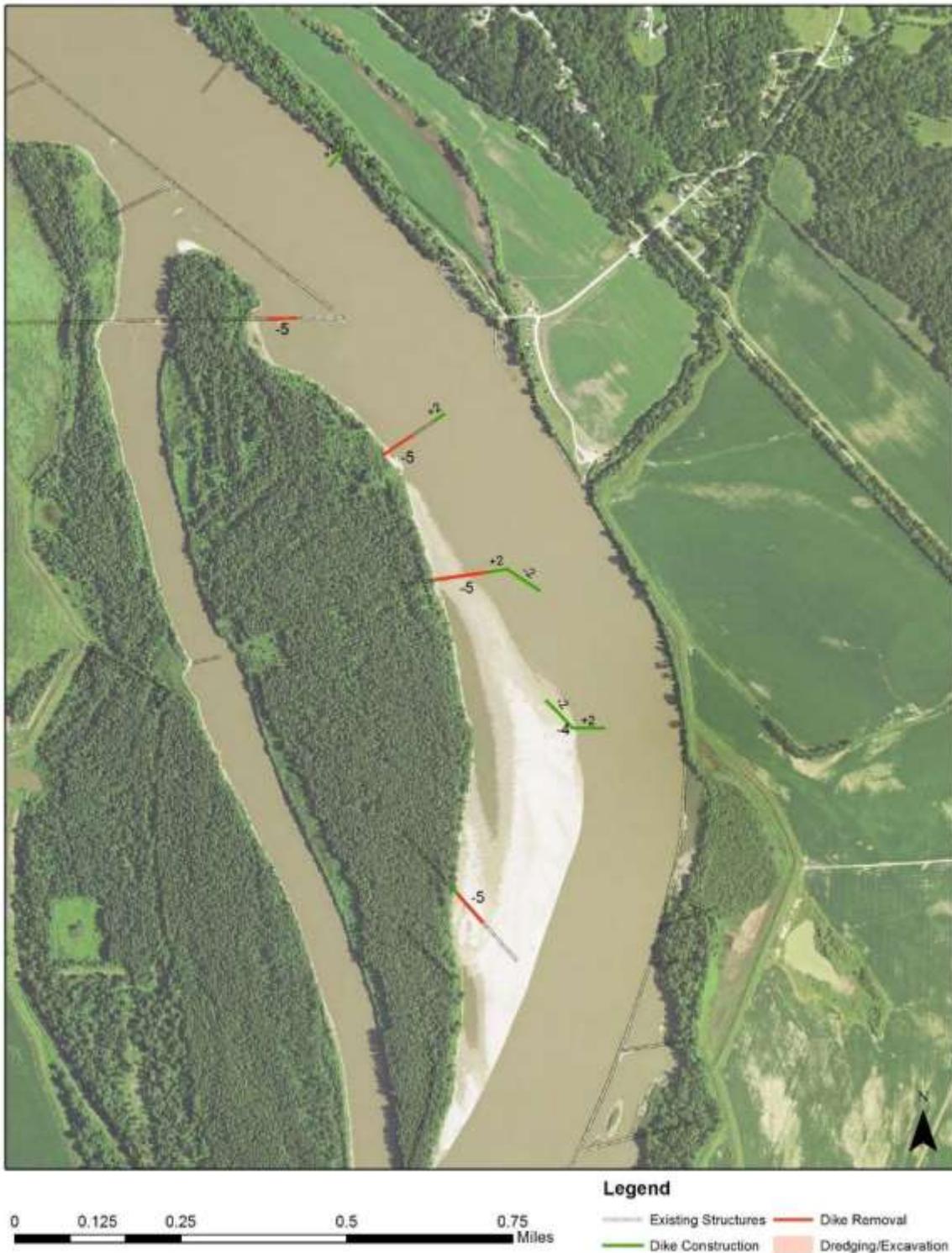


Figure 12: Alternative 2e of the initial array of alternatives.

### 2.2.4 Alternative Concept 3

Concept 3 includes the construction of new rootless rock dike structures along the margins of the RCL similar to Plan 1 and Plan 2 without the angled lowered portion. The purpose of this configuration was to test how a traditional rootless dike compared with the novel angled rootless dikes in the previous plans. This plan includes two rootless structures perpendicular to flow at an elevation +2 feet above CRP with the intent to maintain the navigation channel and create constriction/expansion points that would promote drifting particles to enter the channel margins during flow expansion following the constriction point. One angled dike near the upstream end remains in this plan to promote some flow towards or behind the sand bar.

**Alternative 3a of the Initial Array of Alternatives:** This alternative consists of removing portions of four dikes, the extension of two dikes, and constructing three new dikes, two of which are rootless. The length and orientation of the rootless dikes differ from that shown in other alternatives. This alternative also includes partial dredging of the sandbar to increase the rate at which foraging habitat will develop. See Figure 13.

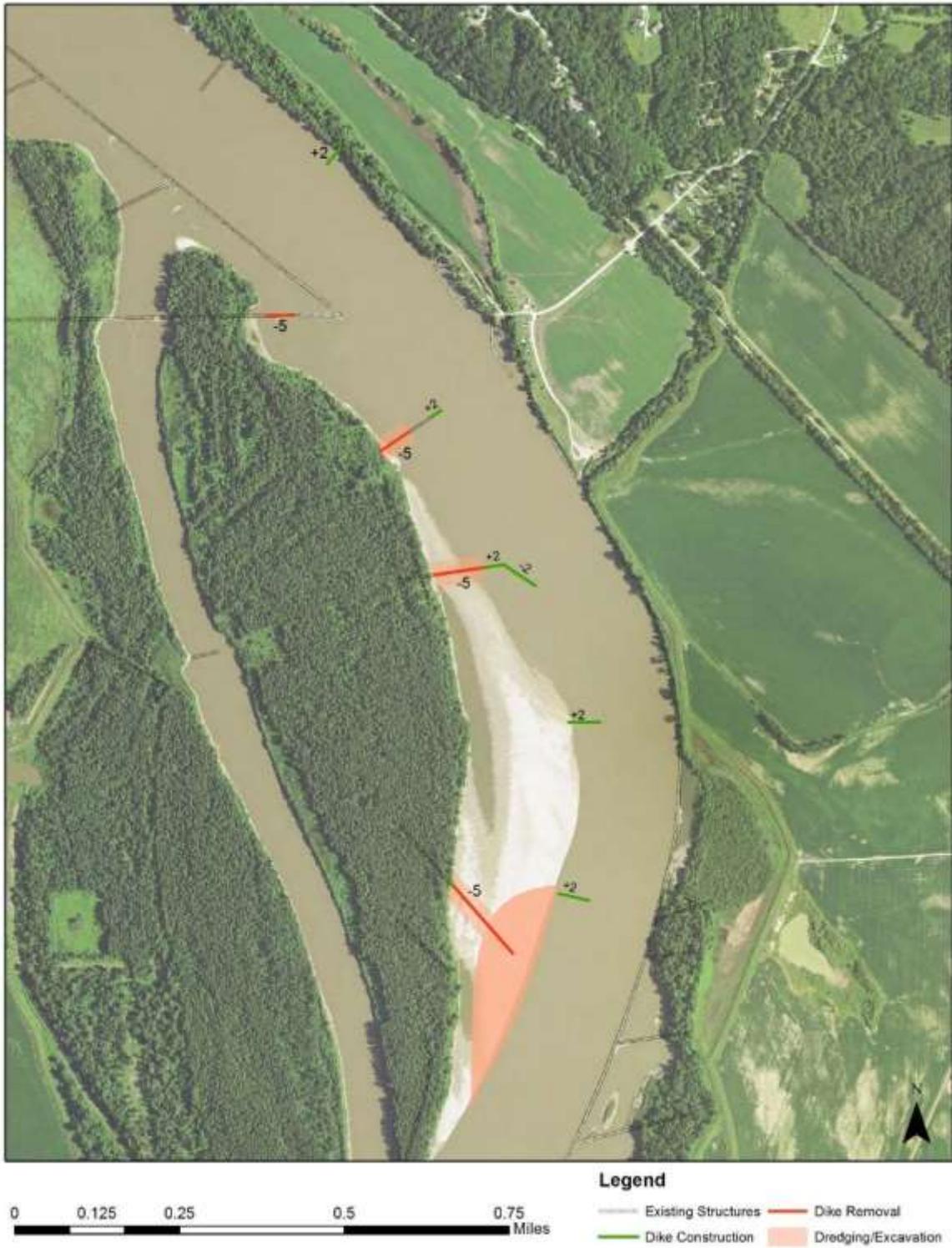


Figure 13: Alternative 3a of the initial array of alternatives.

**Alternative 3b of the Initial Array of Alternatives:** This alternative is similar to alternative 3a except that a shorter length of one of the dikes would be removed. This alternative also includes partial dredging of the sandbar, although less material would be removed compared to alternative 3a. See Figure 14.



Figure 14: Alternative 3b of the initial array of alternatives.

## 2.3 Evaluation of the Initial Array of Alternatives

The initial array of alternatives was evaluated using cost effectiveness and incremental cost analysis. Habitat benefits were determined by multiplying the estimated percentage of free-floating particulates that would be intercepted from the thalweg of the river and transported to the channel margin by the area of suitable foraging habitat to provide interception-rearing-complex habitat units. Hydrodynamic modeling was used as a proxy to determine habitat suitability. Costs for each of the alternatives were also determined. A 50-year period of analysis was used to evaluate alternatives.

### 2.3.1 Habitat Benefits

There are currently not any biological models to quantitatively evaluate habitat suitability for free drifting embryos or larval sturgeon. The habitat requirements for these life stages of sturgeon are not well known. Although there is not a suitable biological model for sturgeon, a hydrodynamic model can be used to quantify the effectiveness of the alternatives to meet the project objectives described in Section 1.5 Goals and Objectives. Specifically, alternatives were evaluated using a two-dimensional hydrodynamic model, Adaptive Hydraulics (ADH), version 4.5 developed by the USACE Engineering Research and Design Center, Coastal and Hydraulics Laboratory and the Particle Tracking Module (PTM) in Surface-Water Modeling System (SMS), version 11.2, developed by Aquaveo®. These analysis were used to evaluate depth, velocity magnitude, and velocity direction of various alternatives to meet the project objectives. Detailed information concerning the use of these tools, including assumptions, model calibration, and validation is included in Appendix C – Hydrodynamic Modeling.

U.S. Geological Survey's (USGS) *Missouri River Pallid Sturgeon Effects Analysis, Integrative Draft Report 2015* identified a lack of suitable conditions for drifting embryos to be able to escape the thalweg and provide suitable foraging habitat. The Effects Analysis provided conditions which would provide depth and flow conditions for suitable foraging habitat.

Habitat benefits were determined by multiplying the estimated percentage of free-floating particulates that would be intercepted from the thalweg of the river and transported to the channel margin by the area of suitable foraging habitat to provide interception-rearing-complex habitat units. Net average annual habitat units (AAHU) were then determined over a 50-year period of analysis (Table 2).

Table 2: Net average annual habitat units (AAHU) for the initial array of alternatives.

<b>Initial Alternative</b>	<b>Habitat Units (Year 0)</b>	<b>Habitat Units (Year 1)</b>	<b>Habitat Units (Year 2)</b>	<b>Habitat Units (Year 3)</b>	<b>Habitat Units (Year 4)</b>	<b>Habitat Units (Year 50)</b>	<b>Average Annual Habitat Units (AAHU)</b>	<b>Net Average Annual Habitat Units* (AAHU)</b>
No-Action/Future Without-Project Condition	5.8	5.8	5.8	5.8	5.8	5.8	5.8	0.0
Initial Alternative 1a	5.8	11.0	16.2	16.2	16.2	16.2	16.0	10.2
Initial Alternative 1b	5.8	8.9	8.9	8.9	8.9	8.9	8.9	3.1
Initial Alternative 1c	16.2	16.2	16.2	16.2	16.2	16.2	16.2	10.4
Initial Alternative 1d	5.8	8.4	11.0	13.6	16.2	16.2	15.8	10.0
Initial Alternative 2a	5.8	10.5	15.2	15.2	15.2	15.2	15.0	9.2
Initial Alternative 2b	5.8	5.9	5.9	5.9	5.9	5.9	5.9	0.1
Initial Alternative 2c	15.2	15.2	15.2	15.2	15.2	15.2	15.2	9.4
Initial Alternative 2d	5.8	8.2	10.5	12.9	15.2	15.2	14.8	9.0
Initial Alternative 2e	5.8	8.2	10.6	13.0	15.3	15.3	14.9	9.1
Initial Alternative 3a	5.8	8.6	11.4	11.4	11.4	11.4	11.3	5.5
Initial Alternative 3b	5.8	5.9	5.9	5.9	5.9	5.9	5.9	0.1

\* Net AAHU = With-Project AAHU – Future Without-Project AAHU

### 2.3.2 Cost

Preliminary cost estimates for each alternative were calculated as average annual costs over the 50-year period of analysis at the approved 2016 fiscal year interest rate of 3.125 percent. Items included in these estimates are various items associated with initial construction cost, annual operation maintenance, repair, replacement and rehabilitation, and annual monitoring costs. All estimates were based on experience from previous projects. See Table 3 for details concerning the total average annual cost estimates for each of the alternatives from the initial array.

Table 3: Total average annual costs for the initial array of alternatives.

Initial Alternative	First Cost (Includes Construction, Contingency, PED, and S&A)	Annualized First Costs	Annual OMRR&R	Annual Monitoring Costs for Adaptive Management	Total Average Annual Costs
No-Action/Future Without- Project Condition	\$ -	\$ -	\$ -	\$ -	\$ -
1a	\$4,320,959	\$171,944	\$12,900	\$24,100	\$208,944
1b	\$2,814,229	\$111,986	\$12,200	\$9,500	\$143,686
1c	\$6,893,470	\$274,312	\$12,900	\$14,900	\$302,112
1d	\$2,923,988	\$116,354	\$12,900	\$32,700	\$161,954
2a	\$3,299,196	\$131,285	\$9,300	\$24,100	\$164,685
2b	\$1,971,530	\$78,453	\$9,000	\$19,500	\$106,953
2c	\$5,985,868	\$238,195	\$9,300	\$14,900	\$262,395
2d	\$2,234,090	\$88,901	\$9,300	\$32,700	\$130,901
2e	\$2,006,469	\$79,843	\$9,300	\$32,700	\$121,843
3a	\$4,219,979	\$167,925	\$9,000	\$24,100	\$201,025
3b	\$3,150,735	\$125,377	\$8,300	\$19,500	\$153,177

Notes: 1) Costs are in FY16 price levels. 2) Average annual costs are calculated using FY16 interest rate of 3.125 percent. 3) Interest during construction not calculated for the

screening because the total durations for all alternatives are approximately one year or less.

### **2.3.3 Cost Effectiveness and Incremental Cost Analysis**

Cost effectiveness and incremental cost analyses are valuable tools to assist in decision making when comparing the non-monetary benefits with the monetary costs of environmental plans. Cost effective alternatives are those in which no other alternative achieves a greater increase in net AAHU of interception-rearing-complex habitat at a lesser cost. Best buy alternatives are the array of cost effective alternatives for which the average cost per incremental output of interception-rearing-complex habitat is strictly increasing. IWR Planning Suite software was used to conduct cost effectiveness and incremental cost analysis.

Alternatives were evaluated over a 50-year period of analysis. It was assumed that there would be no difference between the existing condition and the future without-project condition with regard to interception-rearing-complex habitat because of the river channel is stabilized by the BSNP. Each alternative was considered mutually exclusive from the others. This means that only one alternative could be implemented within the project area and that individual measures included in an alternative could not be added or subtracted to other alternatives.

From the initial array of twelve alternatives, six were determined to be cost effective (Figure 15). This includes the No-Action/Future Without-Project Condition. Of the six cost effective alternatives, five were also best buy plans. The incremental cost per net AAHU ranged from \$0 for the No-Action/Future Without-Project Condition to \$465,800 for alternative 1c (Table 4 and Figure 16).

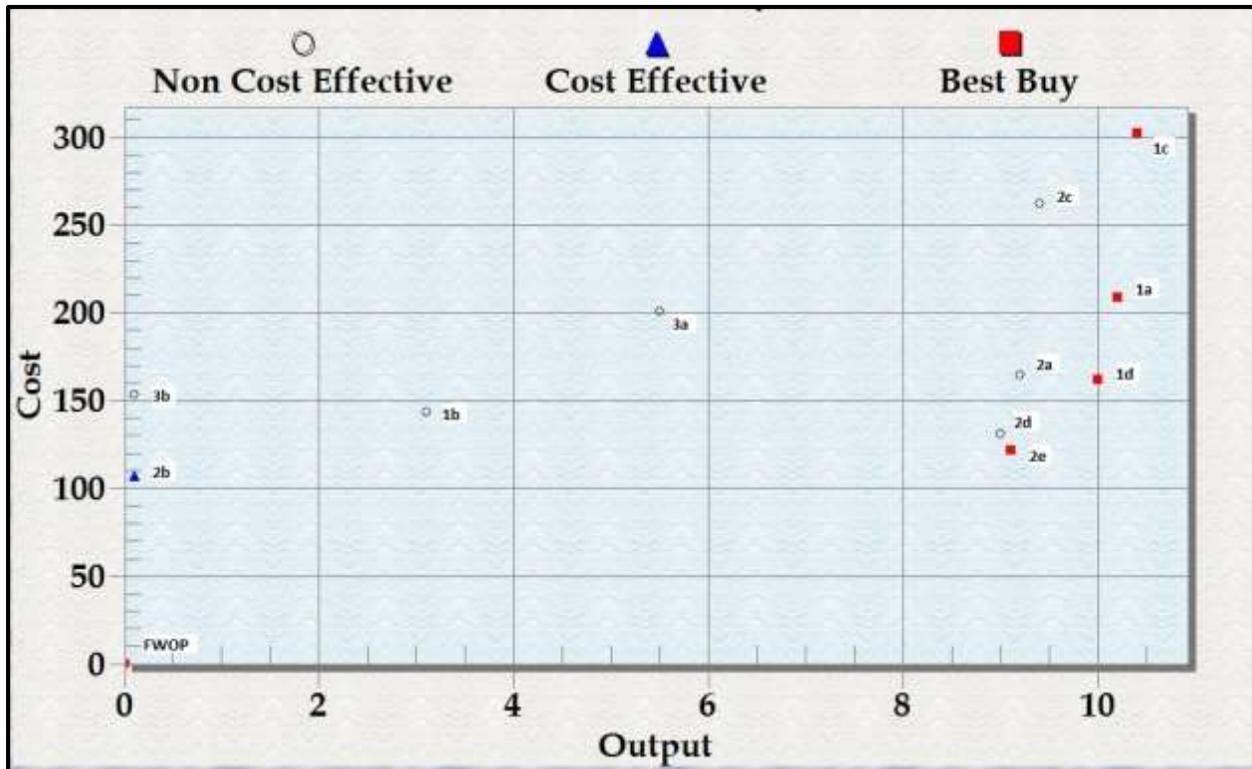


Figure 15: Identification of the cost effective (blue triangle) and best buy plans (red squares) from the initial array of 12 alternatives. Output units are net average annual habitat units (AAHU) of interception-rearing-complex habitat. Cost units are average annual in \$1,000s.

Table 4: Incremental cost per net AAHU of interception-rearing-complex habitat for the five best buy plans. All costs are average annual and in \$1,000s.

<b>Initial Alternative</b>	<b>Net AAHU</b>	<b>Average Annual Cost (\$1,000s)</b>	<b>Average Annual Costs (\$1,000s)/Net AAHU</b>	<b>Incremental Cost (1,000s)</b>	<b>Incremental Output (Net AAHU)</b>	<b>Incremental Cost (\$1,000s) Per Net AAHU</b>
No-Action/ Future Without- Project	0	0.0	\$0	\$0.0	0.0	\$0
Initial Alternative 2e	9.1	\$121.8	\$13.4	\$121.8	9.1	\$13.4
Initial Alternative 1d	10.0	\$162.0	\$16.2	\$40.1	0.9	\$44.6
Initial Alternative 1a	10.2	\$208.9	\$20.5	\$47.0	0.2	\$235.0
Initial Alternative 1c	10.4	\$302.1	\$29.0	\$93.2	0.2	\$465.8

\* Discrepancy in numbers is due to rounding.



Figure 16: Incremental cost analysis for the best buy alternatives. Output units are net average annual habitat units (AAHU) of interception-rearing-complex habitat. Cost units are incremental average annual cost (\$1,000s) per incremental AAHU.

## 2.4 Final Array of Alternatives

Each of the best buy alternatives was carried forward into the final array of alternatives without any additional modifications. For the final array of alternatives: Best Buy Plan 1 is the No-Action/Future Without-Project Condition, Best Buy Plan 2 – Modify Existing Structures and Construct One Rootless Dikes is alternative 2e from the initial array, Best Buy Plan 3 – Modify Existing Structures and Construct Two Rootless Dikes is alternative 1d from the initial array, Best Buy Plan 4 – Modify Existing Structures, Construct Two Rootless Dikes, and Partial Removal of Sand is alternative 1a from the initial array, and Best Buy Plan 5 – Modify Existing Structures, Construct Two Rootless Dikes, and Full Removal of Sand is alternative 1c from the initial array. Based on information from the cost effectiveness and incremental cost analysis process, and an evaluation of potential impacts in Section 4 of this document, Best Buy Plan 2 was identified as the Recommended Plan. Detailed descriptions of each of the five best buy plans in the final array of alternatives follow.

### Best Buy Plan 1 – No-Action/Future Without-Project Condition

For the No-Action/Future Without-Project Condition, no new measures would be implemented to increase the amount of interception-rearing-complex habitat. It was

assumed that the existing conditions shown in Figure 17 would be maintained over the 50-year period of analysis. This is because the BSNP generally maintains the channel in a fixed location. The existing conditions have an interception ratio of 0.25 and 21.3 acres of foraging habitat, which equates to 5.8 AAHUs of interception-rearing-complex. This alternative serves as the baseline condition in which the other alternatives were compared. It would not meet the project objectives.



Figure 17: The No-Action/Future Without-Project Condition would not result in any changes to the amount of interception-rearing-complex habitat at Searcys Bend. There would be 5.8 AAHUs over the 50-year period of analysis.

## **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan would result in an interception ratio of 0.37 and 41.6 acres and foraging habitat when fully developed. It would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$122,000. The average annual cost per AAHU is \$13,400.

Habitat benefits would be obtained by removing portions of four rock dike structures at locations A, B, C, and E in Figure 18. In addition, two new dikes would be constructed at locations 1 and 4. Two existing dikes would be extended in length at locations 2 and 3. Additionally, rock would be added at location 6. These modifications were designed to maintain adequate flow to the navigation channel while directing flow to the channel margin to intercept free drifting embryos and larval sturgeon. Overtime, the flow directed at the channel margin would erode portions of the existing sandbar to increase foraging habitat. It was assumed that this would occur over a four-year period, at which time the project would be considered fully developed. Four years is a reasonable time frame to assume for the project to reach full development from introduction of the planned structures. The rate of development will largely depend on the flows experienced in the years following construction. Four years was assumed a conservative estimate, and full development will likely occur prior to four years. However, although the Missouri River is largely controlled and fixed by the BSNP, the river will change overtime and changes are likely to occur after Four years as well.

Approximately 22,400 cubic yards of rock, wood piling, sand, and wood or woven willow mattress removed from locations A, B, C, and E would be placed along the bank to prevent erosion of Tadpole Island. In order to construct new dikes and extend existing dikes, approximately 14,600 cubic yards of sand would be removed from the footprints of where these structures would be located using an excavator. This would be necessary to provide a stable foundation for the new structures. The excavated sand would be returned to the river. Approximately 7,600 cubic yards of rock would be used to construct the new structures. All construction would take place from a barge.



Figure 18: The Recommended Plan would result in a net benefit of 9.1 AAHUs of interception-rearing-complex habitat for an average annual cost of approximately \$122,000. Numbers with + or – in front represent the elevation in feet of the structure compared to the construction reference plane.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Structures and Construct Two New Rootless Dikes**

Best Buy Plan 3 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a four-year period. It would result in an additional 10.0 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$162,000. Compared to Best Buy Plan 2, the incremental average annual cost per AAHU for Best Buy Plan 3 is \$44,600.

Habitat benefits would be obtained by removing portions of four rock dike structures at locations A, B, C, and D in Figure 19. In addition, three new dikes would be constructed at locations 1, 4 and 5. Two existing dikes would be extended at locations 2 and 3. Additionally, rock would be added at location 6. These modifications were designed to maintain adequate flow to the navigation channel while directing flow to the channel margin to intercept free drifting embryos and larval sturgeon. Overtime, the flow directed at the channel margin would erode portions of the existing sandbar to increase food and foraging habitat. It was assumed that this would occur over a four-year period, at which time the project would be considered fully developed. Four years is a reasonable time frame to assume for the project to reach full development from introduction of the planned structures. The rate of development will largely depend on the flows experienced in the years following construction. Four years was assumed a conservative estimate, and full development will likely occur prior to four years.. However, although the Missouri River is largely controlled and fixed by the BSNP, the river will change overtime and changes are likely to occur after Four years as well.

Approximately 34,500 cubic yards of rock, wood piling, sand, and wood or woven willow mattress removed from locations A, B, C, and D would be placed along the bank to prevent erosion of Tadpole Island. In order to construct new dikes and extend existing dikes, approximately 26,000 cubic yards of sand would be removed from the footprints of where these structures would be located using an excavator. This would be necessary to provide a stable foundation for the new structures. The excavated sand would be returned to the river. Approximately 10,400 cubic yards of rock would be used to construct the new structures. All construction would take place from a barge.

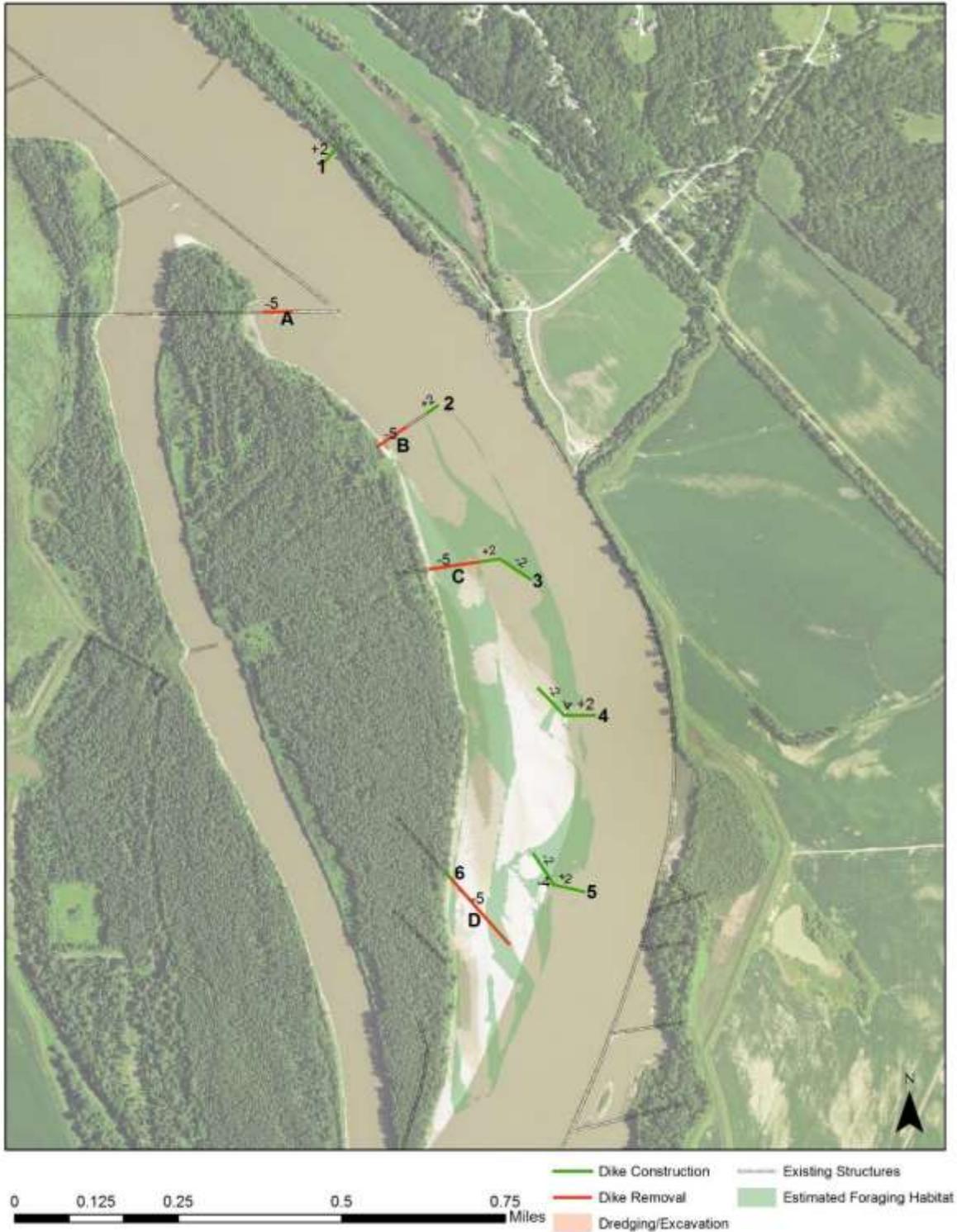


Figure 19: Best Buy Plan 3 would result in a net benefit of 10.0 AAHUs of interception-rearing-complex habitat for an average annual cost of approximately \$162,000. Numbers with + or – in front represent the elevation in feet of the structure compared to the construction reference plane.

#### **Best Buy Plan 4: Alternative 1a – Modify Existing Structures, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar**

Best Buy Plan 4 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a two-year period. It would result in an additional 10.2 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$209,000. Compared to Best Buy Plan 3, the incremental average annual cost per AAHU for Best Buy Plan 4 is \$235,000.

This alternative is similar to Best Buy Plan 3 except that sand would be removed from the sandbar to reduce the amount of time for the project to fully develop. As with Best Buy Plan 3, habitat benefits would be obtained by removing portions of four rock dike structures at locations A, B, C, and D in Figure 20. In addition, three new dikes would be constructed at locations 1, 4 and 5. Two existing dikes would be extended at locations 2 and 3. Additionally, rock would be added at location 6. These modifications were designed to maintain adequate flow to the navigation channel while directing flow to the channel margin to intercept free drifting embryos and larval sturgeon.

Approximately 184,400 cubic yards of sand would be removed from the sandbar. This material would be removed to provide a solid foundation to construct new structures and to increase the rate at which foraging habitat would develop. Sand would be removed using a dredge and be returned to the river. Overtime, the flow directed at the channel margin would erode portions of the existing sandbar to further increase foraging habitat. It was assumed that this would occur over a two-year period, at which time the project would be considered fully developed. Two years is a reasonable time frame to assume for the project to reach full development from introduction of the planned structures and dredging to “jump start” the development. The rate of development will largely depend on the flows experienced in the years following construction. Two years was assumed a conservative estimate, and full development will likely occur prior to four years. However, although the Missouri River is largely controlled and fixed by the BSNP, the river will change overtime and changes are likely to occur after two years as well.

Approximately 34,500 cubic yards of rock, wood piling, sand, and wood or woven willow mattress removed from locations A, B, C, and D would be placed along the bank to prevent erosion of Tadpole Island. Approximately 10,400 cubic yards of rock would be used to construct the new structures. All construction would take place from a barge.

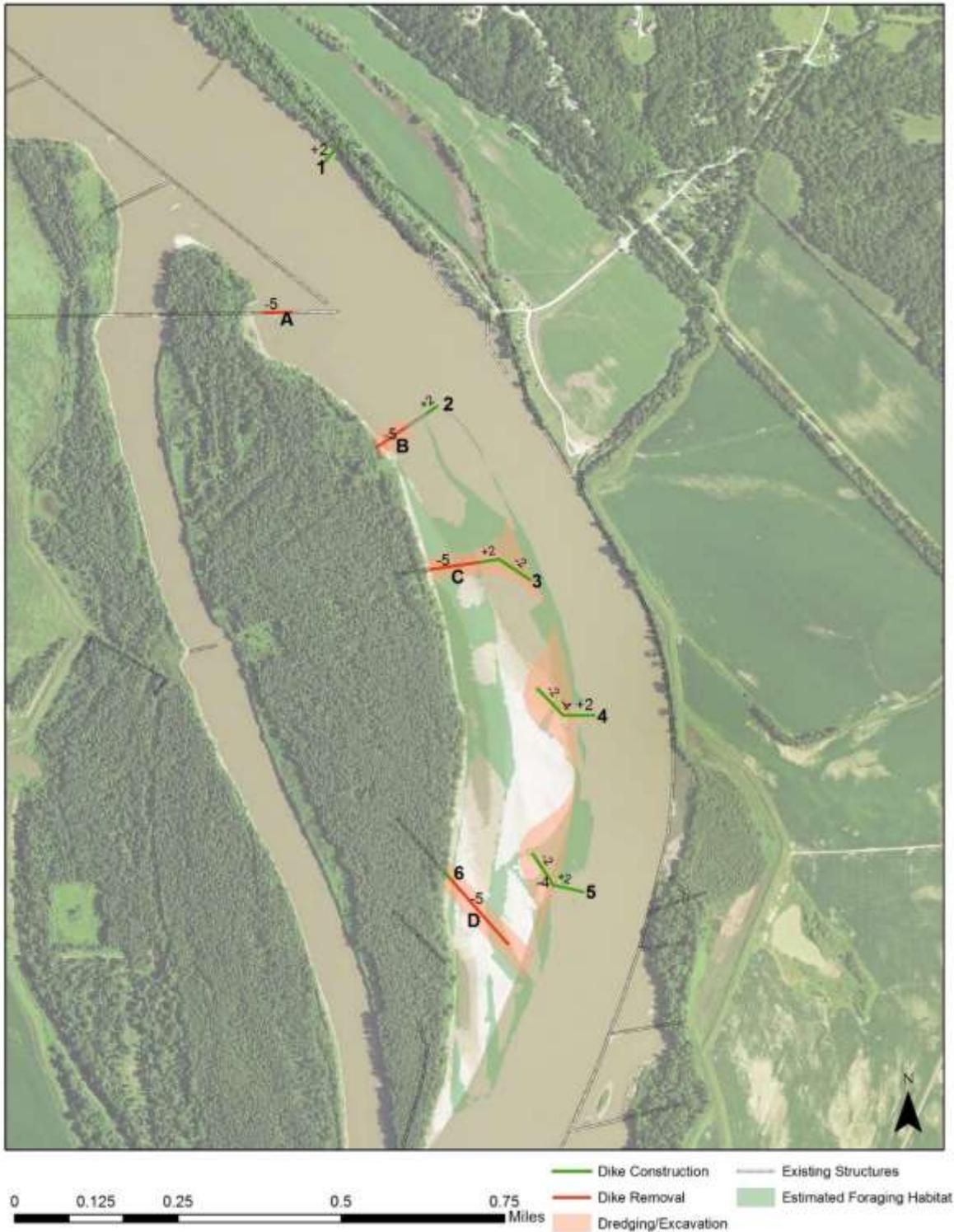


Figure 20: Best Buy Plan 4 would result in a net benefit of 10.2 AAHUs of interception-rearing-complex habitat for an average annual cost of approximately \$209,000. Numbers with + or – in front represent the elevation in feet of the structure compared to the construction reference plane.

### **Best Buy Plan 5: Alternative 1c – Modify Existing Structures, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

Best Buy Plan 5 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed immediately following construction. It would result in an additional 10.4 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. It has an average annual cost of approximately \$302,000. Compared to Best Buy Plan 4, the incremental average annual cost per AAHU for Best Buy Plan 5 is \$465,800.

This alternative is similar to Best Buy Plans 3 and 4 except that approximately 500,000 cubic yards of sand would be removed from the sandbar to eliminate the need for additional time for the project to fully develop. Sand would be removed using a dredge and be returned to the river. As with Alternatives 3, portions of four rock dike structures would be removed at locations A, B, C, and D in Figure 20. In addition, three new dikes would be constructed at locations 1, 4 and 5. Two existing dikes would be extended at locations 2 and 3. Additionally, rock would be added at location 6. These modifications were designed to maintain adequate flow to the navigation channel while directing flow to the channel margin to intercept free drifting embryos and larval sturgeon.

Approximately 34,500 cubic yards of rock, wood piling, sand, and wood or woven willow mattress removed from locations A, B, C, and D would be placed along the bank to prevent erosion of Tadpole Island. Approximately 10,400 cubic yards of rock would be used to construct the new structures. All construction would take place from a barge.

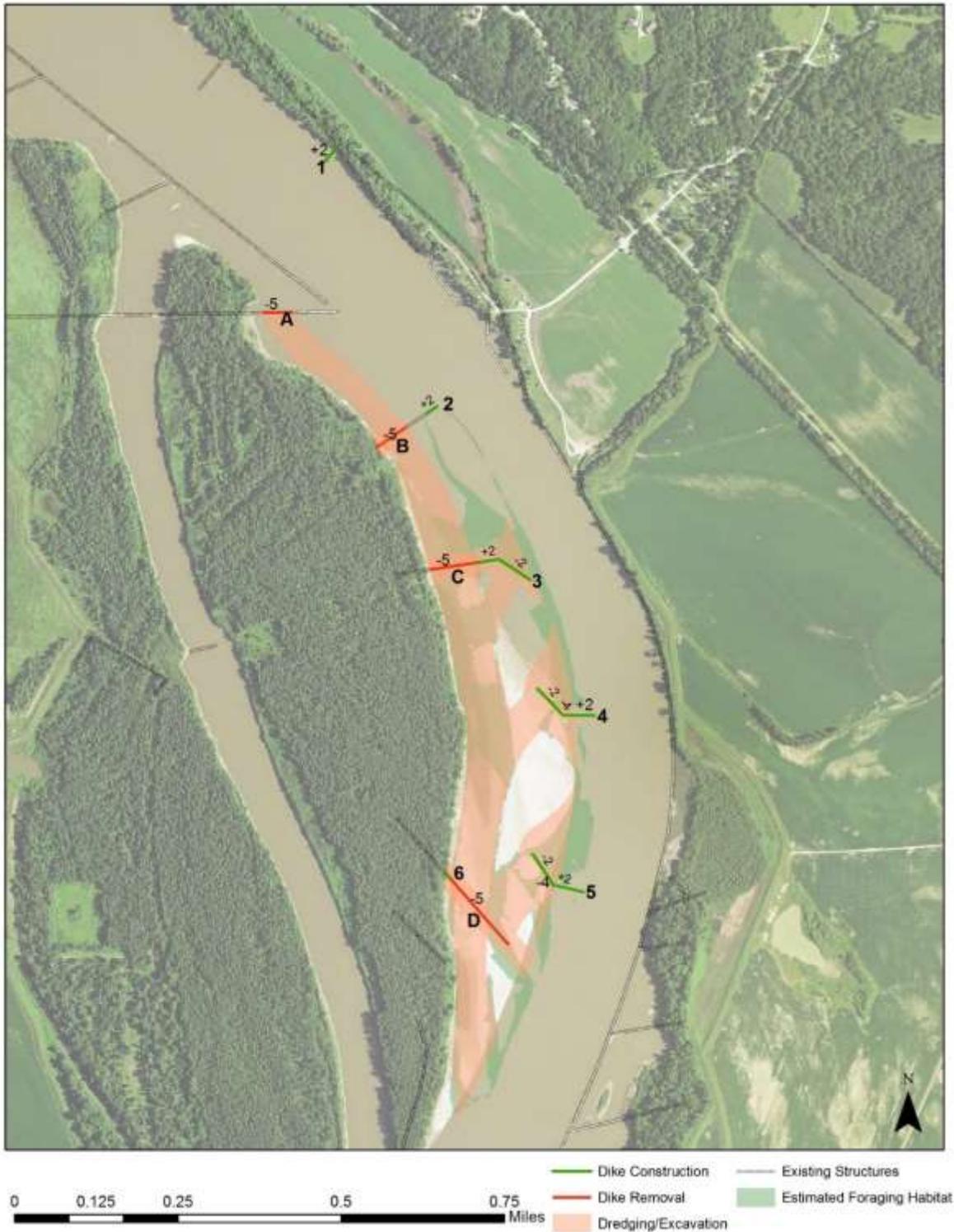


Figure 21. Best Buy Plan 5 would result in a net benefit of 10.4 AAHUs of interception-rearing-complex habitat for an average annual cost of approximately \$302,000. Numbers with + or – in front represent the elevation in feet of the structure compared to the construction reference plane.

## **2.5 Selection of the Recommended Plan**

Potential environmental impacts of each of the alternatives were evaluated in Section 4 of this document. None of the alternatives would result in any significant direct, indirect, or cumulative adverse impacts to the human environment. Except for the No-Action/Future Without-Project Condition, each of the alternatives meets the project objectives and project constraints. Each alternative also meets the P&G criteria for completeness, effectiveness, efficiency, and acceptability. For these reasons, results from the cost effectiveness and incremental cost analysis were used as the primary tool to identify a recommended plan. Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike has been identified as the Recommended Plan. This alternative would result in a net benefit of 9.1 AAHUs with an average annual cost of approximately \$122,000. The next best buy plan, Best Buy Plan 3, would result in a net benefit of 10.0 AAHU with an average annual cost of \$162,000. It was determined that the additional habitat benefits (0.9 AAHUs) that would result from Best Buy Plan 3 were not worth the additional cost (\$40,000 per year).

## **2.6 Physical and Biological Monitoring**

Following project construction, both physical and biological monitoring will occur to determine if the project objectives have been met. Physical monitoring would consist of performing hydro-acoustic depth and velocity surveys of the site at least twice per year following construction to monitor changes to the bed and variations in velocity from pre-construction conditions. Bathymetric surveys will be conducted with single-beam sonar and velocity measurements will be conducted with an acoustic Doppler current profiler. Conditions will be monitored to ensure depths and velocities are progressing in the desired direction to promote interception and increase foraging habitat as well as ensure that conditions in the main channel remain favorable for commercial navigation. Sediment will also be monitored either by physical sampling or side-scan sonar to assess how the bed sediment at the site is affected by the changes in hydrodynamics. In addition, sampling for free drifting embryos and larval sturgeon will be conducted over multiple years to evaluate the effectiveness of the project to intercept free drifting embryos and larval sturgeon.

## **3.0 Affected Environment**

This section describes the affected environment within and surrounding the project area. It includes resources that have the potential to be affected by the proposed alternatives. Information was obtained from site visits, geographic information systems data, review of maps and aerial photography, coordination with other agencies, and previous reports.

### **3.1 Water Quality**

USACE has maintained a water quality monitoring program for the Missouri River as part of the MRRP. The goals of the water quality program include: 1) Assess the

chemical and biological variables of the mainstem river, tributaries, and created habitats relative to the mitigation, recovery, and restoration of the pallid sturgeon, other native fish species, and aquatic communities, and 2) Develop, establish and maintain a high quality, customer responsive, water quality program within the lower Missouri River basin. The water quality program conducts long-term fixed station ambient monitoring at locations on the mainstem of the river, investigative monitoring, and special studies.

Water quality parameters that are measured include total phosphorus, nitrate plus nitrite, ammonia, ortho-phosphorus, dissolved phosphorus, total Kjeldahl nitrogen, total suspended solids, suspended sediment concentration, total dissolved solids, total organic carbon, dissolved organic carbon, turbidity, chlorophyll A, total silica, and dissolved silica. Median concentrations of common water quality constituents are located in Table 5. The Searcys Bend Interception-rearing-complex project site is located approximately 47 miles downstream of the Glasgow site and 20 miles upstream of the Marion site. The Missouri River is listed on the Missouri 303(d) list of impaired waters for *Escherichia coli*.

Table 5: Median concentrations of common water quality collected from the Missouri River between the years 2010 and 2014.

	<b>Atchison, River Mile 423</b>		<b>Fort Osage, River Mile 340</b>		<b>Waverly, River Mile 294</b>		<b>Glasgow, River Mile 227</b>		<b>Marion, River Mile 160</b>		<b>Hermann, River Mile 98</b>		<b>Weldon Springs,* River Mile 50</b>	
	<b>Media n</b>	<b>Rang e</b>	<b>Media n</b>	<b>Rang e</b>	<b>Media n</b>	<b>Rang e</b>	<b>Media n</b>	<b>Rang e</b>	<b>Media n</b>	<b>Rang e</b>	<b>Media n</b>	<b>Rang e</b>	<b>Media n</b>	<b>Rang e</b>
<b>Total Phosphorus (mg/L)</b>	0.33	0.05-2.4	0.37	0.1-2.3	0.35	0.09-2.1	0.38	0.091-2	0.385	0.11-1.8	0.34	0.11-1.4	0.3	0.12-1.9
<b>Total Orthophosphate (mg/L)</b>	0.087	0.024-0.24	0.12	0.053-0.21	0.115	0.052-0.21	0.1	0.059-0.24	0.099	0.056-0.49	0.087	0.05-0.2	0.09	0.026-0.16
<b>Ammonia (mg/L)</b>	0.056	0.01-0.32	0.09	0.03-0.29	0.068	0.01-.24	0.05	0.02-0.92	0.04	0.03-0.28	0.35	0.02-0.65	0.033	0.02-0.52
<b>Nitrate/Nitrite (mg/L)</b>	1.4	0.1-5.0	1.4	0.21-4.4	1.45	.22-4.7	1.2	0.2-3.8	1.3	0.17-4	0.98	0.12-3	0.9	0.1-2.9
<b>Total Kjeldahl Nitrogen (mg/L)</b>	0.9	0.2-8.4	1.1	0.2-6.7	1	0.25-6.7	1	0.22-6.4	1	0.33-4.6	0.89	0.38-3.6	0.78	0.35-4.2
<b>Total Suspended Solids (mg/L)</b>	128	25-4710	123	22.4-4140	160	28-3070	176	44-2660	203	32-1700	144	31.3-1410	132	23-1520

\*Note: Water quality data was not collected at Weldon Springs in 2010.

### **3.2 Wetland Resources**

There are no wetlands within the project area. The project site is located within the Missouri River channel, a water of the United States. A Clean Water Act Section 404 authorization would be required for any activities that would occur below the ordinary high water mark.

### **3.3 Terrestrial Resources**

No terrestrial resources exist within any of the proposed project footprints. The river banks are nearly vertical and range from approximately 10 to 30 feet high during typical flow conditions. The land adjacent to the project area was primarily formed from alluvium that has accreted since construction of the Missouri River BSNP.

### **3.4 Fish and Wildlife Resources**

Fish and wildlife species present within the study area are typical of those described in the 2003 SEIS (USACE, 2003), available online at [http://moriverrecovery.usace.army.mil/mrrp/f?p=136:183:0::NO::SITE\\_ID,PIS\\_ID:,#seis](http://moriverrecovery.usace.army.mil/mrrp/f?p=136:183:0::NO::SITE_ID,PIS_ID:,#seis). Section 3.3.3 Wildlife and Section 3.3.4 Fisheries of this report are hereby incorporated by reference. Searcys Bend provides habitat for numerous wildlife species. Additionally, the Missouri River Valley is an important nesting and feeding area along the Central and Mississippi Flyway for many migratory birds and waterfowl species. Approximately one in every seven bird species in North America can be found along the lower Missouri River (Thogmartin, 2009).

### **3.5 Threatened and Endangered Species**

The only federally listed threatened or endangered species that are known to occur in the Missouri River within the project area is the pallid sturgeon (Table 6). Two other federally listed species, least tern and piping plover, migrate through the area, although they are not known to nest anywhere nearby. Other federally listed threatened and endangered species located in Boone and Moniteau Counties, Missouri include the Indiana bat, northern long-eared bat, rufa red knot, Topeka shiner, and running buffalo clover. Areas immediately adjacent to the project area may provide suitable roosting and maternity habitat for Indiana bat and northern long-eared bat. Although not identified on USFWS county lists as being located in Boone or Moniteau Counties, the federally endangered gray bat may also utilize the area. A cave, not located in either of these counties, is located roughly five miles from the study area and is known to provide hibernacula for Indiana bat, northern long-eared bat, and gray bat. Rufa red knot (an extremely rare migratory bird), Topeka shiner (species of fish), and running buffalo clover (a plant) are not known to be in the immediate vicinity of the project area.

Table 6: Federally listed threatened and endangered species with potential to occur in the vicinity of the project area.

<b>Common Name</b>	<b>Scientific Name</b>	<b>Federal Status</b>
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered
Indiana bat	<i>Myotis sodalis</i>	Endangered
Northern long-eared bat	<i>Myotis septentrionalis</i>	Threatened
Gray bat	<i>Myotis grisescens</i>	Endangered
Least Tern	<i>Sterna antillarum</i>	Endangered
Piping Plover	<i>Charadrius melodus</i>	Threatened

The pallid sturgeon generally occurs in the main channel of the large, turbid, free flowing Missouri River, in the lower segments of some major tributaries. Modification of the natural Missouri River hydrograph, habitat loss, fish migration blockage, pollution, hybridization, and over harvesting are likely responsible for pallid sturgeon decline (USFWS, 1993).

The Indiana bat is an endangered species that has experienced serious population declines due to habitat loss and human disturbance. Indiana bats hibernate in caves during winter and roosts in trees with loose bark in the spring and summer. The loss of wetland and riparian habitat along the Missouri River has contributed to the loss of foraging and roosting habitat for this species.

The northern long-eared bat has recently been listed as a threatened species under the Endangered Species Act. Northern long-eared bats have been experiencing rapidly declining populations due to white nose syndrome, a fungal pathogen. During winter this species of bat is known to hibernate in caves and abandoned mines. Summer habitat is not well defined, but it is believed that roosting habitat includes dead or live trees and snags with cavities, peeling or exfoliating bark, split tree trunk and/or branches. Foraging habitat includes upland and lowland woodlots and tree lined corridors. Occasionally, they may roost in structures like barns and sheds.

Gray bats live in caves year-round. They feed on flying insects present along rivers and lakes. It is expected that gray bats may use the study area for foraging.

Although no longer listed under the Endangered Species Act, the bald eagle is protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The bald eagle is commonly found as both a resident population and in higher concentrations as winter migrants in the project area. Bald eagles commonly nest along the Missouri River. USFWS reported a bald eagle nest located approximately two miles east, along the riparian corridor of the left descending bank of the Missouri River. Bald eagles utilize large trees along the Missouri River for nesting, roosting, and foraging perches. Bald eagles primarily feed on fish and migratory waterfowl. Based on site visits, there are not any known bald eagle nests located in the near the Searcys Bend Project area.

### **3.6 Invasive Species**

Invasive species have the potential to displace native plants and animals. In accordance with Executive Order 13122, Federal agencies may not authorize, fund, or carry out actions that are likely to cause or promote the introduction or spread of invasive species. Invasive aquatic species that are a concern in Missouri which have the potential to be introduced into new water bodies as a result of contaminated construction equipment include zebra mussels, quagga mussels, New Zealand mudsnails, purple loosestrife, and Eurasian watermilfoil. Common invasive fish species on the lower Missouri River include the common carp, goldfish, grass carp, silver carp, bighead carp, and western mosquitofish. It is important to note that the project is located along the Missouri River. Transport of invasive species by the river is common. Furthermore, natural erosion and deposition of material along the river can result in conditions that are susceptible to becoming established with invasive plants.

### **3.7 Cultural Resources**

Cultural resources are defined as any area of past human activity, occupation, or use, identifiable through inventory, historical documentation, or oral evidence. Cultural resources include, but are not limited to, archeological sites, buildings or structures, cemeteries, and traditional cultural properties. Background research of the project areas were conducted to determine if any previously recorded cultural resources were present within or near them. This research included a review of the National Register of Historic Places (NRHP), the Missouri Department of Natural Resources Archaeological Viewer (on-line), and pertinent cultural resource reports and shipwreck location maps on file at the USACE. The cultural resources review found no previously recorded cultural sites in the project area and that the entire site is recently accreted land with little potential for unrecorded buried archeological sites.

### **3.8 Population and Income**

Searcys Bend is located between Boone and Moniteau Counties, Missouri. The estimated population of Boone County was 173,717 people in 2014 (U.S. Census Bureau, 2014). The county experienced a population increase of 6.2 percent from 2010 to 2014. The population of Boone County was roughly 83 percent white. Other ethnicities included black or African American, Asian, and Hispanic. The median household income in Boone County was \$48,625. This is similar to the median income for the State of Missouri at \$47,380 (Bureau of Economic Analysis, 2013).

The estimated population of Moniteau County was 15,856 in 2014, a 1.6 percent increase from 2010 (U.S. Census Bureau, 2014). The population of Moniteau County was approximately 93 percent white. Other ethnicities included black or African American and Hispanic. The median household income was \$47,118. Again, this is similar to the State of Missouri median income.

The age distribution of Boone and Moniteau Counties were also similar to the State of Missouri. Approximately 20 to 25 percent of the population was younger than 18 years old. Approximately 10 to 15 percent of the population was older than 65. The closest community to Searcys Bend is the town of Huntsdale, Missouri located less than a mile from the project. The 2014 population estimate for the city was 30. The closest large city is Columbia, Missouri, located about 9 miles away. It had an estimated population of approximately 117,000 in 2014 (U.S. Census Bureau, 2014).

The proposed project does not have a disproportionate adverse on minorities, low-income residents, or other environmental justice populations.

### **3.9 Recreation**

The Missouri River is important to recreational users in the region. Searcys Bend is located close to the population centers of Jefferson City and Columbia, Missouri. Recreational users of the Missouri River enjoy fishing, boating, canoe/kayaking, and camping. Searcys Bend is located in an area that is a natural stopover for migratory birds. This provides additional opportunity for bird watching. Currently, there are two large sandbars located in this area of the Missouri River that are, depending on the depth of the water, utilized for recreation. One sand bar is located directly within Searcys Bend and the other is located less than a mile south of the project area, the Katy Trail passes through the nearby town of Huntsdale, Missouri. The Katy Trail is a popular biking and hiking trail. Additionally, Katfish Katy's, a privately owned recreation area and campground, is located along the outside bend and contains a private boat access ramp.

### **3.10 Navigation**

The Missouri River from Sioux City, Iowa to its confluence with the Mississippi River just upstream of St. Louis, Missouri, a distance of 735 miles, is maintained and operated by USACE under the authority and in accordance with requirements of the Missouri River BSNP. USACE is directed by Congress to maintain a nine-foot deep by 300-foot wide navigation channel along this portion of the river. In addition, the Missouri River flows are operated in part, for commercial navigation on the Missouri River. Navigation on the Missouri River is limited to the normal ice-free season, with a full-length flow support season of eight months (USACE, 2001).

### **3.11 Flood Risk Management**

There is an extensive flood risk management system (i.e., levees and dams) along the Missouri River. Levees near the property include the McBaine Levee District and Levee District No. 1 of Cooper County. These districts are located directly on the opposite sides of the Missouri River adjacent to the projects location. No building structures, roads, or utilities exist within the project area.

### **3.12 Air Quality and Climate Change**

Air quality in a given location is described by the concentrations of various pollutants in the atmosphere. The quality of the air is measured against National Ambient Air Quality Standards (NAAQS) set by the EPA. Searcys Bend is located in an attainment area, which is an area wherein the concentrations of all criteria pollutants meet the NAAQS. The in the Midwest is predicted to experience climate change impacts. Floods and droughts become more common and intense as rainfall is more concentrated into heavy events with longer dry periods in between,

## **4.0 Environmental Consequences**

This section evaluates potential direct and indirect impacts to the human environment of each of the five best buy plans. The concept of "significance" used in this section considers context and intensity. Duration is also considered when evaluating potential impacts.

### **4.1 Water Quality**

#### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Conditions would not adversely affect water quality. It would not result in any changes to the existing water quality of the Missouri River.

#### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan may result in short-term minor impacts to water quality during project construction. There would likely be localized temporary increases to water turbidity. Based on the quantity of material that would be moved or placed below the ordinary high water mark, these impacts would be less than any of the other alternatives except for the No-Action/Future Without-Project Condition. The Recommended Plan would not result in any State of Missouri water quality standards being exceeded. Approximately 7,600 cubic yards of rock, obtained from a commercial source, would be used to construct the dike extensions and the new dike. The rock would contain minimal fines and would be free of any harmful contaminants. Approximately 22,400 cubic yards of material excavated from the existing dikes would be placed along the bottom portion of the river bank at Tadpole Island to stabilize the bank and prevent erosion of the island.

Roughly 14,600 cubic yards of mostly sand material would be excavated from below the ordinary high water mark where the dike extensions and a new dike would be constructed. This material would be placed in the channel in a manner in which it would disperse downstream. It would not result in a net increase in material below the ordinary high water mark. This is a minimal amount of material compared to the amount of

material that enters the Missouri River by natural processes on an annual basis. It would also be minimal compared to the amount of material that entered the river during construction of the Tadpole side channel that was constructed in 2006. At that time, approximately 800,000 cubic yards of alluvial material was returned to the river and there were not any significant impacts to water quality. It has been documented by Gosch *et al.* (2013) that construction of MRRP projects on the Missouri River have not resulted in any significant impacts to water quality or exceeded state water quality criteria.

The Recommended Plan would be in full compliance with the Clean Water Act Section 404(b)(1) Guidelines. A draft Section 404(b)(1) Evaluation for the Recommended Plan is included in Appendix D. A Clean Water Act Section 401 water quality certification is being requested at this time (Appendix E). If granted, all conditions of a Clean Water Act Section 401 water quality certification would be followed. Based on these facts, it has been determined that this alternative would not result in any significant impacts to water quality of the Missouri River.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes**

Best Buy Plan 3 may result in short-term minor impacts to water quality during project construction. There would likely be localized increases to water turbidity. Based on the quantity of material that would be moved or placed below the ordinary high water mark, these short-term minor impacts would be greater than the Recommended Plan but less than Best Buy Plans 4 and 5. However, it would not result in any State of Missouri water quality standards being exceeded. Approximately 10,400 cubic yards of rock, obtained from a commercial source, would be used to construct the dike extensions and the new dikes. The rock would contain minimal fines and would be free of any harmful contaminants. Approximately 34,500 cubic yards of material excavated from the existing dikes would be placed along the bottom portion of the river bank at Tadpole Island to stabilize the bank and prevent erosion of the island.

Roughly 26,000 cubic yards of mostly sand material would be excavated from below the ordinary high water mark where the dike extensions and new dike would be constructed. This material would be placed in the channel in a manner in which it would disperse downstream. It would not result in a net increase in material below the ordinary high water mark. This is a minimal amount of material compared to the amount of material that enters the Missouri River by natural processes on an annual basis. It would also be minimal compared to the amount of material that entered the river during construction of the Tadpole side channel that was constructed in 2006. At that time, approximately 800,000 cubic yards of alluvial material was returned to the river and there were not any significant impacts to water quality. It has been documented by Gosch *et al.* (2013) that construction of MRRP projects on the Missouri River have not resulted in any significant impacts to water quality or exceeded state water quality criteria. If this alternative were selected for implementation, a Clean Water Act Section

404 authorization and a Clean Water Act Section 401 water quality certification would be obtained prior to project construction.

**Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar**

Best Buy Plan 4 may result in short-term minor impacts to water quality during project construction. There would likely be localized increases to water turbidity. Based on the quantity of material that would be moved or placed below the ordinary high water mark, these short-term minor impacts would be greater than the Recommended Plan and Best Buy Plan 3 but less than Best Buy Plan 5. However, it would not result in any State of Missouri water quality standards being exceeded. Approximately 10,400 cubic yards of rock, obtained from a commercial source, would be used to construct the dike extensions and the new dikes. The rock would contain minimal fines and would be free of any harmful contaminants. Approximately 34,500 cubic yards of material excavated from the existing dikes would be placed along the bottom portion of the river bank at Tadpole Island to stabilize the bank and prevent erosion of the island.

Approximately 184,400 cubic yards of sand would be removed from the sandbar. This material would be removed to provide a solid foundation to construct new structures and to increase the rate at which foraging habitat would develop. Sand would be removed using a dredge and be returned to the river. This would not result in a net increase in material below the ordinary high water mark. This is a minimal amount of material compared to the amount of material that enters the Missouri River by natural processes on an annual basis. It would also be less than the amount of material that entered the river during construction of the Tadpole side channel that was constructed in 2006. At that time, approximately 800,000 cubic yards of alluvial material was returned to the river and there were not any significant impacts to water quality. It has been documented by Gosch *et al.* (2013) that construction of MRRP projects on the Missouri River have not resulted in any significant impacts to water quality or exceeded state water quality criteria. If this alternative were selected for implementation, a Clean Water Act Section 404 authorization and a Clean Water Act Section 401 water quality certification would be obtained prior to project construction.

**Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

Best Buy Plan 5 may result in short-term minor impacts to water quality during project construction. There would likely be localized increases to water turbidity. Based on the quantity of material that would be moved or placed below the ordinary high water mark, these short-term minor impacts would be greater than any of the other alternatives. However, it would not result in any State of Missouri water quality standards being exceeded. Approximately 10,400 cubic yards of rock, obtained from a commercial source, would be used to construct the dike extensions and the new dikes. The rock would contain minimal fines and would be free of any harmful contaminants. Approximately 34,500 cubic yards of material excavated from the existing dikes would

be placed along the bottom portion of the river bank at Tadpole Island to stabilize the bank and prevent erosion of the island.

Approximately 500,000 cubic yards of sand would be removed from the sandbar. This material would be removed to provide a solid foundation to construct new structures and to increase the rate at which foraging habitat would develop. Sand would be removed using a dredge and be returned to the river. This would not result in a net increase in material below the ordinary high water mark. This is a minimal amount of material compared to the amount of material that enters the Missouri River by natural processes on an annual basis. It would also be less than the amount of material that entered the river during construction of the Tadpole side channel that was constructed in 2006. At that time, approximately 800,000 cubic yards of alluvial material was returned to the river and there were not any significant impacts to water quality. It has been documented by Gosch *et al.* (2013) that construction of MRRP projects on the Missouri River have not resulted in any significant impacts to water quality or exceeded state water quality criteria. If this alternative were selected for implementation, a Clean Water Act Section 404 authorization and a Clean Water Act Section 401 water quality certification would be obtained prior to project construction.

## **4.2 Wetland Resources**

### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would not result in any adverse impacts to wetland resources. No wetlands exist within or adjacent to the project area.

### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan would not result in any adverse impacts to wetland resources. No wetlands exist within or adjacent to the project area. This plan would result in fill being placed in waters of the United States (U.S.) As described in Section 4.1, the Recommended Plan would be in full compliance with the Clean Water Act Section 404(b)(1) Guidelines. A draft Section 404(b)(1) Evaluation for the Recommended Plan is included in Appendix D.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes; Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar; Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

None of these plans would result in adverse impacts to wetland resources. No wetlands exist within or adjacent to the project area. If any of these plans were selected for implementation, a Clean Water Act Section 404 authorization would be obtained prior to project construction.

### 4.3 Terrestrial Resources

#### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would not result in any significant impacts to terrestrial resources. It is not expected that there would be any significant changes to terrestrial resources outside the project footprint would occur because of the Missouri River BSNP. However, there may be minor impacts to terrestrial vegetation on Tadpole Island if the bank continued to erode over time. Trees and other vegetation would fall into the river.

**Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan); Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes; Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar; Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

None of these alternatives would result in any significant adverse impacts to terrestrial resources. No terrestrial resources are located in the project construction footprint. Placement of material removed from the existing dikes along the lower portion of the bank at Tadpole Island would reduce erosion of the bank and protect vegetation growing on the top of the bank, primarily small to intermediate sized trees. This would result in a minor indirect effect to terrestrial habitat.

### 4.4 Fish and Wildlife Resources

#### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would not result in any significant impacts to fish or wildlife resources at Searcys Bend. Existing habitat conditions would remain relatively the same as a result of the BSNP stabilizing the river.

**Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan is expected to benefit fish and other aquatic resources. The project is expected to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage. The Recommended Plan would result in an interception ratio of 0.37 and 41.6 acres and foraging habitat when fully developed (approximately 4 years). It would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. This habitat it is expected to improve the overall quality of the aquatic environment by improving habitat diversity.

The sand material excavated from the river bed to construct the dikes would be integrated into the bedload of the Missouri River. Compared to the quantity of bedload material that is typically transported downstream by the Missouri River, the added amount of material would be insignificant. The Missouri River is a sand bed river that naturally transports large quantities of sand as bedload. Species that are native to the river are well suited to this environment.

However, the Recommended Plan may result in minor short-term impacts to fish and wildlife during project construction. This would result from physically disturbing the river and noise from construction equipment. Fish and wildlife are expected to move from areas of disturbance during project construction. They would likely return after the project has been constructed. Benthic invertebrates would be disturbed and lost within the footprint of the dredging and material placement, however, new populations of invertebrates would be expected to repopulate the area following construction. No significant impacts to fish and wildlife are expected from the Recommended Plan.

**Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes**

The types of impacts from Best Buy Plan 3 would be similar to the Recommended Plan. It would benefit fish and other aquatic organisms by providing an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a four-year period. It would result in an additional 10.0 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. This habitat is expected to improve the overall quality of the aquatic environment by improving habitat diversity.

The sand material excavated from the river bed to construct the dikes would be integrated into the bedload of the Missouri River. Compared to the quantity of bedload material that is typically transported downstream by the Missouri River, the added amount of material would be insignificant. The Missouri River is a sand bed river that naturally transports large quantities of sand as bedload. Species that are native to the river are well suited to this environment.

As with the other alternatives, except for the No Action/Future Without-Project Condition, this alternative may result in minor short-term impacts to fish and wildlife during project construction. This would result from physically disturbing the river and noise from construction equipment. Fish and wildlife are expected to move from areas of disturbance during project construction. They would likely return after the project has been constructed. Benthic invertebrates would be disturbed and lost within the footprint of the dredging and material placement, however, new populations of invertebrates would be expected to repopulate the area following construction. No significant impacts to fish and wildlife are expected from this alternative.

**Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar**

The types of impacts from Best Buy Plan 4 would be similar to the other alternatives. Best Buy Plan 4 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a two-year period. It would result in an additional 10.2 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. This habitat is expected to improve the overall quality of the aquatic environment by improving habitat diversity.

The sand material excavated from the river bed to construct the dikes would be integrated into the bedload of the Missouri River. Compared to the quantity of bedload material that is typically transported downstream by the Missouri River, the added amount of material would be insignificant. The Missouri River is a sand bed river that naturally transports large quantities of sand as bedload. Species that are native to the river are well suited to this environment.

As with the other alternatives, except for the No Action/Future Without-Project Condition, this alternative may result in minor short-term impacts to fish and wildlife during project construction. This would result from physically disturbing the river and noise from construction equipment. Fish and wildlife are expected to move from areas of disturbance during project construction. They would likely return after the project has been constructed. Benthic invertebrates would be disturbed and lost within the footprint of the dredging and material placement, however, new populations of invertebrates would be expected to repopulate the area following construction. No significant impacts to fish and wildlife are expected from this alternative.

#### **Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

The types of impacts from Best Buy Plan 5 would be similar to the other alternatives. Best Buy Plan 5 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed immediately following construction. It would result in an additional 10.4 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. This habitat is expected to improve the overall quality of the aquatic environment by improving habitat diversity.

The sand material excavated from the river bed to construct the dikes would be integrated into the bedload of the Missouri River. Compared to the quantity of bedload material that is typically transported downstream by the Missouri River, the added amount of material would be insignificant. The Missouri River is a sand bed river that naturally transports large quantities of sand as bedload. Species that are native to the river are well suited to this environment.

As with the other alternatives, except for the No-Action/Future Without-Project Condition, this alternative may result in minor short-term impacts to fish and wildlife during project construction. This would result from physically disturbing the river, and noise from construction equipment. Fish and wildlife are expected to move from areas of disturbance during project construction. They would likely return after the project has

been constructed. Benthic invertebrates would be disturbed and lost within the footprint of the dredging and material placement, however, new populations of invertebrates would be expected to repopulate the area following construction. No significant impacts to fish and wildlife are expended from this alternative.

#### **4.5 Threatened and Endangered Species**

##### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would have no effect on any threatened and endangered species. At this location, there would not be any actions taken to avoid jeopardy to pallid sturgeon in accordance with the 2003 Amendment to the Biological Opinion. The hypothesis that re-engineering the Missouri River channel morphology in select reaches will increase channel complexity and serve specifically to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage would not be tested at this location.

##### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan “may affect but is not likely to adversely affect” pallid sturgeon. As pallid sturgeon are mobile, they may be temporarily displaced during construction, however, once construction is complete could return to the area. Any impacts to pallid sturgeon would likely be beneficial. The project is expected to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage. The Recommended Plan would result in an interception ratio of 0.37 and 41.6 acres and foraging habitat when fully developed. It would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition.

The Recommended Plan would have no effect on Indiana bat, northern long-eared bat, or gray bat. The Recommended Plan is not located in the immediate vicinity of any caves and would not impact any trees used by these species. It would also have no effect on least tern, piping plover, or rufa red knot. These species may migrate through the region but are not known to utilize the project area.

Bald eagles are not expected to be impacted by the Recommended Plan. There are no known nests in the immediate vicinity of the project area. The nearest known nest is located approximately two miles away.

##### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes**

Best Buy Plan 3 “may affect but is not likely to adversely affect” pallid sturgeon. Any impacts to pallid sturgeon would be beneficial. As pallid sturgeon are mobile, they may be temporarily displaced during construction, however, once construction is complete

could return to the area. The project is expected to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage. This plan would provide an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a four-year period. It would result in an additional 10.0 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition.

Best Buy Plan 3 would have no effect on Indiana bat, northern long-eared bat, or gray bat. It is not located in the immediate vicinity of any caves and would not impact any trees used by these species. It would also have no effect on least tern, piping plover, or rufa red knot. These species may migrate through the region but are not known to utilize the project area.

Bald eagles are not expected to be impacted by Best Buy Plan 3. There are no known nests in the immediate vicinity of the project area. The nearest known nest is located approximately two miles away.

#### **Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar**

Best Buy Plan 4 “may affect but is not likely to adversely affect” pallid sturgeon. Any impacts to pallid sturgeon would be beneficial. As pallid sturgeon are mobile, they may be temporarily displaced during construction, however, once construction is complete they could return to the area. The project is expected to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage. Best Buy Plan 4 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed after a two-year period. It would result in an additional 10.2 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition.

Best Buy Plan 4 would have no effect on Indiana bat, northern long-eared bat, or gray bat. The project is not located in the immediate vicinity of any caves and would not impact any trees used by these species. It would also have no effect on least tern, piping plover, or rufa red knot. These species may migrate through the region but are not known to utilize the project area.

Bald eagles are not expected to be impacted by Best Buy Plan 4. There are no known nests in the immediate vicinity of the project area. The nearest known nest is located approximately two miles away.

#### **Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

Best Buy Plan 5 “may affect but is not likely to adversely affect” pallid sturgeon. Any impacts to pallid sturgeon would be beneficial. The project is expected to promote interception and retention of free drifting embryos and larval sturgeon in areas with

sufficient prey for first feeding and for growth through the juvenile life stage. Best Buy Plan 5 would result in an interception ratio of 0.40 and 40.7 acres of foraging habitat when fully developed immediately following construction. It would result in an additional 10.4 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition.

Best Buy Plan 5 would have no effect on Indiana bat, northern long-eared bat, or gray bat. The project is not located in the immediate vicinity of any caves and would not impact any trees used by these species. It would also have no effect on least tern, piping plover, or rufa red knot. These species may migrate through the region but are not known to utilize the project area.

Bald eagles are not expected to be impacted by the Best Buy Plan 5. There are no known nests in the immediate vicinity of the project area. The nearest known nest is located approximately two miles away.

#### **4.6 Invasive Species**

##### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would have no impact on the spread of invasive species. It would not promote or prevent the spread of any invasive species.

**Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan); Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes; Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar; Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

None of the best buy plans are expected to spread invasive species to new locations. During project construction, all equipment would be required to be free of invasive species to prevent the spread of these species to new locations. All construction activities are expected to take place from a barge. Specific measures will be included in the construction contract that requires inspection and washing of all equipment that will be used during construction. All equipment will be required to be dried if coming from another water body. The primary invasive species within the Missouri River are Asiatic carp. These species are not typically transported to new locations by construction equipment. However, all construction equipment will be required to be dried following project construction before being used on another water body. For these reasons, these plans would not result in the spread of invasive species.

## 4.7 Cultural Resources

### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would have no effect on any historic property or cultural resource within or adjacent to the project area.

### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan would have no effect on any cultural resources. The project is located on accreted lands formed from construction of the BSNP and is not likely to contain any cultural resources. The Missouri State Historic Preservation Officer concurred with this determination in a letter dated February 16, 2016 (Appendix F). If any cultural resources were encountered during project construction, all construction would be halted and the Missouri SHPO would be notified as soon as possible in order to determine the appropriate course of action.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes; Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar; Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

These best buy plans are expected to have no effect to cultural resources. However, these specific plans have not be coordinated with the Missouri SHPO. If any of these plans were to be selected for implementation, it would need to be coordinated with the Missouri SHPO.

## 4.8 Population and Income

### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would involve no construction activity. Therefore, no impacts to populations or income in the project area are anticipated.

### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan); Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes; Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar; Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

None of the best buy plans would adversely affect the makeup of the local population or their current income levels. Minor, short-term benefits from increases in local income

could be realized as a result of construction activities. No adverse impacts to facilities, services, or nearby communities are expected under this alternative. The proposed project does not have a disproportionate adverse on minorities, low-income residents, or other environmental justice populations.

## **4.9 Recreation**

### **Best Buy Plan 1 – No-Action/Future-Without-Project Condition**

The No-Action/Future Without-Project Condition would have no adverse impacts on recreation.

### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan);**

This alternative would have minimal temporary adverse impacts on recreation related to construction activities. Additionally, it would have minor long-term impacts related to the modification of the sandbar that is sometimes used by recreational users. These impacts would vary slightly based on the amount of planned erosion and the size of the residual sand bar. The recommended plan would have an approximately 25% decrease in the size of the existing sandbar when fully developed. Impacts to recreational users would be considered minor based on the fact that another large sandbar is located directly one river mile downstream of the project's location. Both sandbars have similar access. This sandbar is not stationary and is subject to the hydraulic forces of the river. Historical photos of the project area over the past 20 years indicate that over time, this sandbar has moved, changed shape and size, and has been submerged for more years than it has been readily available for recreational users on the river. There would be no significant long-term adverse impacts to recreation or aesthetics from this alternative. For safety reasons, the public would have restricted access from work zone areas during construction.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes; Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar; Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar**

All these alternatives would have minor temporary adverse impacts on recreation related to construction activities. Additionally, they would have minor to moderate long-term impacts related to the modification of the sandbar that is sometimes used by recreational users. Each of these alternatives would have an approximately 75% decrease in the size of the existing sandbar when fully developed. Impacts to recreational users would be considered minor based on the fact that another large sandbar is located directly one river mile downstream of the project's location. Both sandbars have similar access. This sandbar is not stationary and is subject to the hydraulic forces of the river. Historical photos of the project area over the past 20 years

indicate that over time, this sandbar has moved, changed shape and size, and has been submerged for more years than it has been readily available for recreational users on the river. There would be no significant long-term adverse impacts to recreation or aesthetics from this alternative. For safety reasons, the public would have restricted access from work zone areas during construction.

#### **4.10 Navigation**

##### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would not result in any significant adverse impacts to navigation.

##### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan); Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes**

These plans would not adversely impact navigation. Four BSNP dikes would be modified and one new rootless dike would be constructed, however project designs would not impact the authorized navigation channel. A new wing dike near river mile 180 will help maintain the navigation channel. See Appendix C – Hydrodynamic Modeling for details. Remobilization of sediment from excavation and/or dredging activities is not expected to cause any shoaling.

#### **4.11 Flood Risk Management**

##### **Best Buy Plan 1 – No-Action/Future Without-Project Condition**

The No-Action/Future Without-Project Condition would not result in adverse impacts to flood risk management.

##### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The Recommended Plan would not adversely impact the McBaine Levee located immediately adjacent to the outside bend of the river or the Cooper County Levee located approximately 3,000-feet landward of the inside bend of the river. It would not adversely impact water surface elevations. Modeling for this alternative resulted in a slightly lower water surface elevation within the area of interest which is likely due to the increased cross-sectional area due to bathymetry changes from the design. This indicates floodway conveyance would not be affected by the project. See Appendix C – Hydrodynamic Modeling for details.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and K:\MissionProjects\civ\moriver\mit-Searcy Bend\5.0 Environmental Compliance & Permitting\5.1 Environmental AssessmentK:\MissionProjects\civ\moriver\mit-Searcy Bend\5.0 Environmental Compliance & Permitting\5.1 Environmental Assessment**

None of these plans would not adversely impact the McBaine Levee located immediately adjacent to the outside bend of the river or the Cooper County Levee located approximately 3,000-feet landward of the inside bend of the river. It would not adversely impact water surface elevations. Modeling for these alternatives resulted in a slightly lower water surface elevation within the area of interest which is likely due to the increased cross-sectional area due to bathymetry changes from the design. This indicates floodway conveyance would not be affected by the project. See Appendix C – Hydrodynamic Modeling for details.

#### **4.12 Air Quality and Climate Change**

The “No Action” Alternative would not experience any construction related air quality effects and would not result in any changes to the existing air quality or contribute to climate change.

### **Best Buy Plan 2: Alternative 2e – Modify Existing Dikes and Construct One New Rootless Dike (Recommended Plan)**

The project site is in an NAAQS attainment zone. This alternative would have negligible impact air quality impacts from construction activities such as rock placement and excavations. These temporary impacts would have relatively low emission levels and any air pollutants are expected to disperse quickly. Any negative air quality impacts to residences in close proximity would be considered negligible and temporary. No significant adverse impacts are expected to air quality or climate change from Recommended Plan. Due to climate change there may be larger peak flows that over time that could modify the sandbar shape from erosion and deposition. Also periods of more extended drought could alter the amount of available shallow-water habitat.

### **Best Buy Plan 3: Alternative 1d – Modify Existing Dikes and Construct Two New Rootless Dikes**

Impacts to air quality as stated above in the Recommended Plan are similar to Alternative 3. No significant adverse impacts are expected to air quality or climate change from Alternative 3. Due to climate change there may be larger peak flows that over time that could modify the sandbar shape from erosion and deposition. Also periods of more extended drought could alter the amount of available shallow-water habitat.

### **Best Buy Plan 4: Alternative 1a – Modify Existing Dikes, Construct Two New Rootless Dikes, and Partial Dredging of Sandbar**

Impacts to air quality as stated above in the Recommended Plan are similar to Alternative 4. However, due to more dredging construction work associated to Alternative 4 the project would result in higher emissions (greenhouse gases) and air quality impacts than the Recommended Plan or Alternative 3. No significant adverse impacts are expected to air quality or climate change from Alternative 4. Due to climate change there may be larger peak flows that over time that could modify the sandbar shape from erosion and deposition. Also periods of more extended drought could alter the amount of available shallow-water habitat.

**Best Buy Plan 5: Alternative 1c – Modify Existing Dikes, Construct Two New Rootless Dikes, and Full Dredging of Sandbar** Impacts to air quality as stated above in the Recommended Plan are similar to Alternative 5. However, due to more dredging construction work associated to Alternative 4 the project would result in higher emissions (greenhouse gasses) and air quality impacts than Alternative 4. No significant adverse impacts are expected to air quality or climate change from Alternative 5. Due to climate change there may be larger peak flows that over time that could modify the sandbar shape from erosion and deposition. Also periods of more extended drought could alter the amount of available shallow-water habitat.

#### **4.13 Summary of Effects**

A comparison of potential environmental, socioeconomic, and cultural resources impacts for each of the best buy plans is included in Table 7.

Table 7: Summary of potential impacts from each of the best buy plans.

<b>Resource Category</b>	<b>Best Buy Plan 1 (No-Action)</b>	<b>Best Buy Plan 2 (Recommended Plan)</b>	<b>Best Buy Plan 3</b>	<b>Best Buy Plan 4</b>	<b>Best Buy Plan 5</b>
<b>Water Quality</b>	No impact	Short-term minor impacts resulting from localized increases in turbidity during construction.	Short-term minor impacts resulting from localized increases in turbidity during construction.	Short-term minor impacts resulting from localized increases in turbidity during construction.	Short-term minor impacts resulting from localized increases in turbidity during construction.
<b>Wetland Resources</b>	No impact	No impact	No impact	No impact	No impact
<b>Terrestrial Resources</b>	No impact	No impact	No impact	No impact	No impact
<b>Fish and Wildlife Resources</b>	No impact	Long-term minor benefits	Long-term minor benefits	Long-term minor benefits	Long-term minor benefits
<b>Threatened and Endangered Species</b>	No effect	Pallid sturgeon: May affect but not likely to adversely affect. Potential benefits. All others: No effect	Pallid sturgeon: May affect but not likely to adversely affect. Potential benefits. All others: No effect	Pallid sturgeon: May affect but not likely to adversely affect. Potential benefits. All others: No effect	Pallid sturgeon: May affect but not likely to adversely affect. Potential benefits. All others: No effect
<b>Invasive Species</b>	No impact	No impact	No impact	No impact	No impact
<b>Cultural Resources</b>	No effect	No effect	No effect	No effect	No effect
<b>Population and Income</b>	No impact	Short-term minor beneficial impacts to income from construction activity	Short-term minor beneficial impacts to income from construction activity	Short-term minor beneficial impacts to income from construction activity	Short-term minor beneficial impacts to income from construction activity

<b>Recreation</b>	No impact	Long-term minor impact resulting from loss of sandbar	Long-term minor impact resulting from loss of sandbar	Long-term minor impact resulting from loss of sandbar	Long-term minor impact resulting from loss of sandbar
<b>Navigation</b>	No impact	No impact	No impact	No impact	No impact
<b>Flood Risk Management</b>	No impact	No impact	No impact	No impact	No impact
<b>Air Quality and Climate Change</b>	No Impact	Short-term minor localized impact from construction activities			

#### 4.14 Cumulative Impacts

The Council on Environmental Quality (CEQ) Regulations defines cumulative impacts 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, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (CEQ, 1997). The cumulative impacts addressed in this document consist of the impacts of multiple actions that result in similar effects on the natural resources. The geographical areas of consideration are actions located within/along the lower Missouri River.

**Past Actions:** Past actions that have significantly impacted the Missouri River include the Mainstem Reservoir System, the BSNP, and land use changes. Impacts from these activities are documented in the Missouri River Fish and Wildlife Mitigation Iowa, Nebraska, Kansas, and Missouri Final Feasibility Report and Final Environmental Impact Statement (USACE, 1981) and the Missouri River Bank Stabilization Fish and Wildlife Mitigation Project Supplemental Environmental Impact Statement (USACE, 2003) and are being incorporated by reference. Since the supplemental environmental assessment was prepared in 2003, 24 shallow water habitat projects have been constructed in Kansas and Missouri to benefit pallid sturgeon and other native aquatic species. The nearest shallow water habitat sites is Tadpole Chute located landward of Tadpole Island. Overton Bottoms North is located approximately six miles upstream of the project area, and Eagle Bluffs located approximately six miles downstream of the project area. It has not yet been documented that these projects provide significant benefits to the population of pallid sturgeon.

**Present and Future Actions:** Cumulative effects of the Missouri River Bank Stabilization Fish and Wildlife Mitigation Project, of which the project is a part of, were discussed in the Supplemental Environmental Impact Statement prepared in 2003 and are being incorporated by reference (USACE 2003). The Supplemental Environmental Impact Statement is available online at <http://moriverrecovery.usace.army.mil/mrrp/f?p=136:183>. Other projects will be completed over the next several years to benefit pallid sturgeon. These may include modifying other existing side channels or the main channel to benefit pallid sturgeon. Future project will be more defined in the Missouri River Recovery Management Plan and Environmental Impact Statement discussed more below.

Since the Supplemental Environmental Impact Statement was prepared in 2003, additional projects and studies that have the potential to result in cumulative impacts with the Recommended Plan have been undertaken. These other projects or studies include the Missouri River Commercial Dredging Final Environmental Impact Statement and Record of Decision, the Missouri River Recovery Management Plan and Environmental Impact Statement, and the Missouri River Bed Degradation Integrated Feasibility Study and Environmental Impact Statement.

The Missouri River Commercial Dredging Final Environmental Impact Statement and Record of Decision for Authorization of Commercial Sand and Gravel Dredging on the Lower Missouri River were prepared in 2011 as part of an evaluation for a Clean Water Act Section 404 permit application by commercial sand and gravel mining entities to profitably obtain aggregate from the bed of the Missouri River to supply the region's construction and manufacturing needs (USACE, 2011). The Record of Decision limited the amount of aggregate that could be mined from the Missouri River and initiated an adaptive management approach in order to limit degradation, or down cutting, of the river bed and lowering of water surface elevations. As described in these documents, there was information that suggested commercial sand and gravel mining is a contributing cause to the degradation of the river bed in some locations, resulting in impacts to infrastructure. Additional information is available at <http://www.nwk.usace.army.mil/Missions/RegulatoryBranch/MissouriRiverCommercialDredging.aspx>.

The Missouri River Recovery Management Plan and Environmental Impact Statement is an ongoing effort to evaluate the effectiveness of current habitat development and recommend any needed modifications to more effectively create habitat and avoid jeopardy to pallid sturgeon, least terns and piping plovers. It is being led by USACE and USFWS. Additional information is available online at <http://moriverrecovery.usace.army.mil/mrrp/f?p=136:70:0::NO>.

The Missouri River Bed Degradation Integrated Feasibility Study and Environmental Impact Statement is another ongoing study within the Lower Missouri River. The purpose of the study is to develop a complete, effective, efficient, and acceptable plan to avoid additional economic impacts to federal, state, and local infrastructure resulting from the degradation of the Missouri River. The geographic scope of the study extends along the Missouri River from approximately Waverly to St. Joseph Missouri. Additional information about the study is available online at <http://www.marc.org/Environment/Water-Resources/Missouri-Riverbed-Degradation/About>

In addition to the three projects or studies mentioned, it is also expected that USACE may undertake other similar projects to Searcys Bend Interception-Rearing-Complex Habitat project in the future. However, at this time, the extent of such projects is not known. More certainty will exist at such time the Draft Missouri River Recovery Management Plan and Environmental Impact Statement is finished. This is expected to be later in 2016. Other activities that have the potential to contribute to cumulative impacts are discussed as applicable for individual resource categories.

**Cumulative Impact Assessment:** Only resource categories that would result in at least minor impacts as a result of implementing the Recommended Plan are considered for the cumulative impact assessment. See Table 7. It is assumed that the Recommended Plan would not result in any cumulative impacts to resources where it has been determined to result in no impacts. The resource categories considered for cumulative

impacts include water quality, fish and wildlife, threatened and endangered species, population and income, and recreation.

**Water Quality:** In the past, there have been public concerns that sediment contributions to the Missouri River from MRRP projects may adversely impact water quality and also contribute to hypoxia in the Gulf of Mexico. However, a study by the National Research Council (NRC) concluded that given the “relatively small volumes of sediment loadings” from MRRP projects on the Missouri River, “it is not appropriate to relate changes in the areal extent of the hypoxic zone to sediment and nutrient loadings” to these projects (NRC, 2011). Also, there have been long-term declines in suspended sediment loads on the lower Missouri River (Blevins, 2006). Additional analysis by Heimann et al. (2014) indicate that from 1993-2012 the total phosphorous loads from side channel construction only accounted for 1.9 percent of Missouri River and 0.5 percent of Mississippi River total phosphorus loads. Nitrate, the constituent most closely related to gulf hypoxia, was 0.01 percent or less of the Missouri and Mississippi River nitrate loads in the Gulf. The authors also estimated that sediment volumes from side channels, during 1993-2012, accounted for 3.1 percent and 1.5 percent of total suspended sediment loads from the Missouri and Mississippi Rivers respectively.

The Missouri River Commercial Dredging Final Environmental Impact Statement considered MRRP projects, such as the Recommended Plan, when evaluating cumulative impacts. It was stated in the Environmental Impact Statement that “there appears to be little potential for cumulative impacts on nutrient loading and little likelihood of effects on waters meeting water quality standards” as a result of commercial sand and gravel mining (USACE, 2011). Furthermore, it is not anticipated that actions that may result from the Management Plan or the Bed Degradation study would contribute to significant adverse cumulative impacts to water quality. These studies will also include an evaluation of any cumulative impacts.

**Fish and Wildlife:** Since the 2003 Supplemental Environmental Impact Statement was prepared, there have been large scale improvements to fish and wildlife habitat along the Lower Missouri River. It is expected that these projects have resulted in increases to fish and wildlife populations, and increased species diversity. In addition to MRRP, other large scale efforts to improve fish and wildlife habitat include the Big Muddy National Fish and Wildlife Refuge operated by USFWS, the Wetland Reserve Program operated by the Natural Resources Conservation Service, public and private land management programs of the Missouri Department of Conservation, habitat restoration and preservation activities of the MDNR, and other efforts undertaken by individuals on private lands to benefits fish and wildlife resources. The Recommended Plan will provide a benefit to fish and wildlife resources by improving habitat diversity. It is not expected that the Recommended Plan would result in any adverse cumulative impacts when considered with other past, present, and future projects.

**Threatened and Endangered Species:** The Recommended Plan may affect, but not likely to adversely affect pallid sturgeon. It may provide beneficial effects to pallid sturgeon. Information learned from this project will be used in the future as part of the

MRRP to increase the population of pallid sturgeon. The Recommended Plan is not expected to result in any adverse impacts to pallid sturgeon populations when considered with other present and future actions described elsewhere in this section. No other threatened or endangered species would be impacted by the project.

**Population and Income:** The Recommended Plan may result in minor short-term increases in local income as a result of construction activities. This minor project benefit is not expected to result in any cumulative impacts when considered with other past, present, and future actions described elsewhere in this section.

**Recreation:** The Recommended Plan would result in minor long-term impacts to recreation by affecting the sandbar. It is not expected that any of the other potential projects described elsewhere in this section would result in negative impacts to recreation. Therefore, the Recommended Plan is not expected to result in any cumulative impacts to recreation.

For reasons discussed in this section, the Recommended Plan would not result in any adverse cumulative impacts to the human environment.

## 5.0 Conclusions and Recommendations

The Recommended Plan would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition. This would result in a minor long-term benefit to fish and wildlife that potentially includes the federally threatened pallid sturgeon. The project would result in minor short-term impacts to water quality resulting from localized increases in turbidity during construction. There may be minor beneficial impacts to local income as a result of construction activities. The Recommended Plan would result in a minor long-term impacts to recreation because a sandbar that is occasionally used for recreation would be removed. It would not contribute to the spread of invasive species. It would not result in any impacts to wetlands, cultural resources, navigation, or flood risk management.

## 6.0 Compliance with Environmental Quality Statutes

Compliance with environmental laws is listed in Table 8.

Table 5: Compliance with Environmental Quality Statutes.

<b>Federal Policy</b>	<b>Compliance</b>
Archeological Resources Protection Act, 16 U.S.C. 470, et seq.	Not Applicable
Bald and Golden Eagle Protection Act of 1940, 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.	Full Compliance
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not Applicable

Endangered Species Act, 16 U.S.C. 1531, et seq.	Full Compliance
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.	Full Compliance
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.	Full Compliance
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	Full Compliance
	Full Compliance
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full Compliance
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470a, et seq.	Full Compliance
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:**

- a. Full compliance. Having met all requirements of the statute for the current stage of planning (either preauthorization or post authorization).
- b. Partial compliance. Not having met some of the requirements that normally are met in the current stage of planning.
- c. Noncompliance. Violation of a requirement of the statute.
- d. Not applicable. No requirements for the statute required; compliance for the current stage of planning.

## **7.0 List of Preparers**

Mr. Chris Name, Biologist, Environmental Resources Section, Planning Branch, U.S. Army Corps of Engineers, USACE.

Mr. Dane Morris, Hydraulic Engineer, River Engineering and Restoration Section, Hydraulics and Hydrology Branch, U.S. Army Corps of Engineers, USACE

Mr. Thomas Topi, Lead Regional Economist, Plan Formulation Section, Planning Branch, U.S. Army Corps of Engineers, USACE.

Mr. Tim Meade, Archaeologist, Communication, Risk Management, and Project Review Section, Planning Branch, U.S. Army Corps of Engineers, USACE

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**APPENDIX A**

**Public Notice**

**APPENDIX B**

**Public and Agency Comments  
(Pending)**

## **APPENDIX C**

### **Hydrodynamic Modeling**

**APPENDIX D**

**Draft Clean Water Act Section 404(b)(1) Evaluation**

**Missouri River Recovery Program  
Searcys Bend Interception-rearing-complex Habitat Project  
Moniteau County, Missouri**

**Section 404(b)(1) Evaluation**

**1. Introduction**

This Section 404(b)(1) Evaluation is for the Missouri River Recovery Program, Searcys Bend Interception-rearing-complex Habitat Project, Moniteau County, Missouri. The goal of this project is to determine if increasing interception-rearing-complex habitat increases the catch rate of age-0 sturgeon within the lower Missouri River. This project will help test the hypothesis that mostly passive free-floating pallid sturgeon embryos and larvae are entrained in the thalweg, the deepest fastest flowing portion of the channel, and are unable to move to the channel margins where environmental conditions may be more suitable for their growth and survival. Four river dikes exist in the project area would have portions removed near the bank and then three of them would then be extended in length. Additionally, two new dikes would be constructed. All construction would be within the banks of the Missouri River. This evaluation meets the requirements found in 40 CFR 230, Section 404(b)(1): Guidelines for Specification of Disposal Sites for Dredged and Fill Material.

**2. Project Description**

- a. Location:** Searcys Bend is located in the Missouri River approximately 9 miles southwest of Columbia, Missouri (Figure 1). The bend is 10,560-foot long and extends from about Missouri River mile **178.2 to 180.2**. The project area is primarily within the banks of the Missouri River. It is adjacent to Tadpole Island which is owned by USACE and managed by USFWS as part of the Big Muddy National Fish and Wildlife Refuge. Tadpole Island is created by a side channel that was constructed as a part of the MRRP shallow water habitat program in 2006.
- b. General Description:** A detailed description of the proposed action, including illustrations, is described in Section 2 of the Missouri River Recovery Program, Searcys Bend Interception-Rearing-Complex Habitat Project Environmental Assessment. The proposed action would modify four rock dikes and construct two new dikes. All construction would be within the banks of the Missouri River. Approximately, 7,600 cubic yards of rock would be used in modifications and/or the construction of new dikes. Approximately 22,400 cubic yards of existing dike material removed from four dikes and placed along the bank below the ordinary high water mark to prevent erosion of Tadpole Island. An additional 14,600 cubic yards of sand would be removed from the footprint of the new rock placement using an excavator. Excavated sand would be returned to the rivers bed load.

Elevations of the dikes would vary from two feet above or to four feet below the construction reference plane. The construction reference plane is used as a baseline elevation used to construct dikes and revetments on the Missouri River. These modifications were designed to maintain adequate flow to the navigation channel while directing flow to the channel margin to intercept embryonic and larval sturgeon. The project may be constructed in a single year or in phases over several years depending on the availability of funding.

- c. **Authority:** The project would be completed under the authority of the Missouri River Fish and Wildlife Mitigation Project (Mitigation Project) from Water Resource Development Acts (WRDA) of 1986, 1999, and 2007. The proposed action is regulated by USACE under Section 404 of the Clean Water Act (33 USC 1344).

### **3. Review of Compliance (§ 230.10 a-d)**

- a. The proposed alternative is the least cost, environmentally acceptable, technically feasible alternative that meet the project goals and objectives. Additional information on the impacts of various alternatives to waters of the U.S. can be found in Section 4 of the Missouri River Recovery Program, Searcys Bend Interception-Rearing-Complex Habitat Project Environmental Assessment.
- b. The proposed project would not violate any applicable state water quality standards, or applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act. The proposed project is not likely to jeopardize the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, to result in the likelihood of the destruction or adverse modification of critical habitat. Furthermore, the proposed project would not violate the requirements of any federally designated marine sanctuary.
- c. The proposed project would not cause or contribute to significant degradation of waters of the U.S. This includes no adverse effects on human health, life stages of organisms' dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values.
- d. Appropriate and practical steps have been taken which will avoid, minimize, and mitigate potential adverse impacts on the aquatic ecosystem.

### **4. Technical Evaluation Factors (Subparts C-F)**

#### **a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)**

- 1) **Substrate:** The proposed action would result in the placement of rock and excavated riverbed material into the Missouri River. Four rock dikes would

be modified and two new dikes would be constructed to create foraging habitat and interception-rearing-complex habitats. Approximately, 7,600 cubic yards of rock would be used to modify or construct the new dikes. The height of the dikes would vary from two feet above to four feet below the construction reference plane. The construction reference plane is used as a baseline elevation used to construct dikes and revetments on the Missouri River. Approximately 22,400 cubic yards of existing dike material removed from four dikes and placed along the bank to prevent erosion of Tadpole Island. An additional 14,600 cubic yards of sand would be removed from the footprint of the new rock placement using an excavator.

- 2) Suspended particulates/turbidity:** Based on experience from other similar projects, the proposed plan would result in localized minor, short-term impacts to suspended particulates and an increase in turbidity during project construction. These increases would be most evident during construction when 7,600 tons of clean rock rip rap used for modifications and new dike construction, 22,400 cubic yards existing dike material excavated, and 14,600 cubic yards of sand is excavated. The amount of material that would enter or returned the river would be minimal compared to the amount of material that enters the Missouri River by natural processes. The proposed plan would not violate any general criteria of the Missouri Water Quality Standards, 10 CSR 20-7.037(3) (A)-(H).
- 3) Water:** The project would not result in any long-term negative impacts to water quality.
  - a) Salinity:** Not applicable.
  - b) Water Chemistry:** Minor, temporary, and localized effects to water chemistry (see below) would primarily include a negligible increase in turbidity due to construction activities.
  - c) Clarity:** A localized minor temporary increase in turbidity would potentially occur during construction of the project that could impact clarity. Even at the increased level the clarity would be within baseline conditions of the Missouri River and therefore not expected to adversely impact native species.
  - d) Color:** A localized minor temporary change in color is possible due to the potential increased turbidity. Similar to Clarity above, any color change would be greatest during construction and would quickly become unnoticeable within a short distance downstream. Any changes in color would be expected to be within the range that is typically found where natural erosion occurs along the river or out of tributaries during high flow events and

therefore not expected to adversely impact native species or result in adverse aesthetic impacts.

- e) **Odor:** No impacts are anticipated.
  - f) **Taste:** Not applicable.
  - g) **Dissolved Gas Levels:** No changes to dissolved gas levels are anticipated.
  - h) **Nutrients:** Any alluvial sediments and associated nutrients that may be mobilized to construct the proposed action are materials deposited from river transport that are in temporary storage within the river channel. Under natural conditions, the river would flood, rework, remove, and deposit these materials in a dynamic fashion. Any sediment and nutrients being remobilized are not a net addition to the system. This material, or its equivalent, would have been transported through the system by natural geomorphic processes in an unaltered river. This activity will not adversely affect life forms in the immediate project area or in areas downstream.
  - i) **Eutrophication:** The proposed action would not result in any eutrophication to the Missouri River or other water bodies downstream. It has been documented by the National Research Council that other, larger scale, Missouri River Recovery Projects have not contributed to an increase in the increase the areal extent of the Gulf of Mexico hypoxic zone.
- 4) **Current patterns and water circulation:** The intent of this project is to alter localized current patterns and water circulation within the project footprint, however the project is not intended nor is it expected to change current patterns or circulation downstream of the project. Excavated material returned to the Missouri River would not alter flow or circulation patterns substantially. The dynamic sediment transport processes are critical element to the natural ecological function of the Missouri River. Fish and wildlife resources would not be adversely impacted by the resulting changes in current patterns and circulation. The project is designed to ensure that flows and sediment transport on the main channel of the Missouri River would not be adversely impacted. It is not anticipated that this would result in any adverse significant changes to the location, structure and dynamics of the aquatic community, or the rate and extent of the mixing of dissolved and suspended components of the water body.
- 5) **Normal water fluctuations:** There are no anticipated changes to normal water fluctuations that would result from the proposed project. There

would not be any significant change to existing water elevation on the Missouri River within the vicinity of the project as a result of modifying existing dikes or constructing new dikes.

- 6) **Salinity Gradients:** The proposed project would not impact any salinity gradients. The Missouri River is a freshwater system and this would not change as a result of the project.

**b. Potential Impacts to the Biological Characteristics of the Aquatic Ecosystem (Subpart D)**

- 1) **Threatened and endangered species:** This project “may affect but is not likely to adversely affect” pallid sturgeon. Any impacts to pallid sturgeon would be beneficial. The project is expected to promote interception and retention of free drifting embryos and larval sturgeon in areas with sufficient prey for first feeding and for growth through the juvenile life stage. The Recommended Plan would result in an interception ratio of 0.37 and 41.6 acres and foraging habitat when fully developed. It would result in an additional 9.1 AAHUs of interception-rearing-complex habitat compared to the No-Action/Future Without-Project Condition.

This project would have no effect on Indiana bat, northern long-eared bat, or gray bat. The Recommended Plan is not located in the immediate vicinity of any caves and would not impact any trees used by these species. It would also have no effect on least tern, piping plover, or rufa red knot. These species may migrate through the region but are not known to utilize the project area.

- 2) **Fish, crustaceans, mollusks, and other aquatic organisms in the food web:** The project would not result in significant adverse impacts to aquatic organisms. Minor, short-term impacts to the aquatic community may result from the smothering of immobile organisms, direct displacement of organisms, and an increase in turbidity, during project construction. The impacts may affect individual organisms in a limited stretch of the Missouri River, but would be unlikely to have a significant impact on the overall population of any particular species within the river system. Long-term, there would be a positive impact to the aquatic ecosystem by creating a more dynamic aquatic habitat condition with varying depths and water velocities. It would also result in a more dynamic geomorphic condition which would benefit native fish and wildlife. No significant adverse long-term impacts are anticipated.
- 3) **Other wildlife:** Wildlife associated with aquatic ecosystems includes resident and transient mammals, birds, reptiles, and amphibians. There would be minor, short-term impacts to these types of wildlife as a result of

construction activities. No significant adverse long-term impacts are anticipated.

**c. Potential Impacts on Special Aquatic Sites (Subpart E)**

- 2) Sanctuaries and Refuges:** A Big Muddy National Fish and Wildlife Refuge that is managed by the U.S. Fish and Wildlife Service is located directly west and north of the project area. The project would not have any direct effect on the refuge.
- 3) Wetlands:** The proposed action would not result in any direct impacts to wetlands. The project is located within the banks of the Missouri River.
- 4) Mud flats:** No mud flats would be impacted by the proposed project.
- 5) Vegetated shallows:** No vegetated shallows would be impacted by the proposed project. Because of the velocity of the Missouri River, little to no rooted aquatic vegetation is located within the project area.
- 6) Coral reefs:** The project area does not provide the necessary environmental conditions to support corals.
- 7) Riffle and pool complexes:** Because of the low gradient and sandy/silty nature of the Missouri River in the vicinity of the project site, a stable riffle and pool complex does not exist.

**d. Potential Effects on Human Use Characteristics (Subpart F):**

- 1) Municipal and private water supplies:** The project would not impact any municipal or private water supplies. The project is designed to avoid impacts to commercial navigation on the Missouri River.
- 2) Recreational and commercial fisheries:** The project would not affect the suitability of any recreational or commercial fisheries. The proposed action is expected to benefit aquatic organisms.
- 3) Water-related recreation:** The project is not expected to significantly impair or destroy any resources which support recreation activities. A large sandbar that is used for recreation is located in the project area. The project would have minor long-term impacts related to the modification of the sandbar that is sometimes used by recreational users. Impacts to recreational users would be considered minor based on the fact that another large sandbar is located directly one river mile downstream of the projects location. Additionally, it is important to note the history of this specific sandbar at the projects location. This sandbar is not stationary and is subject to the hydraulic forces of the river. Using historical photos of

the project area over the past 20 years this sandbar has moved, changed shape and size, and has had more years where it is submerged than readily available for recreational users on the river. There may be minor, short-term impacts to recreation during project construction due to restricted access.

**4) Aesthetics:** The project may result in minimal impacts to the aesthetics of the area as a result of project construction. This impact is expected to be short-term.

**5) Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves:** The project would not impact any of the above mentioned property types.

## **5. Evaluation of Fill Material (Subpart G)**

**a. General evaluation of fill material:** Fill material associated with the project would include clean rock riprap obtained from commercial sources, existing BSNP structures, or from sandbars.

**b. Chemical, biological, and physical evaluation and testing:** Prior experience indicates that commercially available rock fill would be free from chemical, biological, or other pollutants. There is no reason to believe that existing river material or the clean rock fill would be a carrier of harmful contaminants.

## **6. Disposal Site Delineation (§230.11 f)**

The discharge sites would be within portions of the mainstem of the Missouri River.

## **7. Actions to Minimize Adverse Effects (Subpart H)**

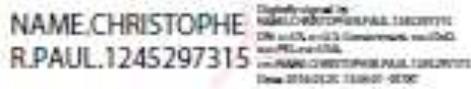
Steps to minimize impacts would include non-structural BMPs such as keeping heavy construction equipment out of the waterway whenever possible, protecting construction materials from precipitation/flooding, having spill containment plans for construction equipment, and using materials that are free from contaminants.

## **8. Factual Determinations (§230.11)**

A review of the information in items 4 through 7 of this report indicates that there is minimal potential for long-term environmental effects of the proposed fill. Additionally, there are not expected to be any adverse cumulative or long-term, secondary impacts as a result of the project.

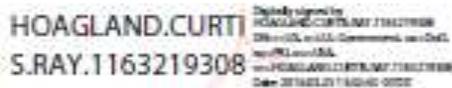
## 9. Findings (§230.12)

The proposed Missouri River Recovery Program, Searcys Bend Interception-Rearing-Complex Habitat Project has been evaluated and determined to be in compliance with Clean Water Act Section 404(b)(1) guidelines, with the inclusion of appropriate and practical conditions to minimize pollution and adverse effects on the aquatic ecosystem.

 Digitally signed by NAME CHRISTOPHE R. PAUL.1245297315  
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Date: 2014.03.13 10:07:02 -0500

Prepared by: \_\_\_\_\_  
Mr. Chris Name  
Environmental Resources Specialist,  
Environmental Resources Section

\_\_\_\_\_  
Date

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Reviewed by: \_\_\_\_\_  
\*For Jason W. Farmer  
Chief, Environmental Resources Section  
Mr. Curtis Hoagland  
Environmental Resource Specialist,  
Environmental Resources Section

\_\_\_\_\_  
Date

Approved by: \_\_\_\_\_  
Andrew D. Sexton  
Colonel, Corps of Engineers

\_\_\_\_\_  
Date

## **APPENDIX E**

**Clean Water Act Section 401 Water Quality Certification (Pending)**

## **APPENDIX F**

### **Cultural Resources Coordination**



**DEPARTMENT OF THE ARMY**  
KANSAS CITY DISTRICT, CORPS OF ENGINEERS  
635 FEDERAL BUILDING  
KANSAS CITY, MISSOURI 64106-2896

January 27, 2016

REPLY TO  
ATTENTION OF

Environmental Resources Section  
Planning Branch

Dr. Toni M. Prawl  
Director and Deputy State Historic Preservation Officer  
State Historic Preservation Office  
Department of Natural Resources  
P. O. Box 176  
Jefferson City, Missouri 65102-0176

Dear Dr. Prawl:

The U.S. Army Corps of Engineers, Kansas City District (Corps), is planning the Searcys Bend Interception Project in Moniteau County. The proposed interception project is part of the larger Missouri River Recovery Program and is being undertaken to incorporate recent scientific findings that the natural channel flows in the lower Missouri River has adversely affected larval pallid sturgeon survivability. The project will be completed with federal funding.

Searcys Bend is located along the Missouri River southwest of Columbia, Missouri in Moniteau County (Figure 1). The bend is 10,560-foot long and extends from about Missouri River mile 178.2 to 180.2 (Figure 2). The project site is primarily within the banks of the Missouri River. It is adjacent to Tadpole Island which is owned by USACE and managed by United States Fish and Wildlife Service as part of the Big Muddy National Fish and Wildlife Refuge. Tadpole Island is created by Tadpole Chute, which was constructed as a part of the shallow water habitat program in 2006.

The proposed project would consist of constructing new rootless rock dike structures (Figure 3). These structures include a 250-foot portion perpendicular to the river flow with the intent to maintain the navigation channel and an angled portion of dike at -4 feet below the construction reference plan for 100 feet and -2 feet below the construction reference plan for 200 ft. The purpose of the angled dike is to direct water perpendicularly across the top of the structure towards the sand bar with the intent to create additional aquatic area (Figure 4). The plan also includes structure removals and partial dredging around removed structures and new structures to promote initial development of site.

An archeological background review of the proposed project area was conducted utilizing the Missouri Department of Natural Resources Archeological Viewer (on-line); shipwreck location maps (Chittenden 1897 and Trail 1858-1965); Lewis and Clark camp site maps, and historic Missouri River channel location maps. The background review

found no NRHP listed properties, archeological sites, shipwrecks, or Lewis and Clark campsites within the proposed project area. The area has not been professionally surveyed for archeological sites. In February 2015, the Corps coordinated modifications to the Tadpole Island project, located immediately west of the present project area, with your office. At that time the Corps, determined that the project would not affect historic properties. Your office concurred with this recommendation on February 11, 2015.

While no archeological sites are recorded within or adjacent to the proposed project area, a number of sites have been recorded in the uplands surrounding Huntsdale and in the flood plain east of the river. In addition several shipwrecks have been recorded both north and south of the project area (Figure 5). All of these recorded sites are well outside of the project area and would not be impacted by the resulting changed conditions.

The review of historic river channel maps show that the project area was crossed by the historic Missouri River channel several times since 1879 (Figure 6). In addition, the proposed changed condition would not cause erosion, but would create additional shallow water habitat areas.

Because of the above-mentioned conditions, the project area is unlikely to affect historic properties. Therefore, we have determined and request your concurrence that the project will have "no effect" on Historic Properties. If in the unlikely event that archeological materials are discovered during project construction, work in the area of discovery will cease and the discovery investigated by a qualified archeologist. The findings on the discovery would be coordinated with your office and appropriate federally recognized Native American tribes.

Thank you for your consideration in this matter. If you have any questions or have need of further information please contact Timothy Meade, USACE Kansas City District Cultural Resource Manager at Timothy.M.Meade@usace.army.mil or at (816) 389-3138.

Sincerely,

**MEADE.TIMOTHY.M.127**  
**0866332**

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Timothy Meade  
District Archeologist

Enclosure

**CULTURAL RESOURCE ASSESSMENT**  
**Section 106 Review**

**CONTACT PERSON/ADDRESS**

Timothy Meade, District Archaeologist  
Corps of Engineers, Kansas City District  
635 Federal Building  
Kansas City, Missouri 64106-2896

**C:**

Amber Tucker, EPA

**PROJECT:**

Searcys Bend Interception Project

**FEDERAL AGENCY**

COE

**COUNTY:**

MONITEAU

**The State Historic Preservation Office has reviewed the information submitted on the above referenced project. Based on this review, we have made the following determination:**

- After review of initial submission, the project area has a low potential for the occurrence of cultural resources. A cultural resource survey, therefore, is not warranted.
- Adequate documentation has been provided (36 CFR Section 800.11). There will be "no historic properties affected" by the current project.
- An adequate cultural resource survey of the project area has been previously conducted. It has been determined that for the proposed undertaking there will be "no historic properties affected".

For the above checked reason, the State Historic Preservation Office has no objection to the initiation of project activities. PLEASE BE ADVISED THAT, IF THE CURRENT PROJECT AREA OR SCOPE OF WORK ARE CHANGED, A BORROW AREA IS INCLUDED IN THE PROJECT, OR CULTURAL MATERIALS ARE ENCOUNTERED DURING CONSTRUCTION, APPROPRIATE INFORMATION MUST BE PROVIDED TO THIS OFFICE FOR FURTHER REVIEW AND COMMENT. Please retain this documentation as evidence of compliance with Section 106 of the National Historic Preservation Act, as amended.

By: Toni M. Prawl  
Toni M. Prawl, Ph.D., Deputy State Historic Preservation Officer

February 4, 2016  
Date

MISSOURI DEPARTMENT OF NATURAL RESOURCES  
STATE HISTORIC PRESERVATION OFFICE  
P.O. Box 176, Jefferson City, Missouri 65102

For additional information, please contact Judith Deel, (573) 751-7862. Please be sure to refer to the project number:  
003-MU-16